EVALUATION REPORT - APPENDICES

Westhill District

City of Waterloo

Date:

June, 2020

MTE

paradigm TRANSPORTATION SOLUTIONS LIMITED

WSP

MHBC PLANNING URBAN DESIGN & LANDSCAPE ARCHITECTURE

THE CITY OF Waterloo

List of Appendices

Appendix A	Record of Pre-submission Consultation
Appendix B	Notice of Complete application
Appendix C	Westhill Study Draft Terms of Reference
Appendix D	Informal Public Meeting Minutes
Appendix E	Information Public Meeting Presentation
Appendix F	Agency Comments Received
Appendix G	DC Background Ira Needles By-pass Project Sheet
Appendix H	Planning and Existing Conditions Report
Appendix I	Waterloo Westside Transportation Network Assessment Study
Appendix J	Stage 1 Environment Impact Study
Appendix K	MTE Technical Memos
Appendix L	Intersection Control Study
Appendix M	Evaluation of Collector Road Alignments
Appendix N	Evaluation of SWM Facilities
Appendix O	Preliminary SWM Report
Appendix P	Natural Environment Stage 2 Report - Evaluation of Alternatives and Impact Assessment
Appendix Q	Transportation Evaluation

Appendix A

Y594E

THE CITY OF Waterloo | **Integrated Planning & Public Works**
Planning Approvals

April 9, 2018

Mr. Paul Britton, BES, MCIP, RPP
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540 Bingemans Centre Drive, Suite 200
Kitchener, ON
N2B 3X9

Mr. David Aston, MSc, MCIP, RPP
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Mr. Britton & Mr. Aston:

Re: Pre-application Consultation Meeting Follow Up
Proposed West Side By-Pass Road
Erb Street West, Ira Needles Boulevard, The Boardwalk
West Hill District

Thank you for attending the pre-application consultation meeting held March 14, 2018 to discuss a possible by-pass road west of Ira Needles Boulevard, between Erb Street West and The Boardwalk.

At this time, we understand the proposal is to construct a collector road north of The Boardwalk, connecting from the Thorndale Drive extension. Prior to confirming the preferred location of the collector road possible alternatives are to be evaluated through a detailed review of a study area including: existing conditions, environmental constraints, servicing networks and transportation need. Once and/or if a preferred location is determined, the road would be created and serviced through one or more Draft Plans of Subdivision(s). In addition, a Zoning By-law Amendment would be required. We understand development of the lands may occur in phases.

1.0 POLICY FRAMEWORK

The following policy review applies to the properties identified in your submission materials as the "Study Area", herein after referred to as the 'lands'.

Waterloo City Centre | 100 Regina Street South, PO Box 337 STN Waterloo, Waterloo, ON, N2J 4A8
P. 519.886.1550 | F. 519.747.8760 | TTY. 1.866.786.3941 | www.waterloo.ca

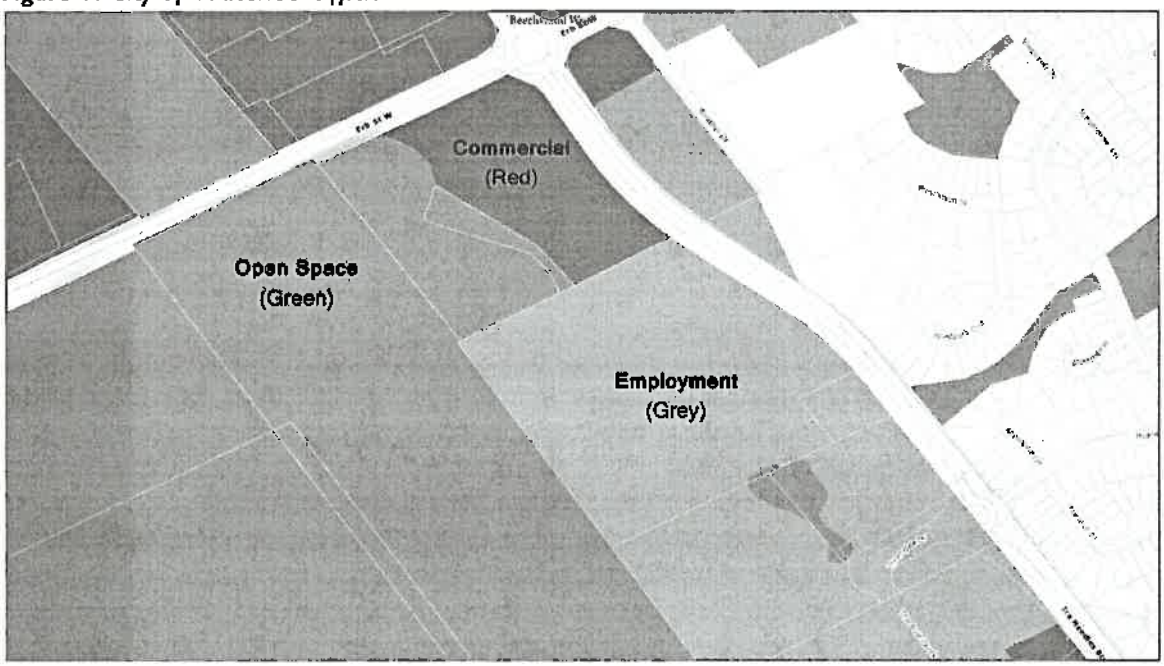
Please consider the environment before printing this letter.

1.1 City of Waterloo Official Plan

The lands are designated Mixed-Use Neighbourhood Commercial, Business Employment and Open Space in the City of Waterloo's Official Plan, (refer to Figure 1).

The Mixed-Use Neighbourhood Commercial designation is intended to provide a focal point or destination to meet day to day commercial needs of adjacent neighbourhoods or business areas. Located in minor nodes, this designation contemplates a range of office, retail and service uses generally in the form of a commercial shopping centre comprised of small to mid-sized units.

Figure 1: City of Waterloo Official Plan – Land Use Schedule 'A'



The Business Employment designation contemplates prestige office as the predominant use of land, generally located on the periphery of employment areas serving as a buffer between traditional industrial uses and sensitive uses. A high standard of urban design is required within this designation.

The Open Space designation is intended to protect ecologically significant natural features and to provide a comprehensive and connected open space system that balances the needs of the community in terms of recreation/leisure, culture, transportation, infrastructure and environmental management.

The lands are identified as a Minor Node and Minor Corridor, and contemplated for Medium High Density (height of up to 40 metres) and Medium Density Employment (height of up to 27 metres).

The lands are also subject to the policies of three separate Specific Provision Areas: SPA 8 (West Side Nodes), SPA 40 (41 Ira Needles Boulevard), and SPA 41 (Part of West Hill District).

1.2 West Hill District Plan

The West Hill District Plan was approved by Council August 24, 1998, with modifications in June 22, 2009. The purpose of the West Hill District Plan is to guide land use development and environmental protection. It is the key planning document between the broad policies of the Official Plan and the more detailed stages of development and environmental protection achieved through the review and approval of various planning applications. The lands are currently shown on Map 1 and Map 2, as follows:

Map 1: Land Use Concept
- Mixed Use Activity Node
- Industrial
- Arterial Commercial
- Parkland
- Collector Road

Map 2: Environmental Plan
- Constraint Level One Area
- Constraint Level Two Area
- Recommended Future Community Trail
- Open Space Greenways

1.3 City of Waterloo Zoning By-law

The lands are zoned 'Mixed Use Commercial' (MXC) and 'Agriculture' (A) under Zoning By-law 1418. In addition, By-law 09-007 applies site specific provisions to a portion of the lands.

As you are aware, the City is currently completing a comprehensive review of its Zoning By-laws. The Second Draft of the Zoning By-law was presented to Council and the public for review and feedback in April of 2017. This draft identifies the subject lands as Mixed Use Neighbourhood Commercial (C2-40), Future Determination (FD), Open Space (OS1) and Waste Management (WM) zones. Also, Site By-law 86 applies to a portion of the lands. For further information related to the City's Comprehensive Zoning By-law Review please refer to the City's webpage: http://www.waterloo.ca/en/business/zoningreview.asp.

2.0 PROCESS

2.1 Class Environmental Assessment

As noted in your correspondence dated January 18, 2018, you opined that the extension of a collector road in this location would warrant a Schedule C Class Environmental Assessment. Based on our review of the Environmental Assessment Act and through discussions with the Municipal Engineers Association, IPPW staff have confirmed that a Class Environmental Assessment is not required for the creation of the proposed collector road.

2.2 Official Plan Amendment

It was also noted in your correspondence dated January 18, 2018, that the collector road extension would be a project to benefit from an integrated approach between the Municipal Class EA process and the Planning Act, and recommend that the Class EA be coordinated with an Official Plan Amendment. The end result of which would be the identification of a preferred alignment of the collector road on Schedule "E" of the Official Plan as well as the Land Use Concept of the West Hill District Plan.

IPPW staff have confirmed that an Official Plan Amendment is not required for the creation of the proposed collector road.

Notwithstanding the above, if a change in land use designation is proposed through the development of the lands, an amendment to the Official Plan will be required to re-designate the lands, or to apply any site specific policies through a Specific Provision Area (SPA).

In addition, an amendment to the West Hill District Plan is required. This amendment can be implemented through any of the herein referenced development applications submitted to the Planning Approvals Division.

2.3 Draft Plan of Subdivision

One or more Draft Plan of Subdivision(s) will be required for the creation of the proposed road and creation of other development land parcels, as may be required. Any Draft Plan of Subdivision will be subject to the requirements of a complete application, to be determined through a future pre-application consultation process, and subject to the statutory requirements of the Planning Act and the City's Official Plan.

2.4 Zoning By-law Amendment

To permit the development of the subject lands, approval of an amendment to Zoning By-law 1418 will be required to establish a zoning framework that aligns with the Business Employment designation of the Official Plan. If the City's new Comprehensive Zoning By-law comes into effect in advance of such an application being submitted, a Zoning By-law Amendment will still be required, as per the Planning Act. Any Zoning By-law Amendment application will be subject to the requirements of a complete application, to be determined through a future pre-application consultation process, and subject to the statutory requirements of the Planning Act and the City's Official Plan.

3.0 BACKGROUND EVALUATION

As discussed at our meeting, and subject to the confirmed process as noted above, it is our opinion that a background review of the possible alternatives for a collector road should be evaluated prior to proceeding with the detail design, subdivision applications and Zoning By-law amendments. The background review should consider the following:

3.1 Study Area

- Determination of the Study Area to be confirmed prior to commencing with the background review, to the satisfaction of City of Waterloo Planning Approval's staff.
- Documentation of each property, including existing conditions, property size and ownership. Please note that Owner Authorization form(s) will be required with the submission of any planning act applications.

3.2 Transportation

- Evaluation of need for the proposed collector road.
- Evaluation of warrant traffic improvements required for each alternative proposed.
- Evaluation of how possible alternatives will be impacted by other transportation construction work in the surrounding area, including Regional upgrades (i.e., Erb Street).
- To be prepared in connection with the City of Waterloo's Integrated Multi-modal Transportation Study (IMMTS).

3.3 Environmental Evaluation

As discussed at our meeting, it is recommended by City and GRCA staff that the environmental work be completed in stages. Particularly through a Stage EIS, to be prepared as follows:

Stage 1:

- Characterization of the ecological and hydrological attributes and functions of the wetlands and watercourses within the study area.
- Determine existing conditions, the significance and status of the natural features and, as it relates to the City's Official Plan, whether the wetlands are Locally Significant Wetlands or Other Wetlands, thereby identifying the applicable policy framework.
- In addition to the 1996 Subwatershed Plan, the Wetland Evaluation that was completed in February 2011 for a portion of the study area and the scoped EIS that was completed for the Cressman lands in December 2014 are available as background information.
- The Stage 1 Report is to be submitted for City and GRCA review and acceptance before proceeding to the next stage.

Stage 2:

- An evaluation of alternatives and the identification of the preferred alternative for the study area, based on the findings and conclusions of Stage 1 above and the applicable Official Plan, District Plan and GRCA policies.
- This evaluation would consider a range of criteria to address environmental, technical and land use planning considerations.
- Recommendations and mitigation measures to be identified in accordance with the preferred alternative.
- The Stage 2 Report is to be submitted for City and GRCA review and acceptance before proceeding to the next stage.

Stage 3:

- Property-specific, implementation focused evaluation.

- These evaluations would build on the previous two stages and be completed for each property at a time when development applications may be advanced.
- The Stage 3 reports would outline specific recommendations and mitigation measures to correspond to the property-specific development proposals.

Other Notes:

- A Terms of Reference (TOR) document shall be prepared prior to the completion of Stage 1, to the satisfaction of the City and GRCA.
- Stages 1 and 2 would be common to all properties within the study area and submitted as part of the background work for all future development applications along with the individualized Stage 3 Reports
- Pre-development monitoring in accordance with the City's Development Monitoring Protocol is required for all draft plans of subdivision. For additional information in this regard please contact Robyn McMullen at robyn.mcmullen@waterloo.ca. Such monitoring could be undertaken alongside the EIS work in preparation for future draft plan of subdivision applications.
- The City's Scoped Environmental Impact Statement review fee of $944.50 is required, made payable to the City of Waterloo.

3.4 Servicing Connections and Stormwater Management

- Evaluation of servicing infrastructure, connections and required capacity for each alternative proposed.
- Evaluation of comprehensive stormwater management solutions for each alternative proposed.

3.5 Formal Submission Requirements – To Be Determined

Once and/or if a preferred location of a Collector Road is determined, any future plans of subdivision and/or Zoning By-law Amendment applications, and Official Plan Amendment as may be required will be subject to pre-application consultation meeting(s). The necessary formal submission requirements will be determined through that process, at that time.

For additional Regional comments and requirements please refer to the attached Regional Pre-Submission Comments dated March 27, 2018. If you require further clarification with respect to Regional requirements, please contact Adam Betteridge at abetteridge@regionofwaterloo.ca.

For additional GRCA comments and requirements please refer to the attached email containing GRCA comments dated April 3, 2018. If you require further clarification with respect to GRCA requirements, please contact Kaitlyn Rosebrugh at krosebrugh@grandriver.ca.

Please note the above noted requirements are based on the information provided by the applicant during the pre-application consultation process and based on staff's understanding of the development proposal at this time. Should new details and/or information become available through the development process, requirements may be subject to change.

I trust the foregoing is satisfactory, however should you have any questions please do not hesitate to contact the undersigned.

Sincerely,

Natalie Hardacre BES, MCIP, RPP
Development Planner
Planning Approvals
Integrated Planning & Public Works
City of Waterloo
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E: natalie.hardacre@waterloo.ca

cc. Adam Betteridge, Region of Waterloo
Kaitlyn Rosebrugh, GRCA
Chris Pidgeon, GSP Group
Scott Patterson, Labreche Patterson & Associates

Appendix B

THE CITY OF Waterloo | Integrated Planning & Public Works
Planning Approvals Division

September 9, 2019

Mr. Paul Britton, BES, MCIP, RPP
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File No.: Official Plan Amendment No. 27
Westhill District Plan Amendment
Proposed West Side Collector Road
Southwest corner of Ira Needles Boulevard and Erb Street West, north of Thorndale Drive

Mr. Britton & Mr. Aston:

In accordance with Subsections 22(6.1)) of the Planning Act, R.S.O. 1990, as amended, and the City of Waterloo Official Plan, please be advised that the Director of Planning for the City of Waterloo has accepted your application to amend the Official Plan and the Westhill District Plan for the above-noted lands as complete, as of the date of this letter.

Your application will be processed in accordance with the requirements of the Planning Act and the City of Waterloo Official Plan. Please be advised that although the application is considered complete, additional information and/or materials may be required to address issues arising during the processing of the application. Please find enclosed a copy of the application form and receipt for the application fee. The Informal Public Meeting has been tentatively scheduled for Monday, October 28, 2019 in the Council Chambers, at the Waterloo City Hall.

If you have any questions, please contact the undersigned.

Sincerely,

WENDY FISHER MA MCIP RPP
Planning Approvals Division
Integrated Planning & Public Works Department
City of Waterloo
P: 519.747.8544 | **E:** wendy.fisher@waterloo.ca

The City of Waterloo is committed to providing accessible formats and communication supports for persons with disabilities. If another format would work better for you, please contact Integrated Planning & Public Works at 1.519.747.8752 or TTY at 1.866.786.3941.

Appendix C

West Waterloo North / South Collector Road
(The Boardwalk By-pass)

Terms of Reference (August 2018)

INTRODUCTION

1) Study Purpose

The purpose of the study and related planning applications is to determine the appropriate location for a new public road to connect The Boardwalk at Thorndale Drive to Erb Street West taking into account ongoing studies of the City of Waterloo and Region of Waterloo that have collectively considered a potential new road connection for the west side of Waterloo. The study will also determine an overall servicing strategy.

A pre-application meeting was held with City, Region and GRCA staff. At the pre-application meeting the Study Area was discussed and confirmed. City staff advised that a Class Environmental Assessment was not required as implementation of a new road would occur through future plan(s) of subdivision. The City advised that the new road has been identified in the City Development Charges By-law.

Comments at the pre-application meeting provided direction to the process for consideration of applications and recommended a phased approach. The first phase would include the background information and existing conditions to provide the recommended road alignment that would be addressed through an Official Plan Amendment and update to the Westhill District Plan to illustrate the road alignment. The second phase includes the property specific applications (plan of subdivision and zoning by-law amendment) to implement the road alignment.

The submission for the pre-application meeting included preliminary road network alternatives for the extension of The Boardwalk from Thorndale Drive to Erb Street West. The Region submitted comments as part of the pre-application process that provided information to assist with the scoping of road alternatives.

The City of Waterloo has recently completed a study that identifies the need for a north/south road connection between Erb Street West and The Boardwalk/Thorndale Drive. A Class Environmental Assessment was undertaken by the Region for Erb Street West and it was confirmed that the Class EA makes provision for the introduction of a new roundabout. The location of the roundabout on Erb Street West was presented to the Regional Planning and Works Committee and supported by the Committee. As a result of these studies, the focus of the studies associated with the Official Plan Amendment and update to the District Plan will be on the road alignment alternatives to extend a new road from Thorndale Drive/The Boardwalk to Erb Street West at the location identified at the Regional Planning and Works Committee which aligns with the existing signalized intersection at the commercial plaza on the north side of Erb Street West and is to the west of the Hydro Corridor and east of the existing Waterloo Commons commercial plaza.

2) Description of Study Area

The Study Area includes the lands to the north of The Boardwalk and Thorndale Drive; east of the Hydro Corridor and Regional Waste Management Centre; West of Ira Needles Boulevard; and, south of Erb Street West. The Study Area is illustrated on Figure 1 and also identifies the location of the potential roundabout on Erb Street West.

All lands within the Study Area are within the City Urban Area with a variety of land use designations, including Commercial, Employment and Open Space. The Study Area forms part of the Westhill District Plan. The Westhill District Plan identifies a road network for development of the area. The Westhill District Plan was updated through the approvals associated with The Boardwalk development. The Westhill District Plan identifies an extension of The Boardwalk to a connection with Ira Needles Boulevard.

Land uses within the Study Area include: existing residential uses, a golf course as an interim use pending development of a future Home Hardware store, stormwater management facilities and a commercial plaza. Prior to the construction of Ira Needles Boulevard and subsequent development, the land was used for agricultural purposes. Historical aerial photos show the lands under agricultural use and the changes to the landscape associated with the construction of roads and development of the lands. The landscape evolved through the development process and anthropogenic features were created as a result of the development.

Comprehensive natural heritage field surveys have been undertaken as part of previous studies. Work was completed in two broad survey areas. Extensive flora, fauna and aquatic field surveys were undertaken in on 13 separate dates in 2016 and 2017. Details of the features within the Study Area from this information are further described below:

- No provincially designated features (e.g., Provincially Significant Wetland [PSW]; Areas of Natural or Scientific Interest [ANSI]) are found on or immediately adjacent to the Study Area.
- No regulated watercourses are present in the study area.
- There is intermittent drainage from the two SWM facilities towards the outlet / culvert at Erb Street West and from a dug pond on the golf course northerly into the wet area adjacent to the Region SWM facility.
- From the culvert at Erb Street West, stormwater runoff is conveyed underground via a piped municipal drain to a SWM pond approximately 750m to the north and ultimately into Clair Creek.
- Four ponds / unevaluated wetlands are present in the Study Area. Three additional wetlands are present on HEPC lands to the west / southwest. All wetlands (not including the golf course ponds) as mapped by GRCA are regulated by GRCA under O. Reg. 150/06

SCOPE OF WORK AND STUDY APPROACH

A phased approach is established to complete the study requirements for the implementation of a new road to connect Erb Street West with The Boardwalk. In general, the phases are as follows:

Phase 1

- Existing conditions characterization for ecological and hydrological features and functions of wetlands and watercourse within the Study Area
- Submission of a Planning Application to identify the road network in the Official Plan and update to the Westhill District Plan. This will include the identification and evaluation of alternatives, selection of the preferred alternative, and recommended plan and mitigation. The completion of this phase will result in the identification of a collector road on the Transportation Schedule in the City of Waterloo Official Plan.

Phase 2

- Planning application(s) that will be property-specific with focused evaluation to implement the approved road network. This may be done concurrently with the Official Plan Amendment and District Plan update or follow the approval and the details and design of the new road will be implemented through a plan of subdivision and associated conditions of approval.

Details associated with the tasks to be completed in each phase are provided below:

Phase 1 - Background Study and Existing Conditions Review and Planning Application Process (Official Plan Amendment and District Plan Update):

1) Existing Conditions Review – Environmental, Economic, Social
    - Complete topographic survey (i.e. Wetland boundaries, tree inventory, monitoring wells/piezometers, pressure transducers, complete any gaps)
    - Update overall Existing Conditions Base Plan, including location of existing municipal services
    - Inventory property ownership/develop legal boundary plan
    - Aerial Photo Analysis – Inventory and Chronology
    - Scoped Hydrogeological Investigation
        i. Characterize Geological and Hydrogeological Setting
        ii. Geological Cross-sections
        iii. Source Water Protection Screening
        iv. Assess Wetland / Groundwater Interaction
    - Surface Water Characterization - Summarize Existing drainage characteristics and prepare Hydrologic/Hydraulic Models
    - Transportation - will rely on study and analysis undertaken by the City and Region
    - Stage 1 EIS will include the following, to be documented in a Stage 1 EIS Report submitted for City and GRCA review and acceptance, before proceeding to Stage 2 (details are provided in Appendix B:
        i. Consolidation and review of all available background information (ecological and hydrogeological) and 2018 field survey results
        ii. Characterization of the ecological and hydrological attributes and functions of the wetlands and watercourses within the study area, using standard protocols and guidelines (e.g., Ecological Land Classification, breeding bird surveys, spring amphibian breeding surveys, SAR bat habitat assessment surveys etc.).
        iii. Determine of the significance and status of the natural features and, as it relates to the City's Official Plan, whether the wetlands are Locally

Significant Wetlands or Other Wetlands, thereby identifying the applicable policy framework.

2) Establishment of Evaluation Criteria for Road Alternatives and Infrastructure Requirements
   - Evaluation criteria will be established to apply to the alternatives and determination of the preferred alternative. .

3) Identification / Assessment of Road and Infrastructure Alternatives
   - An evaluation of alternatives based on the applicable environmental, economic and social criteria.
   - Alternatives will be based on 3 sections of the road, including:
     i) Connection of the new road with Erb Street West and intersection design
     ii) Continuation of The Boardwalk based on the general location and alignment currently identified in the Westhill District Plan
     iii) Extension of The Boardwalk beyond the Westhill District Plan alignment to Erb Street West

4) Submission of Official Plan Amendment and District Plan Update with Road and Infrastructure and Servicing Alternatives

5) City and Agency Review of Applications

6) Selection of Preferred Alternative
   - Selection of the preferred alternative based on all evaluation criteria and provision of recommendations and mitigation measures.

7) Informal Public Meeting for Public Input on the Application

8) Formal Council Meeting and Consideration of Staff Recommendation

Phase 2 – Planning Application Approval Process and Detailed Design for Specific Lands:

9) Completion of Property Specific Reports and Submission of Planning Applications (Plan of Subdivision and Zone Change)
   - Transportation Impact Study, as required
   - Functional Servicing Report
   - Stage 2 EIS studies will be completed in support of specific development applications, with results, conclusions and recommendations submitted for City and GRCA review and acceptance. These reports will include:
     - Any additional information, as available
     - Confirmation / refinement of natural heritage constraints identified through the Stage 1 study
     - Demonstration of compliance with applicable policy and guidelines at the municipal/regional, provincial and federal levels.
     - An impact assessment for the specific site plan in question, including recommended measures to mitigate impacts
     - Conclusions and recommendations

- Vegetation and flora. Impact on feature and function of vegetation communities and flora, considering ecological significance (type, size, composition, species of conservation concern) and sensitivity/ susceptibility (e.g., mortality, stress, composition change)

9) Application Review Process for Planning Applications

10) Planning Application – Draft Plan of Subdivision Approval with Conditions of Approval

11) Detailed Design and Registration of Draft Plan of Subdivision

STUDY DELIVERABLES

Phase 1 – Submission with Official Plan Amendment and District Plan Update:

- Planning Justification Report
- Existing Conditions Report - Servicing Overview Report, including Preliminary Stormwater Management
- Scoped Environmental Impact Study

Phase 2 – Submission with Plan of Subdivision and Zone Change Application to Final Approval with Detailed Design

1) Planning Justification Report
2) Functional Servicing Report, including Preliminary Stormwater Management
3) Functional Road and Roundabout Design
4) Updated Transportation Impact Study, as required
5) Updated Environmental Impact Study, as required
6) Hydrogeological Report

Other reports may be identified at the time of the pre-application submission for the plan(s) of subdivision.

Appendix D

A meeting of the Council of the Corporation of the City of Waterloo was held on October 28, 2019 at 2:02 PM in the Council Chambers, 100 Regina Street South, Waterloo, Ontario

COUNCIL MEETING
Monday, October 28, 2019

Minutes

PRESENT: Mayor Dave Jaworsky, Councillor Sandra Hanmer, Councillor Royce Bodaly, Councillor Angela Vieth, Councillor Diane Freeman, Councillor Jeff Henry, Councillor Tenille Bonoguore

ABSENT: Councillor Jen Vasic

Mayor Jaworsky in the Chair

1. DISCLOSURE OF PECUNIARY INTEREST AND THE GENERAL NATURE THEREOF

No disclosure of pecuniary interest was declared by any member of Council at this point in the meeting.

2. CLOSED MEETING

Moved by Councillor Freeman, seconded by Councillor Hanmer:

That Council hold a closed meeting for the purposes of considering the following subject matters:

a) litigation or potential litigation, including matters before administrative tribunals, affecting the municipality or local board (*Legal Advice re Local Planning Appeal Tribunal Appeals*);

b) advice that is subject to solicitor-client privilege, including communications necessary for that purpose (*Legal Advice re Special Service Area Levies*).

Carried Unanimously

Council Meeting Recessed: (Time: 2:03 p.m.)
Council Meeting Reconvened: (Time: 3:05 p.m.)

PRESENT: Mayor Dave Jaworsky, Councillor Sandra Hanmer, Councillor Royce Bodaly, Councillor Angela Vieth, Councillor Diane Freeman, Councillor Jeff Henry, Councillor Tenille Bonoguore

ABSENT: Councillor Jen Vasic

The Mayor opened the meeting with the following Territorial Acknowledgement:

We would like to begin by acknowledging that the land on which we gather today is the land traditionally used by the Haudenosaunee, Anishnaabe and Neutral People. We also acknowledge the enduring presence and deep traditional knowledge and philosophies of the Indigenous People with whom we share this land today.

3. DISCLOSURE OF PECUNIARY INTEREST AND THE GENERAL NATURE THEREOF

No disclosure of pecuniary interest was declared by any member of Council at this point in the meeting.

4. MOMENT OF REFLECTION

The Mayor provided Council with a moment of reflection.

5. APPROVAL OF MINUTES

Moved by Councillor Freeman, seconded by Councillor Henry:

That the previous meeting minutes be approved.

Carried Unanimously

a) September 23, 2019 – Council Meeting

That the minutes of the Council meeting held on September 23, 2019 be approved as printed.

Carried Unanimously

b) October 7, 2019 – Special Council Meeting

That the minutes of the special Council meeting held on October 7, 2019 be approved as printed.

Carried Unanimously

6. REPORTS OF COMMITTEES

a) Title: Committee of the Whole Report – October 7, 2019
Report No.: CORP2019-078
Prepared By: Kevin Gerlach

Moved by Councillor Henry, seconded by Councillor Vieth:

1. That CORP2019-078 be approved.

2. That the recommendations of the Committee of the Whole meeting of Monday, October 7, 2019 be adopted.

Carried Unanimously

b) Title: Finance and Strategic Planning Committee Report – October 21, 2019
Report No.: CORP2019-079
Prepared By: Kevin Gerlach

Moved by Councillor Henry, seconded by Councillor Vieth:

1. That CORP2019-079 be approved

2. That the recommendations of the Finance and Strategic Planning Committee meeting of Monday, October 21, 2019 be adopted.

Carried Unanimously

7. DELEGATIONS

a) Diaper Changing Stations in City Facilities

Neal Moogk-Soulis, a resident of Waterloo, advised Council that there are no diaper changing stations in the men's washrooms in City Hall. He requested that Council direct staff to install diaper changing stations in the men's washrooms in City Hall and work with the Region of Waterloo to advocate for diaper changing stations in public facilities and local businesses.

Moved by Councillor Henry, seconded by Councillor Freeman:

That staff be directed to install a baby changing station in the second floor male washroom in City Hall as soon as possible.

Carried Unanimously

8. STAFF REPORTS

a) Title: Procurement Award Summary – Q3 2019
Report No.: CORP2019-069
Prepared By: Jason Wilhelm

Moved by Councillor Henry, seconded by Councillor Bonoguore:

1. That Council receive CORP2019-069 as information.

Carried Unanimously

b) Title: 2019 Third Quarter Health and Safety Report
Report No.: CORP2019-073
Prepared By: Lisa Dunlop

Moved by Councillor Bonoguore, seconded by Councillor Hanmer:

1. That Council receives this report for information.

Carried Unanimously

c) Title: Northdale Tax Increment Grant (TIG) Program Renewal and Affordability Grant/Loan Update
Report No.: IPPW2019-057
Prepared By: Tanja Curic
Rachel Martin

Moved by Councillor Henry, seconded by Councillor Bodaly:

1. That IPPW2019-057 be approved.

2. That staff be directed to replace Table E-1 in report IPPW2019-057 with the following Alternative Table E-1 as presented in Council

Alternative Table

Table E-1 Tax Increment Grant Application Evaluation Matrix

As-Built Project Achieves:	Annual Grant as a % of Tax Increment Generated by the Project
Conformity with 6 or fewer of 10 Sustainability Strategies	No Grant
minimum 25% energy and greenhouse gas efficiency improvement beyond the most recent version of the Ontario Building Code, Part 12, and conformity with 7 of 10 Sustainability Strategies	40%
minimum 25% energy and greenhouse gas efficiency improvement beyond the most recent version of the Ontario Building Code, Part 12, and conformity with 8/9 of 10 Sustainability Strategies	60%
minimum 25% energy and greenhouse gas efficiency improvement beyond the most recent version of the Ontario Building Code, Part 12, and conformity with all 10 Sustainability Strategies	80%

3. That the Northdale Community Improvement Plan Tax Increment Grant Program be extended until October 31, 2024.

Carried Unanimously

d) Title: Procedure By-law Revisions and Proposed 2020 Council Schedule
Report No.: CORP2019-071
Prepared By: Kevin Gerlach
Julie Scott
Olga Smith

Kevin Gerlach, Council/Committee Coordinator, reviewed the report and responded to questions from Council.

Moved by Councillor Vieth, seconded by Councillor Freeman:

1. That staff report CORP2019-071 be approved.

2. That the proposed revisions to the Procedure By-law, outlined in Section 3.0 of staff report CORP2019-071, be approved.

3. That the proposed 2020 Council Schedule, attached to staff report CORP2019-071 as Appendix A, be approved.

Carried Unanimously

Council Meeting Recessed: (Time: 3:39 p.m.)
Council Meeting Reconvened: (Time: 6:32 p.m.)

PRESENT: Mayor Dave Jaworsky, Councillor Sandra Hanmer, Councillor Royce Bodaly, Councillor Diane Freeman, Councillor Jeff Henry, Councillor Tenille Bonoguore (arrived at 6:51 p.m.), Councillor Angela Vieth (arrived at 7:06 p.m.)

ABSENT: Councillor Jen Vasic

The Mayor opened the meeting with the following Land Acknowledgement:

We would like to begin by acknowledging that the land on which we gather today is the land traditionally used by the Haudenosaunee, Anishnaabe and Neutral People. We also acknowledge the enduring presence and deep traditional knowledge and philosophies of the Indigenous People with whom we share this land today.

9. DISCLOSURE OF PECUNIARY INTEREST AND THE GENERAL NATURE THEREOF

No disclosure of pecuniary interest was declared by any member of Council at this point in the meeting.

10. STAFF REPORTS

a) Title: 2019 Waterloo Award Recipients
Report No.: CORP2019-063
Prepared By: Christine Rushton

Mayor Jaworsky announced the presentation of the 2019 Waterloo Award to recipients David Marskell and Eric Davis. The Waterloo Award is presented annually to select individuals who have contributed outstandingly to the quality of life within Waterloo without the thought of personal or financial gain.

Councillor Freeman read the Recipient Profile of David Marskell:

David Marskell

David Marskell is a community builder who continually looks for opportunities to bring the world to Waterloo. Through his years of hard work and dedication as the CEO of THEMUSEUM, he has had a huge impact on the wellbeing of our community through the numerous world-class exhibitions he has brought here for all to see.

David Marskell believes in inclusivity and chooses shows and exhibits that are thought provoking and innovative. THEMUSEUM draws visitors from all over and has a significant positive financial, social, cultural and artistic impact on Waterloo Region. He collaborates with all sectors of the community and is well known for thinking outside the box and encouraging others to do the same.

In the words of David Marskell's nominator, Brenda Halloran: "David encourages this community to be the best it can be. He generously offers help and support where needed and when asked – he never says no, but always finds a way to say yes and to help. He supports the art scene, he promotes musicians, he helps our non-profits, he provides support to schools, children, families – his reach and love and kindness for this community is well known and he is respected by everyone he works with."

David is also a strong supporter of the environment as well as local organizations that he volunteers with such as baseball. David has played a significant role in the region's bid to secure the Canada Summer Games. He supports tourism and often participates on community panels and discussions around arts and culture, and engaging more people. David is also a strong voice and advocate for government funding for arts and culture. He is an ambassador and champion for volunteerism and for promoting our community far and wide.

It is an honour to present the 2019 Waterloo Award to David Marskell.

Mayor Jaworsky presented the 2019 Waterloo Award pin and certificate to David Marskell.

David Marskell congratulated Eric Davis and thanked Brenda Halloran and all others who supported his nomination. He noted the support of his family, the MUSEUM board, and the staff at the MUSEUM. Mr. Marskell thanked Council for their support of the MUSEUM.

Councillor Freeman read the Recipient Profile of Eric Davis:

Eric Davis

Eric Davis grew up in Waterloo and for decades, he has been involved in the community in various ways. His community involvement is extensive and he has greatly improved our community; especially considering the significant leadership roles he has held with some very well-established community organizations such as CMHA, the United Way, and the Rotary Club of Waterloo.

Eric Davis has also been involved with many more organizations, including: the City of Waterloo's Municipal Heritage Committee; Connect the Innovation Corridor Secretariat; Greater K-W Chamber of Commerce; Canadian Diabetes Association; Sustainable Waterloo Region; Wilfrid Laurier University Students' Union; and The Record's Community Editorial Board.

According to Eric's nominator, Simon Tunstall, "When Eric gets involved with an organization, he does not get involved part-way – he gives it his all and it shows."

Eric Davis is a partner with Miller Thomson LLP in Waterloo, specializing in municipal and planning law. He acts for a number of municipalities and other public bodies in southwestern Ontario. Eric, through his profession, benefits the Waterloo community as he continually advocates for our region at the Ontario Bar Association and his representation of his clients locally, whether public or private entities, ensures that all voices are heard and important issues are considered from a variety of perspectives. In 2012, Eric received the IMLA Canadian Scholarship and presented a paper at its annual conference that year in Austin, Texas.

Eric has been extensively involved in politics since high school and is probably best known as the provincial Liberal candidate for Kitchener-Waterloo in the 2011 general election and the 2012 by-election, which further demonstrates his level of community involvement.

Eric has been the recipient of many awards, including: one of Waterloo Region's top 40 under 40 by The Record in 2011; the Queen Elizabeth II Diamond Jubilee Medal in 2012; Outstanding Leadership Award by Rotary Waterloo; and a Paul Harris Fellowship by Rotary Waterloo in 2017.

It is an honour to present the 2019 Waterloo Award to Eric Davis.

Mayor Jaworsky presented the 2019 Waterloo Award pin and certificate to Eric Davis.

Eric Davis thanked Council for the honour of receiving the Waterloo Award. He also thanked his spouse and family for their support, as well as Simon Tunstall and all others who supported his nomination. He further congratulated his fellow honoree, David Marskell.

Moved by Councillor Freeman, seconded by Councillor Henry:

1. That Council approve CORP2019-063.

2. That Council recognize Eric Davis and David Marskell as the recipients of the 2019 Waterloo Award.

Carried Unanimously

b) Title: Parkview Crematorium – Future Considerations
Report No.: COM2019-031
Prepared By: Jeff Silcox-Childs
Susan Boldt

Councillor Bonoguore joined the meeting: (Time: 6:51 p.m.)

Jeff Silcox-Childs; Director, Environment and Parks Services, reviewed the report and responded to questions from Council.

Susan Boldt, Senior Financial Analyst, reviewed the options available to address the issues with the Parkview Crematorium and responded to questions from Council.

Councillor Vieth joined the meeting: (Time: 7:06 p.m.)

Stuart McPhail, Owner/Funeral Director, Gray Bruce Cremation and Burial Services, expressed his support for the option recommended by staff. He informed Council that funeral directors value neutral publically-provided service with regular hours of operation. Mr. McPhail thanked staff for the review of the crematorium and their services.

Susan Koswan, Instigator of the Good Green Death Project, informed Council of the Project's aim to reduce the space used by cemeteries, mitigate their environmental impact, and meet community needs. Their goal is to advocate for the composting of human remains and their use in planting trees.

Ms. Koswan recommended that Council consider establish a forest cemetery and composting facility, once provincial legislation permits the practice of composting human remains.

Moved by Councillor Henry, seconded by Councillor Bodaly:

1. That Council approve report COM2019-031.

2. That Council approve the release of capital funding for the necessary HVAC improvements at Parkview Crematorium; non-routine project #180006 (Ref #267) in the amount of $103,000 funded from the Cemetery Reserve Fund, as approved in the 2019 Capital Budget.

3. That Council approve Option 2 and direct staff to initiate the necessary approvals process for the replacement of the crematorium retorts and minor facility upgrades.

Carried Unanimously

11. FORMAL/INFORMAL PUBLIC MEETINGS

Informal Public Meetings

a) Title: Zoning By-law Amendment Z-19-06 – General Amendments to Zoning By-law No. 2018-050, Part 2 (City-wide)
Prepared By: Dominik Simpson

The Chair advised that the Informal Public Meeting was the first opportunity to inform Council and the public of the amendments and emphasized that Council would make no decision at this meeting.

Dominik Simpson, Planner, advised Council that The City of Waterloo's Planning Division is initiating the second phase of general amendments to the City's Zoning By-law 2018-050. The first phase of general amendments (Part 1) was approved by City Council on June 24, 2019.

The objective of this next phase of general amendments (Part 2) is to further correct, update, and/or add provisions that were not reflected in Part 1 or Zoning By-law 2018-050, approved by Council on September 10, 2018. Some of the items being considered include decks, servicing, legislative updates, and other minor amendments.

Councillor Bodaly left the meeting: (Time: 7:27 p.m.)
Councillor Bodaly returned the meeting: (Time: 7:29 p.m.)

As no one else was present to speak to the application, the Chair concluded the Informal Public Meeting and indicated that staff will review the issues and report back to Council at a later date.

b) Title: Official Plan Amendment No. 27 and West Hill District Plan Amendment, 1130814 Ontario Inc., The INCC Corp./Waterloo Commons JV Inc., Home Hardware Stores Ltd.
Prepared By: Wendy Fisher

The Chair advised that the Informal Public Meeting was the first opportunity to inform Council and the public of the application and emphasized that Council would make no decision at this meeting.

Wendy Fisher, Senior Development Planner, advised Council that a group of landowners are proposing to establish a new public collector road to extend from The Boardwalk/Thorndale Drive roundabout to Erb Street West.

The proposed area will be reviewed with consideration given to existing conditions, environmental constraints, servicing networks, and transportation needs. A preferred road alignment will be determined along with a master servicing strategy.

The new collector road and the servicing strategy will be implemented through an amendment to the City's Official Plan (Schedule E, Road Classification System) and an amendment to the Westhill District Plan (Land Use Concept). It is anticipated that the proposed collector road and any future development in this area will be subject to further Planning Act applications initiated by individual landowners.

Wendy Fisher, Senior Development Planner and Joel Cotter, City Planner responded to questions from Council.

Dave Aston; Vice President and Partner, MHBC Planning reviewed the application on behalf of the applicants.

As no one else was present to speak to the application, the Chair concluded the Informal Public Meeting and indicated that staff will review the issues and report back to Council at a later date.

Formal Public Meetings

c) Title: Zoning By-law Amendment Z-18-05, LEHOME Ltd., for 84-86 Hickory Street West and 284-286 Albert Street
Report No.: IPPW2019-055
Prepared By: Rita Szilock

Olga Smith, City Clerk, advised Council that notice was advertised in the Waterloo Chronicle on October 10, 2019, and mailed or emailed on October 8, 2019, to all property owners within 120 metres of the subject property, to public agencies, to all persons who signed in or spoke at the Informal Public Meeting held on April 9, 2018, and to all persons who requested further notice.

Rita Szilock, Development Planner advised Council that the applicant, LEHOME Ltd., was proposing the following zoning amendments.

Within Zoning By-law No. 1108, the applicant is proposing to rezone the lands from (Holding) Northdale Mixed-use-6 ((H) NMU-6) to Northdale Mixed-Use-6 (NMU-6) with site specific regulations. The site specific provisions include an increased flankage yard setback, reduced ground floor height, utilization of density bonusing, and removal of the Holding Symbol.

Within Zoning By-law No. 2018-050, the applicant is proposing to rezone the lands from Zone Change Application (ZC) to Residential Northdale – 6 (RN-6) with site specific regulations. The site specific provisions include an increased flankage yard setback, reduced ground floor height, reduced Landscape Open Space at grade, no loading space, utilization of density bonusing, and removal of the Holding Symbol.

This application is being advanced to permit the development of a 6 storey apartment building with 115 units (143 bedrooms) through the utilization of density bonusing. The development will consist of a mix of one, two and three bedroom units, with 41 parking spaces and 36 bike parking spaces.

Rita Szilock, Development Planner, responded to questions from Council.

Trevor Hawkins, Associate, MHBC Planning, spoke in support of the application on behalf of the applicant and responded to questions from Council.

As no one else was present to speak to the application, the Chair concluded the Formal Public Meeting and advised the application is now open to Council for a motion and debate.

Moved by Councillor Henry, seconded by Councillor Vieth:

WHEREAS Council has considered all written and oral submissions from the public and stakeholders;

AND WHEREAS Council has considered the professional opinions of planning staff;

THEREFORE BE IT RESOLVED:

1. that Council approves Staff Report IPPW2019-055;

2. that Council approves Zoning By-law Amendment Application Z-18-05, LEHOME Ltd., for 84-86 Hickory Street West and 284-286 Albert Street, in accordance with Section 7 (Recommendations) of Staff Report IPPW2019-055 for the reasons specified in Section 6 (Conclusion) of the report;

3. that Council authorizes the Mayor and Clerk to sign the Section 37 Planning Act Agreement for Z-18-05 substantially in the form of the draft agreement contained in Appendix 'F' to Staff Report IPPW2019-055.

Councillor Freeman requested an amendment to the motion:

Moved by Councillor Freeman, seconded by Councillor Bonoguore,

WHEREAS Council has considered all written and oral submissions from the public and stakeholders;

AND WHEREAS Council has considered the professional opinions of planning staff;

THEREFORE BE IT RESOLVED:

1. that Council approves Staff Report IPPW2019-055;

2. that Council approves Zoning By-law Amendment Application Z-18-05, LEHOME Ltd., for 84-86 Hickory Street West and 284-286 Albert Street, in accordance with Section 7 (Recommendations) of Staff Report IPPW2019-055 for the reasons specified in Section 6 (Conclusion) of the report, <u>save and except that Recommendation B. 2. c) be amended to require one Type "A" loading space;</u>

3. that Council authorizes the Mayor and Clerk to sign the Section 37 Planning Act Agreement for Z-18-05 substantially in the form of the draft agreement contained in Appendix 'F' to Staff Report IPPW2019-055.

Following discussion among Council, Councillor Freeman withdrew the motion.

Moved by Councillor Henry, seconded by Councillor Vieth:

WHEREAS Council has considered all written and oral submissions from the public and stakeholders;

AND WHEREAS Council has considered the professional opinions of planning staff;

THEREFORE BE IT RESOLVED:

1. that Council approves Staff Report IPPW2019-055;\

2. that Council approves Zoning By-law Amendment Application Z-18-05, LEHOME Ltd., for 84-86 Hickory Street West and 284-286 Albert Street, in accordance with Section 7 (Recommendations) of Staff Report IPPW2019-055 for the reasons specified in Section 6 (Conclusion) of the report;

3. that Council authorizes the Mayor and Clerk to sign the Section 37 Planning Act Agreement for Z-18-05 substantially in the form of the draft agreement contained in Appendix 'F' to Staff Report IPPW2019-055.

Carried Unanimously

12. ENACTMENT OF BY-LAWS

Moved by Councillor Freeman, seconded by Councillor Hanmer:

That By-law Numbers 2019-054 and 2019-055 be read a first, second and third time and finally passed, and that the Mayor and Clerk be authorized to sign them accordingly.

a)	By-law No. 2019-054	By-law establishing (widening) a public highway in the City of Waterloo known as Lodge Street. (A-44/19, June 18, 2019)
b)	By-law No. 2019-055	By-law to confirm all actions and proceedings of Council, October 28, 2019 - Regular

Carried Unanimously

13. ADJOURNMENT

Moved by Councillor Freeman, seconded by Councillor Bodaly:

That the meeting adjourn. (Time: 8:49 p.m.)

Carried Unanimously

READ AND APPROVED, November 25th, 2019

_____
Mayor

_____
City Clerk

Appendix E

WESTHILL DISTRICT OFFICIAL PLAN AMENDMENT AND DISTRICT PLAN UPDATE

Informal Public Meeting

MHBC
PLANNING
URBAN DESIGN
& LANDSCAPE
ARCHITECTURE

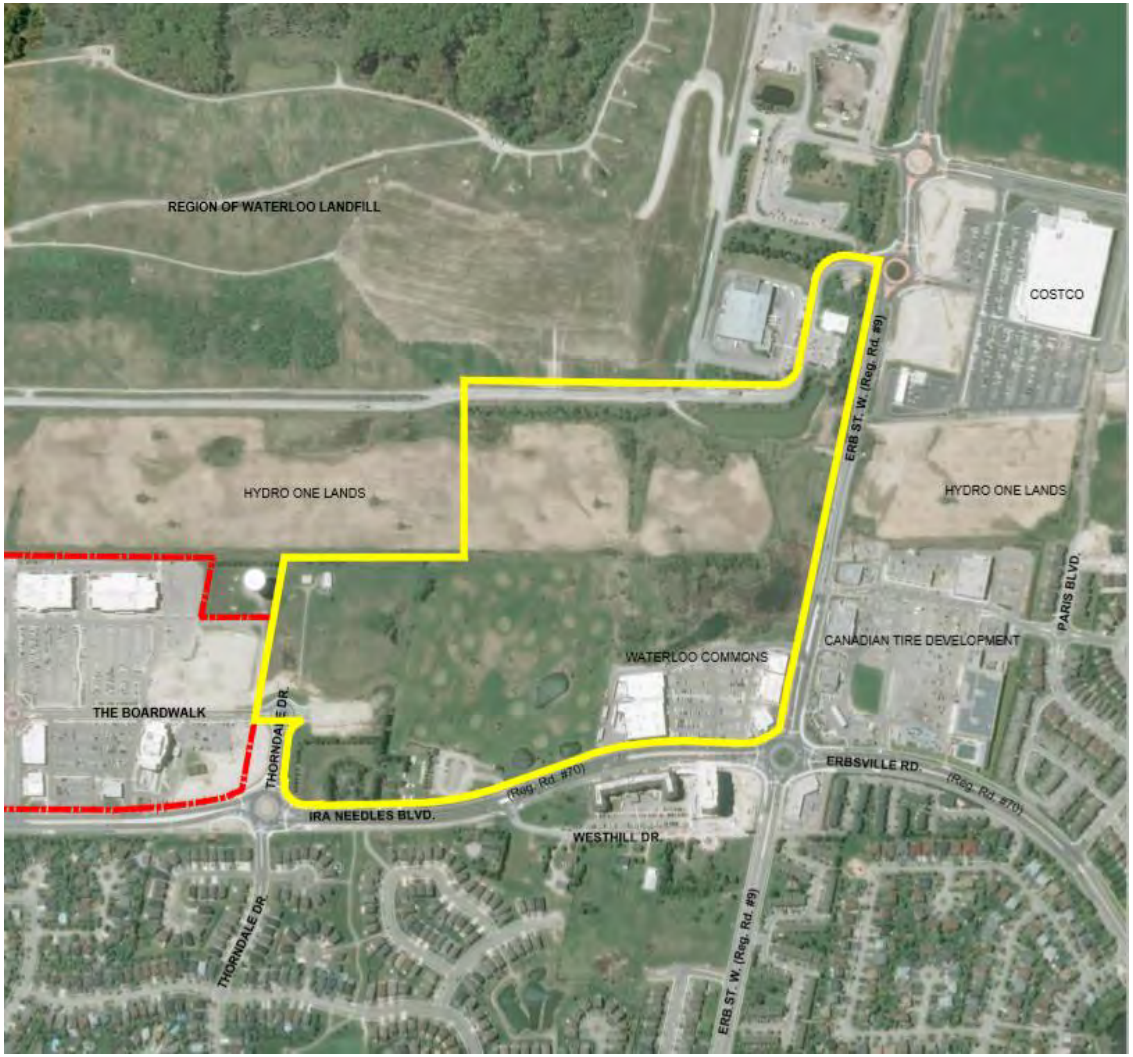
October 28, 2019

Purpose of Applications

- Official Plan Amendment:
    - Establish the final alignment of the extension of The Boardwalk Avenue (Collector Road) and delineate the Collector Road on Schedule E – Transportation Schedule of the Official Plan
- Westhill District Implementation Plan Update:
    - Develop the Master Servicing Strategy for the Westhill District and update the schedules and corresponding policies within the Westhill District Implementation Plan

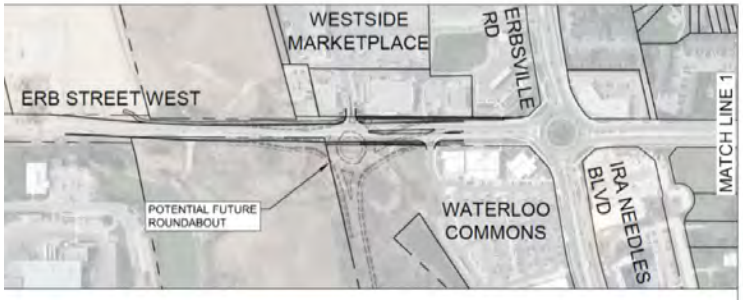
- A phased approach is being utilized:
  - Phase 1 – Official Plan Amendment and District Plan Update
  - Phase 2 – Property Specific Applications with Detailed Studies and Design

Area Subject to Application - Study Area



Background





City & Regional studies considered with application:

- City of Waterloo Development Charges Background Study and Capital Forecast
  - Boardwalk Extension identified as a DC eligible item
- City of Waterloo Integrated Multi-Modal Transportation Study (IMMTS)
  - Collector Road from Thorndale Avenue with connection to Erb Street West as a roundabout at existing signalized intersection

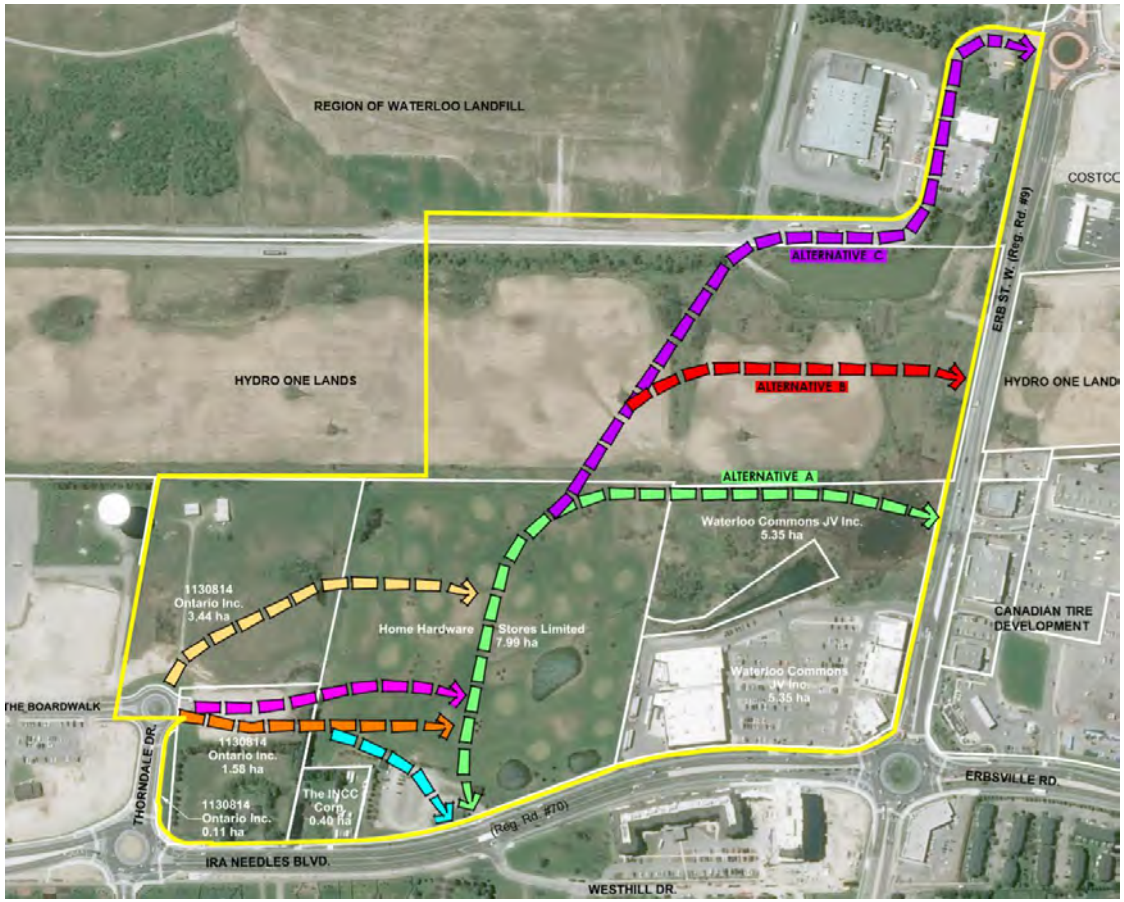
Regional Class Environmental Assessment for Erb Street West

- Potential roundabout on Erb Street West at existing signalized intersection

Objectives of Study / Application

- Improve traffic flow and connections for West Waterloo
- Reduce traffic volumes at the Erb Street / Ira Needles Blvd roundabout and address capacity issues in Erb Street roundabout
- Maintain capacity on Ira Needles Boulevard
- Provide improved vehicular circulation and accessibility to the lands in Westhill District
- Provide a secondary vehicle connection to southbound traffic, for emergency response vehicles
- Provide improved road network, pedestrian and cycling capacity
- Address Official Plan Site Specific Policy 41

Potential Collector Road – Alignment Alternatives

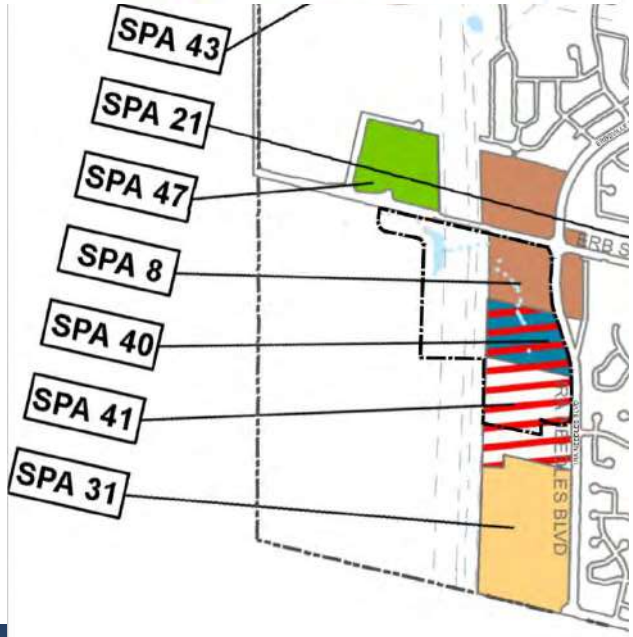


Guiding principles for collector road alignment considerations:

- Transportation Network and Servicing Efficiency
- Integration with the Existing Transportation Network
- Minimize Impacts on Road Network
- Feasibility and Constructability
- Existing Natural Environment
- Agency Requirements and Comments

Official Plan Framework





- Lands in Study Area Designated for Commercial, Business Employment, Open Space, Landfill
- Located within Designated Greenfield Area in City and Regional Official Plans
- Specific Provision Area 41(SPA 41) of the City of Waterloo Official Plan applies:

  "Prior to, or in conjunction with any plan of subdivision application or site plan application, the planned road network shall be adequately addressed. This may necessitate an amendment to Westhill District Implementation Plan."

Westhill District Implementation Plan



- Transportation Network - identifies extension of The Boardwalk from Thorndale Avenue to Ira Needles Boulevard
- This connection does little to solve the identified problem.

Background / Technical Studies

Studies submitted with application:

- Planning and Existing Conditions Report
- Waterloo Westside Transportation Network Assessment Study
- Stage 1 Environmental Impact Study
- Engineering Technical Memorandums:
  - Erb Street Pond Chronology
  - Hydrogeological Assessment
  - Surface Water Monitoring
  - Technical Design Overview
  - Municipal Services and Utilities
  - Stormwater Management Alternatives

Process / Next Steps

- Evaluation of Preferred Collector Road Alignment Alternatives and Servicing Options - systematic evaluation with the application of numerical approach.
- Determination of the Preferred Collector Road Alignment and Servicing Strategy
- Recommendation / Approval of Official Plan Amendment and Westhill District Implementation Plan Update to:
  - Identify final Collector Road Alignment on Schedule E of the Official Plan
  - Incorporate Master Servicing Strategy into the Westhill District Implementation Plan

Conclusion

- The Official Plan Amendment and Amendment to the Westhill District Implementation Plan will establish the final alignment of the extension of The Boardwalk Avenue (collector road) and a Master Servicing Strategy for the Westhill District.
- The proposed OPA amendment will satisfy the requirements of SPA 41.
- Details with be addressed through Property specific applications in the future

THANK-YOU

Appendix F

THE CITY OF Waterloo | **Integrated Planning & Public Works**

Planning Approvals

February 4, 2020

Mr. Paul Britton
President/Treasurer
MHBC Planning
200-540 Bingemans Centre Drive
Kitchener, ON N2B 3X9

Mr. David Aston, MSc, MCIP, RPP
Vice-President
MHBC Planning
200-540 Bingemans Centre Drive
Kitchener, ON N2B 3X9

Dear Paul and Dave:

Re: Post-Circulation Comments
Official Plan Amendment No. 27 and West Hill District Plan Amendment
Proposed West Side Collector Road
Southwest corner of Ira Needles Blvd. and Erb St. W., north of Thorndale Dr.

City of Waterloo staff has completed a preliminary review of the studies and reports submitted in support of the above-noted applications. Feedback has also been received from circulated agencies, staff departments, and meeting participants, at the technical meeting held on October 15, 2019 and at the Informal Public Meeting held on October 28, 2019. Staff's initial comments are based on a review of the following material:

- Planning & Existing Conditions Report, Westhill District, City of Waterloo, MHBC Planning, December 2018.
- Waterloo Westside Transportation Network Assessment Study, Paradigm Transportation Solutions Ltd., August 2019.
- West Waterloo, Westhill District, North/South Collector Road, Technical Memorandums, MTE Consultants Inc., December 4, 2018.
- Westhill District, North-South Collector Road Study, Waterloo, Ontario, Stage 1 Environmental Impact Study, WSP Canada Group Ltd., December 2018.

Waterloo City Centre | 100 Regina Street South, PO Box 337 STN Waterloo, Waterloo, ON, N2J 4A8

P. 519.886.1550 | **F.** 519.747.8760 | **TTY.** 1.866.786.3941 | **www.waterloo.ca**

Please consider the environment before printing this letter.

The applications seek to amend Schedule 'E' (Road Classification System) in the City's Official Plan and Map 1 (Land Use Concept Plan) in the West Hill District Implementation Plan, by delineating a new public collector road. The collector road is proposed to extend from The Boardwalk/ Thorndale Drive roundabout to Erb Street West. The West Hill District Implementation Plan is also proposed to be amended, if and where appropriate, to reflect a preferred servicing strategy.

PLANNING COMMENTS

Official Plan Designation

The subject lands are designated Employment, Commercial, and Open Space on Schedule 'A' (Land Use Plan). Portions of the subject lands are designated Mixed-Use Neighbourhood Commercial on Schedule 'A1' (Commercial Land Uses) and Business Employment on Schedule 'A2' (Employment Areas). The Open Space areas are classified as part of the Natural System on Schedule 'A3' (Open Space Land Uses). There also are Specific Provision Areas (SPAs) that apply to the subject lands, including SPA 8, SPA 40 and SPA 41.

Portions of the subject lands are identified as a Minor Node (lands southwest of the Erb St. W. and Ira Needles Blvd. intersection) and as a Minor Corridor (lands along Ira Needles Blvd.) on Schedule 'B' (City Structure).

Land Use

The land use designations applicable to the subject lands neither permit nor prohibit the construction of a new road. The node and corridor policies of the Official Plan, similarly, do not dictate the location for new transportation routes. As there is no request to modify land uses as part of this proposed Official Plan Amendment (OPA), a proposed new collector road does not conflict with the designated land uses for the subject lands.

Any new road developed on the subject lands must be consistent with Chapters 5 (Networks) and 6 (Transportation) of the Official Plan.

SPA 8 and SPA 40 do not address the alignment of a potential road connection. However, SPA 41 specifically concerns the potential for a new road, which states in Section 11.1.41 (2), that "[p]rior to or in conjunction with any plan of subdivision application or Site Plan application, the planned road network shall be adequately addressed."

Official Plan Amendment and Study Process

There is no requirement for an OPA to create a new road, however a potential future road connection can be added to Schedule "E", Road Classification System, through an amendment. In support of the proposed OPA, the Applicant has submitted studies and reports which include:

- a characterization of the existing conditions of the study area,
- collector road alternatives and preliminary servicing strategies, and
- a proposed method of evaluation and evaluation criteria to assist in determining the preferred road and servicing method.

City staff understands that once the studies and reports have been accepted by the City and commenting agencies, the Applicant will complete an evaluation of the alternatives and will identify a preferred road alignment and servicing strategy. As part of or in conjunction with the evaluation, the Applicant will be required to assess all applicable policy, including those in the City's Official Plan and District Plan. The Applicant is asked to submit a summary to the City which details the evaluation and policy review, and identifies the preferred road alignment and servicing strategy. In this regard, please provide 8 paper copies and 1 digital copy for circulation and review.

Staff also understands that the proposed road alignment and servicing strategy derived through this OPA process will be refined and created through one or more future Draft Plan(s) of Subdivision.

Environmental Comments
Environmental Planning staff provide the following comments:

1. Page 5 (and 40) of the Planning and Existing Conditions Report notes that "The final road alignment and servicing strategy will be determined through a systematic evaluation of the criteria…" and that "The preferred alignment will be determined through the future application process…". Is there an intended difference between the "final" road alignment and the "preferred" alignment?

2. Section 3.2.2 of the Planning and Existing Conditions Report and Section 2.0 of the Stage 1 Environmental Impact Study (EIS) note that the EIS was informed by a Terms of Reference based on input from the agencies. To clarify, while the EIS does follow the staged approach recommended by the agencies, despite the request, the Terms of Reference was not provided to the agencies for review prior the completion of Stage 1.

3. The stormwater management alternatives are outlined under Section 4.3.4 of the Planning and Existing Conditions Report and in the Stormwater Management Alternatives Technical Memorandum. All of the stormwater management alternatives assume a particular road alignment, yet the purpose of this application is to determine the road alignment.

4. How will the preferred stormwater management alternative be selected? Through the same evaluation as the road? As a separate evaluation but using the same criteria?

5. Figure 10 of the Planning and Existing Conditions Report identifies three alternatives for the road alignment – A, B and C. However, four other unlabeled options are also included that connect Alternatives A, B and C to the Thorndale roundabout and/or Ira Needles. It has been explained that the four unlabeled options will be determined as part of a future plan of subdivision with detailed supporting studies. The extent of each alternative should be clearly denoted and described in any subsequent submission so that it is clear what has been reviewed and evaluated.

6. With respect to the evaluation criteria set out in Table 1 under Section 5.1 of the Planning and Existing Conditions Report, recommended modifications are shown in red below. Rationale of each modification is also noted

Factor Category/Factor Group/Factor	**Indicators/Measure**	***Rationale for Modification***
1 Natural Environment		
1A. Terrestrial Ecosystems		
• Wetlands	- Impact on feature and function of ~~PSWs or other~~ wetlands (area; classification/quality, relative extent in relation to entire ~~complex/~~landscape	*We know the wetlands are not PSWs or part of a complex*
• Designated Environmentally Sensitive Policy Areas/Areas of Natural and Scientific Interest, Significant Woodlands	- Impact on feature and function of ESPAs/ANSIs and significant woodlands (area; relative extent in relation to entire designated area)	*Question relevancy given the distance to the ESPA and Significant Woodland (300+ m)*
• Wildlife Habitat	- Impact on feature and function of and/or reduction of interior habitat (area/fragmentation) - Effects on wildlife movement corridors or corridors between critical habitat features (e.g. update/breeding ponds)(number of crossings) - Degree of potential increases in animal-vehicle conflicts	*Question relevancy given the size of the features in the study area.*

7. In addition to the alternatives being evaluated against the criteria proposed in Table 1 of the Planning and Existing Conditions Report, which will include a broad, all-encompassing consideration of land use policy under criterion 2A, the preferred alternative will also need to meet the specific policy requirements of the City's Official Plan. For instance, if Alternative A scores the highest and is deemed the preferred alternative, it will still need to be demonstrated that the relevant policies of Section 8.2.5 are addressed relative to the

Locally Significant Wetland, Other Wetlands, Significant Wildlife Habitat and intermittent watercourses confirmed on site.

8. The next submission should provide proposed policy amendments to the Official Plan and/or District Plan, in addition to illustrating the new collector road location and associated servicing strategy, along with stormwater management facilities.

9. On page 25 of the Technical Memorandum (Tab 2, Hydrogeological Assessment), it is noted that the study area is not located within a Wellhead Protection Area. The Applicant should be advised that the Grand River Source Protection Plan is in the process of being amended. City staff understand that the amended Plan will soon be submitted to the Minister of the Environment, Conservation and Parks for approval. Depending on what amendments are made, the study area may be captured in the Plan.

10. On page 8 of the Technical Memorandum (Tab 3, Surface Water Monitoring), the limitations associated with the 2018 monitoring season are noted. Has monitoring continued into 2019 that could supplement the data set?

ENGINEERING COMMENTS

Engineering staff provide the following comments:

1. A 'Master Plan' approach for servicing and storm water management is required, accounting for both interim and ultimate conditions at build out. This can be completed as part of a future plan of subdivision.

2. Sanitary Servicing - The 300mm diameter sanitary sewer which runs north-south along a servicing easement on the lands on the north side of Erb Street West (within the Canadian Tire development) is undersized for future development. This is based on the additional potential contributing sanitary flow from future development given the current pipe sizes and slopes. The existing sanitary sewer will need to be up-sized or reconstructed to allow for additional sanitary flows without a surcharge condition. In support of the Official Plan Amendment, the Applicant is required to provide a detailed capacity analysis to confirm sanitary needs, and a sanitary sewer design to ensure that existing infrastructure can be upgraded, as necessary.

3. Water Servicing - The existing 200mm watermain stub on the west side of Ira Needles Boulevard across from Westhill Drive must be looped through the development.

4. Storm Water Management Alternatives - The general concept of limiting the total number of public Storm Water Management (SWM) facilities is desirable from the perspective of maintenance and operations costs for the City. Given that Alternative 4, as illustrated within Tab 6 (Stormwater Management Alternatives Considered) of the Technical Memorandum, limits the overall number of SWM facilities, are there any feasible permutations of this alternative in which ponds could be located outside of the hydro

corridor? Have such options been fully explored? The City is not in support of maintaining SWM facilities located on Hydro Lands or to engage in a complex acquisition process / enter into agreements related to this use.

TRANSPORTATION AND ACTIVE TRANSPORTATION

Transportation staff provide the following comments:

1. Some of the road alternatives illustrated in Figure 10 of the Planning & Existing Conditions Report intersect with Ira Needles Blvd., opposite to Westhill Drive. This access, having limited turning movements (right in/right out only), will be a challenge for the City to maintain. Transportation staff are of the opinion that this access is not necessary.

2. In Section 3.1, of the Waterloo Westside Transportation Network Assessment Study, several of the City's roads have been incorrectly classified as "local". The Study should be revised to reflect the correct road classification for Keats Way, Columbia Street West, Thorndale Drive and Platinum Drive.

3. The proposed collector road will need to maintain consistent active transportation infrastructure (sidewalk, trail, bike lane, etc.) from Thorndale Drive to Erb Street West, as required. These elements will need to be determined as part of a future plan or plans of subdivision.

4. For your information, if the proposed road is approved, the City's standard street lights will be used rather than decorative street lights that have been used within the Boardwalk development.

5. As part of a future plan or plans of subdivision, any lots that may be created along the proposed public collector road will be reviewed as a controlled driveway access.

6. The Waterloo Advisory Committee on Active Transportation (WACAT) does not have any comments regarding OPA 27 and the proposed amendment to the West Hill District Plan. However, the Committee has requested that they be engaged in future planning processes to ensure that active transportation objectives are met. Staff note that the WACAT Committee will be consulted as part of any future planning applications that will refine and implement the final road design.

PUBLIC CONSULTATION

At the Informal Public Meeting, some Council members requested that the Applicant consult with the public on the preferred road and servicing alternatives prior to a Formal Public Meeting. Public consultation should be further discussed with staff.

AGENCY COMMENTS

Comments have been received from the Grand River Conservation Authority, dated November 14, 2019, the Region of Waterloo, dated January 8, 2020. These comments are attached for ease of reference.

In considering the above-noted comments, the Applicant is asked to provide a written response, together with any plans or studies required. City staff reserves the right to provide additional comments or modify the above-noted comments subject to further review and/or additional information as may be provided.

Should you have any questions, please do not hesitate to contact the undersigned.

Sincerely,



WENDY FISHER MA MCIP RPP
Planning Approvals Division
Integrated Planning & Public Works Department
City of Waterloo
P: 519.747.8544 | **E:** wendy.fisher@waterloo.ca

cc: Shilling Yip, Region of Waterloo (by email)
Trevor Heywood, Grand River Conservation Authority (by email)
Lana Kegel, Hydro One (by email)
Natalie Hardacre, City of Waterloo (by email)
Robyn McMullen, Growth Management, City of Waterloo (by email)
Darren Scott, Engineering, City of Waterloo (by email)
Chris Dedman, Transportation Services, City of Waterloo (by email)

Att. Grand River Conservation Authority Comments, November 14, 2019
Region of Waterloo Comments, January 8, 2020

Grand River Conservation Authority

Administration Centre: 400 Clyde Road, P.O. Box 729 Cambridge, ON N1R 5W6

Phone: 519-621-2761 Toll free: 1-866-900-4722 Fax: 519-621-4844 www.grandriver.ca

November 14, 2019

Wendy Fisher
Senior Development Planner, City of Waterloo
100 Regina Street South
PO Box 337, Station Waterloo
Waterloo ON N2J 4A8
wendy.fisher@waterloo.ca

Re: Official Plan Amendment 27 and Westhill District Plan Amendment
Westhill District Collector Road and Extension of The Boardwalk

Dear Wendy,

The Grand River Conservation Authority (GRCA) has reviewed the materials submitted to the City for the above-noted application, which include a Planning and Existing Conditions Report (MHBC, December 2018), an Environmental Impact Study (WSP, December 2018), and a series of technical memorandums (MTE, December 2018).

Information currently available at our office indicates that the subject lands contain wetlands which are regulated by the GRCA under Ontario Regulation 150/06 - Development, Interference with Wetlands and Alterations to Shorelines and Watercourses Regulation. Any future development within the regulated area (as shown in yellow on the attached map) will require prior written approval from the GRCA in the form of a permit pursuant to Ontario Regulation 150/06.

Provincial, municipal and GRCA policy allows for public infrastructure within wetlands and their allowances if they are planned through environmental assessments or other comprehensive plans. Detailed policy requirements may depend on the size of the wetland. We offer the following comments.

Wetland Policy

1. During the pre-consultation meeting for this application on October 15, 2019, it was noted that there may be significant barriers to implementing Alternatives B and C, and that this may lead to one or both being eliminated from further consideration. The GRCA does not support eliminating alternatives prior to evaluation, especially since Alternative A has the most significant potential impact on the largest wetland W1.

   We ask that the applicants conduct further consultation with Hydro One and the Region of Waterloo on their requirements and refine alternatives accordingly, so that a meaningful suite of feasible alternatives can be evaluated.

2. Further screening of the wetlands should be done through a Stage 2 Environmental Impact Study (EIS) if the preferred collector road alternative is aligned through any of the wetlands.
   a. For Wetland W1, it should be demonstrated that intrusions have been minimized, and that the wetland functions will be adequately restored and enhanced elsewhere as per GRCA Policy 8.4.6.
   b. The Stage 1 EIS states that wetland W3 was approved for removal through GRCA Permit No. 755/15. It should be clarified that removal of a 0.8 hectare portion of the original wetland was permitted, with 0.1 hectares retained to provide some stormwater detention and wetland function. If the preferred Boardwalk extension alternative will further remove or interfere with this retained portion of the wetland, please demonstrate how it would meet the criteria of GRCA Policy 8.4.5 or 8.4.6.

3. GRCA Policies 8.4.14 and 8.4.15 permit using wetlands for managing water quantity, but not quality. Any SWM works discharging to wetland W1 should have upstream quality controls, and structural components placed outside of the wetland.

Advisory Comments

4. We would advise that a Stage 2 EIS should:
   a. Analyze the potential impact of the road alignment on surface and ground water quality (e.g. road salt) to understand the potential impact on the wetlands; and,
   b. Account for recent changes to the federal Fisheries Act, such as interpretation of fish and fish habitat.

Fees

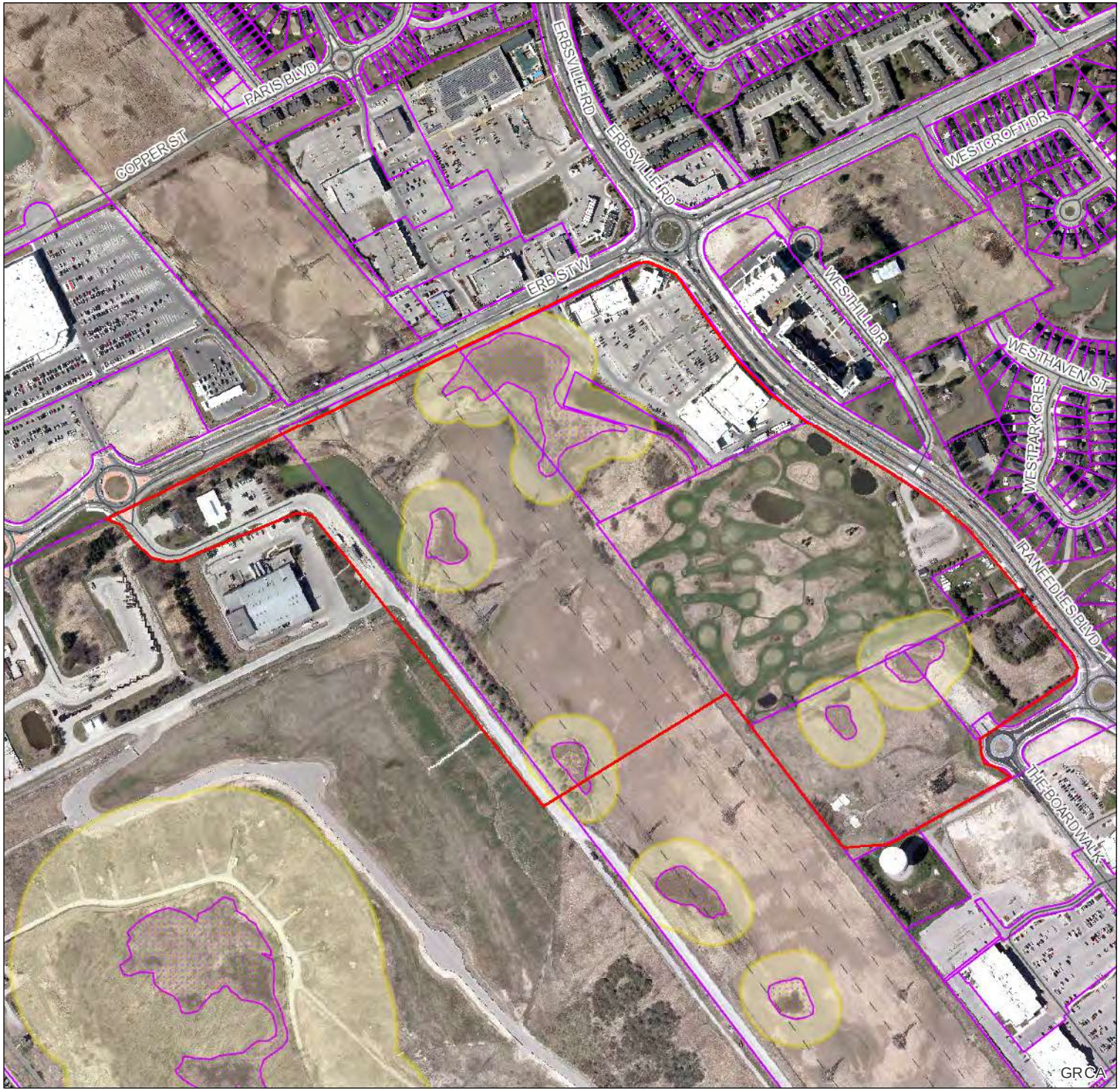
5. We acknowledge the receipt of a review fee for this application. A separate fee for a permit will be required prior to construction.

We trust this information is of assistance. If you have any questions, or require additional information, please contact Trevor Heywood at 519-621-2763 ext. 2292 or theywood@grandriver.ca.

Sincerely,

Melissa Larion MCIP RPP
Supervisor of Resource Planning
Grand River Conservation Authority
*ML/th

c.c. Paul Britton and Dave Aston, MHBC
Robyn McMullen, City of Waterloo
Shilling Yip, Region of Waterloo
Lana Kegel, Hydro One



Grand River Conservation Authority

Date: Oct 15, 2019
Author: TH

OPA 27

Study Area

Legend

- Regulation Limit (GRCA)
- Regulated Watercourse (GRCA)
- Regulated Waterbody (GRCA)
- Wetland (GRCA)
- Floodplain (GRCA)
  - Engineered
  - Estimated
  - Approximate
  - Special Policy Area
- Slope Valley (GRCA)
  - Steep
  - Oversteep
  - Steep
- Slope Erosion (GRCA)
  - Oversteep
  - Toe
- Lake Erie Flood (GRCA)
- Lake Erie Shoreline Reach (GRCA)
- Lake Erie Dynamic Beach (GRCA)
- Lake Erie Erosion (GRCA)
- Parcel - Assessment (MPAC/MNRF)

This legend is static and may not fully reflect the layers shown on the map. The text of Ontario Regulation 150/06 supercedes the mapping as represented by these layers.

Copyright Grand River Conservation Authority, 2019.
Disclaimer: This map is for illustrative purposes only. Information contained herein is not a substitute for professional review or a site survey and is subject to change without notice. The Grand River Conservation Authority takes no responsibility for, nor guarantees, the accuracy of the information contained on this map. Any interpretations or conclusions drawn from this map are the sole responsibility of the user.
The source for each data layer is shown in parentheses in the map legend. For a complete listing of sources and citations go to: https://maps.grandriver.ca/Sources-and-Citations.pdf

0 35 70 140 210 Metres

N

NAD 1983 UTM Zone 17N

Scale: 6,130

Map Centre (UTM NAD83 z17): 534,580.46 4,810,128.74

This map is not to be used for navigation | 2018 Ortho (RMOW)

Region of Waterloo

PLANNING, DEVELOPMENT
AND LEGISLATIVE SERVICES
Community Planning
150 Frederick Street 8th Floor
Kitchener Ontario N2G 4J3 Canada
Telephone: 519-575-4400
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Shilling Yip (519) 575-4496
File: D17-40/4/19027

January 8, 2020

Wendy Fisher, MA, MCIP, RPP
Senior Development Planner
Integrated Planning and Public Works
City of Waterloo
100 Regina Street S.
P.O. Box 337, Station Waterloo
Waterloo, ON N2J 4A8

Dear Ms. Fisher:

Re: Post Circulation Comments
OPA No. 27 and Westhill District Plan
1130814 Ontario Inc., et al
CITY OF WATERLOO

Region staff has reviewed the above-noted Official Plan and Westhill District Plan amendment applications and provide the following comments for the City's consideration at this time. The purpose of the amendments is to delineate a collector road extending from The Boardwalk / Thorndale Drive roundabout to Erb Street West. Corresponding policies for servicing infrastructure may also be considered if and where applicable.

The lands identified in the study area are designated in the Regional Official Plan ("ROP") as follows: "Urban Designated Greenfield Areas", as well as "Built-Up Area" on Map 3a; "Planned Cycling Route" (Erb St. W. & Ira Needles Blvd.) on Map 5c; and, Wellhead Protection Areas WPSA-8 on Map 6a.

Water Services
Water Services staff reviewed TAB 5 Municipal Services and Utilities dated Dec 4, 2018 and provide the following comments:

Section 3.0

- Clarification is required on the Municipal Services. The existing developed Boardwalk lands not including the Thorndale extension is serviced by an Agreement with the City of Kitchener for Water and Wastewater.

- All new development will be serviced from the Waterloo water and waste water distribution and collection systems. Thorndale extension has a 200mm local watermain in pressure zone Wat 6 that can be extended.

- Just needs to be stated more clearly.

Section 3.1
- Modify the following:

    - Twin 450mm diameter watermains *connect to* ~~exit~~ the *elevated* water tank and extend to Ira Needles Boulevard. One watermain runs south along Ira Needles Boulevard and eventually connects to the Mannheim PS system, which serves as the principle water source for *both pressure zones Kit Zone 6 and Wat Zone 6*.

    - Lastly, there is a 200mm diameter PVC *Zone 6* watermain along the newly extended Thorndale Drive, which terminates at the northern leg of the newly constructed roundabout at the intersection of Thorndale Drive and The Boardwalk

Section 5.0 Conclusions
- The conclusion is applicable to only one route option i.e., Alternative A. Was it the intent to exclude the other two route options? Notes should be provided why they would not work from a servicing perspective.

- Alternative A is the most preferred solution in regards to water servicing. No dead end watermains are created and looping is established for the distribution in pressure Zone Wat 6.

- Alternative B would require additional watermains to be constructed on the north side of Erb St. as the Zone 6 450 mm dia watermain terminates at the existing intersection of Erb and the BMO Bank of Montreal site entrance. Does not supply water to any additional customers. Extra cost and no additional benefit when compared to Alternative A.

- Alternative C would be crossing the pressure zone boundary and possibly create a long dead end watermain and no looping of the distribution system. The entrance to Costco has no watermains located at this roundabout. The watermains at Erb St. W. and Platinum Dr. are serviced from pressure zone Wat 7.

Corridor Planning

Access Permit / TIS / Access Regulation
Staff concurs with the recommendation that Alternative A would be the most preferred connection to Erb Street. Detailed Boardwalk North/South Collector Road layout (Alternative A) would be required once more detailed information/plans are available for

the proposed land uses for the subject lands, if possible in line with the scheduled Erb Street road widening project (2021).

Alternative B extends The Boardwalk from the Westhill Drive connection to Erb Street W. about 400 metres west of Ira Needles Boulevard within the Hydro One lands. This route is subject to approval from the Hydro One authority. The Region's experience is that Hydro One does not permit parallel municipal roads within their corridor. Given the location of the connection to Erb Street W. as a T-intersection, the forecast volumes at this intersection would not justify signalization. Without a signal or roundabout at this intersection, left-turn movements would experience high delays given the eastbound and westbound approach volumes. Alternative B is not recommended.

Alternative C bisects the Region's Waste Management facility to join in with the site's Gate 1 and the Costco entrance. This would bring public traffic through Region lands (a designated waste management facility).

This option is not considered feasible for the following reasons:

1. Significant infrastructure, both above and below grade would need to be relocated at significant cost. This includes, at a minimum, weigh scales, buildings and a sewage lift station.

2. The site has several approvals with the Ministry of Environment, Conservation and Parks which would need to be amended for the proposed road which would require a significant amount of time and cost to put in place before any construction would be allowed by the Province.

3. The proposed road is the primary route for truck traffic (tractor trailers and curbside garbage collection vehicles, approximately 275 a day) accessing the landfill and recycling facility. The interaction between larger landfill site traffic and other smaller vehicles passing through the site is not a recommended practice and would introduce traffic delays and significant safety concerns.

4. There is a significant grade differential which would potentially require additional land and therefore the relocation of additional infrastructure at the site.

5. Several onsite waste management buildings have access to the internal road that would require access to the new road, creating traffic delays and potential safety issues with vehicles entering and exiting the buildings.

Overall, Alternative C as a proposed road through the Region's Waste Management facility would have significant operational, regulatory, cost and safety impacts. Therefore, Waste Management does not feel this is a practical Alternative and request that it be eliminated from further consideration. Alternative C is not recommended.

<u>Other Potential Alternatives</u>
Staff suggests looking at a potential alternative which modifies Alternative A (by moving alignment east of the wetland along the Winners Plaza) to address concerns raised by the Grand River Conservation Authority.

Access Permits with applicable application fees at such times in future, will be required for any private/municipal street entrance on Erb Street W. A Transportation Impact Study (TIS) will be required to assess the impacts of the proposed amendment and prospective land uses on these lands, on the Municipal and Regional Road system in the vicinity. The scope of the TIS will be determined through a pre-study meeting with the City, the Regional staff and a qualified transportation consultant.

Regional Traffic Systems supports the results and analysis in the Intersection Control Study for Erb Street and The Boardwalk Extension, dated August 2019. A roundabout at the intersection of Erb Street and West Side Market is the preferred option. In addition to the comments provided in the report, a signal at the 4-leg intersection would potentially back up through the roundabout at intersection of Erb Street W. and Ira Needles Blvd.

Servicing and Storm Water Management

Regional staff has undertaken review of the Technical Memorandums on servicing considerations and stormwater management considerations for the study area as a whole, and as provided in Westhill District North/South Collector Road dated December 4, 2018 prepared by MTE Consultants. Staff has concerns with relocation of Regional SWM facilities onto hydro lands (proposed). The applicant is requested to undertake a detailed study to verify the capacity of proposed hydro land SWM facility. Region staff considers this the greatest challenge to overcome with Alternative A.

Detailed Functional Servicing and Stormwater Management reports will be required once more detailed plans are available for the proposed land uses for the subject lands.

Detailed Site Grading plans would be required at the Site Plan application stage(s) for each individual block. The grading along Erb Street W. and Ira Needles Boulevard must be compatible with the existing and the future road widening projects.

Transit Planning

There are currently no plans to extend the transit service to those sections of The Boardwalk and along section of Ira Needles Boulevard. Any transit requirements and need for the extension of transit services would be identified at a later stage once more detailed plans for proposed development on subject lands are available.

Transportation Capital Program (TCP)

Erb Street W. is currently scheduled for road widening in 2021 and installation of sidewalk and cycling facilities (TCP #5209).

For any further information please contact Jim Ellerman @ 519-575-4100 X 3757 Email: JEllerman@regionofwaterloo.ca

Archaeological Assessment

Regional Cultural Heritage staff has reviewed the documents submitted in support of the applications and provide the following comments:

- A portion of the study area retains the potential for the recovery of archaeological resources due to the proximity of an historic road and water courses (Waterloo Commons JV Inc site and Home Hardware site).

- As such, in the Regional Pre-submission Consultation comments for the proposed application dated March 27, 2018, the Region requested the submission of an Archaeological Assessment as part of a Complete Application. Regional Cultural Heritage staff has yet to receive a copy of this Assessment as well as the Acknowledgment of the Assessment from the Ministry of Tourism, Culture and Sport. If this Assessment has been completed, please provide it to Regional staff along with a copy of the Ministry Acknowledgement at your earliest convenience.

- The completed Archaeological Assessment will be required prior to final approval of the subject application. Further, staff requests that if a Stage 3 Archaeological Assessment is recommended by the licensed Archaeologist, that the Region of Waterloo be circulated the Stage 1 and 2 Assessments, and be consulted, prior to commencement of the Stage 3 Assessment.

- The applicant should be made aware that the completed Archaeological Assessment may result in recommendations that will need to be implemented as part of the subject development application or as part of subsequent development applications, to the satisfaction of the Region. Implementation of recommendations may need to be secured through a development agreement or through other legal mechanisms acceptable to the Region.

Environmental Planning

Environmental Planning staff has reviewed the "Westhill District North-South Collector Road Study, Waterloo, Ontario, Stage 1 Environment Impact Study" prepared by WSP Canada Group Ltd. (December 2018) as well as supporting information including "West Waterloo, Westhill District North/South Collector Road, Technical Memorandums by MTE (December 4, 2018), and the Planning and Existing Conditions Report, Westhill District, City of Waterloo from MHBC (December, 2018).

Environmental Planning staff does not have any concern with the Stage 1 work that has been provided. There are no Regionally-designated features within the study area and the Environmental Impact Study (EIS) does not identify any new features that meet criterion to be considered features under the Regional Official Plan's Greenlands Network. It is understood that additional work will be undertaken in the future through a Stage 2 EIS to evaluate alternatives and provide recommendations for mitigation measures, and Environmental Planning staff would appreciate receiving this information once it is available.

The following minor editorial comments on the EIS are offered for the applicant's consideration:

1. Page 9, bullet 1 appears to be missing words (...only moderate changes outlet pipe..."), and it is not clear if the entire bullet should be in quotation marks.
2. Page 14, first sentence: Should "addition" be "additional"? i.e. "Note that one additional potentially regionally significant..."
3. Page 45, first paragraph: The first paragraph under 4.5.1.2 identifies the Waldau East Wetland Complex as being located on lands to the east; this should be corrected to identify the wetland on lands to the west.

Source Water Protection
Hydrogeology and Source Water staff comments are outstanding, and will provide them once available.

Region Development Charges
The Applicant/Owner should also be advised that any future development on the subject lands will be subject to provisions of Regional Development Charge By-law 19-037 or any successor thereof.

Other
The Region acknowledges receipt October 15, 2019 the required approval fee for the OPA approval.

Should you have any questions, please do not hesitate to contact the undersigned.

Yours truly,

Shilling Yip, MCIP, RPP
Principal Planner

cc. Paul Britton, MHBC Planning

Appendix G

PROJECT:	Ira Needles Boulevard – By-Pass			**PROJECT MANAGER:**	TBD
PROJ BUDGET DIV:	IPPW-Eng	**IMPLEMENTATION DIV:**	IPPW-Eng	**PREPARED BY:**	Jeff Little
PROJ SHEET DATE:	15-Mar-17	**EXISTING CAPITAL PROJECT #:**	150042	**PROJECT START YEAR:**	2018
PROJECT TYPE:	Growth			**WARD:**	Ward 1 - Southwest
THEME:	Road Reconstruction (including Underground)	**LINK TO STRATEGIC PLAN:**		Infrastructure Renewal	
DESCRIPTION		**PROJECT ID:**	P1053	**REFERENCE NUMBER:**	551

New Collector Road between the Boardwalk and Erb St
Including Servicing of Future lands and a possible Round About at Erb St

Construction year anticipated to be 2018 or 2019 to accommodate demand for industrial land.
Exact location will be determined based on the approved draft plan.

Estimated Quantities used on this sheet are items included in DC by-law



COST ESTIMATE (use a separate line for each project component)	QUANTITY	Unit of Measure	$ / UNIT	TOTAL COST
				$0
				$0
New Sanitary Sewers	300	m	$ 600	$180,000
New Watermain	250	m	$ 600	$150,000
New Storm Sewers	700	m	$ 750	$525,000
New Collector Road (estimated at 11m wide Pavement) including (Sidewalks, Bike Lanes etc.)	8360	m2	$ 135	$1,128,600
Curvert Crossings	2	each	$ 250,000	$500,000
Pond Restoration/ Relocations (including any Storm Pipe Outlets)	1	L.S.	$ 500,000	$500,000
Roundabout at Erb	1	L.S.	$ 1,000,000	$1,000,000
Roundabout	1	L.S.	$ 500,000	$500,000
				$0
				$0
				$0
				$0
				$0

Attention: All lines should be rounded to the nearest $100.

SUBTOTAL			$4,483,600
HST (non-recoverable)	2%		$89,672
OVERHEAD RATE	5%		$224,180
ENGINEERING RATE	15%		$719,618
CONTINGENCY RATE	15%		$719,618
Less previous project funding received			
TOTAL PROJECT COST 2017			**$6,236,688**
TOTAL INFLATED COST			**$6,361,421**

OPERATING BUDGET IMPACT:		Year	Amount
What will be the annual operating impact of this project and in what year will it begin?			
If there is expected to be a later **increase** to the operating impact, please indicate the amount and the year.	+		
If there is expected to be a later **decrease** to the operating impact, please indicate the amount and the year.	-		

NOTES:

DC-Sanitary

FUNDING SOURCE

FUNDING SOURCE	Funding Share %	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	TOTAL
DC	50%	$ 3,118,344										$ 3,118,344
DEV	50%	$ 3,118,344										$ 3,118,344
Select												
Select												
Select												
Select												
Select												
Select												
TOTAL	100%	**$ 6,236,688**										**$ 6,236,688**
Inflated		**$ 6,361,421**										**$ 6,361,421**

Project Submission Signature

Project Authorization (to be signed by Director of Division that will complete the work)

Appendix H

MHBC
PLANNING
URBAN DESIGN
& LANDSCAPE
ARCHITECTURE

KITCHENER
WOODBRIDGE
LONDON
KINGSTON
BARRIE
BURLINGTON

PLANNING & EXISTING CONDITIONS **REPORT**

Westhill District

City of Waterloo

Date:

December, 2018

Prepared by:
MacNaughton Hermsen Britton Clarkson Planning Limited (MHBC)
540 Bingemans Centre Drive, Suite 200
Kitchener, Ontario
T: 519.576.3650
F: 519.576.0121

Our File Y594E

Table of Contents

EXECUTIVE SUMMARY 3
1.0 INTRODUCTION 6
1.1 Purpose of Report and Applications 6
1.2 Background and Focus of Planning and Existing Conditions Report 8
1.3 Approach to the Amendment and Future Applications 9
2.0 POLICY OVERVIEW 12
2.1 Region of Waterloo Official Plan and Transportation Master Plan 12
2.2 City of Waterloo Official Plan 13
2.3 Westhill District Implementation Plan 14
2.4 City of Waterloo Zoning By-law 2018-050 15
2.5 Development Charges Background Study 15
2.6 Ongoing Studies in West Waterloo and the Westhill District 16
3.0 OVERVIEW OF EXISTING CONDITIONS 18
3.1 Social-Cultural Environment 18
3.1.1 Land Use 18
3.1.2 Cultural Heritage and Archaeological Resources 19
3.2 Characterization of the Landscape and Natural Environment 19
3.2.1 Historical Background 19
3.2.2 Overview of Natural Features 21
3.2.3 Existing Stormwater Management Ponds 23
3.2.4 Hydrogeological Assessment 23
3.2.4 Water Courses and Surface Water 24
3.3 Transportation Network, Municipal Services and Utilities 25
3.3.1 Transportation Network 25
3.3.2 Municipal Services and Utilities 26
4.0 DESCRIPTION OF COLLECTOR ROAD ALTERNATIVES AND PRELIMINARY SERVICING STRATEGY 30
4.1 Development of Collector Road Alignment Alternatives and Servicing Consideration 30

4.2 Description of Collector Road Alignment Alternatives 31
4.3 Description of Preliminary Servicing Considerations and Stormwater Management Alternatives 32
4.3.1 Water Servicing 32
4.3.2 Sanitary Servicing 32
4.3.3 Stormwater Servicing 32
4.3.4 Stormwater Management Alternatives 32
5.0 DESCRIPTION OF EVALUATION CRITERIA AND METHOD 34
5.1 Evaluation Criteria 34
5.2 Methodology for Evaluation of Alternatives and Selection of Preferred Alignment 39
6.0 STUDY OUTCOMES AND DELIVERABLES 40

Appendices

Appendix A Pre-submission Consultation Comments
Appendix B Draft Terms of Reference
Appendix C DC Background Report Study – Ira Needles By-Pass Project Page
Appendix D Stormwater Management Alternatives

List of Figures

Figure 1 Property Ownership
Figure 2 Study Area
Figure 3 Region of Waterloo Official Plan Map 3A – Urban Area
Figure 4 Official Plan Schedule A – Land Use Plan
Figure 5 Official Plan Schedule A6 – Specific Provision Areas
Figure 6 Official Plan Schedule E – Road Classification System
Figure 7 Westhill District Implementation Plan – Amended Land Use Concept Plan
Figure 8 Zoning By-law 2018-050 Schedule 'A'
Figure 9 Waterloo West-Side Integrated Multi-Modal Transportation Study – 2031 Intersection Operations with Planned Roadway Improvements Plus Additional Recommendations
Figure 10 Collector Road Alignment Alternatives

EXECUTIVE SUMMARY

MHBC, in conjunction with MTE and WSP, was retained on behalf of the landowners within the Westhill District, to coordinate the submission of an Official Plan Amendment application for the identification of a new collector road for the extension of The Boardwalk Avenue to Erb Street West and to identify a servicing strategy to be implemented through amendment to the Westhill District Plan and future planning applications. The property ownership is included as **Figure 1** and the Study Area is illustrated on **Figure 2** of this Report.

The objectives of the Study are discussed in detail in this Report, and are to:

i. Characterize existing conditions and policy overview;
ii. Identify road alignment and servicing alternatives;
iii. Establish evaluation criteria to determine the preferred road alignment and master servicing strategy, including water, sanitary and stormwater management;

The following items provide rationale for the Official Plan Amendment and Westhill District Plan Amendment:

- The Boardwalk Avenue currently terminates at the Thorndale roundabout, and the design of the roundabout contemplates its northerly extension. The need for this extension has been identified in the Westhill District Plan, the City of Waterloo Official Plan and a recent transportation study completed by the City of Waterloo;
- The proposed collector road will extend beyond individual properties and will give direction to all land owners in the broader Study Area for future applications and implementation;
- An update to the Westhill District Plan will guide future development in the District overall, including roads and servicing; and
- The DC Background Study includes funding for the proposed collector road, demonstrating the City's financial commitment to construct the road.

The collector road extension (Boardwalk Avenue extension) is proposed to:

i. Improve traffic flow and connections for west Waterloo;
ii. Provide improved vehicular circulation; and accessibility to the lands in Westhill, with independent access via the collector to Erb Street;
iii. Provide a secondary vehicle connection to southbound traffic, for emergency response vehicles and access to/from the Regional landfill;
iv. Reduce traffic volumes at the Erb Street / Ira Needles Blvd roundabout;
v. Provide improved vehicular access to Waterloo Commons; and

vi. Provide improved cycling and pedestrian connections.

The Study is being undertaken in two phases. This Report represents Phase 1, which includes background information and characterizes the existing conditions, as identified in the reports prepared by MTE and WSP, and summarizes other ongoing studies of the area, at the Regional and Municipal levels.

Phase 1 will conclude with the identification of a Collector Road on the Transportation Schedule (Schedule E) and satisfy Specific Provision Area 41 in the City of Waterloo Official Plan, through an Official Plan Amendment and Amendment to the Westhill District Plan to reflect the transportation and servicing strategy.

Phase 2 will include the property specific applications (plan of subdivision and zoning by-law amendment) to implement the preferred road alignment and the recommended servicing strategy.

The Regional Official Plan designates the Area as 'Built-Up Area' and 'Urban Designated Greenfield Area'. The area subject to the Study is included in Specific Provision Area 41(SPA 41) in the City of Waterloo Official Plan which identifies that prior to, or in conjunction with, any plan of subdivision application or site plan application, the planned road network in the Westhill District shall be adequately addressed, which may necessitate an amendment to Westhill District Implementation Plan.

The City of Waterloo Official Plan designates the majority of the lands as 'Employment', and the remainder of the lands 'Open Space'. Under the recently approved City of Waterloo Zoning By-law 2018-050, the majority of the Study Area is zoned Future Determination (FD) Zone, and the remainder is zoned Open Space 1 (OS1) Zone, Commercial 2 (C2-40) Zone, and Waste Management (WM) Zone.

This Report identifies collector road alignment alternatives to connect The Boardwalk Avenue and Thorndale Drive roundabout to Erb Street West and identifies evaluation criteria. This Report also includes a summary of the Technical Memorandum (MTE) and Stage 1 Environmental Impact Study (WSP)) which are provided to assess and characterize existing conditions. The information will be used as consideration for the evaluation and determination of the final road alignment and servicing strategy. The collector road alignment alternatives are included as **Figure 10** of this Report.

In conclusion, the Official Plan Amendment and Amendment to the Westhill District Implementation Plan will establish the final alignment of the extension of The Boardwalk Avenue (collector road) and a master servicing strategy for the Westhill District.

An Official Plan Amendment and Amendment to the Westhill District Implementation Plan will delineate the proposed collector road on Schedule E – Transportation Schedule of the Official Plan and major servicing infrastructure on the schedules and within the corresponding policies of the Official Plan and the Westhill District Implementation Plan.

The final road alignment and servicing strategy will be determined through a systematic evaluation of the criteria and the application of the numerical approach described in this Report. The preferred alignment will be determined through the future application process, and the Study will also:

i. Confirm an overall servicing strategy for the Westhill District Plan;
ii. Confirm a preferred stormwater solution including the location of stormwater management pond(s); and
iii. Provide overall direction to the submission of future property-specific *Planning Act* applications within the Study Area

This Report represents a summary of background information and characterizes the existing conditions and identifies road alignment and servicing alternatives to fulfill Phase 1 of the process. The completion of this phase will address Specific Provision Area 41 in the City of Waterloo Official Plan and establish the policy direction for Phase 2 of the process.

1.0 INTRODUCTION

MHBC, in conjunction with MTE and WSP, was retained on behalf of the landowners within the Westhill District, to coordinate the submission of an Official Plan Amendment application for the identification of a new collector road for the extension of The Boardwalk Avenue to Erb Street West and to identify a servicing strategy to be implemented through amendment to the Westhill District Plan and future planning applications. A property ownership schedule is included as **Figure 1**.

This Planning and Existing Conditions Report provides a contextual framework of the studies undertaken for the planning application and provides a summary of the socio-economic, natural environment and existing conditions; and reviews the framework for the road alternatives for the determination of the final alignment of the collector road.

For the purposes of this Planning Report and the supporting reports, relating to the environment, traffic and engineering, the area subject to the review for the application is referred to as the 'Study Area', as shown on **Figure 2.**

1.1 Purpose of Report and Applications

The purpose of this Report and planning application is to determine the appropriate location for a new public collector road to extend The Boardwalk Avenue from the roundabout at Thorndale Drive to Erb Street West. A master servicing strategy for the Study Area based on the preferred road alignment will be determined. This road and servicing strategy will be implemented by an Official Plan Amendment an update to the Westhill District Plan. Future development in the Study Area will be subject to further Planning Act applications, by individual land owners.

The Boardwalk Avenue currently terminates at the Thorndale roundabout, and the design of the roundabout contemplates its northerly extension. The need for this extension to Erb Street West has been identified in the Westhill District Plan and the City Official Plan, as identifed by Special Provision 41 (SPA 41), and the recent City of Waterloo Integrated Multi-Modal Transportation Study (IMMTS).

The following Problem / Opportunity Statement was developed for the extension of the Boardwalk Avenue collector road assessment:

> *To determine the final alignment of the proposed collector road, and associated sanitary and water infrastructure, including stormwater management facilities, within the Westhill District lands. The collector road will include the extension of* The *Boardwalk Avenue collector road from*

its current terminus at Thorndale Drive, to Erb Street West, and Master servicing strategy to support development of the Study Area.

The objectives of the Study are as follows, and discussed in this Report:

i. Characterize existing conditions and policy overview;
ii. Identify road alignment and servicing alternatives;
iii. Establish evaluation criteria to determine the preferred road alignment and master servicing strategy, including water, sanitary and stormwater management;

The rationale for the Official Plan Amendment and Westhill District Plan Amendment is as follows:

- The Boardwalk Avenue currently terminates at the Thorndale roundabout, and the design of the roundabout contemplates its northerly extension. The need for this extension has been identified in the Westhill District Plan, the City of Waterloo Official Plan and a recent transportation study completed by the City of Waterloo;
- The proposed collector road will extend beyond individual properties and will give direction to all land owners in the broader Study Area for future applications and implementation;
- An update to the Westhill District Plan will guide future development in the District overall, including roads and servicing; and
- The DC Background Study includes funding for the proposed collector road, demonstrating the City's financial commitment to construct the road.

The objectives of the extension of The Boardwalk collector road are:

i. To improve traffic flow and connections;
ii. Provide improved vehicular circulation; and accessibility to the lands in Westhill, with independent access via the collector to Erb Street;
iii. To provide a secondary vehicle connection to southbound traffic, for emergency response vehicles and access to/from the Regional landfill;
iv. To reduce traffic volumes at the Erb Street / Ira Needles Blvd roundabout; and
v. To provide improved vehicular access to Waterloo Commons.
vi. Provide improved cycling and pedestrian connections.

The final alignment of the collector road will be determined through the processing of this application and the final Official Plan Amendment. This Study includes and description of alternatives, included in **Section 4.0** of this Report, and the development of comprehensive evaluation criteria, including in **Section 5.0**.

1.2 Background and Focus of Planning and Existing Conditions Report

The area subject to the application is located within the Westhill District, on the west side of the City of Waterloo, being one of the City's last remaining undeveloped designated greenfield areas. The Westhill District is within the Grand River Watershed, located south and west of Laurel Creek, and south of Erb Street West and west of Ira Needles Boulevard.

The focus of the 'existing conditions' report includes the lands to the north of The Boardwalk and Thorndale Drive; east of the Hydro Corridor and Regional Waste Management Centre; West of Ira Needles Boulevard; and, south of Erb Street West. The Study Area is approximately 16.06 hectares (40 acres) in size. The Study Area is illustrated on **Figure 2**.

The lands are within the City Urban Area with a variety of land use designations, including Commercial, Employment and Open Space. The lands form the majority of the Westhill District Plan.

The City of Waterloo municipal boundary to the west delineates the western limit of the Westhill District Study Area and separates the community from the rural area to the west. This boundary line aligns with Wilmot Line to the north, which terminates at Erb Street West. The Wilmot Line generally runs in a north/south direction and defines the western limit of the City of Waterloo. This represents a long-term boundary between existing Urban Area/Township Urban Areas and the Countryside.

Prior to the construction of Ira Needles Boulevard and subsequent development, the land was used for agricultural purposes. Historical aerial photos show the lands under agricultural use and the changes to the landscape associated with the construction of roads and development of the lands. The landscape evolved through the development on the lands and surrounding area, which resulted in the creation of anthropogenic features.

Existing commercial development in the Westhill District is located to the north, east and south of the Study Area. The Costco lands, and Canadian Tire development are located to the north, some smaller commercial uses are located to the east, and The Boardwalk mixed use development is located to the south.

Residential development exists to the east of the Study Area, on the opposite side of Ira Needles Blvd, in the Westvale neighbourhood and about 300 metres north of the Study Area, including the Vista Hills neighbourhood to the northwest, and Rummelhardt neighbourhood to the north. These residential subdivisions are characterized by primarily low and medium density residential development including single detached dwellings, and street fronting townhouse dwellings. There are also intervening land uses including open space, parks, natural heritage features and community facilities, such as schools.

The subdivisions have been designed as a modified grid network, with limited access points to the surrounding collector road network, Erb Street West and Ira Needles Blvd (Erbsville Road). Traffic from these subdivisions is directed to Erb Street West and Ira Needles (Erbsville Road). There is currently no direct vehicular access between the Vista Hills neighbourhood and Erb Street West.

Development applications, including a Draft Plan of Subdivision, an Official Plan Amendment and Zoning By-law Amendment were recently submitted for the West Side Employment Lands, surrounding Platinum Drive behind the Costco location. These lands are planned for a mix of employment uses, which will contribute to additional traffic generation in the area.

The existing Boardwalk development contains a collector road which terminates at the north limit of The Boardwalk Avenue, and connects to Ira Needles Blvd via Thorndale Drive. All traffic in the surrounding area is directed toward the roundabout at Ira Needles Blvd and Erb Street West. The existing collector road has been established as a common element as part of the overall condominium. The common element is also subject to easements in favour of the City and the Region to ensure public use, including transit service.

The Thorndale Drive roundabout has been designed and constructed with consideration for future extension as evidenced by the street stub extending to the north.

Significant public infrastructure, including the Region of Waterloo landfill, the Hydro Corridor, and existing development in the surrounding area has limited the development of a collector road network, to the west of Ira Needles Blvd in both north/south and east/west directions. The Boardwalk collector road is the only other collector road in this area. The Boardwalk collector provides limited access to Ira Needles Blvd, internalizing turning movements. The existing Boardwalk Avenue collector road currently terminates at the roundabout with Thorndale Drive, which connects to Ira Needles to the east and does not connect north to Erb Street West.

Bus transit service is currently provided along Ira Needles Blvd and Erb Street West, offering service throughout Kitchener-Waterloo with a transit terminal located further south within The Boardwalk. The extension of transit service through the extension of the existing road network is a possibility.

1.3 Approach to the Amendment and Future Applications

A pre-application consultation meeting was held with City, Region and GRCA staff, on August 29, 2013, to discuss the approach to planning applications to establish a new collector road for the Westhill District and confirm a Study Area. The submission for the pre-application meeting included the presentation and discussion of preliminary road network alternatives for the extension of The Boardwalk from Thorndale Drive to Erb Street West. At the pre-application meeting, the City advised

that a new collector road has been included within the City Development Charges By-law, which is discussed in more detail in **Section 2.5** of this Report.

Comments at the pre-application meeting provided direction to the process for consideration of applications. City staff advised that a Class Environmental Assessment was not required as the implementation of a new road would occur through future plan(s) of subdivision and recommended a phased approach to the application process. The first phase would include the background information and existing conditions to provide the recommended road alignment that would be addressed through an Official Plan Amendment and update to the Westhill District Plan to illustrate the road alignment. The second phase includes the property specific applications (plan of subdivision and zoning by-law amendment) to implement the road alignment.

Based on the City direction, Terms of Reference were developed to guide the project team. A phased approach was established to complete the study requirements for the implementation of a new road to connect Erb Street West with The Boardwalk collector road. The phases are generally characterized as follows:

Phase 1:

- Existing conditions characterization for ecological and hydrological features and functions of wetlands and watercourse within the Study Area
- Submission of a Planning Application to identify the road network in the Official Plan and update to the Westhill District Plan. This will include the identification and evaluation of alternatives, selection of the preferred alternative, and recommended plan and mitigation. The completion of this phase will result in the identification of a collector road on the Transportation Schedule in the City of Waterloo Official Plan.
- A review of surface drainage, services and approaches to stormwater management will provide direction for a master servicing strategy.

Phase 2:

- Planning application(s) that will be property-specific with focused evaluation to implement the approved road network. This may be done concurrently with the Official Plan Amendment and District Plan update or follow the approval and the details and design of the new road will be implemented through a plan of subdivision and associated conditions of approval.
- The second phase would include the property specific applications (plan of subdivision and zoning by-law amendment) to implement the road alignment and servicing strategy.

The Region submitted comments as part of the pre-application process that provided information to assist with the scoping of road alternatives, and the creation of the evaluation criteria, which have been reflected in this Report.

This Report and the technical memorandum (MTE), and Stage 1 EIS (WSP), represents the summary of background information and characterizes the existing conditions to fulfill Phase 1 of the process. This Report has been prepared in support of an Official Plan Amendment to add a collector road to the City Official Plan and to update the Westhill District Plan.

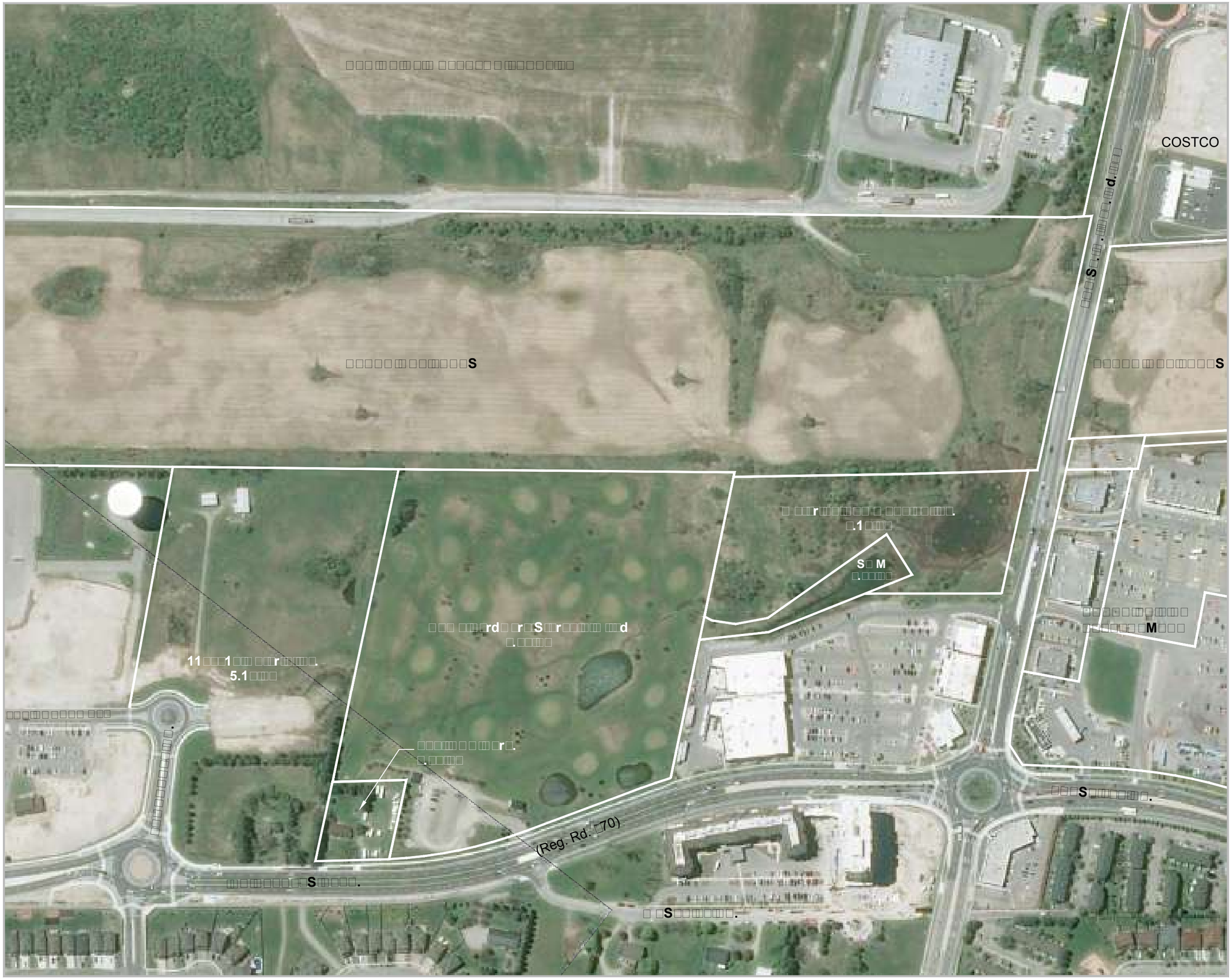


Figure 1

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City o□Waterloo

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Parcel Fabric (MPAC)

The INCC Corp. Property Ownership

Area by Property Ownership		
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The INCC Corp.	0.40	2.5
Waterloo Commons □V Inc.	2.54□□	15.8
1130814 Ontario Inc.	5.13	31.□
Home Hardware Development Limited	7.□□	4□.8
□□□□□	16.06	100

□Area based on Geowarehouse (Teranet) parcel mapping that was compiled using plans and documents recorded in the Land Registry System and is appro□imate.

□□Area includes 0.38 ha SWM Pond currently owned by the Region o□Waterloo

Air Photo Source: Bing

□□□□□December 2018

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K:□Y5□4E WESTHILL DISTRICT PLAN□RPT□PLANNING REPORT DECEMBER 2018□PROPERTY OWNERSHIP MAP.DWG

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Figure 2

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The Boardwalk

Study Area

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City o□Waterloo

Region o□Waterloo

Air Photo Source: Bing

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2.0 POLICY OVERVIEW

2.1 Region of Waterloo Official Plan and Transportation Master Plan

The ROP was processed as a Municipal Comprehensive Review and approved as the Region's implementation of the *Places to Grow – Growth Plan*. The Region of Waterloo's Official Plan (ROP) by the Ministry of Municipal Affairs and Housing, with modifications, on December 22, 2010 and approved with amendments by Oral Decision of the Ontario Municipal Board on June 18, 2015.

The ROP places increased emphasis on: intensification, higher densities in greenfield areas, promoting a balanced approach to growth, making better use of existing infrastructure, building more compact and complete communities, promoting efficient development patterns, reducing the need to expand roads, transit oriented development and the creation of a balanced transportation network comprised of roads, rail, active transportation and transit.

The Westhill District is designated as 'Built-Up Area' and 'Urban Designated Greenfield Area' and forms part of the Urban Area of the approved Regional Official Plan (ROP) as shown in **Figure 3.** The Primary Study Area is part of the 'Designated Greenfield Area'. The Urban Area designation in the ROP commits the Westhill District to urban uses.

Lands within the Urban Area have the greatest capacity to accommodate growth and are to be the primary focus for employment, housing, cultural and recreational opportunities in the Region. The Region's greenfield areas that serve primarily a residential function are to meet or exceed a minimum density of 55 residents and jobs combined per hectare. The minimum density target has an influence on the total amount of development and the infrastructure that is required to accommodate anticipated development within the Westhill District. The lands are planned to have future jobs.

The Regional Transportation Master Plan (January, 2011) reflects the policy direction of the Regional Official Plan. The RTMP promotes the role of public transit in a more balanced transportation system and is based on a number of goals including:

- Optimizing the transportation system (making the most of what exists).
- Promoting transportation choice.
- Fostering a strong economy.
- Supporting sustainable development.

The RTMP includes a complementary road network plan, which was developed to assist in prioritizing road network improvements including some expansions, widenings, intersection

improvements and transit priority improvements. The RTMP includes a road network plan and related short (0-5 years), medium (5-10 years) and long-term (10-20 years) road improvement priorities.

The RTMP confirms that as the community grows, congestion will increase throughout the Region and as a result, transit will become a more competitive travel choice if higher quality transit service is provided. The RTMP acknowledges the increased emphasis on transit may result in a period of transition where vehicle delay experienced on the road network will increase and there may be public pressure to widen/expand roadway infrastructure, for example the West Side of Waterloo.

The proposed collector road would provide both for vehicular and transit connections on the West Side of Waterloo. The design of the collector road will also provide opportunity for additional modes of travel, including pedestrian and cycling.

2.2 City of Waterloo Official Plan

The City of Waterloo Official Plan was approved by Region of Waterloo Council, with modifications, on November 21, 2012. The Official Plan represents the City's vision for growth and change within the community. The Official Plan sets out principles, objectives and policies designed to direct the form, extent, nature and rate of growth and change within the City to 2031.

The City of Waterloo Official Plan designates the portion of the Study Area closest to Ira Needles Blvd as 'Employment', and the remainder of the lands 'Open Space'. The existing commercial development at the corner of Erb St W and Ira Needles Blvd and the existing Boardwalk commercial development are designated 'Commercial'. The Official Plan land use designations within the Study Area are shown on **Figure 4.**

Specific Provision Area 41(SPA 41) of the City of Waterloo Official Plan applies to Part of the Westhill District, as identified on Schedule A6 – Specific Provision Areas of the Official Plan, included as **Figure 5.** SPA 41 contains the following policy:

> *Prior to, or in conjunction with any plan of subdivision application or site plan application, the planned road network shall be adequately addressed. This may necessitate an amendment to Westhill District Implementation Plan.*

The City of Waterloo Official Plan The Official Plan identifies Erb Street West and Ira Needles Blvd as Regional Arterial Roads, Thorndale Drive as a Minor Collector, and Platinum Drive as a Proposed Major Collector, on Schedule E, as shown on **Figure 6.** The City of Waterloo Official Plan generally supports a multi-modal transportation network which supports walking, cycling and transit use.

The Westhill District is proposed to be developed as a commercial and employment district. Future *Planning Act* applications will be required to facilitate future development.

2.3 Westhill District Implementation Plan

The subject lands are located within Westhill District Implementation Plan (WDIP) area. The WDIP is a land use policy document which provides greater detail for implementation of the Official Plan in the west side of Waterloo. The WDIP serves as the key planning document between the broad policies of the Official Plan and the more detailed stages of development, related various to planning applications.

The Westhill District is located in the southwest corner in the City of Waterloo, and is bounded by Erb Street West and the Clair Hills district to the north by Erb Street West, Ira Needles Blvd and the Westvale District to the east, and by the City of Kitchener and Township of Wilmot borders to the south and west, respectively.

The Westhill District straddles the border of two watersheds. The northern portion of the District is located within the Laurel Creek Watershed and the southern portion is located within the Henry Sturm watershed. The Westhill district is distinguished by unique land uses, including the Region of Waterloo Landfill site and recycling depot, and the Ontario Hydro transmission corridor, which occupy approximately three quarters of the District. At the time of the preparation of the Implementation Plan, the remaining lands in the Westhill district were comprised of a golf course (Westhill Meadows), agricultural uses and estate residential properties.

The Implementation Plan includes development policies and a development concept plan. The development concept plan included a range of land uses, including open space, mixed use activity node, arterial commercial, industrial special policy area, and parkland. The transportation policies note that the transportation system proposed in the concept plan, will be subject to minor variation through approval of development applications.

The WDIP was completed and resulted in the recommendation for the City of Waterloo to initiate a study to determine the alignment of a new collector road to facilitate The Boardwalk Avenue extension to the north.

The WDIP was amended as part of Official Plan Amendment (OPA) 74. The amendment related to the addition of the Mixed Use Commercial Centre as a land use as well as a minor relocation of collector roads. The north/south collector road, developed through The Boardwalk, is planned to extend through a portion of the Study Area in a northerly direction and then connect to Ira Needles Blvd. The amended plan is included as **Figure 7.**

The WDIP recognizes that the location of roads will be determined through the review and approval of Draft Plans of Subdivision, severances, zone changes, site plan and other development applications.

The amendment to the District Plan will illustrate the new collector road location and associated servicing strategy, along with stormwater management facilities.

2.4 City of Waterloo Zoning By-law 2018-050

The City of Waterloo recently completed its comprehensive zoning by-law review process, and Zoning By-law 2018-050 came into effect on September 10, 2018. Lands within the Study Area are zoned for a mix of commercial, open space (associated with the hydro corridor), and waste management uses (Regional Waste Management Centre).

The majority of the Primary Study Area is zoned Future Determination (FD) Zone. The remainder of the Study Area is zoned Open Space 1 (OS1) Zone, Commercial 2 (C2-40) Zone, and Waste Management (WM) Zone, as shown on **Figure 8.** The zoning schedule also illustrates the general road network.

The FD zone permits uses, buildings and/or structures that actually and legally existed on the lot on the effective date of the by-law. Staff Report IPPW2018-058.2 presented to the Committee of the Whole, with the final by-law on September 10, 2018 included a recommendation that Council pursuant to subsection 34 (10.0.0.2) of the Planning Act approve a resolution that lands zoned FD shall not be subject to subsection 34 (10.0.0.1) of the Planning Act. Applications for lands zoned FD are not subject to the 2 year moratorium for zoning by-law amendment applications, and applications for development are anticipated to be submitted for review by City staff and Council.

A zone change application is not submitted as part of this application. Future applications will be submitted by landowners as part of plans of subdivision.

2.5 Development Charges Background Study

Council approved a new Development Charges By-law that took effect January 1, 2018. To inform the development of this By-law, a Background Study was prepared by Watson & Associates Economics Ltd. in September, 2017.

The Development Charges (DC) Background Study reviewed the anticipated growth and development in terms of both population and employment, for which the City of Waterloo is required to provide services over a 10 and 15 year time horizon. Capital projects were included for infrastructure, including road improvements and expansions.

The DC Background Study included the 'Ira Needles Boulevard By-Pass' in its 2018 Capital Budget Project Sheets, included as **Appendix C.** The project includes new services, including sanitary sewers, watermain and storm sewers, a new collector road to include sidewalks, bike lanes, culvert crossings, pond restoration/ relocations and a roundabout at Erb Street West.

The project sheet identifies that the funding source for the project is intended to be 50% development charges and 50% developer funded. The inclusion of this project in the City's DC Background Study indicates a financial commitment to the collector road network development.

2.6 Ongoing Studies in West Waterloo and the Westhill District

In addition to this Report and associated studies, a number of other studies have been ongoing in recognition of traffic consideration associated with growth on the west side of Waterloo.

Costco Development Background

As part of the development applications associated with the Costco development, the need for a broader transportation impact review was identified, which was a contributing factor in the preparation of the 'Waterloo West Side Integrated Multi-Modal Transportation Study' (IMMTS).

The recent development of the Costco located on Erb Street West, has resulted in increased traffic in the area, specifically the Ira Needles Blvd and Erb Street West roundabout. Further, the area surrounding Platinum Drive is planned for employment uses (West Side Employment Lands), and is currently subject to active development applications, which will generate additional traffic in the area.

'Waterloo West Side Integrated Multi-Modal Transportation Study' (IMMTS).

WSP prepared the 'Waterloo West Side Integrated Multi-Modal Transportation Study' (IMMTS). A draft of this Study was presented to Council on June 25, 2018.

The study reviewed existing traffic conditions and intersection operations, and planned city and regional transportation improvements and the additional traffic that was expected as a result of urban growth in the Westhill District, specifically the projected employment growth.

The IMMTS notes the inclusion of a new road (The Boardwalk) from Thorndale Drive, northerly to intersect with Erb Street. The study recommends a controlled intersection (a new roundabout) at the intersection of The Boardwalk Avenue and Erb St West. Figure 3-9 of the IMMTS identifies the

extension of the Boardwalk Avenue and the proposed roundabout location and is attached as **Figure 9** of this Report.

The IMMTS also identified that together with the ION LRT and the conventional bus service, the study area will be well served by public transit, with connection to frequent service along key corridors. Figure 3-10 illustrates the planned transit services within the study area, up to 2021. The proposed extension will allow for improved transit connections to the Transit Terminal (Boardwalk Station).

The IMMTS developed a number of Active Transportation and Transportation Demand Management (TDM) measures intended to provide current and future residents and employees in and surrounding the study area with viable active transportation options beyond the private automobile. The proposed road extension would be designed with cycling and pedestrian facilities.

Regional Class EA for Erb Street West

A Class Environmental Assessment (Class EA) is being undertaken by the Region of Waterloo for Erb Street West. The Class EA makes provision for the introduction of a new roundabout, at the location on Erb Street West, generally identified by the City study.

In summary, the ongoing studies have recognized the need for road improvements to address existing and future traffic considerations. The policy framework and ongoing studies have informed the application to amend the Official Plan and Westhill District Plan.



Figure 3

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Sub□ect Lands

Urban Area

Built-Up Area*

Urban Designated Greenfield Areas

Central Transit Corridor Environmental Assessment Study Area

Urban Area Boundary

Base Map Source:
Region o□Waterloo O□icial Plan, Map 3a Urban Area (□une 2015)

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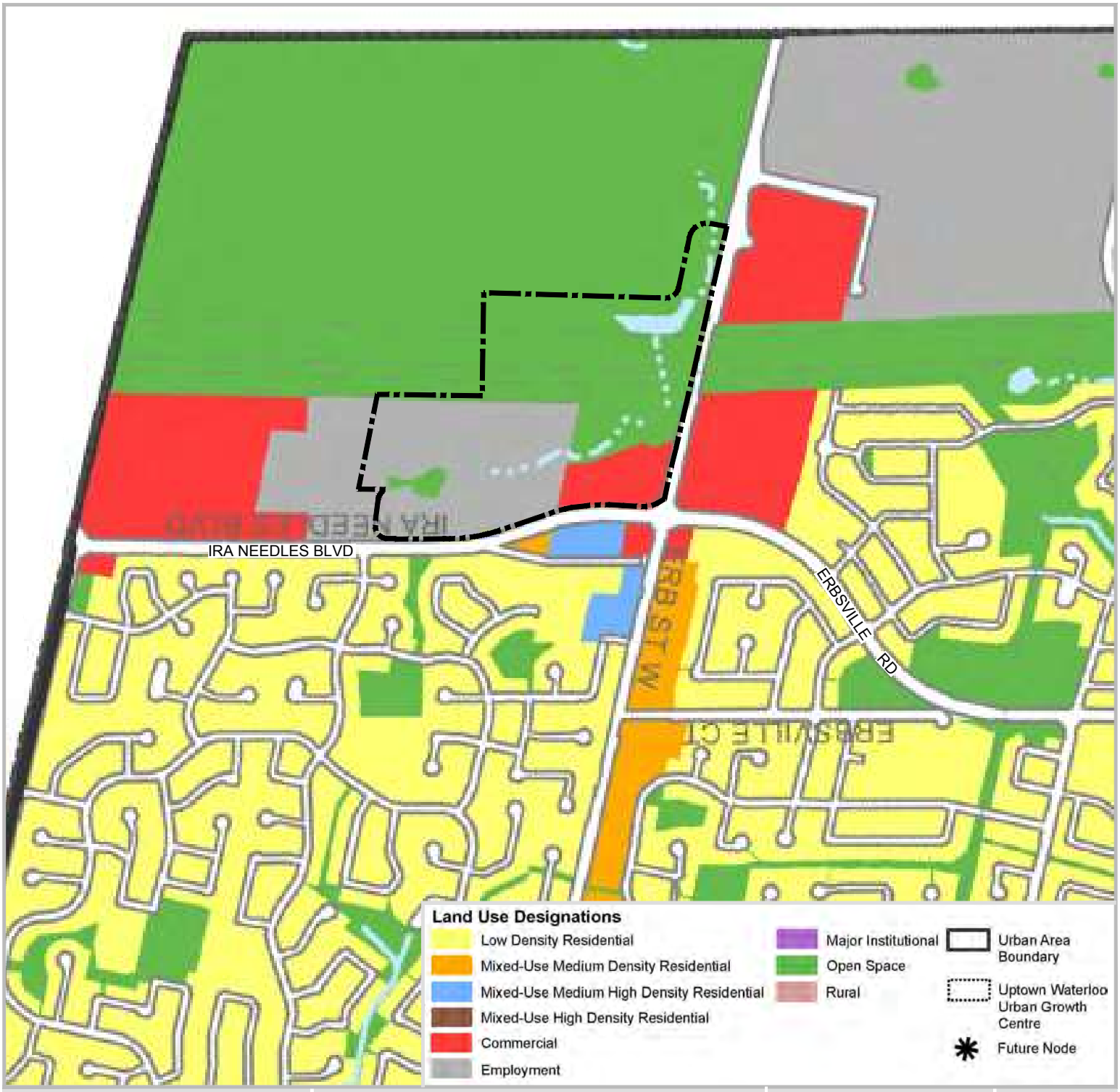


Figure 4

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Sub□ect Lands

Base Map Source:
City o□Waterloo O□icial Plan, Schedule "A" (Revision Date: November 2016)

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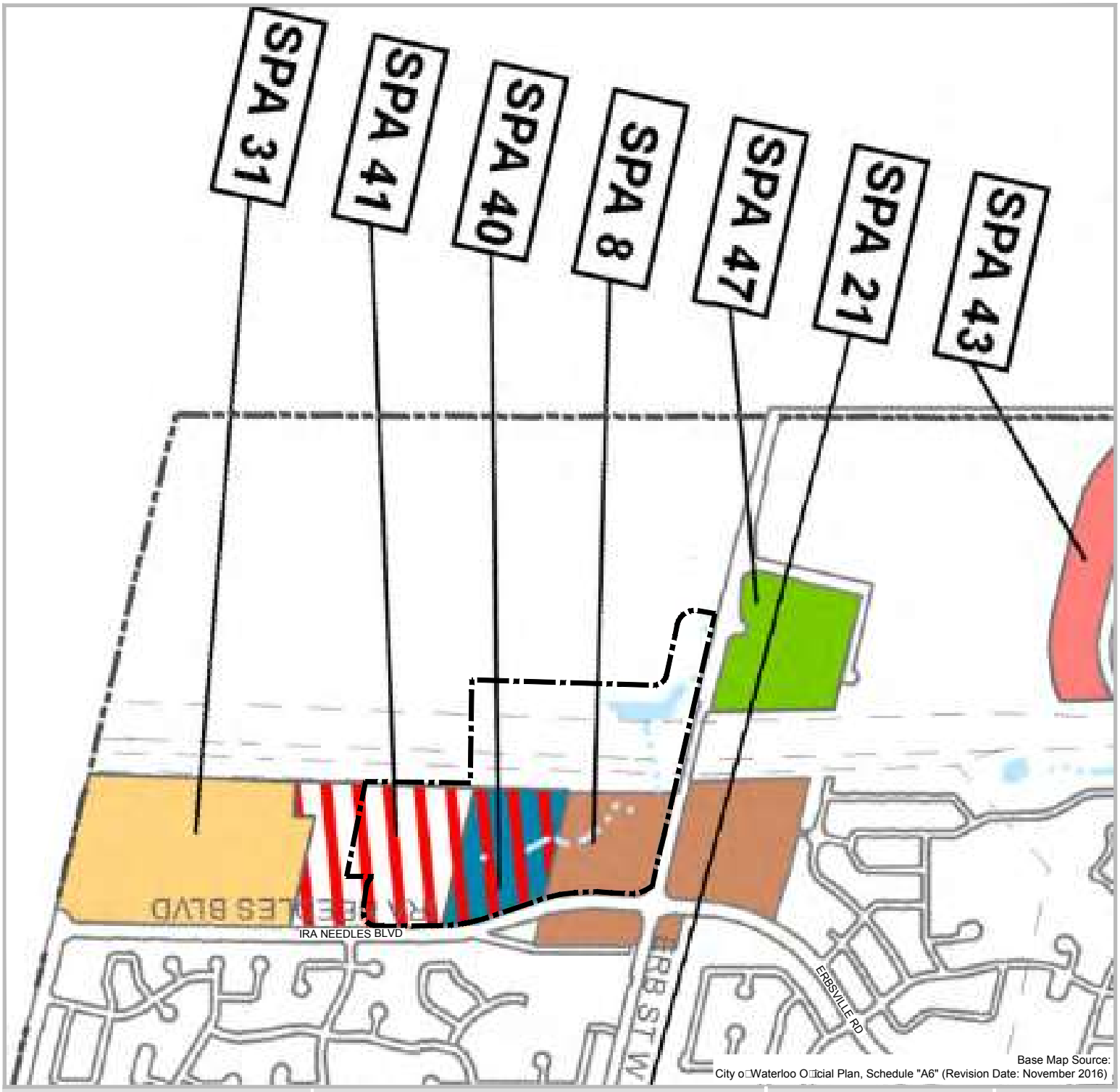


Figure 5

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Region o Waterloo

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SPA Specific Provision Area

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MHBC PLANNING URBAN DESIGN & LANDSCAPE ARCHITECTURE
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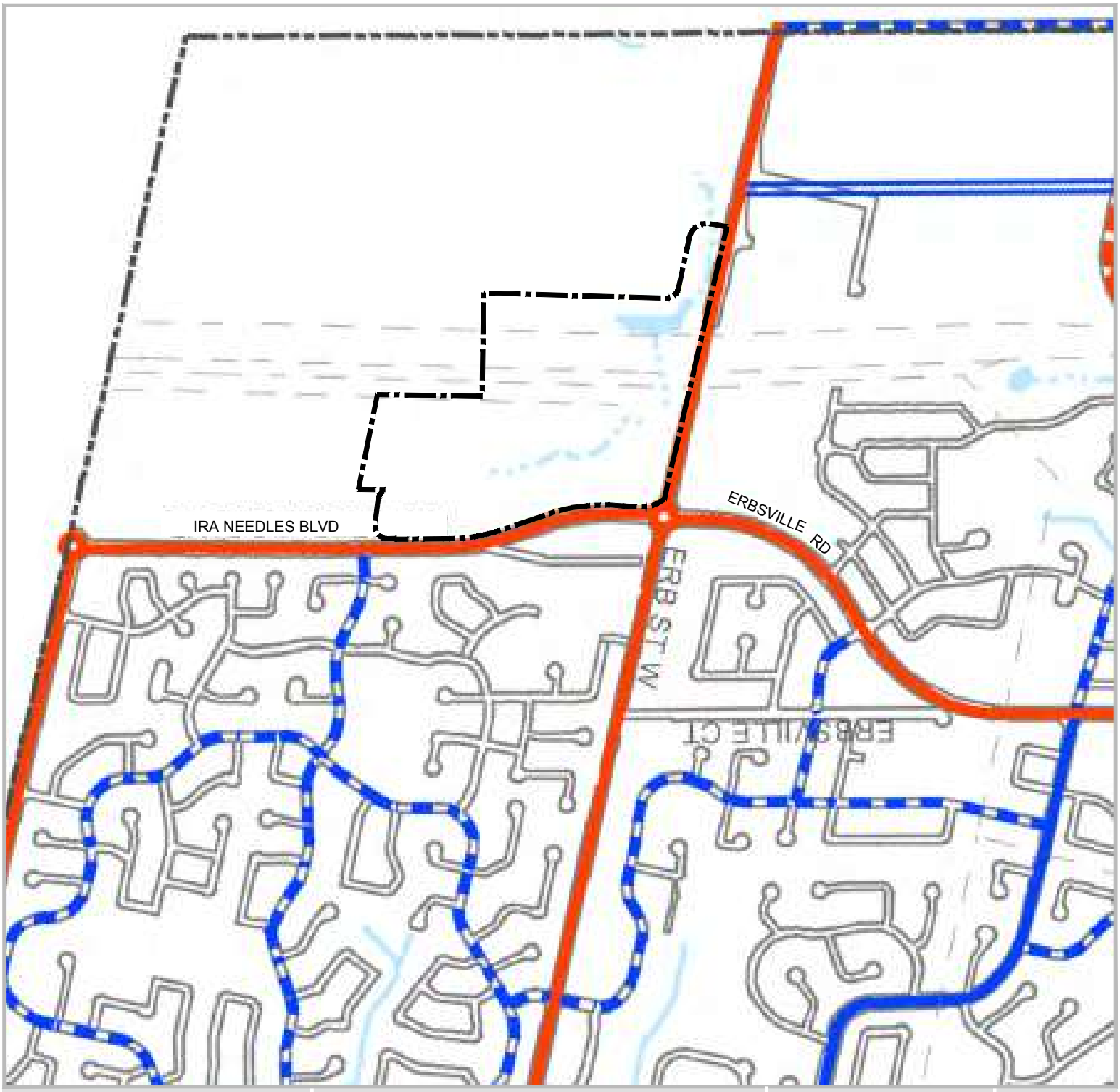


Figure 6

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Road Classification

Secondary Roads	Primary Roads
Local Roads	City Arterial
Potential Future Local Roads	Regional Arterial
Minor Collector	
Proposed Major Collector	
Major Collector	

Base Map Source:
City o□Waterloo O□icial Plan, Schedule "E" (Revision Date: November 2016)

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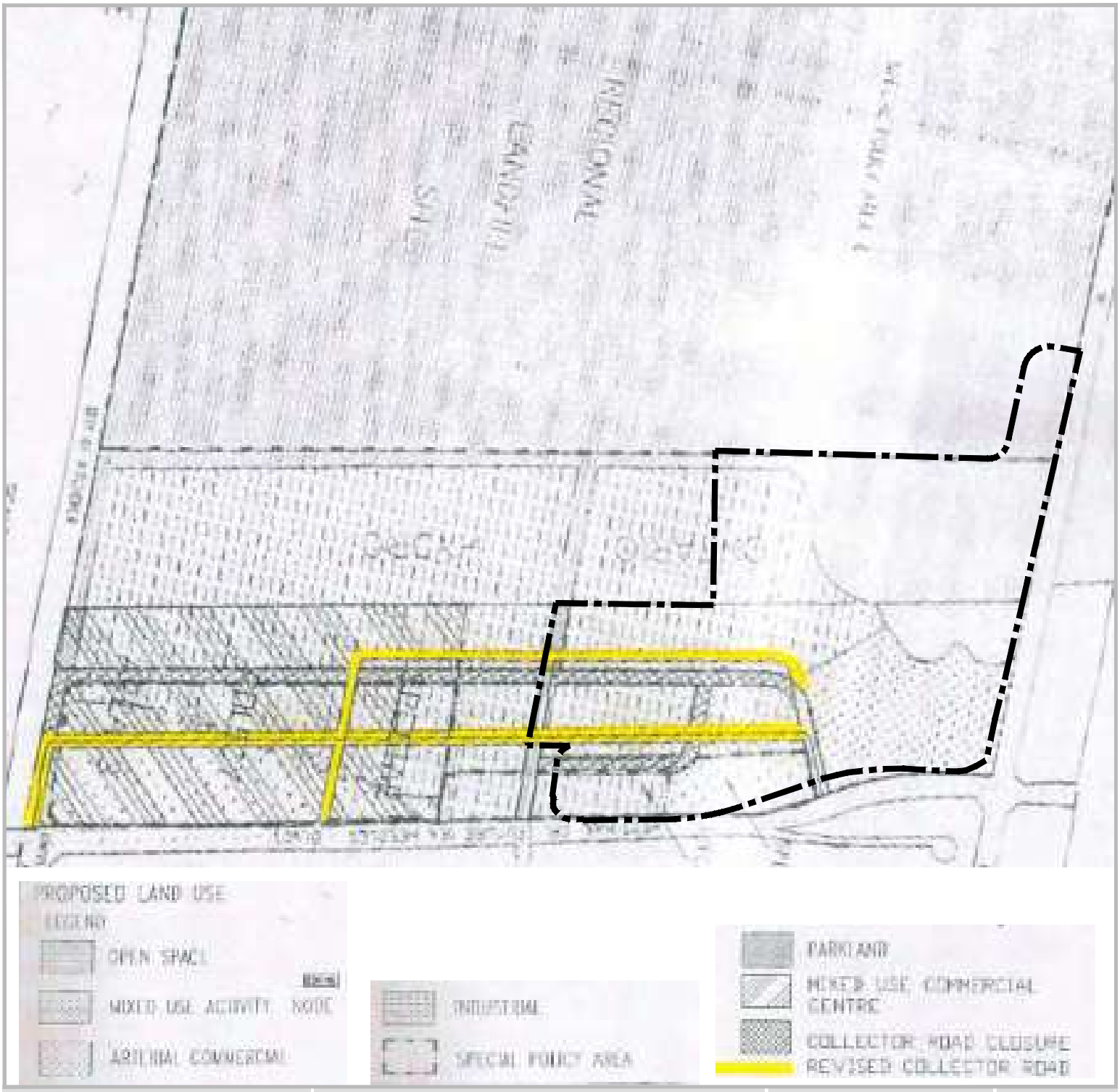


Figure 7

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Base Map Source: City o□Waterloo DS-0□-34, Map □ (□une 15, 200□)

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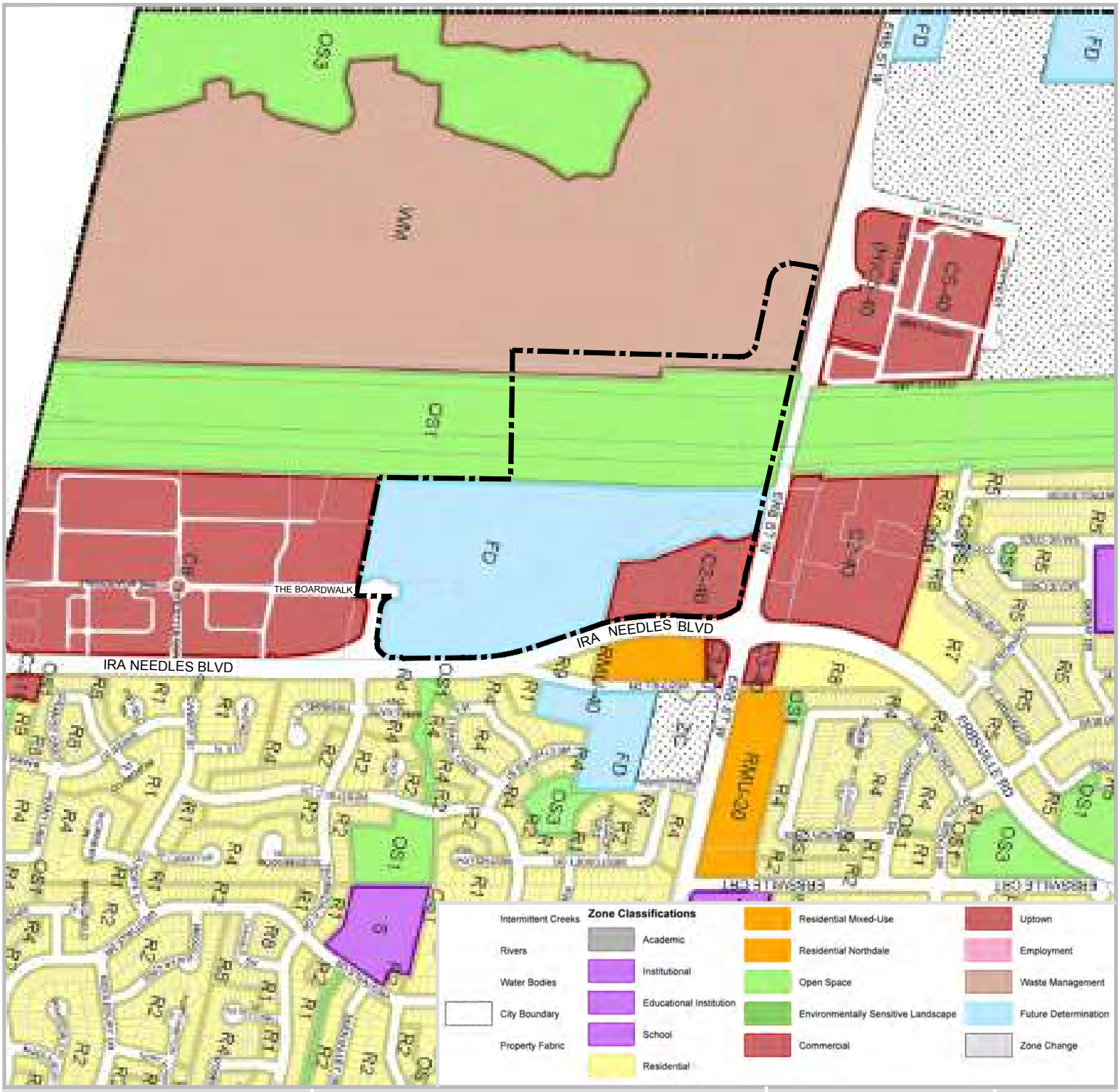


Figure 8

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City o□Waterloo

Region o□Waterloo

Base Map Source:
City o□Waterloo Zoning By-law, Zoning Map Schedule "A" (Sept.10, 2018)

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Base Map Source:
WSP, Waterloo West Side Integrated Multi Modal Transportation Study □Dra□t□
City o□Waterloo (□une 2018) Figure 3-5

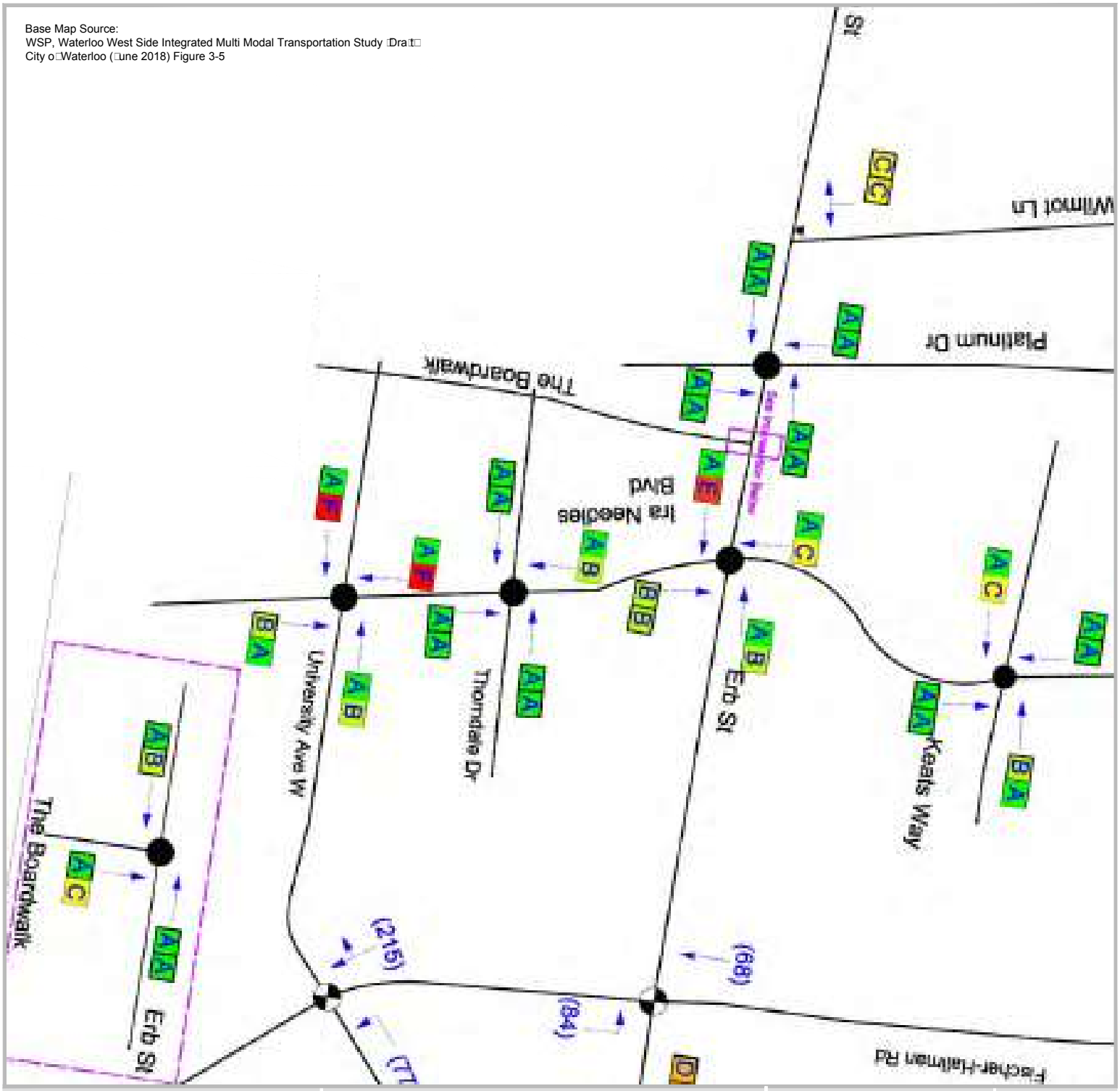
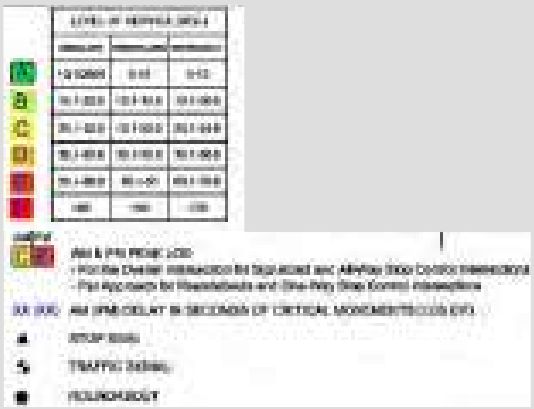


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3.0 OVERVIEW OF EXISTING CONDITIONS

Understanding existing conditions provides a framework for considering the project alternatives, project benefits and project impacts. This section of the Report summarizes existing conditions within the Study Area including the natural environment, the social cultural environment, municipal transportation services and utilities, financial and technical considerations.

A more detailed description of existing conditions is outlined in the technical reports forming part of this Background Report and included with the submission of the application.

3.1 Social-Cultural Environment

3.1.1 Land Use

Land uses within the Primary Study Area include vacant former agricultural land, a golf course as an interim use pending development of a future Home Hardware store, stormwater facilities, a commercial plaza, the Region of Waterloo Landfill and the Hydro Corridor.

Existing commercial development in the larger Westhill District is located to the north, east and south of the Study Area. The Costco lands, and Canadian Tire development are located to the north and west, some smaller commercial uses are located to the east, and The Boardwalk mixed use development is located to the south.

Residential development exists to the east of the Primary Study Area, on the opposite side of Ira Needles Blvd, in the Westvale neighbourhood and approximately 300 metres north of the Study Area, including the Vista Hills neighbourhood to the northwest, and the Rummelhardt neighbourhood to the north. These residential subdivision are characterized by primarily low and medium density residential development including single detached dwellings, and street fronting townhouse dwellings. There are also open space areas, parks, natural heritage features and community facilities, such as schools, included in the subdivisions.

The Region of Waterloo Emergency Services (EMS) Training and Research Centre is located at 1001 Erbs Road, Waterloo. The Centre is used by authorized groups, who have access to the Centre 24 hours a day, 7 days a week.

The proposed road will provide a connection between these various land uses. The new road will be located within commercial and employment land uses, and will generally run parallel to Ira Needles Blvd to enhance travel capacity and minimize turning movements on Ira Needles Blvd. There will be no impact on existing residential land uses.

3.1.2 Cultural Heritage and Archaeological Resources

A review of the City of Waterloo's Municipal Heritage Register, was most recently updated on June 5, 2017 and confirms that there are no heritage properties within or in proximity to the Westhill District Community.

The City of Waterloo is currently undertaking a study to develop an inventory of significant Cultural Heritage Landscapes. The Preliminary Candidate Cultural Heritage Landscape map indicates that none are located adjacent to the Westhill District Community.

The Primary Study Area has been significantly altered through the development and associated grading of the development of the golf course. Any required archaeological assessments will be submitted through the future plan of subdivision application process.

3.2 Characterization of the Landscape and Natural Environment

The follow sections provide a summary of the technical memorandums prepared by MTE, and the Stage 1 EIS prepared by WSP. These reports considered the historical background, overview of existing natural features, existing SWM ponds, and hydrogeology, as well as the water courses and surface water of the Study Area related to the landscape and natural environment.

3.2.1 Historical Background

The Study Area was a rural agricultural landscape until the early 1980s when urban development began to occur in the area.

Historical aerial photographs of the Study Area were reviewed to understand the changes in the landscape over time associated with the evolution from agricultural to other land uses and the resulting effects. A component of the review was to understand how the existing pond in proximity to Erb Street and the surrounding wetland features were formed.

The photos of the Study Area between 1930 and 1971 show no presence of any surface water feature near the location of what is now considered the Erb Street Pond, southwest of the intersection of Erb Street West and Ira Needles Boulevard. Sometime between 1971 and 1975, work began on constructing the Region's landfill site. It appears that the earthworks associated with this construction began to disturb existing drainage paths as well as increase the runoff generated on the previously farmed lands, which would have otherwise absorbed a majority of the annual precipitation. An aerial photo from 1975 demonstrates significant ponding near the Erb Street Pond location. It appears that the pond began to collect surface runoff from the Region's landfill site and the surrounding areas south of Erb Street where other work was being done. In summary, the

review suggested that major earthworks associated with the creation of the Region of Waterloo's landfill, located to the west of the pond, are primarily responsible for changes to the landscape and impacting natural stormwater runoff that occurred at that time.

Historically, the properties within the Study Area, included multiple topographic low lying depressions with no natural surface runoff outfalls. Following rainfall events, surface water would collect in these depressions and infiltrate back into the ground. In order to prevent surface water from ponding on their properties, the land owners collectively installed a 250mm diameter underground clay tile drain through the properties to drain the excess surface and sub-surface water. The drain was installed in two sections; the first in the 1930s and the second in the 1950s. The completed drain was installed from just south of what is now Westhill Meadows Golf Course and extended north, well beyond Erb Street West. Before major development was undertaken in the area, the drain would outlet into a channel on the north side of Erb Street West and be conveyed north to Clair Creek. Based on the landowner information, the installation of the tile drain significantly improved the drainage situation on their properties.

In 1982, the landfill construction was underway as well as the reconstruction of Erb Street, at which time, the formation of the Erb Street Pond is evident. These road works created a damming effect south of Erb Street. In 1990, the landfill construction is even more evident, and construction north of Erb Street is approaching from the east. Erb Street Pond is vaguely evident as a much smaller feature and no watercourses, ponds or natural vegetation are evident. No defined watercourse is evident north of Erb Street West.

In the spring of 1996, construction of the Westhill Meadows Golf Course began. The golf course property, 41 Ira Needles Boulevard, was significantly graded and reshaped during this time. It is understood, based on landowner information that the tile drainage was damaged as a result of the golf course construction. This anthropogenic influence alteration to the historic drainage pattern has contributed to ponding in the area.

The City of Waterloo required the owner of the golf course to install a drainage ditch across the course to resolve ponding concerns. The golf course's consultant suggested a 150mm diameter underground pipe that led to an onsite storage pond complete with a control valve. Unfortunately, this system was incorrectly installed at elevations that could only collect surface water. The golf course drain could not properly drain the sub-surface water that was causing problems on the neighbouring sites; which was previously being adequately drained by the underground clay tile drain. After a series of site visits and investigations, it was concluded that the previously installed drain must have been damaged or destroyed by the grading activities that took place to construct the golf course.

An investigation into the downstream wetland, what is now considered the Erb Street Pond, suggested that the overall size of the wetland had dramatically increased due to ongoing activities

upstream. However, the wetland water level was measured to be approximately 3.0m lower than the surface ponding on the properties south of the golf course.

In May of 1997, the Region/City of Waterloo staff cleaned the area near the culvert installed under Erb Street West; the outlet for the Erb Street Pond. After debris was removed, water was observed to be draining through the culvert; from the south side of Erb Street West to the north side. A new field survey revealed that the surface water elevations on the properties south of Erb Street West had dropped, but not enough to actually dry out the newly formed wetlands. It was therefore concluded that the condition of the Erb Street West culvert would have a minimal impact on drainage of these adjacent properties.

Presently, the wetlands which formed on the properties south of the golf course still exist. The location and condition of the original clay tile drain running underneath the golf course is unknown at this time. However, it is evident by the presence of the wetlands that the tile is not functioning as it was originally designed.

In summary, the historical air photo analysis indicates that there a number of changes associated with urban development and grading in the area, which altered the landscape and created the existing features.

A detailed chronology of the events is included in the Stage 1 Environmental Impact Study, prepared by WSP.

3.2.2 Overview of Natural Features

WSP (MMM Group Ltd., and Ecoplans Ltd) was engaged in 2016 to prepare an Environmental Impact Study for the Study Area. Work completed to date has included field surveys (flora/fauna inventories, wetland delineation etc.), the preparation of various reports, and their review of other reports.

This EIS was informed by a Terms of Reference based on input from City of Waterloo, Region of Waterloo and Grand River Conservation Authority (GRCA) staff. Per agency direction, the EIS will be completed in three stages, with each stage reviewed and accepted prior to moving to the next stage:

- Stage 1: Existing conditions characterization for ecological and hydrological features and functions of wetlands and watercourse within the study area
- Stage 2: Evaluation of alternatives, identification of the preferred alternative, and recommended mitigation
- Stage 3: Property-specific, focused evaluation

The current report addresses Stage 1 and includes the following components:

- Review of available background information, as relevant and available
- Field surveys. Scope of field surveys was informed by existing background information, including natural heritage designations, site characteristics (i.e., habitat suitability for various wildlife guilds) and landscape context.
- Consideration of relevant natural heritage planning and policy documents

Overview of Natural Features

The following is a summary of the natural features within the Study Area:

- No provincially designated features (e.g., Provincially Significant Wetland [PSW]; Areas of Natural or Scientific Interest [ANSI]) are found on or immediately adjacent to the study area, therefore there are no potential impacts.
- No Regional Official Plan designated features are present within the study area and no features meet criteria for inclusion within the Greenlands Network within the study area.
- No regulated watercourses are present in the study area.
- There is intermittent drainage from the two SWM facilities towards the outlet / culvert at Erb Street and from a dug pond on the golf course northerly into the wet area adjacent to the Region SWM facility.
    - From the culvert at Erb Street, stormwater runoff is conveyed underground via a piped municipal drain to a SWM pond approximately 750m to the north and ultimately into Clair Creek.
- Portions of the *Waldau East Wetland Complex* (evaluated, non-provincially significant wetland) are located on the landfill lands to the west.
- This wetland is designated as a *Core Natural Feature* in Schedule A4 of the City of Waterloo Official Plan and *Core Environmental Feature* on Map 4 of the Region of Waterloo Official Plan (2015).
- Five ponds / unevaluated wetlands are present in the study area. Additional wetlands are present on HEPC lands to the west / southwest.
- All wetlands (not including the golf course ponds) as mapped by GRCA are regulated by GRCA under O. Reg. 150/06.
- Regenerating areas in the vicinity of the two SWM ponds are designated as *Supporting Natural Features* in Schedule A4 of the City of Waterloo Official Plan.
- The regenerating area in the vicinity of the Landfill SWM pond is designated as *Open Space (Parks and Other Green Space)* in Schedule A3 of the City of Waterloo Official Plan.

Based on input from the City and GRCA, during the scoping of work, an analysis of the significance and status of the natural features and, as it relates to the City's Official Plan, whether the wetlands

are *Locally Significant Wetlands* or *Other Wetlands*, thereby identifying the applicable policy framework.

Based on analysis included in the EIS, the wetlands within the study area are concluded to be:

- *Locally Significant Wetlands*: W1 (comprised of Vegetation Units 3 / 4 / 5 / 7 / 8 / 9), a wetland of anthropogenic origin with a total estimated area of ~ 3.4 ha
- *Other Wetlands*: W2 and W4, as noted above

Other wetlands:

- W3 – approved for removal in accordance with GRCA Permit No. 755/15
- HEPC south wetland – not in proximity to any of the proposed alignments, and no expected impact

Next Steps

Following acceptance of the Stage 1 EIS, Stage 2 will be undertaken, including an evaluation of alternatives, identification of the preferred alternative, and recommended mitigation. Any further details would also be addressed on a property site specific basis at the time of future development applications.

3.2.3 Existing Stormwater Management Ponds

The southerly SWM pond near Erb Street, installed prior to 2004, is owned and operated by the Region of Waterloo, and treats runoff from Ira Needles Boulevard, Waterloo Commons and lands east of Ira Needles Boulevard.

The westerly SWM pond in the hydro corridor, installed in the early/mid 1990s, is owned and operated by the Region of Waterloo, and treats runoff from the Regional landfill site.

3.2.4 Hydrogeological Assessment

MTE completed a hydrogeological characterization and assessment of properties within the Study Area. The assessment included a review of Preliminary Geotechnical Investigations, Phase II Environmental Site Assessments, Wetland Interaction at Westhill District Plan Update Technical Memo, as well as a water well record search, and a review of the regional geography and hydrogeology and a field program.

The objective of the scoped hydrogeological investigation was to identify and evaluate the hydrogeological features located within the Study Area, specifically:

- Assess the local and regional hydrogeological characteristics;
- Determine local surface water and groundwater elevations; and
- Assess local wetland and groundwater interactions across the Subject Lands.

Based on this scoped hydrogeological investigation, the following general characteristics are summarized below:

- Stratigraphic conditions beneath the Study Area primarily consist of fine grained cohesive (silt and clayey silt till) materials;
- Topography across the Study Area was determined to range between 377.0 mAMSL and 394.0 mAMSL, decreasing in elevation along the northwesterly direction;
- Groundwater levels in the Study Area were measured to range from 377.19 mAMSL to 380.27 mAMSL in installed monitoring wells and the mini-piezometer;
- The local scale groundwater table elevation, interpreted based on collected water levels, regional groundwater elevation contours, and historical levels, was interpreted to generally follow the Study Area topography and ranged between 377.0 m and 382.5 mAMSL with the direction of groundwater flow being inferred to be northwesterly towards Clair Creek;
- An in depth groundwater-wetland interaction assessment of the smaller unevaluated wetland features (HEPC North, HEPC South, and Cressman West) was not completed based on review of collected surface water level data and the relatively small areas of the wetland features. Surface water level data at these locations suggest that the wetland features would generally behave as depression features, retaining water following precipitations events and then becoming dry as a result of evapotranspiration and infiltration losses.
- The Waterloo Commons SWM/wetland feature receives minor volumes of groundwater discharge and is primarily sustained by surface water runoff. Surface water runoff directed to the wetland feature is general conveyed from the surrounding Subject Lands, Ira Needles Boulevard, and the hydraulically up-gradient Region of Waterloo Landfill's SWM pond.

3.2.4 Water Courses and Surface Water

An analysis of the local watercourses and surface water monitoring program for the drainage area associated with the Study Area was completed by MTE.

The Surface Water Monitoring study area is located southwest of the intersection of Erb Street and Ira Needles Boulevard, encompassed by Erb Street to the north, Region of Waterloo Landfill to the west, Ira Needles Boulevard to the east and The Boardwalk commercial plaza to the south. The drainage area also contains the Westhill Meadows Golf Course and is bisected by a hydro corridor.

The surface water monitoring study observed the following trends:

- The overall catchment area collectively drains to the Waterloo Commons SWM/wetland feature.
- Five sub-catchments were identified for further detail and analysis of local wetland features and depression storage in the surface water monitoring study.
- Waterloo Commons SWM/wetland is utilized for local stormwater management control and the outlet is not functioning as designed, causing surface water elevations to be higher than intended;
- Waterloo Commons wetland (230P) water elevation levels varied from 377.16 to 377.66 (0.21 to 0.71m of ponding);
- HEPC North wetland (231P) did not observe any surface water ponding during summer months
- Cressman West wetland (232P) did not observe any surface water ponding
- SWM Retention Area (Former Cressman East wetland 233P) water elevation levels varied from 379.92 to 380.24 (0.0 to 0.32m of ponding);
- HEPC South wetland (234P) water elevation levels varied from 382.01 to 382.35 (0.0 to 0.34m of ponding);
- Region of Waterloo Landfill SWMP water elevation levels varied from 379.18 to 379.70 (0.44 to 0.96m of ponding/storage); and
- Chloride water sample results demonstrated elevated concentrations in the Waterloo Commons wetland and the Landfill SWMP, likely due to long-term exposure to local road salt runoff in the winter and spring.

3.3 Transportation Network, Municipal Services and Utilities

3.3.1 Transportation Network

Roads, transit and active transportation infrastructure to support the Westhill District are existing and are comprehensively planned through City and Regional Transportation Master Plans and Official Plans.

3.3.1.1 Existing and Planned Road Network:

The main roads within the Study Area are:

- Ira Needles Boulevard (Erbsville Road) is a north-south Regional arterial road with a four lane cross-section. Sidewalks are present along both sides of the road for the portion of the road in the City of Waterloo.

- Erb Street is an east-west city arterial road. Further west of the urban boundary, the road has a rural cross section. West of the roundabout, Erb Street is 3-4 lanes, and is constrained to 2 lanes at the Hydro Corridor. Improvements to Erb Street were identified in the Class EA.

- Laurelwood Drive, Columbia Forest Boulevard and Keats Way and several local roads from existing developed areas to Erbsville Road/Ira Needles Boulevard offer additional east-west connections.

- Platinum Drive between Columbia Street and Erb Street is proposed to be constructed from Erb Street West, via a roundabout, to the lands to the north, to service the West Side Employment Lands. The road will have the potential to connect to Columbia Street West to the north in the future.

- There is a northerly street stub extension that terminates at the roundabout of Ira Needles Blvd and Thorndale Drive.

3.3.1.2 Transit Network

Bus transit service is currently provided along Ira Needles Blvd and Erb Street West, offering service throughout Kitchener-Waterloo. There is a transit terminal located within The Boardwalk commercial development. The extension of transit service through the Study Area to Erb Street West provides an alternative route potential that would include the potential to increase service coverage and provide connections to future employment uses.

3.3.1.3 Active Transportation Network

Pedestrian connections are provided through the existing sidewalk network along Ira Needles Blvd and through The Boardwalk. A bicycle lane is provided for along Ira Needles Blvd.

3.3.2 Municipal Services and Utilities

Municipal services, including water and sanitary services are existing or planned for expansion for the Study Area. The existing services, the assessment and scoring of various road connection alternatives, the opportunities for connections to, or extensions of, the existing services will play an important role in determining the benefit, or lack thereof, of certain proposed road alignments.

The following is a summary of the existing water, sanitary and storm services.

3.3.2.1 Water Distribution

The lands within the Study Area all reside within the City of Waterloo Pressure Zone 6 (Wat Zone 6). Wat Zone 6 receives water from the Zone 6 Reservoir elevated water tank, located at the northwestern end of The Boardwalk development, north of the Landmark Cinemas and adjacent to the hydro corridor.

Twin 450mm diameter watermains exit the water tank and extend to Ira Needles Boulevard. One watermain runs south along Ira Needles Boulevard and eventually connects to the Mannheim PS system, which serves as the principle water source for Kit Zone 6. The second 450mm diameter watermain, which services the Wat Zone 6, crosses Ira Needles Boulevard near the Medical Centre at The Boardwalk and connects to a local 400mm diameter watermain running north-south on the eastern side of Ira Needles Boulevard. This watermain extends north along Ira Needles Boulevard and traverses along Westhill Drive, eventually intersecting with Erb Street West. It also runs south along Ira Needles Boulevard until it reaches University Avenue West, where it traverses easterly.

There are also other local watermains which surround the subject lands. The existing residential dwellings and commercial building at 41, 65, and 73 Ira Needles Boulevard are currently serviced by private onsite wells.

Lastly, there is a 200mm diameter PVC watermain along the newly extended Thorndale Drive, which terminates at the northern leg of the newly constructed roundabout at the intersection of Thorndale Drive and The Boardwalk.

3.3.2.2 Sanitary Servicing

There are not an abundance of sanitary servicing options for the Study Area. There are no municipal sanitary sewers running along either Ira Needles Boulevard or Erb Street West in the traditional sense.

The existing residential dwellings and commercial building at 41, 65, and 73 Ira Needles Boulevard are currently serviced by private onsite septic systems. No sanitary outlet currently exists along Ira Needles Boulevard for these properties.

The only sanitary sewer servicing any of the subject properties is a 300mm diameter sanitary sewer which runs south-north along a servicing easement through the western portion of the Canadian Tire development lands.

3.3.2.3 Stormwater Servicing

The ultimate terminus for the stormwater for the majority of the Study Area is the outlet through the culvert under Erb Street West to the servicing easement along the western portion of the Canadian Tire development lands. However, there are some areas fronting the Study Area that are not included in this servicing outlet.

It is understood that the onsite stormwater runoff generated within the majority of the lands, which make up the Study Area, is all directed towards the Erb Street Pond; whether through interactions with groundwater or surface water features existing on these properties.

The existing Erb Street Pond outlet is a 900mm diameter sewer located in the southern embankment of the Erb Street West right-of-way. It is approximately lined up with the plaza entrance adjacent to the BMO Bank of Montreal and the Shoppers Drug Mart. Before the outlet crosses Erb Street West, additional storm runoff is collected by a series of 300mm and 375mm diameter sewers installed along Erb Street West, from the Ira Needles Boulevard roundabout to the low point in the road near the pond's outlet. Additionally, 450mm and 525mm diameter CSP culverts collect runoff from a ditch running west along the northern side of Erb Street.

Finally, all this runoff is combined and conveyed through the previously discussed servicing easement through the Canadian Tire lands, which also contains the Study Area's sanitary outlet.

The dedicated 900mm storm sewer does not collect any further stormwater runoff as it travels north through the easement, through the intersection of Bordeaux Place and Paris Boulevard, through the Clair Meadows Subdivision, before outletting directly to Clair Creek - north of the Brandenburg Stormwater Management Facility.

3.3.2.4 Utilities

The proposed road connection alternatives will all have to deal with the usual conflicts associated with the construction of new roads and municipal services, which include crossings with utilities such as underground Bell wires, hydro wires, and local gas lines. These conflicts will be present with any of the proposed road alignment options as these utilities are present along the western side of Ira Needles Boulevard and the southern side of Erb Street West. Additionally, a connection point may be available to the existing 100mm diameter high pressure gas main along the north side of Erb Street West, or the 300mm diameter main along the east side of Ira Needles Boulevard.

There may however be additional concerns with some of the road alignment alternatives that are proposed to cross or encroach on the hydro corridor within the study area. There exists a 400mm gasmain, within a gas easement, running parallel to the hydro corridor along its eastern property line. This is a major Union Gas transmission main which crosses Erb Street West into the Union Gas

Station near the southwestern corner of the Canadian Tire development lands. It is understood that Union Gas does not allow any work to be performed atop this transmission main, so agreements will need to be made with them in order to entertain any road alignment option that would cross or encroach on the gas easement.

Additionally, there also exist three major high voltage hydro transmission lines and one local hydro line within the hydro corridor. The multiple transmission line towers require a minimum 15m setback from their base and may create conflicts with some of the proposed road alignment alternatives. Hydro One has already expressed concerns with having a road run longitudinally within the hydro corridor, but may be in favour of a road crossing it perpendicularly. Special considerations and negotiations with Hydro One will be required to receive approval for any work to be done on their land.

In summary, consideration will need to be made while selecting a preferred route alternative and servicing strategy to existing utilities, such as underground Bell lines, hydro lines, and gas lines, throughout the study area. This is especially true for any alternative that may cross or encroach on the gas easement along the eastern property line of the hydro corridor, which contains a 400mm diameter Union Gas transmission main.

4.0 DESCRIPTION OF COLLECTOR ROAD ALTERNATIVES AND PRELIMINARY SERVICING STRATEGY

One of the principal purposes of this Report is to identify collector road alternatives for the proposed alignment and the framework to determine the preferred road alternative and the associated servicing strategy.

4.1 Development of Collector Road Alignment Alternatives and Servicing Consideration

Collector road alignment alternatives and servicing considerations were developed, having regard to the following guiding principles:

Transportation Network and Servicing Efficiency: The role of the potential collector road alignment within the study area must also be considered as it relates to the overall broader transportation network for West Waterloo, the Westhill District and surrounding area.

Integration with the Existing Transportation Network: The proposed collector road should be a logical extension of existing road patterns. The collector road should integrate with the existing and planned road network to the north, south and east. The transportation infrastructure developed will support appropriate road connections and facilitate pedestrian, cycling and transit trips.

Minimize Impacts on Road Network: The impacts of increased traffic on existing roads and the function of the roads to efficiently disperse of traffic from local streets to the existing arterial and collector road network.

Feasibility and Constructability: The potential collector road and servicing strategy must be planned and designed in such a manner as to meet the requirements of the City and approving authorities. The potential collector road location needs to be located to minimize conflicts with existing infrastructure and uses. The road and associated infrastructure (SWM and servicing), are to be planned and designed comprehensively.

Existing Natural Environment: The alternatives were initially developed to minimize impacts on existing natural heritage features and functions to a connection to Erb Street West was generally established by the City of Waterloo Study.

Agency Requirements and Comments: The proposed alternatives have had consideration for lands in public ownership, which are used for landfill and utility purposes.

4.2 Description of Collector Road Alignment Alternatives

The collector road alternatives to be evaluated are shown on **Figure 10**. Three collector road alternatives have been identified and proposed to be considered for the collector road alignment. All of the alternatives have the same beginning point at Thorndale Drive / The Boardwalk, and end point connection to Erb Street West. A connection to Ira Needles Boulevard is also consistent with all alternatives.

A summary of each of the alternatives follows:

1) **Waterloo Commons Connection (Alternative A)**

   This alignment requires a crossing through environmental features, and would travel immediately east of the Hydro One lands, with a terminus at the existing location of the intersection of Erb Street West adjacent to the commercial development. The intersection may be considered for redevelopment as a roundabout.

2) **Hydro One Lands Connection (Alternative B)**

   This alignment requires a crossing into the Hydro One Lands, and the alignment of the collector would travel through the Hydro One Lands, parallel to the Hydro Corridor, with a terminus at a new intersection or roundabout at Erb Street West.

3) **Region of Waterloo Landfill Lands Connection (Alternative C)**

   This alignment requires a crossing through the Hydro One Lands as well as into the Region of Waterloo Landfill lands. The alignment would travel around the Region Training Facility and Region Waste Management Offices to the north and east, and the terminus of the alignment would be at the existing roundabout at Erb Street West at the landfill entrance and adjacent to the West Waterloo Centre (Costco site). There are significant grading changes within the Landfill lands.

4.3 Description of Preliminary Servicing Considerations and Stormwater Management Alternatives

Based on the existing servicing conditions, preliminary alternatives for servicing, including stormwater management, have been identified for consideration through the application review process and are summarized as follows:

4.3.1 Water Servicing

Water servicing for the Subject Lands can be made along the extension of The Boardwalk to the road connection between Ira Needles Boulevard and Erb Street west. Connections can be made to the existing 200mm diameter watermain stub at the Thorndale Drive extension roundabout and at the existing 300mm watermain stub within the Waterloo Commons which ultimately connects to the 450mm diameter watermain along Erb Street West.

4.3.2 Sanitary Servicing

Sanitary servicing for the subject lands can be made along the newly proposed road alignments and connected to the existing 300mm diameter sanitary stub at the southwestern corner of the Waterloo Commons lands. This existing sewer would then convey sewage north through the Clair Meadows Subdivision.

4.3.3 Stormwater Servicing

Storm servicing for the Study Area can be made along the newly proposed road alignments and connected to the existing and/or newly proposed stormwater management facilities within the Subject Lands. Ultimately, the area's storm outlet is found at the north end of the Study Area, wherein an existing 900mm diameter storm sewer would convey storm runoff north through the Clair Meadows Subdivision to be discharged directly to Clair Creek.

4.3.4 Stormwater Management Alternatives

MTE completed an existing conditions characterization of the Study Area, which resulted in the identification of four stormwater management alternatives to be considered through the study process, are included as **Appendix D** and summarized as follows:

Alternative 1

This alternative is the 'Do Nothing' alternative where the N/S Collector roadway would bisect the existing SWM/Wetland. This alternative would have one Open Space Stormwater Management

Facility (SWMF) with two Public SWMF and the proposed roadway. In this alternative, the storm sewer would outlet to the existing Erb Street SWMF, and there would be no quality control upstream of wetland. This alternative would result in flooding over the roadway.

Alternative 2

This alternative would be serviced by seven private site SWMF plus three public SWMF, and the allowable flow rates would be established based on prorating available culvert capacity. This alternative provides for a dual sewer within the municipal right of way, which allows for a "clean" water sewer for treated water from private sites and a "dirty" water sewer for road drainage. The Public SWMF would be located downstream of roadway drainage. This alternative allows for double routings for large storm events. This alternative requires extensive infrastructure with on-site private SWMF and public SWMF.

Alternative 3

This alternative would allow new development to be serviced by six public ownership SWMF, each SWMF having a dedicated storm outlet. This alternative would allow developments to proceed independently. It would include a double sewer for Cressman SWMF, Home Hardware SWMF and road drainage. This alternative also allows for a "clean" water sewer for treated water from private sites and a "dirty" water sewer for road drainage.

Alternative 4

This alternative proposes two public SWMF, and one private SWMF. This alternative minimizes infrastructure costs and maintenance by having the minimal number of municipal SWMF.

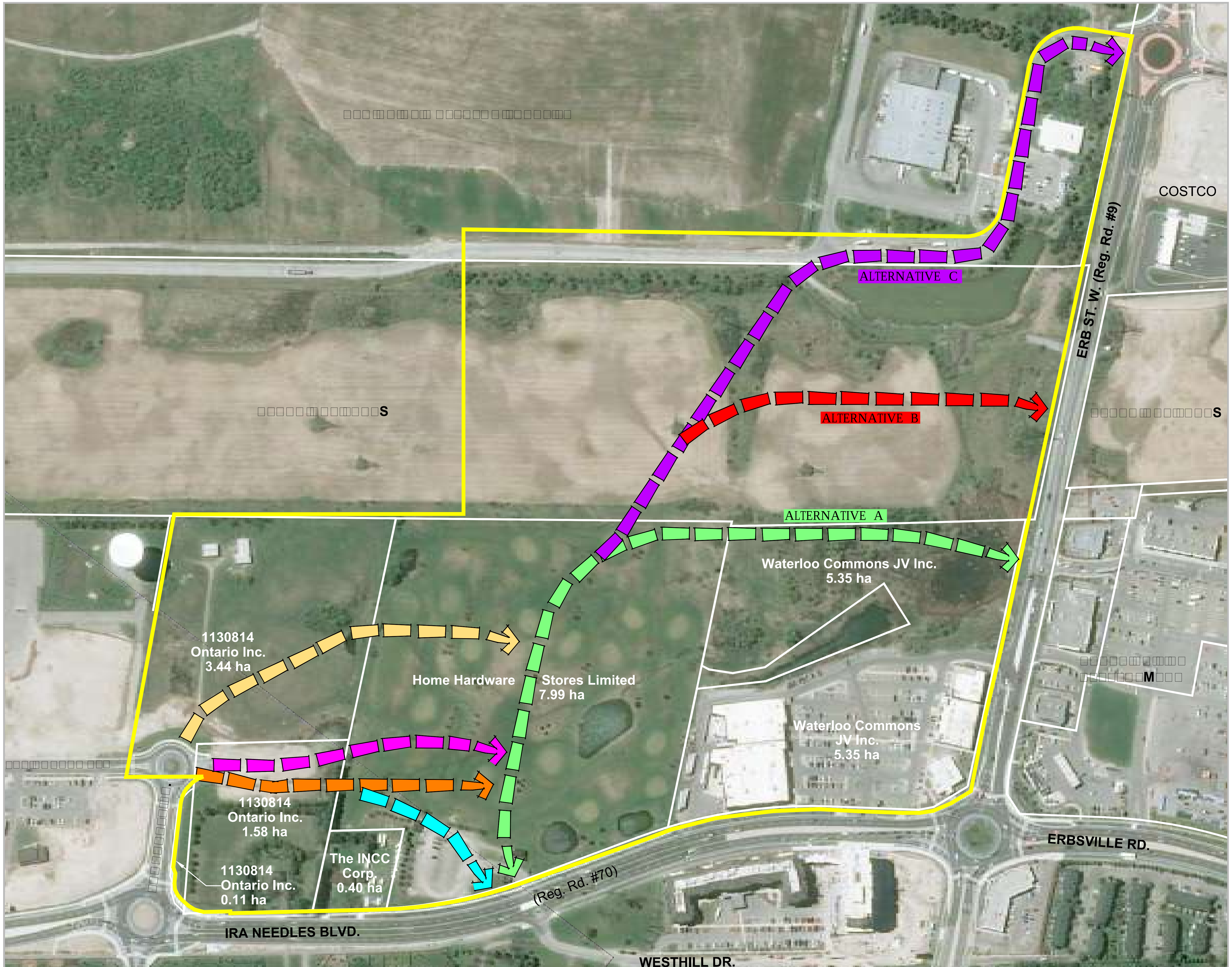


Figure 10

City o Waterloo
Region o Waterloo

Study Area

Parcel Fabric (MPAC)

The INCC Corp. Property Ownership

Collector Road Alignment Alternatives

Alternative A

Alternative B

Alternative C

Air Photo Source: Bing

December 2018

Y5 4E

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DGS

north

K: Y5 4E WESTHILL DISTRICT PLAN RPT PLANNING REPORT DECEMBER 2018 ROAD ALIGNMENT OPTIONS.DWG

MHBC PLANNING URBAN DESIGN & LANDSCAPE ARCHITECTURE
200-540 BINGEMANS CENTRE DR. KITCHENER, ON, N2B 3X9
P: 519.576.3650 F: 519.576.0121 | WWW.MHBCPLAN.COM

5.0 DESCRIPTION OF EVALUATION CRITERIA AND METHOD

Given the outcome of the application is the identification of a preferred alternative, a process for evaluation of the alternatives was developed. Comprehensive evaluation criteria were developed and relevant planning considerations were taken into account. A method for evaluation was established.

5.1 Evaluation Criteria

The evaluation criteria/factors were grouped into five factor categories including: natural environment; socio-economic environment; cultural environment; transportation/municipal services and utilities; and financial / technical considerations. Within each category, there are various factor groups.

Evaluation criteria/factors have been prepared and are included in the table below.

Table 1 – Evaluation Criteria

Factor Category/Factor Group/Factor	Indicator/Measure
1 Natural Environment	
1A. Terrestrial Ecosystems	
• Wetlands	- Impact on feature and function of PSWs or other wetlands (area; classification/quality, relative extent in relation to entire complex)
• Designated Environmentally Sensitive Policy Areas/Areas of Natural and Scientific Interest, Significant Woodlands	- Impact on feature and function of ESPAs/ANSIs and significant woodlands (area; relative extent in relation to entire designated area)
• Vegetation communities	- Impact on feature and function of vegetation communities (area, type quality, composition, relative extent; and potential for mortality, stress, composition change)

• Wildlife habitat	- Impact on feature and function of and/or reduction of interior habitat (area; fragmentation) - Effects on wildlife movement corridors or corridors between critical habitat features (e.g. upland/breeding ponds) (number of crossings) - Degree of potential increases in animal-vehicle conflicts
1B. Aquatic Ecosystems	
• Water bodies and Watercourses providing fish habitat (including food/shelter)	- Number of water bodies and watercourse crossings, sensitivity of fish/fish habitat and thermal regime (warm, cool or cold water) - Extent (area) and function of riparian habitat removed - Extent and type of fish habitat (in-stream) altered/displaced at water bodies and watercourse, including importance to aquatic ecosystem (e.g. spawning, nursery areas)
• Water quality, thermal regime and baseflow	- Encroachment on headwater areas (1st or 2nd Order Streams) (area) - Degree of interference with known groundwater discharge areas that contribute to creek baseflow - Effects on surface drainage/floodplain contributions to fish habitat
1C. Groundwater Resources	
• Groundwater recharge areas	- Encroachment on significant groundwater recharge areas (Regional Recharge Area) (removal/disruption of function – area; depth)
• Groundwater quality	- Potential for impacts to vulnerable areas (area)
• Shallow groundwater movement	- Potential for interference with existing flow patterns (baseflow) relative to proximity to surface water and significant groundwater discharge areas
1D. Surface Drainage	

• Watercourses; drainage catchments	- Need for diversion/channelization of existing drainage and catchment area impacts (area)
• Flood plain function	- Impacts to Regulatory Floodplain
• Stormwater management	- Opportunities to enhance roadway stormwater management measures, including coordination with/use of adjacent development facilities
1E. Species at Risk Permits	
• Vegetation Species at Risk	- Effects on vegetation SAR or species of local/regional significance (type, number, quality)
• Wildlife Species at Risk	- Effects on terrestrial SAR or species of local/regional significance (type, area of critical habitat; breeding timing windows)
• Aquatic Species at Risk	- Effects on aquatic Species at Risk or species of local/regional significance (type, length)
• Species at Risk permits required for construction	- Permit requirement (yes, no); probability of obtaining permit(s) (high, medium, low); degree of associated risk to project implementation
Socio-Economic Environment	
2A. Land Use Policy	
• Land use/resource designations and policies	- Degree of compatibility with Provincial, Regional and City growth/development goals/objectives policies (high, medium, low)
2B. Existing and Approved Land Use	
• Existing business operations	- Business infrastructure/employees displaced (type; number) - Changes (+/-) in business exposure/viability
• Approved development proposals	- Impacts on approved development lands (area; exposure/viability)
• Planned Land Uses	- Impacts on planned land uses
2C. Communities	
• Impacts to individual properties/communities	- Encroachment on individual properties (number/area)

• Community connectivity (cultural/social linkages)	- Physical changes (+/-) to established community connectors (trails/roads) - Changes to delivery of community services (school transportation)
• Recreational opportunities	- Changes (+/-) in community access to recreational areas
2D. Noise	
• Noise sensitive areas	- Noise sensitive receptors experiencing increases (5 dB ranges) in sound levels over pre-existing conditions - Noise sensitive receptors experiencing resultant absolute noise levels over 60 bDA
2E. Impact on Emergency Services	
• Community connectivity	- Changes to delivery to emergency services
3. Cultural Environment	
3A. Archaeological Resources	
• Known and/or potential archaeological sites	- Number/type/significance of direct/indirect impacts to registered archaeological sites - Number/type/significance of direct/indirect impacts to known archaeological resources and/or areas of high archaeological potential
3B. Built Heritage	
• Built Heritage Features	- Number/type/significance of direct/indirect impacts to built heritage resources
3C. Cultural Heritage Landscapes	
• Cultural Heritage Landscapes	- Number/type/significance of direct/indirect impacts to cultural heritage landscapes
4. Transportation/Municipal Services and Utilities	
4A. Transportation Network/Infrastructure	
• Transportation network	- Relieve future demand on other arterial / collector roads within the community - Potential impacts to local roads/intersections

• Traffic operations	- Road safety and accessibility (sight distance; turning movements)
• Transportation policy initiatives • Capacity/capability to accommodate forecast traffic demand. • Provides for appropriate access to existing properties	- Capability to support municipal policy initiatives (transit, active transportation, roundabouts) - Impact on access to existing properties - Connectivity to Ira Needles Boulevard and Erb Street
• Capacity	- Capacity to accommodate forecast demand
4B. Municipal Services and Utilities	
• Municipal services	- Opportunities for connections to or logical extension of existing services - Provision of standard cross-section locations for services - Provision of continuous services
• Utilities	- Degree of exposure of utilities and/or utility conflicts with road design
5. Financial/Technical	
5A. Financial	
• Cost	- Estimated capital cost ($) - Road length - Property requirements (number, area) and ease of acquisition - Extraordinary operations and maintenance requirements/costs (e.g., differences in the number of valves and water treatment requirements; collector road maintenance) - Species at Risk mitigation/overall benefit - Cultural heritage mitigation measures
5B. Technical Complexity	
• Roadway geometric design requirements	- Conformance to TAC and City of Waterloo/RMOW standards
• Structural/foundation/pavement design requirements	- Conformance to TAC and City of Waterloo standards - Requirements for pavement depth and/or foundation footprint, based on soil conditions

	- Structural requirements relative to capital cost and long term maintenance requirements
• Topographic; extent of cut/fill	- Potential for excessive borrow quantity or excessive off-site disposal of earth material (volume) - Requirements for excessive (steep) grades (length) - Ability to maintain positive drainage, in combination with number of suitable drainage outlets
• Constructability	- Physical constructability (adequate access to corridor) - Potential conflicts with existing infrastructure (other than utilities) - Provision of standard horizontal and vertical clearance requirements - Current staging of development for full implementation of the road network

5.2 Methodology for Evaluation of Alternatives and Selection of Preferred Alignment

The Numerical Evaluation approach is the preferred methodology. This methodology requires a "must score" approach. For each criteria/factor the least preferred alternative received a score of 1 and the most preferred alternative received a score of 10. All other alternatives will be scored between these values with ties permitted.

It is recognized that different factor categories and factor groups do not have the same number of criteria/factors and as a result certain factor categories and factor groups could be weighted. To address this issue, a normalized scoring approach should be adopted wherein the total score for each factor group is averaged in order to calculate an average category score. The average category scores should then be added together to determine the total normalized score for each alternative. The alternative with the highest total normalized score will emerge as the overall preferred alignment and the alternative with the lowest total normalized score will be determined to be the least preferred alignment.

6.0 STUDY OUTCOMES AND DELIVERABLES

In conclusion, the Official Plan Amendment and Amendment to the Westhill District Implementation Plan will establish the final alignment of the extension of The Boardwalk Avenue (collector road) and a master servicing strategy for the Westhill District.

An Official Plan Amendment and Amendment to the Westhill District Implementation Plan will delineate the proposed collector road on Schedule E – Transportation Schedule of the Official Plan and major servicing infrastructure on the schedules and within the corresponding policies of the Official Plan and the Westhill District Implementation Plan.

The final road alignment and servicing strategy will be determined through a systematic evaluation of the criteria and the application of the numerical approach described in this Report. The preferred alignment will be determined through the future application process, and the Study will also:

iv. Confirm an overall servicing strategy for the Westhill District Plan;
v. Confirm a preferred stormwater solution including the location of stormwater management pond(s); and
vi. Provide overall direction to the submission of future property-specific *Planning Act* applications within the Study Area

This Report represents a summary of background information and characterizes the existing conditions and identifies road alignment and servicing alternatives to fulfill Phase 1 of the process. The completion of this phase will address Specific Provision Area 41 in the City of Waterloo Official Plan and establish the policy direction for phase 2 of the process.

Appendix A – Pre-Submission Consultation Comments

Y594E

THE CITY OF Waterloo | **Integrated Planning & Public Works**
Planning Approvals

April 9, 2018

Mr. Paul Britton, BES, MCIP, RPP
Partner
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N2B 3X9

Mr. David Aston, MSc, MCIP, RPP
Vice President
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Mr. Britton & Mr. Aston:

Re: Pre-application Consultation Meeting Follow Up
Proposed West Side By-Pass Road
Erb Street West, Ira Needles Boulevard, The Boardwalk
West Hill District

Thank you for attending the pre-application consultation meeting held March 14, 2018 to discuss a possible by-pass road west of Ira Needles Boulevard, between Erb Street West and The Boardwalk.

At this time, we understand the proposal is to construct a collector road north of The Boardwalk, connecting from the Thorndale Drive extension. Prior to confirming the preferred location of the collector road possible alternatives are to be evaluated through a detailed review of a study area including: existing conditions, environmental constraints, servicing networks and transportation need. Once and/or if a preferred location is determined, the road would be created and serviced through one or more Draft Plans of Subdivision(s). In addition, a Zoning By-law Amendment would be required. We understand development of the lands may occur in phases.

1.0 POLICY FRAMEWORK

The following policy review applies to the properties identified in your submission materials as the "Study Area", herein after referred to as the 'lands'.

Waterloo City Centre | 100 Regina Street South, PO Box 337 STN Waterloo, Waterloo, ON, N2J 4A8
P. 519.886.1550 | F. 519.747.8760 | TTY. 1.866.786.3941 | www.waterloo.ca

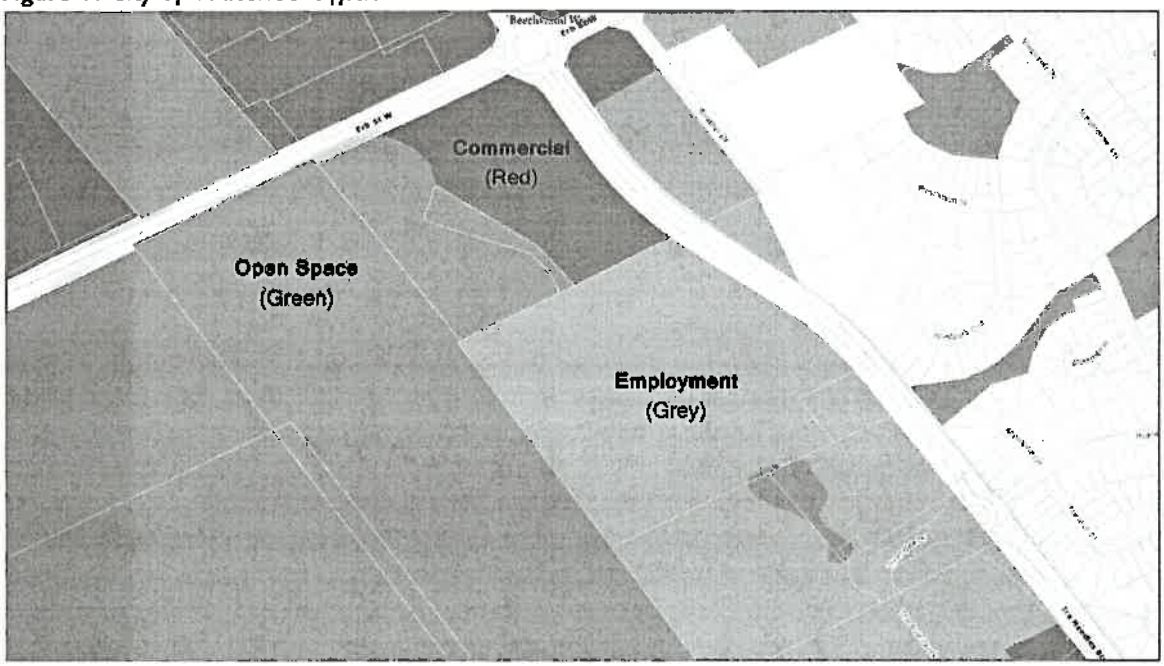
Please consider the environment before printing this letter.

1.1 City of Waterloo Official Plan

The lands are designated Mixed-Use Neighbourhood Commercial, Business Employment and Open Space in the City of Waterloo's Official Plan, (refer to Figure 1).

The Mixed-Use Neighbourhood Commercial designation is intended to provide a focal point or destination to meet day to day commercial needs of adjacent neighbourhoods or business areas. Located in minor nodes, this designation contemplates a range of office, retail and service uses generally in the form of a commercial shopping centre comprised of small to mid-sized units.

Figure 1: City of Waterloo Official Plan – Land Use Schedule 'A'



The Business Employment designation contemplates prestige office as the predominant use of land, generally located on the periphery of employment areas serving as a buffer between traditional industrial uses and sensitive uses. A high standard of urban design is required within this designation.

The Open Space designation is intended to protect ecologically significant natural features and to provide a comprehensive and connected open space system that balances the needs of the community in terms of recreation/leisure, culture, transportation, infrastructure and environmental management.

The lands are identified as a Minor Node and Minor Corridor, and contemplated for Medium High Density (height of up to 40 metres) and Medium Density Employment (height of up to 27 metres).

The lands are also subject to the policies of three separate Specific Provision Areas: SPA 8 (West Side Nodes), SPA 40 (41 Ira Needles Boulevard), and SPA 41 (Part of West Hill District).

1.2 West Hill District Plan

The West Hill District Plan was approved by Council August 24, 1998, with modifications in June 22, 2009. The purpose of the West Hill District Plan is to guide land use development and environmental protection. It is the key planning document between the broad policies of the Official Plan and the more detailed stages of development and environmental protection achieved through the review and approval of various planning applications. The lands are currently shown on Map 1 and Map 2, as follows:

Map 1: Land Use Concept
- Mixed Use Activity Node
- Industrial
- Arterial Commercial
- Parkland
- Collector Road

Map 2: Environmental Plan
- Constraint Level One Area
- Constraint Level Two Area
- Recommended Future Community Trail
- Open Space Greenways

1.3 City of Waterloo Zoning By-law

The lands are zoned 'Mixed Use Commercial' (MXC) and 'Agriculture' (A) under Zoning By-law 1418. In addition, By-law 09-007 applies site specific provisions to a portion of the lands.

As you are aware, the City is currently completing a comprehensive review of its Zoning By-laws. The Second Draft of the Zoning By-law was presented to Council and the public for review and feedback in April of 2017. This draft identifies the subject lands as Mixed Use Neighbourhood Commercial (C2-40), Future Determination (FD), Open Space (OS1) and Waste Management (WM) zones. Also, Site By-law 86 applies to a portion of the lands. For further information related to the City's Comprehensive Zoning By-law Review please refer to the City's webpage: http://www.waterloo.ca/en/business/zoningreview.asp.

2.0 PROCESS

2.1 Class Environmental Assessment

As noted in your correspondence dated January 18, 2018, you opined that the extension of a collector road in this location would warrant a Schedule C Class Environmental Assessment. Based on our review of the Environmental Assessment Act and through discussions with the Municipal Engineers Association, IPPW staff have confirmed that a Class Environmental Assessment is not required for the creation of the proposed collector road.

2.2 Official Plan Amendment

It was also noted in your correspondence dated January 18, 2018, that the collector road extension would be a project to benefit from an integrated approach between the Municipal Class EA process and the Planning Act, and recommend that the Class EA be coordinated with an Official Plan Amendment. The end result of which would be the identification of a preferred alignment of the collector road on Schedule "E" of the Official Plan as well as the Land Use Concept of the West Hill District Plan.

IPPW staff have confirmed that an Official Plan Amendment is not required for the creation of the proposed collector road.

Notwithstanding the above, if a change in land use designation is proposed through the development of the lands, an amendment to the Official Plan will be required to re-designate the lands, or to apply any site specific policies through a Specific Provision Area (SPA).

In addition, an amendment to the West Hill District Plan is required. This amendment can be implemented through any of the herein referenced development applications submitted to the Planning Approvals Division.

2.3 Draft Plan of Subdivision

One or more Draft Plan of Subdivision(s) will be required for the creation of the proposed road and creation of other development land parcels, as may be required. Any Draft Plan of Subdivision will be subject to the requirements of a complete application, to be determined through a future pre-application consultation process, and subject to the statutory requirements of the Planning Act and the City's Official Plan.

2.4 Zoning By-law Amendment

To permit the development of the subject lands, approval of an amendment to Zoning By-law 1418 will be required to establish a zoning framework that aligns with the Business Employment designation of the Official Plan. If the City's new Comprehensive Zoning By-law comes into effect in advance of such an application being submitted, a Zoning By-law Amendment will still be required, as per the Planning Act. Any Zoning By-law Amendment application will be subject to the requirements of a complete application, to be determined through a future pre-application consultation process, and subject to the statutory requirements of the Planning Act and the City's Official Plan.

3.0 BACKGROUND EVALUATION

As discussed at our meeting, and subject to the confirmed process as noted above, it is our opinion that a background review of the possible alternatives for a collector road should be evaluated prior to proceeding with the detail design, subdivision applications and Zoning By-law amendments. The background review should consider the following:

3.1 Study Area

- Determination of the Study Area to be confirmed prior to commencing with the background review, to the satisfaction of City of Waterloo Planning Approval's staff.
- Documentation of each property, including existing conditions, property size and ownership. Please note that Owner Authorization form(s) will be required with the submission of any planning act applications.

3.2 Transportation

- Evaluation of need for the proposed collector road.
- Evaluation of warrant traffic improvements required for each alternative proposed.
- Evaluation of how possible alternatives will be impacted by other transportation construction work in the surrounding area, including Regional upgrades (i.e., Erb Street).
- To be prepared in connection with the City of Waterloo's Integrated Multi-modal Transportation Study (IMMTS).

3.3 Environmental Evaluation

As discussed at our meeting, it is recommended by City and GRCA staff that the environmental work be completed in stages. Particularly through a Stage EIS, to be prepared as follows:

Stage 1:

- Characterization of the ecological and hydrological attributes and functions of the wetlands and watercourses within the study area.
- Determine existing conditions, the significance and status of the natural features and, as it relates to the City's Official Plan, whether the wetlands are Locally Significant Wetlands or Other Wetlands, thereby identifying the applicable policy framework.
- In addition to the 1996 Subwatershed Plan, the Wetland Evaluation that was completed in February 2011 for a portion of the study area and the scoped EIS that was completed for the Cressman lands in December 2014 are available as background information.
- The Stage 1 Report is to be submitted for City and GRCA review and acceptance before proceeding to the next stage.

Stage 2:

- An evaluation of alternatives and the identification of the preferred alternative for the study area, based on the findings and conclusions of Stage 1 above and the applicable Official Plan, District Plan and GRCA policies.
- This evaluation would consider a range of criteria to address environmental, technical and land use planning considerations.
- Recommendations and mitigation measures to be identified in accordance with the preferred alternative.
- The Stage 2 Report is to be submitted for City and GRCA review and acceptance before proceeding to the next stage.

Stage 3:

- Property-specific, implementation focused evaluation.

- These evaluations would build on the previous two stages and be completed for each property at a time when development applications may be advanced.
- The Stage 3 reports would outline specific recommendations and mitigation measures to correspond to the property-specific development proposals.

Other Notes:

- A Terms of Reference (TOR) document shall be prepared prior to the completion of Stage 1, to the satisfaction of the City and GRCA.
- Stages 1 and 2 would be common to all properties within the study area and submitted as part of the background work for all future development applications along with the individualized Stage 3 Reports
- Pre-development monitoring in accordance with the City's Development Monitoring Protocol is required for all draft plans of subdivision. For additional information in this regard please contact Robyn McMullen at robyn.mcmullen@waterloo.ca. Such monitoring could be undertaken alongside the EIS work in preparation for future draft plan of subdivision applications.
- The City's Scoped Environmental Impact Statement review fee of $944.50 is required, made payable to the City of Waterloo.

3.4 Servicing Connections and Stormwater Management

- Evaluation of servicing infrastructure, connections and required capacity for each alternative proposed.
- Evaluation of comprehensive stormwater management solutions for each alternative proposed.

3.5 Formal Submission Requirements – To Be Determined

Once and/or if a preferred location of a Collector Road is determined, any future plans of subdivision and/or Zoning By-law Amendment applications, and Official Plan Amendment as may be required will be subject to pre-application consultation meeting(s). The necessary formal submission requirements will be determined through that process, at that time.

For additional Regional comments and requirements please refer to the attached Regional Pre-Submission Comments dated March 27, 2018. If you require further clarification with respect to Regional requirements, please contact Adam Betteridge at abetteridge@regionofwaterloo.ca.

For additional GRCA comments and requirements please refer to the attached email containing GRCA comments dated April 3, 2018. If you require further clarification with respect to GRCA requirements, please contact Kaitlyn Rosebrugh at krosebrugh@grandriver.ca.

Please note the above noted requirements are based on the information provided by the applicant during the pre-application consultation process and based on staff's understanding of the development proposal at this time. Should new details and/or information become available through the development process, requirements may be subject to change.

I trust the foregoing is satisfactory, however should you have any questions please do not hesitate to contact the undersigned.

Sincerely,

Natalie Hardacre BES, MCIP, RPP
Development Planner
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cc. Adam Betteridge, Region of Waterloo
Kaitlyn Rosebrugh, GRCA
Chris Pidgeon, GSP Group
Scott Patterson, Labreche Patterson & Associates

Appendix B –
Draft Terms of Reference

West Waterloo North / South Collector Road
(The Boardwalk By-pass)

Terms of Reference (August 2018)

INTRODUCTION

1) Study Purpose

The purpose of the study and related planning applications is to determine the appropriate location for a new public road to connect The Boardwalk at Thorndale Drive to Erb Street West taking into account ongoing studies of the City of Waterloo and Region of Waterloo that have collectively considered a potential new road connection for the west side of Waterloo. The study will also determine an overall servicing strategy.

A pre-application meeting was held with City, Region and GRCA staff. At the pre-application meeting the Study Area was discussed and confirmed. City staff advised that a Class Environmental Assessment was not required as implementation of a new road would occur through future plan(s) of subdivision. The City advised that the new road has been identified in the City Development Charges By-law.

Comments at the pre-application meeting provided direction to the process for consideration of applications and recommended a phased approach. The first phase would include the background information and existing conditions to provide the recommended road alignment that would be addressed through an Official Plan Amendment and update to the Westhill District Plan to illustrate the road alignment. The second phase includes the property specific applications (plan of subdivision and zoning by-law amendment) to implement the road alignment.

The submission for the pre-application meeting included preliminary road network alternatives for the extension of The Boardwalk from Thorndale Drive to Erb Street West. The Region submitted comments as part of the pre-application process that provided information to assist with the scoping of road alternatives.

The City of Waterloo has recently completed a study that identifies the need for a north/south road connection between Erb Street West and The Boardwalk/Thorndale Drive. A Class Environmental Assessment was undertaken by the Region for Erb Street West and it was confirmed that the Class EA makes provision for the introduction of a new roundabout. The location of the roundabout on Erb Street West was presented to the Regional Planning and Works Committee and supported by the Committee. As a result of these studies, the focus of the studies associated with the Official Plan Amendment and update to the District Plan will be on the road alignment alternatives to extend a new road from Thorndale Drive/The Boardwalk to Erb Street West at the location identified at the Regional Planning and Works Committee which aligns with the existing signalized intersection at the commercial plaza on the north side of Erb Street West and is to the west of the Hydro Corridor and east of the existing Waterloo Commons commercial plaza.

2) Description of Study Area

The Study Area includes the lands to the north of The Boardwalk and Thorndale Drive; east of the Hydro Corridor and Regional Waste Management Centre; West of Ira Needles Boulevard; and, south of Erb Street West. The Study Area is illustrated on Figure 1 and also identifies the location of the potential roundabout on Erb Street West.

All lands within the Study Area are within the City Urban Area with a variety of land use designations, including Commercial, Employment and Open Space. The Study Area forms part of the Westhill District Plan. The Westhill District Plan identifies a road network for development of the area. The Westhill District Plan was updated through the approvals associated with The Boardwalk development. The Westhill District Plan identifies an extension of The Boardwalk to a connection with Ira Needles Boulevard.

Land uses within the Study Area include: existing residential uses, a golf course as an interim use pending development of a future Home Hardware store, stormwater management facilities and a commercial plaza. Prior to the construction of Ira Needles Boulevard and subsequent development, the land was used for agricultural purposes. Historical aerial photos show the lands under agricultural use and the changes to the landscape associated with the construction of roads and development of the lands. The landscape evolved through the development process and anthropogenic features were created as a result of the development.

Comprehensive natural heritage field surveys have been undertaken as part of previous studies. Work was completed in two broad survey areas. Extensive flora, fauna and aquatic field surveys were undertaken in on 13 separate dates in 2016 and 2017. Details of the features within the Study Area from this information are further described below:

- No provincially designated features (e.g., Provincially Significant Wetland [PSW]; Areas of Natural or Scientific Interest [ANSI]) are found on or immediately adjacent to the Study Area.
- No regulated watercourses are present in the study area.
- There is intermittent drainage from the two SWM facilities towards the outlet / culvert at Erb Street West and from a dug pond on the golf course northerly into the wet area adjacent to the Region SWM facility.
- From the culvert at Erb Street West, stormwater runoff is conveyed underground via a piped municipal drain to a SWM pond approximately 750m to the north and ultimately into Clair Creek.
- Four ponds / unevaluated wetlands are present in the Study Area. Three additional wetlands are present on HEPC lands to the west / southwest. All wetlands (not including the golf course ponds) as mapped by GRCA are regulated by GRCA under O. Reg. 150/06

SCOPE OF WORK AND STUDY APPROACH

A phased approach is established to complete the study requirements for the implementation of a new road to connect Erb Street West with The Boardwalk. In general, the phases are as follows:

Phase 1

- Existing conditions characterization for ecological and hydrological features and functions of wetlands and watercourse within the Study Area
- Submission of a Planning Application to identify the road network in the Official Plan and update to the Westhill District Plan. This will include the identification and evaluation of alternatives, selection of the preferred alternative, and recommended plan and mitigation. The completion of this phase will result in the identification of a collector road on the Transportation Schedule in the City of Waterloo Official Plan.

Phase 2

- Planning application(s) that will be property-specific with focused evaluation to implement the approved road network. This may be done concurrently with the Official Plan Amendment and District Plan update or follow the approval and the details and design of the new road will be implemented through a plan of subdivision and associated conditions of approval.

Details associated with the tasks to be completed in each phase are provided below:

Phase 1 - Background Study and Existing Conditions Review and Planning Application Process (Official Plan Amendment and District Plan Update):

1) Existing Conditions Review – Environmental, Economic, Social
    - Complete topographic survey (i.e. Wetland boundaries, tree inventory, monitoring wells/piezometers, pressure transducers, complete any gaps)
    - Update overall Existing Conditions Base Plan, including location of existing municipal services
    - Inventory property ownership/develop legal boundary plan
    - Aerial Photo Analysis – Inventory and Chronology
    - Scoped Hydrogeological Investigation
        i. Characterize Geological and Hydrogeological Setting
        ii. Geological Cross-sections
        iii. Source Water Protection Screening
        iv. Assess Wetland / Groundwater Interaction
    - Surface Water Characterization - Summarize Existing drainage characteristics and prepare Hydrologic/Hydraulic Models
    - Transportation - will rely on study and analysis undertaken by the City and Region
    - Stage 1 EIS will include the following, to be documented in a Stage 1 EIS Report submitted for City and GRCA review and acceptance, before proceeding to Stage 2 (details are provided in Appendix B:
        i. Consolidation and review of all available background information (ecological and hydrogeological) and 2018 field survey results
        ii. Characterization of the ecological and hydrological attributes and functions of the wetlands and watercourses within the study area, using standard protocols and guidelines (e.g., Ecological Land Classification, breeding bird surveys, spring amphibian breeding surveys, SAR bat habitat assessment surveys etc.).
        iii. Determine of the significance and status of the natural features and, as it relates to the City's Official Plan, whether the wetlands are Locally

Significant Wetlands or Other Wetlands, thereby identifying the applicable policy framework.

2) Establishment of Evaluation Criteria for Road Alternatives and Infrastructure Requirements
   - Evaluation criteria will be established to apply to the alternatives and determination of the preferred alternative. .

3) Identification / Assessment of Road and Infrastructure Alternatives
   - An evaluation of alternatives based on the applicable environmental, economic and social criteria.
   - Alternatives will be based on 3 sections of the road, including:
     i) Connection of the new road with Erb Street West and intersection design
     ii) Continuation of The Boardwalk based on the general location and alignment currently identified in the Westhill District Plan
     iii) Extension of The Boardwalk beyond the Westhill District Plan alignment to Erb Street West

4) Submission of Official Plan Amendment and District Plan Update with Road and Infrastructure and Servicing Alternatives

5) City and Agency Review of Applications

6) Selection of Preferred Alternative
   - Selection of the preferred alternative based on all evaluation criteria and provision of recommendations and mitigation measures.

7) Informal Public Meeting for Public Input on the Application

8) Formal Council Meeting and Consideration of Staff Recommendation

Phase 2 – Planning Application Approval Process and Detailed Design for Specific Lands:

9) Completion of Property Specific Reports and Submission of Planning Applications (Plan of Subdivision and Zone Change)
   - Transportation Impact Study, as required
   - Functional Servicing Report
   - Stage 2 EIS studies will be completed in support of specific development applications, with results, conclusions and recommendations submitted for City and GRCA review and acceptance. These reports will include:
     - Any additional information, as available
     - Confirmation / refinement of natural heritage constraints identified through the Stage 1 study
     - Demonstration of compliance with applicable policy and guidelines at the municipal/regional, provincial and federal levels.
     - An impact assessment for the specific site plan in question, including recommended measures to mitigate impacts
     - Conclusions and recommendations

- Vegetation and flora. Impact on feature and function of vegetation communities and flora, considering ecological significance (type, size, composition, species of conservation concern) and sensitivity/ susceptibility (e.g., mortality, stress, composition change)

9) Application Review Process for Planning Applications

10) Planning Application – Draft Plan of Subdivision Approval with Conditions of Approval

11) Detailed Design and Registration of Draft Plan of Subdivision

STUDY DELIVERABLES

Phase 1 – Submission with Official Plan Amendment and District Plan Update:

- Planning Justification Report
- Existing Conditions Report - Servicing Overview Report, including Preliminary Stormwater Management
- Scoped Environmental Impact Study

Phase 2 – Submission with Plan of Subdivision and Zone Change Application to Final Approval with Detailed Design

1) Planning Justification Report
2) Functional Servicing Report, including Preliminary Stormwater Management
3) Functional Road and Roundabout Design
4) Updated Transportation Impact Study, as required
5) Updated Environmental Impact Study, as required
6) Hydrogeological Report

Other reports may be identified at the time of the pre-application submission for the plan(s) of subdivision.

Appendix C –
DC Background Report Study – Ira Needles Blvd By-Pass Project Page

PROJECT:	Ira Needles Boulevard – By-Pass			**PROJECT MANAGER:**	TBD
PROJ BUDGET DIV:	IPPW-Eng	**IMPLEMENTATION DIV:**	IPPW-Eng	**PREPARED BY:**	Jeff Little
PROJ SHEET DATE:	15-Mar-17	**EXISTING CAPITAL PROJECT #:**	150042	**PROJECT START YEAR:**	2018
PROJECT TYPE:	Growth			**WARD:**	Ward 1 - Southwest
THEME:	Road Reconstruction (including Underground)	**LINK TO STRATEGIC PLAN:**		Infrastructure Renewal	
DESCRIPTION		**PROJECT ID:**	P1053	**REFERENCE NUMBER:**	551

New Collector Road between the Boardwalk and Erb St
Including Servicing of Future lands and a possible Round About at Erb St

Construction year anticipated to be 2018 or 2019 to accommodate demand for industrial land.
Exact location will be determined based on the approved draft plan.

Estimated Quantities used on this sheet are items included in DC by-law



COST ESTIMATE (use a separate line for each project component)	QUANTITY	Unit of Measure	$ / UNIT	TOTAL COST
				$0
				$0
New Sanitary Sewers	300	m	$ 600	$180,000
New Watermain	250	m	$ 600	$150,000
New Storm Sewers	700	m	$ 750	$525,000
New Collector Road (estimated at 11m wide Pavement) including (Sidewalks, Bike Lanes etc.)	8360	m2	$ 135	$1,128,600
Curvert Crossings	2	each	$ 250,000	$500,000
Pond Restoration/ Relocations (including any Storm Pipe Outlets)	1	L.S.	$ 500,000	$500,000
Roundabout at Erb	1	L.S.	$ 1,000,000	$1,000,000
Roundabout	1	L.S.	$ 500,000	$500,000
				$0
				$0
				$0
				$0
				$0

Attention: All lines should be rounded to the nearest $100.

SUBTOTAL			$4,483,600
HST (non-recoverable)	2%		$89,672
OVERHEAD RATE	5%		$224,180
ENGINEERING RATE	15%		$719,618
CONTINGENCY RATE	15%		$719,618
Less previous project funding received			
TOTAL PROJECT COST 2017			**$6,236,688**
TOTAL INFLATED COST			**$6,361,421**

OPERATING BUDGET IMPACT:		Year	Amount
What will be the annual operating impact of this project and in what year will it begin?			
If there is expected to be a later **increase** to the operating impact, please indicate the amount and the year.	+		
If there is expected to be a later **decrease** to the operating impact, please indicate the amount and the year.	-		

NOTES:

DC-Sanitary

FUNDING SOURCE

FUNDING SOURCE	Funding Share %	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	TOTAL
DC	50%	$ 3,118,344										$ 3,118,344
DEV	50%	$ 3,118,344										$ 3,118,344
Select												
Select												
Select												
Select												
Select												
Select												
TOTAL	100%	**$ 6,236,688**										**$ 6,236,688**
Inflated		**$ 6,361,421**										**$ 6,361,421**

Project Submission Signature

Project Authorization (to be signed by Director of Division that will complete the work)

Appendix D – Stormwater Management Alternatives

MTE FILE No: 34280-101-MS11.0
PRELIMINARY SWM ALTERNATIVE 3
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EXISTING REGION OF WATERLOO LANDFILL POND

HYDRO CORRIDOR

KW ZONE 6 ELEVATED TANK

87 IRA NEEDLES BOULEVARD

41 IRA NEEDLES BOULEVARD

WATERLOO COMMONS

66 IRA NEEDLES BOULEVARD

THE BOARDWALK

THORNDALE DRIVE

73 IRA NEEDLES BOULEVARD

65 IRA NEEDLES BOULEVARD

IRA NEEDLES BOULEVARD

WESTHILL DRIVE

ERB STREET WEST

750mmø 825mmø 900mmø 900mmø 900mmø

LEGEND

- PROPERTY BOUNDARY
- EASEMENT
- EXISTING SPOT ELEVATIONS/CONTOURS
- EXISTING SANITARY SEWER
- EXISTING WATERMAIN
- EXISTING STORM SEWER
- EXISTING EMBANKMENT (SLOPE AS NOTED)
- LIMIT CONSTRAINT LEVEL 1
- STANDING WATER w/ ECOLOGICAL VEGETATION/FUNCTION
- STANDING WATER

MS11.0 Scale: 1:2500 Date: OCT.16/18

The Westhill Landowners Group

101 IRA NEEDLES BOULEVARD WATERLOO, ON

WESTHILL DISTRICT PLAN
ERB STREET CONNECTION REVIEW

ERB STREET WATERLOO, ON

EXISTING CONDITIONS

MTE Engineers | Scientists | Surveyors

Project No.: 34280-101

October 18, 2018 - 12:39 p.m. - Plotted By: mmiddle

34280-101-MS11.1
PRELIMINARY SWM ALTERNATIVE 3
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HYDRO CORRIDOR

EXISTING
REGION OF WATERLOO
LANDFILL POND

KW ZONE 6
ELEVATED TANK

87 IRA NEEDLES
BOULEVARD

41 IRA NEEDLES
BOULEVARD

WATERLOO
COMMONS

66 IRA NEEDLES
BOULEVARD

THE
BOARDWALK

THORNDALE DRIVE

73 IRA NEEDLES
BOULEVARD

65 IRA
NEEDLES
BOULEVARD

IRA NEEDLES BOULEVARD

WESTHILL DRIVE

ERB STREET WEST

750mmø 825mmø
900mmø 900mmø 900mmø

LEGEND

- EXISTING REGIONAL STORM DETENTION STORAGE AREA
- CONCEPTUAL STORM SEWER COLLECTOR ROAD
- (P) (PRIVATE) SWM POND OWNERSHIP
- (C) (CITY) SWM POND OWNERSHIP
- (R) (REGION) SWM POND OWNERSHIP

MS11.1

Scale: 1:2500
Date: OCT.16/18

The Westhill
Landowners Group

101 IRA NEEDLES BOULEVARD WATERLOO, ON

WESTHILL DISTRICT PLAN
ERB STREET CONNECTION
REVIEW

ERB STREET WATERLOO, ON

ALTERNATIVE 1
FIGURE

MTE
Engineers | Scientists | Surveyors

Project No: 34280-101

HYDRO CORRIDOR

EXISTING
REGION OF WATERLOO
LANDFILL POND

KW ZONE 6
ELEVATED TANK

87 IRA NEEDLES
BOULEVARD

41 IRA NEEDLES
BOULEVARD

WATERLOO
COMMONS

56 IRA NEEDLES
BOULEVARD

THE
BOARDWALK

THORNDALE DRIVE

73 IRA NEEDLES
BOULEVARD

65 IRA
NEEDLES
BOULEVARD

ERB STREET

IRA NEEDLES BOULEVARD

WESTHILL DRIVE

750mmø 825mmø
900mmø 900mmø 900mmø

P
C
R

LEGEND

- PROPOSED STORM DETENTION STORAGE AREA
- CONCEPTUAL STORM SEWER(UNTREATED)
- STORM SEWER(TREATED)
- COLLECTOR ROAD
- (P) (PRIVATE) SWM POND OWNERSHIP
- (C) (CITY) SWM POND OWNERSHIP
- (R) (REGION) SWM POND OWNERSHIP

MS11.2

Scale: 1:2500
Date: OCT.16/18

The Westhill
Landowners Group
101 IRA NEEDLES BOULEVARD WATERLOO, ON

WESTHILL DISTRICT PLAN
ERB STREET CONNECTION
REVIEW
ERB STREET WATERLOO, ON

ALTERNATIVE 2
FIGURE

MTE
Engineers | Scientists | Surveyors

Project No.: 34280-101

34280-101-MS11.2
PRELIMINARY SWM ALTERNATIVE 3
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MTE FILE No: 34280-101-MS11.3
PRELIMINARY SWM ALTERNATIVE 3
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HYDRO CORRIDOR

EXISTING
REGION OF WATERLOO
LANDFILL POND

KW ZONE 6
ELEVATED TANK

87 IRA NEEDLES
BOULEVARD

41 IRA NEEDLES
BOULEVARD

66 IRA NEEDLES
BOULEVARD

73 IRA NEEDLES
BOULEVARD

65 IRA
NEEDLES
BOULEVARD

THE
BOARDWALK

THORNDALE DRIVE

ERB STREET WEST

IRA NEEDLES BOULEVARD

WESTHILL DRIVE

WATERLOO
COMMONS

900mmø

750mmø

825mmø

900mmø

900mmø

C

R

LEGEND

- REGIONAL SWM FACILITIES
- CONCEPTUAL STORM SEWER(UNTREATED)
- STORM SEWER(TREATED)
- COLLECTOR ROAD
- (P) (PRIVATE) SWM POND OWNERSHIP
- (C) (CITY) SWM POND OWNERSHIP
- (R) (REGION) SWM POND OWNERSHIP

MS11.3

Scale: 1:2500
Date: OCT.16/16

The Westhill
Landowners Group
101 IRA NEEDLES BOULEVARD WATERLOO, ON

WESTHILL DISTRICT PLAN
ERB STREET CONNECTION
REVIEW
ERB STREET WATERLOO, ON

ALTERNATIVE 3
FIGURE

MTE
Engineers | Scientists | Surveyors

Project No.: 34280-101

October 19, 2016 - 12:29 p.m. - Robert Ilic website

34280-101-MS11.4
PRELIMINARY SWM ALTERNATIVE 3

EXISTING
REGION OF WATERLOO
LANDFILL POND

HYDRO CORRIDOR

KW ZONE 6
ELEVATED TANK

87 IRA NEEDLES
BOULEVARD

41 IRA NEEDLES
BOULEVARD

WATERLOO
COMMONS

66 IRA NEEDLES
BOULEVARD

THE
BOARDWALK

THORNDALE DRIVE

73 IRA NEEDLES
BOULEVARD

65 IRA
NEEDLES
BOULEVARD

ERB STREET

IRA NEEDLES BOULEVARD

WESTHILL DRIVE

750mmø
825mmø
900mmø
900mmø
900mmø

LEGEND

- REGIONAL SWM FACILITIES
- CONCEPTUAL STORM SEWER(UNTREATED)
- STORM SEWER(TREATED)
- COLLECTOR ROAD
- (X) REMOVE SWM POND
- (P) (PRIVATE) SWM POND OWNERSHIP
- (C) (CITY) SWM POND OWNERSHIP
- (R) (REGION) SWM POND OWNERSHIP

MS11.4

Scale: 1:2500
Date: OCT.16/18

The Westhill
Landowners Group
101 IRA NEEDLES BOULEVARD WATERLOO, ON

WESTHILL DISTRICT PLAN
ERB STREET CONNECTION
REVIEW
ERB STREET WATERLOO, ON

ALTERNATIVE 4
FIGURE

MTE
Engineers | Scientists | Surveyors

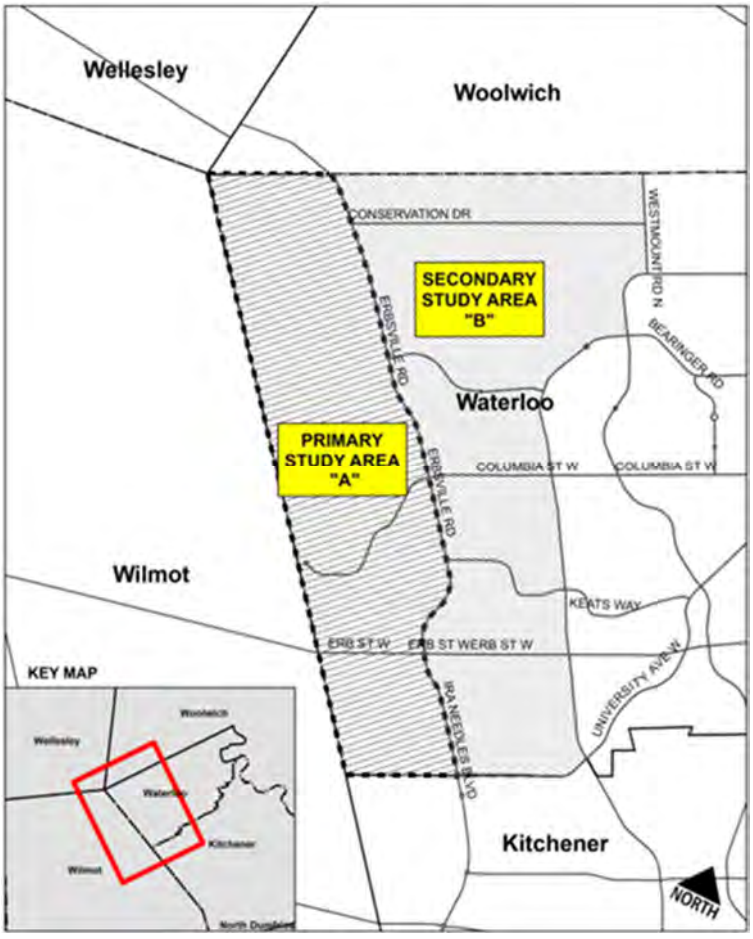
Project No.: 34280-101

Appendix I

CITY OF WATERLOO

WATERLOO WEST SIDE INTEGRATED MULTI MODAL TRANSPORTATION STUDY

DRAFT



WATERLOO WEST SIDE INTEGRATED MULTI MODAL TRANSPORTATION STUDY

DRAFT

CITY OF WATERLOO

DRAFT

PROJECT NO.: 161-05368
DATE: AUGUST 2018

WSP
100 COMMERCE VALLEY DRIVE WEST
THORNHILL, ON, CANADA L3T 0A1

T: +1 905 882-1100
F: +1 905 882-0055
WSP.COM

WSP Canada Inc.

CITY OF WATERLOO

Mr. Philip Hewitson, P.Eng.
Manager, Active Transportation & LRT Integration
Engineering Services
Integrated Planning & Public Works
Waterloo City Hall, 100 Regina Street South, 3rd Floor
P.O. BOX 337, Stn Waterloo
Waterloo ON N2J 4A8

Attention: Philip Hewitson, P.Eng.

Dear Mr. Hewitson:

Subject:

Attached please find the report for the Integrated Multi-Modal Transportation Study, Waterloo West Side.

Should you have any questions, please feel free to contact us.

DL/NK

161-14905_WaterlooWSIMMTS_2018-08-10.docx

100 Commerce Valley Drive West
Thornhill, ON, Canada L3T 0A1

T: +1 905 882-1100
F: +1 905 882-0055
wsp.com

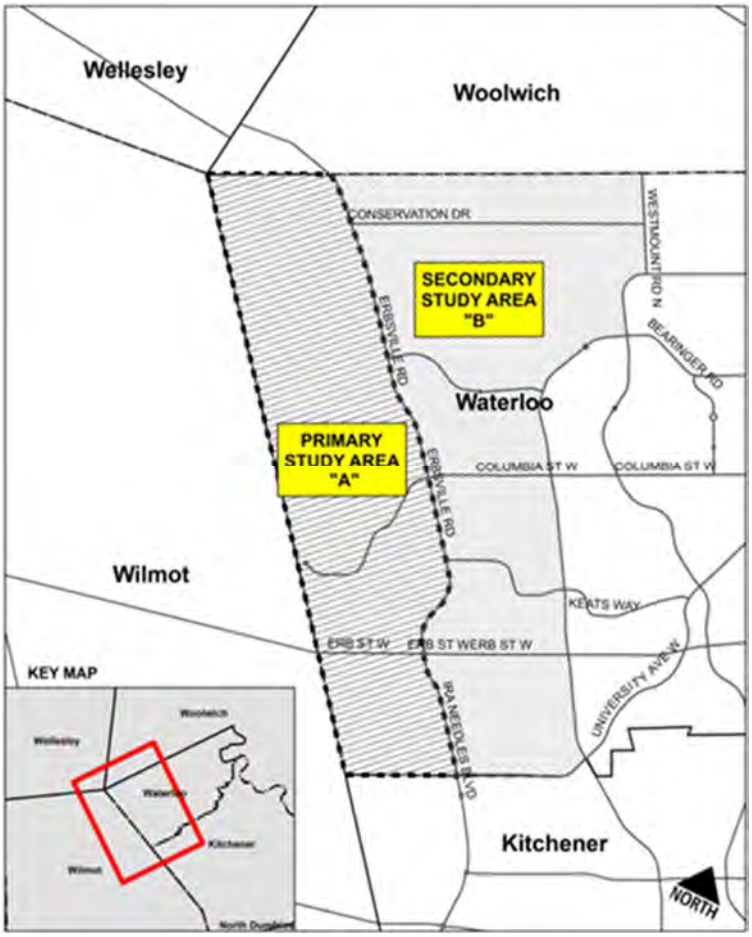
This report was prepared by WSP for the account of the CITY OF WATERLOO, in accordance with the professional services agreement. The disclosure of any information contained in this report is the sole responsibility of the intended recipient. The material in it reflects WSP's best judgement in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. WSP accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. This limitations statement is considered part of this report.

The original of the technology-based document sent herewith has been authenticated and will be retained by WSP for a minimum of ten years. Since the file transmitted is now out of WSP's control and its integrity can no longer be ensured, no guarantee may be given with regards to any modifications made to this document.

EXECUTIVE SUMMARY

WSP has been retained to complete the Integrated Multi-Modal Transportation Study (IMMTS), Waterloo West Side for the City of Waterloo. The study area for this project is bound by Erbsville Road / Ira Needles Boulevard to the east, Wilmot Line to the west, the Waterloo-Kitchener border to the south and the Waterloo-Woolwich border to the north, as shown in Figure 1-1.

Figure 1-1 Study Area



This area of Waterloo is expecting significant population and employment growth by 2031. Much of the Primary Study Area "A" is currently undeveloped and there are a number of developments that are partially completed and being planned. The Secondary Study Area "B" also includes a number of developments that are partially completed and being planned but the area is generally more built out relative to Primary Study Area "A".

Population and employment growth in the City of Waterloo and neighbor municipalities, especially from developments in West Waterloo will add traffic to the existing and planned roadways. Based on the City of Waterloo Transportation Master Plan (TMP), there are a number of intersections in both Primary Study Area "A" and Secondary Study Area "B" that are forecasted to operate at LOS F with volumes exceeding capacity. Base on these findings, the TMP recommends a future transportation system that is less reliant on the automobile and that supports the strategic initiatives Waterloo is planning for – a Healthy and Safe Community through provision of active transportation. The TMP recognizes that the City will see manageable and acceptable delays at some locations within its road network as other modes of transportation become more prioritized.

The only continuous north south link in the Primary Study Area "A" is Erbsville Road/Ira Needles Boulevard, which is a Regional Road. East-west connections are provided by Columbia Street and Erb Street (City Arterial), three City Minor Collector Roads (Laurelwood Drive, Columbia Forest Boulevard and Keats Way) and several Local Roads from existing developed areas to Erbsville Road/Ira Needles Boulevard. The proposed new Collector Road between

Columbia Street and Erb Street will provide additional north-south connectivity in the area, and it is anticipated that additional connectivity will be required for the planned employment lands.

The new Region of Waterloo Regional Transportation Master Plan "Moving Forward 2031" (Regional TMP) recommends a number of roadway and capacity improvements on Regional Roads within the City of Waterloo by 2031. A number of individual EA for roadway improvements have also been initiated and / or recently completed within the study area. The Beaver Creek Meadows (BCM) District Plan and associated Transportation Study assessed future transportation conditions to the 2035 horizon for key intersections along Conservation Drive, and downstream intersections impacted by the BCM development area.

Transit service in Waterloo has just received a significant improvement with the new ION Light Rail Transit (LRT) Service. The improvements to roadway connectivity, through the addition of new connective roadways and improving existing roadways, as well as the proposed development also offers an opportunity to improve the sparse level of transit service in this corner of the City.

The City of Waterloo TMP also includes a comprehensive section on Active Transportation, with a stronger focus on trails and cycling routes from the perspective of transportation and less emphasis on recreation. At the Regional level, Council approved the Region of Waterloo Active Transportation Master Plan in early 2014. The Regional plan generally focuses on improvements to Regionally-owned infrastructure, with seamless connections to City infrastructure. Together these two serve as the guiding documents for active transportation within and surrounding Study Areas "A" and "B".

The IMMTS builds on and includes the following components:

1. Existing conditions analysis
2. Described roadway improvements
3. Forecast and analysis of future conditions
4. Recommend improvements
5. Consultation with agencies and the public

Existing Conditions

The study area, along with showing the existing roadway classification and intersection type for the intersections that were assessed in this study, is shown in Figure 2-1. The study assessed 19 intersections, of which five are unsignalized intersections, five are roundabouts and nine are signalized intersections. Four of the intersections are under the jurisdiction of the City of Waterloo and the remaining 15 intersections are under the jurisdictions of the Region of Waterloo.

15 bus routes were identified (12 conventional and 3 iXpress services) operating within the study area. These routes operate within neighbourhoods and along major corridors, providing connections between industrial and suburban neighbourhoods with the downtown core. There are numerous points of interest that are accessible along each route, including schools (elementary, secondary, and post-secondary), parks, community centres, plazas, and hospitals, which are identified in Figure 2-3.

Existing active transportation facilities are available both on and off road, as detailed below:

- Existing on-road facilities pertain to cycling, amounting to a total length of 30.7 km. On-road facilities consist of 23.5 km of bicycle lanes, 5.6 km of paved shoulder and 1.6 km of signed routes.
- Existing off-road facilities pertain to both cycling and pedestrian activities, amounting to a total length of 216.5 km. Off-road facilities consist of 40.6 km of community trail, 7.9 km of in-boulevard multi-use trail, 7.1 km of walkway and 160.9 km of sidewalk.

Figure 2-5 illustrates the entirety of the active transportation network existing in the study area.

The City and Region provided WSP with the latest turning movements counts (TMC) for the study intersections. Intersection capacity analyses for the study intersections under existing traffic conditions for the AM and PM peak hours was analyzed based on Highway Capacity Manual (HCM) methodologies and Synchro 9 software. The analysis of roundabouts was completed using ARCADY 7.

Signalized study intersections within the study area currently operate with acceptable LOS D or better during the AM and PM peak hours, while unsignalized study intersections currently operate with LOS C or better during the AM and PM peak hours. The roundabout capacity analysis results indicate that all approaches are operating at LOS

B or better during both the AM and PM peak hours. A summary of the existing intersection operations for the study area is provided in Figure 2-8.

Future Conditions

Based on the City of Waterloo Transportation Capital Base and System Expansion Programs, the City of Waterloo Transportation Master Plan, Region of Waterloo Transportation Master Plan, completed and ongoing EA's and consultation with both the Region and City a number of improvements are planned in the study area. Stantec Consulting prepared a Transportation Overview Study, dated November 2015, for Beaver Creek Road and Conservation Drive Upgrades and Extension Municipal Class EA, which identified additional improvements in the study area. These improvements are shown in Figure 3-1.

Due to the size of the study area, it was important to use a macro model to capture the potential changes in the travel patterns within the area. For the purposes of this study an updated VISUM model provided by the Region was used, and WSP coded an additional 8,000 employees (split 25% office and 75% industrial) to the employment zone based on directions from the City. It should be noted that the 8,000 additional employees were not rebalanced (i.e. the 8,000 employees addition was not subtracted from other zones) resulting in conservative estimates of traffic.

Based on Region's VISUM model, population (age 10 and over) in the Region is estimated to grow by approximately 100,000 (20%) and employment by approximately 41,000 (17%) between 2017 and 2031. With the additional 8,000 employees modeled in Zone 141, the employment growth is approximately 50,000 (20%). based on Region's VISUM model, population (age 10 and over) in the Study Area A and B is estimated to grow by approximately 6,400 (21%) and employment by approximately 736 (22%) between 2017 and 2031. With the additional 8,000 employees modeled in Zone 141, the employment growth is approximately 8,700 (365%).

WSP used the link growth between 2017 and 2031 from the VISUM model and applied this growth to existing traffic to estimate the directional link volumes for 2031 in the study area. To estimate 2031 turning movement counts, WSP used the NCHRP 255 Report Iterative Method, which employs the traditional Fratar method.

Using the projected 2031 traffic volumes, WSP assessed 2031 traffic conditions with the planned roadway improvements. Most intersections are projected to operate over capacity, with high delays during the PM Peak Hour for the intersections of Fischer-Hallman Road at University Drive West and Erbsville Road at Columbia Street West. All movements at unsignalized study intersections are projected to operate with LOS D or better during the AM and PM peak hours. Capacity constraints are projected at the approaches of multiple roundabouts. A summary of the 2031 intersection operations with planned roadway improvements for the study area is illustrated in Figure 3-5.

Based on the results, WSP recommends a number of additional roadway improvements not identified in the City / Region capital programmes, which would reduce delays and capacity constraints at the study intersections. These recommendations are detailed in the Recommended Plan. A summary of the 2031 intersection operations for the study area, with recommended roadway improvements applied, is illustrated in Figure 3-9.

Together with the ION LRT and the conventional bus service, the study area will be well served by public transit, with connection to frequent service along key corridors. Figure 3-10 illustrates the planned transit services within the study area, up to 2021. Historically, the Region has endeavoured to provide conventional, fixed-route transit service within 450 metres of 95% of residents, places of work, and public facilities in urban areas. This 'service coverage' standard has not been met with the existing network, which provides coverage for 87.5% of residents in the urban area. There are several reasons why achieving 95% service coverage with fixed-routes has been challenging and not necessarily desirable. Alternative transit service delivery models should be explored for isolated transit-dependent facilities. These are detailed in the Recommended Plan.

Through Grand River Transit's (GRT) Five-Year Business Plan, a variety of transit initiatives were identified in the proposed marketing plan. Some additional transit initiatives that are recommended include special event fares, short trip fares, and ride share to meet first/last mile demand. These are also detailed in the Recommended Plan.

With respect to active transportation, the Regional TMP states the following mode share target:

"The target is to increase the walking and cycling mode share, from 8% of PM peak period trips today (2011) to 12% by 2031. Achieving this increase will require investment in active transportation infrastructure and will require a number of policy initiatives to encourage greater usage for non-recreational based trips."

WSP developed a number of Active Transportation and Transportation Demand Management (TDM) measures intended to provide current and future residents and employees in and surrounding the study area with viable active transportation options beyond the private automobile. These measures are detailed in the Recommended Plan and offer solutions for increasing the active transportation mode share for the study area by improving the active transportation network to make walking, cycling, and taking transit a more comfortable and appealing transportation option.

By choosing to prioritize active transportation and TDM measures in the Primary and Secondary Study Areas, the City will be contributing to the Region's vision of achieving a higher walking, cycling, and transit mode share by 2031. This will be possible by making walking, cycling, and taking transit as comfortable and safe as possible, and that involves providing facilities that are separated from motor vehicles.

Consultation

WSP undertook extensive consultation throughout this project. This includes agency consultation with the City of Waterloo, Region of Waterloo and Salvini Consulting Inc, as well as two public meetings.

The Project Initiation Meeting, with the City, the Region and Salvini Consulting, was held on June 1, 2016 where the project team, data and information required, schedule, major tasks from the work plan and next steps were discussed. Since the project initiation meeting, one additional meeting was held on May 3, 2018 and 14 teleconferences were held.

Public Information Centre (PIC) No. 1 was held on April 4, 2017 between 5:00 p.m. and 7:30 p.m. The PIC was held at the Kitchener-Waterloo Bilingual School, 600 Erb Street West, Waterloo, Ontario N2J 3Z4. The purpose of the PIC was to present the existing conditions, identify planned roadway improvements and receive public input on the study. A total of 29 residents signed in for attending the PIC. PIC No. 2 was held on June 5, 2018 between 4:30 p.m. and 7:30 p.m. The PIC was held at the Hauser Haus, Waterloo Memorial Recreation Complex, 101 Father David Bauer Drive, Waterloo, Ontario N2L 0B4. The purpose of this second PIC was to present the future conditions and recommendations and receive public input. The PIC was a drop-in open house format.

Throughout the meetings and teleconferences WSP was obtaining relevant background information, reports, traffic data and traffic model, confirming study parameters and planned roadway improvements. The public comments from the public consultation was used as input when developing the recommendations.

Recommended Plan

Traffic

With the planned population and employment growth identified by the Region and the 8,000 additional employees in the employment zone 141, the planned roadway improvements identified in the City and Region capital programmes would result in several intersections and roundabouts projected to operate over capacity, with high delays during the AM and PM peak hours. Additional improvements not identified in the City and Region capital programmes can reduce delays at the study intersections. The intersection lane configuration for the additional roadway improvements are shown in Figure 3-6 and a summary of the improvements and recommendation are provided in Table 5-1.

Table 5-1 Additional Roadway Improvements

Location	Improvement	Recommendation
Fischer-Hallman Road at University Avenue	• Second Westbound Left-turn Lane • Improve Signal Timing Plan	The Region should plan to monitor the traffic volumes and operation of the intersection and potentially initiate a study to investigate the improvements
Fischer-Hallman Road at Erb Street	• Introduce a Southbound Right-turn Lane • Improve Signal Timing Plan	The Region should plan to monitor the traffic volumes and operation of the intersection and potentially initiate a study to investigate the improvements

Location	Improvement	Recommendation
Erbsville Road at Columbia Street West	• Introduce an Eastbound Right-turn Lane • Introduce a Second Eastbound Through Lane • Introduce a Second Westbound Through Lane • Introduce a Second Northbound Through Lane • Introduce a Southbound Right-turn Lane • Improve Signal Timing Plan	• The Region should plan to monitor the traffic volumes and operation of the intersection and potentially initiate a study to investigate the improvements. • The future Region EA for Erbsville Road widening from Columbia Street to Erb Street should include a detail review of the operation and improvements for the intersection. • It should be noted that based on the Region's TMP, the Erbsville Road widening from Columbia Street West to Erb Street is recommended within the 10 to 20 years horizon. Should the employment lands start developing at a faster pace than the planned EA, the Region could consider initiating the EA at an earlier time.
Fischer-Hallman Road at Columbia Street West	• Introduce a Westbound Right-turn Lane • Improve Signal Timing Plan	The Region / City should plan to monitor the traffic volumes and operation of the intersection and potentially initiate a study to investigate the improvements
Northfield Drive at Westmount Road	• Improve Signal Timing Plan	The Region should plan to monitor the traffic volumes and operation of the intersection and adjust the signal timing when needed
University Avenue West at Ira Needles Boulevard	• Introduce an Eastbound Right-turn Lane • Introduce a Southbound Bypass Lane • Introduce a Northbound Bypass Lane	The Region should plan to monitor the traffic volumes and operation of the intersection and potentially initiate a study to investigate the improvements
Extending the Boardwalk north to intersect with Erb Street, and recommends that the intersection be controlled by a roundabout	• Eastbound Approach: One Shared Through and Left-turn Lane and One Shared Through and Right-turn Lane • Westbound Approach: One Shared Through and Left-turn Lane and One Shared Through and Right-turn Lane	The City should initiate a study to determine the alignment of the Boardwalk extension and take ownership of the roadway. The Boardwalk is anticipated to have traffic volumes to be classified as a collector road.

Location	Improvement	Recommendation
	• Northbound Approach: One Shared Left, Through, and Right-turn Lane • Southbound Approach: One Shared Left, Through, and Right-turn Lane	

Population and employment in the Study Area will not occur instantly and travel patterns and mode choice change over time. The City and Region should monitor traffic volumes, especially on roadways surrounding the employment lands to determine the timing when certain improvements will be needed. The monitoring should occur through the municipal counts programmes as well as through the City and Region Transportation Master Plans which should typically be updated every five years.

An issue with emergency was identified during the public consultation process, the subdivisions north of Columbia Street and east of Wilmot Line have emergency accesses off Wilmot Line. Based on information received at the first PIC, residents informed WSP that there are times when the emergency access is blocked by snow as a result of snow removal operations. They were aware of an incident where the emergency response was significantly delayed as the emergency vehicle travelled via Conservation Drive and Erbsville Road to access the subdivision. WSP recommends that City of Waterloo traffic operations investigate snow cleaning practices at the emergency accesses from Wilmot Line.

The existing and projected 2031 traffic on Wilmot Line south of Conservation Drive exceeds 1,000 vehicles per day. Despite more than doubling the traffic volumes on Wilmot Line by 2031, the two study intersections would continue to operate at good levels of service (LOS C or better) with minor increases in delay. No intersection improvements are required to accommodate projected traffic volumes. Should the City of Waterloo and Wilmot Township Councils continue to require reducing the traffic volumes to a maximum of 1,000 vehicles per day to address issues other than traffic operations, a separate study should be initiated.

Transit

Recommendations specific to the City of Waterloo are provided for implementation in addition to the existing strategies presented in the GRT Business Plan.

Infrastructure Improvements

It is recommended that an assessment be completed at all bus stops and transit infrastructure within the study area to determine improvements that will enhance the customer experience. An asset inventory should be maintained with the existing condition, lifecycle, and parts of each piece of infrastructure.

Connectivity

Figure 3-10 illustrates the planned service within the study area, up to 2021. Together with the ION LRT and conventional bus services, the study area will be well served, with connections to frequent service along key corridors.

It is recommended that each new development area follow a standard service design guideline for the type of service that should be implemented at each phase of development. The ION LRT stations should be used as central hubs for bus routes to increase regional connectivity and provide ease of access to areas with lower demand.

Additionally, the City is planning for 8,000 additional employees beyond what the Region has forecasted. This will occur primarily in Zone 141 (vacant area between Columbia Street and Erb Street, east of Wilmot Line). As a result, there will be significant demand for travel along Platinum Drive. WSP recommends adding the employment node around Platinum Drive as a growth area for transit and that this area be considered a connectivity point for future transit service. Furthermore, WSP traffic forecasts show that the roundabouts along Ira Needles Boulevard from Erb Street to University Avenue will be at capacity by 2031 and traffic will divert to the Boardwalk. Consequently, WSP is recommending that the Boardwalk becomes a public collector road and there be consideration for connectivity opportunities to provide transit along this route.

Alternative Delivery

GRT will continue to use the 450 metres walk distance as a guideline for conventional service, but not as a service standard. This does not preclude GRT from serving areas of lower population/employment density; however, fixed-route services will be focused in areas with densities that can generate sufficient ridership and alternative service models will be considered for other areas. The following are recommended strategies to provide alternative service in these challenging areas.

1 Community Bus Route
GRT currently operates one route that could be classified as a 'community bus' – Route 77 Wilmot, which operates between New Hamburg and the Boardwalk. GRT should consider additional community bus routes in the Study Area based on the following characteristics of a community bus model:

- The route be a pilot service funded through a grant.
- The route be customized to a specific time of day and travel pattern, based on the demands of the area.
- Offer a 'flex-route' option, in which the bus may deviate within a set area to drop-off and pick-up customers who are not directly on the route alignment
- Operate with smaller vehicles instead of a conventional bus.

2 Subsidized Taxi
GRT could enter into co-operative agreements with taxi operators to offer subsidized services to potential transit customers that need service in lower-demand areas (such as developing or low density areas) or times of the day (evenings, nights, weekends), where and when conventional bus service cannot be cost-effectively provided. The subsidized taxi concept has three elements: regulation of the service provided, negotiation with the taxi provider to achieve favourable rates for transit users, and setting subsidy rates to the taxi company.

3 Ridesharing
Services like Uber and RideCo are a relatively new transportation option similar to taxis, but provided by Transportation Network Companies (TNCs). These services are summoned (and paid for) using a mobile phone app. There may be opportunities to integrate these services with public transit, subsidizing and regulating the services to meet the needs for transit service in lower demand areas and times.

4 Home-to-Hub
Home-to-hub service provides a similar service as taxis and ridesharing services, but would be provided by the MobilityPLUS specialized transit service instead of a private provider. Trips are provided by specialized transit buses and operators, and are scheduled and dispatched along with specialized trips over the course of the day. This service is more convenient than a community bus route, as it can be scheduled to arrive at a pre-arranged time (as opposed to operating on a fixed schedule) and comes directly to the customer's door.

Transit Initiatives

Through GRT's Five-Year Business Plan, a variety of transit initiatives were identified in the proposed marketing plan. Some additional transit initiatives that are recommended include special event fares, short trip fares, and ride share (as discussed in the Alternative Delivery section) to meet first/last mile demand.

Given the popularity and support for professional sports franchises and the range of events and festivals within the Region, WSP believes operating service to special events at premium pricing would prove to be beneficial. GRT could work with some of the major sport teams, promoters, and organizers to educate attendees on special event service to/from these venues.

These services attract discretionary riders who are willing to pay a premium price to avoid crowded parking and congestion around events. Professional sports franchises are more than willing to help promote these services to relieve congestion before and after games. Cooperative promotion of the service inside stadiums or arenas will help raise awareness of transit service among populations that do not use transit.

There are two obvious benefits that would likely be experienced by introducing a short-distance fare. First, reducing fares for some trips would be expected to induce new ridership. Second, and more importantly, short-distance fare would improve the equity of the transit system by more closely aligning user costs with the value of service provided to the user. Closely aligning user costs with value received is critical in creating a transparent, sustainable, and equitable transit system, and would likely improve customer satisfaction.

Active Transportation

Measures contained in this report offer solutions for increasing the active transportation mode share for the study area by improving the active transportation network to make walking, cycling, and taking transit a more comfortable and appealing transportation option. Figure 3-13 illustrates the location where potential improvements can be applied.

The active transportation recommendations focus on the following key themes:

1. Providing cycling facilities that are separated from motor vehicle traffic
2. Focusing on Active School Travel and removing barriers to school-related active transportation trips
3. Improving pedestrian and cyclist safety at all intersections and mid-block crossings
4. Mandating end-of-trip facilities for active transportation users as part of all development applications
5. Neighbourhood level initiatives to improve the active transportation experience

Short trips are excellent candidates for active transportation. In particular, walking trips less than 2 km and cycling trips less than 5 km in length can be easily incorporated into one's daily routine. The key to changing transportation behaviours and habits is to make walking, cycling, and taking transit as comfortable and safe as possible. If individuals do not feel safe walking, cycling, or taking transit, they will resort to using their private automobiles.

Separated Cycling Facilities

The implementation of separated cycling facilities throughout the Study area is strongly encouraged, particularly on arterial streets with higher vehicle volumes and speeds, as a means of broadening the appeal of cycling to a larger number of people. Given that cyclists can generally be categorized into four groups, "Strong and Fearless", "Enthused and Confident", "Interested but Concerned", and "No Way No How", the desired goal of implementing cycling facilities should be to appeal to the broadest range of potential users.

The results from pilot projects in Calgary, Minneapolis, and Ottawa, as well as the growth and expansion of separated cycling facilities in Vancouver, Edmonton, Montreal, and Toronto, suggest that these cycling facilities appeal to a great number of potential cyclists. In order to replicate the experience of the municipalities listed above, it is recommended that the City of Waterloo proceed with the implementation of separated cycling facilities, particularly on streets with higher vehicle volumes and speeds, in an effort to attract as many people to cycle as possible.

There are several existing roadway construction projects that will contribute to the active transportation network in the study area and offer pedestrians, cyclists, and transit users enhanced facilities compared to what exists today. In addition to existing road reconstruction projects, WSP recommends that the following corridors be reconstructed with pedestrian and cycling facilities that are separated from motor vehicles:

- Columbia Street West ("Waterloo Geo Time Trail" to Erbsville Road)
- Erbsville Road (Regal Place to Erb Street West)
- Ira Needles Blvd. (Erb Street West to University Avenue West)
- Bearinger Road (Westmount Road North to Laurelwood Drive)
- Fischer Hallman Road (Columbia Street West to University Avenue West)
    - To be completed in conjunction with the planned widening of Fischer Hallman Road to accommodate bus-only travel lanes
- Beavercreek Road (450m north of Laurelwood Drive to Laurelwood Drive)
- Laurelwood Drive (Erbsville Road to Fischer Hallman Road)
- Keats Way (Erbsville Road to Fischer Hallman Blvd)
- Platinum Drive (Columbia Street West to Erb Street West)

The design and implementation of separated cycling facilities should include crossrides at intersections per Ontario Traffic Manual Book 18-Cycling Facilities. Crossrides enable cyclists to legally travel through intersections without

having to dismount and walk. The City is beginning to establish the crossride precedent with the roundabouts of the Columbia Street West project.

In addition to the implementation of separated cycling facilities, it is recommended that key existing off-road trails be upgraded to a minimum width of 3.0m, with a paved /asphalt surface and be upgraded to "Major Active Transportation Routes", as recognized in the City of Waterloo Transportation Master Plan (2011). These routes serve a similar purpose as the separated cycling facilities, in that they provide higher-order cycling facilities which allows for a direct and separated cycling and pedestrian route that is located off-road. The following existing off-road trail facilities are recommended to be included as "Major Active Transportation Routes":

- Bennington Gate Hydro Corridor (Bennington Gate to Erbsville Road);
- Bennington Gate Hydro Corridor (West) (Erbsville Road to Path to Brandenburg Blvd.); and
- Keatsway Hydro Corridor (Erbsville Road to Fischer Hallman Road).

This will close gaps in the existing multi-use trail network and improve connectivity for active transportation. A number of gaps in active transportation infrastructure were identified in the study area, and are illustrated in Figure 3-13. In some cases, closure of the small gaps will result in significantly longer segments of off –road trail.

A major opportunity exists in utilizing the north-south hydro corridor, which would allow for the implementation of a major off-road active transportation corridor connecting Columbia Street West with Erb Street West. Topographic challenges in select locations can be overcome by aligning any future trail in a manner that works with the existing topography, or could include grading at key locations to create a favourable trail alignment and slope.

Existing trails in hydro corridors in Primary Study Area "A" and Secondary Study Area "B" should be enhanced and recognized as "Major Active Transportation Routes", as mentioned above, given their direct path of travel free from conflict with motor vehicles.

Active School Travel

It is recommended that the City of Waterloo work with the Waterloo Region District School Board, School Travel Planning team to conduct a School Travel Planning exercise for all of the schools in the Primary and Secondary Study Areas, with the intent of implementing school-specific School Travel Plans. The City should implement the recommendations from the School Travel Plans, specifically recommendations that focus on modifications to the physical environment which remove barriers to active transportation.

Improving Pedestrian and Cyclist Safety

The improvement of pedestrian crossings at bus stop locations should be a priority in the primary and secondary study areas, as they allow for transit users to safely cross the street to utilize bus stops in both directions.

It is recommended that the City, in partnership with the Region and the GRT, implement transit-supportive facilities at bus stops. Facilities that should be implemented include concrete bus stop pads where none currently exist, adding bus shelters to high-volume bus stops, providing concrete sidewalk extensions from the existing municipal sidewalk to the concrete bus stop pad, and consider installation of pedestrian crossing enhancements such as pedestrian crossovers (PXOs) at mid-block bus stop locations where a formal pedestrian crossing does not exist (many bus stops along Erbsville Road).

Businesses located within the study area should be encouraged to participate in and become members of TravelWise. TravelWise is a transportation management association that works with employers across Waterloo Region to encourage employees to take transit, cycle, walk, and carpool to work (Regional Municipality of Waterloo, 2018). Service provided by TravelWise include:

- Discounted transit passes;
- Carpool matching and trip logging software;
- Emergency ride home reimbursement; and
- TravelWise services for your organization (promotions, behaviour surveys, commuter action planning).

It is recommended that developers be required to work with the City at the site plan stage of development/redevelopment and incorporate pedestrian and cycling networks through their parking lots by creating linkages where none currently exist, or enhancing existing linkages by improving the pedestrian and cycling experience. Alternatively, the City can encourage property owners of large commercial centres to introduce pedestrian and cycling networks through their parking lots at the expense of (excess) vehicle parking. This can serve

as an interim measure to improve the active transportation network through large surface parking lots, until such time that the site may be redeveloped in the future.

Related to the TDM measure of improving the active transportation network at commercial centres, end of trip (cycling) facilities should be provided at all commercial buildings, where cyclists can lock up their bikes. Bicycle parking should be located in a visible, well-lit location as close to the main building entrance as possible. The end of trip facilities will vary depending on the building in question (i.e: bicycle parking located in front of a retail store, bicycle parking and a shower/change room facility at an office building). It is recommended that the City mandate the inclusion of these end of trip facilities as part of all development applications.

Neighbourhood-Level Initiatives

The following are TDM initiatives that are suggested for consideration at the neighbourhood-level and offer solutions to aspects of the greater transportation network that influence the perception of safety as it pertains to active transportation.

Street design influences driver behaviour and driving speeds. When designing new streets and redesigning existing streets a *Complete Streets* approach should be used. Complete Streets are designed to be safe for all users; pedestrians, cyclists, transit users, motor vehicle drivers, and people of all ages and abilities. The Complete Streets approach ensures that transportation planners and engineers consistently design and operate the entire street network for all road users, not only motorists.

In a retrofit condition, the implementation of traffic calming measures assists in creating the conditions necessary for people to feel more comfortable walking and cycling, as a result of motor vehicle speeds being reduced. It is recommended that the City conduct traffic calming reviews of local streets and identify locations for retrofitting existing roads with traffic calming measures. Measures may include speed humps, raised crosswalks, curb bulb-outs, and centre medians. The City should implement the necessary traffic calming measures, based on the outcomes of the traffic calming reviews.

Improving intersections can contribute to creating the necessary conditions for people to feel more comfortable walking and cycling, as intersections are barriers in the active transportation network. The City should work with the Region to upgrade major intersections located within the study area to include measures such as ladder crosswalks for all crossing movements, incorporate countdown timers at intersections where they do not currently exist, reduce the curb radii to slow the movement of turning vehicles, reduce the overall crossing distances faced by pedestrians by extending median islands (where they exist) through the crosswalk to act as a refuge point and slow down vehicles.

Additional measures include introduce pedestrian crossovers at high-volume crossing locations such as at mid-block bus stops, locations where a trail and major road intersect, locations where there is a known desire for pedestrians to cross, and widening pedestrian refuge islands and adding additional signage to raise awareness of the pedestrian crossing location. Improvements to pedestrian crossings at intersections and at midblock locations directly influence the safety of pedestrians, cyclists, and transit users, and improve the active transportation experience of users.

Finally, the development of neighbourhood-specific wayfinding (i.e. signage) can help familiarize residents of the active transportation network that is available not only for recreation and leisure purposes, but also as a means of transportation for trips to work or school. As a means of providing clarity to users of the active transportation network, the City should review the existing way-finding in the study area and identify where existing way-finding can be updated to reflect the City's current standards.

TABLE OF CONTENTS

1 INTRODUCTION 1

2 EXISTING CONDITIONS 3

2.1 Roadway Network 3

2.2 Transit Network 11

2.3 Active Transportation Network 19

2.4 Existing Traffic Volumes 23

2.5 Existing Traffic Analysis 29

3 FUTURE CONDITIONS 35

3.1 Planned Roadway Improvements 35

3.2 2031 Total Traffic Volumes Forecast 39

3.2.1 VISUM MODEL 39

3.2.2 2017 Model 40

3.2.3 2031 Model 40

3.2.4 2031 Total Traffic Volumes 42

3.3 2031 Traffic Conditions 47

3.3.1 Traffic Conditions With Planned Roadway Improvements 47

3.3.2 Additional Roadway Improvements 57

3.3.3 Traffic Conditions with Recommended Additional Improvements 61

3.3.4 Wilmot Line 73

3.4 Future Transit Improvements 75

3.4.1 Recommendations 75

3.5 Future Active Transportation Improvements 87

3.5.1 Study Area-Wide Initiatives 87

3.5.2 Active School Travel 95

3.5.3 TDM Measures Related to Public Transit 96

3.5.4 Workplace measures 97

3.5.5 Neighbourhood-Level Initiatives 98

4 CONSULTATION 103

4.1 Agency Consultation 103

4.2 Public Information Centre 1 103
4.3 Public Information Centre 2 103
5 RECOMMENDED PLAN 105
5.1 Traffic 105
5.2 Transit 107
5.2.1 Infrastructure Improvements 107
5.2.2 Connectivity 107
5.2.3 Alternative Delivery 107
5.2.4 Transit Initiatives 108
5.3 Active Transportation 108
5.3.1 Separated Cycling Facilities 109
5.3.2 Active School Travel 110
5.3.3 Improving Pedestrian and Cyclist Safety 110
5.3.4 Mandating End-of-Trip Facilities for Active Transportation Users 111
5.3.5 Neighbourhood-Level Initiatives 111

TABLES

TABLE 2-1 GRT ROUTES IN STUDY AREA 12
TABLE 2-2 GRT ROUTE SERVICE DETAILS (STUDY AREA).....13
TABLE 2-3 GRT MAJOR CORRIDORS SERVICED BY ROUTES (STUDY AREA) 15
TABLE 2-4 INTERSECTION TMC SOURCE.....23
TABLE 2-5 INTERSECTION CAPACITY ANALYSIS RESULTS, SIGNALIZED INTERSECTIONS - EXISTING TRAFFIC VOLUMES.....29
TABLE 2-6 INTERSECTION CAPACITY ANALYSIS RESULTS, UNSIGNALIZED INTERSECTIONS - EXISTING TRAFFIC VOLUMES.....30
TABLE 2-7 ROUNDABOUT ANALYSIS RESULTS - EXISTING TRAFFIC VOLUMES.....31
TABLE 3-1 REGION OF WATERLOO POPULATION AND EMPLOYMENT GROWTH 39
TABLE 3-2 STUDY AREA A AND B POPULATION AND EMPLOYMENT GROWTH.....40
TABLE 3-3 INTERSECTION CAPACITY ANALYSIS RESULTS, SIGNALIZED INTERSECTIONS - 2031 TRAFFIC VOLUMES 51
TABLE 3-4 INTERSECTION CAPACITY ANALYSIS RESULTS, UNSIGNALIZED INTERSECTIONS - 2031 TRAFFIC VOLUMES 52
TABLE 3-5 ROUNDABOUT ANALYSIS RESULTS - 2031 TRAFFIC VOLUMES.....53
TABLE 3-6 INTERSECTION CAPACITY ANALYSIS RESULTS, SIGNALIZED INTERSECTIONS - 2031 TRAFFIC VOLUMES, WITH ROADWAY IMPROVEMENTS.....67
TABLE 3-7 ROUNDABOUT ANALYSIS RESULTS - 2031 TRAFFIC VOLUMES, WITH ROADWAY IMPROVEMENTS.....68
TABLE 3-8 INTERSECTION CAPACITY ANALYSIS RESULTS, WILMOT LINE.....73
TABLE 5-1 ADDITIONAL ROADWAY IMPROVEMENTS 105

FIGURES

FIGURE 1-1 STUDY AREA..... IV
FIGURE 1-1 STUDY AREA.....1
FIGURE 2-1 EXISTING ROADWAY CLASSIFICATION AND INTERSECTION TYPE.....7
FIGURE 2-2 EXISTING LANE CONFIGURATION.....9
FIGURE 2-3 EXISTING GRT ROUTES WITH POINTS OF INTEREST IN STUDY AREA 17
FIGURE 2-4 TYPICAL TYPES OF ACTIVE TRANSPORTATION FACILITIES IN STUDY AREA A AND B 20
FIGURE 2-5 EXISTING ACTIVE TRANSPORTATION NETWORK 21
FIGURE 2-6 EXISTING TRAFFIC VOLUMES – AM PEAK HOUR.....25
FIGURE 2-7 EXISTING TRAFFIC VOLUMES – PM PEAK HOUR.....27
FIGURE 2-8 EXISTING INTERSECTION OPERATIONS 33
FIGURE 3-1 PLANNED ROADWAY IMPROVEMENTS 37
FIGURE 3-2 TOTAL 2031 TRAFFIC VOLUMES, WEEKDAY AM PEAK HOUR 43
FIGURE 3-3 TOTAL 2031 TRAFFIC VOLUMES, WEEKDAY PM PEAK HOUR 45
FIGURE 3-4 PLANNED 2031 INTERSECTION LANE CONFIGURATIONS 49
FIGURE 3-5 2031 STUDY INTERSECTION OPERATIONS (WITH PLANNED ROADWAY IMPROVEMENTS).....55
FIGURE 3-6 2031 INTERSECTION LANE CONFIGURATIONS WITH ADDITIONAL ROADWAY IMPROVEMENTS.....59
FIGURE 3-7 TOTAL 2031 TRAFFIC VOLUMES WITH REASSIGNMENT, WEEKDAY AM PEAK HOUR.....63
FIGURE 3-8 TOTAL 2031 TRAFFIC VOLUMES WITH REASSIGNMENT, WEEKDAY PM PEAK HOUR.....65
FIGURE 3-9 2031 INTERSECTION OPERATIONS WITH PLANNED ROADWAY IMPROVEMENTS PLUS ADDITIONAL RECOMMENDATIONS 71
FIGURE 3-10 GRT PLANNED SERVICE AREAS.....77
FIGURE 3-11 HOME-TO-HUB SERVICE MAP 81
FIGURE 3-12 METRO BUS ADVERTISING.....84

FIGURE 3-13 PLANNED AND RECOMMENDED FUTURE ACTIVE TRANSPORTATION NETWORK 101

APPENDICES

A TURNING MOVEMENT COUNT (TMC) DATA

B SYNCHRO REPORTS

B-1 Existing Conditions

B-2 2031 Conditions – with Planned Improvements

B-3 2031 Conditions – With Recommended IMPROVEMENTS

C REGION OF WATERLOO ROUNDABOUT TRAFFIC FLOW SHEETS

C-1 Existing Conditions

C-2 2031 Conditions – With Planned Improvements

C-3 2031 Conditions – With Recommended Improvements

D ARCADY REPORTS

D-1 Existing Conditions

D-2 2031 Conditions – With Planned Improvements

D-3 2031 Conditions - With Recommended Improvements

E VISUM MODEL INFORMATION

E-1 2017 and 2031 Population and Employment

E-2 2017 Study Area Network

E-3 2017 Model Results

E-4 2031 Study Area Network

E-5 2031 Model Results – Base Case (Without Additional Employment)

E-6 2031 Model Results – With Additional Employment

F ESTIMATED 2031 DIRECTIONAL LINK VOLUMES

G TMC FORECAST FROM THE NCHRP 255 ITERATIVE METHOD

H PIC NO. 1

H-1 PIC No.1 Notice

H-2 PIC No.1 Boards

H-3 PIC No.1 Sign In List and Comments

H-4 PIC No. 1 Comments and Consideration of Comments Received

I PIC NO. 2

I-1 PIC No.2 Notice

I-2 PIC No.2 Boards

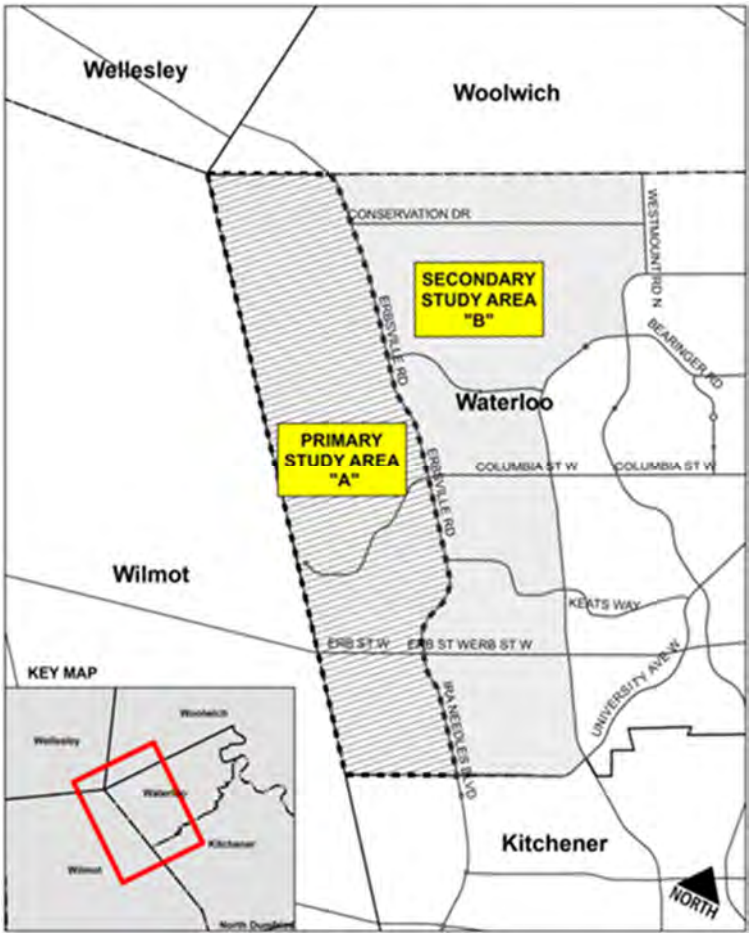
I-3 PIC No.2 Sign In List and Comments

I-4 PIC No. 2 Comments and Consideration of Comments Received

1 INTRODUCTION

WSP has been retained to complete the Integrated Multi-Modal Transportation Study (IMMTS), Waterloo West Side. The study area for this project is shown in Figure 1-1.

Figure 1-1 Study Area



This area of Waterloo is expecting significant population and employment growth by 2031. Much of the Primary Study Area "A" is currently undeveloped and there are a number of developments that are partially completed and being planned. The Secondary Study Area "B" also includes a number of developments that are partially completed and being planned but the area is generally more built out relative to Primary Study Area "A".

Population and employment growth in the City of Waterloo and neighbor municipalities, especially from developments in West Waterloo will add traffic to the existing and planned roadways. Based on the City of Waterloo Transportation Master Plan there are a number of intersections in both Primary Study Area "A" and Secondary Study Area "B" that are forecasted to operate at LOS F with volumes exceeding capacity. The TMP recommends a future transportation system that is less reliant on the auto and that supports the strategic initiatives Waterloo is planning for – a Healthy and Safe Community through provision of active transportation. The TMP recognizes that the City will see manageable but acceptable delays at some locations within its road network as prioritization begins to be redistributed to the other modes of transportation.

The only continuous north south link in the Primary Study Area "A" is Erbsville Road/Ira Needles Boulevard, which is a Regional Road. Columbia Street and Erb Street (City Arterial), three City Minor Collector Roads (Laurelwood Drive, Columbia Forest Boulevard and Keats Way) and several Local Roads provide connections from currently developed areas to Erbsville Road/Ira Needles Boulevard. The proposed new Collector Road between Columbia

Street and Erb Street will provide additional connectivity. It is anticipated that additional connectivity will be required for the planned employment lands.

The new Regional TMP recommends a number of roadway and capacity improvements on Regional Roads within the City of Waterloo to 2031. A number of individual EA for roadway improvements have also been initiated and / or recently completed within the study area. The Beaver Creek Meadows (BCM) District Plan and associated Transportation Study assessed future transportation conditions to 2035 for key intersections along Conservation Drive and downstream intersections impacted by the BCM development area.

Transit service in Waterloo is experiencing a massive upgrade with the ION light rail service. The improvements to roadway connectivity, through the addition of new connective roadways and improving existing roadways, as well as the proposed development also offers an opportunity to improve the sparse level of transit service in this corner of the City.

The City of Waterloo 2011 Transportation Master Plan, included a comprehensive section on Active Transportation. The active transportation section in the TMP included a stronger focus on trails and cycling routes from the perspective of transportation with less emphasis on recreation. At the Regional level, Council approved the Region of Waterloo Active Transportation Master Plan in early 2014. The Regional plan generally focuses on improvements to Regionally-owned infrastructure, with seamless connections to City infrastructure. Together these two serve as the guiding documents for active transportation within and surrounding Study Areas A and B.

The IMMTS builds on previous work and includes the following:

- Existing conditions analysis
- Described roadway improvements
- Forecast and analysis of future conditions
- Recommend improvements
- Consultation with agencies and the public

Information used in this study includes:

- The City of Waterloo 2016 Transportation Capital Base and System Expansion Programs
- City of Waterloo Transportation Master Plan, 2011
- Region of Waterloo Transportation Master Plan, 2011
- Region of Waterloo Active Transportation Master Plan, 2014
- Beaver Creek Road and Conservation Drive Upgrades and Extension Municipal Class EA Transportation Overview, 2015
- Columbia Street West from Erbsville Road to Fischer-Hallman Road Schedule C EA Traffic Analysis, 2013
- Erb Street (Regional Road No. 9) Improvements, Fischer-Hallman Road to Ira Needles Boulevard EA Project information, 2015.
- Update VISUM model that was initially completed by WSP in 2017 for the LRT ION Stage 2 study
- Turning movement counts for the study intersections supplied by the City and Region
- Turning movement counts for Erb Street at Platinum Drive supplied by Accu-Traffic
- Signal timing plans for the study intersections supplied by the Region
- Roundabout parameters for several existing roundabouts supplied by the Region
- City of Waterloo geodatabase containing GIS information such as existing bicycle routes, existing trails and sidewalks, parks, existing schools, parcel fabric
- ARCADY 7 was used for roundabout analysis and Synchro 9 was used for signalized and unsignalized intersection analysis

2 EXISTING CONDITIONS

2.1 ROADWAY NETWORK

The intersections assessed within this study include the following roadways:

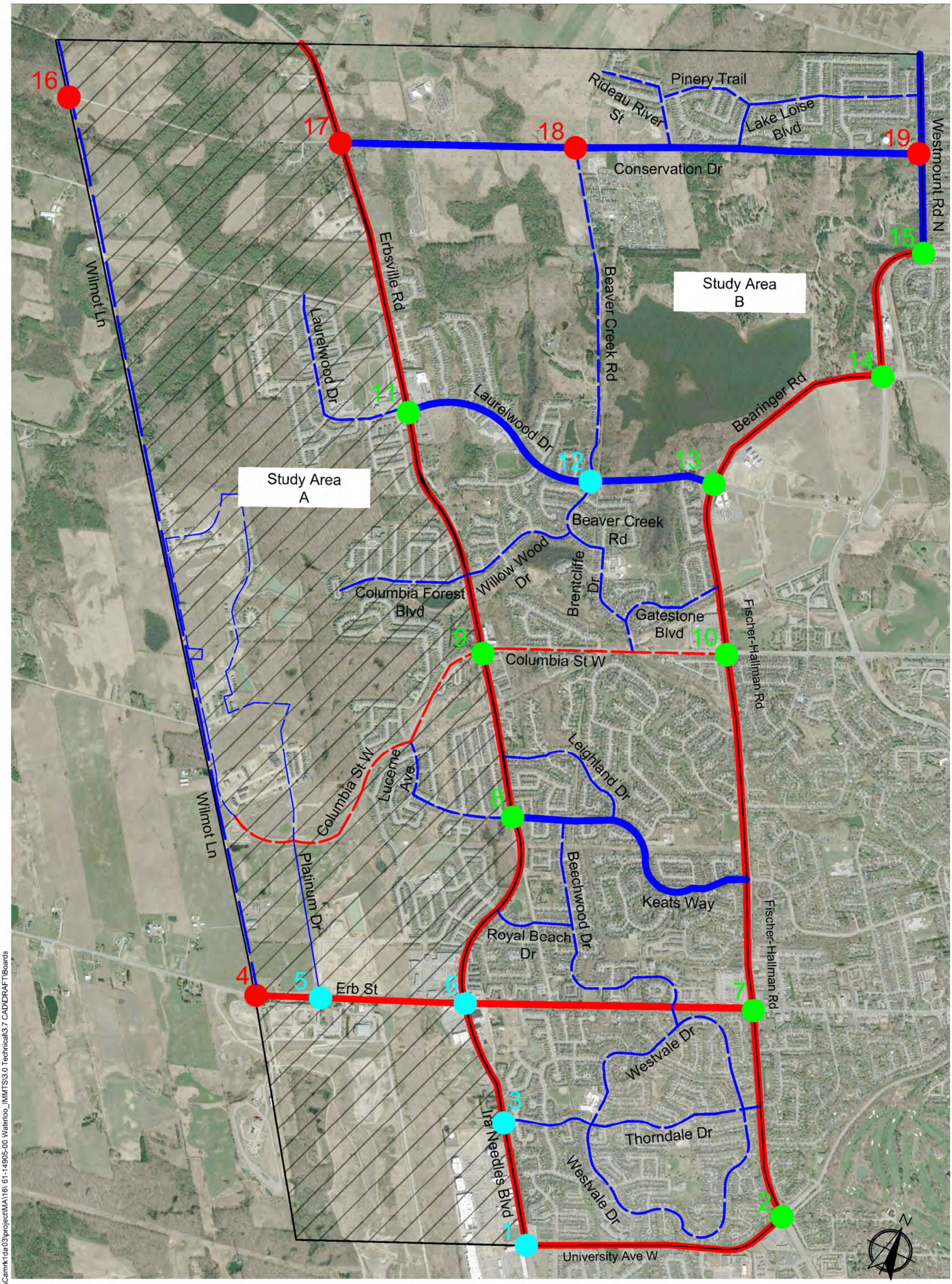
- **Fischer-Hallman Road** is a north-south roadway under the jurisdiction of the Region of Waterloo. Fischer-Hallman Road is classified as an arterial roadway, with a posted speed limit of 60 km/h. Within the study area Fischer-Hallman Road primarily consists of a four-lane roadway (with two lanes in each direction) south of Columbia Street West, and a two-lane roadway (with one lane in each direction) north of Columbia Street West. Sidewalks are located on both sides of the roadway south of Columbia Street West, separated from the roadway by a boulevard strip. A sidewalk is located on the west side of the roadway north of Columbia Street West, separated from the roadway by a boulevard strip.
- **Erb Street** is an east-west roadway under the jurisdiction of the Region of Waterloo. Erb Street is classified as an arterial roadway, with a posted speed limit of 60 km/h. Within the study area, Erb Street consists of a four-lane roadway (with two lanes in each direction) between Erbsville Road/Ira Needles Boulevard and Erbsville Court and between Beechwood Drive and Fischer-Hallman Road, a three-lane roadway (two lanes westbound and one lane eastbound) between Erbsville Court/Ira Needles Boulevard and Beechwood Drive, and a two-lane roadway (with one lane in each direction) west of Erbsville Court/Ira Needles Boulevard. Within the study area sidewalks are primarily located on both sides of the roadway, separated from the roadway by a boulevard strip.
- **University Avenue West** is an east-west roadway under the jurisdiction of the Region of Waterloo. University Avenue West is classified as an arterial roadway, with a posted speed limit of 60 km/h. Within the study area, University Avenue West primarily consists of a two-lane roadway (with one lane in each direction). Sidewalks are primarily located on both sides of the roadway, separated from the roadway by a boulevard strip.
- **Thorndale Drive** is an east-west roadway under the jurisdiction of the City of Waterloo. Thorndale Drive is classified as a minor collector roadway, with an assumed speed limit of 50 km/h per municipal regulation. Thorndale Drive consists of a two-lane roadway (with one lane in each direction). Within the study area sidewalks are located on both sides of the roadway, separated from the roadway by a boulevard strip.
- **Ira Needles Boulevard** is a north-south roadway under the jurisdiction of the Region of Waterloo. Ira Needles Boulevard is classified as an arterial roadway, with a posted speed limit of 60 km/h. Within the study area, Ira Needles Boulevard primarily consists of a four-lane roadway (with two lanes in each direction). Within the study area, a sidewalk is located on the west side of the roadway, primarily separated from the roadway by a boulevard strip, while a paved trail is located on the east side of the roadway, separated from the roadway by a boulevard strip.
- **Columbia Street West** is an east-west roadway under the jurisdiction of the City of Waterloo. Columbia Street West is classified as an arterial roadway with a posted speed limit of 60 km/h east of Erbsville Drive and 50 km/h west of Erbsville Drive. Within the study area, Columbia Street West consists of a two-lane roadway (with one lane in each direction). Within the study area, sidewalks are located on both sides of the roadway between Fischer-Hallman Road and Bennington Gate, as well as west of Erbsville Road, separated from the roadway by a boulevard strip. Sidewalks are only located on the north side of the roadway between Bennington Gate and Cavendish Drive, separated from the roadway by a boulevard strip. No sidewalks are located between Erbsville Road and Cavendish Drive.
- **Laurelwood Drive** is an east-west roadway under the jurisdiction of the City of Waterloo. Laurelwood Drive is classified as a major collector roadway between Erbsville Road and Fischer-Hallman Road with a posted speed limit of 50 km/h staring approximately 90 metres east of Erbsville Road, and 40km/h west of said location. Within the study area, Laurelwood Drive consists of a two-lane roadway (with one lane in each direction). Sidewalks are located on both sides of the roadway west of Beaver Creek Road, and on the south side between Beaver Creek Road and Fischer-Hallman Road/Bearinger Road, separated from the roadway by a boulevard strip.
- **Keats Way** is an east-west roadway under the jurisdiction of the City of Waterloo. Keats Way is classified as a major collector roadway, with a posted speed limit of 50 km/h. Within the study area, Keats Way consists of a

two-lane roadway (with one lane in each direction). Sidewalks are located on both sides of the roadway, separated from the roadway by a boulevard strip.

- **Bearinger Road** is an east-west roadway classified as arterial. Between Laurelwood Drive and Westmount Road North, Bearinger Road is under the jurisdiction of the Region of Waterloo. East of Westmount Road North Bearingrer Road is under the jurisdiction of the City of Waterloo. Bearing Road has a posted speed limit of 60 km/h between Laurelwood Drive and Westmount Road North, and 50 km/h east of Westmount Road North. Bearinger Road primarily consists of a two-lane roadway (with one lane in each direction) within the study area. A trail exists to the north of the roadway west of Westmount Road North, while east of Westmount Road North a sidewalk is located to the north side and a paved trail is located on the south side both separated from the roadway by a boulevard strip.
- **Beaver Creek Road** is a north-south roadway under the jurisdiction of the City of Waterloo. Beaver Creek Road is classified as a minor collector roadway, with a posted speed limit of 60 km/h south of Conservation Drive, until approximately 400m north of Laurelwood Drive where it becomes 50 km/h. Beaver Creek Road consists of a two-lane roadway (with one lane in each direction). No sidewalks are located along the roadway north of Laurelwood Drive, while sidewalks are located on both sides of the roadway south of Laurelwood Drive separated from the roadway by a boulevard strip.
- **Conservation Drive** is an east-west roadway under the jurisdiction of the City of Waterloo. Conservation Drive is classified as a major collector roadway between Westmount Road North and Erbsville Road, and a local road between Erbsville Road and Wilmot Line. Conservation Drive has a posted speed limit of 60 km/h starting approximately 250m east of Beaver Creek Road, a 70 km/h speed limit approximately 530 metres west of Erbsville Road, and a posted speed limit of 50 km/h in between. Conservation Drive consists of a two-lane roadway (with one lane in each direction). A sidewalk is located on the north side of the roadway between Westmount Road North and Roy Schmidt Road, and on both sides of the roadway east of Westmount Road North, separated from the roadway by a boulevard strip.
- **Westmount Road North** is a north-south roadway. North of Northfield Drive West Westmount Road North is under the jurisdiction of the City of Waterloo and is classified as a major collector roadway, with a posted speed limit of 50 km/h. Said section of the roadway consists of a two-lane cross-section (with one lane in each direction), with a sidewalk located on its east side and a trail on its west side. West of Northfield Drive West Westmount Road North is under the jurisdiction of the Region of Waterloo and is classified as an arterial roadway, with a posted speed limit of 60 km/h. Said section of the roadway consists of a four-lane cross-section (with two lanes in each direction), a sidewalk is located on both sides separated from the roadway by a boulevard strip.
- **Northfield Drive West** is an east-west roadway under the jurisdiction of the Region of Waterloo. Northfield Drive West is classified as an arterial roadway with a posted speed limit of 50 km/h. Within the study area Northfield Drive West consists of a four-lane roadway (with two lanes in each direction). Within the study area a sidewalk is located on the north side of the roadway while a paved trail is located on the south side of the roadway, both separated from the roadway by a boulevard strip.
- **Erbsville Road** is a north-south roadway under the jurisdiction of the Region of Waterloo. Erbsville Road Boulevard is classified as an arterial roadway, with a posted speed limit of 50 km/h starting approximately 150m north of its intersection with Forest Gate Crescent, and 60 km/h south of said location. Within the study area, Erbsville Road primarily consists of a two-lane roadway (with one lane in each direction). Between Erb Street and Keats Way, a sidewalk is located on the west side of the roadway and a paved trail is located on its east side. Between Keats Way and Laurelwood Drive sidewalks are primarily located on the west side of the roadway. Between Laurelwood Drive and Wideman Road sidewalks are located on both sides of the roadway.
- **Wilmot Line is a** is a north-south roadway under the jurisdiction of the Wilmot Township. Wilmot Line is classified as a minor collector roadway, with a posted speed limit of 60 km/h. Within the study area, Wilmot Line consists of a two-lane roadway (one lane in each direction). No sidewalks are located along Wilmot Line within the study area.
- **Platinum Drive** is a north-south roadway under the jurisdiction of the City of Waterloo. Platinum Drive is planned to be classified as a minor collector roadway, with an assumed speed limit of 50 km/h per municipal regulation. Platinum rive consists of a two-lane roadway (with one lane in each direction), with a sidewalk and paved trail along the roadway.

- **The Boardwalk** is a north south roadway under the jurisdiction of the City of Waterloo. The Boardwalk is classified as a local roadway, with a posted speed limit of 20 km/h. The Boardwalk consists of a two-lane roadway (with one lane in each direction), with sidewalks on both sides of the roadway.

Please refer to Figure 2-1 for a map of the study area with existing roadway classification and intersection type. Please refer to Figure 2-2 for the study intersection existing lane configurations.



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Source: Google Earth

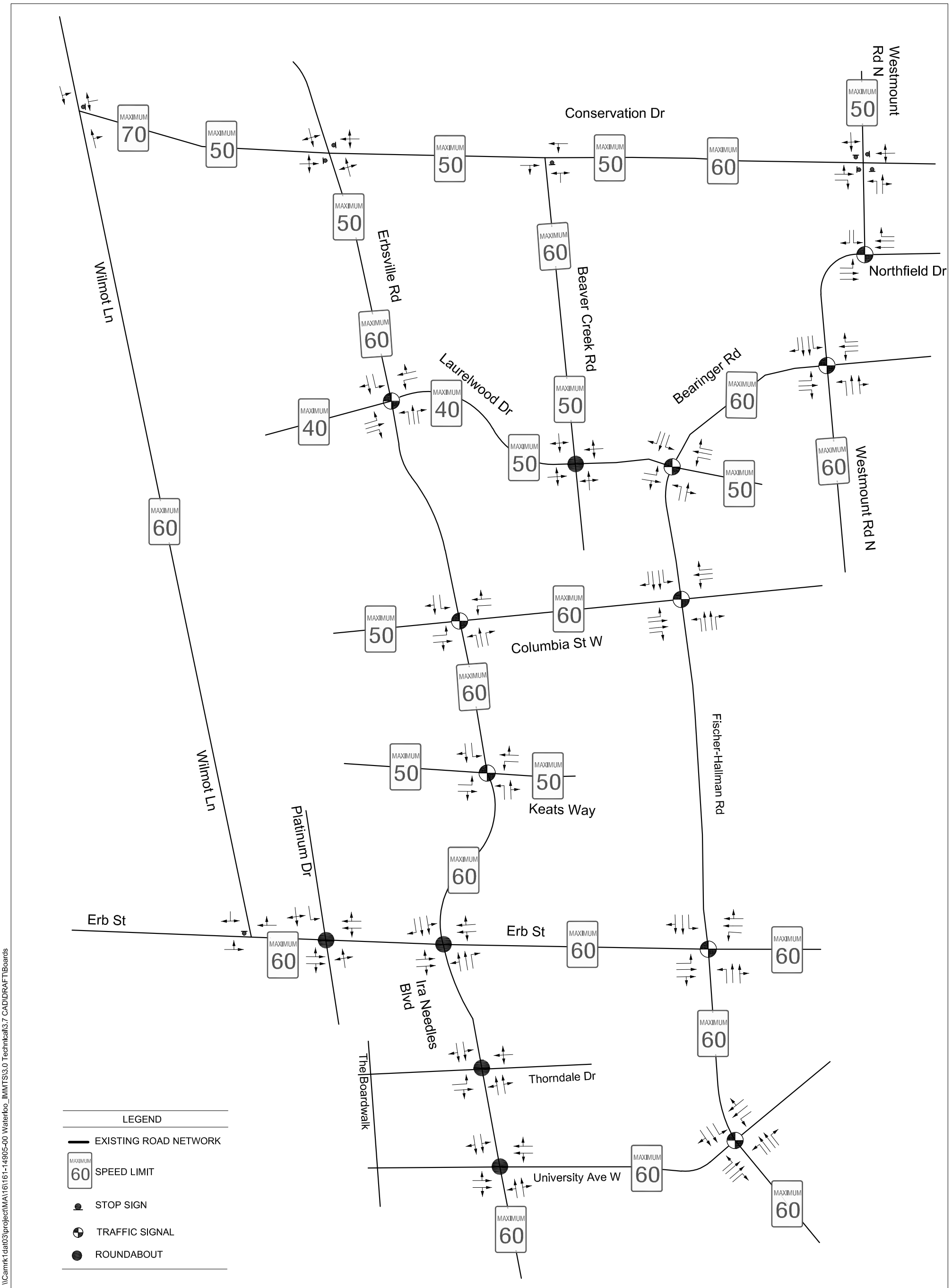
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Legend

Signalized Intersection	Regional Road	Planned Major Collector
Unsignalized Intersection	City Arterial	Minor Collector
Roundabout	Major Collector	Planned Minor Collector

Note: All other roadways within the study area that are not highlighted on the map are local roads.

Figure 2-1
Existing Roadway Classification and Intersection Type
Waterloo West Side Integrated Multi-Modal Transportation Study



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Figure 2-2
Existing Study Intersection Lane Configuration
Waterloo West Side Integrated Multi-Modal Transportation Study

161-0537.00-Existing-planned-recom Configuration_v0-1_20180321.dwg_Existing Lane Configuration

Modified: 4/30/2018 5:23 PM By: nawfal.kammah Plot Date: 2018/05/01

2.2 TRANSIT NETWORK

The current Grand River Transit (GRT) network originated in 2000 when the Region of Waterloo combined the transit systems for the cities of Waterloo, Kitchener, and Cambridge, providing amalgamated service for the entire region. GRT offers multiple service delivery methods including fully accessible[1] local, cross-service area, and express buses; ION light rail; as well as door-to-door accessible services. Bus service operates 70 routes, divided into conventional service, busPLUS service, limited express, iXpress, and MobilityPLUS. Routes may operate locally and/or cross-service area.

Conventional service operates throughout the region year-round on a fixed schedule and accommodates increased passenger traffic during the fall and winter seasons by modifying route schedules for connectivity to seasonal routes, like school specials and limited express routes. Conventional bus routes are both local, accessing communities, and cross-service area, providing streamlined routes across the entire region.

BusPLUS service operates in areas of lower ridership, particularly in new neighbourhoods, on new routes, and to more remote locations with lower ridership. Smaller, 19-seat fully accessible vehicles are used on these routes, with standard-sized accessible buses being introduced when ridership increases sufficiently.

Limited express service is provided on 3 routes, connecting the Fairview Park, Ainsley Street, and Forest Glen terminals with Conestoga College Doon Campus or Cambridge Campus. Route 110 operates weekdays only, while Routes 111 and 116 operate during rush hours only from September to April.

iXpress buses provide frequent, limited-stop service along major corridors, and are divided into 5 routes, numbered 200-204. Route 200 iXpress/ION is currently the only rapid transit bus in the system, with the portion between Conestoga Mall and Fairview Park Mall to be replaced by ION light rail in 2018. A sixth express route, 205 iXpress, is scheduled to be added to the system in 2018.

MobilityPLUS service is offered for individuals who cannot ride conventional transit service and meet certain disability criteria determined by GRT. Small, fully accessible, bus-style vehicles that are used for this service. There is no fixed service for MobilityPLUS; trips are determined by user request.

WSP has identified 15 bus routes (12 conventional and 3 iXpress) that operate within the study area. They are listed below in Table 2-1, along with their start and end locations.

[1] Defined as kneeling buses with low floors and wheelchair ramps.

Table 2-1 GRT Routes in Study Area

ROUTE #	ROUTE NAME	TERMINUS LOCATION 1	TERMINUS LOCATION 2
4	Glasgow	Charles Terminal	The Boardwalk
5	Erb	Bridgeport (Erb/King Sundays)	The Boardwalk
7	Mainline	Conestoga Mall	Fairview Park
8	University/Fairview	King/University	Fairview Park
9	Lakeshore	University of Waterloo	Conestoga Mall
12	Westmount	Conestoga Mall	Fairview Park
13	Laurelwood	The Boardwalk	UW Davis Centre
14	Waterloo Industrial	Conestoga Mall	
21	Elmira	Arthur/Church (Elmira)	Conestoga Mall
29	Keats Way	King/University	The Boardwalk
31	Columbia	Clair Hills	Conestoga Mall
73 busPLUS	Northlake	McCormick	
200	iXpress ION Conestoga Mall/Ainslie Terminal	Ainslie Terminal	Conestoga Mall
201	iXpress Forest Glen/Conestoga Mall	Forest Glen (Kitchener)	Conestoga Mall
202	iXpress The Boardwalk/Conestoga Mall	The Boardwalk	Conestoga Mall

Major terminals within the study area are Conestoga Mall and The Boardwalk, with Charles Street Terminal and St. Jacob's Farmers Market short distances (usually 2-3 stops) outside of the area and are therefore used as timepoints for routes that access these stops.

Service provided by the above routes within the study area is demonstrated in the below table. It shows the start and endpoints of the routes which fall within the study area, as well as frequency in both directions on weekdays, Saturdays, and Sundays/Holidays. Frequency is measured in minutes, and there are a number of routes which use the Charles Street Terminal or St. Jacob's Market stop as timepoints for the frequency schedule, though they fall just outside of the study area. For routes where frequency varies, peak frequency is indicated within Table 2-2, and off-peak frequency is generally double peak frequency for applicable routes.

Table 2-2 GRT Route Service Details (Study Area)

ROUTE #	ROUTE NAME	TERMINAL DIRECTION 1	TERMINAL DIRECTION 2	FREQUENCY IN MINUTES					
				Weekday Direction 1	Weekday Direction 2	Saturday Direction 1	Saturday Direction 2	Sunday/Holiday Direction 1	Sunday/Holiday Direction 2
4	Glasgow	Charles Terminal	The Boardwalk	30	30	60	60	No Service	No Service
5	Erb	Erb/Weber / Erb/Bridgeport	The Boardwalk	30	30	30	30	45	45
7	Mainline	Charles Terminal	King/University	15	15	15	15	15	20
7C	Mainline	Charles Terminal	Conestoga Mall	15	15	15	15	15	30
7D	Mainline	Charles Terminal	UW Davis Centre	15	30	15	30	No Service	No Service
7E	Mainline	Charles Terminal	UW Columbia	15	30	15	30-45	15	30
8	University/Fairview (via Courtland/Weber)	Charles Terminal	King/University	30	30-45	30	30	45	45
8	University/Fairview (via Franklin/Westmount)	Westmount/Union	King/University	30	30-45	30	30	45	45
9	Lakeshore (Fall/Winter/Spring)	UW	Conestoga Mall	15	15-30	30	30	45	45
9	Lakeshore (Summer)	UW	Conestoga Mall	30	30				
12[2]	Westmount	Westmount/Highland	Conestoga Mall	30	30	30	30	30	30
13	Laurelwood	The Boardwalk	UW Davis Centre/Needles Hall	15	15	30	30	45	45
14	Waterloo Industrial	Conestoga Mall		30	No Service	No Service	No Service	No Service	No Service
21	Elmira	St. Jacob's Market	Conestoga Mall	40	40	40	40	No Service	No Service
29	Keats Way	King/University	The Boardwalk	30	30	30	30	45	45
31	Columbia	Clair Hills	Conestoga Mall	30	30	No Service	No Service	No Service	No Service

[2] Operates 15 minute service during the fall and winter seasons from ~8-10am.

73 busPLUS	Northlake	McCormick		30	No Service	No Service	No Service	No Service	No Service
200	iXpress ION Conestoga Mall/Ainslie Terminal	Charles Terminal	Conestoga Mall	15-20	15	15	15	30	30
201	iXpress Forest Glen/Conestoga Mall	Conestoga Mall	Fischer-Hallman/Erb	15	15	30	30	30	30
202	iXpress The Boardwalk/Conestoga Mall	The Boardwalk	Conestoga Mall	15	15	30	30	30	30

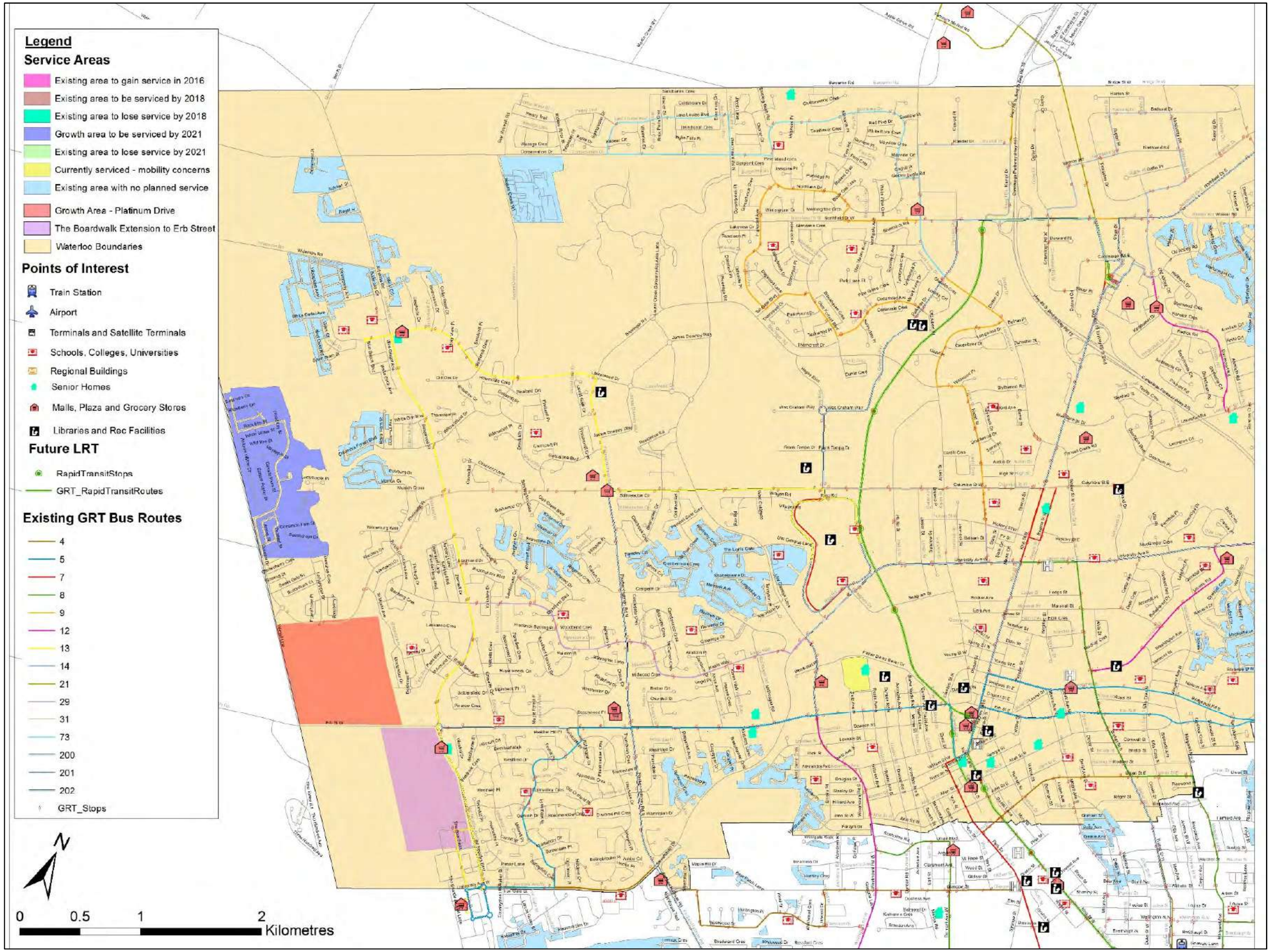
Routes in the study area operate within neighbourhoods and along major corridors, providing connections between industrial or suburban neighbourhoods with the downtown core. A complete list of the major corridors serviced by the routes in the study area, as well as brief notes regarding the route, when relevant, are outlined in Table 2-3 below.

Table 2-3 GRT Major Corridors Serviced by Routes (Study Area)

ROUTE #	ROUTE NAME	MAJOR CORRIDORS	ROUTE NOTES
4	Glasgow	University Av.; Fischer-Hallman Rd.; Weber St.; Frederick St.	
5	Erb	Erb St.; University Av.; Bridgeport Rd.; King St.	
7	Mainline	King St. W	
8	University/Fairview (via Courtland/Weber)	University Av.; Weber St.; Westmount Rd.; Union St.	
9	Lakeshore (Fall/Winter/Spring)	University Av.; Hazel St.; Weber St.; Northfield Dr. W.	Kumpf extension serviced every hour
9	Lakeshore (Summer)		Arrives at UW Needles Hall, departs from UW Davis Centre
12	Westmount	University Av.; Westmount Rd.	Highland time point slightly out of study area but used
13	Laurelwood	Erbsville Rd./Ira Needles Blvd.; Fischer-Hallman Rd.; Columbia St.	
14	Waterloo Industrial	Weber St.; Northfield Dr.; King St	Unidirectional loop route
21	Elmira	King St.	
29	Keats Way	Ira Needles/Erbsville; Keats Way; University Av.	
31	Columbia	Columbia St.; Bridge St.	
73 busPLUS	Northlake	Conservation Dr.; Northlake Dr.; Weber St.	Unidirectional loop route
200	iXpress ION Conestoga Mall/Ainslie Terminal	Highway 8; Northfield Dr. W; Parkside Dr.; Weber St.; Bridgeport Rd. E; Erb St. S	
201	iXpress Forest Glen/Conestoga Mall	Fischer-Hallman Rd,; Columbia St. W.; King St. N.; Northfield Dr. W.	Weekday frequency 30 minutes between 9:15-14:13 during spring/summer

There are a number of points of interest that are accessible along each route, within neighbourhoods and along major corridors. Some key points are schools (elementary, secondary, and post-secondary), parks, community centres, plazas, and hospitals. They are identified in Figure 2-3.

Figure 2-3 **Existing GRT Routes with Points of Interest in Study Area**



2.3 ACTIVE TRANSPORTATION NETWORK

Multiple Active Transportation facilities are currently available within the study area of the IMMTS, composed of cycling and pedestrian facilities. Active transportation facilities exist on and off road, as detailed below:

- Existing on-road facilities pertain to cycling, amounting to a total length of 30.7 km. On-road facilities consist of 23.5 km of bicycle lanes, 5.6 km of paved shoulder and 1.6 km of signed routes.
- Existing off-road facilities pertain to both cycling and pedestrian activities, amounting to a total length of 216.5 km. Off-road facilities consist of 40.6 km of community trail, 7.9 km of in-boulevard multi-use trail, 7.1 km of walkway and 160.9 km of sidewalk.

The purpose of active transportation facilities is to provide balance to the transportation system by allowing commuter to have a choice in their mode of travel and not solely focus on automobile travel. Municipalities now apply the concept of "Complete Streets", which are roads designed to safely accommodate cars, cyclists, pedestrians, wheelchair and transit users.

Part of this study will focus on the provision of additional active transportation facilities to improve the existing network, and provide greater connections to community destinations, provide facilities across barrier (such as major roads, railway lines, creeks etc.), and improve a better connection between the active transportation network and the transit network. As per the Region of Waterloo Active Transportation Master Plan (2014), recommended improvements will contribute to increasing the mode share of walking and cycling trips to the 12% target, and will contribute to the creation of an integrated network of City and Regional active transportation facilities.

As detailed above, the study area contains various types of active transportation facilities. Figure 2-4 illustrates the typical active transportation facilities found in the study area. Figure 2-5 illustrates the entirety of the active transportation network existing in the study area.

Figure 2-4 Typical Types of Active Transportation Facilities in Study Area A and B



Legend:

1. Walkway, Brentcliffe Drive at Beaver Creek Road
2. Multi-use Trail near Mary Johnston Public School, Keats Way
3. Boulevard Multi-Use Trail, Fischer Hallman Road north of Keats Way
4. Signed Cycling Route, Wideman Road west of Erbsville Road
5. Paved Shoulder, Erbsville Road, north of Keats Way
6. Bike Lane, Laurelwood Drive east of Erbsville Road

INTEGRATED MULTI-MODAL TRANSPORTATION STUDY WATERLOO WEST SIDE

CITY OF WATERLOO

JUNE 2018

Existing On-Road Cycling Facilities	
Type	**Length (km)**
Bike Lane	23.5
Paved Shoulder	5.6
Signed Route	1.6

Existing Trails / Walkways	
Type	**Length (km)**
Community Trail	40.9
In-Boulevard Multi-Use Trail	7.9
Walkway	7.1
Sidewalk	160.9

Note: Lengths provided are based on existing data provided by the City of Waterloo and Region of Waterloo. Select field investigations are required.



LEGEND

Destinations

- Points of Interest
- Schools
- GRT Bus Stop
- Bicycle Parking

Existing On-Road Cycling Facilities

- Bike Lane
- Paved Shoulder
- Signed Route

Existing Trails / Walkways

- Community Trail
- In-Boulevard Multi-Use Trail Route
- Walkway
- Sidewalk

Other

- Roads
- Creeks
- Lake / Pond
- City Parks
- Study Area A
- Study Area B

Figure 2-5
Existing Active Transportation Network

THE CITY OF Waterloo

WSP

2.4 EXISTING TRAFFIC VOLUMES

The City and Region provided WSP with the latest turning movements counts (TMC) for the study intersections. In addition, WSP arranged for Accu-Traffic to collect TMC at the Erb Street and Platinum Drive intersection. The intersection source, count date and peak hours are provided in Table 2-4. The TMC data is provided in Appendix A. The existing AM and PM peak hour turning movements are shown in Figure 2-6 and Figure 2-7.

Table 2-4 Intersection TMC Source

Intersection		Source	Date	Peak Hours	
1	Ira Neeles Blvd at University Drive W	Region	9-Sep-15	8:30 to 9:30 AM	4:45 to 5:45 PM
2	Fischer-Hallman Rd at University Dr W	Region	23-Mar-17	8:00 to 9:00 AM	4:45 to 5:45 PM
3	Ira Neeles Blvd at Thorndale Dr	Region	23-Mar-17	8:00 to 9:00 AM	4:15 to 5:15 PM
4	Wilmot Ln at Erb St	Region	23-Mar-17	7:45 to 8:45 AM	4:30 to 5:30 PM
5	Platinum Drive at Erb Street	Accu-Traffic	16-Jan-18	8:00 to 9:00 AM	4:15 to 5:15 PM
6	Ira Neeles Blvd/Erbsville Rd at Erb St	Region	23-Mar-17	8:00 to 9:00 AM	4:15 to 5:15 PM
7	Fischer-Hallman Rd at Erb St	Region	23-Mar-17	8:00 to 9:00 AM	4:45 to 5:45 PM
8	Erbsville Rd at Keats Way	Region	21-May-15	8:00 to 9:00 AM	5:00 to 6:00 PM
9	Erbsville Rd at Columbia St W	Region	21-May-15	8:00 to 9:00 AM	5:00 to 6:00 PM
10	Fischer-Hallman Rd at Columbia St W	Region	18-Feb-16	8:00 to 9:00 AM	4:30 to 5:30 PM
11	Erbsville Rd at Laurelwood Dr	Region	21-May-15	8:00 to 9:00 AM	5:00 to 6:00 PM
12	Beaver Creek Dr at Laurelwood Dr	City	19-Oct-15	8:00 to 9:00 AM	5:00 to 6:00 PM
13	Fischer-Hallman Rd at Laurelwood Dr	Region	18-Feb-16	8:00 to 9:00 AM	4:45 to 5:45 PM
14	Westmount Rd N at Bearinger Rd	Region	18-Feb-16	8:00 to 9:00 AM	4:30 to 5:30 PM
15	Westmount Rd N at Northfield Dr	Region	28-Mar-17	8:00 to 9:00 AM	4:45 to 5:45 PM
16	Wilmot Ln at Conservation Dr	City	13-Oct-15	7:30 to 8:30 AM	4:45 to 5:45 PM
17	Erbsville Rd at Conservation Dr	Region	21-May-15	7:45 to 8:45 AM	5:00 to 6:00 PM
18	Beaver Creek Dr at Conservation Dr	City	21-Oct-15	7:45 to 8:45 AM	4:15 to 5:15 PM
19	Westmount Rd N at Conservation Dr	City	26-Jun-17	7:30 to 8:30 AM	5:00 to 6:00 PM

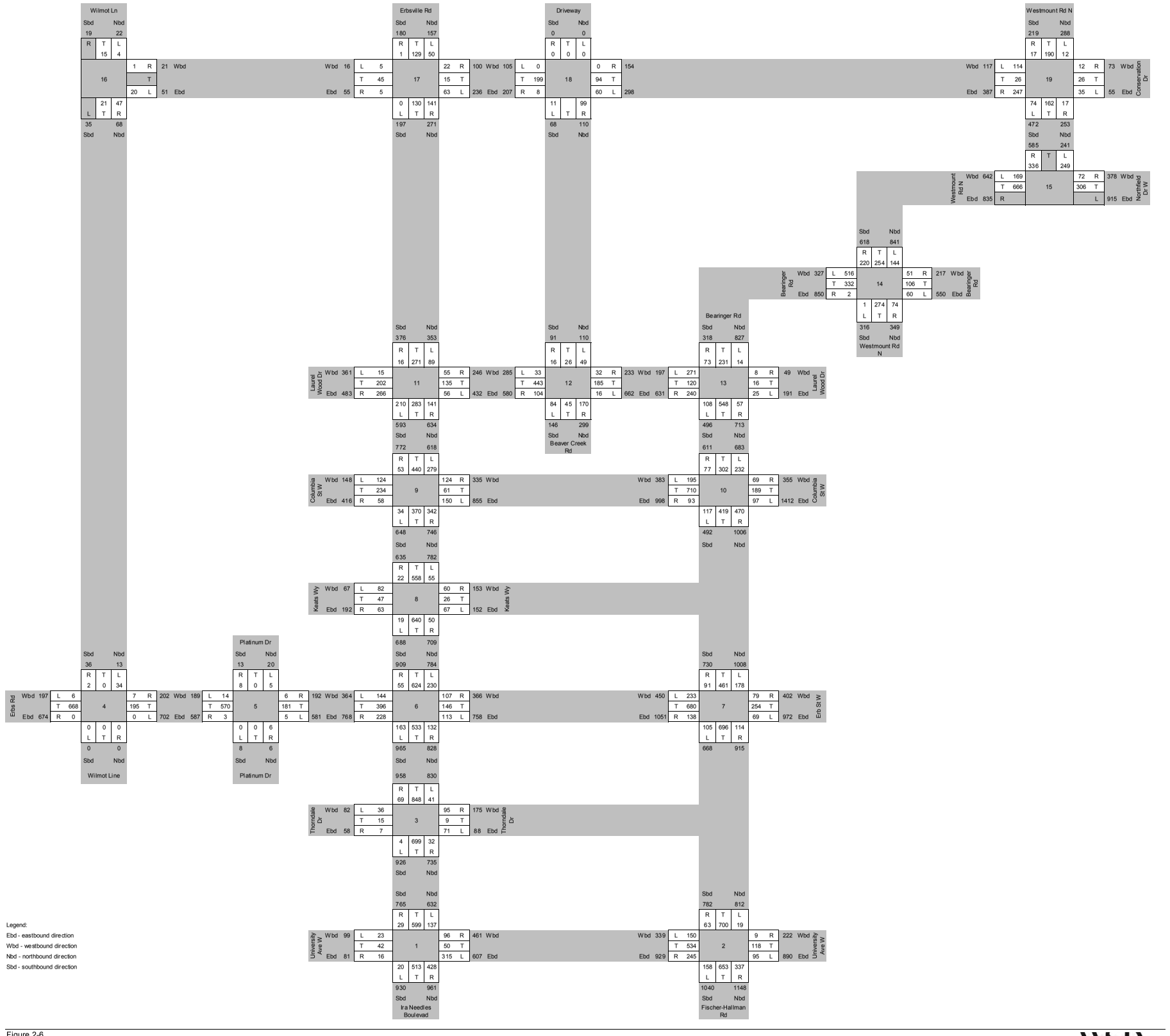
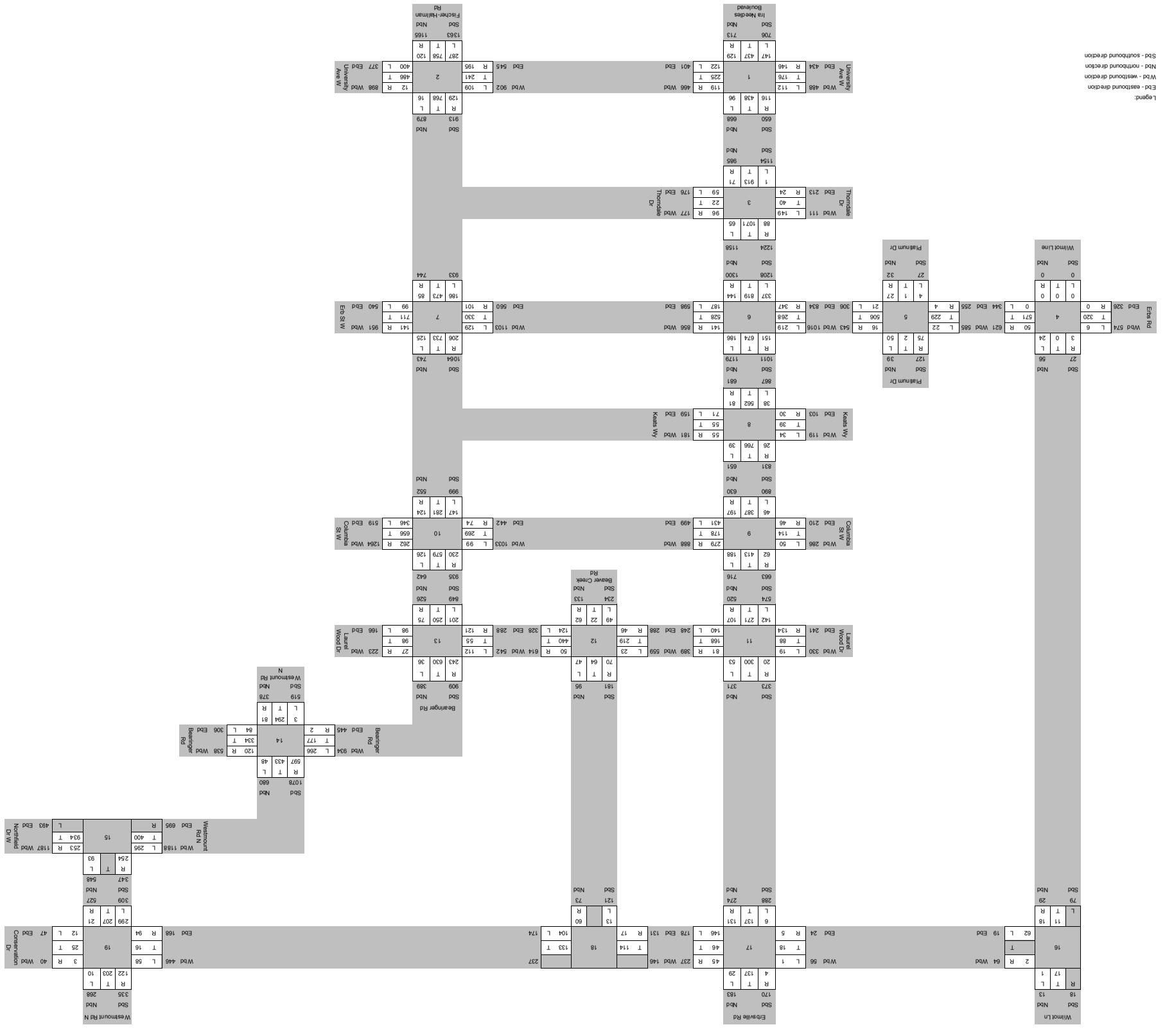


Figure 2-6
Existing Traffic Volumes - AM Peak Hour
Waterloo West Side Integrated Multi-Modal Transportation Study

Figure 2-7
Existing Traffic Volumes - PM Peak Hour
Waterloo West Side Integrated Multi-Modal Transportation Study



2.5 EXISTING TRAFFIC ANALYSIS

Intersection capacity analyses for the study intersections for existing traffic conditions for the AM and PM peak hours was analyzed using Lanes, Volumes Timings and Highway Capacity Manual (HCM) methodologies and Synchro 9 software. The analysis of roundabouts was completed using ARCADY 7. For the analysis WSP referenced the Region of Waterloo TIS Requirements for Capacity Analysis, Roundabouts & Signal Warrants.

A summary of the intersection capacity analysis results for signalized intersections is provided in Table 2-5. A summary of the intersection capacity analysis results for unsignalized intersections is provided in Table 2-6. A summary of the roundabout analysis results is provided in Table 2-7.

For the signalized intersections, only the critical movements were showed within the tables. Critical movements were defined as movements operating under Level of Service E or F, as per the Region of Waterloo Transportation Study Guidelines Section 7. For the unsignalized intersections, only movements operating under stop-control were showed within the tables. Additionally, as per the Region of Waterloo TIS Requirements, summary of analysis for signalized study intersections was derived using the "Lanes, Volumes, Timings" report in Synchro, while summary of analysis for unsignalized study intersections was derived using the "HCM" report. Appendix B contains both the "Lanes, Volumes, Timings" and "HCM" reports for each intersection. The Region of Waterloo Roundabout Traffic Flow Sheets are provided in Appendix C. The ARCADY generated roundabout analysis reports are provided in Appendix D.

Table 2-5 Intersection Capacity Analysis Results, Signalized Intersections - Existing Traffic Volumes

Intersection		AM Peak Hour			PM Peak Hour		
Movement		V/C	Delay (sec.)	LOS	V/C	Delay (sec.)	LOS
Fischer-Hallman Rd at University Dr W		**0.73 (max)**	**29**	**C**	**0.98 (max)**	**39**	**D**
Northbound Left	NBL	0.48	21	C	0.98	78	E
Southbound Through+Right	SBT	0.73	46	D	0.92	55	E
Fischer-Hallman Rd at Erb St		**0.76 (max)**	**30**	**C**	**0.89 (max)**	**40**	**D**
Northbound Left	NBL	0.32	13	B	0.89	75	E
Erbsville Rd at Keats Way		**0.72 (max)**	**16**	**B**	**0.69 (max)**	**16**	**B**
Erbsville Rd at Columbia St W		**0.74 (max)**	**24**	**C**	**0.78 (max)**	**25**	**C**
Fischer-Halman Rd at Columbia St W		**0.71 (max)**	**28**	**C**	**0.96 (max)**	**36**	**D**
Westbound Through	WBT	0.37	36	D	0.96	63	E
Erbsville Rd at Laurelwood Dr		**0.69 (max)**	**21**	**C**	**0.75 (max)**	**21**	**C**
Fischer-Hallman Rd at Laurelwood Dr		**0.76 (max)**	**21**	**C**	**0.70 (max)**	**17**	**B**
Westmount Rd N at Bearinger Rd		**0.85 (max)**	**24**	**C**	**0.70 (max)**	**20**	**B**
Westmount Rd N at Northfield Dr		**0.40 (max)**	**15**	**B**	**0.79 (max)**	**19**	**B**

Based on the table above, the signalized study intersections currently operate with acceptable LOS D or better during the AM and PM peak hours. All turning movements currently operate at LOS D or better, with the exception of the northbound left-turns at Fischer-Hallman Road at University Drive West and Fischer-Hallman Road at Erb Street, and the southbound shared through and right-turn movement at the intersection of Fischer-Hallman Road at University Drive West, all during the PM peak hour. However, all turning movements operate under capacity. The maximum overall intersection delay is 40 seconds at the intersection of Fischer-Hallman Road at Erb Street during the PM peak hour.

Table 2-6 Intersection Capacity Analysis Results, Unsignalized Intersections - Existing Traffic Volumes

Intersection Movement		AM Peak Hour Delay (sec.)	LOS	PM Peak Hour Delay (sec.)	LOS
Wilmot Ln at Erb St					
Southbound Left+Right	SBLR	17	C	18	C
Wilmot Ln at Conservation Dr					
Westbound Left+Right	WBLR	9	A	9	A
Erbsville Rd at Conservation Dr					
Eastbound Through+Left+Right	EBTLR	14	B	12	B
Westbound Through+Left+Right	WBTLR	14	B	16	C
Beaver Creek Dr at Conservation Dr					
Northbound Left+Right	NBLR	10	B	10	A
Westmount Rd N at Conservation Dr		**11**	**B**	**13**	**B**
Eastbound Through+Left	EBTL	11	B	10	B
Eastbound Right	EBR	10	B	9	A
Westbound Through+Left+Right	WBTLR	11	B	11	B
Northbound Left	NBL	10	B	14	B
Northbound Through+Right	NBTR	11	B	10	B
Southbound Through+Left+Right	SBTLR	13	B	15	B

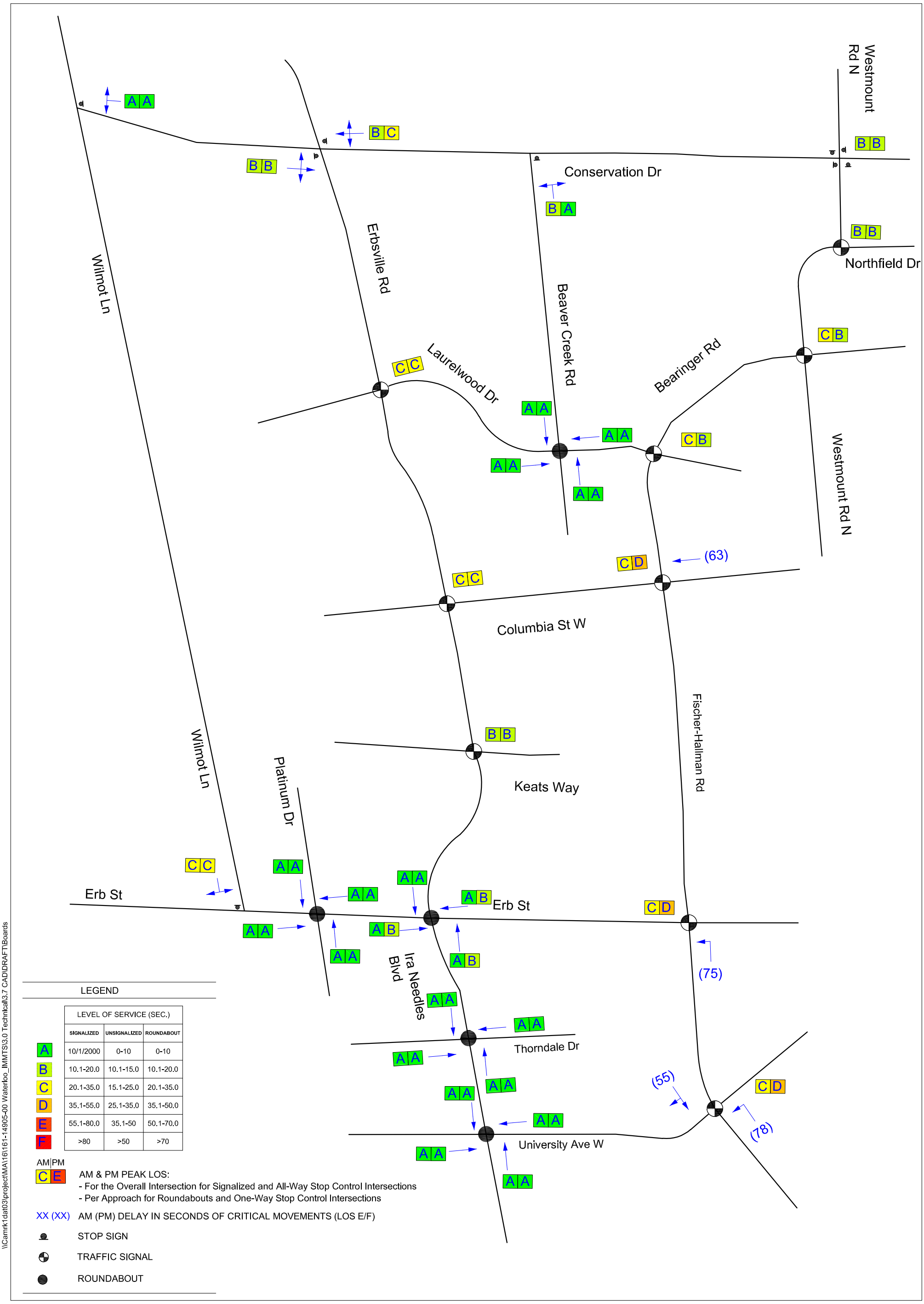
Based on the table above, turning movements at unsignalized study intersections currently operate with LOS C or better during the AM and PM peak hours. A maximum delay of 18 seconds is experienced by the southbound shared left and right-turn movements at the intersection of Wilmot Lane at Erb Street during the PM peak hour.

Table 2-7 Roundabout Analysis Results - Existing Traffic Volumes

Intersection	AM Peak Hour			PM Peak Hour		
Approach	RFC	Delay (sec.)	LOS	RFC	Delay (sec.)	LOS
Ira Needles Blvd at University Avenue						
East - University Ave	0.32	3.31	A	0.41	4.87	A
North - Ira Needles Blvd	0.55	5.28	A	0.54	5.96	A
West - Private Access	0.17	8.36	A	0.52	8.04	A
South - Ira Needles Blvd	0.68	7.23	A	0.54	5.31	A
Ira Needles Blvd at Thorndale Dr						
East - Thorndale Dr	0.22	5.19	A	0.27	6.90	A
North - Ira Needles Blvd	0.56	4.32	A	0.70	6.38	A
West - Boardwalk Access	0.05	3.10	A	0.20	3.75	A
South - Ira Needles Blvd	0.42	3.19	A	0.58	4.68	A
Erb St at Platinum Dr						
East - Erb St	0.11	2.11	A	0.30	2.55	A
North - Platinum Dr	0.01	2.45	A	0.08	2.32	A
West - Erb St	0.33	2.68	A	0.14	2.13	A
South - Landfill Gate 2	0.01	5.31	A	0.04	4.07	A
Ira Needles Blvd at Erb St						
East - Erb St	0.25	3.02	A	0.75	11.21	B
North - Erbsville Rd	0.52	3.95	A	0.75	9.68	A
West - Erb St	0.61	6.73	A	0.78	14.01	B
South - Ira Needles Blvd	0.56	5.11	A	0.83	12.43	B
Beaver Creek Rd at Laurelwood Dr						
East - Laurelwood Dr	0.26	4.89	A	0.65	9.93	A
North - Beaver Creek Rd	0.10	4.08	A	0.26	6.43	A
West - Laurelwood Dr	0.60	8.35	A	0.34	5.84	A
South - Beaver Creek Rd	0.46	9.20	A	0.26	4.89	A

The roundabout capacity analysis results indicate that the approaches are operating at LOS A during both the AM and PM peak hours, with the exception of the Ira Needles Boulevard at Erb Street intersection operating at LOS B during the PM peak hour. All approaches operate with a delay of less than 15 seconds during both peak periods.

A summary of the existing intersection operations for the study area is provided in Figure 2-8.



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Figure 2-8
Existing Intersection Operations (Based on Surveyed Turning Movement Counts)
Waterloo West Side Integrated Multi-Modal Transportation Study

3 FUTURE CONDITIONS

3.1 PLANNED ROADWAY IMPROVEMENTS

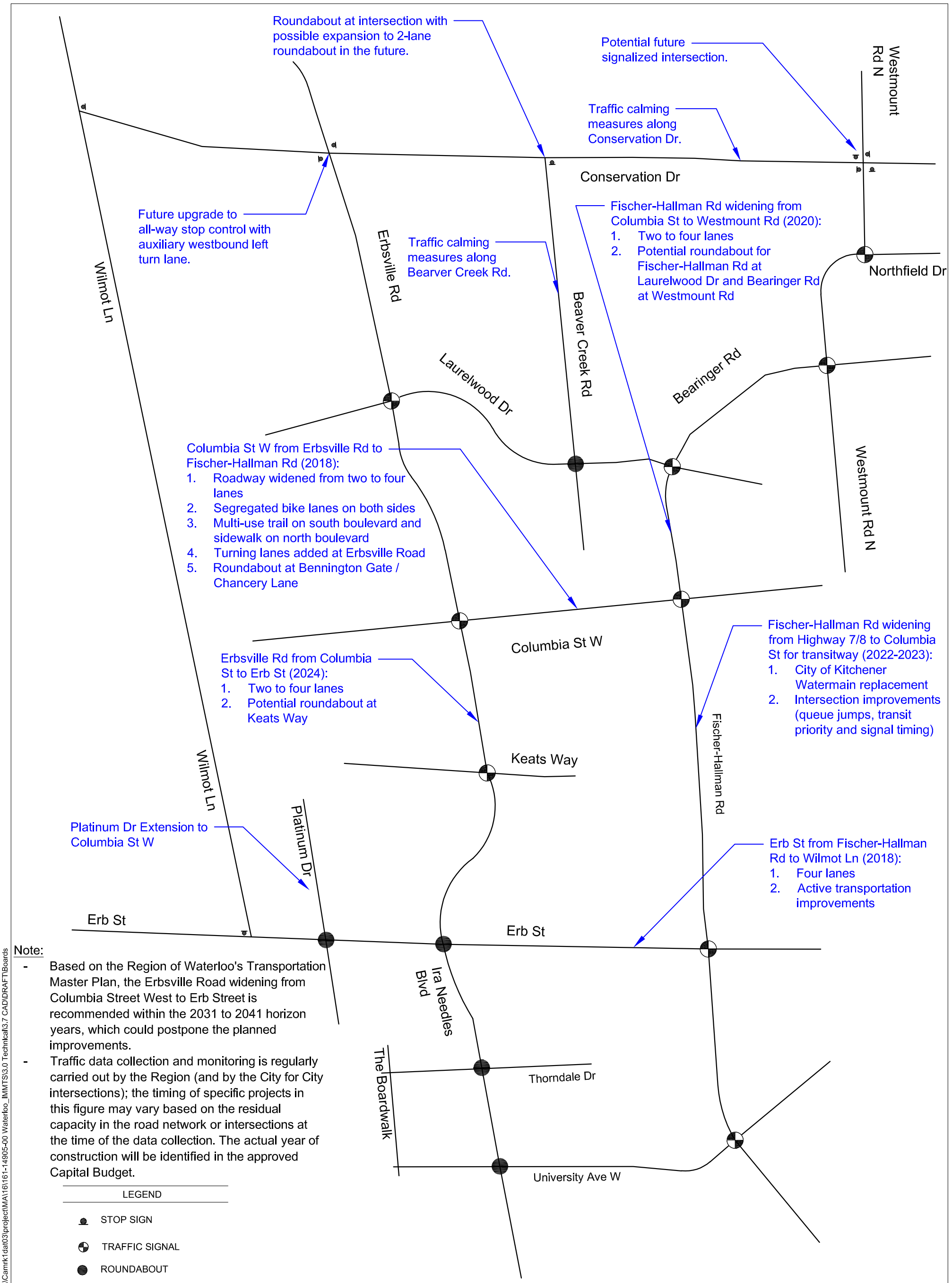
Based on the City of Waterloo Transportation Capital Base and System Expansion Programs, the City of Waterloo Transportation Master Plan, Region of Waterloo Transportation Master Plan, completed and ongoing EA's and consultation with both the Region and City, the following improvements are planned for the study area:

- Platinum Drive extension where the roadway would connect to Columbia Street.
- Erb Street widening from Fischer-Hallman Road to Wilmot Line. Road widening from two to four lanes and active transportation improvements on Erb Street. The corridor will also include two roundabouts on Erb Street providing access to the Costco site and at Platinum Drive. Provision of eastbound left turn lane on Erb Street at Beechwood Drive. These improvements are planned to be completed in 2018. Implementation of the Erb Street widening (INB – Wilmot Line) may be delayed depending on result of negotiations with various hydro utilities regarding relocation of towers.
- Erbsville Road widening from Columbia Street to Erb Street, including watermain installation. These improvements are planned to be completed by 2024. A future Regional EA is planned. WSP confirmed with the Region and City that for this study it will be assumed that the roadway will be widened from two to four lanes, a roundabout will be provided at Keats Way and the intersection at Columbia Street West will remain signalized. It should be noted that based on the Region's TMP, the Erbsville Road widening from Columbia Street West to Erb Street is recommended within the 2031 to 2041 horizon years, which could postpone the planned improvement.
- Improvements to Columbia Street West. These improvements will be completed by 2018. The design from the EA study has been completed and will include widening Columbia Street West to four lanes with segregated bike lanes on both sides of the roadways, a multi-use trail in the south boulevard and sidewalk on the north boulevard, turning lanes added to Erbsville Road and a roundabout at Bennington Gate / Chancery Lane.
- Fischer-Hallman Road widening for transitway from Highway 7/8 to Columbia Street. Includes portions of City of Kitchener watermain replacement. These improvements are planned to be completed by 2022/2023. The EA will likely be initiated this year. The Region confirmed that the project is more likely to be a series of improvements at intersections (signal timing, queues jump lanes and transit priority), rather than a full 6-lane widening.
- Fischer-Hallman Road widening of existing two lanes to four lanes from Columbia Street West to Westmount Road and potential roundabout installation at Fischer-Hallman Road and Laurelwood Drive and at Bearinger Road and Westmount Road. Includes Region watermain installation. These improvements are planned to be completed by 2020. The Region confirmed that this study should assume roundabouts for Fischer-Hallman Road and Laurelwood Drive and at Bearinger Road and Westmount Road.

Stantec Consulting prepared a Transportation Overview Study, dated November 2015, for Beaver Creek Road and Conservation Drive Upgrades and Extension Municipal Class EA. The following additional improvements were identified in the Transportation Overview Study and will be assumed as improvements for future conditions analysis in this study:

- Beaver Creek Road at Conservation Drive constructed as a roundabout. This improvement is based on the Beaver Creek Meadows District Plan by 2021. The roundabout at Beaver Creek Road and Conservation Drive is recommended to include an additional through lane (2 in total) in the westbound direction by 2035 and property should be protected for a full 2-lane roundabout.
- The two-way stop controlled intersection of Erbsville Road and Conservation Drive is recommended to be upgraded to an all-way stop control with an auxiliary westbound left turn lane by 2035.
- The intersection of Westmount Road and Conservation Drive is expected to experience significant delays and is likely to require higher order control and potentially widening by 2035. The report recommended the City is to monitor traffic volumes and initiate a study to determine higher order control type. For this study we will assume that the intersection will remain under stop control.
- Traffic calming measures along Beaver Creek Road and Conservation Drive.

Traffic data collection and monitoring is regularly carried out by the Region (and by the City for City intersections); the timing of specific projects in this list may vary based on the residual capacity in the road network or intersections at the time of the data collection. The actual year of construction will be identified in the approved Capital Budget. These improvements are shown in Figure 3-1.



Note:

- Based on the Region of Waterloo's Transportation Master Plan, the Erbsville Road widening from Columbia Street West to Erb Street is recommended within the 2031 to 2041 horizon years, which could postpone the planned improvements.
- Traffic data collection and monitoring is regularly carried out by the Region (and by the City for City intersections); the timing of specific projects in this figure may vary based on the residual capacity in the road network or intersections at the time of the data collection. The actual year of construction will be identified in the approved Capital Budget.

LEGEND

- STOP SIGN
- TRAFFIC SIGNAL
- ROUNDABOUT

Figure 3-1
Planned Roadway Improvements
Waterloo West Side Integrated Multi-Modal Transportation Study

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3.2 2031 TOTAL TRAFFIC VOLUMES FORECAST

3.2.1 *VISUM MODEL*

Due to the size of the study area it was important to use a macro model to capture the potential changes in the travel patterns within said area. For the purposes of this study an updated VISUM model was used. The update to the model was completed by WSP in 2017 for the LRT ION Stage 2 study. The update involved redesigning the mode choice model in order to implement best practices in transit modelling, and in order to include the LRT as a separate transit mode. The mode choice model was calibrated at the daily level using the 2011 TTS and expansion rates that were used for the development of the GGHMv4 model. The daily trips were then split into various time periods using time-of-day factors. The 2011 and 2031 VISUM networks were obtained from the Region and used in this study.

POPULATION AND EMPLOYMENT

The 2011 and 2031 models provided the population and employment for their respective years. Using these numbers, and as instructed by the City, the 2017 population and employment was interpolated. The 2031 Proposed (With Additional Employment) employment was obtained by adding 8,000 employees (split 25% office and 75% industrial) to Zone 141. The assumed population and employment for 2017, 2031 Base Case (Without Additional Employment) and 2031 Proposed (With Additional Employment) totals are shown Table 3-1. Appendix E shows the population and employment by zones within the study area. It should be noted that the 8,000 employees addition was not rebalanced (i.e. the 8,000 employees addition was not subtracted from other zones) resulting in conservative estimates of traffic.

Table 3-1 Region of Waterloo Population and Employment Growth

Year	Population	Total Employment	Industrial	Warehouse	Retail	Office	Education	Service
2011	457,172	226,791	59,003	19,052	28,619	51,161	21,235	47,721
2017	499,731	244,516	67,099	21,043	31,308	52,961	22,129	49,976
2031 Base Case	599,003	285,568	85,907	25,669	37,518	57,170	24,201	55,103
2031 Proposed	599,003	293,568	91,907	25,669	37,518	59,170	24,201	55,103

Note: The population and employment values listed within this table only include individuals of age 10 and older.

As shown in Table 3-1, based on Region's VISUM model, between 2017 and 2031 population (age 10 and over) in the Region is estimated to grow by approximately 100,000 (20%) and employment by approximately 41,000 (17%). With the additional 8,000 employees modeled in Zone 141, the employment growth is approximately 50,000 (20%).

The population and employment growth in Study Area A and B is shown in Table 3-2.

Table 3-2 Study Area A and B Population and Employment Growth

	Population (Age >10)			Employment			
	2011	2017	2031	2011	2017	2031 Base Case	2031 With Development
Study Area A	7,565	9,204	13,029	1,539	1,639	1,871	9,871
Study Area B	19,806	20,902	23,460	1,431	1,650	2,154	2,154
Combined	27,371	30,106	36,489	2,970	3,289	4,025	12,025

Note: The population and employment values listed within this table only include individuals of age 10 and older.

As shown in Table 3-2, based on Region's VISUM model, between 2017 and 2031 population (age 10 and over) in the Study Area A and B is estimated to grow by approximately 6,400 (21%) and employment by approximately 736 (22%). With the additional 8,000 employees modeled in Zone 141, the employment growth is approximately 8,700 (365%).

3.2.2 2017 MODEL

The Region did not have a 2017 network available, therefore for the purposes of this study the 2011 network was modified to represent 2017. These updates are described below.

NETWORK UPDATES

LINKS AND NODES

The network updates were done at two levels. The first level consisted of a general review of major arterial and highway links in the Region. This consisted of identifying new roadways or links where the number of lanes have changed since 2011. The 2017 network was updated accordingly.

The second level update consisted of a detailed review of the links and nodes within the study area. At this level, the review examined:

- Missing minor streets/links
- Number of lanes
- Link speed
- Link capacities
- Intersection types
- Centroid connectors

The identified changes were coded into the 2017 network. The resulting 2017 network (including the number of lanes, capacities, centroid connectors and intersection types) within the study area is shown in Appendix E.

TRANSIT ROUTES

The transit routes and schedules were updated to reflect the 2017 Grand River Transit network. The individual routes and schedules were obtained from the Grand River Transit website and coded into VISUM.

MODEL RESULTS

Once the network updates were implemented, the 2017 VISUM model was run. The study area network results (auto volumes) are shown in Appendix E.

3.2.3 2031 MODEL

The Region's 2031 network was used as a base.

NETWORK UPDATES

LINKS AND NODES

The 2031 network within the study area was updated to better reflect the proposed changes. These changes consisted of:

- Adding missing minor streets/links
- Updating the number of lanes
- Updating link speed
- Updating the capacity of link
- Updating the intersection types
- Updating centroid connectors

The identified changes were coded into the 2031 network. The resulting 2031 network (including the number of lanes, capacities, centroid connectors and intersection types) within the study area is shown in Appendix E.

TRANSIT ROUTES

The 2031 transit routes were maintained from the original model, as was programmed by the Region.

MODEL RESULTS

2031 BASE CASE

Once the network updates were implemented the 2031 VISUM model was run. The study area network results (auto volumes) are shown in Appendix E.

2031 WITH ADDITIONAL EMPLOMENT

To run the model with the proposed development, the employment number for zone 141 were updated (as shown in Appendix E). The 2031 VISUM model with the update employment was run. The study area network results (auto volumes) are shown in Appendix E.

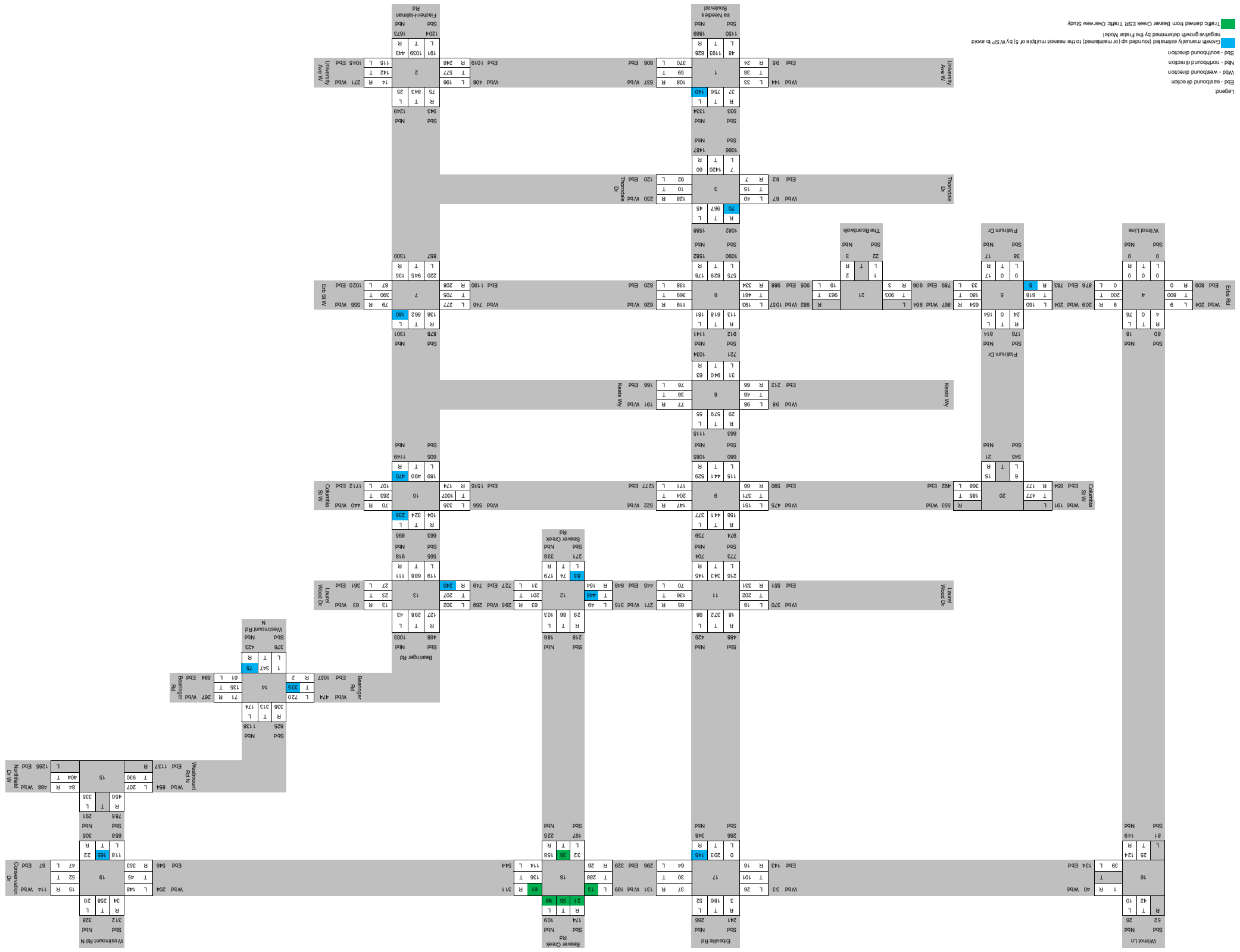
3.2.4 2031 TOTAL TRAFFIC VOLUMES

Based on the directions from the City, the 2031 traffic volumes for this study were estimated for the scenario with 8,000 additional employees in Zone 141 (the Region's model included 11 employees in this zone). Since the 2017 VISUM model was not calibrated to existing traffic counts, WSP did not use the projections from VISIM as the forecasted 2031 link volumes. WSP used the link growth between 2017 and 2031 from the VISUM model and applied this growth to existing traffic to estimate the directional link volumes for 2031 in the study area. The estimated 2031 directional link volumes for the AM and PM peak hour are provided in Appendix F.

To estimate 2031 turning movement counts WSP used the NCHRP 255 Report Iterative Method, which employs the traditional Fratar method, which has been widely used in practice to balance trip tables. The iterative method is based on an incremental procedure of applying implied growth between the base year and the future year to actual traffic counts. The peak hour turning movement forecast calculations from the NCHRP 255 Iterative Method is provided in Appendix G.

The resulting 2031 link volumes from the estimated turning movement counts typically match the estimated link volumes within 5 percent. The traffic forecast along Ira Needles Boulevard are higher in the WSP forecast relative to the VISUM forecast as the growth from VISUM was applied to existing counts. The resulting AM and PM peak hour turning movement counts are shown schematically in Figure 3-2 (AM peak hour) and Figure 3-3 (PM peak hour).

Figure 3-2
Forecasted Total 2031 Traffic Volumes, Weekday AM Peak Hour (Turning Movements Derived from Fratar Model)
Waterloo West Side Integrated Multi-Modal Transportation Study



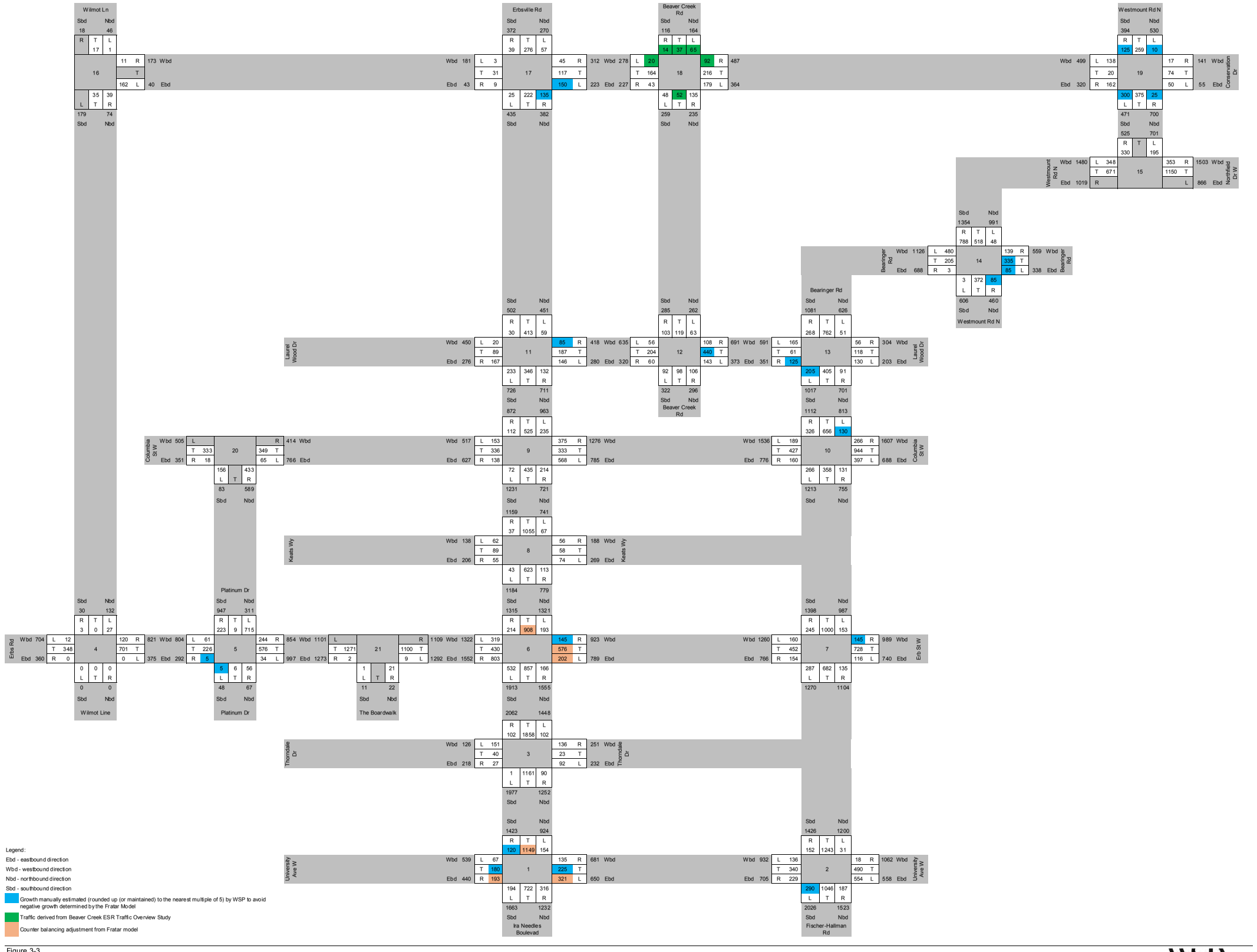


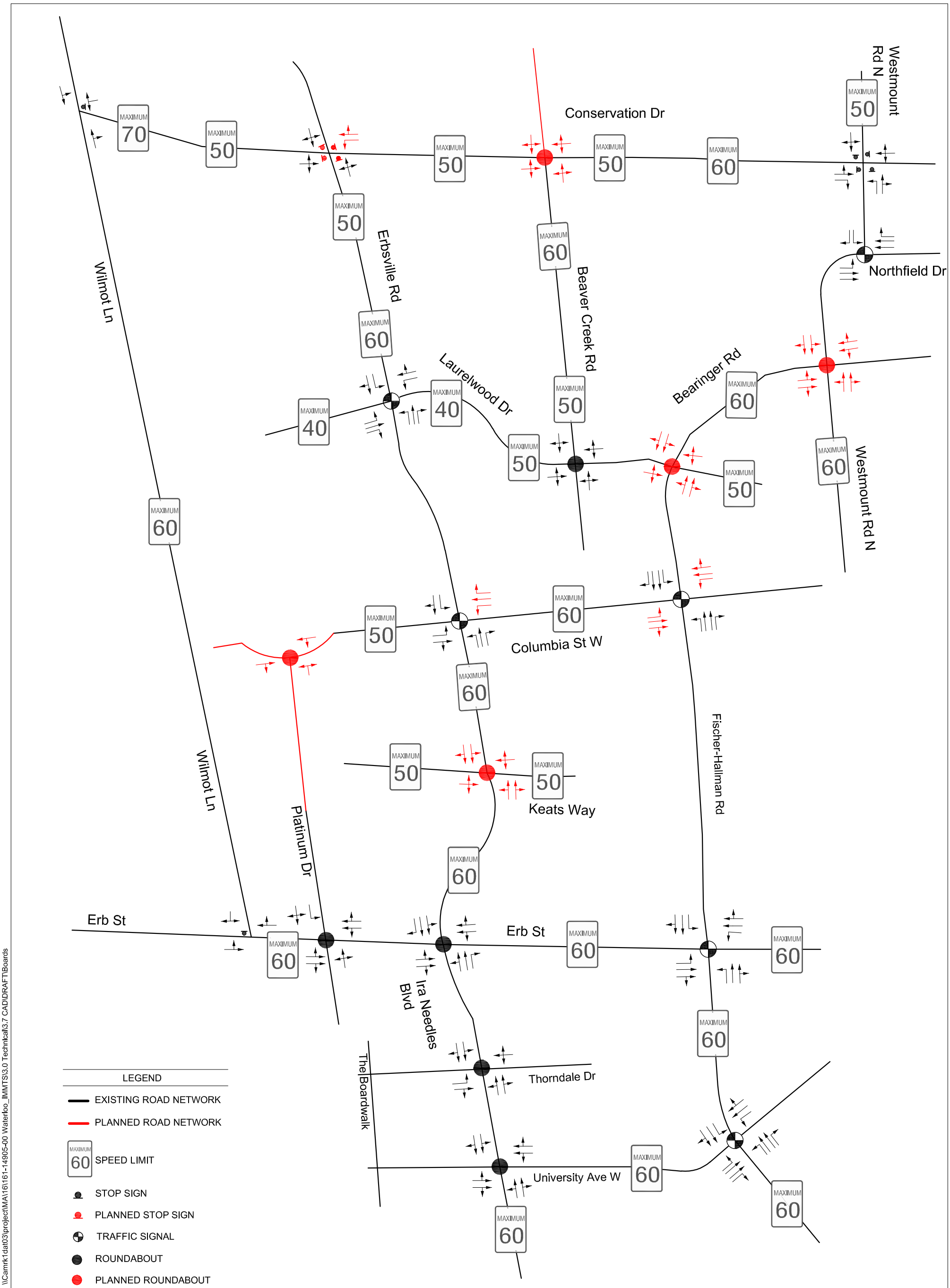
Figure 3-3
Forecasted Total 2031 Traffic Volumes, Weekday PM Peak Hour (Turning Movements Derived from Fratar Model)
Waterloo West Side Integrated Multi-Modal Transportation Study

3.3 2031 TRAFFIC CONDITIONS

3.3.1 *TRAFFIC CONDITIONS WITH PLANNED ROADWAY IMPROVEMENTS*

Intersection capacity analyses for the study intersections for 2031 traffic conditions for the AM and PM peak hours was analyzed using Lanes, Volumes Timings and Highway Capacity Manual (HCM) methodologies and Synchro 9 software. The analysis of roundabouts was completed using ARCADY 7. For the analysis WSP referenced the Region of Waterloo TIS Requirements for Capacity Analysis, Roundabouts & Signal Warrants.

The assumed intersection configurations were based on the City of Waterloo Transportation Capital Base and System Expansion Programs, the City of Waterloo Transportation Master Plan, Region of Waterloo Transportation Master Plan, completed and ongoing EA's, Stantec Consulting Transportation Overview Study, dated November 2015 for Beaver Creek Road and Conservation Drive Upgrades and Extension Municipal Class EA, and consultation with both the Region and City. The roadway improvements are provided in detail in Section 3-1. The 2031 planned study intersection configurations are shown in Figure 3-4.



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Figure 3-4
Planned 2031 Study Intersection Lane Configuration
Waterloo West Side Integrated Multi-Modal Transportation Study

A summary of the intersection capacity analysis results for signalized intersections is provided in Table 3-3. A summary of the intersection capacity analysis results for unsignalized intersections is provided in Table 3-4. A summary of the roundabout analysis results is provided in Table 3-5.

For the signalized intersections, only the critical movements were showed within the tables. Critical movements were defined as movements operating under Level of Service E or F, as per the Region of Waterloo Transportation Study Guidelines Section 7. For the unsignalized intersections, only movements operating under stop-control were showed within the tables. Additionally, as per the Region of Waterloo TIS Requirements, summary of analysis for signalized study intersections was derived using the "Lanes, Volumes, Timings" report in Synchro, while summary of analysis for unsignalized study intersections was derived using the "HCM" report. Appendix B contains both the "Lanes, Volumes, Timings" and "HCM" reports for each intersection. The Region of Waterloo Roundabout Traffic Flow Sheets are provided in Appendix C. The ARCADY generated roundabout analysis reports are provided in Appendix D.

Table 3-3 Intersection Capacity Analysis Results, Signalized Intersections - 2031 Traffic Volumes

Intersection		AM Peak Hour			PM Peak Hour		
Movement		V/C	Delay (sec.)	LOS	V/C	Delay (sec.)	LOS
Fischer-Hallman Rd at University Dr W		**0.88 (max)**	**36**	**D**	**1.42 (max)**	**101**	**F**
Westbound Left	WBL	0.42	27	C	1.14	115	F
Northbound Left	NBL	0.67	34	C	0.99	80	E
Southbound Through+Right	SBTR	0.88	57	E	1.42	228	F
Fischer-Hallman Rd at Erb St		**1.03 (max)**	**44**	**D**	**1.43 (max)**	**78**	**E**
Northbound Left	NBL	0.83	37	D	1.43	243	F
Northbound Through+Right	NBTR	1.03	62	E	0.72	50	D
Southbound Through+Right	SBTR	0.59	31	C	1.18	122	F
Erbsville Rd at Columbia St W		**1.12 (max)**	**47**	**D**	**1.98 (max)**	**114**	**F**
Eastbound Through+Right	EBTR	0.97	68	E	1.04	85	F
Westbound Left	WBL	0.79	46	D	1.98	473	F
Southbound Left	SBL	1.12	108	F	0.94	66	E
Southbound Through+Right	SBTR	0.87	40	D	0.98	58	E
Fischer-Hallman Rd at Columbia St W		**1.13 (max)**	**56**	**E**	**1.02 (max)**	**52**	**D**
Eastbound Left	EBL	0.87	53	D	0.95	84	F
Eastbound Through+Right	EBTR	1.13	108	F	0.57	35	D
Westbound Left	WBL	0.64	40	D	1.02	75	E
Westbound Through+Right	WBTR	0.35	31	C	1.00	63	E
Northbound Left	NBL	0.39	25	C	0.93	79	E
Northbound Through	NBT	0.42	39	D	0.33	56	E
Erbsville Rd at Laurelwood Dr		**0.71 (max)**	**22**	**C**	**0.76 (max)**	**22**	**C**
Westmount Rd N at Northfield Dr		**0.56 (max)**	**18**	**B**	**1.02 (max)**	**28**	**C**
Eastbound Left	EBL	0.47	18	B	1.02	79	E

Under the projected 2031 traffic volumes, operations at LOS F or better are projected for the signalized intersection turning movements. Most intersections are projected to operate over capacity, with high delays during the PM Peak Hour for the intersections of Fischer-Hallman Road at University Drive West and Erbsville Road at Columbia Street West. These capacity deficiencies are mainly caused by the projected high volume of vehicles moving through the intersections, which results in long delays. WSP has provided signal timing and geometrical recommendations to improve these operations and allow intersections to operate within capacity, as detailed in the following sections of this report.

Table 3-4 Intersection Capacity Analysis Results, Unsignalized Intersections - 2031 Traffic Volumes

Intersection		AM Peak Hour		PM Peak Hour	
Movement		Delay (sec.)	LOS	Delay (sec.)	LOS
Wilmot Ln at Erb St					
Southbound Left+Right	SBLR	24	C	23	C
Wilmot Ln at Conservation Dr					
Westbound Left+Right	WBLR	10	A	10	A
Erbsville Rd at Conservation Dr		**12**	**B**	**15**	**B**
Eastbound Through+Left+Right	EBTLR	11	B	10	B
Westbound Left	WBL	10	A	12	B
Westbound Through+Right	WBTLR	9	A	11	B
Northbound Through+Left+Right	NBTLR	13	B	16	C
Southbound Through+Left+Right	SBTLR	12	B	16	C
Westmount Rd N at Conservation Dr		**16**	**C**	**25**	**C**
Eastbound Through+Left	EBTL	14	B	15	C
Eastbound Right	EBR	17	C	13	B
Westbound Through+Left+Right	WBTLR	13	B	16	C
Northbound Left	NBL	13	B	22	C
Northbound Through+Right	NBTR	13	B	30	D
Southbound Through+Left+Right	SBTLR	21	C	32	D

As per the table above, all movements within the unsignalized study intersections are projected to operate with LOS C or better during the AM and PM peak hours, with the exception of the northbound shared through and right-turn movement and southbound movement of the Westmount Road North at Conservation Drive intersection operating at LOS D during the PM peak hour.

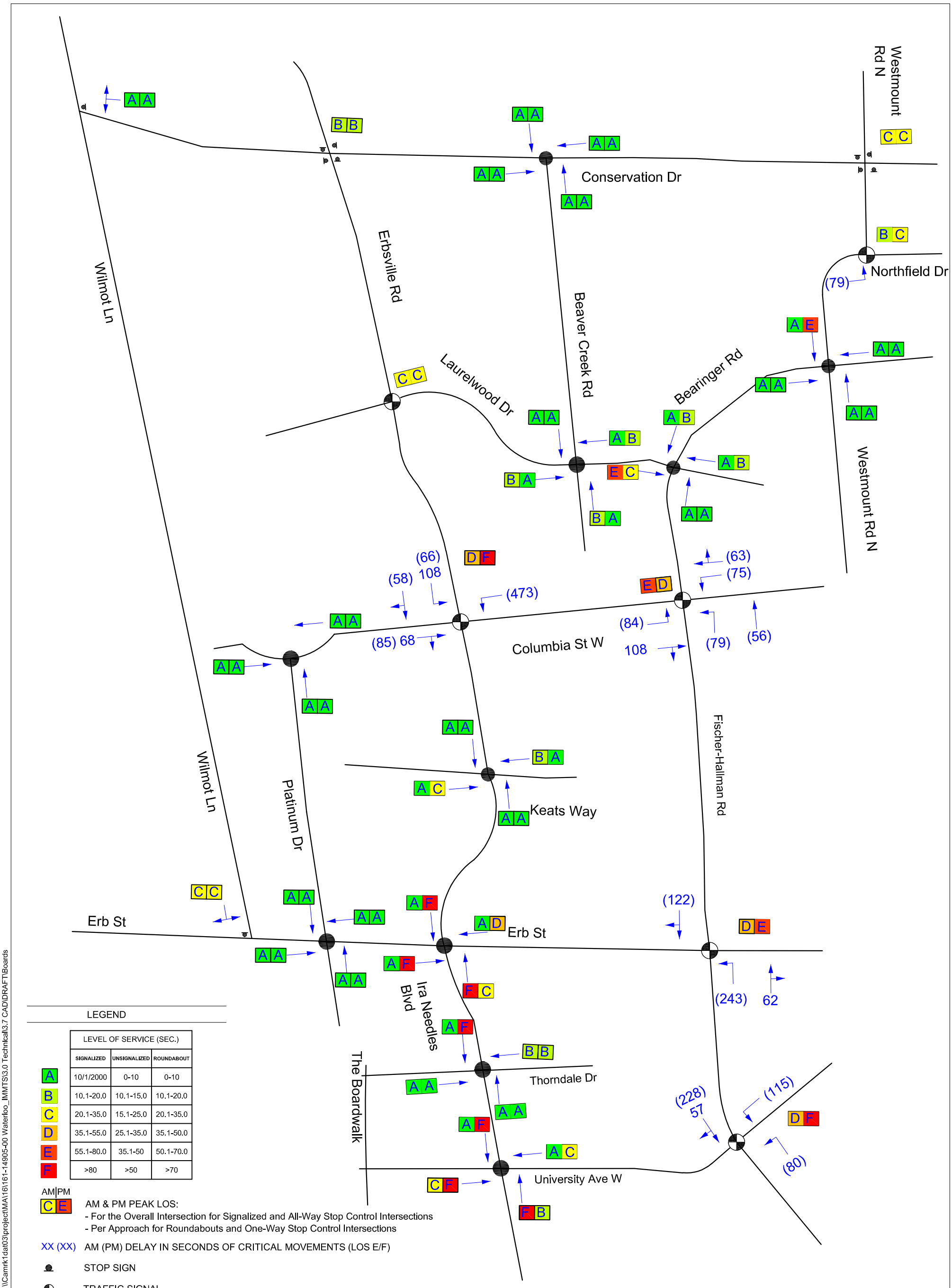
Table 3-5 Roundabout Analysis Results - 2031 Traffic Volumes

Intersection	AM Peak Hour			PM Peak Hour		
Approach	RFC	Delay (sec.)	LOS	RFC	Delay (sec.)	LOS
Ira Needles Blvd at University Avenue						
East - University Ave	0.44	4.75	A	0.80	17.87	C
North - Ira Needles Blvd	0.66	6.82	A	1.34	585.40	F
West - Private Access	0.32	16.25	C	2.40	5560.33	F
South - Ira Needles Blvd	1.25	514.63	F	0.83	12.74	B
Ira Needles Blvd at Thorndale Dr						
East - Thorndale Dr	0.49	13.54	B	0.45	10.59	B
North - Ira Needles Blvd	0.60	4.56	A	1.14	234.12	F
West - Boardwalk Access	0.06	3.20	A	0.30	6.38	A
South - Ira Needles Blvd	0.80	8.80	A	0.71	6.36	A
Erb St at Platinum Dr						
East - Erb St	0.53	4.27	A	0.45	3.09	A
North - Platinum Dr	0.15	3.20	A	0.61	5.34	A
West - Erb St	0.45	3.46	A	0.20	2.83	A
South - Landfill Gate 2	0.04	7.29	A	0.12	6.91	A
Ira Needles Blvd at Erb St						
East - Erb St	0.59	7.63	A	0.89	26.31	D
North - Erbsville Rd	0.66	6.81	A	1.16	226.79	F
West - Erb St	0.73	9.10	A	1.75	2061.31	F
South - Ira Needles Blvd	1.05	104.38	F	0.91	20.50	C
Erbsville Rd at Keats Way						
East - Keats Way	0.38	10.53	B	0.29	7.21	A
North - Erbsville Rd	0.38	2.99	A	0.67	5.72	A
West - Keats Way	0.32	7.39	A	0.54	18.26	C
South - Erbsville Rd	0.60	4.78	A	0.46	3.62	A
Beaver Creek Rd at Laurelwood Dr						
East - Laurelwood Dr	0.32	5.12	A	0.72	12.13	B
North - Beaver Creek Rd	0.23	4.60	A	0.38	7.04	A
West - Laurelwood Dr	0.68	10.82	B	0.35	5.57	A
South - Beaver Creek Rd	0.53	11.08	B	0.32	5.10	A
Fischer Hallman Rd at Laurelwood Dr						
East - Laurelwood Dr	0.13	7.79	A	0.48	10.08	B
North - Bearinger Rd	0.27	2.57	A	0.78	10.71	B
West - Laurelwood Dr	0.90	36.00	E	0.68	19.76	C
South - Bearinger Rd	0.61	5.57	A	0.42	3.41	A

Intersection	AM Peak Hour			PM Peak Hour		
Approach	RFC	Delay (sec.)	LOS	RFC	Delay (sec.)	LOS
Bearinger Rd at Westmount Rd						
East - Bearinger Rd	0.22	3.55	A	0.46	4.96	A
North - Westmount Rd	0.48	3.64	A	0.95	36.92	E
West - Bearinger Rd	0.70	7.35	A	0.49	4.51	A
South - Westmount Rd	0.39	4.90	A	0.32	3.46	A
Conservation Dr at Beaver Creek Rd						
East - Conservation Dr	0.31	4.80	A	0.51	6.86	A
North - Beaver Creek Rd	0.20	4.57	A	0.15	4.83	A
West - Conservation Dr	0.37	5.82	A	0.26	5.04	A
South - Beaver Creek Rd	0.27	5.39	A	0.27	5.10	A
Columbia St W at Platinum Dr						
East - Columbia St	0.53	6.64	A	0.43	5.87	A
West - Columbia St	0.64	8.93	A	0.29	3.87	A
South - Platinum Drive	0.02	3.49	A	0.57	7.25	A

Under the projected 2031 traffic volumes, capacity constraints are projected at the approaches of multiple roundabouts. These are mainly caused by the large volume of vehicles moving through intersections causing conflicting movements to yield, which results in long delays and significant queuing. WSP has provided geometrical recommendations to improve these operations, as detailed in the sections below.

A summary of the 2031 intersection operations with planned roadway improvements for the study area is illustrated in Figure 3-5.



LEGEND

LEVEL OF SERVICE (SEC.)			
	SIGNALIZED	UNSIGNALIZED	ROUNDABOUT
A	10/1/2000	0-10	0-10
B	10.1-20.0	10.1-15.0	10.1-20.0
C	20.1-35.0	15.1-25.0	20.1-35.0
D	35.1-55.0	25.1-35.0	35.1-50.0
E	55.1-80.0	35.1-50	50.1-70.0
F	>80	>50	>70

AM|PM

AM & PM PEAK LOS:
- For the Overall Intersection for Signalized and All-Way Stop Control Intersections
- Per Approach for Roundabouts and One-Way Stop Control Intersections

XX (XX) AM (PM) DELAY IN SECONDS OF CRITICAL MOVEMENTS (LOS E/F)

STOP SIGN

TRAFFIC SIGNAL

ROUNDABOUT

\\Camrk1dat03\project\MA\16\161-14905-00 Waterloo_IMMTS\3.0 Technical\3.7 CAD\DRAFT\Boards

Figure 3-5
2031 Study Intersection Operations (With Planned Roadway Improvements)
Waterloo West Side Integrated Multi-Modal Transportation Study

3.3.2 *ADDITIONAL ROADWAY IMPROVEMENTS*

As noted is Section 3.5.1 with the planned roadway improvements some intersections will operate with longer delays. The following additional improvements not identified in the City / Region capital programmes would result in improving delays at the study intersections:

- For the signalized intersection of Fischer-Hallman Road at University Avenue:
  - Introduce a second Westbound Left-turn Lane
  - Improve Signal Timing Plan

- For the signalized intersection of Fischer-Hallman Road at Erb Street:
  - Introduce a Southbound Right-turn Lane
  - Improve Signal Timing Plan

- For the signalized intersection of Erbsville Road at Columbia Street West:
  - Introduce an Eastbound Right-turn Lane
  - Introduce a Second Eastbound Through Lane
  - Introduce a Second Westbound Through Lane
  - Introduce a Second Northbound Through Lane
  - Introduce a Southbound Right-turn Lane
  - Improve Signal Timing Plan

- For the signalized intersection of Fischer-Hallman Road at Columbia Street West:
  - Introduce a Westbound Right-turn Lane
  - Improve Signal Timing Plan

- For the signalized intersection of Northfield Drive at Westmount Road:
  - Improve Signal Timing Plan

- For the roundabout intersection of University Avenue West at Ira Needles Boulevard:
  - Introduce an Eastbound Right-turn Lane
  - Introduce a Southbound Bypass Lane
  - Introduce a Northbound Bypass Lane
  - Right Turn bypasses were added to the north and south approaches of the roundabout to accommodate the large volumes of right turning traffic at these approaches

- WSP recommends extending The Boardwalk north to intersect with Erb Street, and recommends that the intersection be controlled by a Roundabout. The intersection is recommended to have the following lane configuration:
  - Eastbound Approach: One Shared Through and Left-turn Lane and One Shared Through and Right-turn Lane
  - Westbound Approach: One Shared Through and Left-turn Lane and One Shared Through and Right-turn Lane
  - Northbound Approach: One Shared Left, Through, and Right-turn Lane
  - Southbound Approach: One Shared Left, Through, and Right-turn Lane
  - It should be noted that the north leg of the roundabout will be approximately at the driveway location between BMO and Shoppers Drug Mart

The intersection lane configuration for the additional roadway improvements are shown Figure 3-6.

Conservation Dr
Westmount Rd N
Northfield Dr
Erbsville Rd
Beaver Creek Rd
Laurelwood Dr
Bearinger Rd
Wilmot Ln
Columbia St W
Fischer-Hallman Rd
Platinum Dr
Keats Way
Erb St
Erb St
Ira Needles Blvd
The Boardwalk
Thorndale Dr
University Ave W
Westmount Rd N

MAXIMUM 70
MAXIMUM 50
MAXIMUM 50
MAXIMUM 50
MAXIMUM 50
MAXIMUM 60
MAXIMUM 50
MAXIMUM 60
MAXIMUM 60
MAXIMUM 40
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LEGEND

- EXISTING ROAD NETWORK
- PLANNED ROAD NETWORK
- RECOMMENDED ROAD NETWORK
- MAXIMUM 60 SPEED LIMIT
- STOP SIGN
- PLANNED STOP SIGN
- TRAFFIC SIGNAL
- ROUNDABOUT
- PLANNED ROUNDABOUT
- RECOMMENDED ROUNDABOUT
- PLANNED LANE CONFIGURATION
- RECOMMENDED LANE CONFIGURATION

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Figure 3-6
Planned 2031 Study Intersection Lane Configuration with Recommendations
Waterloo West Side Integrated Multi-Modal Transportation Study

161-0537.00-Existing-planned-recom Configuration_v0-1_20180321.dwg_Planned 2031 Lane Configuration w Recommendations

Modified: 5/28/2018 3:28 PM By: nawfal.kammah Plot Date: 2018/06/07

3.3.3 TRAFFIC CONDITIONS WITH RECOMMENDED ADDITIONAL IMPROVEMENTS

Based on the traffic forecast associated with the planned roadway improvements, it is predicted that the roundabouts along Ira Needles Boulevard from Erb Street to University Drive would be operating over capacity. The model estimated that less than 50 vehicles per hour would be traveling along the Boardwalk during the AM and PM peak hours indicating that there would be significant reserve capacity along this roadway. In reality drivers would avoid using the congested Ira Needles Boulevard and divert to the Boardwalk. WSP estimated that the following amount of trips would be diverted from the Ira Needles Boulevard at Erb Street roundabout:

- 150 eastbound right turns and 300 northbound left turns in the AM peak hour
- 650 eastbound right turns and 300 northbound left turns in the PM peak hour

This is the amount of traffic that would need to be diverted so that the ratio of flow to capacity (RFC) for roundabouts along Ira Needles Boulevard is less than 1.0.

The resulting AM and PM peak hour turning movement, with reassignment, are shown schematically in Figure 3-7 (AM peak hour) and Figure 3-8 (PM peak hour).

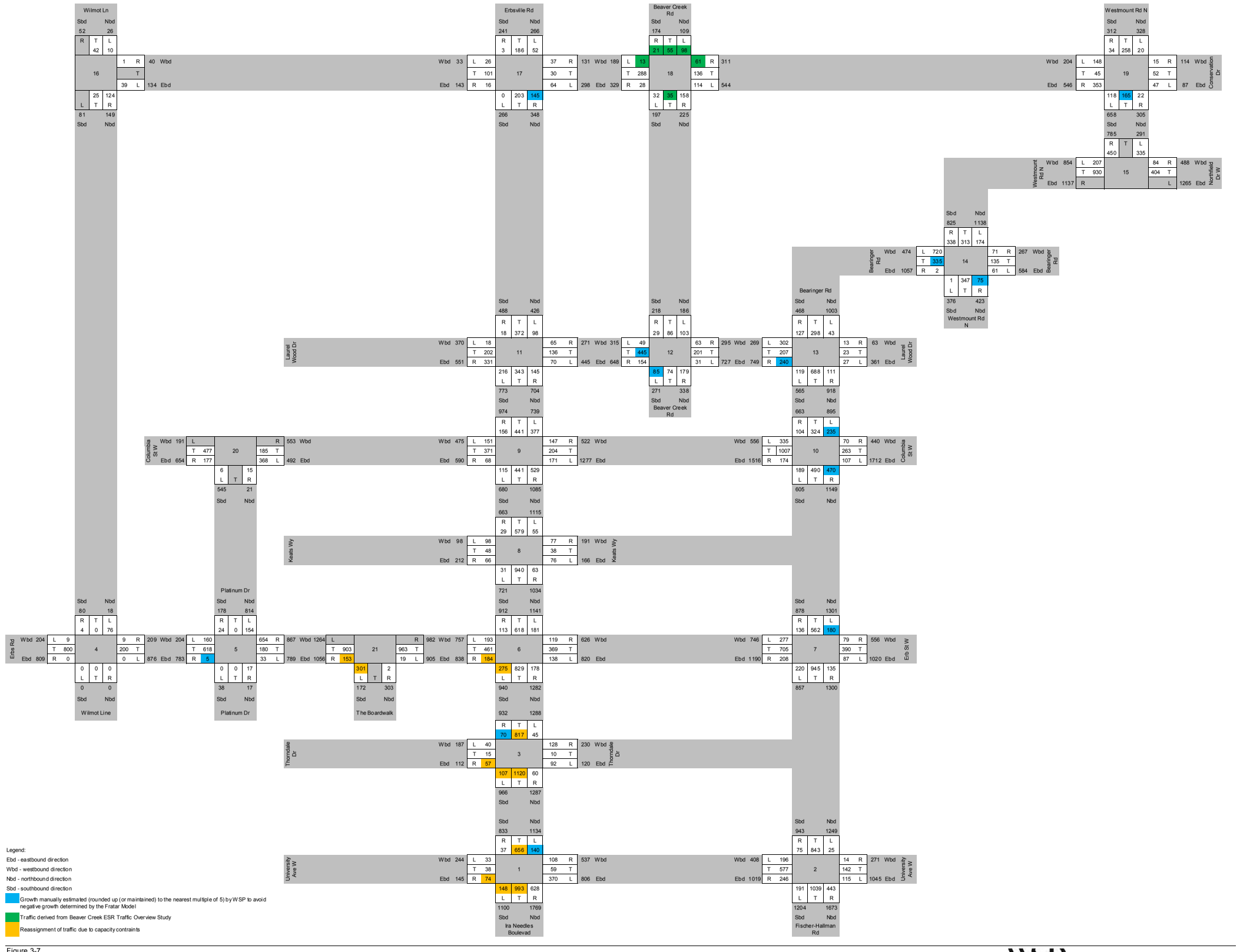


Figure 3-7
Forecasted 2031 Weekday AM Peak Hour (Turning Movements Derivd based on Fratar Model) with Reassignment
Waterloo West Side Integrated Multi-Modal Transportation Study

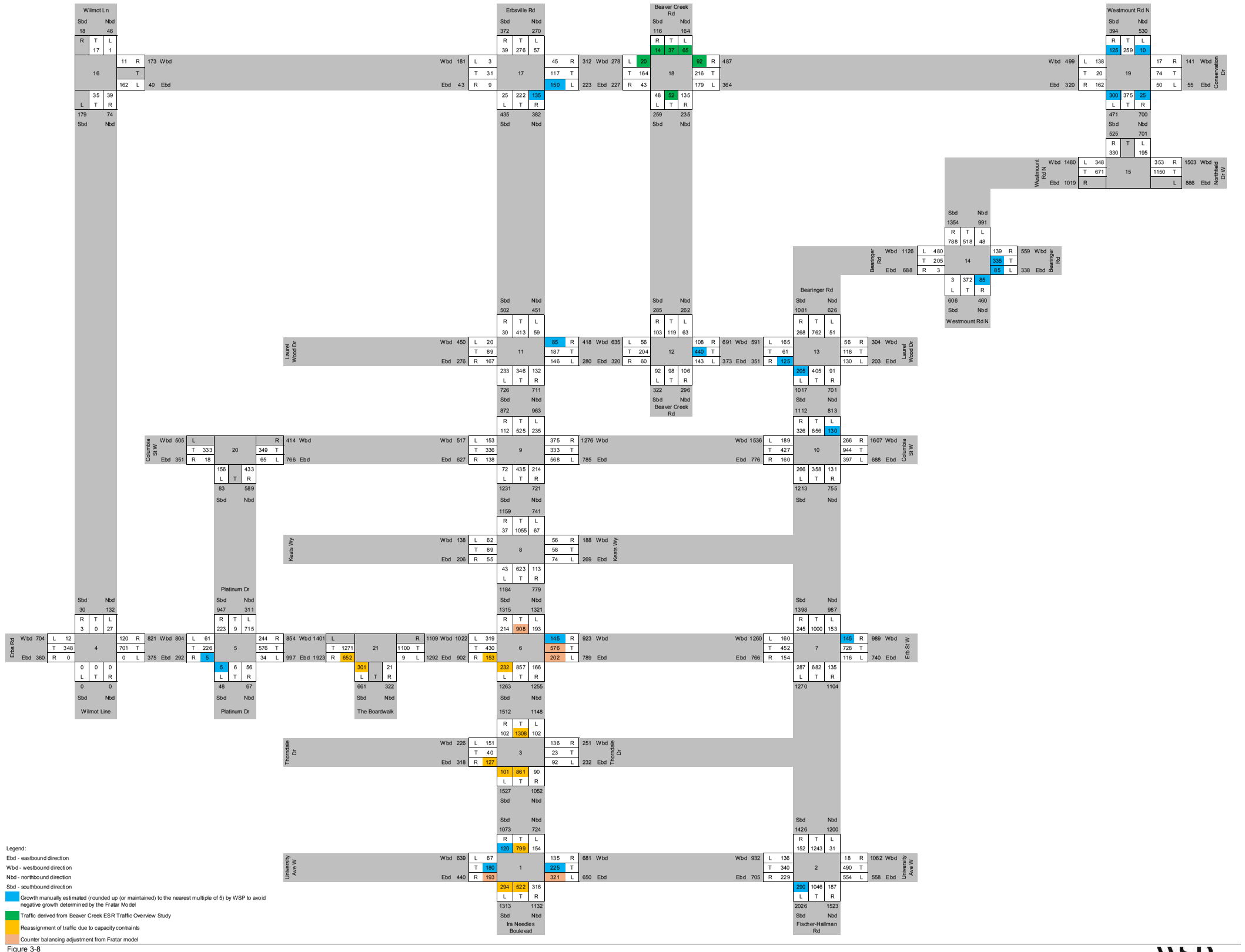


Figure 3-8
Forecasted 2031 Weekday PM Peak Hour (Turning Movements Derivd based on Fratar Model) with Reassignment
Waterloo West Side Integrated Multi-Modal Transportation Study

A summary of the intersection capacity analysis results for signalized intersections with recommended additional roadway improvements is provided in Table 3-6. No recommendations were made to the unsignalized study intersections; therefore operations do not differ from the scenario with planned roadway improvements. A summary of the roundabout analysis results with applied roadway improvements is provided in Table 3-7.

As previously stated, for the signalized intersections, only the critical movements were showed within the tables. Critical movements were defined as movements operating under Level of Service E or F, as per the Region of Waterloo Transportation Study Guidelines Section 7.

Appendix B contains both the "Lanes, Volumes, Timings" and "HCM" reports for each intersection. The Region of Waterloo Roundabout Traffic Flow Sheets are provided in Appendix C. The ARCADY generated roundabout analysis reports are provided in Appendix D.

Table 3-6 Intersection Capacity Analysis Results, Signalized Intersections - 2031 Traffic Volumes, With Roadway Improvements

Intersection		AM Peak Hour			PM Peak Hour		
Movement		V/C	Delay (sec.)	LOS	V/C	Delay (sec.)	LOS
Fischer-Hallman Rd at University Dr W		**0.85 (max)**	**36**	**D**	**1.38 (max)**	**93**	**F**
Westbound Left	WBL	0.33	54	D	0.92	77	E
Southbound Through+Right	SBTR	0.85	47	D	1.38	215	F
Fischer-Hallman Rd at Erb St		**0.91(max)**	**42**	**D**	**0.97 (max)**	**49**	**D**
Northbound Left	NBL	0.56	22	C	0.97	84	F
Southbound Through	SBT	0.50	32	C	0.97	68	E
Erbsville Rd at Columbia St W		**0.69 (max)**	**25**	**C**	**0.91 (max)**	**35**	**D**
Eastbound Through	EBT	0.51	39	D	0.59	57	E
Northbound Left	NBL	0.43	36	D	0.45	57	E
Fischer-Hallman Rd at Columbia St W		**0.92 (max)**	**35**	**D**	**0.92 (max)**	**41**	**D**
Erbsville Rd at Laurelwood Dr		**0.71 (max)**	**19**	**B**	**0.76 (max)**	**22**	**C**
Westmount Rd N at Northfield Dr		**0.56 (max)**	**18**	**B**	**0.90 (max)**	**26**	**C**

As per the above table, with the applied recommendations made by WSP, all signalized study intersections are projected to operate with overall LOS D or better, with turning movements operating under capacity and a maximum overall intersection delay of 49 seconds for the Fischer-Hallman Road at Erb Street intersection during the PM peak hour. The only exception is for the Fischer-Hallman Road at University Drive West intersection, projected to operate with overall LOS F during the PM peak hour and a delay of 93 seconds due to the southbound shared through and right-turn movement operating over capacity.

As per the above table, other select turning movements are projected to operate at LOS E and F during the PM peak hour, however they are projected to operate under capacity. These Levels of Service are due to the high forecasted volume of vehicles. Additionally, study intersections with turning movements at LOS F (Fischer-Hallman Road at University Drive West and Fischer-Hallman Road at Erb Street) are located within fully-developed areas, which limits the possibility of additional geometrical recommendations.

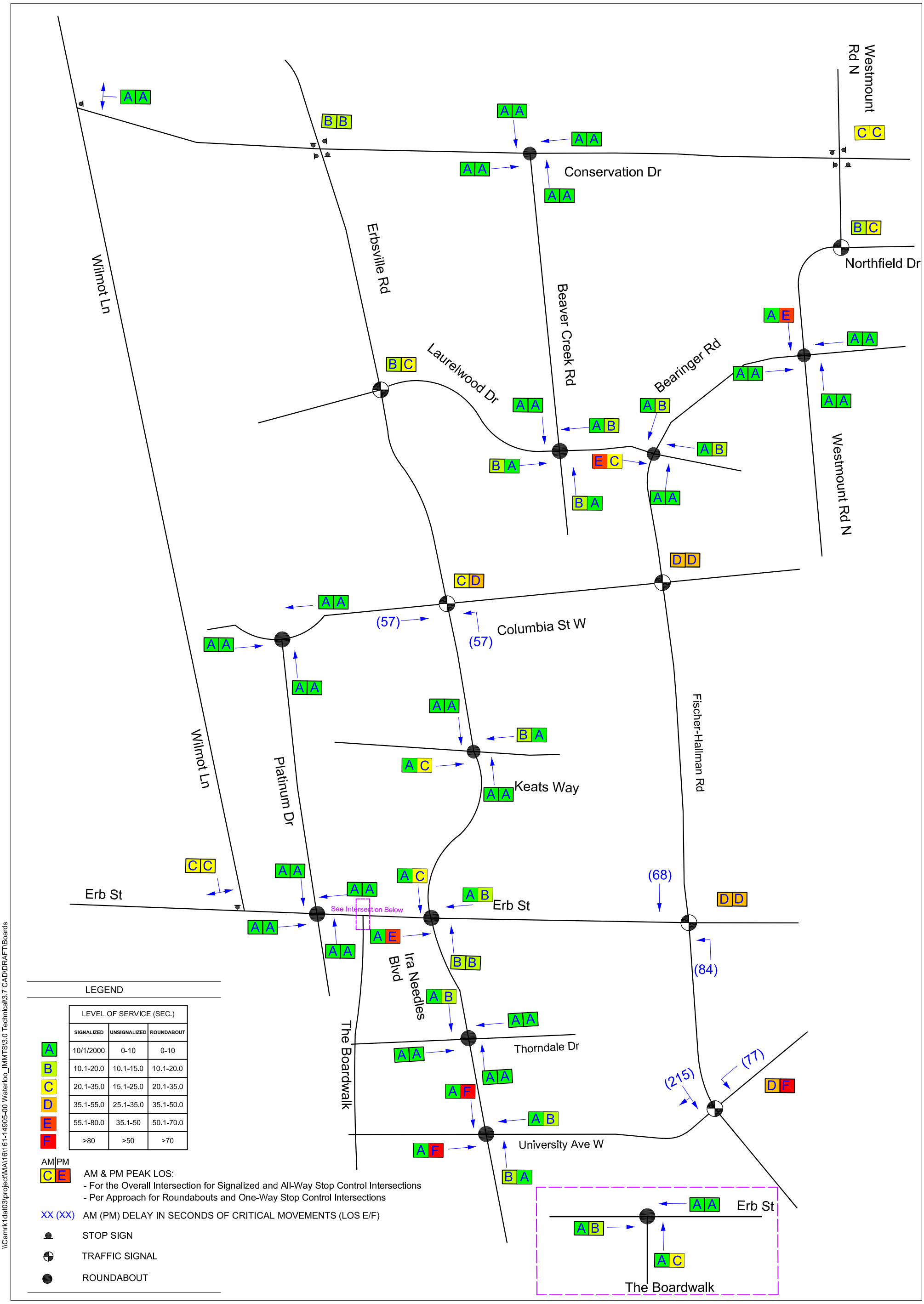
Table 3-7 Roundabout Analysis Results - 2031 Traffic Volumes, With Roadway Improvements

Intersection Approach	AM Peak Hour			PM Peak Hour		
	RFC	Delay (sec.)	LOS	RFC	Delay (sec.)	LOS
Ira Needles Blvd at University Avenue						
East - University Ave	0.51	6.33	A	0.69	10.54	B
North - Ira Needles Blvd	0.63	7.12	A	0.99	64.31	F
West - Private Access	0.20	5.68	A	0.91	58.50	F
South - Ira Needles Blvd	0.82	12.87	B	0.63	6.70	A
Ira Needles Blvd at Thorndale Dr						
East - Thorndale Dr	0.41	9.78	A	0.38	7.92	A
North - Ira Needles Blvd	0.54	4.16	A	0.84	11.26	B
West - Boardwalk Access	0.09	2.89	A	0.42	5.72	A
South - Ira Needles Blvd	0.70	6.06	A	0.60	4.61	A
Erb St at Platinum Dr						
East - Erb St	0.53	4.27	A	0.45	3.09	A
North - Platinum Dr	0.15	3.20	A	0.61	5.34	A
West - Erb St	0.45	3.46	A	0.20	2.83	A
South - Landfill Gate 2	0.04	7.29	A	0.12	6.91	A
Ira Needles Blvd at Erb St						
East - Erb St	0.52	5.57	A	0.77	12.05	B
North - Erbsville Rd	0.58	4.88	A	0.90	20.86	C
West - Erb St	0.62	6.43	A	0.94	42.17	E
South - Ira Needles Blvd	0.85	14.14	B	0.85	14.58	B
Erbsville Rd at Keats Way						
East - Keats Way	0.38	10.53	B	0.29	7.21	A
North - Erbsville Rd	0.38	2.99	A	0.67	5.72	A
West - Keats Way	0.32	7.39	A	0.54	18.26	C
South - Erbsville Rd	0.60	4.78	A	0.46	3.62	A
Beaver Creek Rd at Laurelwood Dr						
East - Laurelwood Dr	0.32	5.12	A	0.72	12.13	B
North - Beaver Creek Rd	0.23	4.60	A	0.38	7.04	A
West - Laurelwood Dr	0.68	10.82	B	0.35	5.57	A
South - Beaver Creek Rd	0.53	11.08	B	0.32	5.10	A
Fischer Hallman Rd at Laurelwood Dr						
East - Laurelwood Dr	0.13	7.79	A	0.48	10.08	B
North - Bearinger Rd	0.27	2.57	A	0.78	10.71	B
West - Laurelwood Dr	0.90	36.00	E	0.68	19.76	C
South - Bearinger Rd	0.61	5.57	A	0.42	3.41	A
Bearinger Rd at Westmount Rd						
East - Bearinger Rd	0.22	3.55	A	0.46	4.96	A
North - Westmount Rd	0.48	3.64	A	0.95	36.92	E
West - Bearinger Rd	0.70	7.35	A	0.49	4.51	A
South - Westmount Rd	0.39	4.90	A	0.32	3.46	A

Intersection Approach	AM Peak Hour			PM Peak Hour		
	RFC	Delay (sec.)	LOS	RFC	Delay (sec.)	LOS
Conservation Dr at Beaver Creek Rd						
East - Conservation Dr	0.31	4.80	A	0.51	6.86	A
North - Beaver Creek Rd	0.20	4.57	A	0.15	4.83	A
West - Conservation Dr	0.37	5.82	A	0.26	5.04	A
South - Beaver Creek Rd	0.27	5.39	A	0.27	5.10	A
Columbia St W at Platinum Dr						
East - Columbia St	0.53	6.64	A	0.43	5.87	A
West - Columbia St	0.64	8.93	A	0.29	3.87	A
South - Platinum Drive	0.02	3.49	A	0.57	7.25	A
Erb St at The Boardwalk						
East – Erb St	0.58	4.58	A	0.65	5.57	A
West – Erb St	0.48	2.86	A	0.87	11.40	B
South – The Boardwalk	0.43	8.03	A	0.65	18.52	C

The roundabout capacity analysis under the recommended improvements indicates that most approaches are projected to operate at LOS C or better with delays less than 40 seconds, with the exception of a select few approaches operating at LOS E and F due to the high forecasted volume of vehicles. However, all approaches are projected to operate within capacity, at an RFC of less than 1.00. The maximum delay is projected at the north approach of the Ira Needles Boulevard at University Avenue, projected at approximately 64 seconds during the PM peak hour.

A summary of the 2031 intersection operations for the study area, with applied recommended roadway improvements, is illustrated in Figure 3-9.



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Figure 3-9
2031 Intersection Operations with Planned Roadway Improvements Plus Additional Recommendations
Waterloo West Side Integrated Multi-Modal Transportation Study

3.3.4 *WILMOT LINE*

At the Council meeting on June 25, 2018, WSP presented an overview of the study process, analysis of the data and outline of the report. Council has asked that the report informs on the operations and traffic volumes on Wilmot Line.

A City of Waterloo Council resolution from 2004 stated that should traffic volumes on Wilmot Line exceed 1,000 vehicles per day, steps would be taken with the goal of reducing the traffic volumes to a maximum of 1,000 vehicles per day. Wilmot Line is a 2-lane minor collector road with a rural cross-section under the jurisdiction of the Wilmot Township, with a posted speed limit is 60 km/hr. No cycling facilities or sidewalks are provided along the roadway.

The existing two-way AM and PM peak hour traffic volumes on Wilmot Line, south of Conservation Drive, were 103 vehicles in the AM peak hour and 108 vehicles in the PM peak hour based on turning movement counts dated October 13, 2015. The daily traffic volume on this section of Wilmot Line in 2017 was 1,020 vehicles. As such, the AM and PM peak hour volumes represent approximately 20 percent of the daily volumes, and future daily traffic could be estimated using the formula (AM + PM) x 5.

In 2031 the projected two-way AM and PM peak hour traffic volumes on Wilmot Line, south of Conservation Drive, are 230 vehicles in the AM peak hour and 253 vehicles in the PM peak hour. Using the existing peak hour to daily traffic ratios and formula (AM + PM) x 5, the daily traffic volume on this section of Wilmot Line in 2031 is estimated to be approximately 2,400 vehicles.

As part of this report WSP assessed the existing and projected 2031 traffic operations during the AM and PM peak hours at the following intersections:

- Wilmot Line at Conservation Drive
- Wilmot Line at Erb Street

The operations of these intersections are provided in Section 2.5 (Existing Traffic Conditions) and Section 3.3.1 (2031 Traffic Conditions) and summarized in Table 3-8 below.

Table 3-8 Intersection Capacity Analysis Results, Wilmot line

Intersection Movement		AM Peak Hour Delay (sec.)	 LOS	PM Peak Hour Delay (sec.)	 LOS
Existing Conditions					
Wilmot Ln at Erb St					
Southbound Left+Right	SBLR	17	C	18	C
Wilmot Ln at Conservation Dr					
Westbound Left+Right	WBLR	9	A	9	A
2031 Conditions					
Wilmot Ln at Erb St					
Southbound Left+Right	SBLR	24	C	23	C
Wilmot Ln at Conservation Dr					
Westbound Left+Right	WBLR	10	A	10	A

The analysis shows that despite more than doubling the traffic volumes on Wilmot Line, the two study intersections would continue to operate at good levels of service with minor increases in delay compared to existing conditions. The intersection of Wilmot Line at Erb Street is projected to continue operating at LOS C in both the AM and PM peak hours and the intersection of Wilmot Line at Conservation Drive is projected to continue operating at LOS A. No intersection improvements are required to accommodate projected traffic volumes.

Furthermore, no new accesses to Wilmot Line from the City of Waterloo are proposed and the existing accesses from the City include Erb Street, Conservation Drive and Wideman Road. The increase in traffic on Wilmot Line is a result of traffic growth in the City of Waterloo as well as background traffic growth from adjacent townships of Wilmot, Woolwich and Wellesly.

In summary, the existing and projected 2031 traffic volumes on Wilmot Line south of Conservation Drive exceed 1,000 vehicles per day. Despite more than doubling the traffic volumes on Wilmot Line by 2031, the two study intersections would continue to operate at good levels of service (LOS C or better) with minor increases in delay. No intersection improvements are required to accommodate projected traffic volumes.

Should the City of Waterloo and Wilmot Township Councils continue to require reducing the traffic volumes to a maximum of 1,000 vehicles per day to address issues other than traffic operations, a separate study should be initiated. It should be noted that traffic calming measures are typically not provided on collector roads. Other potential measures such as closing some or more existing accesses from the City of Waterloo and Wilmot Township would have negative impacts on accessibility, connectivity and emergency response times and would require public consultation.

3.4 FUTURE TRANSIT IMPROVEMENTS

Recommendations specific to the City of Waterloo are provided for implementation in addition to the existing strategies presented in the GRT Business Plan.

3.4.1 *RECOMMENDATIONS*

INFRASTRUCTURE IMPROVEMENTS

The development of ION's rail stations represents a number of opportunities for GRT and for Waterloo Region. The presence and architecture of the stations make a strong statement about the region as a growing community at the leading edge of technology and development. The stations offer Waterloo Region the opportunity to better integrate transit into existing and redeveloping areas as well as new development by strategically positioning the stations as the economic and cultural centre of their neighborhoods. The stations also can serve as a focal point for neighborhood and regional active transportation networks, extending the area over which customers can walk and bike to the transit station beyond the immediate station area and increasing the pedestrian and bicycle connectivity of the region.

It is also recommended that an assessment be completed on all bus stops and transit infrastructure within the study area to determine improvements that will enhance the customer experience. An asset inventory should be maintained with the existing condition, lifecycle, and parts of each piece of infrastructure.

CONNECTIVITY

GRT is planning annual service improvements between 2017 and 2021 based on three key principles:

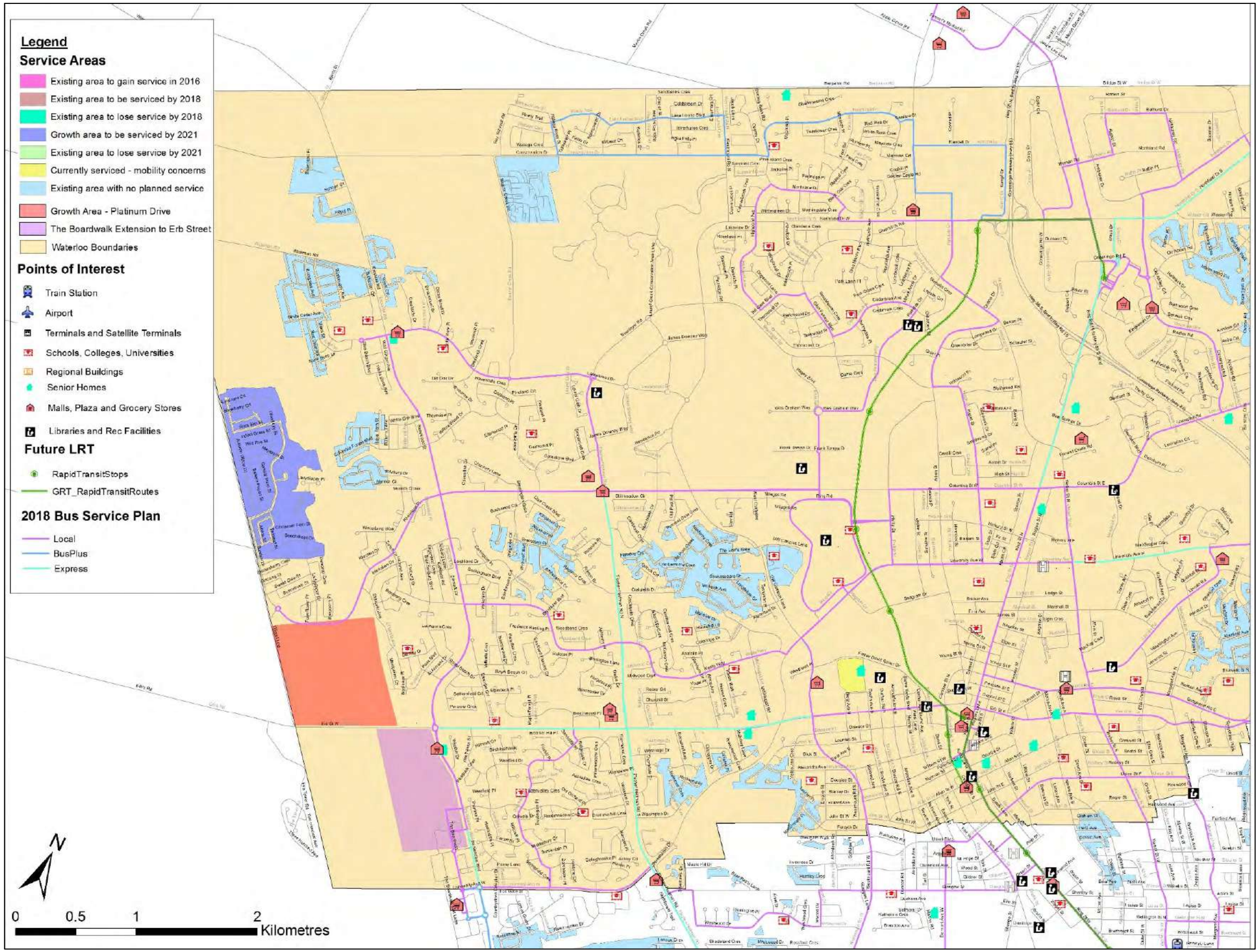
1) Completing the iXpress network of limited-stop bus routes;
2) Realigning routes to more of a grid network, focused on ION LRT stations; and
3) Providing frequent service on high ridership routes.

Figure 3-10 illustrates the planned service within the study area, up to 2021. Together with ION LRT and the conventional bus service, the study area will be well served, with connection to frequent service along key corridors.

It is recommended that each new development area follow a set service design standard guideline for the type of service that should be implemented at each phase of development. The ION LRT stations should be used as central hubs for bus routes to increase regional connectivity and provide ease of access to areas with lower demand.

Additionally, the City is planning for 8,000 additional employees beyond what the Region has forecasted. This will occur primarily in Zone 141 (vacant area between Columbia Street and Erb Street, east of Wilmot Line). As a result, there will be significant demand for travel along Platinum Drive. WSP recommends adding the employment node around Platinum Drive as a growth area for transit and that this area be considered a connectivity point for future transit service. Furthermore, WSP traffic forecasting shows that the roundabouts along Ira needles Boulevard from Erb Street to University Avenue will be at capacity in 2031 and traffic will divert to the Boardwalk. Consequently, WSP is recommending that the Boardwalk becomes a public collector road and there be consideration for connectivity opportunities to provide transit along this route.

Figure 3-10 GRT Planned Service Areas



ALTERNATE DELIVERY

Historically, the Region has endeavoured to provide conventional, fixed-route transit service within 450 metres to 95% of residents, places of work, and public facilities in the urban municipalities. This 'service coverage' standard has not been met, with the current network providing coverage for 87.5% of residents in the urban area. There are several reasons why achieving 95% service coverage with fixed-routes has been challenging and not necessarily desirable. These include: indirect, circuitous route patterns; less efficient, lower-performing service; and fewer resources for service along main corridors where transit is more competitive.

Areas that are challenging to serve with conventional transit service are the result of numerous factors such as:

1) Lack of a fine-grid of arterial and collector roads;
2) Neighbourhoods with circuitous street patterns, cul-de-sacs and limited number of connecting streets to back-lotted arterials;
3) Lack of sidewalks and large building setbacks from roadway;
4) Physicals barriers such as rivers, highways and extreme grades;
5) Lower-density and new growth areas; and
6) Areas with senior's buildings (or other transit-dependent facilities) located away from major corridors.

Alternative transit service delivery models should be explored for isolated transit-dependent facilities. In addition, GRT staff will continue to work with Regional and municipal planners to ensure better support for transit-oriented development.

Taking the above into account, GRT will continue to use the 450 metres walk distance as a guideline for conventional service, but not as a service standard. This does not preclude GRT from serving areas of lower population/employment density; however, fixed-route services will be focused in areas with densities that can generate sufficient ridership and alternative service models will be considered for other areas as described below. GRT has been actively reviewing the existing network and determining where these difficult areas to serve are, and how they can be addressed. The following are recommended strategies to provide alternative service in these difficult areas.

COMMUNITY BUS ROUTE

GRT currently operates one route that could be classified as a 'community bus' – Route 77 Wilmot, which operates between New Hamburg and the Boardwalk. There are several important characteristics of a community bus model that could serve as a template for other lower-density areas within the urban municipalities. First, the route is a pilot service funded through a grant. This allows GRT to test out the route with limited impact on other services. Second, it is customized to a specific time of day and travel pattern, based on the demands of the area. Third, a 'flex-route' option is offered, in which the bus may deviate within a set area to drop-off and pick-up customers who are not directly on the route alignment. Finally, it operates with a smaller vehicle instead of a conventional bus.

These operational characteristics could be implemented as necessary in other low-demand, low-density areas to connect riders to the core GRT network. The flexibility of the community bus model means services can be customized to the individualized needs of a community, which minimizes operating costs. For example, in a community where the primary need is transportation for seniors and disabled people to attend daytime activities, go shopping or attend medical appointments, routes that operate only in the midday period (from approximately 10:00 am to 3:00 pm) may be appropriate. Further to this concept, the same bus could serve two, three or more communities on different days during the week.

SUBSIDIZED TAXI

Many transit agencies in North America have entered into co-operative agreements with taxi operators to offer subsidized services to potential transit customers that need service in lower-demand areas (such as developing or low density areas) or times of the day (evenings, nights, weekends), where and when conventional bus service cannot be cost-effectively provided. Trips originating or ending within designated areas would eligible for door-to-door service within the area, or for a ride to the nearest bus stop or bus hub in or near the designated area. From this bus hub, the customer could complete his or her trip using conventional bus service, arranging for the taxi to provide the return trip.

The subsidized taxi concept has three elements: regulation of the service provided, negotiation with the taxi provider to achieve favourable rates for transit users, and setting subsidy rates to the taxi company. Because the transit

provider is providing the taxi company with the opportunity to carry additional trips each year and guarantees payment on a lump sum basis, the transit provider may be able to negotiate lower rates or other concessions on trips which will allow them to provide more service. Customers can be required to pay a part of the cost of the taxi trip in much the same way as they pay the transit fare. Costs to the transit provider would be dependent on the number of trips provided, the regulation of trip lengths and times, and the prices arranged with the taxi providers.

RIDESHARING

Services like Uber and RideCo are a relatively new transportation option similar to taxis, but provided by Transportation Network Companies (TNCs). These services are summoned (and paid for) using a mobile phone app. Those who drive are generally not professional drivers, and perform the service on an ad-hoc basis. Prices of ridesharing services are generally lower than comparable trips using taxis and providing trips using MobilityPLUS. However, TNCs use a demand-based pricing system, in which customers pay higher prices for trips during periods of peak demand. There may be opportunities to integrate these services with public transit, subsidizing and regulating the services to meet the needs for transit service in lower demand areas and times.

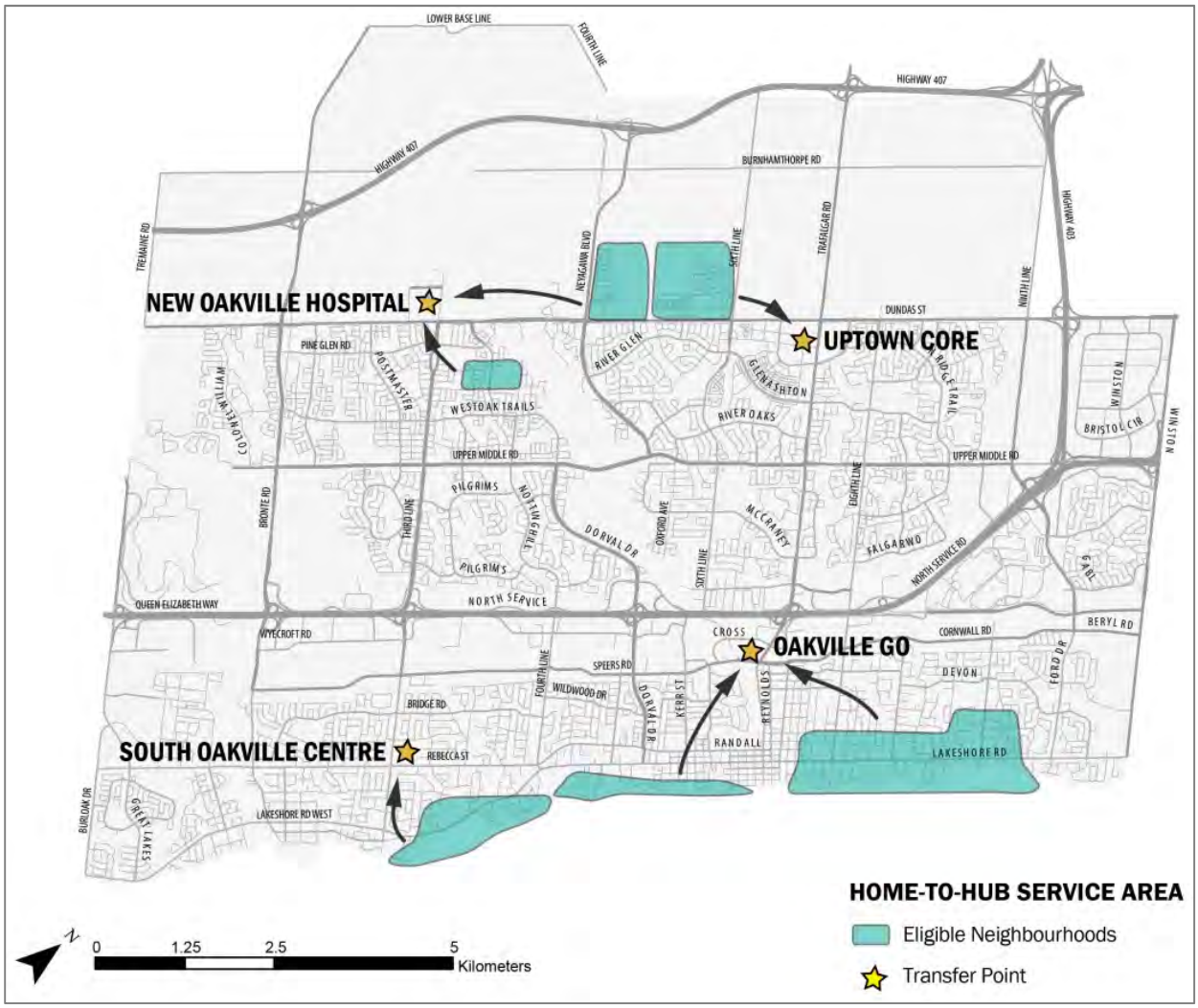
Most of the issues concerning the regulation, negotiation and subsidies discussed above with regard to taxi service also apply to ridesharing, with some additional caveats. The demand-based pricing algorithms of TNCs sometimes generate prices that are multiples of the normal base fare. This not only causes pricing volatility for the transit provider subsidizing the service, but could generate political scandal, where a transit subsidy to cover a fare of $50, $60 or more may be required. In addition, TNCs require users to have smartphones and credit cards in order to use them. Many GRT customers, particularly elderly and lower-income users, may lack one or both of these amenities.

Transit agencies in other areas are exploring ways to overcome these issues. For example, transit agency dispatchers could potentially book trips on behalf of customers that have access to standard telephones but not smartphones. Customers without credit cards could potentially set up pre-paid accounts with the transit agency or be billed by the agency as part of a larger integrated fare payment scheme to avoid the impediment of credit card payment. Some transit providers sidestep this TNC requirement by simply directing customers who lack smartphones and/or credit cards to conventional taxi services, though this may limit the cost savings of using TNCs for both customers and the transit provider. Continued interaction among transit agencies, TNCs, taxi operators and other providers is likely to produce a consensus approach to integrating the three service types. GRT should begin its own discussions with these providers while monitoring the state of the industry as this consensus develops.

HOME-TO-HUB

Home-to-hub service provides a similar service as taxis and ridesharing services would in the sections above, but would be provided by the MobilityPLUS specialized transit service instead of a private provider. Trips are provided by specialized transit buses and operators, and are scheduled and dispatched along with specialized trips over the course of the day. This service is more convenient than a community bus route, as it can be scheduled to arrive at a pre-arranged time (as opposed to operating on a fixed schedule) and comes directly to the customer's door. The cost of service, while predictable and stable after an initial period, is likely to be higher than service provided by a taxi service or TNC, and may be higher than community bus service, depending on the number of trips operated from each area. These higher prices might reduce the areas and number of hours during which the service could be provided. Oakville Transit currently utilizes this model and operates services in some newer communities with this model (see Figure 3-11 below).

Figure 3-11 Home-To-Hub Service Map



ANTERNATE DELIVERY – BEST PRACTICES

SYSTEM	COMMUNITY TRANSIT	SUBSIDIZED TAXI	RIDESHARING	HOME-TO-HUB
York Region Transit	• Local community bus routes • 5 available fixed routes • 30' buses • Regular YRT fare • Hub-and-spoke around major destinations • Daily • Operating cost varies between $12/pax to over $70/pax to operate	• Offered through Mobility Plus • Only applicable to people subject to YRT's eligibility criteria • Regular YRT fare • Uses taxi or specialized bus • 5-year contract to Royal Taxi: $11.7 million • 5-year contract to Care Accessible Transportation: $11.9 million	• Offered through Dial-a-Ride • Regular YRT fare • Direct stop-to-stop service (does not have to follow fixed route) • Dial-A-Ride North (7:30 a.m. to 10:45 p.m.) operating characteristics: average 9 riders per weekday, $21.72 per passenger, r/c ratio of 12% • Other operating characteristics on YRT DAR Strategy tab • Operating cost varies from $8/pax to $49/pax	• Offered through Mobility Plus • Only applicable to people subject to YRT's eligibility criteria • Regular YRT fare • Uses taxi or specialized bus • Special transfer locations with TTC Wheel-Trans • Potential on-demand route to Aurora GO Station (separate from Mobility Plus) with planned implementation in September 2018
Oakville Transit	• Available 'Seniors Specials' bus routes • 5 available fixed routes • 3 regular fare routes, two free routes (sponsored) • Directly connects major destinations and trip generators • Daily	• Provide taxi service for specialized transit trips	• Offered through the Home to Hub service	• On request transit service to North Oakville and Southeast Oakville using smaller buses • Regular fare • Uses care-A-van fleet • Service comingled with care-A-van • Anyone unable to use conventional services due to disability can apply • Special connections to Peel Transhelp and Burlington Handi-van (transfer hubs) • 7.2% recovery ratio in late 2017

SYSTEM	COMMUNITY TRANSIT	SUBSIDIZED TAXI	RIDESHARING	HOME-TO-HUB
Toronto Transit Commission	• Local community bus routes (400-series) • 6 available fixed routes • Specialized buses (Friendly bus) • Regular fare • Directly connects major destinations and trip generators • Daily • Annual operating cost for five routes is approximately $1.01 million	• Offered through Wheel-Trans • Only applicable to people subject to TTC's eligibility criteria • Regular TTC fare • Proposed to be phased out once transit network is entirely accessible • Dodge Pro-Master mini-buses or contracted taxi • Contracted taxi contract value (4 vendors combined) at $71.3 million for five years (2018) • Approximately $19.71 cost per trip	• Offered through Wheel-Trans wherever convenient (for example, clients in the same general area)	• Offered through Wheel-Trans • Only applicable to people subject to TTC's eligibility criteria • Regular TTC fare • Enlarged bus stops as access hubs (transfer points) • Specialized buses, vans or contracted taxi • Total Wheel-Trans operating budget $152.0 million/yr ($143.0 million subsidy) (2018) • Undergoing transformation program incl. Family of Services initiative (creating transfer hubs)
London Transit Commission	• Local community bus routes • 5 available fixed routes • Specialized buses • Each route operates for a single day only • Proposed additional community bus services with small deviations from fixed route		• Through Paratransit service, shared-ride schedule	• Through Paratransit service, shared-ride schedule • Potential Workshop and Medical Shuttles • $4.5 million budget (2018) • 144,100 revenue hours
OC Transpo	• 'Shopper Routes' • 5 available fixed routes • Free • Conventional accessible transit bus • Directly connects major destinations and trip generators • Very specific operating times (days)	• Fare coupon as an alternative to ParaTranspo services • $24 coupon book worth $40 in taxi fares	• Rural Community Support Services (uses Paratranspo fleet) for one rural area to another rural area only	• Paratranspo service • Only applicable to people subject to OC's eligibility criteria • Regular OC Transpo fare • 164 municipal staff, 132 contracted staff (2016) • $33.05 million budget (2016)

TRANSIT INITIATIVES

Through GRT's Five-Year Business Plan, a variety of transit initiatives were identified in the proposed marketing plan. Some additional transit initiatives that are recommended include special event fares, short trip fares, and ride share (as discussed in the Alternative Delivery section) to meet first/last mile demand.

SPECIAL EVENT FARES

The solid loyalty of the fans of professional sports franchises and the range of events and festivals within the Region, WSP believes operating service to special events at premium pricing would prove to be beneficial. GRT could work with some of the major sport teams, promoters, and organizers to educate attendees on special event service to/from these venues.

Figure 3-12 Metro Bus Advertising



These services attract discretionary riders who are willing to pay a premium price to avoid crowded parking and congestion around events. Professional sports franchises are more than willing to help promote these services to relieve congestion before and after games. Cooperative promotion of the service inside stadiums or arenas helps raise awareness of transit service among populations that do not use transit.

SHORT TRIP FARES

There are two obvious benefits that would likely be experienced by introducing a short-distance fare. First, reducing fares for some trips would be expected to induce new ridership. Second, and more importantly, doing so would improve the equity of the transit system by more closely aligning user costs with the value of service provided to the user. Closely aligning user costs with value received is critical in creating a transparent, sustainable, and equitable transit system, and would likely improve customer satisfaction.

Distance-based fares are straightforward to implement if users are obliged to use a fare card (or other electronic media) that requires users to "tap on" and "tap off" the transit system. Tapping both on and off provides the fare management system sufficient information to automatically calculate and deduct the correct fare. Systems that rely on non-electronic media (cash, tickets, etc.) or require users to only tap on to a system place the onus of determining the correct fare on the user. Placing the onus on the user increases the likelihood of mistakes being made by users, and makes it easier for users to abuse (underpay) the fare system. Implementing a short-distance fare should coincide with an increase in fare enforcement activities. Short-distance fares are more likely to be abused, intentionally or otherwise, and would make the fare system more complicated for users than the existing system.

PEER TRANSIT INITIATIVES

YORK REGION / YORK REGION TRANSIT (YRT)

In York Region, the underlying direction for promoting public transit is linking transportation to health and the environment. In York Region's 2016 Transportation Master Plan, a number of strategies for increasing ridership are presented. One of the main strategies is implementing strong transit oriented development (TOD) policies. When developments are centred on rapid transit, it makes the entire network more accessible and therefore more likely that people will use it. Specific actions include further developing the rapid transit network, creating compact and complete communities around these transportation hubs, and implementing maximum walking distances to bus stops from homes, businesses, and all other locations.

Another way York Region and YRT are working to promote transit use is through dealing with the first/last-km problem, which is often seen as a key for converting people to transit use. Specific strategies include increasing multi-modal potential of stations by adding bike channels on staircases, bike parking, secure bike storage facilities, park 'n' ride facilities, and pickup/drop-off areas for example. Additionally, Mobility-as-a-Service (MaaS) should be adopted allowing for access to shared services (carshare, bikeshare, ride hailing, etc.) at major transit hubs, further promoting multi-modal trips including transit, and addressing the first/last-km issue.

Further on the transit level, there are other strategies that can help promote transit use. Regional integration is important in attracting ridership, as seamless connectivity for cross-jurisdictional trips makes transit a viable option for longer distance trips. This can be further incentivised with discounted fares for transfers between agencies and other general fare subsidies for select socioeconomic groups.

YRT is also beginning to use emerging technologies to its advantage. Providing Wi-Fi on vehicles and at stations, displaying real-time vehicle arrival information at stops and stations, testing and adopting automated, connected, electric, and shared (ACES) technologies in fleets, and developing smartphone apps are examples of what YRT is doing and that could be done by GRT.

Another option that YRT has considered is increasing the overall service it provides to customers. To attract and maintain ridership, the transit network should provide service where and when there is demand. Riders want an easy to use service with many options to cater to their specific needs at a given time. This can be done by extending service hours, increasing service to areas where there is limited or no service, and providing a family of service including conventional, accessible door-to-door, and shared dial-a-ride transit options for example.

Finally, maps of the station and surrounding area with the best biking and walking routes to nearby destinations should be available for reference to promote active modes of transportation in conjunction with transit.

At a municipal level, there are also strategies to promote transit. One of the main ones is discouraging driving. This can be done by implementing HOV/HOT lanes, congestion charges, and mobility pricing. By making driving less attractive and increasing the attractiveness of transit, people will be more likely to choose transit as their preferred mode. Another option at the municipal level is to better manage the road network. Adding road use and turning restrictions or dedicated turning lanes for example can help decrease congestion and mitigate the effect of cars turning and slowing transit vehicles.

TORONTO / TORONTO TRANSIT COMMISSION (TTC)

The TTC recently released its Ridership Growth Strategy for 2018-2022, which provides actionable items in order to increase ridership over the next five years. WSP identified four main topics, each with a number of specific strategies that the TTC plans on implementing in the coming years, some of which are similar to YRT's presented above.

First is growing the network. This is planning on being accomplished by **expanding service hours and geographic areas** that have access to transit. New LRT and RRT lines are either in development or planned for the coming years which deliver rapid transit to areas where it does not currently exist. Additionally, TTC is working to improve connections with other jurisdictions and agencies in order to provide customers easy access to an even larger transit network.

Next is creating a **barrier-free system**. This includes increasing accessibility within the network, and access to other networks. Specific actions include ensuring all streetcars are low-floor accessible by 2019; making all subway stations fully accessible by 2050; increasing the number of vehicles, and coverage area for accessible transit

services; facilitating multi-modal transportation; continuing to put customer service agents in stations to assist people with their trips; and continuing to develop the Wheel-Trans Family of Services.

The third topic is using technology. There are numerous ways that current and emerging technologies can be employed in a productive manner. The TTC plans on introducing customer information screens on new buses; expanding station Wi-Fi to subway tunnels; transitioning all subway trains to automatic train control to increase safety, reliability, and capacity; upgrading bus fleets to electric; exploring microtransit as an additional service option; and using MaaS to help users access and pay for multiple modes in through a single application.

The final topic relates to fares. The TTC is working to improve payment options for customers by making PRESTO the primary fare medium, as well as adding contactless and mobile payment options in order to make paying for fares easier and more efficient. Additionally, TTC is exploring improving fare integration with other agencies for cross-jurisdictional trips, and ensuring that fares within its system are affordable for all, specifically students, seniors, and low-income individuals, who are more likely than others to rely on public transit as their primary means of transportation to school, work, appointments, and other activities.

LONDON, ENGLAND / TRANSPORT FOR LONDON (TFL)

In London, the Mayor recently released his 2018 Transport Strategy, which contains strategies to improve transit and increase ridership, many of which are the same as those presented by YRT and TTC, though others are unique to TfL.

Strategies related to **fares, affordability, and accessibility** are as follows. The Mayor, in partnership with TfL, has implemented a fare freeze to 2020, and prioritised affordability beyond then so all socioeconomic groups can have access to public transit at a reasonable cost. TfL operates a 'turn-up and go' service for persons with accessibility needs, removing the necessity of pre-booking assistance for using the network. Further to increasing accessibility for disabled customers, TfL plans to upgrade all national rail and Tube stations to step-free. They also recently ran a pilot for customers with hidden disabilities who would wear badges and carry cards identifying their disabilities so they could interact with other customers and employees with ease, and are more likely to have access to services specifically for those with disabilities. Staff on the network have also been equipped with mobile devices with real-time transit information that they can provide to riders.

In terms of fares, TfL provides visitor Oyster cards (their smart fare card) for individuals staying for short times in London. These cards offer discounts on travel, food, and entertainment and are useful for attracting tourists to the service. There is also the hopper fare which allows for two trips to be completed in an hour for the price of a single trip, and technology to allow for unlimited bus and tram transfers in an hour is being developed. Finally, TfL offers contactless and mobile payment options through credit cards, Android Pay, and Apple Pay for ease of payment for those without Oyster cards.

TfL is also taking advantage of technology and big data in order to improve the overall transit experience for customers. Their open data policy has allowed for the creation of over 600 mobile apps by external developers that improve riders' experience. 4G mobile connectivity on the Underground is set to begin in 2019, allowing riders to stay connected while on the Tube. Technology is also being used on fleets in order to increase comfort, safety, and reliability of services. Full and partial automation is being explored for lines that do not currently have it; ultra-low emissions and fully electric vehicles are being added to fleets; new and refurbished trains are being equipped with improved cooling systems; and traffic signal timing is being improved.

Finally, TfL has taken actions to engage the public and promote services through various marketing campaigns and their strong social media presence. TfL operates numerous Twitter accounts to deliver real-time updates for delays on rail and Tube services, and information related to roads, bus services, bikeshare, cable car, and ferry. Marketing campaigns include partnerships with Scrabble and Nike for a limited edition board game and shoes using the TfL typeface, and a speed-dating event to promote the cable car, which is one of its lesser known and used services.

3.5 FUTURE ACTIVE TRANSPORTATION IMPROVEMENTS

The following Active Transportation and Transportation Demand Management (TDM) measures are intended to provide the current and future residents and employees in and surrounding the study area with viable active transportation options beyond the private automobile. Measures contained in this report offer solutions for increasing the active transportation mode share for the study area by improving the active transportation network to make walking, cycling, and taking transit a more comfortable and appealing transportation option. Figure 3-13 located at the end of Section 3.5 illustrates the location where potential improvements can be applied.

The recommendations provided in this report focus on the following key themes:

5 Providing cycling facilities that are separated from motor vehicle traffic
6 Focusing on Active School Travel and removing barriers to school-related active transportation trips
7 Improving pedestrian and cyclist safety at intersections and mid-block crossings
8 Mandating end-of-trip facilities for active transportation users as part of all development applications
9 Enhancing traffic calming in neighbourhoods to improve the active transportation experience.

Short trips are excellent candidates for active transportation. In particular walking trips less than 2 km and cycling trips less than 5 km in length can be easily incorporated into one's daily routine. The key to changing transportation behaviours and habits is to make walking, cycling, and taking transit as comfortable and safe as possible. If individuals do not feel safe walking, cycling, or taking transit, they will resort to using their private automobiles.

CONTEXT

The Region of Waterloo Regional Transportation Master Plan "Moving Forward 2031" states the following with respect to the Active Transportation mode share target:

"The target is to increase the walking and cycling mode share, from 8% of PM peak period trips today (2011) to 12% by 2031. Achieving this increase will require investment in active transportation infrastructure and will require a number of policy initiatives to encourage greater usage for non-recreational based trips."

As stated in Exhibit 10-2: Regional Mode Share Targets in "Moving Forward 2031", the Region is seeking to achieve the following targets by 2031:

Mode	2006 PM Peak Hour	2031 PM Peak Hour
Auto Driver	69.6%	58.0%
Auto Passenger	15.6%	12.0%
Local Transit	3.8%	14.8%
School Bus	2.7%	2.7%
Cycle	0.7%	3.0%
Walk	7.1%	9.0%
Other	0.4%	0.5%

By choosing to prioritize active transportation and TDM measures in the Primary and Secondary Study Areas, the City will be contributing to the Region's vision of achieving a higher walking, cycling, and transit mode share by 2031. This will be possible by making walking, cycling, and taking transit as comfortable and safe as possible, and that involves providing facilities that are separated from motor vehicles.

3.5.1 *STUDY AREA-WIDE INITIATIVES*

SEPARATED CYCLING FACILITIES

The implementation of separated cycling facilities throughout the Study area is strongly encouraged, particularly on arterial streets with higher vehicle volumes and speeds, as a means of broadening the appeal of cycling to a larger

number of people. Given that cyclists can generally be categorized into four groups, “Strong and Fearless”, “Enthused and Confident”, “Interested but Concerned”, and “No Way No How”, the desired goal of implementing cycling facilities should be to appeal to the broadest range of potential users.

CALGARY, ALBERTA

It has been demonstrated in Calgary, Alberta, that the sharp increase in the number of cyclists in the Downtown Core can be attributed to the implementation of separated cycling facilities (City of Calgary, 2016). The City of Calgary piloted the implementation of a grid of separated cycling facilities in the Downtown Core on 5 Street SW, 12 Avenue SW and SE, and 8 Avenue SW. On 5 Street SW, and the total daily on-street trips made by bicycle at the Canadian Pacific Railroad underpass increased from 4% prior to the implementation of the cycle track, to 15% after its implementation. Further, data collected by the City illustrates that the number of women cycling along 5 Street SW during a 6 hour period increased from 50 cyclists in 2014, to 276 in 2016 after the implementation of the cycle track.

This trend was replicated on 12 Avenue SE and SW., where 6% of all on-street trips are made by bicycle at 12 Avenue west of 2 Street S.W., compared to 1% before the implementation of the cycle track. Following the implementation of the cycle track on 12 Avenue SW and SE, the roadway saw a higher number of daily bicycle trips in the winter with the cycle tracks than in the summer before the cycle track was installed.

MINNEAPOLIS, MN

Minneapolis is another City where an increase in the number of people cycling can be attributed to the implementation of separated cycling facilities. In 2012, Portland Ave. S. north of 28th St E had on-street painted cycle lanes. According to the City of Minneapolis’ 2017 Minneapolis Pedestrian and Bicyclist Count Report (2017), the number of cyclists using this street was 430 on September 11, 2012, when the count was conducted. The following year, the City had implemented a buffered bike lane on Portland Ave. S north of 28th St E, and the number of cyclists increased to 830 cyclists on September 10, 2013, when the count was conducted. This represents a 93% increase in cyclists on this street, based on year-over-year data.

8th Ave NE east of Marshall St NE also saw the implementation of a protected bike lane, where no cycling facilities previously existed. According to the 2017 Minneapolis Pedestrian and Bicyclist Count Report (2017), the number of cyclists using the street was 110 on September 11, 2012, when the count was conducted. The City implemented the protected bike lane on the street in 2015, and 240 cyclists were counted on September 15, 2015. This represents a 218% increase in the number of cyclists using 8th Ave NE east of Marshall St NE, from when the street had no cycling infrastructure to having a protected bike lane.

The following page contains images of the conditions before and after the implementation of separated cycling facilities.



Above: Portland Ave. S. north of 28th St E. with painted bike lane. (June 2011) Source: Google Earth



Above: Portland Ave. S. north of 28th St E. with buffered bike lane (August 2013) Source: Google Earth



Above: 8th Ave NE east of Marshall St NE with no cycling facilities (June 2011) Source: Google Earth



Above: 8th Ave NE east of Marshall St NE with a protected bike lane (August 2017) Source: Google Earth

OTTAWA, ONTARIO

The City of Ottawa has embarked on implementing a number of separated cycling facilities, with a tremendous amount of success and cyclist uptake. The three streets discussed below have all encountered a significant increase in the number of cyclists following the implementation of separated cycling facilities.

The City reconstructed Churchill Avenue North, between Byron Avenue and Carling Avenue, starting in the spring of 2013 and ending in the fall of 2014. The street was reconstructed as a complete street, incorporating dedicated pedestrian sidewalks on both sides of the street, off-road cycle tracks on both sides of the street, and cross-rides at intersections. Prior to the start of construction, the City had counted approximately 50 to 75 cyclists using Churchill Avenue North per day in August of 2012[1]. Following the reconstruction project, a daily average of 250 cyclists were using the Churchill Avenue North, with the number rising to a daily average of 280 cyclists between Monday and Friday[1]. This significant increase in the number of cyclists using this corridor can be attributed to the reconstructed street incorporating a cycling facility design that provides an enjoyable and comfortable cycling experience compared to the previous condition of the street.

The experience on Churchill Avenue North was replicated on O'Connor Street, where the City installed an on-road, bi-directional separated cycling facility between north of Laurier Avenue and Strathcona Avenue. The City had counted approximately 100 cyclists per day using O'Connor Street at Summerset Street during the summer of 2016[1].

Following the implementation of the separated cycling facility, the number of cyclists had increased to a daily average of between 550 and 600 cyclists per direction per day[1] between May and September of 2017. Excluding weekends, the daily average of cyclists observed was between 650 and 700 cyclists per direction per business day[3].

A third street where the City of Ottawa has implemented on-road separated cycling facility is on Laurier Avenue West, between Bronson Avenue and Elgin Street. The separated cycling facilities were implemented by the City and available for use by the public in July of 2011. The City had counted approximately 100 cyclists per peak hour using Laurier Avenue West at Metcalfe Street, during the summer of 2010[1]. The daily average number of cyclists using Laurier Avenue West, from May to September of 2017, increased to 2,300 cyclists per day, with that figure increasing to a daily average of 2,740 cyclists per business day[3].

On each of these three streets, the City implemented cycling facilities that provided a degree of separation from motor vehicles. Each of these streets saw the number of cyclists increase significantly, which can likely be attributed to the cycling conditions that were more comfortable and enjoyable compared to the previous experience of cyclists.

SEPARATED CYCLING FACILITIES SUMMARY

The results from the pilot project in Calgary, Minneapolis, and Ottawa, as well as the growth and expansion of separated cycling facilities in Vancouver, Edmonton, Montreal, and Toronto, suggest that these cycling facilities appeal to a greater number of potential cyclists. This observation was confirmed in the "Road to Health: Improved Walking and Cycling in Toronto" report by Toronto Public Health (2012). The report stated:

"Cycling and walking are safer and more enjoyable if cyclists and pedestrians are well separated from traffic for the entire length of their journey". The report also states: Well-connected and high quality bicycle facilities are also essential to improving safety and attracting new people to bicycling (Dill 2009, Titze et al. 2008). Bicycle facilities that separate cyclists from motor vehicle traffic are strongly associated with increased levels of cycling (Pucher et al. 2010), and reduced crashes and injuries (Reynolds et al. 2010). In the City of Portland, the 210% increase in cycling from 1991 to 2004 is linked to two key factors: the quality of cycling facilities; and the completeness of the bikeway network, including clear connections and near-continuous service. Where the bikeway network was not well connected and not of the highest quality, bicycle use essentially remained at the levels that existed prior to network expansion (Birk and Geller 2005).

Building on these successes and others across North America the Region of Waterloo has embarked on a separated cycling network pilot project in the Uptown Waterloo to University of Waterloo area to test various types of separated cycling infrastructure. It is anticipated that the pilot project will be implemented in late summer 2018 for monitoring over the remainder of 2018 and 2019. In order to replicate the experience of the municipalities listed above, it is recommended that the City of Waterloo proceed with the implementation of separated cycling facilities, in particular on streets with higher vehicle volumes and speeds, in an effort to attract as many people to cycle as possible.

CURRENT ROAD RECONSTRUCTION PROJECTS

As part of existing road reconstruction projects, it has been identified that the following corridors are planned to receive active transportation facilities:

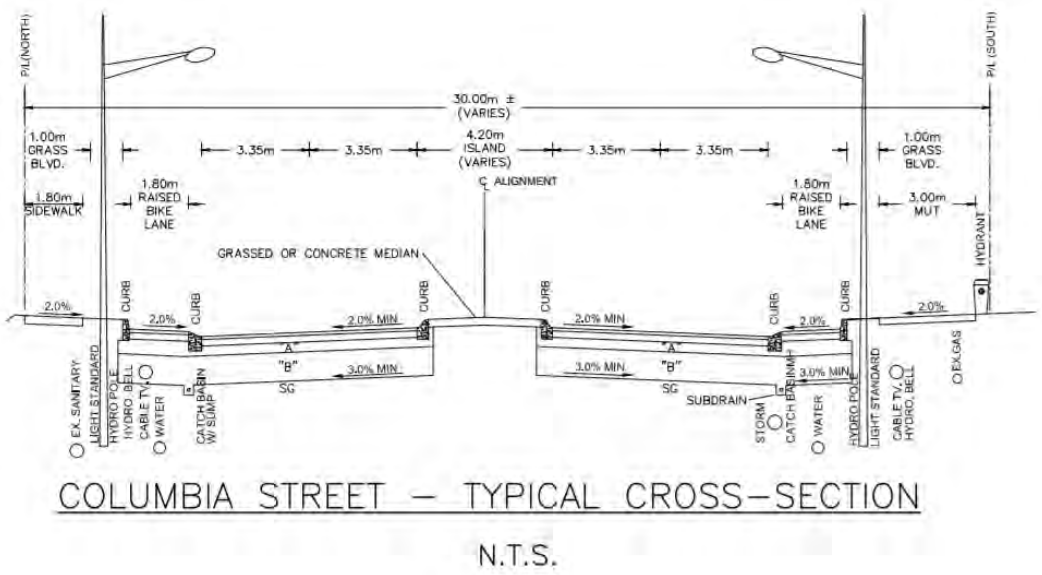
- Conservation Drive (municipal boundary to Beavercreek Road)
- Beavercreek Road (Conservation Drive to 450m north of Laurelwood Drive)
- Erb Street West (Wilmot Line to Fischer Hallman Road)

These corridors, once construction is complete, will contribute to the active transportation network in the study area and offer pedestrians, cyclists, and transit users enhanced facilities compared to what exists today.

Columbia Street West is currently being reconstructed between Erbsville Road and Fischer Hallman Road, featuring a road widening and the addition of active transportation facilities. The active transportation component includes the implementation of a 1.8m sidewalk and a 1.8m cycle track lane on the north side, and a 3.0m multi-use trail and a

[3] Data obtained via correspondence with City of Ottawa Transportation Services staff.

1.8m raised cycle track lane on the south side (see below). The principles of separation developed for this corridor should be applied on other arterials.



COLUMBIA STREET – TYPICAL CROSS-SECTION

N.T.S.



Columbia Street West- Typical cross-section, above (Source City of Waterloo); photo of recent construction, below. (Source WSP)

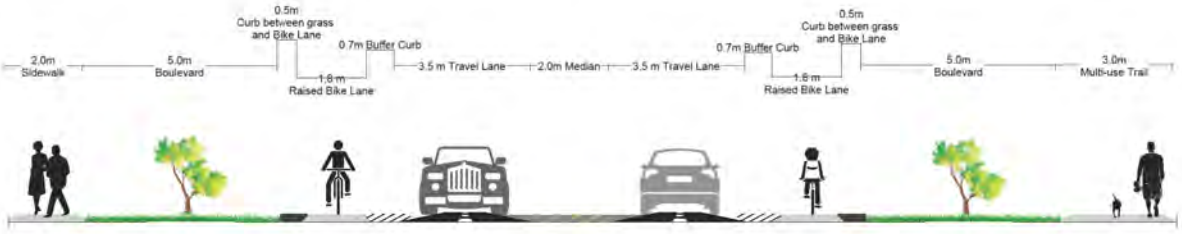
POTENTIAL CORRIDORS FOR SEPARATED CYCLING FACILITIES (AS PROPOSED BY WSP)

As a means of providing a consistent and separated active transportation experience along the major streets within the study area, it is recommended that the following corridors be reconstructed with pedestrian and cycling facilities that are separated from motor vehicles:

- Columbia Street West ("Waterloo Geo Time Trail" to Erbsville Road)
- Erbsville Road (Regal Place to Erb Street West)
- Ira Needles Blvd. (Erb Street West to University Avenue West)
- Bearinger Road (Westmount Road North to Laurelwood Drive)
- Fischer Hallman Road (Columbia Street West to University Avenue West)
    - To be completed in conjunction with the planned widening of Fischer Hallman Road to accommodate bus-only travel lanes
- Beavercreek Road (450m north of Laurelwood Drive to Laurelwood Drive)
- Laurelwood Drive (Erbsville Road to Fischer Hallman Road)
- Keats Way (Erbsville Road to Fischer Hallman Blvd)
- Platinum Drive (Columbia Street West to Erb Street West)

Keats Way provides an opportunity for an enhanced east-west connector through the Secondary Study Area B, linking Primary Study Area A with destinations further east, given the presence of a painted median from Erbsville Road to University Avenue West. There is an opportunity to improve upon the existing painted cycle lanes that exist there today by reallocating the space that currently makes up the centre median, and using it to introduce a painted buffer for the existing cycle lanes. This buffer may also allow for the installation of physical delineators, should they be recommended.

Platinum Drive presents the City with an opportunity to design the street with a "blank slate". Separated cycling facilities are proposed in this report on Columbia Street West (by WSP) and are already under construction (i.e. boulevard multi-use trail), and will be implemented on Erb Street West this coming year. In order to provide a separated cycling experience, it is recommended that Platinum Drive be designed to accommodate separated cycling facilities, specifically an in boulevard multi-use trail for a variety of user groups in addition to a sidewalk on both sides of the street for pedestrians. The figure below shows a potential cross-section based on this principle of separation. Similar to the cross-sectional design of Columbia Street, it includes two 1.8m raised cycle lane on both sides of the travel lanes, a 3.0m wide multi-use trail on one side and a 1.8m cycle track lane on the other.



BEAVER CREEK ROAD AND CONSERVATION DRIVE UPGRADES AND EXTENSION OF MUNICIAL SERVICES EA

A review of the alternative scenarios contained within the *Beaver Creek Road and Conservation Drive Upgrades and Extension of Municipal Services Environmental Assessment* identified that active transportation facilities are planned to be included as part of the reconstruction project. Four alternatives are being considered:

- Alternative 1: "Upgrade Roadway to a Standard Collector Road Centred Along Existing Right-of-Way" provides a typical cross section which includes two 1.5m sidewalks on both sides of the street and two 1.5m on-street painted bike lanes adjacent to two 3.7m vehicle lanes.

- Alternative 2: “Minimized Pavement Width with Addition of Multi-Use Trail” provides a typical cross section which includes one 1.5m sidewalk on the north side of the street and a 3.0m multi-use trail on the south side of the street, along with two 4.2m vehicle lanes.
- Alternative 3: “Enhanced Intersection Improvements with implementation of On-Street Bicycle Lanes” provides a typical cross section which includes a 1.5m sidewalk on both sides of the street and two 1.5m on-street painted bike lanes adjacent to two 3.7m vehicle lanes. At intersections, a typical cross section would include a 1.5m and 2.0m sidewalk, two 1.5m bike lanes, along with two 3.5m vehicle travel lanes in each direction and a 3.5m centre turn lane.
- Alternative 4: “Enhanced Intersection Improvements including Roundabout at Conservation Drive and Beaver Creek Road” provides a typical cross section that includes a 1.5m and 2.0m sidewalk, two 1.5m bike lanes, along with two 3.5m vehicle travel lanes in each direction and a 3.5m centre turn lane. The intersection of Conservation Drive and Beaver Creek Road features a roundabout.

While each of the four alternatives contained within the Environmental Assessment provide for active transportation facilities, preference should be given to those alternatives that provide a higher degree of separation for cyclists similar to the recent design and construction on Columbia Street West. Additionally, the preferred alternative should include measures that facilitate a comfortable pedestrian crossing experience at intersections by reducing pedestrian crossing distances, highly visible pavement markings, and AODA compliant signals.

CROSSRIDES

The design and implementation of separated cycling facilities should include crossrides at intersections per Ontario Traffic Manual Book 18-Cycling Facilities. Crossrides enable cyclists to legally travel through intersections without having to dismount and walk. The City is beginning to establish the crossride precedent with the roundabouts on the Columbia Street West project.

The photos below illustrate a crossride and cycle track implemented on Churchill Avenue North in Ottawa (Source: Google Earth), and an example of a crossride along the Finch Hydro Corridor Trail, Toronto (Source WSP).





MUTLI-USE TRAIL IMPROVEMENTS

In addition to the implementation of separated cycling facilities, it is recommended that key existing off-road trails be upgraded to a minimum width of 3.0m, with a paved /asphalt surface and be upgraded to "Major Active Transportation Routes", as recognized in the City of Waterloo Transportation Master Plan (2011). These routes serve a similar purpose as the separated cycling facilities, in that they provide a higher-order cycling facility which allows for a direct and separated facility that is located off-road. The following existing off-road trail facilities are recommended to be included as "Major Active Transportation Routes":

- Bennington Gate Hydro Corridor (Bennington Gate to Erbsville Road);
- Bennington Gate Hydro Corridor (West) (Erbsville Road to Path to Brandenburg Blvd.); and
- Keatsway Hydro Corridor (Erbsville Road to Fischer Hallman Road).



Older asphalt trail in the Keatsway Hydro Corridor at Mary Johnston Public School. (Source WSP)

This will lead to closing gaps in the multi-use trail network and will improve connectivity for active transportation. A number of gaps were identified in the study area, and these are illustrated Figure 3-13 (found at the end of Section 3.5). In some cases, closure of the small gaps will result in significantly longer segments of off –road trail.

HYDRO CORRIDORS

A major opportunity exists in utilizing the north-south hydro corridor shown below, which would allow for the implementation of a major off-road active transportation corridor connecting Columbia Street West with Erb Street West. Topographic challenges in select locations can be overcome by aligning any future trail in a manner that works with the existing topography, or could include grading at key locations to create a favourable trail alignment and slope.

Existing trails in hydro corridors in Primary Study Area A and Secondary Study Area B should be enhanced and recognized as "Major Active Transportation Routes", as mentioned above, given their direct path of travel free from conflict with motor vehicles.



Hydro corridor – Columbia Street West near St. Moritz Avenue, view south towards the Boardwalk area. This location provides an opportunity to continue a multi-use trail along Columbia as well as a major trail south, connecting to the Boardwalk commercial and employment node (Source WSP).

3.5.2 ACTIVE SCHOOL TRAVEL

A significant but often overlooked component of effective transportation demand management involves the implementation of School Travel Plans for schools within the study area. According to the Waterloo Region District School Board (WRDSB, 2018), by implementing school travel plans, schools support active transportation and:

- Encourage children to gain independence;
- Improve student achievement and health through increased Daily Physical Activity;
- Reduce traffic congestion around school sites;
- Reduce the environmental impact of school-related travel;

- Improve the quality of life for all school community members; and
- Build lifelong healthy habits by normalizing walking/biking as part of a child/family's lifestyle (healthier kids = healthier adults).

In the context of trip modelling, an evaluation of school travel plans published by Mammen, Stone, Buliung & Faulkner (2014) found that 17% of parents reported driving their children to/from school less often as a result of the school travel planning intervention. Of those parents who reported driving less, the large majority (83%) had switched to active transportation, thus highlighting the potential of school travel planning interventions to increase active transportation in parents and their children (WRDSB, 2018).

The following schools and their associated catchment areas, are located within Primary Study Area "A": Edna Staebler Public School; Vista Hills Public School; Abraham Erb Public School; and Sir John A. Macdonald Secondary School. The following schools and their associated catchment areas, are located within Secondary Study Area "B": Laurelwood Public School; Mary Johnston Public School; Westvale Public School; Holy Rosary Catholic School; and St. Nicholas Catholic School.

Active School Travel is often successful at schools when there are champions present. These individuals ensure that active transportation is made a part of a student's daily routine through a variety of means, such as outreach programs, educational events, and regular encouragement of active transportation. Elizabeth Zeigler Public School in Waterloo is an example of a school with an active transportation champion. Based on information provided by Leslie Maxwell School Travel Planner, Student Transportation Services of Waterloo Region; over the past several years, Elizabeth Zeigler Public School has implemented "Cycling into the Future", a program targeted at grade 5 students that teaches road safety and basic bike maintenance practices, and features an on-site obstacle course and on-road experience. This program contributes to an active transportation culture that then becomes a part of an active healthy lifestyle, and participation rates have been very encouraging.

It is recommended that the City of Waterloo work with the Waterloo Region District School Board, School Travel Planning team to conduct a School Travel Planning exercise for all of the schools in the Primary and Secondary Study Areas, with the intent of implementing school-specific School Travel Plans. The City should implement the recommendations that come out of the School Travel Plans, specifically recommendations that focus on modifications to the physical environment that remove barriers to active transportation.

3.5.3 *TDM MEASURES RELATED TO PUBLIC TRANSIT*

IMPROVE PESDESTRIAN CROSSINGS AT BUS STOPS

The improvement of pedestrian crossings at bus stop locations should be a priority in the primary and secondary study areas, as they allow for transit users to safely cross the street to utilize the bus stops in both directions. The lack of formal crossings at these locations may discourage some individuals from considering using public transit, as they know that their trip would include having to cross a busy street at a location where a formal crossing is not provided.

It is recommended that the City, in partnership with the Region and Grand River Transit, implement transit-supportive facilities at bus stops. Facilities that should be implemented include concrete bus stop pads where none currently exist, adding bus shelters to high-volume bus stops, providing concrete sidewalk extensions from the existing municipal sidewalk to the concrete bus stop pad, and consider installation of pedestrian crossing enhancements such as pedestrian crossovers (PXOs) at mid-block bus stop locations where a formal pedestrian crossing does not exist (many bus stops along Erbsville Road).



Erbsville Road at Brandenburg Blvd., facing south. No formal crossing is provided. (Source Google Earth)



Erbsville Road at Path to Wild Ginger Avenue, facing north. There are no concrete bus stop pads provided, nor is there a connection to the adjacent sidewalk (Source Google Earth)

3.5.4 WORKPLACE MEASURES

PARTICIPATE IN TRAVELWISE

Businesses located within the study area should be encouraged to participate in and become members of TravelWise. TravelWise is a transportation management association that works with employers across Waterloo Region to encourage employees to take transit, cycle, walk, and carpool to work (Regional Municipality of Waterloo, 2018). Service provided by TravelWise include:

- Discounted transit passes;
- Carpool matching and trip logging software;
- Emergency ride home reimbursement; and
- TravelWise services for your organization (promotions, behaviour surveys, commuter action planning).

A significant benefit of having companies become members of TravelWise is having access to a wealth of information that they may not have been aware of. TravelWise addresses the barrier of employers and employees lacking information to make the best transportation-related decision possible, in situations where individuals may not be aware of the transit service or active transportation network leading to their place of employment.

IMPROVE THE ACTIVE TRANSPORTATION NETWORK AT COMMERCIAL CENTRES

An impediment to active transportation and TDM measures within the study area, specific to commercial areas, is the navigating of vast expanses of surface parking lots between the municipal sidewalk and/or bus stop, and the main entrance of the commercial building. The orientation of some of the commercial buildings are located in a way that is not conducive to pedestrian access from the municipal sidewalk.

Additionally, there are a number of commercial buildings within the study area that do not offer a good pedestrian experience leading to their main entrances. These commercial buildings either do not have a pedestrian connection between the main entrance of the building and the municipal sidewalk, or offer a sidewalk with sub-par facilities (no curb-cuts, no pavement markings to illustrate crossing locations). It is recommended that developers be required to work with the City at the site plan stage of development/redevelopment and incorporate pedestrian and cycling networks through their parking lots by creating linkages where none currently exist, or enhancing existing linkages by improving the pedestrian and cycling experience. Alternatively, the City can encourage property owners of large commercial centres to introduce pedestrian and cycling networks through their parking lots at the expense of (excess) vehicle parking. This can serve as an interim measure to improve the active transportation network through large surface parking lots, until such time that the site may be redeveloped in the future.

PROVIDE END OF TRIP FACILTIES AT ALL COMMERCIAL BUILDINGS

Related to the TDM measure of improving the active transportation network at commercial centres, end of trip (cycling) facilities should be provided at all commercial buildings, where cyclists can lock up their bikes. Bicycle parking should be located in a visible, well-lit location as close to the main building entrance as possible. The end of trip facilities will vary depending on the building in question (i.e: bicycle parking located in front of a retail store, bicycle parking and a shower/change room facility at an office building). It is recommended that the City mandate the inclusion of these end of trip facilities as part of all development applications.

3.5.5 *NEIGHBOURHOOD-LEVEL INITIATIVES*

The following are TDM initiatives that are suggested for consideration at the neighbourhood-level and offer solutions to aspects of the greater transportation network that influence the perception of safety as it pertains to active transportation.

IMPLEMENT TRAFFIC CALMING MEASURES

Street design influences driver behaviour and driving speeds. When designing new streets and redesigning existing streets a *Complete Streets* approach should be used. Complete Streets are designed to be safe for all users; pedestrians, cyclists, transit users, motor vehicle drivers, and people of all ages and abilities. The Complete Streets approach ensures that transportation planners and engineers consistently design and operate the entire street network for all road users, not only motorists.

In a retrofit condition, the implementation of traffic calming measures assists in creating the conditions necessary for people to feel more comfortable walking and cycling, as a result of motor vehicle speeds being reduced. It is recommended that the City conduct traffic calming reviews of local streets and identify locations for retrofitting existing roads with traffic calming measures. Measures may include speed humps, raised crosswalks, curb bulb-outs, and centre medians. The City should implement the necessary traffic calming measures, based on the outcomes of the traffic calming reviews.

IMPROVE PEDESTRIAN CROSSINGS AT INTERSECTIONS

Improving intersections can also contribute to creating the necessary conditions for people to feel more comfortable walking and cycling, as intersections are barriers in the active transportation network. According to the Waterloo Region School Travel Planning 2015 Project Summary, parents cited that they would allow their children to walk to school if “there were less traffic dangers” and “there was a safer way to get there (to school)”. A study conducted by Nicaj et al. (2009) found that “a large proportion of (cycling) crashes occur at intersections and on multilane roads and disproportionately involve large vehicles , suggesting that when road users compete for space in a crowded road environment, characterized by restricted space, intersecting paths, and reduced visibility, the likelihood of a crash increases.” Improving intersection crossing locations is one way that the City can alleviate the concerns of parents

when it comes to reasons they don't allow their children to walk to school, and in turn, reduce the number of car trips to and from schools.

The City should work with the Region to upgrade major intersections located within the study area to include measures such as ladder crosswalks for all crossing movements, incorporate countdown timers at intersections where they do not currently exist, reduce the curb radii to slow the movement of turning vehicles, reduce the overall crossing distances faced by pedestrians by extending median islands (where they exist) through the crosswalk to act as a refuge point and slow down vehicles, and introduce protected intersections where the intersection is scheduled for reconstruction. Additional measures include introduce pedestrian crossovers at high-volume crossing locations such as at mid-block bus stops, locations where a trail and major road intersect, locations where there is a known desire for pedestrians to cross, and widening pedestrian refuge islands and adding additional signage to raise awareness of the pedestrian crossing location. Improvements to pedestrian crossings at intersections and at midblock locations directly influence the safety of pedestrians, cyclists, and transit users, and improve the active transportation experience of users.

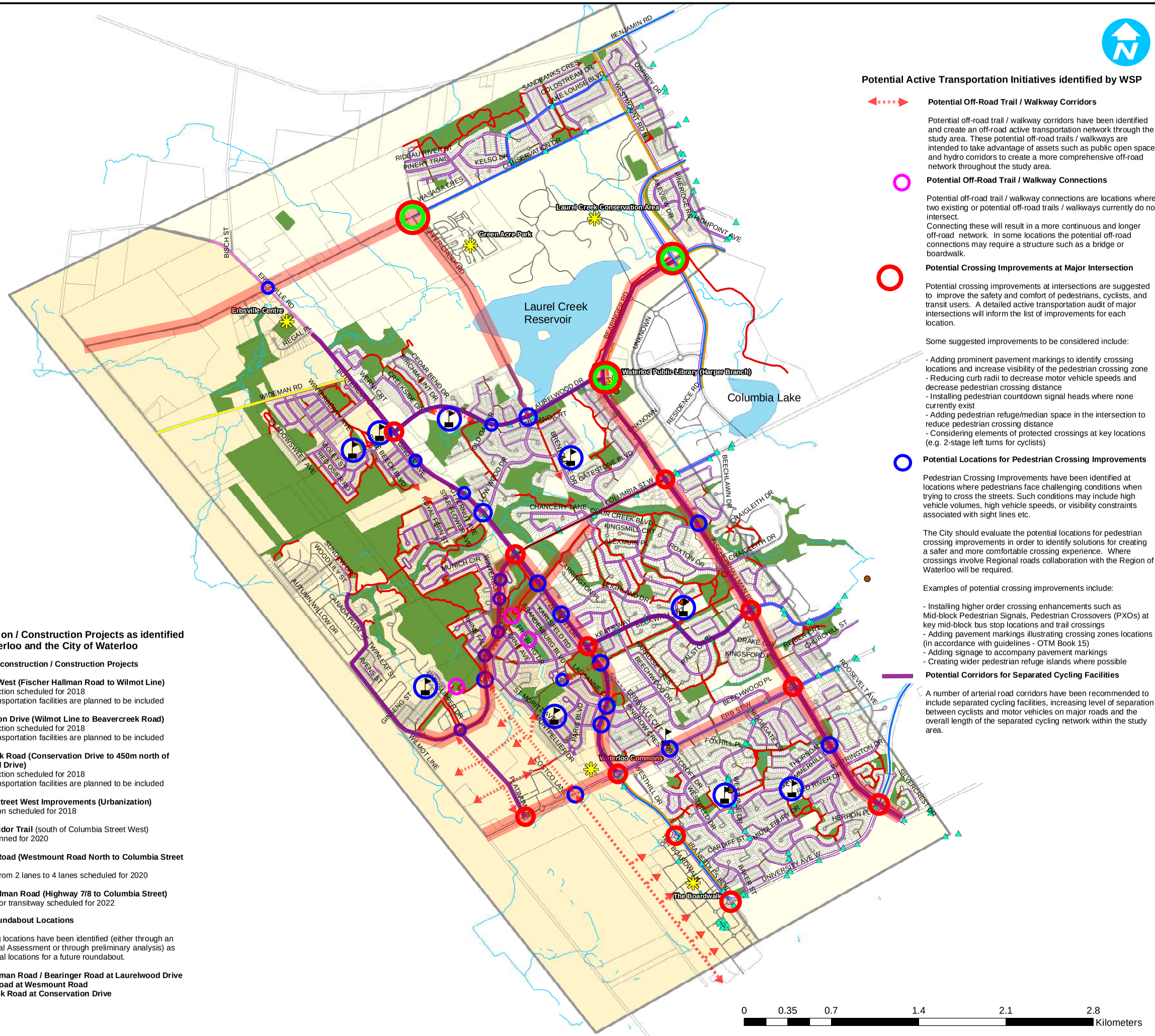
DEVELOP NEIGHBOURHOOD-SPECIFIC WAYFINDING

Residents may not be familiar with the active transportation network (trail network, sidewalk cut-throughs) in their neighbourhood. The development of neighbourhood-specific wayfinding (i.e. signage) can help to improve the familiarity on the part of residents of the active transportation network that is available to use not only for recreation and leisure purposes, but also as a means of transportation for trips to work or school. As a means of providing clarity to users of the active transportation network, the City should review the existing way-finding in the study area and identify the existing way-finding can be updated to reflect the City's current standards.

INTEGRATED MULTI-MODAL TRANSPORTATION STUDY WATERLOO WEST SIDE

CITY OF WATERLOO

JUNE 2018



Potential Active Transportation Initiatives identified by WSP

Potential Off-Road Trail / Walkway Corridors

Potential off-road trail / walkway corridors have been identified and create an off-road active transportation network through the study area. These potential off-road trails / walkways are intended to take advantage of assets such as public open space and hydro corridors to create a more comprehensive off-road network throughout the study area.

Potential Off-Road Trail / Walkway Connections

Potential off-road trail / walkway connections are locations where two existing or potential off-road trails / walkways currently do not intersect.
Connecting these will result in a more continuous and longer off-road network. In some locations the potential off-road connections may require a structure such as a bridge or boardwalk.

Potential Crossing Improvements at Major Intersection

Potential crossing improvements at intersections are suggested to improve the safety and comfort of pedestrians, cyclists, and transit users. A detailed active transportation audit of major intersections will inform the list of improvements for each location.

Some suggested improvements to be considered include:

- Adding prominent pavement markings to identify crossing locations and increase visibility of the pedestrian crossing zone
- Reducing curb radii to decrease motor vehicle speeds and decrease pedestrian crossing distance
- Installing pedestrian countdown signal heads where none currently exist
- Adding pedestrian refuge/median space in the intersection to reduce pedestrian crossing distance
- Considering elements of protected crossings at key locations (e.g. 2-stage left turns for cyclists)

Potential Locations for Pedestrian Crossing Improvements

Pedestrian Crossing Improvements have been identified at locations where pedestrians face challenging conditions when trying to cross the streets. Such conditions may include high vehicle volumes, high vehicle speeds, or visibility constraints associated with sight lines etc.

The City should evaluate the potential locations for pedestrian crossing improvements in order to identify solutions for creating a safer and more comfortable crossing experience. Where crossings involve Regional roads collaboration with the Region of Waterloo will be required.

Examples of potential crossing improvements include:

- Installing higher order crossing enhancements such as Mid-block Pedestrian Signals, Pedestrian Crossovers (PXOs) at key mid-block bus stop locations and trail crossings
- Adding pavement markings illustrating crossing zones locations (in accordance with guidelines - OTM Book 15)
- Adding signage to accompany pavement markings
- Creating wider pedestrian refuge islands where possible

Potential Corridors for Separated Cycling Facilities

A number of arterial road corridors have been recommended to include separated cycling facilities, increasing level of separation between cyclists and motor vehicles on major roads and the overall length of the separated cycling network within the study area.

Planned Reconstruction / Construction Projects as identified by the Region of Waterloo and the City of Waterloo

Planned Reconstruction / Construction Projects

Erb Street West (Fischer Hallman Road to Wilmot Line)
- Reconstruction scheduled for 2018
- Active Transportation facilities are planned to be included

Conservation Drive (Wilmot Line to Beavercreek Road)
- Reconstruction scheduled for 2018
- Active Transportation facilities are planned to be included

Beavercreek Road (Conservation Drive to 450m north of Laurelwood Drive)
- Reconstruction scheduled for 2018
- Active Transportation facilities are planned to be included

Columbia Street West Improvements (Urbanization)
- Construction scheduled for 2018

Hydro Corridor Trail (south of Columbia Street West)
- Project planned for 2020

Bearinger Road (Westmount Road North to Columbia Street West)
- Widening from 2 lanes to 4 lanes scheduled for 2020

Fischer Hallman Road (Highway 7/8 to Columbia Street)
- Widening for transitway scheduled for 2022

Planned Roundabout Locations

The following locations have been identified (either through an Environmental Assessment or through preliminary analysis) as being potential locations for a future roundabout.

Fischer Hallman Road / Bearinger Road at Laurelwood Drive
Bearinger Road at Wesmount Road
Beaver Creek Road at Conservation Drive

LEGEND

Destinations
- Points of Interest
- Schools
- GRT Bus Stop

Existing Off-Road Trails
- Community Trail
- In-Boulevard Multi-Use Trail
- Walkway

Existing On-Road Cycling Facilities
- Separated Bike Lane
- Bike Lane
- Paved Shoulder
- Signed Route

Other
- Roads
- Creeks
- Lake / Pond
- City Parks
- Study Area A
- Study Area B

Figure 3-13 Planned and Recommended Future Active Transportation Network

THE CITY OF Waterloo

wsp

4 CONSULTATION

WSP undertook extensive consultation throughout this project. This includes agency consultation and two public meetings.

4.1 AGENCY CONSULTATION

WSP consulted extensively throughout the project with the City of Waterloo, Region of Waterloo and Salvini Consulting Inc.

The Project Initiation Meeting was held on June 1, 2016 where the project team, data and information required, schedule, major tasks from the work plan and next steps were discussed. Since the project initiation meeting, one additional meeting was held on May 3, 2018 and 14 teleconferences were held.

Throughout the meetings and teleconferences WSP was obtaining relevant background information, reports, traffic data and traffic model, confirming study parameters and planned roadway improvements.

4.2 PUBLIC INFORMATION CENTRE 1

Public Information Centre (PIC) No. 1 was held on April 4, 2016 between 5:00 p.m. and 7:30 p.m. The PIC was held at the Kitchener-Waterloo Bilingual School, 600 Erb Street West, Waterloo, Ontario N2J 3Z4.

The advertisement for the PIC was posted in the Waterloo Chronicle on March 23, 2017 and March 30, 2017 (see Appendix H). The City also notified the relevant agencies and stakeholders regarding the PIC.

The purpose of the PIC was to present the existing conditions, identify planned roadway improvements and receive public input on the study. The PIC was a drop-in open house format. The boards that were presented at the PIC are provided in Appendix H.

A total of 29 residents signed in for attending the PIC and a total of four comment sheets were returned (see Appendix H).

Most comments were associated with active transportation where residents suggested facilities on arterial roads need to more separated from vehicular traffic than the typical painted bike lane provides. (Erb Street, Erbsville Road, Conservation Drive and other roadways), wider sidewalks (e.g. Conservation Drive) and filling in gaps in missing sidewalks (e.g. on Erb Street). Active transportation comments also included the need to develop direct and convenient east-west routes linking West side Waterloo to the University of Waterloo area and to Uptown.

One resident requested improvement to transit in the study area (better routes and off-peak service).

The traffic comments varied. One resident noted that the proposed roadway improvements for Erb Street and Columbia St are both scheduled for 2018 and recommended that potential closure of east west traffic associated with construction for these two projects occur at different times. Snow removal operations occasionally block emergency access to a subdivision from Wilmot Line resulting for increased emergency response times.

Developers also commented on traffic. One suggested a collector road between Erb Street and University Avenue, west of Ira Needless Boulevard. Another developer is developing options to create a new road connection on his lands to bypass the Erb St at Ira Needles Blvd intersection in the southwest quadrant.

Two residents provided land use planning suggestions that a dog park (leash free) be provided at the west end of the City.

A summary of the considerations of the comments received is provided in Appendix H.

4.3 PUBLIC INFORMATION CENTRE 2

PIC No. 2 was held on June 5, 2018 between 4:30 p.m. and 7:30 p.m. The PIC was held at the Hauser Haus, Waterloo Memorial Recreation Complex, 101 Father David Bauer Drive, Waterloo, Ontario N2L 0B4.

The advertisement for the PIC was posted in the Waterloo Chronicle on May 31, 2018 (see Appendix I). The City also notified the relevant agencies, stakeholders and residents that signed up for the first PIC regarding this PIC.

The purpose of the PIC was to present the future conditions and recommendations and receive public input. The PIC was a drop-in open house format. The boards that were presented at the PIC are provided in Appendix I.

A total of 18 residents signed in for attending the PIC and a total of five comment sheets were returned and one resident provided written comments in a separate document subsequent to the PIC (see Appendix I).

Comments from the PIC varied. In terms of traffic operation residents identified the need for alternatives to traveling along Ira Needles Blvd as well as several congested intersections / roundabouts. Priority should be provided to alternative modes of travel, and the active transportation network near Keats Way should improve. Several comments included the need for improved east-west routes for active transportation to enable residents to travel from the west side to the university, uptown and downtown Kitchener by bicycle using continuous, convenient and safe routes.

One resident noted that for almost two decades citizens have faced horrendous planning issues on the west side of Waterloo where it seems individual applications and developments have been approved with little co-ordination or regard to other developments. The result has been an ongoing series of traffic issues that have required a variety of remedies and the acknowledgement that the long-term traffic prognosis is not good, with tens of thousands of residents and new employment positions hoping to be located in an area that is already facing bottlenecks, traffic issues, and a lack of transportation infrastructure in areas. Some suggestions were made to include more off-road trails, further extensions of several roadways (the Boardwalk and Laurelwood Drive), new Regional road in the hydro corridor, not just a multi-use path and that Phase 3 LRT should connect to this area.

One resident suggested that measures should be taken to reduce traffic on Wilmot Line and expressed concerns regarding speeding, safety and environment on this corridor.

A summary of the considerations of the comments received is provided in Appendix I.

5 RECOMMENDED PLAN

5.1 TRAFFIC

The subdivisions north of Columbia Street and east of Wilmot Line have emergency accesses from Wilmot Line. Based on information received at the first PIC, residents informed WSP that there are times when the emergency access is blocked by snow as a result of snow removal operations. They were aware of an incident where the emergency response time significantly increased as the emergency vehicle travelled via Conservation Drive and Erbsville Road to access the subdivision. WSP recommends that City of Waterloo traffic operations investigate snow cleaning practices at the emergency accesses from Wilmot Line.

The existing and projected 2031 traffic on Wilmot Line south of Conservation Drive exceeds 1,000 vehicles per day. Despite more than doubling the traffic volumes on Wilmot Line by 2031, the two study intersections would continue to operate at good levels of service (LOS C or better) with minor increases in delay. No intersection improvements are required to accommodate projected traffic volumes. Should the City of Waterloo and Wilmot Township Councils continue to require reducing the traffic volumes to a maximum of 1,000 vehicles per day to address issues other than traffic operations, a separate study should be initiated.

With the planned population and employment growth identified by the Region plus 8,000 employees in the employment zone 141 the planned roadway improvements identified in the City and Region capital programmes would result in several intersections and roundabouts projected to operate over capacity, with high delays during the AM and PM peak hours. Additional improvements not identified in the City and Region capital programmes would result in improving delays at the study intersections. The intersection lane configuration for the additional roadway improvements are shown Figure 3-6 and a summary of the improvements and recommendation are provided in Table 5-1.

Table 5-1 Additional Roadway Improvements

Location	Improvement	Recommendation
Fischer-Hallman Road at University Avenue	• Second Westbound Left-turn Lane • Improve Signal Timing Plan	The Region should plan to monitor the traffic volumes and operation of the intersection and potentially initiate a study to investigate the improvements
Fischer-Hallman Road at Erb Street	• Introduce a Southbound Right-turn Lane • Improve Signal Timing Plan	The Region should plan to monitor the traffic volumes and operation of the intersection and potentially initiate a study to investigate the improvements
Erbsville Road at Columbia Street West	• Introduce an Eastbound Right-turn Lane • Introduce a Second Eastbound Through Lane • Introduce a Second Westbound Through Lane • Introduce a Second Northbound Through Lane • Introduce a Southbound Right-turn Lane • Improve Signal Timing Plan	• The Region should plan to monitor the traffic volumes and operation of the intersection and potentially initiate a study to investigate the improvements. • The future Region EA for Erbsville Road widening from Columbia Street to Erb Street should include a detail review of the operation and improvements for the intersection.

		• It should be noted that based on the Region's TMP, the Erbsville Road widening from Columbia Street West to Erb Street is recommended within the 10 to 20 years horizon. Should the employment lands start developing at a faster pace than the planned EA, the Region could consider initiating the EA at an earlier time.
Fischer-Hallman Road at Columbia Street West	• Introduce a Westbound Right-turn Lane • Improve Signal Timing Plan	The Region / City should plan to monitor the traffic volumes and operation of the intersection and potentially initiate a study to investigate the improvements
Northfield Drive at Westmount Road	• Improve Signal Timing Plan	The Region should plan to monitor the traffic volumes and operation of the intersection and adjust the signal timing when needed
University Avenue West at Ira Needles Boulevard	• Introduce an Eastbound Right-turn Lane • Introduce a Southbound Bypass Lane • Introduce a Northbound Bypass Lane	The Region should plan to monitor the traffic volumes and operation of the intersection and potentially initiate a study to investigate the improvements
Extending The Boardwalk north to intersect with Erb Street, and recommends that the intersection be controlled by a roundabout	• Eastbound Approach: One Shared Through and Left-turn Lane and One Shared Through and Right-turn Lane • Westbound Approach: One Shared Through and Left-turn Lane and One Shared Through and Right-turn Lane • Northbound Approach: One Shared Left, Through, and Right-turn Lane • Southbound Approach: One Shared Left, Through, and Right-turn Lane	The City should initiate a study to determine the alignment of the Boardwalk extension and take ownership of the roadway. The Boardwalk is anticipated to have traffic volumes to be classified as a collector road.

Population and employment in the Study Area will not occur instantly and travel patterns and mode choice change over time. The City and Region should monitor the traffic volumes, especially on roadways surrounding the employment lands to determine the timing when certain improvements will be needed. The monitoring should occur through the municipal counts programmes as well as through the City and Region Transportation Master Plans which should typically be updated every five years.

5.2 TRANSIT

Recommendations specific to the City of Waterloo are provided for implementation in addition to the existing strategies presented in the GRT Business Plan.

5.2.1 *INFRASTRUCTURE IMPROVEMENTS*

It is recommended that an assessment be completed on all bus stops and transit infrastructure within the study area to determine improvements that will enhance the customer experience. An asset inventory should be maintained with the existing condition, lifecycle, and parts of each piece of infrastructure.

5.2.2 *CONNECTIVITY*

Figure 3-10 illustrates the planned service within the study area, up to 2021. Together with ION LRT and the conventional bus service, the study area will be well served, with connection to frequent service along key corridors.

It is recommended that each new development area follow a set service design standard guideline for the type of service that should be implemented at each phase of development. The ION LRT stations should be used as central hubs for bus routes to increase regional connectivity and provide ease of access to areas with lower demand (refer to section below).

Additionally, the City is planning for 8,000 additional employees beyond what the Region has forecasted. This will occur primarily in Zone 141 (vacant area between Columbia Street and Erb Street, east of Wilmot Line). As a result, there will be significant demand for travel along Platinum Drive. WSP recommends adding the employment node around Platinum Drive as a growth area for transit and that this area be considered a connectivity point for future transit service. Furthermore, WSP traffic forecasting shows that the roundabouts along Ira needles Boulevard from Erb Street to University Avenue will be at capacity in 2031 and traffic will divert to the Boardwalk. Consequently, WSP is recommending that the Boardwalk becomes a public collector road and there be consideration for connectivity opportunities to provide transit along this route.

5.2.3 *ALTERNATIVE DELIVERY*

GRT will continue to use the 450 metres walk distance as a guideline for conventional service, but not as a service standard. This does not preclude GRT from serving areas of lower population/employment density; however, fixed-route services will be focused in areas with densities that can generate sufficient ridership and alternative service models will be considered for other areas. The following are recommended strategies to provide alternative service in these difficult areas.

10 Community Bus Route
GRT currently operates one route that could be classified as a ‘community bus’ – Route 77 Wilmot, which operates between New Hamburg and the Boardwalk. GRT should consider additional community bus routes in the Study Area based on the following important characteristics of a community bus model:

- The route is a pilot service funded through a grant.
- It is customized to a specific time of day and travel pattern, based on the demands of the area.
- A ‘flex-route’ option is offered, in which the bus may deviate within a set area to drop-off and pick-up customers who are not directly on the route alignment
- It operates with a smaller vehicle instead of a conventional bus.

11 Subsidized Taxi
GRT could enter into co-operative agreements with taxi operators to offer subsidized services to potential transit customers that need service in lower-demand areas (such as developing or low density areas) or times of the day (evenings, nights, weekends), where and when conventional bus service cannot be cost-effectively provided. The subsidized taxi concept has three elements: regulation of the service provided, negotiation with the taxi provider to achieve favourable rates for transit users, and setting subsidy rates to the taxi company.

12 Ridesharing

Services like Uber and RideCo are a relatively new transportation option similar to taxis, but provided by Transportation Network Companies (TNCs). These services are summoned (and paid for) using a mobile phone app. There may be opportunities to integrate these services with public transit, subsidizing and regulating the services to meet the needs for transit service in lower demand areas and times.

13 Home-to-Hub

Home-to-hub service provides a similar service as taxis and ridesharing services, but would be provided by the MobilityPLUS specialized transit service instead of a private provider. Trips are provided by specialized transit buses and operators, and are scheduled and dispatched along with specialized trips over the course of the day. This service is more convenient than a community bus route, as it can be scheduled to arrive at a pre-arranged time (as opposed to operating on a fixed schedule) and comes directly to the customer's door.

5.2.4 *TRANSIT INITIATIVES*

Through GRT's Five-Year Business Plan, a variety of transit initiatives were identified in the proposed marketing plan. Some additional transit initiatives that are recommended include special event fares, short trip fares, and ride share (as discussed in the Alternative Delivery section) to meet first/last mile demand.

SPECIAL EVENT FARES

The solid loyalty of the fans of professional sports franchises and the range of events and festivals within the Region, WSP believes operating service to special events at premium pricing would prove to be beneficial. GRT could work with some of the major sport teams, promoters, and organizers to educate attendees on special event service to/from these venues.

These services attract discretionary riders who are willing to pay a premium price to avoid crowded parking and congestion around events. Professional sports franchises are more than willing to help promote these services to relieve congestion before and after games. Cooperative promotion of the service inside stadiums or arenas helps raise awareness of transit service among populations that do not use transit.

SHORT TRIP FARES

There are two obvious benefits that would likely be experienced by introducing a short-distance fare. First, reducing fares for some trips would be expected to induce new ridership. Second, and more importantly, doing so would improve the equity of the transit system by more closely aligning user costs with the value of service provided to the user. Closely aligning user costs with value received is critical in creating a transparent, sustainable, and equitable transit system, and would likely improve customer satisfaction.

5.3 ACTIVE TRANSPORTATION

Measures contained in this report offer solutions for increasing the active transportation mode share for the study area by improving the active transportation network to make walking, cycling, and taking transit a more comfortable and appealing transportation option. Figure 3-13 located at the end of Section 3.5 illustrates the location where potential improvements can be applied.

The active transportation recommendations focus on the following key themes:

6. Providing cycling facilities that are separated from motor vehicle traffic
7. Focusing on Active School Travel and removing barriers to school-related active transportation trips
8. Improving pedestrian and cyclist safety at all intersections and mid-block crossings
9. Mandating end-of-trip facilities for active transportation users as part of all development applications
10. Neighbourhood level initiatives to improve the active transportation experience

Short trips are excellent candidates for active transportation. In particular walking trips less than 2 km and cycling trips less than 5 km in length can be easily incorporated into one's daily routine. The key to changing transportation

behaviours and habits is to make walking, cycling, and taking transit as comfortable and safe as possible. If individuals do not feel safe walking, cycling, or taking transit, they will resort to using their private automobiles.

5.3.1 *SEPARATED CYCLING FACILITIES*

The implementation of separated cycling facilities throughout the Study area is strongly encouraged, particularly on arterial streets with higher vehicle volumes and speeds, as a means of broadening the appeal of cycling to a larger number of people. Given that cyclists can generally be categorized into four groups, "Strong and Fearless", "Enthused and Confident", "Interested but Concerned", and "No Way No How", the desired goal of implementing cycling facilities should be to appeal to the broadest range of potential users.

The results from the pilot project in Calgary, Minneapolis, and Ottawa, as well as the growth and expansion of separated cycling facilities in Vancouver, Edmonton, Montreal, and Toronto, suggest that these cycling facilities appeal to a greater number of potential cyclists. In order to replicate the experience of the municipalities listed above, it is recommended that the City of Waterloo proceed with the implementation of separated cycling facilities, in particular on streets with higher vehicle volumes and speeds, in an effort to attract as many people to cycle as possible.

There are several existing roadway construction projects that will contribute to the active transportation network in the study area and offer pedestrians, cyclists, and transit users enhanced facilities compared to what exists today. In addition to existing road reconstruction projects, WSP recommends that the following corridors be reconstructed with pedestrian and cycling facilities that are separated from motor vehicles:

- Columbia Street West ("Waterloo Geo Time Trail" to Erbsville Road)
- Erbsville Road (Regal Place to Erb Street West)
- Ira Needles Blvd. (Erb Street West to University Avenue West)
- Bearinger Road (Westmount Road North to Laurelwood Drive)
- Fischer Hallman Road (Columbia Street West to University Avenue West)
    - To be completed in conjunction with the planned widening of Fischer Hallman Road to accommodate bus-only travel lanes
- Beavercreek Road (450m north of Laurelwood Drive to Laurelwood Drive)
- Laurelwood Drive (Erbsville Road to Fischer Hallman Road)
- Keats Way (Erbsville Road to Fischer Hallman Blvd)
- Platinum Drive (Columbia Street West to Erb Street West)

CROSSRIDES

The design and implementation of separated cycling facilities should include crossrides at intersections per Ontario Traffic Manual Book 18-Cycling Facilities. Crossrides enable cyclists to legally travel through intersections without having to dismount and walk. The City is beginning to establish the crossride precedent with the roundabouts on the Columbia Street West project.

MUTLI-USE TRAIL IMPROVEMENTS

In addition to the implementation of separated cycling facilities, it is recommended that key existing off-road trails be upgraded to a minimum width of 3.0m, with a paved /asphalt surface and be upgraded to "Major Active Transportation Routes", as recognized in the City of Waterloo Transportation Master Plan (2011). These routes serve a similar purpose as the separated cycling facilities, in that they provide a higher-order cycling facility which allows for a direct and separated facility that is located off-road. The following existing off-road trail facilities are recommended to be included as "Major Active Transportation Routes":

- Bennington Gate Hydro Corridor (Bennington Gate to Erbsville Road);
- Bennington Gate Hydro Corridor (West) (Erbsville Road to Path to Brandenburg Blvd.); and

- Keatsway Hydro Corridor (Erbsville Road to Fischer Hallman Road).

This will lead to closing gaps in the multi-use trail network and will improve connectivity for active transportation. A number of gaps were identified in the study area, and these are illustrated Figure 3-13 (found at the end of Section 3.5). In some cases, closure of the small gaps will result in significantly longer segments of off –road trail.

HYDRO CORRIDORS

A major opportunity exists in utilizing the north-south hydro, which would allow for the implementation of a major off-road active transportation corridor connecting Columbia Street West with Erb Street West. Topographic challenges in select locations can be overcome by aligning any future trail in a manner that works with the existing topography, or could include grading at key locations to create a favourable trail alignment and slope.

Existing trails in hydro corridors in Primary Study Area A and Secondary Study Area B should be enhanced and recognized as "Major Active Transportation Routes", as mentioned above, given their direct path of travel free from conflict with motor vehicles.

5.3.2 *ACTIVE SCHOOL TRAVEL*

The following schools and their associated catchment areas, are located within Primary Study Area "A": Edna Staebler Public School; Vista Hills Public School; Abraham Erb Public School; and Sir John A. Macdonald Secondary School. The following schools and their associated catchment areas, are located within Secondary Study Area "B": Laurelwood Public School; Mary Johnston Public School; Westvale Public School; Holy Rosary Catholic School; and St. Nicholas Catholic School.

It is recommended that the City of Waterloo work with the Waterloo Region District School Board, School Travel Planning team to conduct a School Travel Planning exercise for all of the schools in the Primary and Secondary Study Areas, with the intent of implementing school-specific School Travel Plans. The City should implement the recommendations that come out of the School Travel Plans, specifically recommendations that focus on modifications to the physical environment that remove barriers to active transportation.

5.3.3 *IMPROVING PEDESTRIAN AND CYCLIST SAFETY*

The improvement of pedestrian crossings at bus stop locations should be a priority in the primary and secondary study areas, as they allow for transit users to safely cross the street to utilize the bus stops in both directions.

It is recommended that the City, in partnership with the Region and Grand River Transit, implement transit-supportive facilities at bus stops. Facilities that should be implemented include concrete bus stop pads where none currently exist, adding bus shelters to high-volume bus stops, providing concrete sidewalk extensions from the existing municipal sidewalk to the concrete bus stop pad, and consider installation of pedestrian crossing enhancements such as pedestrian crossovers (PXOs) at mid-block bus stop locations where a formal pedestrian crossing does not exist (many bus stops along Erbsville Road).

PARTICIPATE IN TRAVELWISE

Businesses located within the study area should be encouraged to participate in and become members of TravelWise. TravelWise is a transportation management association that works with employers across Waterloo Region to encourage employees to take transit, cycle, walk, and carpool to work (Regional Municipality of Waterloo, 2018). Service provided by TravelWise include:

- Discounted transit passes;
- Carpool matching and trip logging software;
- Emergency ride home reimbursement; and
- TravelWise services for your organization (promotions, behaviour surveys, commuter action planning).

IMPROVE THE ACTIVE TRANSPORTATION NETWORK AT COMMERCIAL CENTRES

It is recommended that developers be required to work with the City at the site plan stage of development/redevelopment and incorporate pedestrian and cycling networks through their parking lots by creating

linkages where none currently exist, or enhancing existing linkages by improving the pedestrian and cycling experience. Alternatively, the City can encourage property owners of large commercial centres to introduce pedestrian and cycling networks through their parking lots at the expense of (excess) vehicle parking. This can serve as an interim measure to improve the active transportation network through large surface parking lots, until such time that the site may be redeveloped in the future.

5.3.4 MANDATING END-OF-TRIP FACILITIES FOR ACTIVE TRANSPORTATION USERS

Related to the TDM measure of improving the active transportation network at commercial centres, end of trip (cycling) facilities should be provided at all commercial buildings, where cyclists can lock up their bikes. Bicycle parking should be located in a visible, well-lit location as close to the main building entrance as possible. The end of trip facilities will vary depending on the building in question (i.e: bicycle parking located in front of a retail store, bicycle parking and a shower/change room facility at an office building). It is recommended that the City mandate the inclusion of these end of trip facilities as part of all development applications.

5.3.5 NEIGHBOURHOOD-LEVEL INITIATIVES

The following are TDM initiatives that are suggested for consideration at the neighbourhood-level and offer solutions to aspects of the greater transportation network that influence the perception of safety as it pertains to active transportation.

IMPLEMENT TRAFFIC CALMING MEASURES

Street design influences driver behaviour and driving speeds. When designing new streets and redesigning existing streets a *Complete Streets* approach should be used. Complete Streets are designed to be safe for all users; pedestrians, cyclists, transit users, motor vehicle drivers, and people of all ages and abilities. The Complete Streets approach ensures that transportation planners and engineers consistently design and operate the entire street network for all road users, not only motorists.

In a retrofit condition, the implementation of traffic calming measures assists in creating the conditions necessary for people to feel more comfortable walking and cycling, as a result of motor vehicle speeds being reduced. It is recommended that the City conduct traffic calming reviews of local streets and identify locations for retrofitting existing roads with traffic calming measures. Measures may include speed humps, raised crosswalks, curb bulb-outs, and centre medians. The City should implement the necessary traffic calming measures, based on the outcomes of the traffic calming reviews.

IMPROVE PEDESTRIAN CROSSINGS AT INTERSECTIONS

Improving intersections can contribute to creating the necessary conditions for people to feel more comfortable walking and cycling, as intersections are barriers in the active transportation network. The City should work with the Region to upgrade major intersections located within the study area to include measures such as ladder crosswalks for all crossing movements, incorporate countdown timers at intersections where they do not currently exist, reduce the curb radii to slow the movement of turning vehicles, reduce the overall crossing distances faced by pedestrians by extending median islands (where they exist) through the crosswalk to act as a refuge point and slow down vehicles, and introduce protected intersections where the intersection is scheduled for reconstruction.

Additional measures include introduce pedestrian crossovers at high-volume crossing locations such as at mid-block bus stops, locations where a trail and major road intersect, locations where there is a known desire for pedestrians to cross, and widening pedestrian refuge islands and adding additional signage to raise awareness of the pedestrian crossing location. Improvements to pedestrian crossings at intersections and at midblock locations directly influence the safety of pedestrians, cyclists, and transit users, and improve the active transportation experience of users.

DEVELOP NEIGHBOURHOOD-SPECIFIC WAYFINDING

The development of neighbourhood-specific wayfinding (i.e. signage) can help to improve the familiarity on the part of residents of the active transportation network that is available to use not only for recreation and leisure purposes,

but also as a means of transportation for trips to work or school. As a means of providing clarity to users of the active transportation network, the City should review the existing way-finding in the study area and identify the existing way-finding can be updated to reflect the City's current standards.

APPENDICES

Appendix A – Turning Movement Count (TMC) Data

Appendix B – Synchro Reports

Appendix C – Region of Waterloo Roundabout Traffic Flow Sheets

Appendix D – Arcady Reports

Appendix E – VISUM Model Information

Appendix F – Estimated 2031 Directional Link Volumes

Appendix G – TMC Forecast from the NCHRP 255 Iterative Method

Appendix H – PIC No. 1

Appendix I – PIC No. 2

APPENDIX

A TURNING MOVEMENT COUNT (TMC) DATA

REGIONAL MUNICIPALITY OF WATERLOO
TURNING MOVEMENT COUNT

Region of Waterloo

Morning Peak Diagram

Count Period
From: 7:30 AM
To: 10:30 AM

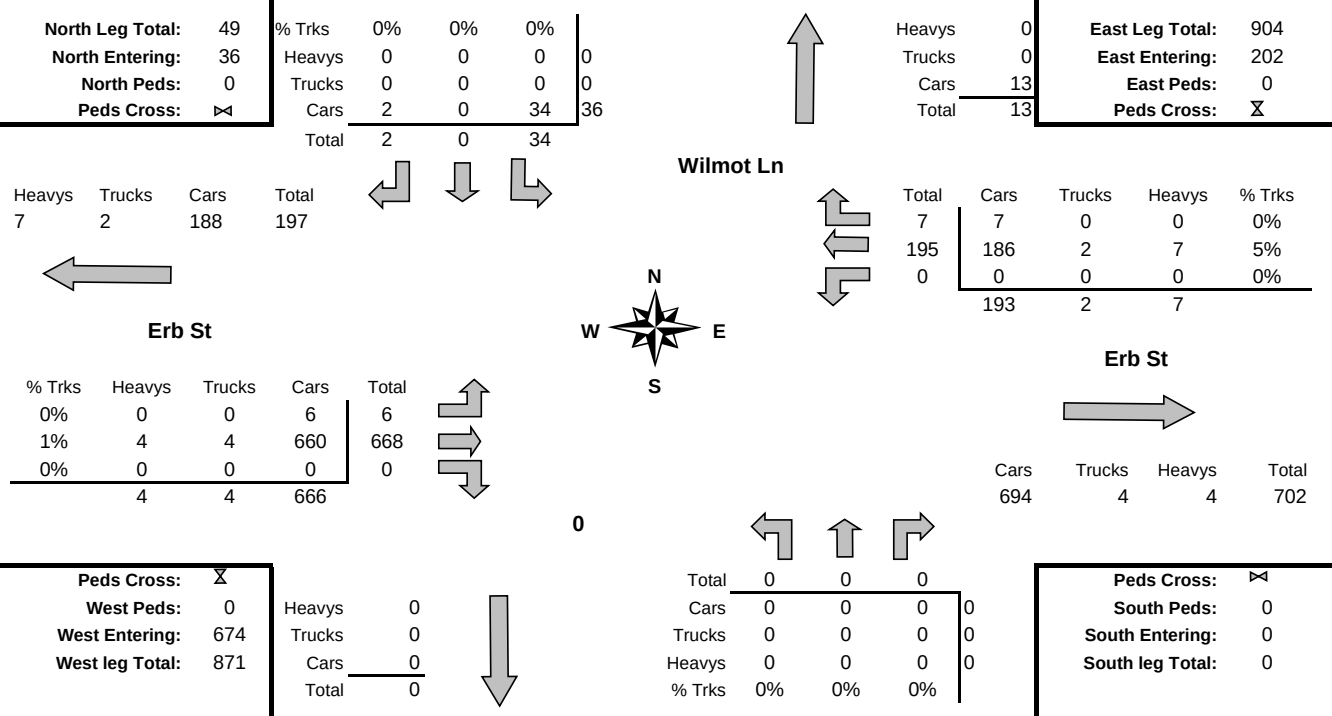
Peak Hour
From: 7:45 AM
To: 8:45 AM

Municipality: Wilmot
Intersection: Erb St & Wilmot Ln
Control: Non Signalized
Major Road: Erb St

Weather conditions: Sunny

Person(s) who counted: AT08-AB

GeoID: 5802
Count Date: Thursday, 23-Mar-17



Comments

To determine total vehicles entering the intersection during morning peak hour, add all leg totals entering.

Example 1: Total Entering = West leg total entering + South leg total entering + East leg total entering + North leg total entering
Therefore, total vehicles entering intersection = **912**

Example 2: Total vehicles entering from the west = eastbound left turn + eastbound through + eastbound right turn
Therefore, vehicles entering from the west = **674**

REGIONAL MUNICIPALITY OF WATERLOO
TURNING MOVEMENT COUNT

Region of Waterloo

Afternoon Peak Diagram

Count Period
From: 3:00 PM
To: 6:00 PM

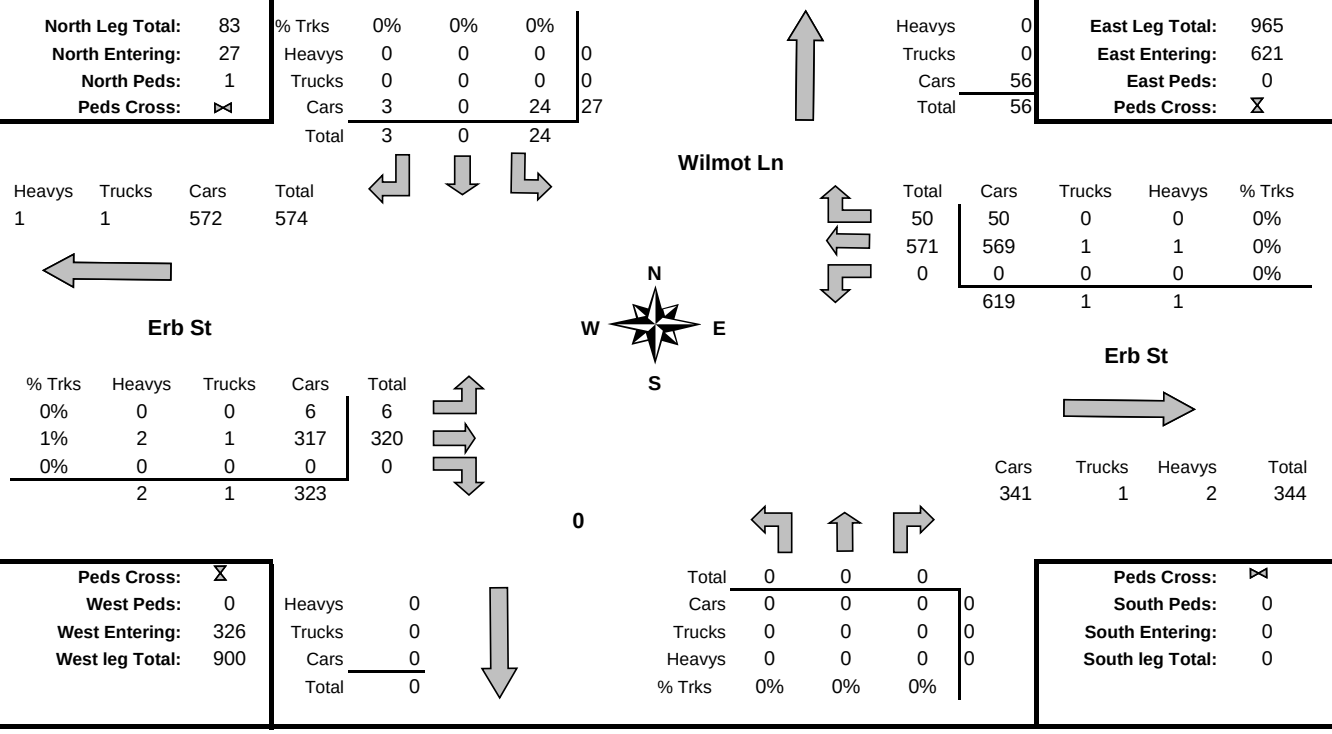
Peak Hour
From: 4:30 PM
To: 5:30 PM

Municipality: Wilmot
Intersection: Erb St & Wilmot Ln
Control: Non Signalized
Major Road: Erb St

Weather conditions: Sunny

Person(s) who counted: AT08-AB

GeoID: 5802
Count Date: Thursday, 23-Mar-17



Comments

To determine total vehicles entering the intersection during afternoon peak hour, add all leg totals entering.

Total Entering = West leg total entering + South leg total entering + East leg total entering + North leg total entering

Example 1: Therefore, total vehicles entering intersection = **974**

Example 2: Total vehicles entering from the west = eastbound left turn + eastbound through + eastbound right turn

Therefore, vehicles entering from the west = **326**

REGIONAL MUNICIPALITY OF WATERLOO
TURNING MOVEMENT COUNT

Region of Waterloo

Morning Peak Diagram

Count Period
From: 7:30 AM
To: 10:30 AM

Peak Hour
From: 8:00 AM
To: 9:00 AM

Municipality: Waterloo
Intersection: Northfield Dr & Westmount Rd N
Control: Signalized
Major Road: Westmount Rd/Northfield Dr

Weather conditions: Cloudy

Person(s) who counted: AT02-JK

GeoID: 4229
Count Date: Tuesday, 28-Mar-17

North Leg Total: 826
North Entering: 585
North Peds: 0
Peds Cross: ⋈

% Trks	0%	0%	2%		
Heavys	0	0	3	3	
Trucks	1	0	1	2	
Cars	335	0	245	580	
Total	336	0	249		

Heavys	Trucks	Cars	Total
3	1	638	642

Heavys	Trucks	Cars	Total
5	3	233	241

East Leg Total: 1,293
East Entering: 378
East Peds: 0
Peds Cross: ⋈

Westmount Rd N

Total	Cars	Trucks	Heavys	% Trks
72	67	3	2	7%
306	303	0	3	1%
0	0	0	0	0%
	370	3	5	

N
W E
S

Westmount Rd

% Trks	Heavys	Trucks	Cars	Total
2%	3	0	166	169
1%	7	2	657	666
0%	0	0	0	0
	10	2	823	

Northfield Dr

Cars	Trucks	Heavys	Total
902	3	10	915

0

Peds Cross: ⋈
West Peds: 1
West Entering: 835
West leg Total: 1,477

Heavys	0			
Trucks	0			
Cars	0			
Total	0			

Total	0	0	0	
Cars	0	0	0	0
Trucks	0	0	0	0
Heavys	0	0	0	0
% Trks	0%	0%	0%	

Peds Cross: ⋈
South Peds: 0
South Entering: 0
South leg Total: 0

Comments

To determine total vehicles entering the intersection during morning peak hour, add all leg totals entering.

Example 1: Total Entering = West leg total entering + South leg total entering + East leg total entering + North leg total entering
Therefore, total vehicles entering intersection = **1,798**

Example 2: Total vehicles entering from the west = eastbound left turn + eastbound through + eastbound right turn
Therefore, vehicles entering from the west = **835**

REGIONAL MUNICIPALITY OF WATERLOO
TURNING MOVEMENT COUNT

Region of Waterloo

Afternoon Peak Diagram

Count Period
From: 3:00 PM
To: 6:00 PM

Peak Hour
From: 4:45 PM
To: 5:45 PM

Municipality: Waterloo
Intersection: Northfield Dr & Westmount Rd N
Control: Signalized
Major Road: Westmount Rd/Northfield Dr

Weather conditions: Cloudy

Person(s) who counted: AT02-JK

GeoID: 4229
Count Date: Tuesday, 28-Mar-17

North Leg Total: 895
North Entering: 347
North Peds: 1
Peds Cross: ⋈

% Trks	0%	0%	0%	
Heavys	0	0	0	0
Trucks	1	0	0	1
Cars	253	0	93	346
Total	254	0	93	

Heavys	1
Trucks	0
Cars	547
Total	548

East Leg Total: 1,680
East Entering: 1,187
East Peds: 0
Peds Cross: ⧖

Heavys	Trucks	Cars	Total
0	2	1,186	1,188

Westmount Rd N

Total	Cars	Trucks	Heavys	% Trks
253	252	0	1	0%
934	933	1	0	0%
0	0	0	0	0%
	1,185	1	1	

N
W E
S

Westmount Rd

% Trks	Heavys	Trucks	Cars	Total
0%	0	0	295	295
0%	1	0	399	400
0%	0	0	0	0
	1	0	694	

Northfield Dr

Cars	Trucks	Heavys	Total
492	0	1	493

0

Peds Cross: ⧖
West Peds: 0
West Entering: 695
West leg Total: 1,883

Heavys	0
Trucks	0
Cars	0
Total	0

Total	0	0	0	
Cars	0	0	0	0
Trucks	0	0	0	0
Heavys	0	0	0	0
% Trks	0%	0%	0%	

Peds Cross: ⋈
South Peds: 0
South Entering: 0
South leg Total: 0

Comments

To determine total vehicles entering the intersection during afternoon peak hour, add all leg totals entering.

Total Entering = West leg total entering + South leg total entering + East leg total entering + North leg total entering

Example 1: Therefore, total vehicles entering intersection = **2,229**

Example 2: Total vehicles entering from the west = eastbound left turn + eastbound through + eastbound right turn

Therefore, vehicles entering from the west = **695**

REGIONAL MUNICIPALITY OF WATERLOO
TURNING MOVEMENT COUNT

Region of Waterloo

Morning Peak Diagram

Count Period
From: 7:30 AM
To: 10:30 AM

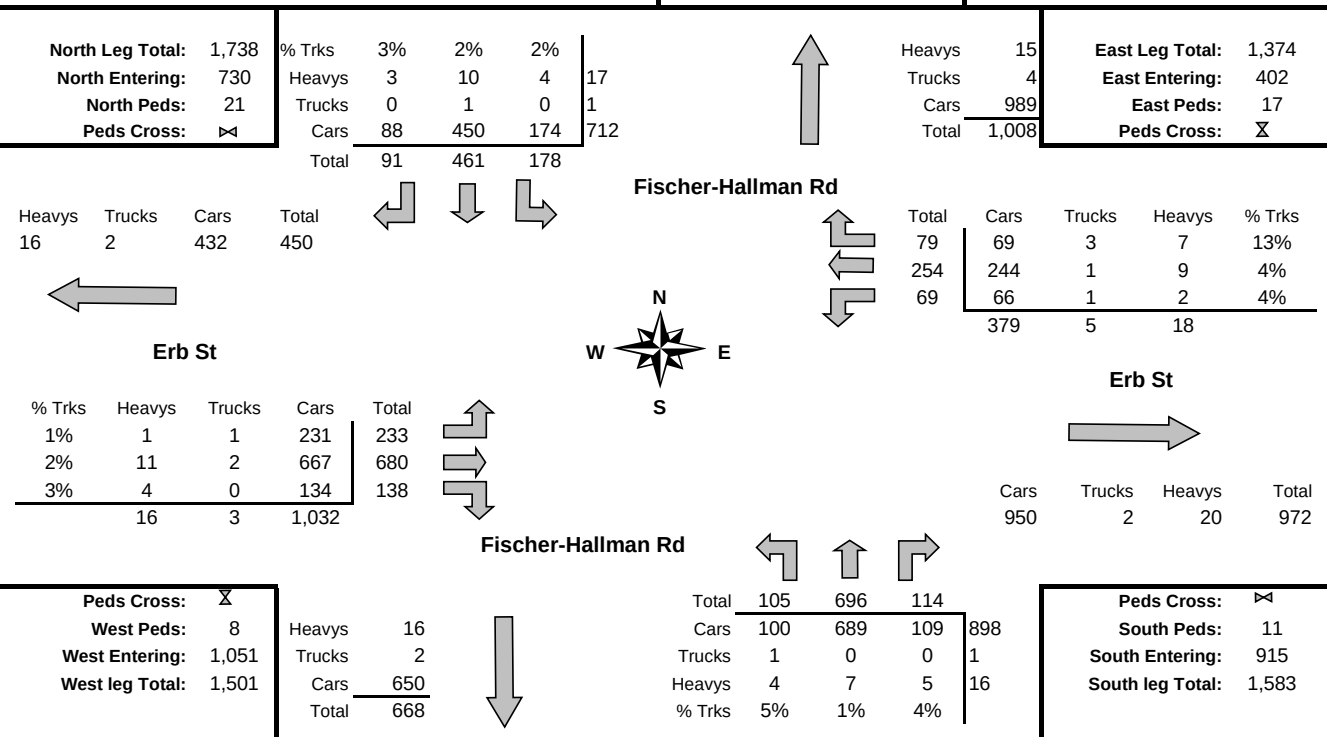
Peak Hour
From: 8:00 AM
To: 9:00 AM

Municipality: Waterloo
Intersection: Erb St & Fischer-Hallman Rd
Control: Signalized
Major Road: Erb St

Weather conditions: Sunny

Person(s) who counted: AT01-GR

GeoID: 8449
Count Date: Thursday, 23-Mar-17



Comments

To determine total vehicles entering the intersection during morning peak hour, add all leg totals entering.

Example 1: Total Entering = West leg total entering + South leg total entering + East leg total entering + North leg total entering
Therefore, total vehicles entering intersection = **3,098**

Example 2: Total vehicles entering from the west = eastbound left turn + eastbound through + eastbound right turn
Therefore, vehicles entering from the west = **1,051**

REGIONAL MUNICIPALITY OF WATERLOO
TURNING MOVEMENT COUNT

Region of Waterloo

Afternoon Peak Diagram

Count Period
From: 3:00 PM
To: 6:00 PM

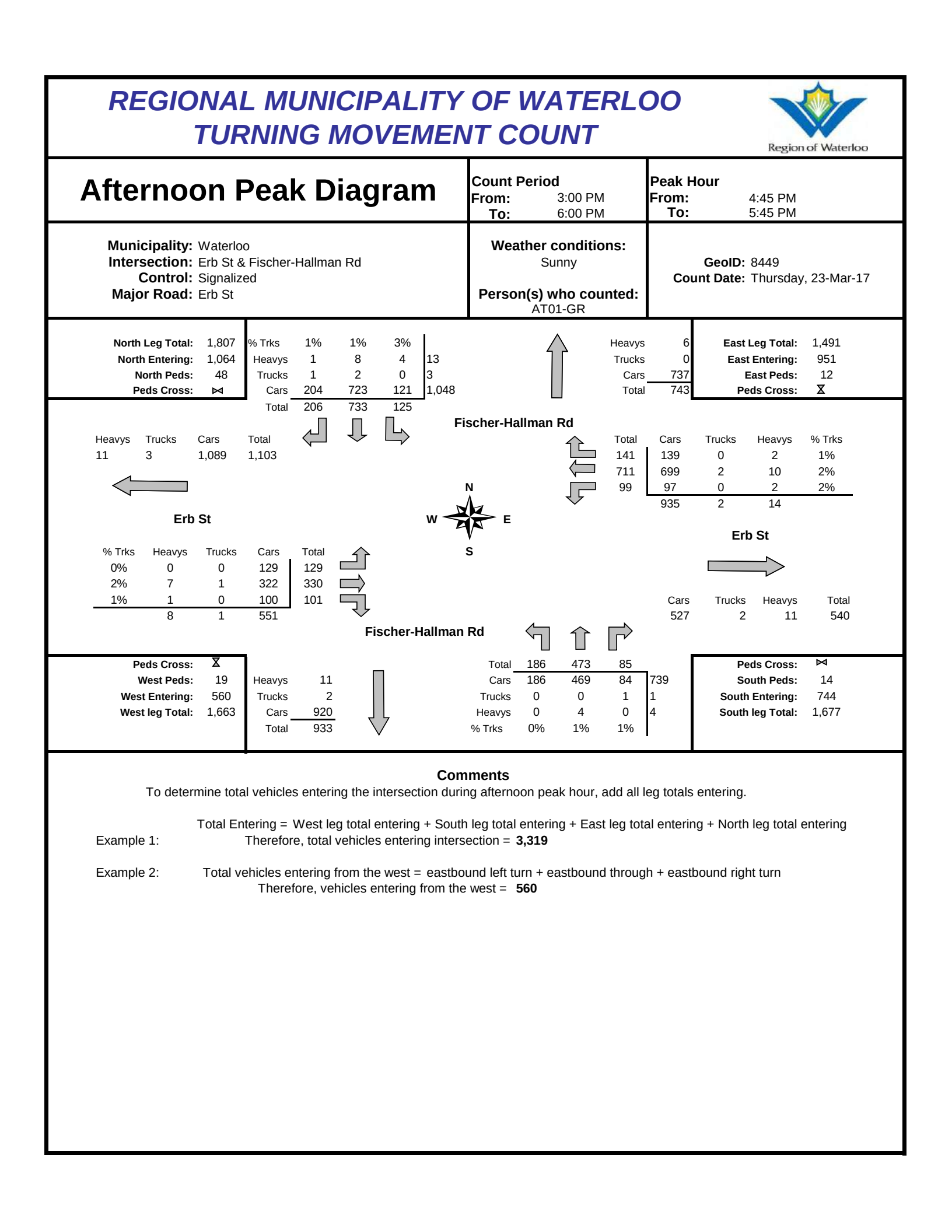
Peak Hour
From: 4:45 PM
To: 5:45 PM

Municipality: Waterloo
Intersection: Erb St & Fischer-Hallman Rd
Control: Signalized
Major Road: Erb St

Weather conditions: Sunny

Person(s) who counted: AT01-GR

GeoID: 8449
Count Date: Thursday, 23-Mar-17



Comments

To determine total vehicles entering the intersection during afternoon peak hour, add all leg totals entering.

Total Entering = West leg total entering + South leg total entering + East leg total entering + North leg total entering

Example 1: Therefore, total vehicles entering intersection = **3,319**

Example 2: Total vehicles entering from the west = eastbound left turn + eastbound through + eastbound right turn

Therefore, vehicles entering from the west = **560**

REGIONAL MUNICIPALITY OF WATERLOO
TURNING MOVEMENT COUNT

Region of Waterloo

Morning Peak Diagram

Count Period
From: 7:30 AM
To: 10:30 AM

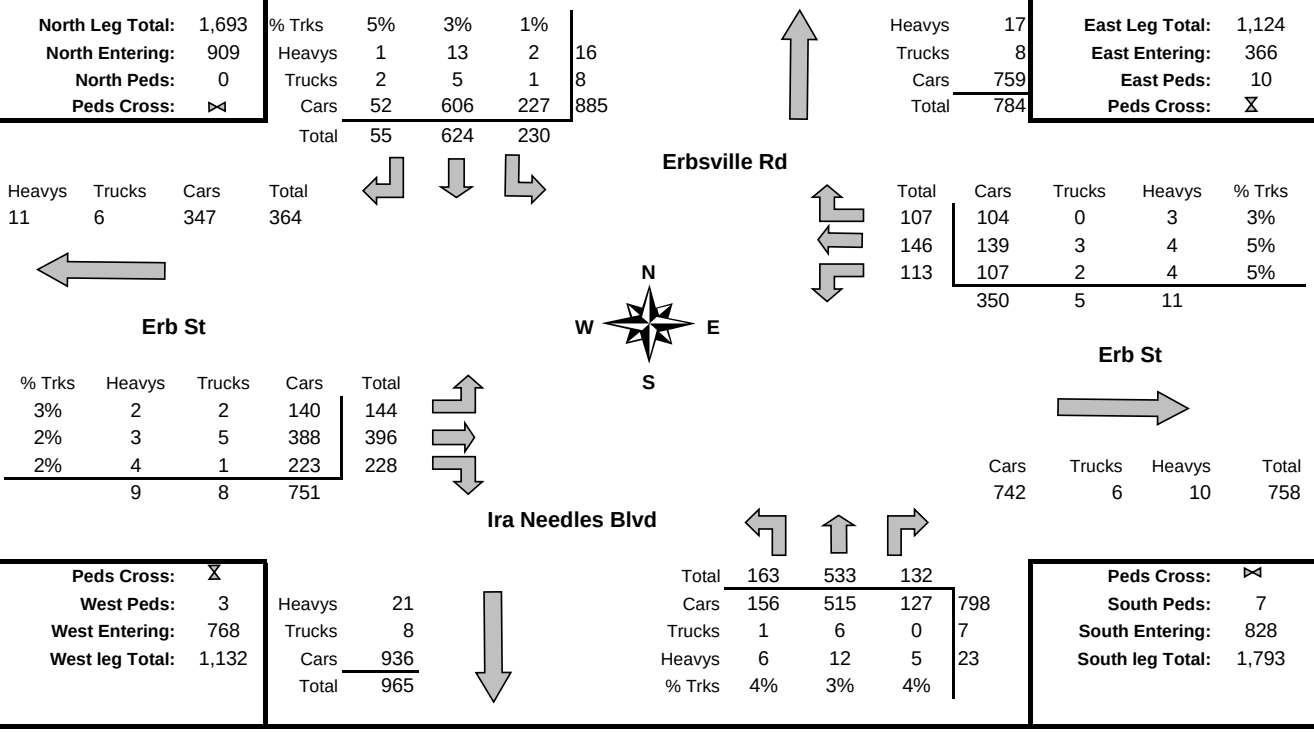
Peak Hour
From: 8:00 AM
To: 9:00 AM

Municipality: Waterloo
Intersection: Erb St & Ira Needles Blvd/Erbsville Rd
Control: Non Signalized
Major Road: Erb St

Weather conditions: Sunny

Person(s) who counted: AT06-NS

GeoID: 29541
Count Date: Thursday, 23-Mar-17



Comments

To determine total vehicles entering the intersection during morning peak hour, add all leg totals entering.

Example 1: Total Entering = West leg total entering + South leg total entering + East leg total entering + North leg total entering
Therefore, total vehicles entering intersection = **2,871**

Example 2: Total vehicles entering from the west = eastbound left turn + eastbound through + eastbound right turn
Therefore, vehicles entering from the west = **768**

REGIONAL MUNICIPALITY OF WATERLOO
TURNING MOVEMENT COUNT

Region of Waterloo

Afternoon Peak Diagram

Count Period
From: 3:00 PM
To: 6:00 PM

Peak Hour
From: 4:15 PM
To: 5:15 PM

Municipality: Waterloo
Intersection: Erb St & Ira Needles Blvd/Erbsville Rd
Control: Non Signalized
Major Road: Erb St

Weather conditions: Sunny

Person(s) who counted: AT06-NS

GeoID: 29541
Count Date: Thursday, 23-Mar-17

North Leg Total:	2,190
North Entering:	1,011
North Peds:	0
Peds Cross:	⋈

% Trks	1%	2%	2%	
Heavys	1	10	1	12
Trucks	1	3	2	6
Cars	149	661	183	993
Total	151	674	186	

Heavys	12
Trucks	3
Cars	1,164
Total	1,179

East Leg Total:	1,454
East Entering:	856
East Peds:	3
Peds Cross:	⋈

Heavys	Trucks	Cars	Total
3	9	1,004	1,016

Erbsville Rd

Total	Cars	Trucks	Heavys	% Trks
141	140	0	1	1%
528	522	5	1	1%
187	180	2	5	4%
	842	7	7	

Erb St

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% Trks	Heavys	Trucks	Cars	Total
1%	0	2	217	219
0%	1	0	267	268
3%	3	8	336	347
	4	10	820	

Erb St

Cars	Trucks	Heavys	Total
589	3	6	598

Ira Needles Blvd

Peds Cross:	⋈
West Peds:	8
West Entering:	1,300
West leg Total:	2,508

Peds Cross:	⧖
West Peds:	10
West Entering:	834
West leg Total:	1,850

Heavys	18
Trucks	13
Cars	1,177
Total	1,208

Total	337	819	144	
Cars	333	807	139	1,279
Trucks	3	1	1	5
Heavys	1	11	4	16
% Trks	1%	1%	3%	

Comments

To determine total vehicles entering the intersection during afternoon peak hour, add all leg totals entering.

Total Entering = West leg total entering + South leg total entering + East leg total entering + North leg total entering

Example 1: Therefore, total vehicles entering intersection = **4,001**

Example 2: Total vehicles entering from the west = eastbound left turn + eastbound through + eastbound right turn

Therefore, vehicles entering from the west = **834**

REGIONAL MUNICIPALITY OF WATERLOO
TURNING MOVEMENT COUNT

Region of Waterloo

Morning Peak Diagram

Count Period
From: 7:30 AM
To: 10:30 AM

Peak Hour
From: 8:00 AM
To: 9:00 AM

Municipality: Waterloo
Intersection: Ira Needles Blvd & Thorndale Dr
Control: Non Signalized
Major Road: Ira Needles Blvd

Weather conditions: Sunny

Person(s) who counted: AT02-AB

GeoID: 32009
Count Date: Thursday, 23-Mar-17

North Leg Total: 1,788
North Entering: 958
North Peds: 0
Peds Cross: ⋈

% Trks	3%	3%	2%	
Heavys	0	0	0	0
Trucks	2	24	1	27
Cars	67	824	40	931
Total	69	848	41	

Heavys	Trucks	Cars	Total
1	2	79	82

Thorndale Dr

% Trks	Heavys	Trucks	Cars	Total
22%	8	0	28	36
0%	0	0	15	15
0%	0	0	7	7
	8	0	50	

Ira Needles Blvd

	Total	Cars	Trucks	Heavys	% Trks
	4	3	0	1	25%
	699	675	6	18	3%
	32	30	1	1	6%
		708	7	20	

Peds Cross: ⋈
West Peds: 0
West Entering: 58
West leg Total: 140

Heavys	0
Trucks	25
Cars	901
Total	926

Heavys	Trucks	Cars	Total
26	8	796	830

East Leg Total: 263
East Entering: 175
East Peds: 3
Peds Cross: ⋈

Total	Cars	Trucks	Heavys	% Trks
95	93	2	0	2%
9	9	0	0	0%
71	70	1	0	1%
	172	3	0	

Thorndale Dr

Cars	Trucks	Heavys	Total
85	2	1	88

Peds Cross: ⋈
South Peds: 0
South Entering: 735
South leg Total: 1,661

Comments

To determine total vehicles entering the intersection during morning peak hour, add all leg totals entering.

Example 1: Total Entering = West leg total entering + South leg total entering + East leg total entering + North leg total entering
Therefore, total vehicles entering intersection = **1,926**

Example 2: Total vehicles entering from the west = eastbound left turn + eastbound through + eastbound right turn
Therefore, vehicles entering from the west = **58**

REGIONAL MUNICIPALITY OF WATERLOO
TURNING MOVEMENT COUNT

Region of Waterloo

Afternoon Peak Diagram

Count Period
From: 3:00 PM
To: 6:00 PM

Peak Hour
From: 4:15 PM
To: 5:15 PM

Municipality: Waterloo
Intersection: Ira Needles Blvd & Thorndale Dr
Control: Non Signalized
Major Road: Ira Needles Blvd

Weather conditions: Sunny

Person(s) who counted: AT02-AB

GeoID: 32009
Count Date: Thursday, 23-Mar-17

North Leg Total: 2,382
North Entering: 1,224
North Peds: 0
Peds Cross: ⋈

	1%	2%	0%	
% Trks				
Heavys	1	20	0	21
Trucks	0	4	0	4
Cars	87	1,047	65	1,199
Total	88	1,071	65	

Heavys	Trucks	Cars	Total
1	0	110	111

Thorndale Dr

% Trks	Heavys	Trucks	Cars	Total
4%	6	0	143	149
0%	0	0	40	40
0%	0	0	24	24
	6	0	207	

Ira Needles Blvd

	Total	Cars	Trucks	Heavys	% Trks
	96	94	0	2	2%
	22	22	0	0	0%
	59	58	1	0	2%
		174	1	2	

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Thorndale Dr

Cars	Trucks	Heavys	Total
176	0	0	176

Ira Needles Blvd

Total	1	913	71	
Cars	1	899	71	971
Trucks	0	3	0	3
Heavys	0	11	0	11
% Trks	0%	2%	0%	

Peds Cross: ⧖
West Peds: 1
West Entering: 213
West leg Total: 324

Heavys	20
Trucks	5
Cars	1,129
Total	1,154

Peds Cross: ⋈
South Peds: 10
South Entering: 985
South leg Total: 2,139

Heavys	19
Trucks	3
Cars	1,136
Total	1,158

East Leg Total: 353
East Entering: 177
East Peds: 0
Peds Cross: ⧖

Comments

To determine total vehicles entering the intersection during afternoon peak hour, add all leg totals entering.

Total Entering = West leg total entering + South leg total entering + East leg total entering + North leg total entering

Example 1: Therefore, total vehicles entering intersection = **2,599**

Example 2: Total vehicles entering from the west = eastbound left turn + eastbound through + eastbound right turn

Therefore, vehicles entering from the west = **213**

REGIONAL MUNICIPALITY OF WATERLOO
TURNING MOVEMENT COUNT

Region of Waterloo

Morning Peak Diagram

Count Period
From: 7:30 AM
To: 10:30 AM

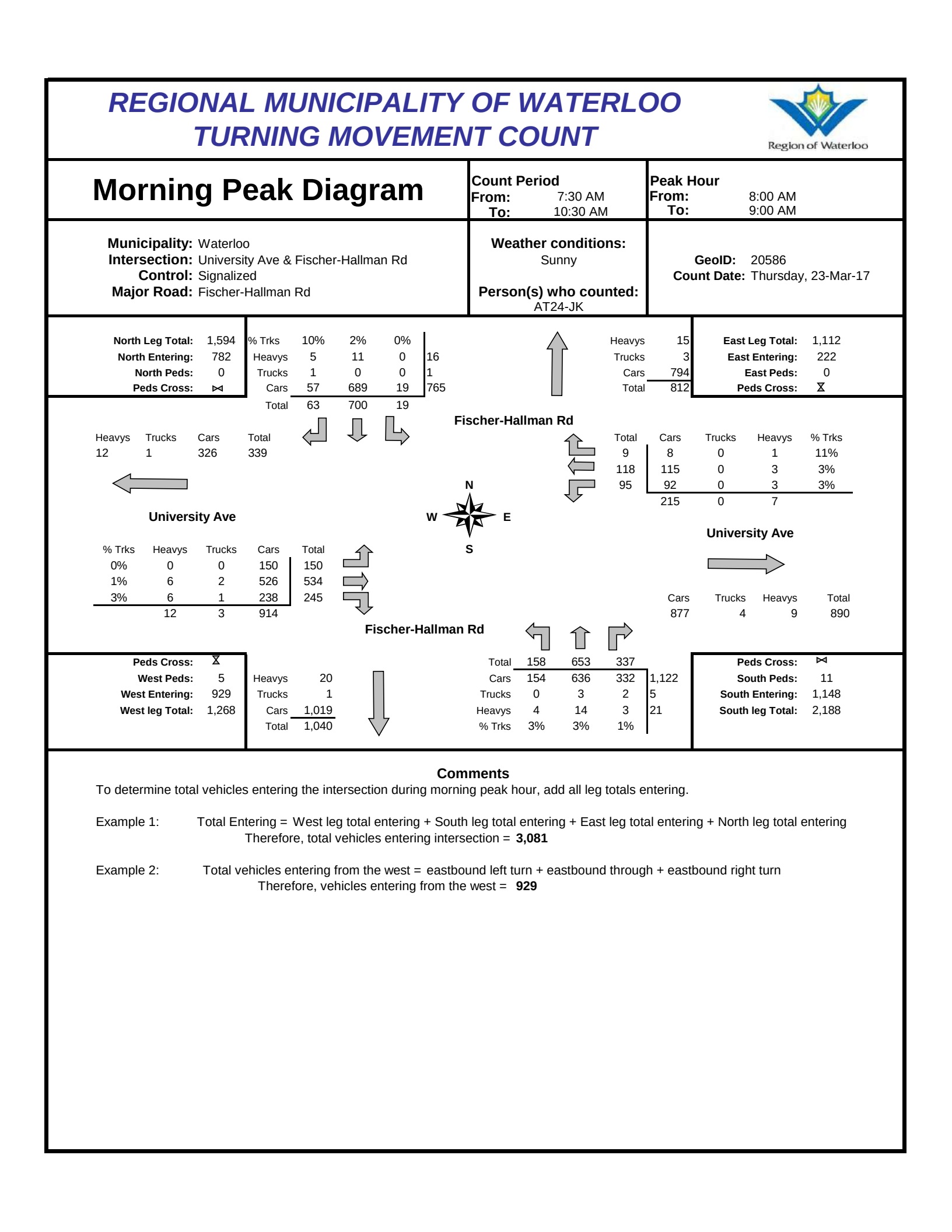
Peak Hour
From: 8:00 AM
To: 9:00 AM

Municipality: Waterloo
Intersection: University Ave & Fischer-Hallman Rd
Control: Signalized
Major Road: Fischer-Hallman Rd

Weather conditions: Sunny

Person(s) who counted: AT24-JK

GeoID: 20586
Count Date: Thursday, 23-Mar-17



Comments

To determine total vehicles entering the intersection during morning peak hour, add all leg totals entering.

Example 1: Total Entering = West leg total entering + South leg total entering + East leg total entering + North leg total entering
Therefore, total vehicles entering intersection = **3,081**

Example 2: Total vehicles entering from the west = eastbound left turn + eastbound through + eastbound right turn
Therefore, vehicles entering from the west = **929**

REGIONAL MUNICIPALITY OF WATERLOO
TURNING MOVEMENT COUNT

Region of Waterloo

Afternoon Peak Diagram

Count Period
From: 3:00 PM
To: 6:00 PM

Peak Hour
From: 4:45 PM
To: 5:45 PM

Municipality: Waterloo
Intersection: University Ave & Fischer-Hallman Rd
Control: Signalized
Major Road: Fischer-Hallman Rd

Weather conditions: Sunny

Person(s) who counted: AT24-JK

GeoID: 20586
Count Date: Thursday, 23-Mar-17

North Leg Total: 1,792
North Entering: 913
North Peds: 1
Peds Cross: ⋈

% Trks	1%	1%	0%	
Heavys	1	9	0	10
Trucks	0	1	0	1
Cars	128	758	16	902
Total	129	768	16	

Heavys	4
Trucks	1
Cars	874
Total	879

East Leg Total: 1,275
East Entering: 898
East Peds: 0
Peds Cross: ⧖

Fischer-Hallman Rd

Heavys	Trucks	Cars	Total
3	0	899	902

Total	Cars	Trucks	Heavys	% Trks
12	12	0	0	0%
486	486	0	0	0%
400	397	1	2	1%
	895	1	2	

University Ave

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University Ave

% Trks	Heavys	Trucks	Cars	Total
0%	0	0	109	109
0%	1	0	240	241
2%	4	0	191	195
	5	0	540	

Cars	Trucks	Heavys	Total
374	1	2	377

Fischer-Hallman Rd

Peds Cross: ⧖
West Peds: 17
West Entering: 545
West leg Total: 1,447

Heavys	15			
Trucks	2			
Cars	1,346			
Total	1,363			

Total	287	758	120	
Cars	285	753	118	1,156
Trucks	0	1	1	2
Heavys	2	4	1	7
% Trks	1%	1%	2%	

Peds Cross: ⋈
South Peds: 5
South Entering: 1,165
South leg Total: 2,528

Comments

To determine total vehicles entering the intersection during afternoon peak hour, add all leg totals entering.

Total Entering = West leg total entering + South leg total entering + East leg total entering + North leg total entering

Example 1: Therefore, total vehicles entering intersection = **3,521**

Example 2: Total vehicles entering from the west = eastbound left turn + eastbound through + eastbound right turn

Therefore, vehicles entering from the west = **545**

Westmount Rd N @ Conservation Dr

Morning Peak Diagram

Specified Period
From: 7:30:00
To: 10:30:00

One Hour Peak
From: 7:30:00
To: 8:30:00

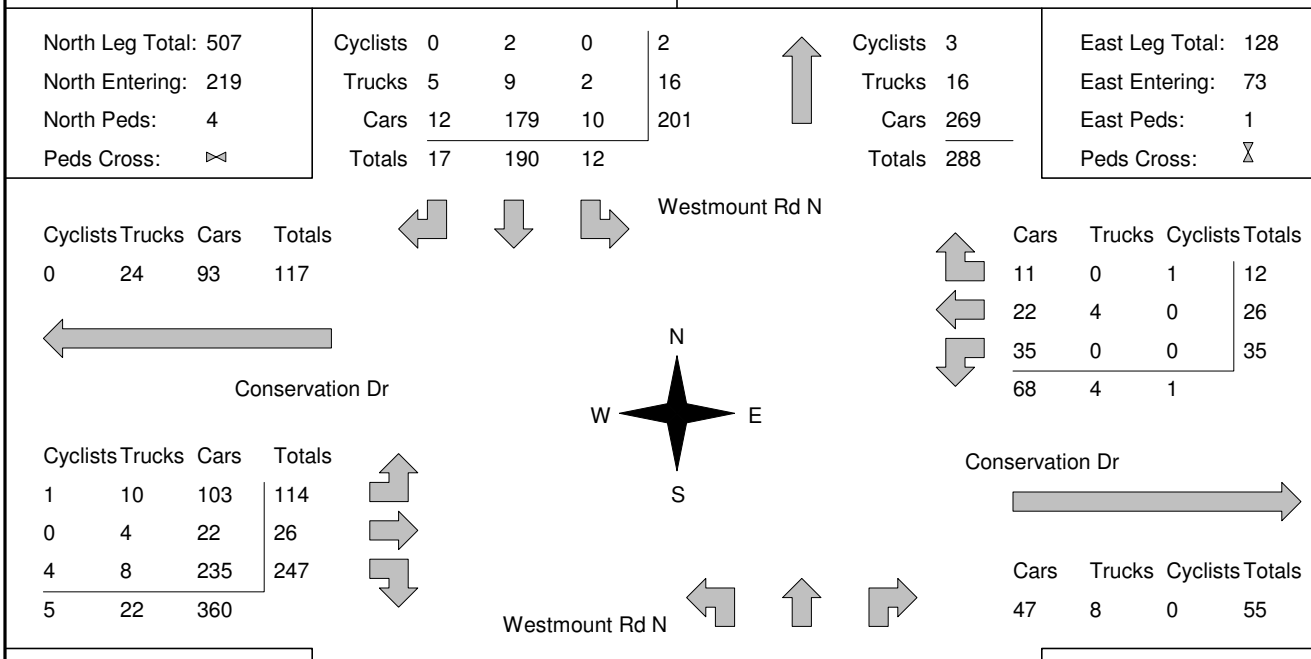
Municipality: Waterloo
Site #: 0000000001
Intersection: Westmount Rd N & Conservation Dr
TFR File #: 5
Count date: 26-Jun-2017

Weather conditions:
Overcast/Dry

Person(s) who counted:
Armando

**** Non-Signalized Intersection ****

Major Road: Westmount Rd N runs N/S



Comments

Westmount Rd N @ Conservation Dr

Afternoon Peak Diagram

Specified Period
From: 15:00:00
To: 18:00:00

One Hour Peak
From: 17:00:00
To: 18:00:00

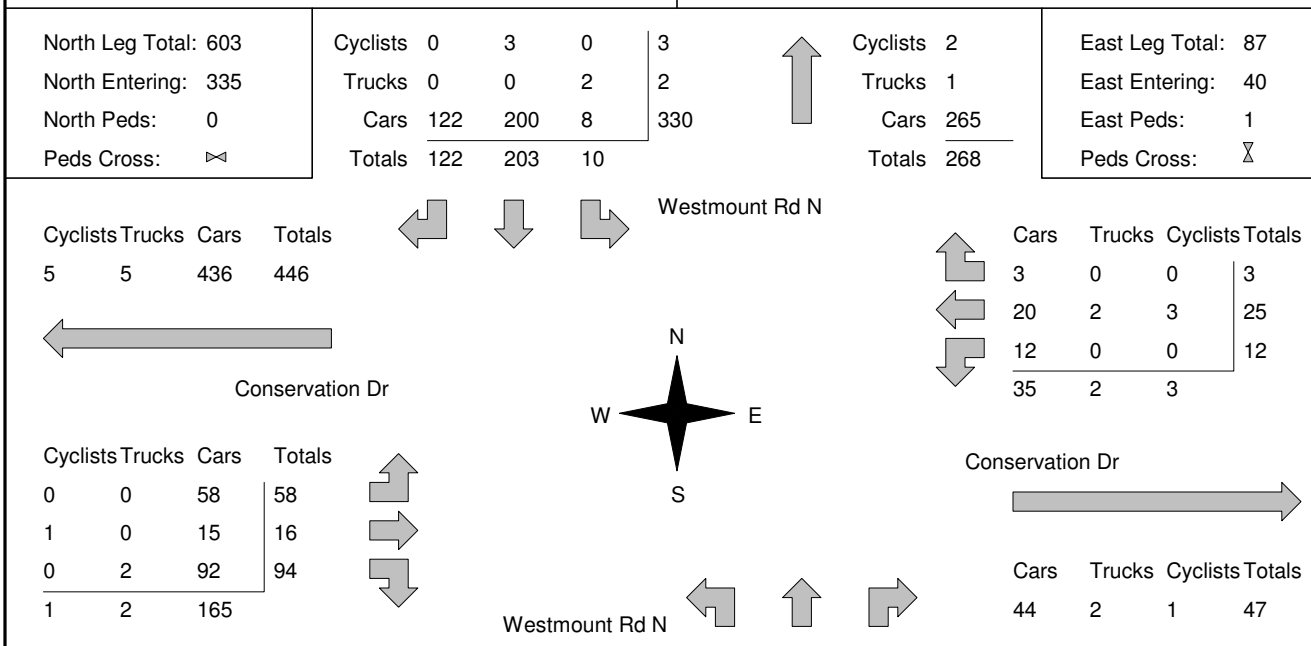
Municipality: Waterloo
Site #: 0000000001
Intersection: Westmount Rd N & Conservation Dr
TFR File #: 5
Count date: 26-Jun-2017

Weather conditions:
Overcast/Dry

Person(s) who counted:
Armando

**** Non-Signalized Intersection ****

Major Road: Westmount Rd N runs N/S



Comments

Beaver Creek Rd @ Laurelwood Dr

Morning Peak Diagram

Specified Period
From: 7:30:00
To: 10:30:00

One Hour Peak
From: 8:00:00
To: 9:00:00

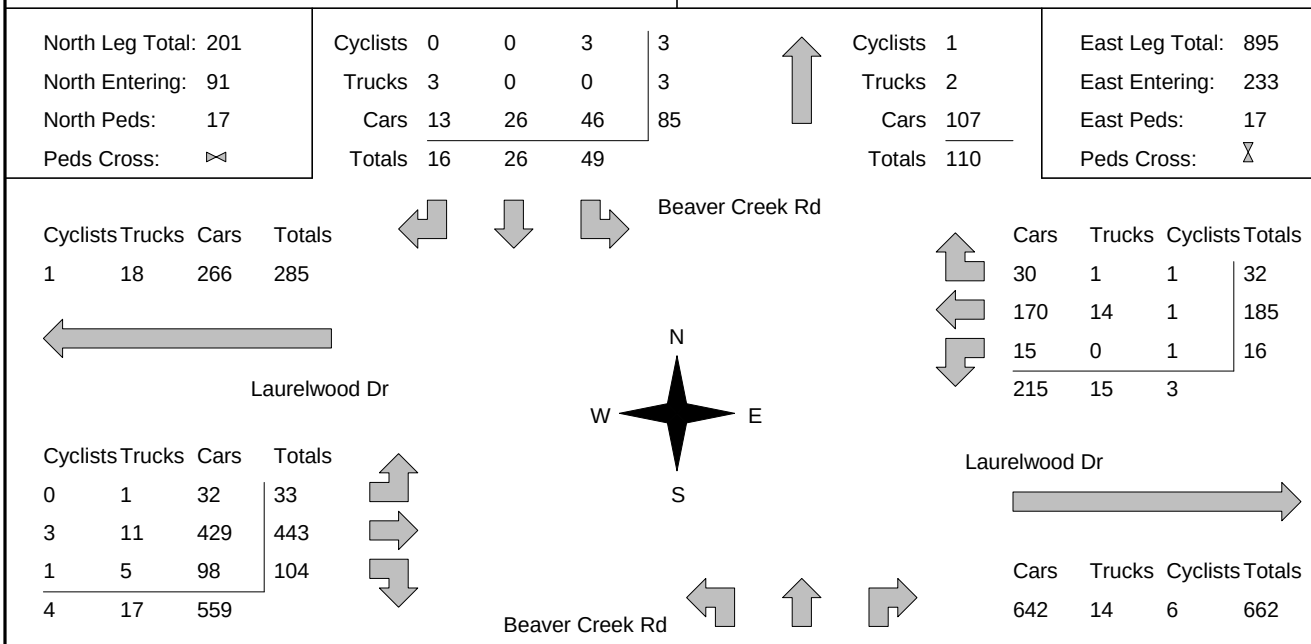
Municipality: Waterloo
Site #: 0000000022
Intersection: Laurelwood Dr & Beaver Creek Rd
TFR File #: 1
Count date: 19-Oct-2015

Weather conditions:
Sunny/Dry

Person(s) who counted:
Eugene

**** Non-Signalized Intersection ****

Major Road: Laurelwood Dr runs W/E



Comments

Beaver Creek Rd @ Laurelwood Dr

Afternoon Peak Diagram

Specified Period
From: 15:00:00
To: 18:00:00

One Hour Peak
From: 17:00:00
To: 18:00:00

Municipality: Waterloo
Site #: 0000000022
Intersection: Laurelwood Dr & Beaver Creek Rd
TFR File #: 1
Count date: 19-Oct-2015

Weather conditions:
Sunny/Dry

Person(s) who counted:
Eugene

**** Non-Signalized Intersection ****

Major Road: Laurelwood Dr runs W/E

North Leg Total: 276
North Entering: 181
North Peds: 8
Peds Cross: ⋈

Cyclists	0	1	1	2
Trucks	1	0	0	1
Cars	69	63	46	178
Totals	70	64	47	

Cyclists	3
Trucks	0
Cars	92
Totals	95

East Leg Total: 942
East Entering: 614
East Peds: 0
Peds Cross: ⧖

Beaver Creek Rd

Cyclists	Trucks	Cars	Totals
8	5	546	559

Cars	Trucks	Cyclists	Totals
48	0	2	50
429	4	7	440
122	1	1	124
599	5	10	

Laurelwood Dr

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Cyclists	Trucks	Cars	Totals
1	0	22	23
0	4	215	219
0	0	46	46
1	4	283	

Laurelwood Dr

Cars	Trucks	Cyclists	Totals
323	4	1	328

Beaver Creek Rd

Peds Cross: ⧖
West Peds: 0
West Entering: 288
West Leg Total: 847

Cars	231
Trucks	1
Cyclists	2
Totals	234

Cars	48	22	62	132
Trucks	0	0	0	0
Cyclists	1	0	0	1
Totals	49	22	62	

Peds Cross: ⋈
South Peds: 7
South Entering: 133
South Leg Total: 367

Comments

Wilmot Line @ Conservation Dr

Morning Peak Diagram

Specified Period
From: 7:30:00
To: 10:30:00

One Hour Peak
From: 7:30:00
To: 8:30:00

Municipality: Waterloo
Site #: 0000000004
Intersection: Wilmot Line & Conservation Dr
TFR File #: 1
Count date: 13-Oct-2015

Weather conditions:
Cloudy/Dry am, Rain mid+pm

Person(s) who counted:
Eugene

**** Non-Signalized Intersection ****

Major Road: Wilmot Line runs N/S

North Leg Total: 41
North Entering: 19
North Peds: 0
Peds Cross: ⋈

Cyclists	1	0	1
Trucks	3	0	3
Cars	11	4	15
Totals	15	4	

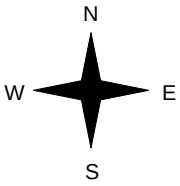
Cyclists	1
Trucks	2
Cars	19
Totals	22

East Leg Total: 72
East Entering: 21
East Peds: 0
Peds Cross: ⧖





Cars	Trucks	Cyclists	Totals
0	1	0	1
18	2	0	20
18	3	0	





Cars	Trucks	Cyclists	Totals
48	3	0	51



Cars	29		
Trucks	5		
Cyclists	1		
Totals	35		



Cars	19	44	63
Trucks	1	3	4
Cyclists	1	0	1
Totals	21	47	

Peds Cross: ⋈
South Peds: 0
South Entering: 68
South Leg Total: 103

Comments

Wilmot Line @ Conservation Dr

Afternoon Peak Diagram

Specified Period
From: 15:00:00
To: 18:00:00

One Hour Peak
From: 16:45:00
To: 17:45:00

Municipality: Waterloo
Site #: 0000000004
Intersection: Wilmot Line & Conservation Dr
TFR File #: 1
Count date: 13-Oct-2015

Weather conditions:
Cloudy/Dry am, Rain mid+pm

Person(s) who counted:
Eugene

**** Non-Signalized Intersection ****

Major Road: Wilmot Line runs N/S

North Leg Total: 31
North Entering: 18
North Peds: 0
Peds Cross: ⋈

Cyclists	0	0	0
Trucks	0	0	0
Cars	17	1	18
Totals	17	1	

Cyclists	0
Trucks	1
Cars	12
Totals	13

East Leg Total: 83
East Entering: 64
East Peds: 0
Peds Cross: ⋈

Wilmot Line

	Cars	Trucks	Cyclists	Totals
	2	0	0	2
	56	6	0	62
	58	6	0	

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Conservation Dr

Cars	Trucks	Cyclists	Totals
19	0	0	19

Wilmot Line

Cars	73
Trucks	6
Cyclists	0
Totals	79

Cars	10	18	28
Trucks	1	0	1
Cyclists	0	0	0
Totals	11	18	

Peds Cross: ⋈
South Peds: 0
South Entering: 29
South Leg Total: 108

Comments

Beaver Creek Rd @ Conservation Dr

Morning Peak Diagram

Specified Period
From: 7:30:00
To: 10:30:00

One Hour Peak
From: 7:45:00
To: 8:45:00

Municipality: Waterloo
Site #: 0000000019
Intersection: Conservation Dr & Beaver Creek Rc
TFR File #: 3
Count date: 21-Oct-2015

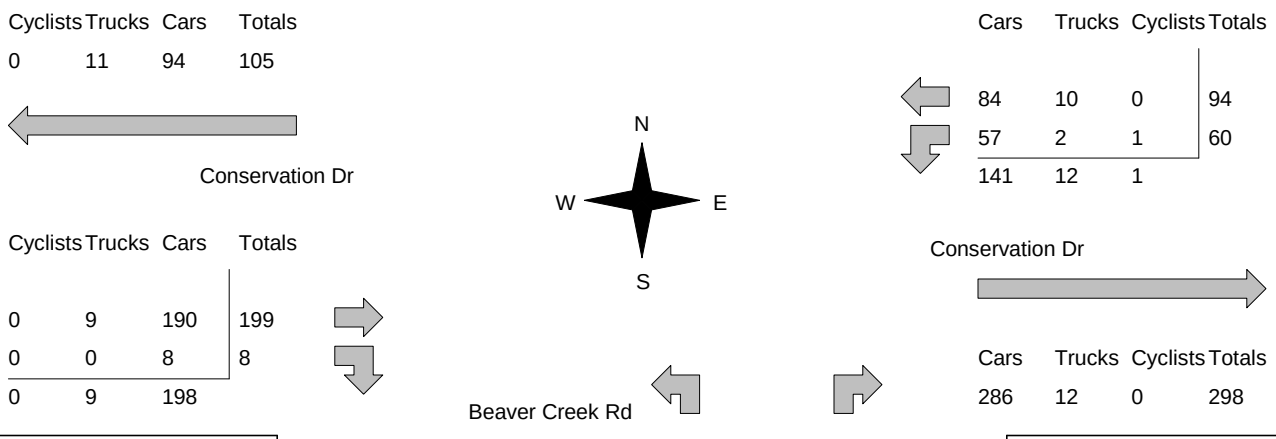
Weather conditions:
Rain

Person(s) who counted:
Rick W

**** Non-Signalized Intersection ****

Major Road: Conservation Dr runs W/E

East Leg Total: 452
East Entering: 154
East Peds: 0
Peds Cross:



Peds Cross:
West Peds: 0
West Entering: 207
West Leg Total: 312

Cars 65
Trucks 2
Cyclists 1
Totals 68

Cars 10 96 106
Trucks 1 3 4
Cyclists 0 0 0
Totals 11 99

Peds Cross:
South Peds: 0
South Entering: 110
South Leg Total: 178

Comments

Beaver Creek Rd @ Conservation Dr

Afternoon Peak Diagram

Specified Period
From: 15:00:00
To: 18:00:00

One Hour Peak
From: 16:15:00
To: 17:15:00

Municipality: Waterloo
Site #: 0000000019
Intersection: Conservation Dr & Beaver Creek Rc
TFR File #: 3
Count date: 21-Oct-2015

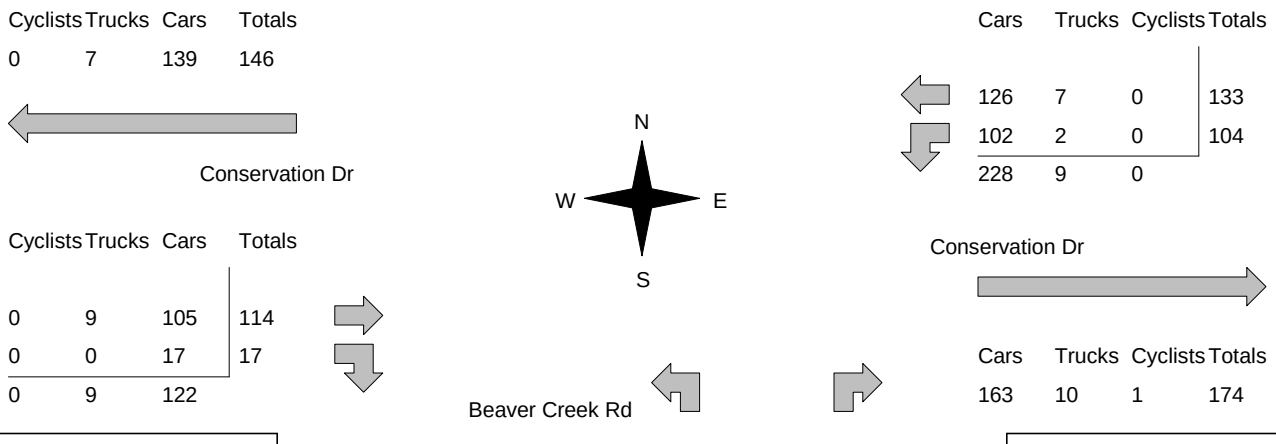
Weather conditions:
Rain

Person(s) who counted:
Rick W

**** Non-Signalized Intersection ****

Major Road: Conservation Dr runs W/E

East Leg Total: 411
East Entering: 237
East Peds: 0
Peds Cross: ⧖



Peds Cross: ⧖
West Peds: 0
West Entering: 131
West Leg Total: 277

Cars 119
Trucks 2
Cyclists 0
Totals 121

Cars 13 58 71
Trucks 0 1 1
Cyclists 0 1 1
Totals 13 60

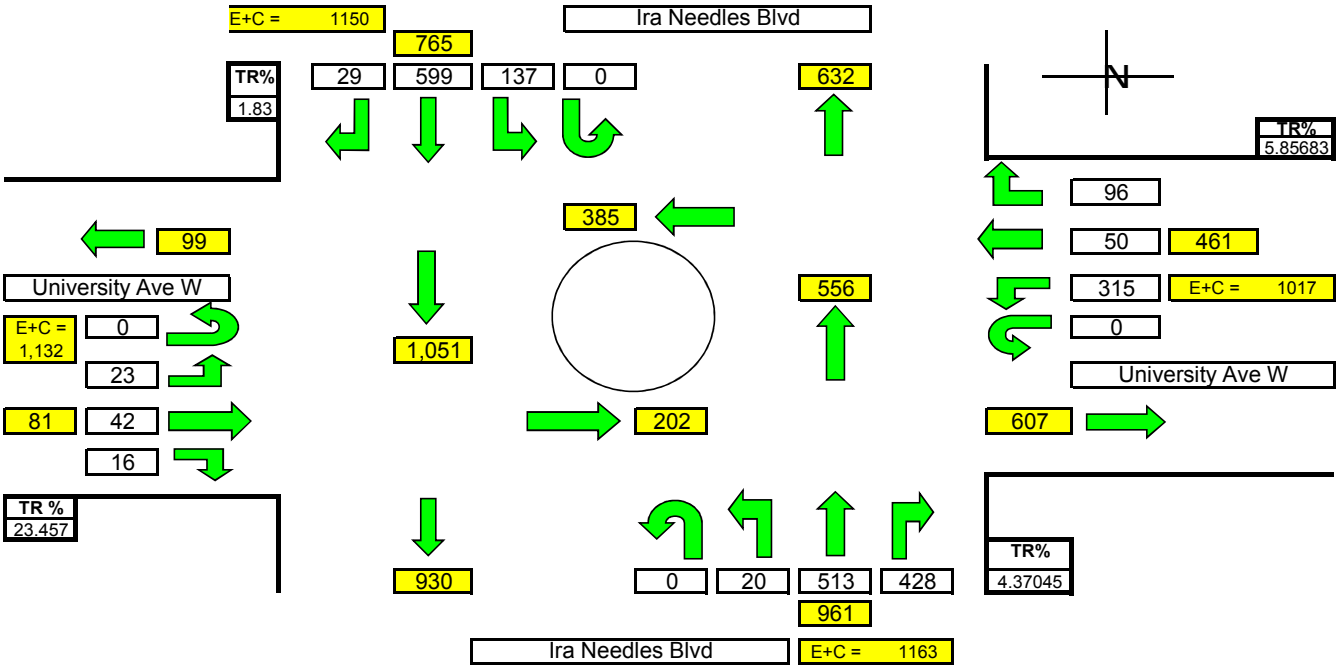
Peds Cross: ⋈
South Peds: 0
South Entering: 73
South Leg Total: 194

Comments

REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali
Project No.: **Sheet** 1 **of** 2
Intersection: Ira Needles Blvd/University Ave W
Time Period: AM PEAK

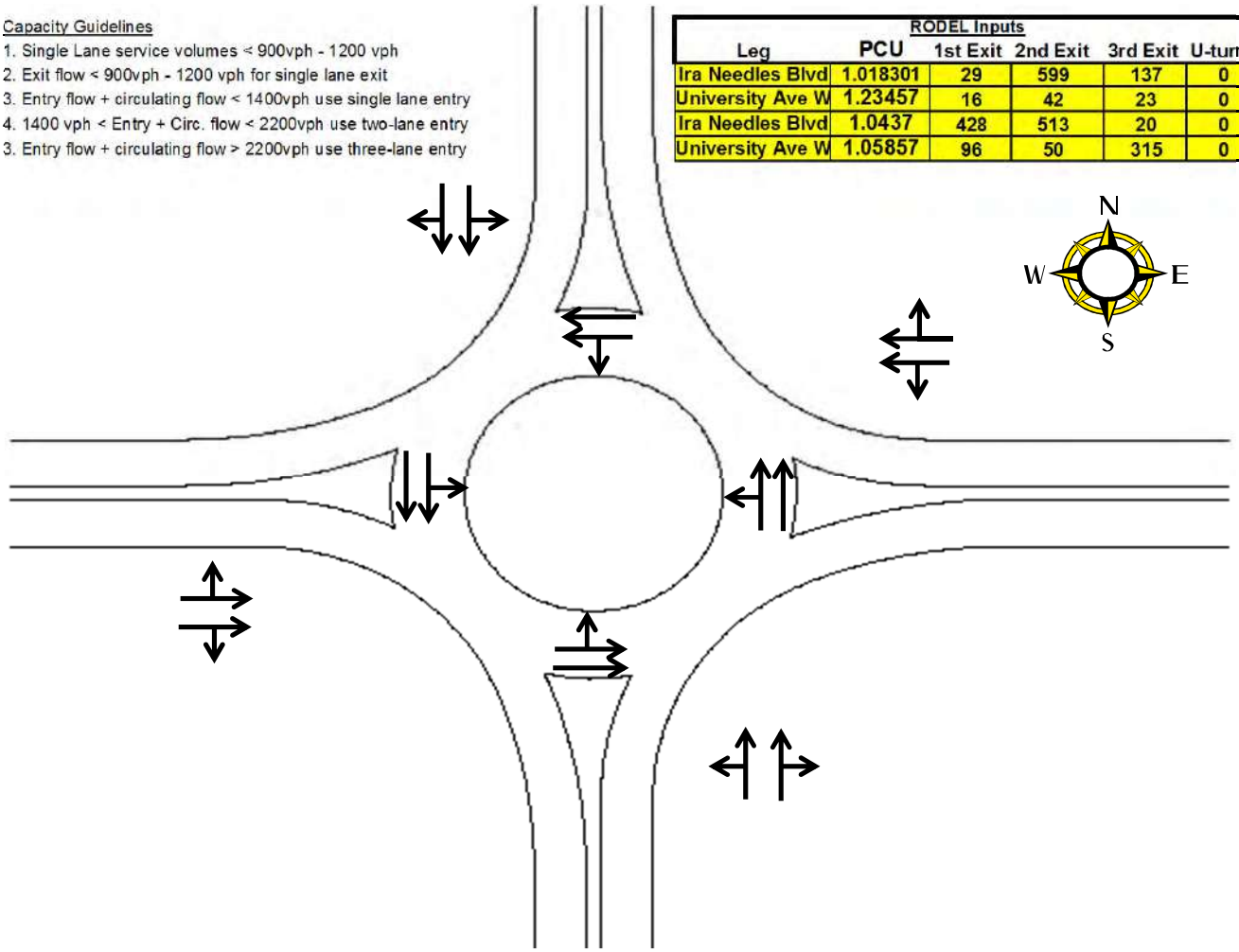


Capacity Guidelines

1. Single Lane service volumes ≤ 900vph - 1200 vph
2. Exit flow < 900vph - 1200 vph for single lane exit
3. Entry flow + circulating flow < 1400vph use single lane entry
4. 1400 vph < Entry + Circ. flow < 2200vph use two-lane entry
3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

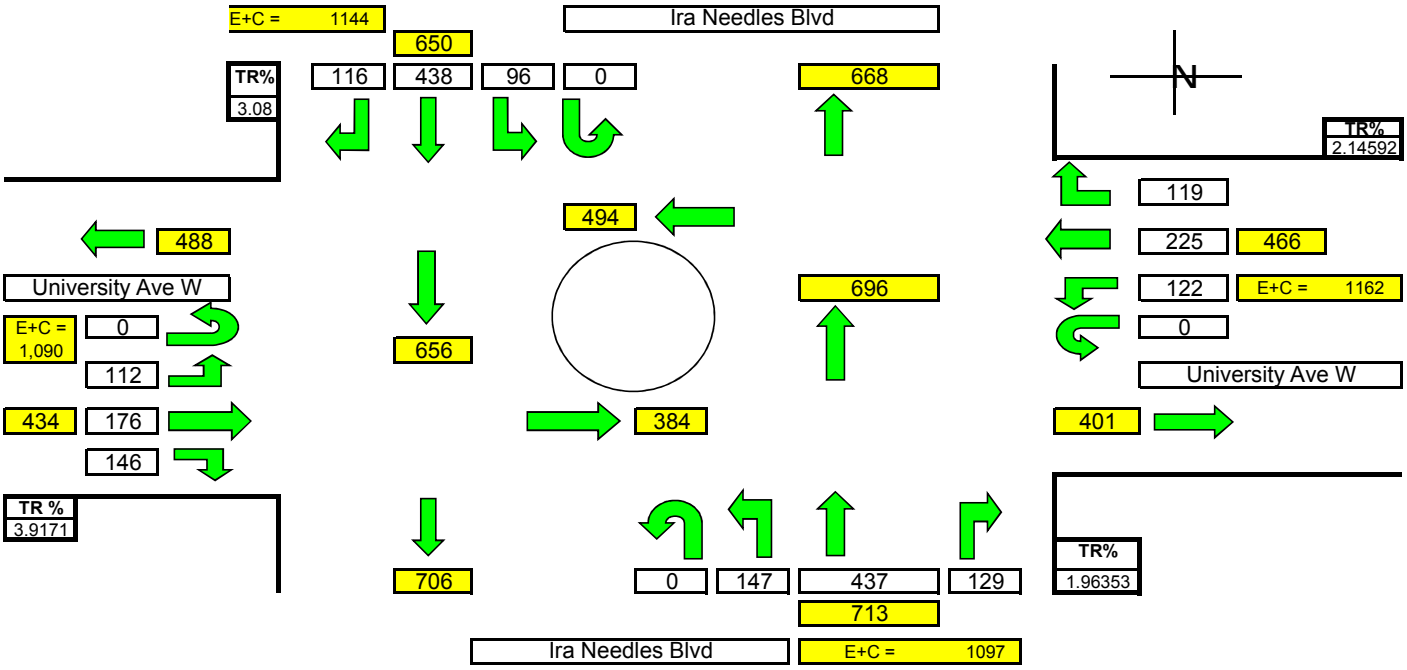
Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Ira Needles Blvd	1.018301	29	599	137	0
University Ave W	1.23457	16	42	23	0
Ira Needles Blvd	1.0437	428	513	20	0
University Ave W	1.05857	96	50	315	0



REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali
Project No.: **Sheet** 2 of 2
Intersection: Ira Needles Blvd/University Ave W
Time Period: PM PEAK

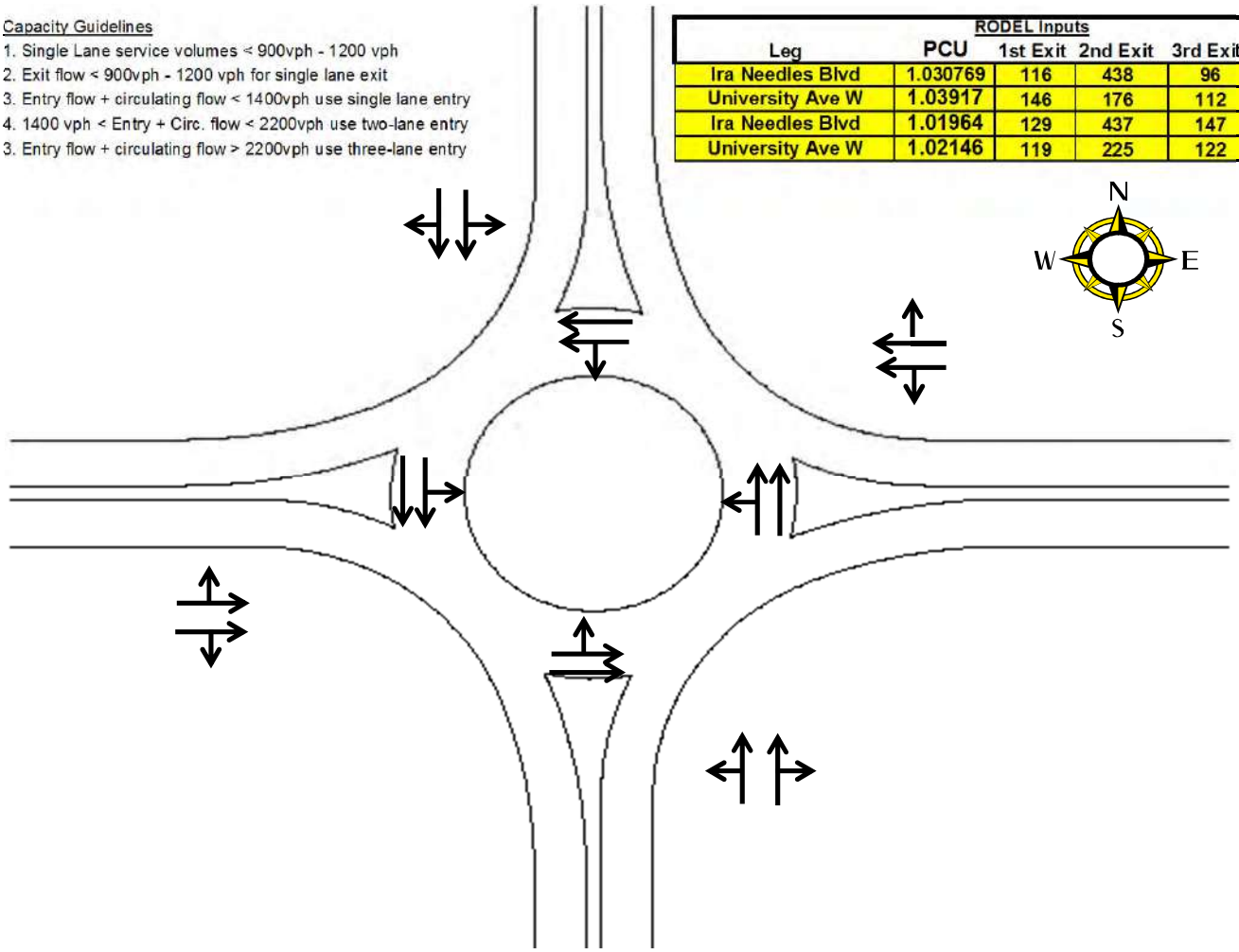


Capacity Guidelines

1. Single Lane service volumes ≤ 900vph - 1200 vph
2. Exit flow < 900vph - 1200 vph for single lane exit
3. Entry flow + circulating flow < 1400vph use single lane entry
4. 1400 vph < Entry + Circ. flow < 2200vph use two-lane entry
3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Ira Needles Blvd	1.030769	116	438	96	0
University Ave W	1.03917	146	176	112	0
Ira Needles Blvd	1.01964	129	437	147	0
University Ave W	1.02146	119	225	122	0

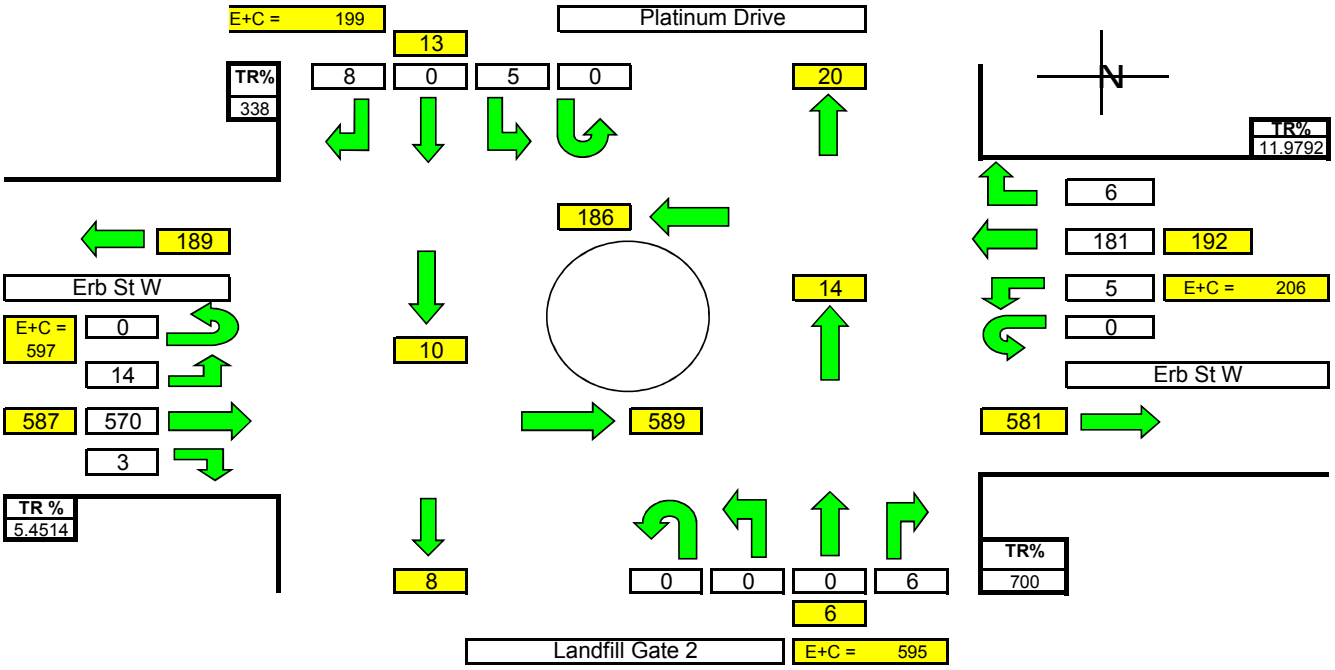


REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME
Project No.:
Intersection: Erb St W/Platinum Drive
Time Period: AM PEAK

Drawn By: Ubaid Ali
Sheet 1 **of** 2

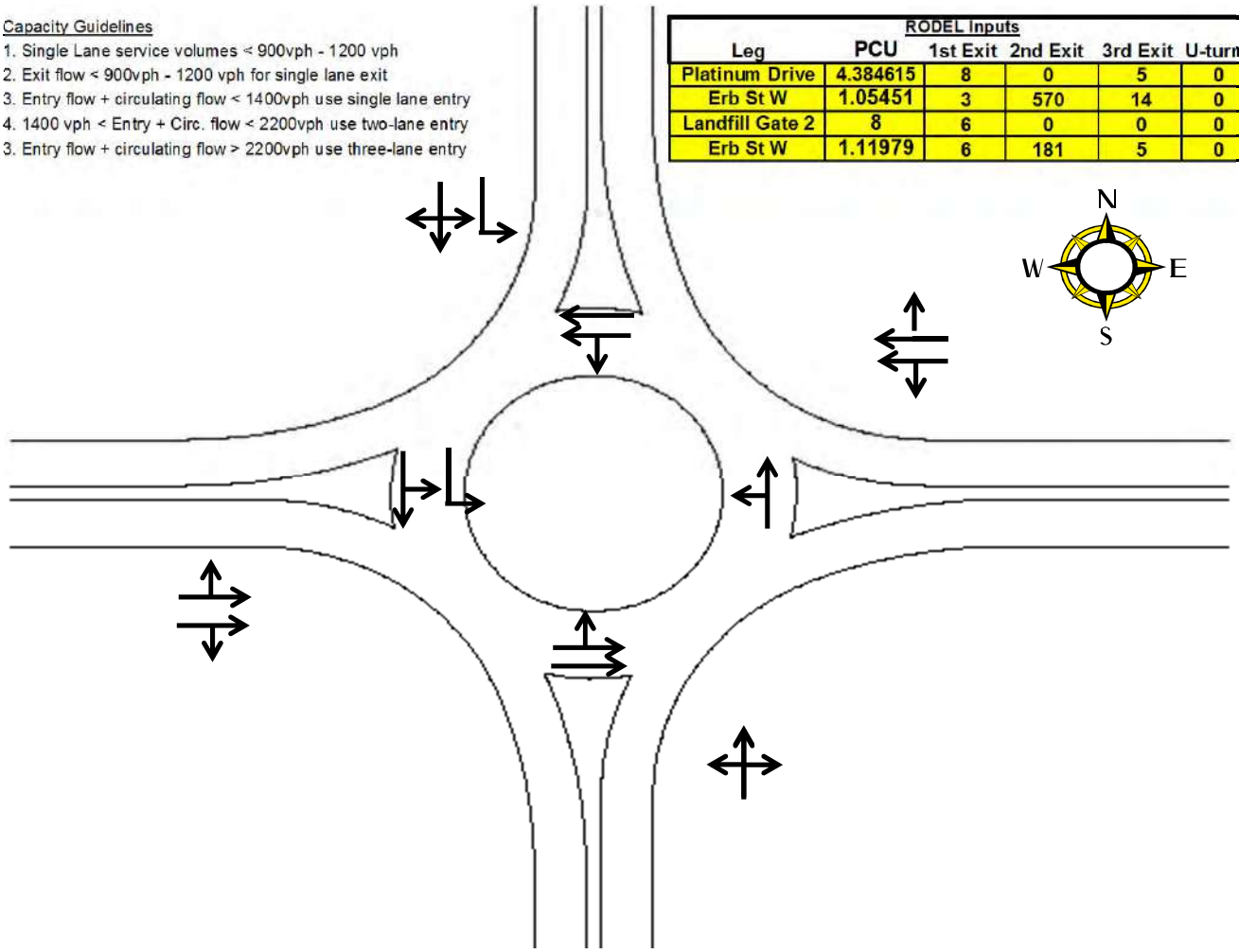


Capacity Guidelines

1. Single Lane service volumes ≤ 900vph - 1200 vph
2. Exit flow < 900vph - 1200 vph for single lane exit
3. Entry flow + circulating flow < 1400vph use single lane entry
4. 1400 vph < Entry + Circ. flow < 2200vph use two-lane entry
3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Platinum Drive	4.384615	8	0	5	0
Erb St W	1.05451	3	570	14	0
Landfill Gate 2	8	6	0	0	0
Erb St W	1.11979	6	181	5	0

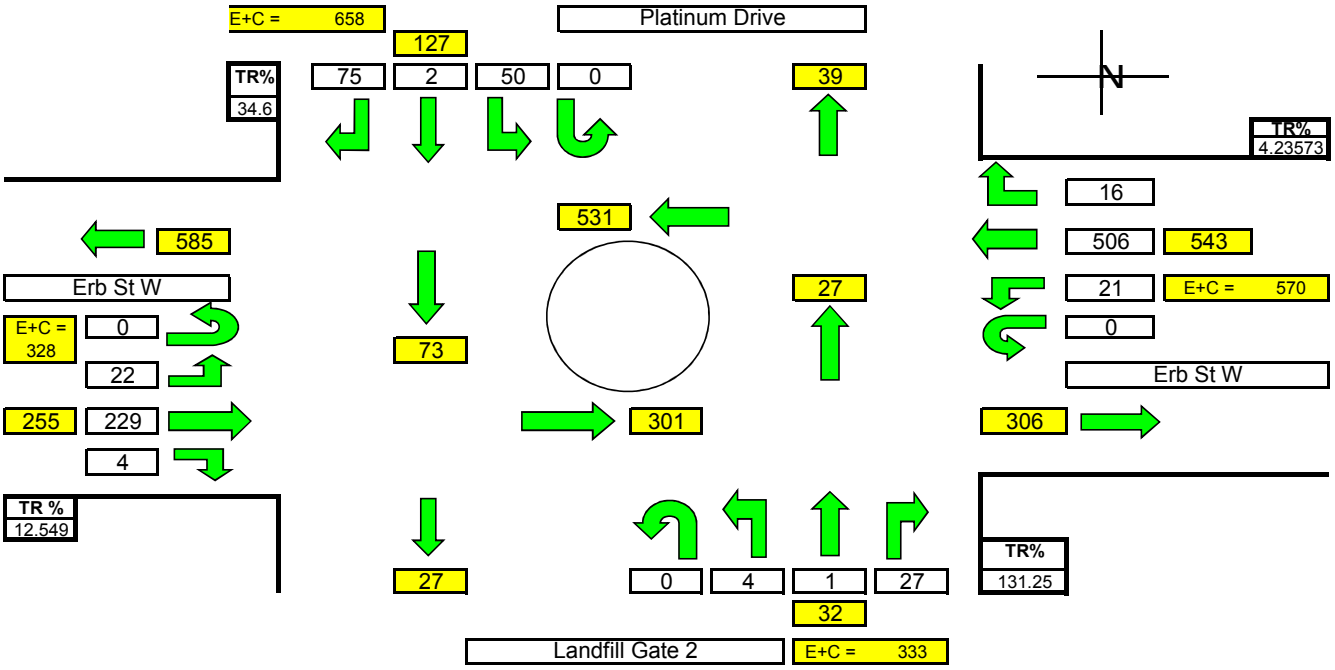


REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME
Project No.:
Intersection: Erb St W/Platinum Drive
Time Period: PM PEAK

Drawn By: Ubaid Ali
Sheet 1 **of** 2

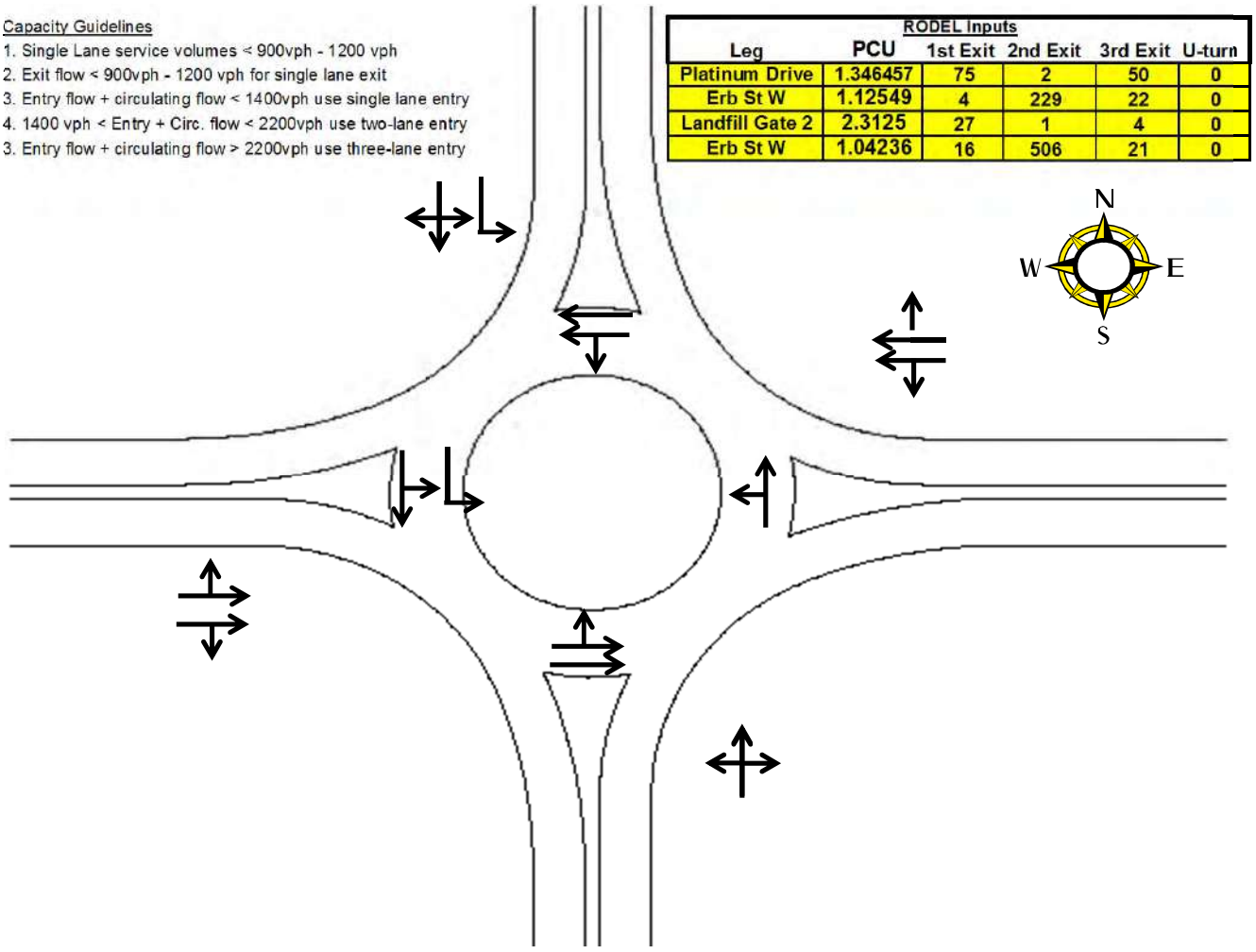


Capacity Guidelines

1. Single Lane service volumes ≤ 900vph - 1200 vph
2. Exit flow < 900vph - 1200 vph for single lane exit
3. Entry flow + circulating flow < 1400vph use single lane entry
4. 1400 vph < Entry + Circ. flow < 2200vph use two-lane entry
3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Platinum Drive	1.346457	75	2	50	0
Erb St W	1.12549	4	229	22	0
Landfill Gate 2	2.3125	27	1	4	0
Erb St W	1.04236	16	506	21	0



REGIONAL MUNICIPALITY OF WATERLOO
TURNING MOVEMENT COUNT

Region of Waterloo

Morning Peak Diagram

Count Period
From: 7:30 AM
To: 10:30 AM

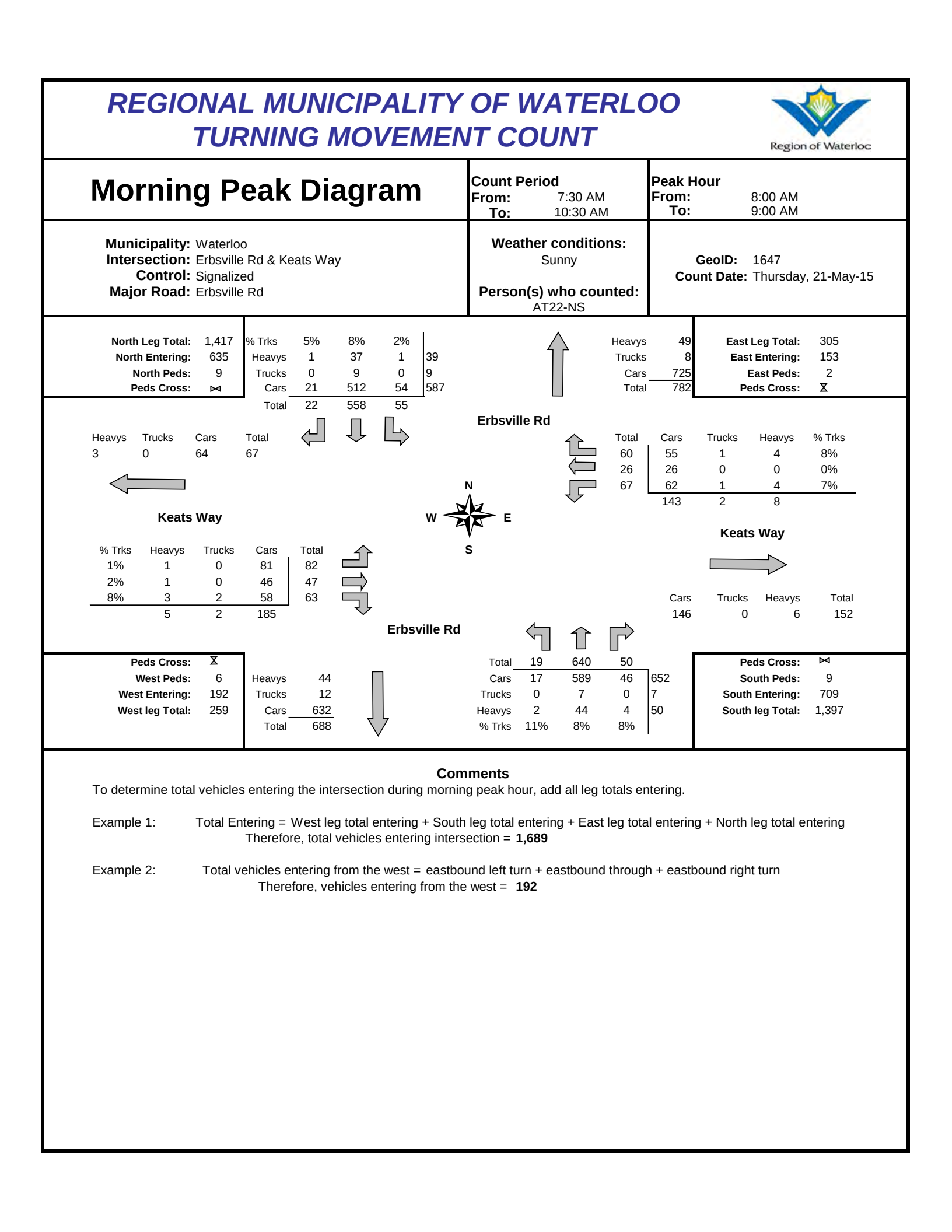
Peak Hour
From: 8:00 AM
To: 9:00 AM

Municipality: Waterloo
Intersection: Erbsville Rd & Keats Way
Control: Signalized
Major Road: Erbsville Rd

Weather conditions: Sunny

Person(s) who counted: AT22-NS

GeoID: 1647
Count Date: Thursday, 21-May-15



Comments

To determine total vehicles entering the intersection during morning peak hour, add all leg totals entering.

Example 1: Total Entering = West leg total entering + South leg total entering + East leg total entering + North leg total entering
Therefore, total vehicles entering intersection = **1,689**

Example 2: Total vehicles entering from the west = eastbound left turn + eastbound through + eastbound right turn
Therefore, vehicles entering from the west = **192**

REGIONAL MUNICIPALITY OF WATERLOO
TURNING MOVEMENT COUNT

Region of Waterloo

Afternoon Peak Diagram

Count Period
From: 3:00 PM
To: 6:00 PM

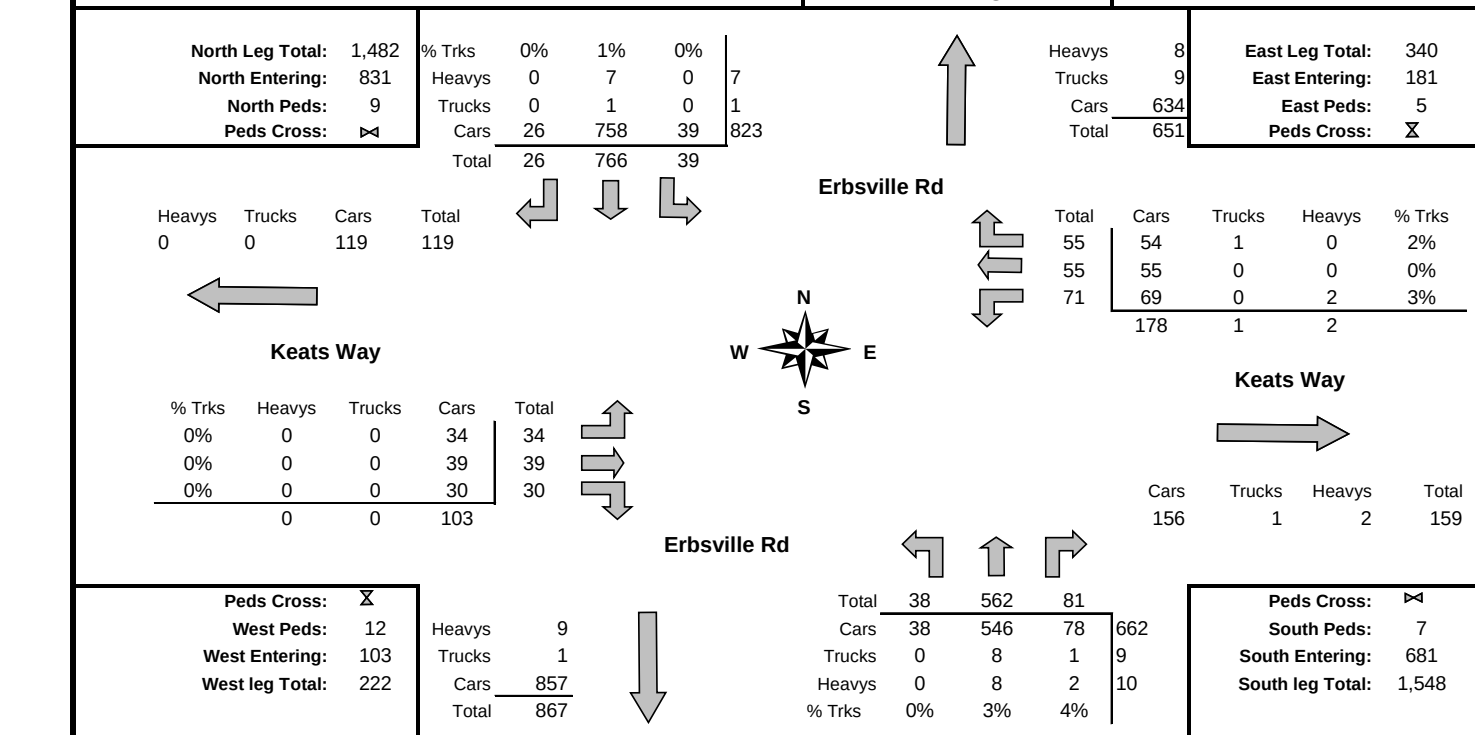
Peak Hour
From: 5:00 PM
To: 6:00 PM

Municipality: Waterloo
Intersection: Erbsville Rd & Keats Way
Control: Signalized
Major Road: Erbsville Rd

Weather conditions: Sunny

Person(s) who counted: AT22-NS

GeoID: 1647
Count Date: Thursday, 21-May-15



Comments

To determine total vehicles entering the intersection during afternoon peak hour, add all leg totals entering.

Total Entering = West leg total entering + South leg total entering + East leg total entering + North leg total entering

Example 1: Therefore, total vehicles entering intersection = **1,796**

Example 2: Total vehicles entering from the west = eastbound left turn + eastbound through + eastbound right turn

Therefore, vehicles entering from the west = **103**

REGIONAL MUNICIPALITY OF WATERLOO
TURNING MOVEMENT COUNT

Region of Waterloo

Morning Peak Diagram

Count Period
From: 7:30 AM
To: 10:30 AM

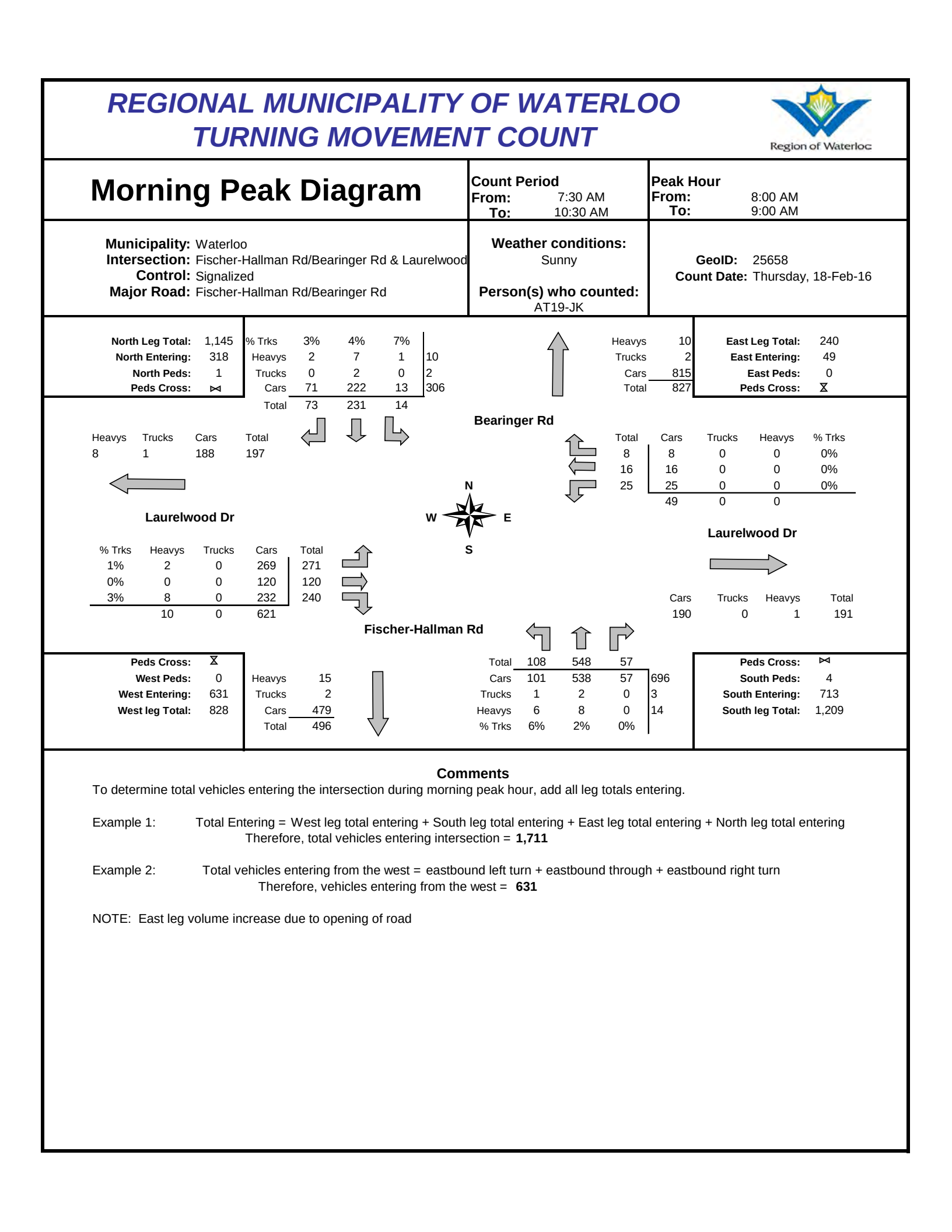
Peak Hour
From: 8:00 AM
To: 9:00 AM

Municipality: Waterloo
Intersection: Fischer-Hallman Rd/Bearinger Rd & Laurelwood
Control: Signalized
Major Road: Fischer-Hallman Rd/Bearinger Rd

Weather conditions: Sunny

Person(s) who counted: AT19-JK

GeoID: 25658
Count Date: Thursday, 18-Feb-16



Comments

To determine total vehicles entering the intersection during morning peak hour, add all leg totals entering.

Example 1: Total Entering = West leg total entering + South leg total entering + East leg total entering + North leg total entering
Therefore, total vehicles entering intersection = **1,711**

Example 2: Total vehicles entering from the west = eastbound left turn + eastbound through + eastbound right turn
Therefore, vehicles entering from the west = **631**

NOTE: East leg volume increase due to opening of road

REGIONAL MUNICIPALITY OF WATERLOO
TURNING MOVEMENT COUNT

Region of Waterloo

Afternoon Peak Diagram

Count Period
From: 3:00 PM
To: 6:00 PM

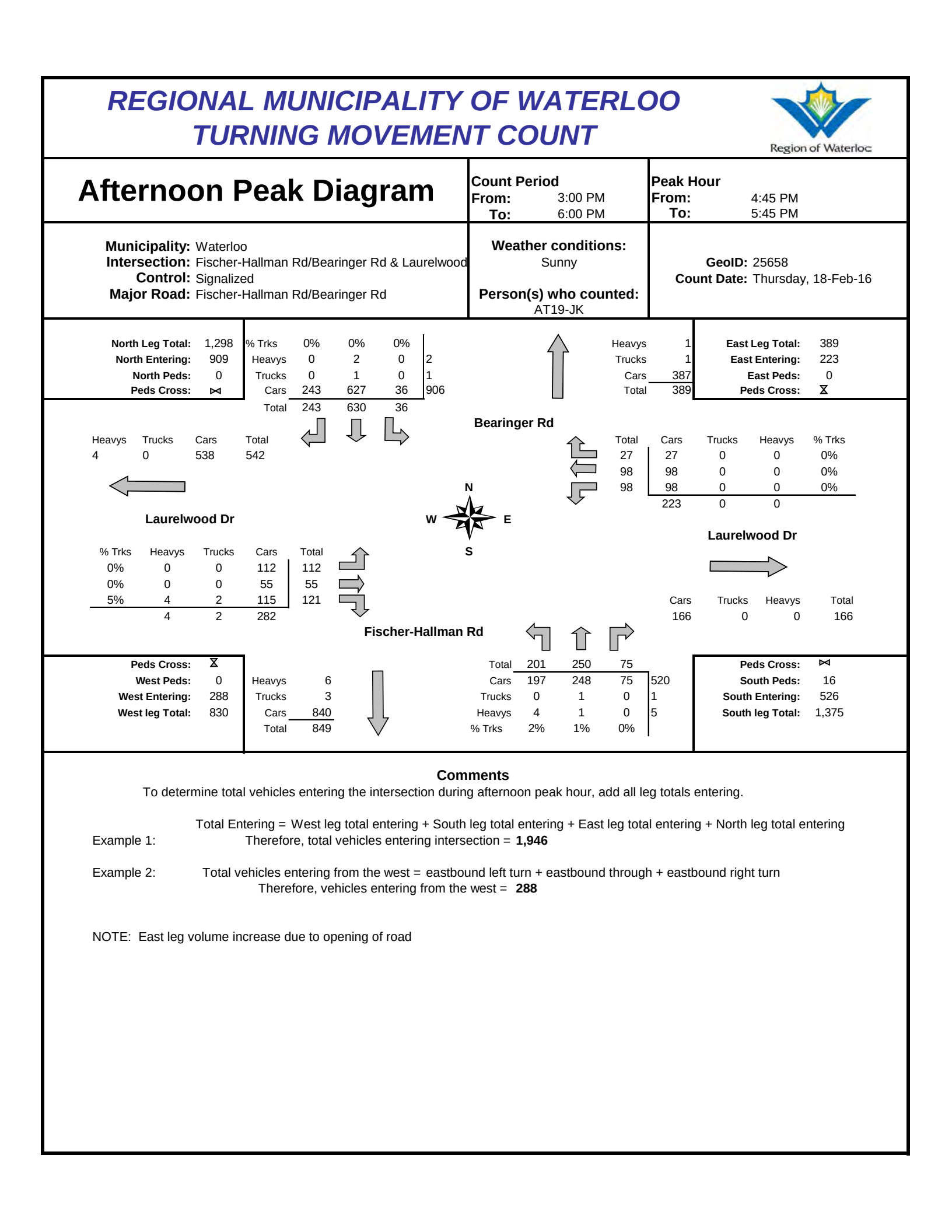
Peak Hour
From: 4:45 PM
To: 5:45 PM

Municipality: Waterloo
Intersection: Fischer-Hallman Rd/Bearinger Rd & Laurelwood
Control: Signalized
Major Road: Fischer-Hallman Rd/Bearinger Rd

Weather conditions: Sunny

Person(s) who counted: AT19-JK

GeoID: 25658
Count Date: Thursday, 18-Feb-16



Comments

To determine total vehicles entering the intersection during afternoon peak hour, add all leg totals entering.

Total Entering = West leg total entering + South leg total entering + East leg total entering + North leg total entering

Example 1: Therefore, total vehicles entering intersection = **1,946**

Example 2: Total vehicles entering from the west = eastbound left turn + eastbound through + eastbound right turn
Therefore, vehicles entering from the west = **288**

NOTE: East leg volume increase due to opening of road

REGIONAL MUNICIPALITY OF WATERLOO
TURNING MOVEMENT COUNT

Region of Waterloo

Morning Peak Diagram

Count Period
From: 7:30 AM
To: 10:30 AM

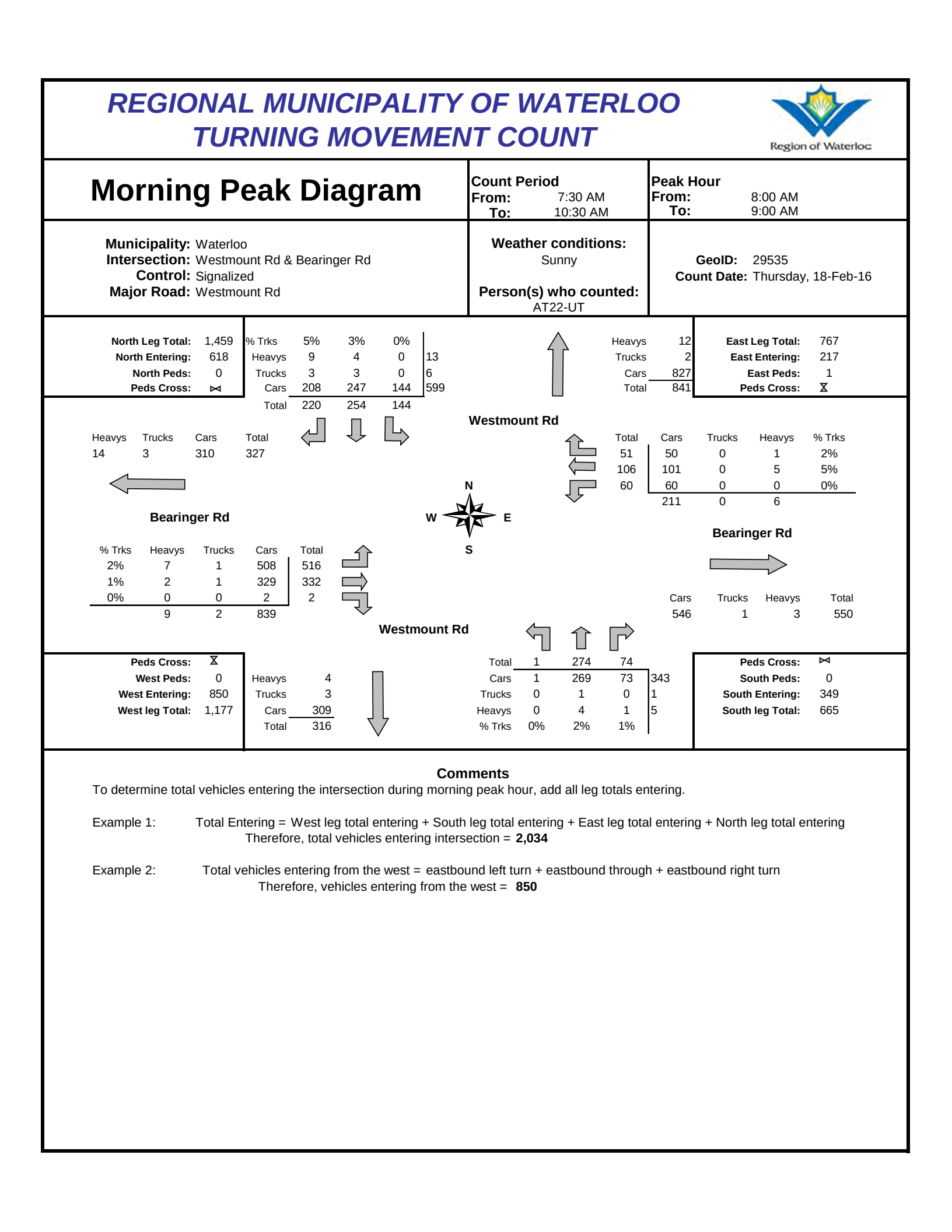
Peak Hour
From: 8:00 AM
To: 9:00 AM

Municipality: Waterloo
Intersection: Westmount Rd & Bearinger Rd
Control: Signalized
Major Road: Westmount Rd

Weather conditions: Sunny

Person(s) who counted: AT22-UT

GeoID: 29535
Count Date: Thursday, 18-Feb-16



Comments

To determine total vehicles entering the intersection during morning peak hour, add all leg totals entering.

Example 1: Total Entering = West leg total entering + South leg total entering + East leg total entering + North leg total entering
Therefore, total vehicles entering intersection = **2,034**

Example 2: Total vehicles entering from the west = eastbound left turn + eastbound through + eastbound right turn
Therefore, vehicles entering from the west = **850**

REGIONAL MUNICIPALITY OF WATERLOO
TURNING MOVEMENT COUNT

Region of Waterloo

Afternoon Peak Diagram

Count Period
From: 3:00 PM
To: 6:00 PM

Peak Hour
From: 4:30 PM
To: 5:30 PM

Municipality: Waterloo
Intersection: Westmount Rd & Bearinger Rd
Control: Signalized
Major Road: Westmount Rd

Weather conditions: Sunny

Person(s) who counted: AT22-UT

GeoID: 29535
Count Date: Thursday, 18-Feb-16

North Leg Total: 1,758
North Entering: 1,078
North Peds: 0
Peds Cross: ⋈

% Trks	1%	0%	0%	
Heavys	2	0	0	2
Trucks	1	1	0	2
Cars	594	432	48	1,074
Total	597	433	48	

Heavys	Trucks	Cars	Total
3	1	930	934

Bearinger Rd

% Trks	Heavys	Trucks	Cars	Total
2%	3	1	262	266
0%	0	0	177	177
0%	0	0	2	2
	3	1	441	

Westmount Rd

Total	3	294	81	
Cars	3	292	81	376
Trucks	0	2	0	2
Heavys	0	0	0	0
% Trks	0%	1%	0%	

Peds Cross: ⧖
West Peds: 0
West Entering: 445
West leg Total: 1,379

Heavys	0
Trucks	1
Cars	518
Total	519

Heavys	3
Trucks	3
Cars	674
Total	680

East Leg Total: 844
East Entering: 538
East Peds: 3
Peds Cross: ⧖

Westmount Rd

Total	Cars	Trucks	Heavys	% Trks
120	120	0	0	0%
334	333	0	1	0%
84	84	0	0	0%
	537	0	1	

Bearinger Rd

Cars	Trucks	Heavys	Total
306	0	0	306

Peds Cross: ⋈
South Peds: 0
South Entering: 378
South leg Total: 897

Comments

To determine total vehicles entering the intersection during afternoon peak hour, add all leg totals entering.

Total Entering = West leg total entering + South leg total entering + East leg total entering + North leg total entering

Example 1: Therefore, total vehicles entering intersection = **2,439**

Example 2: Total vehicles entering from the west = eastbound left turn + eastbound through + eastbound right turn

Therefore, vehicles entering from the west = **445**

REGIONAL MUNICIPALITY OF WATERLOO
TURNING MOVEMENT COUNT

Region of Waterloo

Morning Peak Diagram

Count Period
From: 7:30 AM
To: 10:30 AM

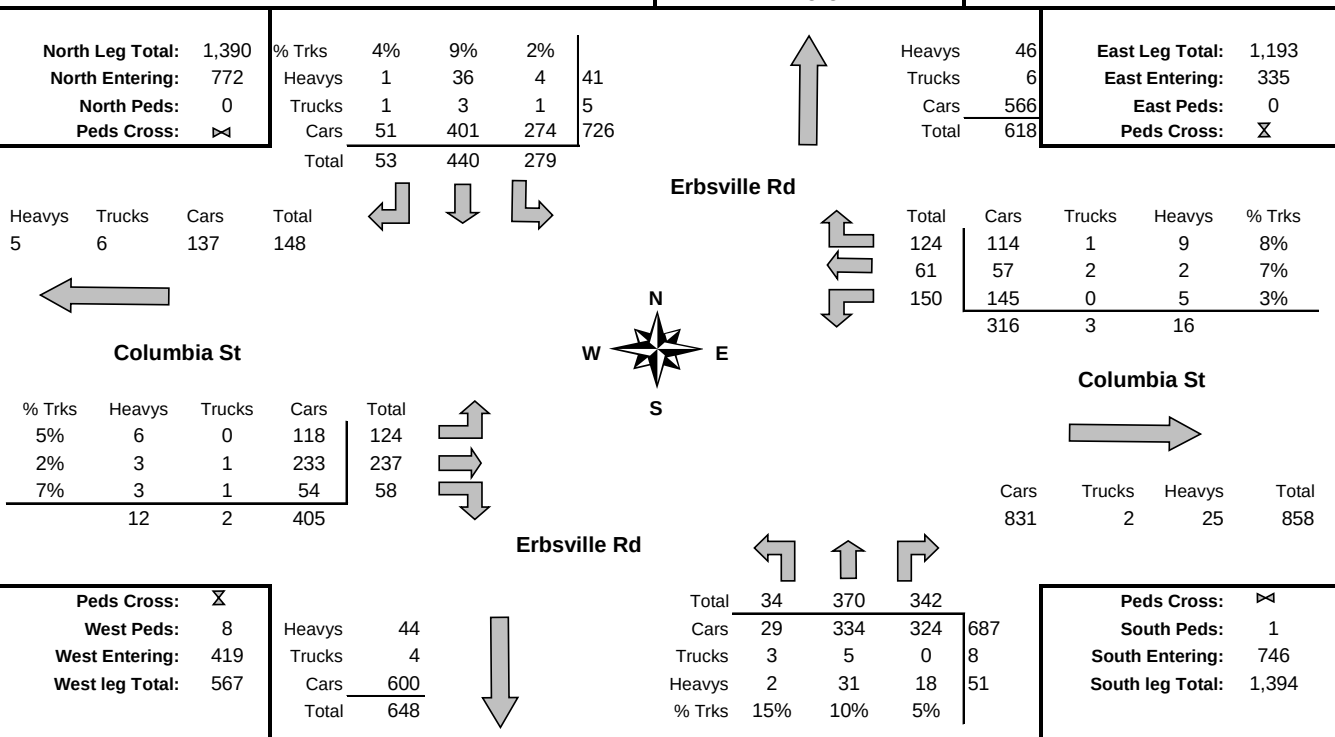
Peak Hour
From: 8:00 AM
To: 9:00 AM

Municipality: Waterloo
Intersection: Erbsville Rd & Columbia St
Control: Signalized
Major Road: Erbsville Rd

Weather conditions: Sunny

Person(s) who counted: AT23-UT

GeoID: 48
Count Date: Thursday, 21-May-15



Comments

To determine total vehicles entering the intersection during morning peak hour, add all leg totals entering.

Example 1: Total Entering = West leg total entering + South leg total entering + East leg total entering + North leg total entering
Therefore, total vehicles entering intersection = **2,272**

Example 2: Total vehicles entering from the west = eastbound left turn + eastbound through + eastbound right turn
Therefore, vehicles entering from the west = **419**

REGIONAL MUNICIPALITY OF WATERLOO
TURNING MOVEMENT COUNT

Region of Waterloo

Afternoon Peak Diagram

Count Period
From: 3:00 PM
To: 6:00 PM

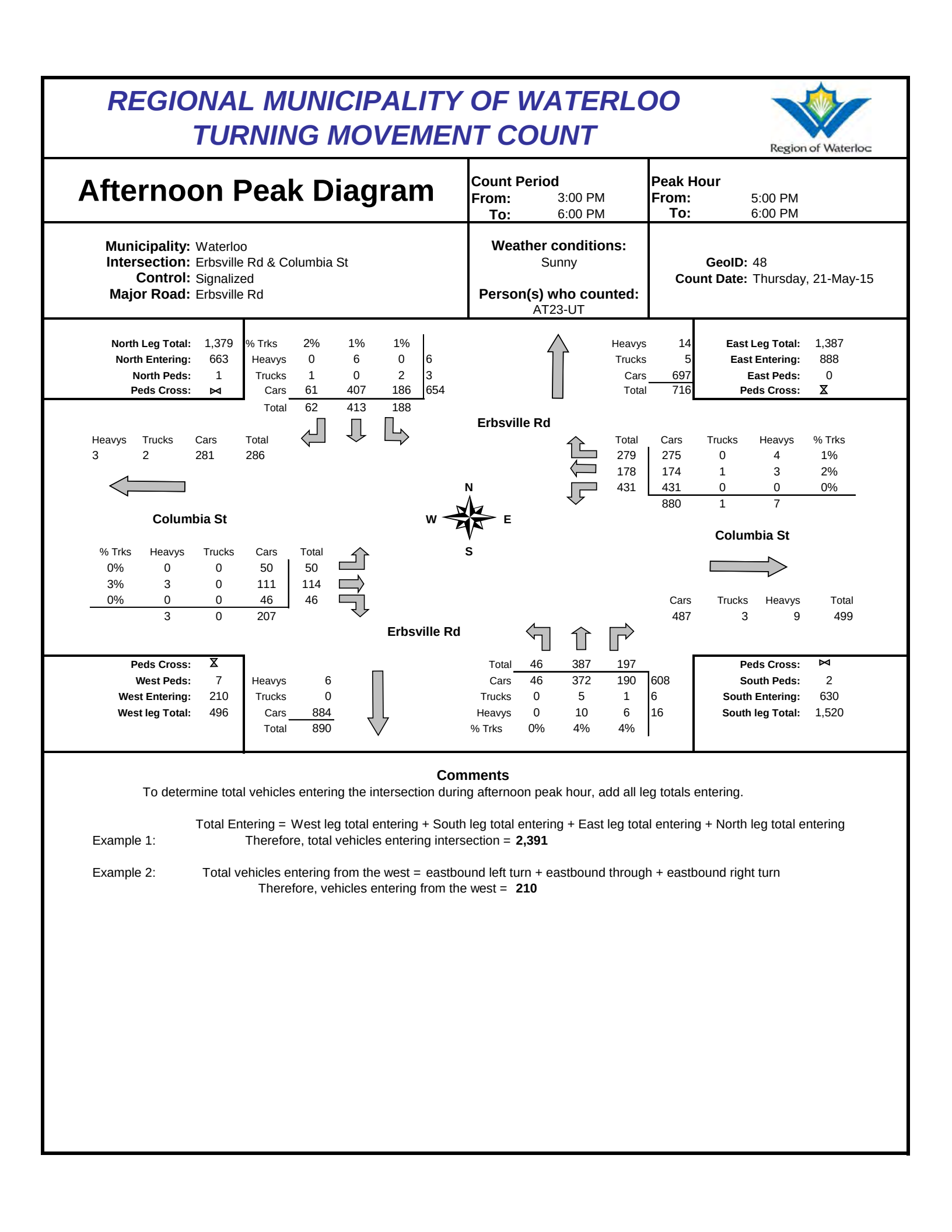
Peak Hour
From: 5:00 PM
To: 6:00 PM

Municipality: Waterloo
Intersection: Erbsville Rd & Columbia St
Control: Signalized
Major Road: Erbsville Rd

Weather conditions: Sunny

Person(s) who counted: AT23-UT

GeoID: 48
Count Date: Thursday, 21-May-15



Comments

To determine total vehicles entering the intersection during afternoon peak hour, add all leg totals entering.

Total Entering = West leg total entering + South leg total entering + East leg total entering + North leg total entering

Example 1: Therefore, total vehicles entering intersection = **2,391**

Example 2: Total vehicles entering from the west = eastbound left turn + eastbound through + eastbound right turn

Therefore, vehicles entering from the west = **210**

REGIONAL MUNICIPALITY OF WATERLOO
TURNING MOVEMENT COUNT

Region of Waterloo

Morning Peak Diagram

Count Period
From: 7:30 AM
To: 10:30 AM

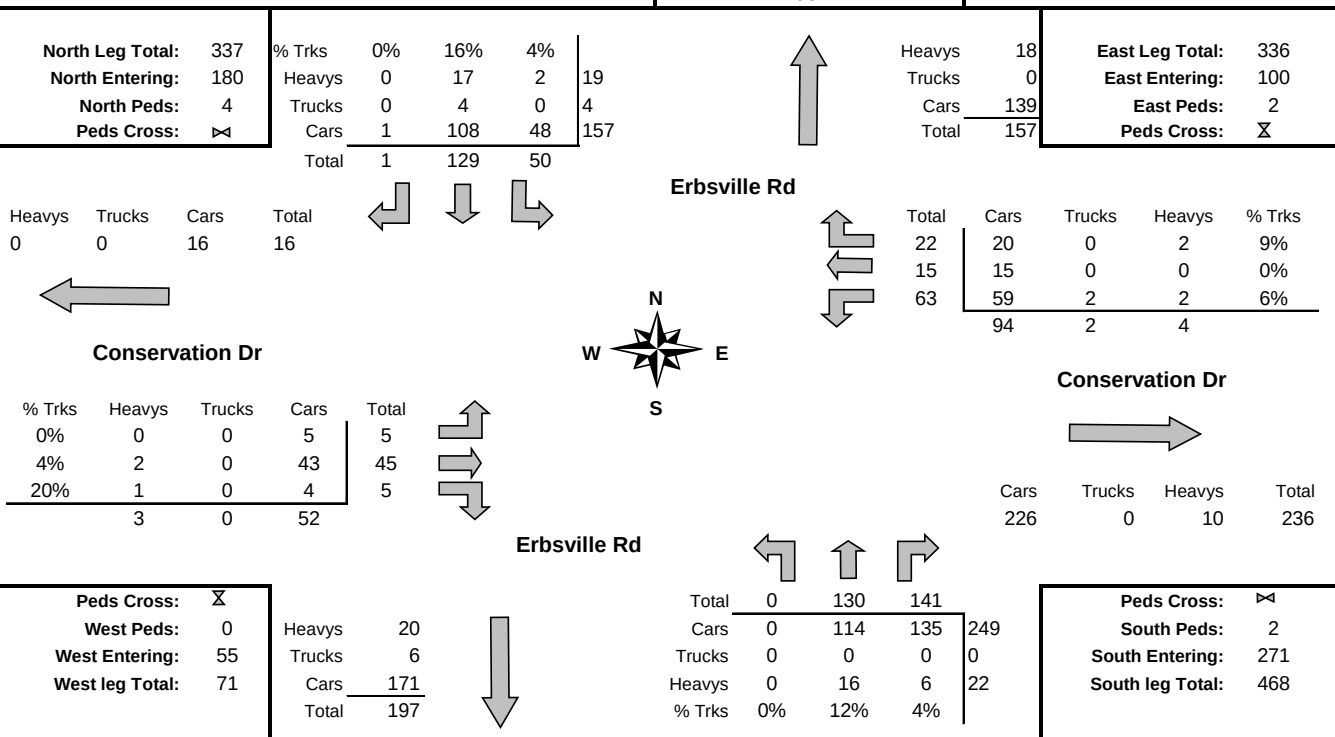
Peak Hour
From: 7:45 AM
To: 8:45 AM

Municipality: Waterloo
Intersection: Erbsville Rd & Conservation Dr
Control: Stop w/ IPS
Major Road: Erbsville Rd

Weather conditions: Sunny

Person(s) who counted: AT06-AP

GeoID: 4247
Count Date: Thursday, 21-May-15



Comments

To determine total vehicles entering the intersection during morning peak hour, add all leg totals entering.

Example 1: Total Entering = West leg total entering + South leg total entering + East leg total entering + North leg total entering
Therefore, total vehicles entering intersection = **606**

Example 2: Total vehicles entering from the west = eastbound left turn + eastbound through + eastbound right turn
Therefore, vehicles entering from the west = **55**

REGIONAL MUNICIPALITY OF WATERLOO
TURNING MOVEMENT COUNT

Region of Waterloo

Afternoon Peak Diagram

Count Period
From: 3:00 PM
To: 6:00 PM

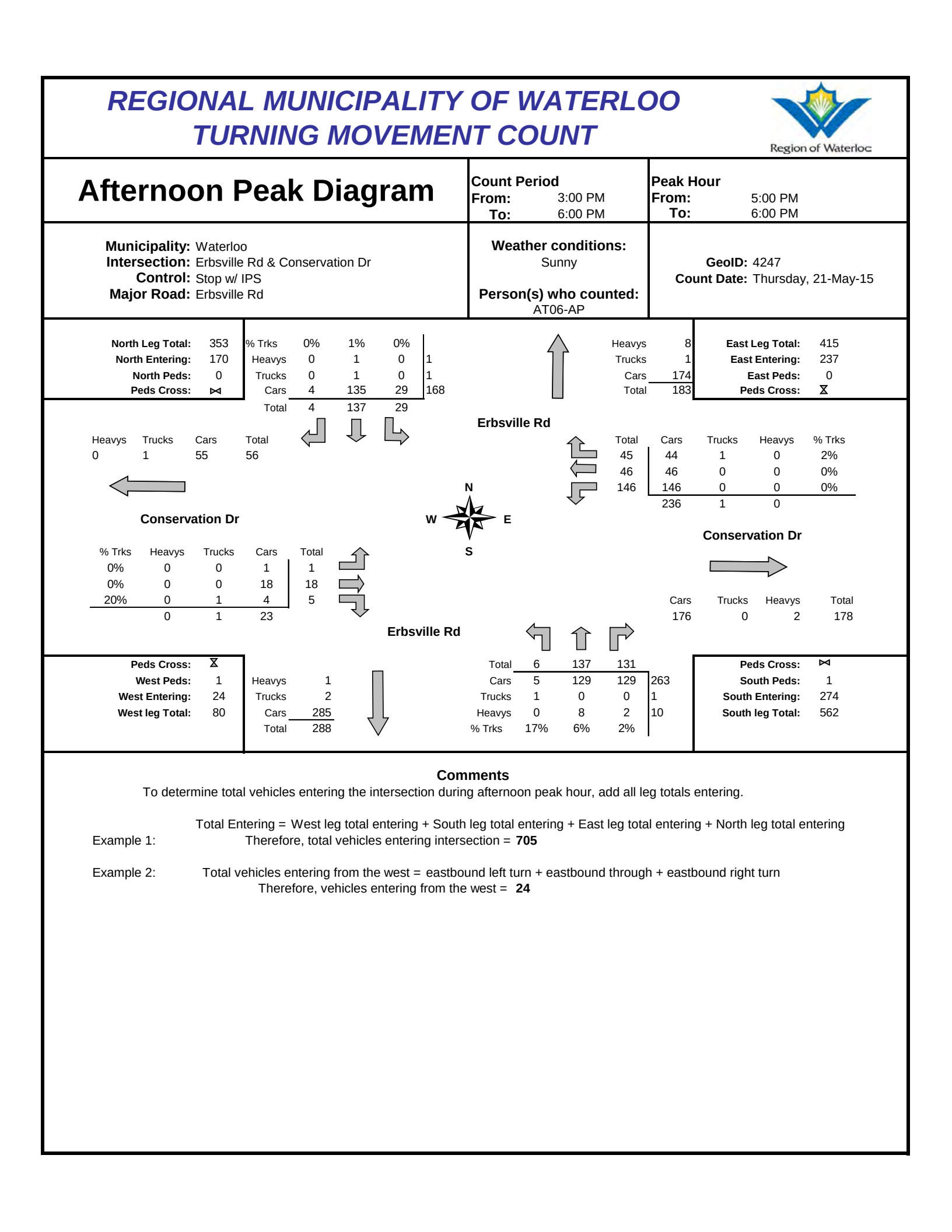
Peak Hour
From: 5:00 PM
To: 6:00 PM

Municipality: Waterloo
Intersection: Erbsville Rd & Conservation Dr
Control: Stop w/ IPS
Major Road: Erbsville Rd

Weather conditions: Sunny

Person(s) who counted: AT06-AP

GeoID: 4247
Count Date: Thursday, 21-May-15



Comments

To determine total vehicles entering the intersection during afternoon peak hour, add all leg totals entering.

Total Entering = West leg total entering + South leg total entering + East leg total entering + North leg total entering

Example 1: Therefore, total vehicles entering intersection = **705**

Example 2: Total vehicles entering from the west = eastbound left turn + eastbound through + eastbound right turn

Therefore, vehicles entering from the west = **24**

REGIONAL MUNICIPALITY OF WATERLOO
TURNING MOVEMENT COUNT

Region of Waterloo

Morning Peak Diagram

Count Period
From: 7:30 AM
To: 10:30 AM

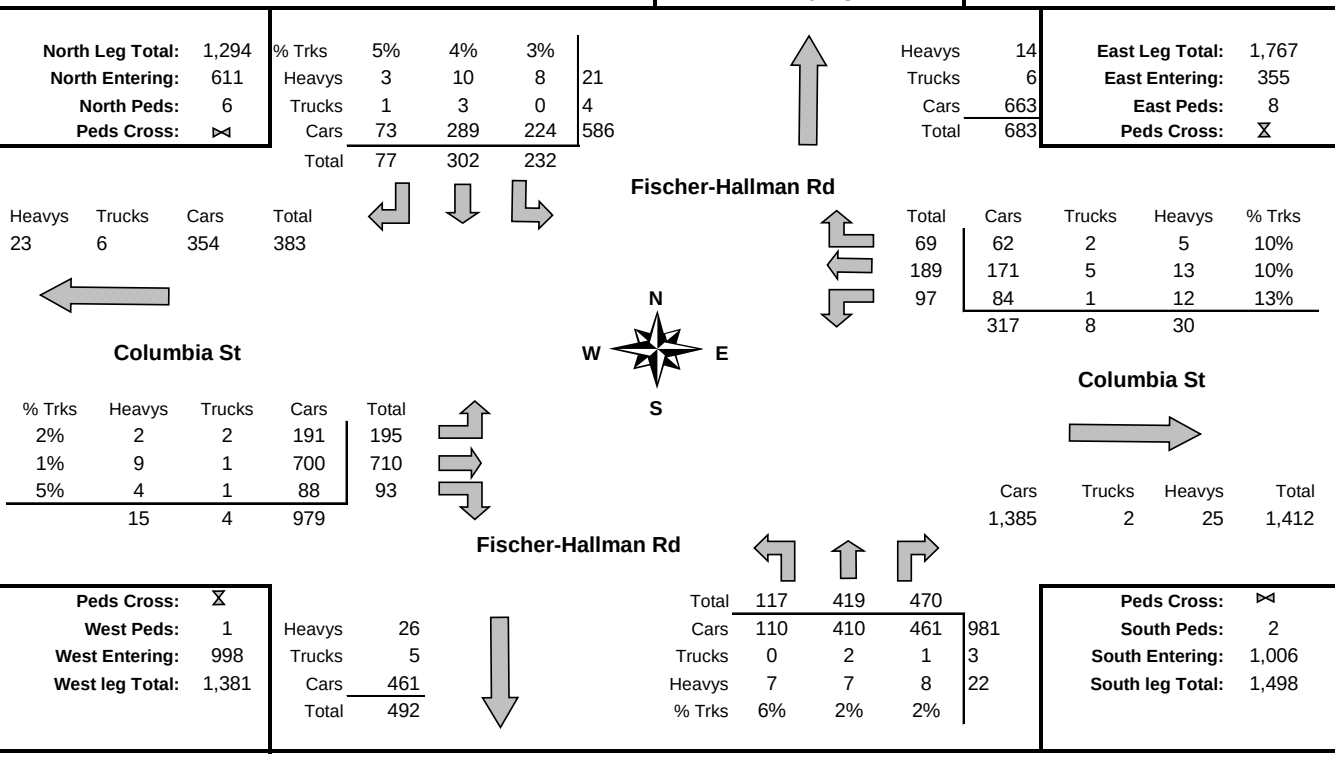
Peak Hour
From: 8:00 AM
To: 9:00 AM

Municipality: Waterloo
Intersection: Fischer-Hallman Rd & Columbia St
Control: Signalized
Major Road: Fischer-Hallman Rd

Weather conditions: Sunny

Person(s) who counted: AT16-NS

GeoID: 7303
Count Date: Thursday, 18-Feb-16



Comments

To determine total vehicles entering the intersection during morning peak hour, add all leg totals entering.

Example 1: Total Entering = West leg total entering + South leg total entering + East leg total entering + North leg total entering
Therefore, total vehicles entering intersection = **2,970**

Example 2: Total vehicles entering from the west = eastbound left turn + eastbound through + eastbound right turn
Therefore, vehicles entering from the west = **998**

REGIONAL MUNICIPALITY OF WATERLOO
TURNING MOVEMENT COUNT

Region of Waterloo

Afternoon Peak Diagram

Count Period
From: 3:00 PM
To: 6:00 PM

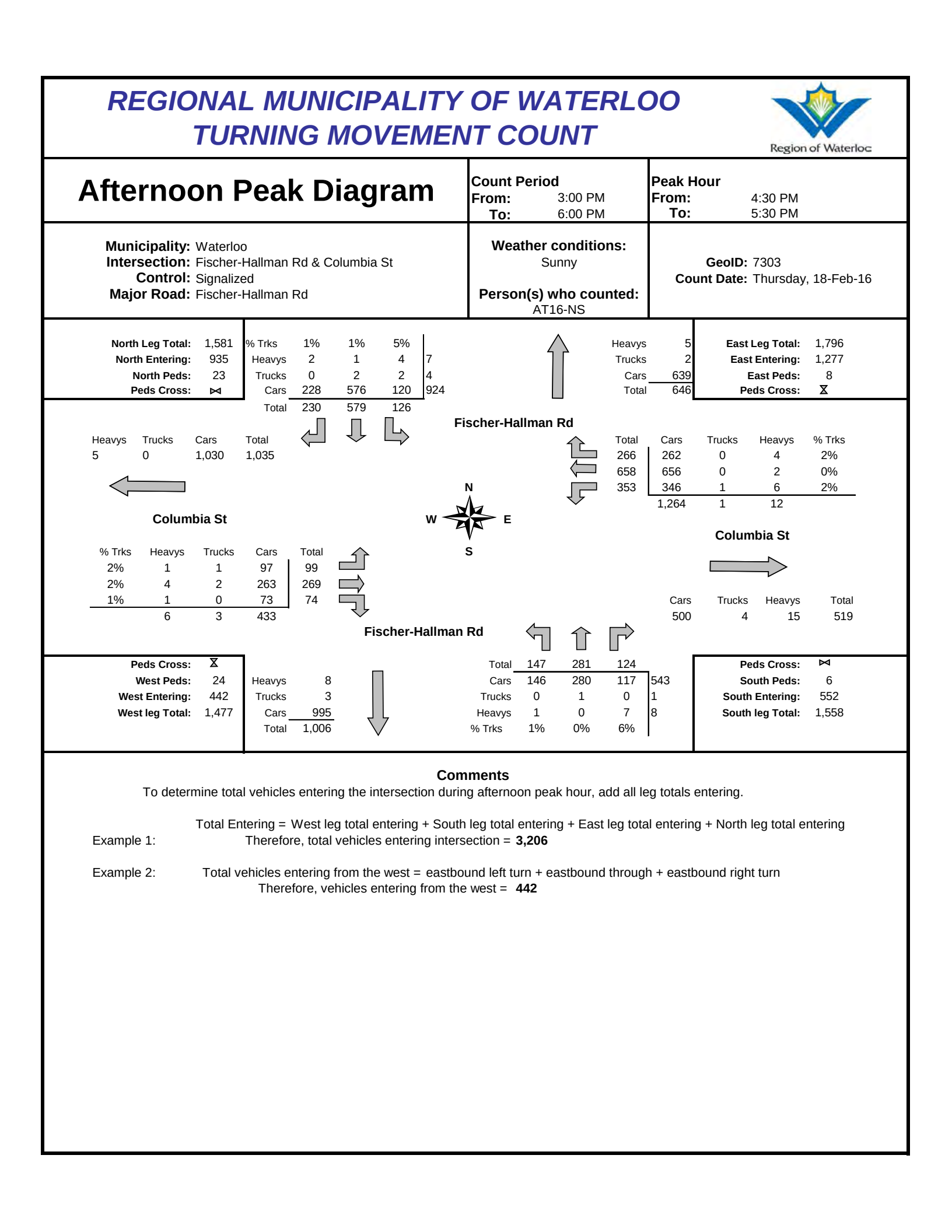
Peak Hour
From: 4:30 PM
To: 5:30 PM

Municipality: Waterloo
Intersection: Fischer-Hallman Rd & Columbia St
Control: Signalized
Major Road: Fischer-Hallman Rd

Weather conditions: Sunny

Person(s) who counted: AT16-NS

GeoID: 7303
Count Date: Thursday, 18-Feb-16



Comments

To determine total vehicles entering the intersection during afternoon peak hour, add all leg totals entering.

Total Entering = West leg total entering + South leg total entering + East leg total entering + North leg total entering

Example 1: Therefore, total vehicles entering intersection = **3,206**

Example 2: Total vehicles entering from the west = eastbound left turn + eastbound through + eastbound right turn

Therefore, vehicles entering from the west = **442**

REGIONAL MUNICIPALITY OF WATERLOO
TURNING MOVEMENT COUNT

Region of Waterloo

Morning Peak Diagram

Count Period
From: 7:30 AM
To: 10:30 AM

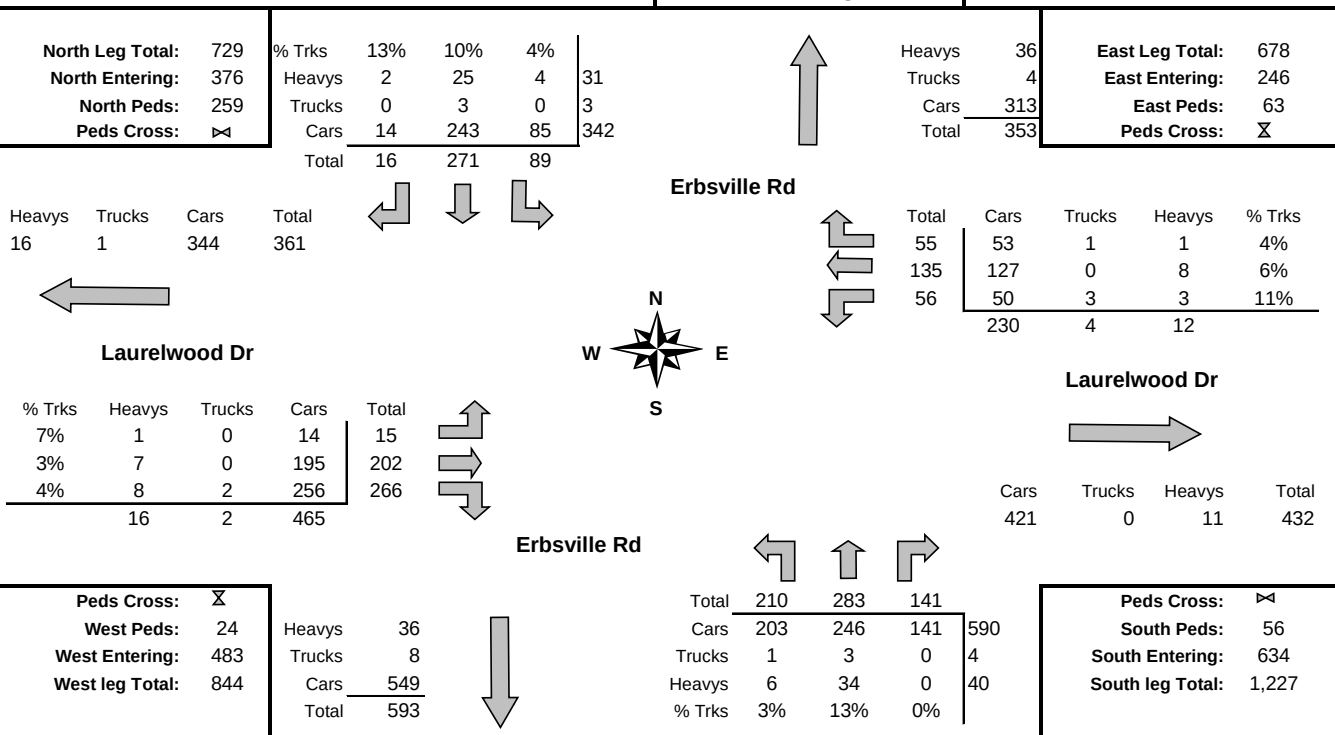
Peak Hour
From: 8:00 AM
To: 9:00 AM

Municipality: Waterloo
Intersection: Erbsville Rd & Laurelwood Dr
Control: Signalized
Major Road: Erbsville Rd

Weather conditions: Sunny

Person(s) who counted: AT17-NS

GeoID: 28702
Count Date: Thursday, 21-May-15



Comments

To determine total vehicles entering the intersection during morning peak hour, add all leg totals entering.

Example 1: Total Entering = West leg total entering + South leg total entering + East leg total entering + North leg total entering
Therefore, total vehicles entering intersection = **1,739**

Example 2: Total vehicles entering from the west = eastbound left turn + eastbound through + eastbound right turn
Therefore, vehicles entering from the west = **483**

REGIONAL MUNICIPALITY OF WATERLOO
TURNING MOVEMENT COUNT

Region of Waterloo

Afternoon Peak Diagram

Count Period
From: 3:00 PM
To: 6:00 PM

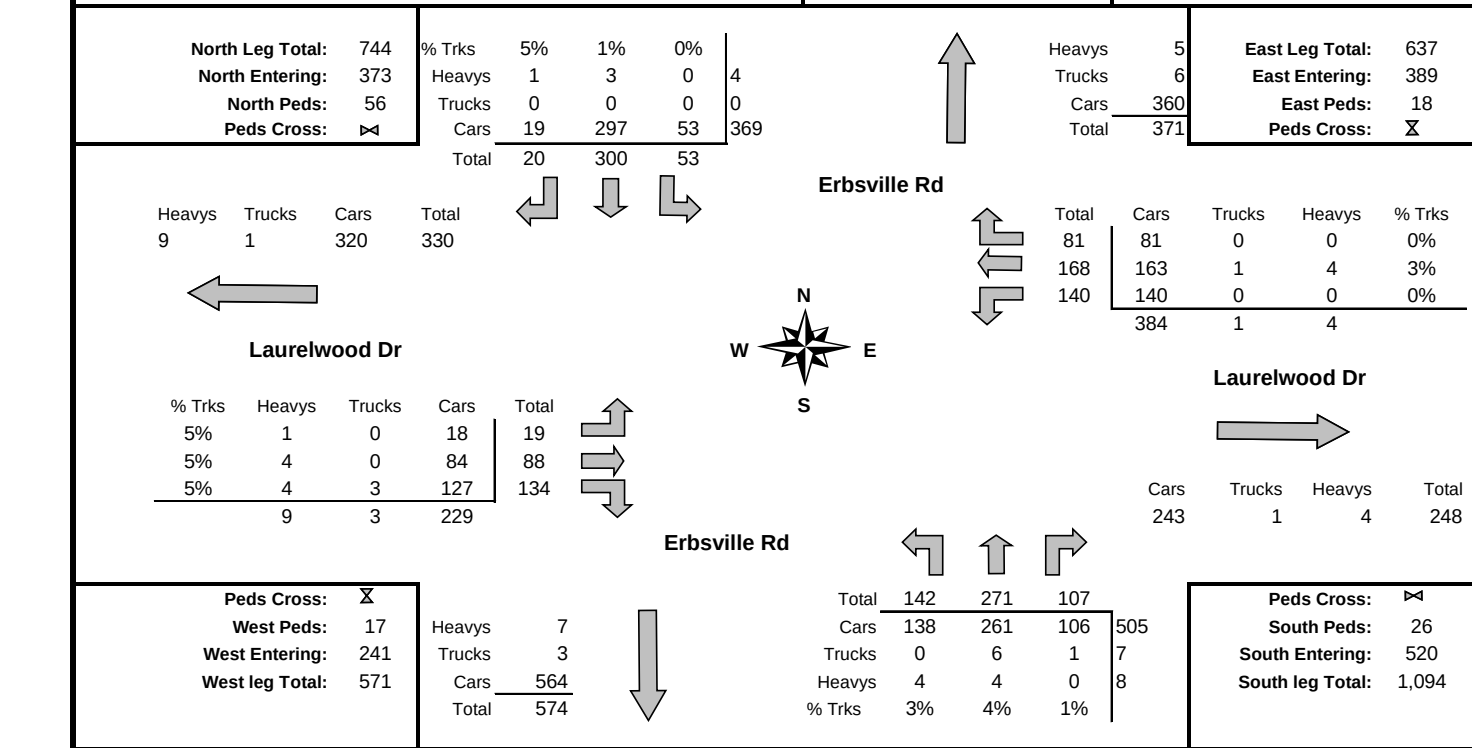
Peak Hour
From: 5:00 PM
To: 6:00 PM

Municipality: Waterloo
Intersection: Erbsville Rd & Laurelwood Dr
Control: Signalized
Major Road: Erbsville Rd

Weather conditions: Sunny

Person(s) who counted: AT17-NS

GeoID: 28702
Count Date: Thursday, 21-May-15



Comments

To determine total vehicles entering the intersection during afternoon peak hour, add all leg totals entering.

Total Entering = West leg total entering + South leg total entering + East leg total entering + North leg total entering

Example 1: Therefore, total vehicles entering intersection = **1,523**

Example 2: Total vehicles entering from the west = eastbound left turn + eastbound through + eastbound right turn

Therefore, vehicles entering from the west = **241**

APPENDIX

B SYNCHRO REPORTS

APPENDIX

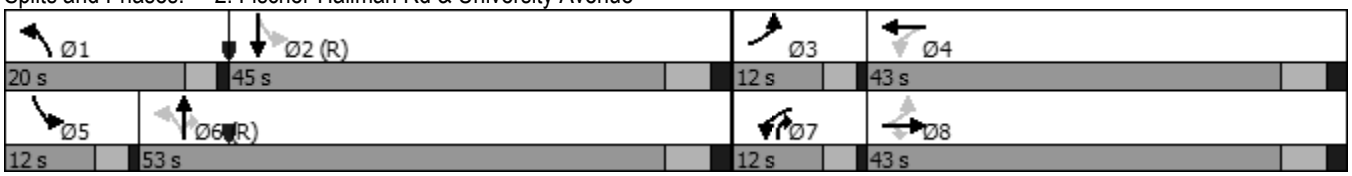
B-1 EXISTING CONDITIONS

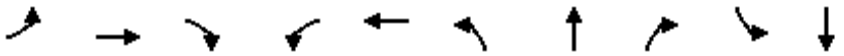
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	150	534	245	95	118	9	158	653	337	19	700	63
Future Volume (vph)	150	534	245	95	118	9	158	653	337	19	700	63
Ideal Flow (vphpl)	1775	1900	1750	1775	1775	1775	1775	1900	1750	1775	1775	1775
Storage Length (m)	35.0		35.0	100.0		0.0	80.0		125.0	50.0		0.0
Storage Lanes	1		1	1		0	1		1	1		0
Taper Length (m)	30.0			65.0			30.0			60.0		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	0.95	1.00	0.95	1.00	1.00	0.95	0.95
Ped Bike Factor			0.98	1.00			1.00				1.00	
Frt			0.850		0.989				0.850		0.988	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1668	3535	1428	1619	3185	0	1619	3466	1456	1668	3205	0
Flt Permitted	0.671			0.339			0.183			0.370		
Satd. Flow (perm)	1178	3535	1396	575	3185	0	311	3466	1456	649	3205	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			212		7				254		8	
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		701.9			786.3			349.5			1136.8	
Travel Time (s)		42.1			47.2			21.0			68.2	
Confl. Peds. (#/hr)			11	11			5					5
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	1%	3%	3%	3%	11%	3%	3%	1%	0%	2%	10%
Adj. Flow (vph)	150	534	245	95	118	9	158	653	337	19	700	63
Shared Lane Traffic (%)												
Lane Group Flow (vph)	150	534	245	95	127	0	158	653	337	19	763	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.11	1.01	1.13	1.11	1.11	1.11	1.11	1.01	1.13	1.11	1.11	1.11
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	pm+ov	pm+pt	NA	
Protected Phases	3	8		7	4		1	6	7	5	2	
Permitted Phases	8		8	4			6		6	2		
Minimum Split (s)	9.0	43.0	43.0	9.0	43.0		9.0	45.0	9.0	9.0	45.0	
Total Split (s)	12.0	43.0	43.0	12.0	43.0		20.0	53.0	12.0	12.0	45.0	
Total Split (%)	10.0%	35.8%	35.8%	10.0%	35.8%		16.7%	44.2%	10.0%	10.0%	37.5%	
Maximum Green (s)	8.0	37.0	37.0	8.0	37.0		16.0	47.0	8.0	8.0	39.0	
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0		3.0	4.0	3.0	3.0	4.0	
All-Red Time (s)	1.0	2.0	2.0	1.0	2.0		1.0	2.0	1.0	1.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	4.0	6.0	6.0	4.0	6.0		4.0	6.0	4.0	4.0	6.0	
Lead/Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lead	Lead	Lag	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	
Walk Time (s)		15.0	15.0		15.0			14.0			14.0	
Flash Dont Walk (s)		22.0	22.0		22.0			25.0			25.0	
Pedestrian Calls (#/hr)		0	0		0			0			0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Act Effct Green (s)	47.0	37.0	37.0	47.0	37.0		61.0	47.0	61.0	49.0	39.0	
Actuated g/C Ratio	0.39	0.31	0.31	0.39	0.31		0.51	0.39	0.51	0.41	0.32	
v/c Ratio	0.30	0.49	0.42	0.32	0.13		0.48	0.48	0.39	0.06	0.73	
Control Delay	24.2	35.7	8.8	24.4	28.7		21.2	28.8	5.9	21.9	46.0	
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Delay	24.2	35.7	8.8	24.4	28.7		21.2	28.8	5.9	21.9	46.0	
LOS	C	D	A	C	C		C	C	A	C	D	
Approach Delay		26.7			26.8			21.0			45.4	
Approach LOS		C			C			C			D	

Intersection Summary			
Area Type:	Other		
Cycle Length: 120			
Actuated Cycle Length: 120			
Offset: 42 (35%), Referenced to phase 2:SBTL and 6:NBTL, Start of Green			
Natural Cycle: 110			
Control Type: Pretimed			
Maximum v/c Ratio: 0.73			
Intersection Signal Delay: 29.4		Intersection LOS: C	
Intersection Capacity Utilization 98.3%		ICU Level of Service F	
Analysis Period (min) 15			

Splits and Phases: 2: Fischer-Hallman Rd & University Avenue





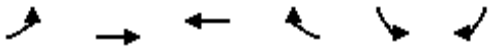
Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	150	534	245	95	127	158	653	337	19	763
v/c Ratio	0.30	0.49	0.42	0.32	0.13	0.48	0.48	0.39	0.06	0.73
Control Delay	24.2	35.7	8.8	24.4	28.7	21.2	28.8	5.9	21.9	46.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	24.2	35.7	8.8	24.4	28.7	21.2	28.8	5.9	21.9	46.0
Queue Length 50th (m)	21.9	53.7	5.5	13.4	10.6	19.6	59.8	9.9	2.2	78.7
Queue Length 95th (m)	36.2	70.4	25.6	24.5	18.1	32.2	76.7	27.5	m5.6	100.7
Internal Link Dist (m)		677.9			762.3		325.5			1112.8
Turn Bay Length (m)	35.0		35.0	100.0		80.0		125.0	50.0	
Base Capacity (vph)	494	1089	577	294	986	332	1357	865	332	1047
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.30	0.49	0.42	0.32	0.13	0.48	0.48	0.39	0.06	0.73

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

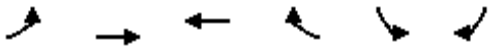
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	150	534	245	95	118	9	158	653	337	19	700	63
Future Volume (vph)	150	534	245	95	118	9	158	653	337	19	700	63
Ideal Flow (vphpl)	1775	1900	1750	1775	1775	1775	1775	1900	1750	1775	1775	1775
Total Lost time (s)	4.0	6.0	6.0	4.0	6.0		4.0	6.0	4.0	4.0	6.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1668	3535	1396	1617	3186		1619	3466	1456	1668	3204	
Flt Permitted	0.67	1.00	1.00	0.34	1.00		0.18	1.00	1.00	0.37	1.00	
Satd. Flow (perm)	1179	3535	1396	576	3186		312	3466	1456	650	3204	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	150	534	245	95	118	9	158	653	337	19	700	63
RTOR Reduction (vph)	0	0	147	0	5	0	0	0	138	0	5	0
Lane Group Flow (vph)	150	534	98	95	122	0	158	653	199	19	758	0
Confl. Peds. (#/hr)			11	11			5					5
Heavy Vehicles (%)	0%	1%	3%	3%	3%	11%	3%	3%	1%	0%	2%	10%
Turn Type	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	pm+ov	pm+pt	NA	
Protected Phases	3	8		7	4		1	6	7	5	2	
Permitted Phases	8		8	4			6		6	2		
Actuated Green, G (s)	45.0	37.0	37.0	45.0	37.0		59.0	47.0	55.0	47.0	39.0	
Effective Green, g (s)	45.0	37.0	37.0	45.0	37.0		59.0	47.0	55.0	47.0	39.0	
Actuated g/C Ratio	0.38	0.31	0.31	0.38	0.31		0.49	0.39	0.46	0.39	0.32	
Clearance Time (s)	4.0	6.0	6.0	4.0	6.0		4.0	6.0	4.0	4.0	6.0	
Lane Grp Cap (vph)	474	1089	430	285	982		327	1357	667	322	1041	
v/s Ratio Prot	0.02	c0.15		c0.02	0.04		c0.06	0.19	0.02	0.00	c0.24	
v/s Ratio Perm	0.10		0.07	0.10			0.17		0.12	0.02		
v/c Ratio	0.32	0.49	0.23	0.33	0.12		0.48	0.48	0.30	0.06	0.73	
Uniform Delay, d1	25.8	33.8	30.9	25.3	29.8		19.7	27.4	20.4	22.5	35.8	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.40	1.17	
Incremental Delay, d2	1.7	1.6	1.2	3.1	0.3		5.0	1.2	1.1	0.3	4.1	
Delay (s)	27.5	35.4	32.1	28.4	30.1		24.7	28.6	21.5	31.7	46.0	
Level of Service	C	D	C	C	C		C	C	C	C	D	
Approach Delay (s)		33.3			29.4			26.0			45.6	
Approach LOS		C			C			C			D	

Intersection Summary			
HCM 2000 Control Delay	33.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	98.3%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	6	668	195	7	34	2
Future Volume (vph)	6	668	195	7	34	2
Ideal Flow (vphpl)	1650	1650	1650	1650	1765	1765
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.995		0.992	
Flt Protected					0.955	
Satd. Flow (prot)	0	1616	1549	0	1654	0
Flt Permitted					0.955	
Satd. Flow (perm)	0	1616	1549	0	1654	0
Link Speed (k/h)		60	60		60	
Link Distance (m)		400.5	434.2		345.8	
Travel Time (s)		24.0	26.1		20.7	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	1%	5%	0%	0%	0%
Adj. Flow (vph)	6	668	195	7	34	2
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	674	202	0	36	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.5	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.21	1.21	1.21	1.21	1.12	1.12
Turning Speed (k/h)	24			14	24	14
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	56.0%	ICU Level of Service	B
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	6	668	195	7	34	2
Future Volume (Veh/h)	6	668	195	7	34	2
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	6	668	195	7	34	2
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	202				878	198
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	202				878	198
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				89	100
cM capacity (veh/h)	1382				319	848

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	674	202	36
Volume Left	6	0	34
Volume Right	0	7	2
cSH	1382	1700	331
Volume to Capacity	0.00	0.12	0.11
Queue Length 95th (m)	0.1	0.0	2.8
Control Delay (s)	0.1	0.0	17.2
Lane LOS	A		C
Approach Delay (s)	0.1	0.0	17.2
Approach LOS			C

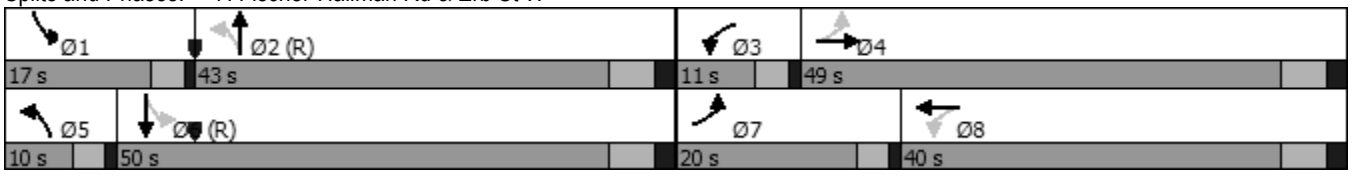
Intersection Summary			
Average Delay	0.8		
Intersection Capacity Utilization	56.0%	ICU Level of Service	B
Analysis Period (min)	15		

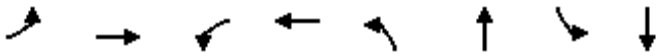
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	233	680	138	69	254	79	105	696	114	178	461	91
Future Volume (vph)	233	680	138	69	254	79	105	696	114	178	461	91
Ideal Flow (vphpl)	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775
Storage Length (m)	40.0		0.0	50.0		0.0	78.0		0.0	170.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	50.0			75.0			78.0			35.0		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	0.95	0.95	1.00	0.95	0.95
Ped Bike Factor	0.99	1.00		1.00	0.99		1.00	1.00		1.00	1.00	
Frt		0.975			0.964			0.979			0.975	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1651	3170	0	1603	3004	0	1588	3206	0	1635	3172	0
Flt Permitted	0.445			0.257			0.406			0.158		
Satd. Flow (perm)	763	3170	0	432	3004	0	676	3206	0	271	3172	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		22			34			16			22	
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		819.0			343.1			1136.8			2051.4	
Travel Time (s)		49.1			20.6			68.2			123.1	
Confl. Peds. (#/hr)	21		11	11		21	8		17	17		8
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	1%	2%	3%	4%	4%	13%	5%	1%	4%	2%	2%	3%
Adj. Flow (vph)	233	680	138	69	254	79	105	696	114	178	461	91
Shared Lane Traffic (%)												
Lane Group Flow (vph)	233	818	0	69	333	0	105	810	0	178	552	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8			2			6		
Detector Phase	7	4		3	8		5	2		1	6	
Switch Phase												
Minimum Initial (s)	5.0	33.0		5.0	33.0		5.0	35.0		5.0	35.0	
Minimum Split (s)	9.0	39.0		9.0	39.0		9.0	41.0		9.0	41.0	
Total Split (s)	20.0	49.0		11.0	40.0		10.0	43.0		17.0	50.0	
Total Split (%)	16.7%	40.8%		9.2%	33.3%		8.3%	35.8%		14.2%	41.7%	
Maximum Green (s)	16.0	43.0		7.0	34.0		6.0	37.0		13.0	44.0	
Yellow Time (s)	3.0	4.0		3.0	4.0		3.0	4.0		3.0	4.0	
All-Red Time (s)	1.0	2.0		1.0	2.0		1.0	2.0		1.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	4.0	6.0		4.0	6.0		4.0	6.0		4.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		None	C-Max		None	C-Max	
Walk Time (s)		11.0			11.0			20.0			20.0	
Flash Dont Walk (s)		22.0			22.0			15.0			15.0	
Pedestrian Calls (#/hr)		0			0			0			0	
Act Effct Green (s)	54.3	43.5		42.0	33.2		48.5	39.6		57.2	44.8	
Actuated g/C Ratio	0.45	0.36		0.35	0.28		0.40	0.33		0.48	0.37	
v/c Ratio	0.51	0.70		0.32	0.39		0.32	0.76		0.67	0.46	
Control Delay	25.0	36.1		23.3	32.9		12.6	32.9		26.5	22.2	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	25.0	36.1		23.3	32.9		12.6	32.9		26.5	22.2	
LOS	C	D		C	C		B	C		C	C	
Approach Delay		33.7			31.3			30.6			23.2	
Approach LOS		C			C			C			C	

Intersection Summary			
Area Type:	Other		
Cycle Length: 120			
Actuated Cycle Length: 120			
Offset: 13.2 (11%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 100			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.76			
Intersection Signal Delay: 30.0		Intersection LOS: C	
Intersection Capacity Utilization 97.7%		ICU Level of Service F	
Analysis Period (min) 15			

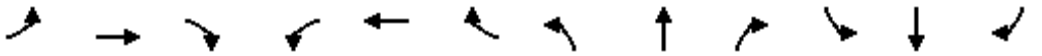
Splits and Phases: 7: Fischer-Hallman Rd & Erb St W





Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	233	818	69	333	105	810	178	552
v/c Ratio	0.51	0.70	0.32	0.39	0.32	0.76	0.67	0.46
Control Delay	25.0	36.1	23.3	32.9	12.6	32.9	26.5	22.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	25.0	36.1	23.3	32.9	12.6	32.9	26.5	22.2
Queue Length 50th (m)	33.8	85.5	9.0	30.0	11.8	92.3	13.5	50.0
Queue Length 95th (m)	51.3	107.2	17.3	42.8	21.4	119.4	29.0	67.8
Internal Link Dist (m)		795.0		319.1		1112.8		2027.4
Turn Bay Length (m)	40.0		50.0		78.0		170.0	
Base Capacity (vph)	463	1184	220	875	326	1068	280	1197
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.50	0.69	0.31	0.38	0.32	0.76	0.64	0.46

Intersection Summary



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	233	680	138	69	254	79	105	696	114	178	461	91
Future Volume (vph)	233	680	138	69	254	79	105	696	114	178	461	91
Ideal Flow (vphpl)	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775
Total Lost time (s)	4.0	6.0		4.0	6.0		4.0	6.0		4.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	0.99	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.97		1.00	0.96		1.00	0.98		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1642	3169		1602	3006		1586	3206		1634	3173	
Flt Permitted	0.45	1.00		0.26	1.00		0.41	1.00		0.16	1.00	
Satd. Flow (perm)	770	3169		433	3006		678	3206		272	3173	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	233	680	138	69	254	79	105	696	114	178	461	91
RTOR Reduction (vph)	0	14	0	0	24	0	0	11	0	0	14	0
Lane Group Flow (vph)	233	804	0	69	309	0	105	799	0	178	538	0
Confl. Peds. (#/hr)	21		11	11		21	8		17	17		8
Heavy Vehicles (%)	1%	2%	3%	4%	4%	13%	5%	1%	4%	2%	2%	3%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	53.1	43.5		39.6	34.0		45.7	38.8		54.9	44.0	
Effective Green, g (s)	53.1	43.5		39.6	34.0		45.7	38.8		54.9	44.0	
Actuated g/C Ratio	0.44	0.36		0.33	0.28		0.38	0.32		0.46	0.37	
Clearance Time (s)	4.0	6.0		4.0	6.0		4.0	6.0		4.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	450	1148		197	851		310	1036		261	1163	
v/s Ratio Prot	c0.07	c0.25		0.02	0.10		0.02	c0.25		c0.07	0.17	
v/s Ratio Perm	0.16			0.10			0.11			0.24		
v/c Ratio	0.52	0.70		0.35	0.36		0.34	0.77		0.68	0.46	
Uniform Delay, d1	22.0	32.7		28.5	34.3		24.7	36.6		23.0	29.0	
Progression Factor	1.00	1.00		1.00	1.00		0.53	0.78		0.74	0.75	
Incremental Delay, d2	1.0	2.0		1.1	0.3		0.6	5.2		7.1	1.3	
Delay (s)	23.0	34.6		29.6	34.6		13.6	33.6		24.2	23.2	
Level of Service	C	C		C	C		B	C		C	C	
Approach Delay (s)		32.1			33.7			31.3			23.4	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	30.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	97.7%	ICU Level of Service	F
Analysis Period (min)	15		

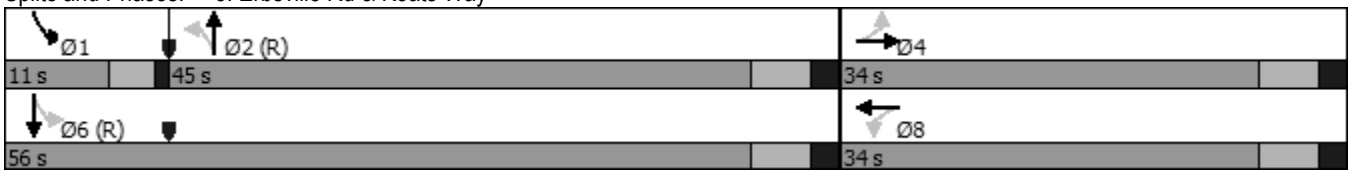
c Critical Lane Group

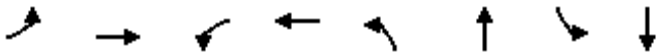
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	82	47	63	67	26	60	19	640	50	55	558	22
Future Volume (vph)	82	47	63	67	26	60	19	640	50	55	558	22
Ideal Flow (vphpl)	1775	1650	1650	1775	1650	1650	1775	1650	1650	1775	1650	1650
Storage Length (m)	35.0		0.0	36.0		0.0	22.0		0.0	23.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	5.0			21.0			49.0			50.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor	0.99	0.98		0.99	0.98		1.00	1.00		1.00	1.00	
Frt		0.914			0.895			0.989			0.994	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1651	1387	0	1558	1350	0	1502	1492	0	1635	1502	0
Flt Permitted	0.701			0.686			0.446			0.280		
Satd. Flow (perm)	1203	1387	0	1111	1350	0	703	1492	0	482	1502	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		63			60			6			4	
Link Speed (k/h)		50			50			60			60	
Link Distance (m)		272.1			461.3			757.2			946.8	
Travel Time (s)		19.6			33.2			45.4			56.8	
Confl. Peds. (#/hr)	9		9	9		9	6		2	2		6
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	1%	2%	8%	7%	0%	8%	11%	8%	8%	2%	8%	5%
Adj. Flow (vph)	82	47	63	67	26	60	19	640	50	55	558	22
Shared Lane Traffic (%)												
Lane Group Flow (vph)	82	110	0	67	86	0	19	690	0	55	580	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.11	1.21	1.21	1.11	1.21	1.21	1.11	1.21	1.21	1.11	1.21	1.21
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Perm	NA		Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases		4			8			2		1	6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		2	2		1	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0		39.0	39.0		5.0	39.0	
Minimum Split (s)	34.0	34.0		34.0	34.0		45.0	45.0		9.0	45.0	
Total Split (s)	34.0	34.0		34.0	34.0		45.0	45.0		11.0	56.0	
Total Split (%)	37.8%	37.8%		37.8%	37.8%		50.0%	50.0%		12.2%	62.2%	
Maximum Green (s)	28.0	28.0		28.0	28.0		39.0	39.0		7.0	50.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		3.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		1.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		4.0	6.0	
Lead/Lag							Lag	Lag		Lead		
Lead-Lag Optimize?							Yes	Yes		Yes		
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		C-Max	C-Max		None	C-Max	
Walk Time (s)	10.0	10.0		10.0	10.0		26.0	26.0			26.0	
Flash Dont Walk (s)	18.0	18.0		18.0	18.0		13.0	13.0			13.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0			0	
Act Effct Green (s)	11.9	11.9		11.9	11.9		57.7	57.7		68.1	66.1	
Actuated g/C Ratio	0.13	0.13		0.13	0.13		0.64	0.64		0.76	0.73	
v/c Ratio	0.52	0.46		0.46	0.38		0.04	0.72		0.12	0.53	
Control Delay	47.3	23.3		45.3	18.8		8.6	18.5		3.1	5.7	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	47.3	23.3		45.3	18.8		8.6	18.5		3.1	5.7	
LOS	D	C		D	B		A	B		A	A	
Approach Delay		33.5			30.4			18.3			5.5	
Approach LOS		C			C			B			A	

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 79.2 (88%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 90			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.72			
Intersection Signal Delay: 16.3		Intersection LOS: B	
Intersection Capacity Utilization 73.5%		ICU Level of Service D	
Analysis Period (min) 15			

Splits and Phases: 8: Erbsville Rd & Keats Way





Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	82	110	67	86	19	690	55	580
v/c Ratio	0.52	0.46	0.46	0.38	0.04	0.72	0.12	0.53
Control Delay	47.3	23.3	45.3	18.8	8.6	18.5	3.1	5.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	47.3	23.3	45.3	18.8	8.6	18.5	3.1	5.7
Queue Length 50th (m)	13.5	7.4	10.9	4.1	1.2	74.4	1.6	23.4
Queue Length 95th (m)	25.8	21.2	22.1	16.0	4.6	#165.0	m3.5	52.0
Internal Link Dist (m)		248.1		437.3		733.2		922.8
Turn Bay Length (m)	35.0		36.0		22.0		23.0	
Base Capacity (vph)	374	474	345	461	450	958	455	1104
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.22	0.23	0.19	0.19	0.04	0.72	0.12	0.53

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	82	47	63	67	26	60	19	640	50	55	558	22
Future Volume (vph)	82	47	63	67	26	60	19	640	50	55	558	22
Ideal Flow (vphpl)	1775	1650	1650	1775	1650	1650	1775	1650	1650	1775	1650	1650
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		4.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	0.98		1.00	0.98		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	0.99	1.00		0.99	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.91		1.00	0.90		1.00	0.99		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1630	1387		1539	1351		1498	1492		1635	1502	
Flt Permitted	0.70	1.00		0.69	1.00		0.45	1.00		0.28	1.00	
Satd. Flow (perm)	1203	1387		1112	1351		703	1492		481	1502	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	82	47	63	67	26	60	19	640	50	55	558	22
RTOR Reduction (vph)	0	55	0	0	52	0	0	2	0	0	1	0
Lane Group Flow (vph)	82	55	0	67	34	0	19	688	0	55	579	0
Confl. Peds. (#/hr)	9		9	9		9	6		2	2		6
Heavy Vehicles (%)	1%	2%	8%	7%	0%	8%	11%	8%	8%	2%	8%	5%
Turn Type	Perm	NA		Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases		4			8			2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	11.9	11.9		11.9	11.9		56.9	56.9		66.1	66.1	
Effective Green, g (s)	11.9	11.9		11.9	11.9		56.9	56.9		66.1	66.1	
Actuated g/C Ratio	0.13	0.13		0.13	0.13		0.63	0.63		0.73	0.73	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		4.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	159	183		147	178		444	943		419	1103	
v/s Ratio Prot		0.04			0.03			c0.46		0.01	c0.39	
v/s Ratio Perm	c0.07			0.06			0.03			0.09		
v/c Ratio	0.52	0.30		0.46	0.19		0.04	0.73		0.13	0.52	
Uniform Delay, d1	36.4	35.3		36.1	34.8		6.3	11.3		5.4	5.2	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		0.77	0.72	
Incremental Delay, d2	2.8	0.9		2.2	0.5		0.2	4.9		0.1	1.4	
Delay (s)	39.2	36.2		38.3	35.3		6.4	16.2		4.2	5.1	
Level of Service	D	D		D	D		A	B		A	A	
Approach Delay (s)		37.5			36.6			16.0			5.0	
Approach LOS		D			D			B			A	

Intersection Summary			
HCM 2000 Control Delay	16.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	73.5%	ICU Level of Service	D
Analysis Period (min)	15		

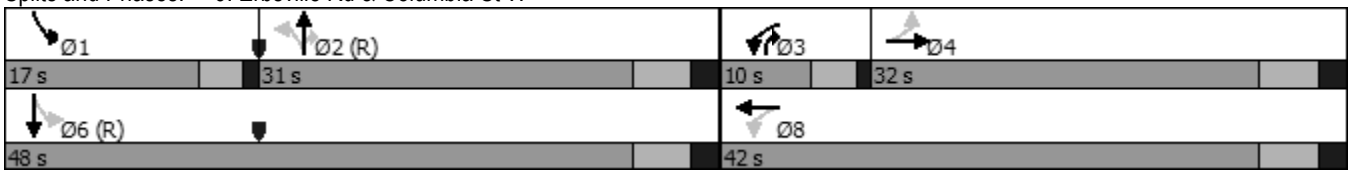
c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	124	234	58	150	61	124	34	370	342	279	440	53
Future Volume (vph)	124	234	58	150	61	124	34	370	342	279	440	53
Ideal Flow (vphpl)	1775	1650	1650	1775	1650	1650	1775	1900	1750	1775	1650	1650
Storage Length (m)	80.0		0.0	50.0		0.0	43.0		45.0	45.0		0.0
Storage Lanes	1		0	1		0	1		1	1		0
Taper Length (m)	57.0			82.0			30.0			45.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor		1.00		1.00			0.99				1.00	
Frt		0.970			0.899				0.850		0.984	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1588	1530	0	1619	1362	0	1450	1708	1401	1635	1475	0
Flt Permitted	0.641			0.366			0.483			0.285		
Satd. Flow (perm)	1072	1530	0	623	1362	0	732	1708	1401	490	1475	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		14			124				337		9	
Link Speed (k/h)		50			60			60			60	
Link Distance (m)		309.3			1370.2			946.8			1422.7	
Travel Time (s)		22.3			82.2			56.8			85.4	
Confl. Peds. (#/hr)			1	1			8					8
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	5%	2%	7%	3%	7%	8%	15%	10%	5%	2%	9%	4%
Adj. Flow (vph)	124	234	58	150	61	124	34	370	342	279	440	53
Shared Lane Traffic (%)												
Lane Group Flow (vph)	124	292	0	150	185	0	34	370	342	279	493	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.11	1.21	1.21	1.11	1.21	1.21	1.11	1.01	1.13	1.11	1.21	1.21
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2	1	1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru	Right	Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5	6.1	6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8	6.1	6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	pm+ov	pm+pt	NA	
Protected Phases		4		3	8			2	3	1	6	
Permitted Phases	4			8			2		2	6		
Detector Phase	4	4		3	8		2	2	3	1	6	
Switch Phase												
Minimum Initial (s)	24.0	24.0		5.0	24.0		25.0	25.0	5.0	5.0	25.0	
Minimum Split (s)	30.0	30.0		9.0	30.0		31.0	31.0	9.0	9.0	31.0	
Total Split (s)	32.0	32.0		10.0	42.0		31.0	31.0	10.0	17.0	48.0	
Total Split (%)	35.6%	35.6%		11.1%	46.7%		34.4%	34.4%	11.1%	18.9%	53.3%	
Maximum Green (s)	26.0	26.0		6.0	36.0		25.0	25.0	6.0	13.0	42.0	
Yellow Time (s)	4.0	4.0		3.0	4.0		4.0	4.0	3.0	3.0	4.0	
All-Red Time (s)	2.0	2.0		1.0	2.0		2.0	2.0	1.0	1.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	6.0	6.0		4.0	6.0		6.0	6.0	4.0	4.0	6.0	
Lead/Lag	Lag	Lag		Lead			Lag	Lag	Lead	Lead		
Lead-Lag Optimize?	Yes	Yes		Yes			Yes	Yes	Yes	Yes		
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None		None	None		C-Max	C-Max	None	None	C-Max	
Walk Time (s)	10.0	10.0			10.0		10.0	10.0			10.0	
Flash Dont Walk (s)	14.0	14.0			14.0		15.0	15.0			15.0	
Pedestrian Calls (#/hr)	0	0			0		0	0			0	
Act Effct Green (s)	24.7	24.7		36.7	34.7		26.5	26.5	38.5	45.3	43.3	
Actuated g/C Ratio	0.27	0.27		0.41	0.39		0.29	0.29	0.43	0.50	0.48	
v/c Ratio	0.42	0.68		0.47	0.31		0.16	0.74	0.43	0.68	0.69	
Control Delay	31.8	36.6		22.8	8.4		22.0	32.8	3.0	27.4	28.6	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Delay	31.8	36.6		22.8	8.4		22.0	32.8	3.0	27.4	28.6	
LOS	C	D		C	A		C	C	A	C	C	
Approach Delay		35.2			14.8			18.6			28.2	
Approach LOS		D			B			B			C	

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 44.1 (49%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 80			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.74			
Intersection Signal Delay: 24.4		Intersection LOS: C	
Intersection Capacity Utilization 111.3%		ICU Level of Service H	
Analysis Period (min) 15			

Splits and Phases: 9: Erbsville Rd & Columbia St W





Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	124	292	150	185	34	370	342	279	493
v/c Ratio	0.42	0.68	0.47	0.31	0.16	0.74	0.43	0.68	0.69
Control Delay	31.8	36.6	22.8	8.4	22.0	32.8	3.0	27.4	28.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	31.8	36.6	22.8	8.4	22.0	32.8	3.0	27.4	28.6
Queue Length 50th (m)	17.8	43.3	16.8	6.8	3.5	57.7	7.1	33.2	76.8
Queue Length 95th (m)	33.1	69.0	28.6	20.0	m5.7	#98.7	m4.8	#55.6	116.3
Internal Link Dist (m)		285.3		1346.2		922.8			1398.7
Turn Bay Length (m)	80.0		50.0		43.0		45.0	45.0	
Base Capacity (vph)	309	451	320	619	215	502	791	418	714
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.40	0.65	0.47	0.30	0.16	0.74	0.43	0.67	0.69

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	124	234	58	150	61	124	34	370	342	279	440	53
Future Volume (vph)	124	234	58	150	61	124	34	370	342	279	440	53
Ideal Flow (vphpl)	1775	1650	1650	1775	1650	1650	1775	1900	1750	1775	1650	1650
Total Lost time (s)	6.0	6.0		4.0	6.0		6.0	6.0	4.0	4.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		0.99	1.00	1.00	1.00	1.00	
Frt	1.00	0.97		1.00	0.90		1.00	1.00	0.85	1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1588	1530		1618	1363		1439	1708	1401	1635	1475	
Flt Permitted	0.64	1.00		0.37	1.00		0.48	1.00	1.00	0.29	1.00	
Satd. Flow (perm)	1071	1530		623	1363		732	1708	1401	491	1475	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	124	234	58	150	61	124	34	370	342	279	440	53
RTOR Reduction (vph)	0	10	0	0	76	0	0	0	215	0	5	0
Lane Group Flow (vph)	124	282	0	150	109	0	34	370	127	279	488	0
Confl. Peds. (#/hr)			1	1			8					8
Heavy Vehicles (%)	5%	2%	7%	3%	7%	8%	15%	10%	5%	2%	9%	4%
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	pm+ov	pm+pt	NA	
Protected Phases		4		3	8			2	3	1	6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)	24.7	24.7		34.7	34.7		26.5	26.5	32.5	43.3	43.3	
Effective Green, g (s)	24.7	24.7		34.7	34.7		26.5	26.5	32.5	43.3	43.3	
Actuated g/C Ratio	0.27	0.27		0.39	0.39		0.29	0.29	0.36	0.48	0.48	
Clearance Time (s)	6.0	6.0		4.0	6.0		6.0	6.0	4.0	4.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	293	419		306	525		215	502	505	398	709	
v/s Ratio Prot		c0.18		c0.03	0.08			0.22	0.02	0.10	c0.33	
v/s Ratio Perm	0.12			0.16			0.05		0.07	c0.24		
v/c Ratio	0.42	0.67		0.49	0.21		0.16	0.74	0.25	0.70	0.69	
Uniform Delay, d1	26.8	29.1		19.5	18.5		23.5	28.6	20.2	16.3	18.1	
Progression Factor	1.00	1.00		1.00	1.00		0.82	0.83	0.70	1.30	1.24	
Incremental Delay, d2	1.0	4.2		1.2	0.2		1.2	7.4	0.2	5.4	5.3	
Delay (s)	27.8	33.3		20.7	18.7		20.5	31.0	14.3	26.6	27.7	
Level of Service	C	C		C	B		C	C	B	C	C	
Approach Delay (s)		31.6			19.6			22.9			27.3	
Approach LOS		C			B			C			C	

Intersection Summary			
HCM 2000 Control Delay	25.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	111.3%	ICU Level of Service	H
Analysis Period (min)	15		

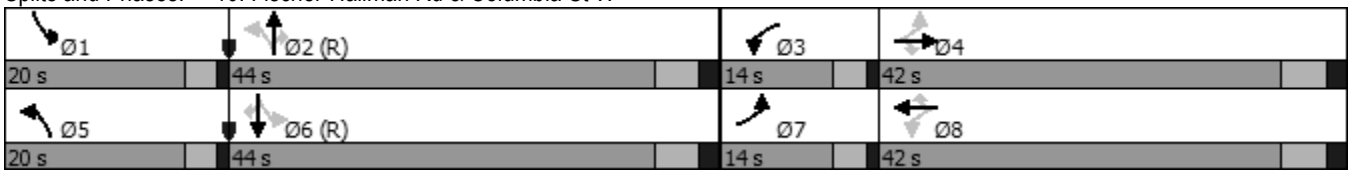
c Critical Lane Group

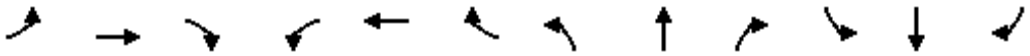
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	195	710	93	97	189	69	117	419	470	232	302	77
Future Volume (vph)	195	710	93	97	189	69	117	419	470	232	302	77
Ideal Flow (vphpl)	1775	1900	1750	1775	1900	1750	1775	1900	1750	1775	1900	1750
Storage Length (m)	24.0		82.0	82.0		0.0	95.0		72.0	70.0		53.0
Storage Lanes	1		1	1		1	1		1	1		1
Taper Length (m)	73.0			100.0			36.0			33.0		
Lane Util. Factor	1.00	0.95	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Ped Bike Factor	0.99		0.99	1.00		0.97	1.00		0.98	1.00		0.98
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1635	3535	1401	1476	1708	1337	1573	3500	1442	1619	3433	1401
Flt Permitted	0.556			0.224			0.568			0.401		
Satd. Flow (perm)	950	3535	1381	348	1708	1297	940	3500	1414	681	3433	1371
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			100			100			295			100
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		1370.2			231.9			2051.4			968.6	
Travel Time (s)		82.2			13.9			123.1			58.1	
Confl. Peds. (#/hr)	6		2	2		6	1		8	8		1
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	2%	1%	5%	13%	10%	10%	6%	2%	2%	3%	4%	5%
Adj. Flow (vph)	195	710	93	97	189	69	117	419	470	232	302	77
Shared Lane Traffic (%)												
Lane Group Flow (vph)	195	710	93	97	189	69	117	419	470	232	302	77
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.11	1.01	1.13	1.11	1.01	1.13	1.11	1.01	1.13	1.11	1.01	1.13
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2	1	1	2	1	1	2	1	1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Leading Detector (m)	6.1	30.5	6.1	6.1	30.5	6.1	6.1	30.5	6.1	6.1	30.5	6.1
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	6.1	1.8	6.1	6.1	1.8	6.1	6.1	1.8	6.1	6.1	1.8	6.1
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	5.0	36.0	36.0	5.0	36.0	36.0	5.0	38.0	38.0	5.0	38.0	38.0
Minimum Split (s)	9.0	42.0	42.0	9.0	42.0	42.0	9.0	44.0	44.0	9.0	44.0	44.0
Total Split (s)	14.0	42.0	42.0	14.0	42.0	42.0	20.0	44.0	44.0	20.0	44.0	44.0
Total Split (%)	11.7%	35.0%	35.0%	11.7%	35.0%	35.0%	16.7%	36.7%	36.7%	16.7%	36.7%	36.7%
Maximum Green (s)	10.0	36.0	36.0	10.0	36.0	36.0	16.0	38.0	38.0	16.0	38.0	38.0
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes		
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	None	None	None	None	None	C-Max	C-Max	None	C-Max	C-Max
Walk Time (s)		15.0	15.0		15.0	15.0		17.0	17.0		17.0	17.0
Flash Dont Walk (s)		21.0	21.0		21.0	21.0		21.0	21.0		21.0	21.0
Pedestrian Calls (#/hr)		0	0		0	0		0	0		0	0
Act Effct Green (s)	48.8	36.9	36.9	47.1	36.0	36.0	52.1	39.8	39.8	59.5	43.7	43.7
Actuated g/C Ratio	0.41	0.31	0.31	0.39	0.30	0.30	0.43	0.33	0.33	0.50	0.36	0.36
v/c Ratio	0.44	0.65	0.19	0.44	0.37	0.15	0.25	0.36	0.71	0.52	0.24	0.14
Control Delay	26.1	39.7	6.2	27.2	35.7	3.0	21.8	34.7	21.2	22.1	27.8	3.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	26.1	39.7	6.2	27.2	35.7	3.0	21.8	34.7	21.2	22.1	27.8	3.4
LOS	C	D	A	C	D	A	C	C	C	C	C	A
Approach Delay		33.9			27.0			26.9			22.5	
Approach LOS		C			C			C			C	

Intersection Summary			
Area Type:	Other		
Cycle Length: 120			
Actuated Cycle Length: 120			
Offset: 115.2 (96%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 105			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.71			
Intersection Signal Delay: 28.4		Intersection LOS: C	
Intersection Capacity Utilization 103.7%		ICU Level of Service G	
Analysis Period (min) 15			

Splits and Phases: 10: Fischer-Hallman Rd & Columbia St W

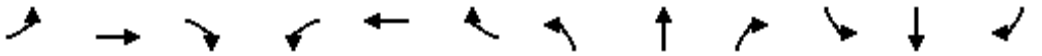




Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	195	710	93	97	189	69	117	419	470	232	302	77
v/c Ratio	0.44	0.65	0.19	0.44	0.37	0.15	0.25	0.36	0.71	0.52	0.24	0.14
Control Delay	26.1	39.7	6.2	27.2	35.7	3.0	21.8	34.7	21.2	22.1	27.8	3.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	26.1	39.7	6.2	27.2	35.7	3.0	21.8	34.7	21.2	22.1	27.8	3.4
Queue Length 50th (m)	29.0	77.0	0.0	13.6	35.0	0.0	14.7	33.2	29.4	30.9	25.8	0.0
Queue Length 95th (m)	46.0	97.6	10.7	24.6	55.6	5.1	m25.4	49.7	68.1	47.6	38.5	6.4
Internal Link Dist (m)		1346.2			207.9			2027.4			944.6	
Turn Bay Length (m)	24.0		82.0	82.0			95.0		72.0	70.0		53.0
Base Capacity (vph)	444	1085	493	233	512	459	534	1159	665	463	1249	562
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.44	0.65	0.19	0.42	0.37	0.15	0.22	0.36	0.71	0.50	0.24	0.14

Intersection Summary

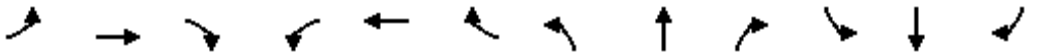
m Volume for 95th percentile queue is metered by upstream signal.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	195	710	93	97	189	69	117	419	470	232	302	77
Future Volume (vph)	195	710	93	97	189	69	117	419	470	232	302	77
Ideal Flow (vphpl)	1775	1900	1750	1775	1900	1750	1775	1900	1750	1775	1900	1750
Total Lost time (s)	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.99	1.00	1.00	0.97	1.00	1.00	0.98	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1629	3535	1381	1476	1708	1297	1572	3500	1414	1617	3433	1371
Flt Permitted	0.56	1.00	1.00	0.22	1.00	1.00	0.57	1.00	1.00	0.40	1.00	1.00
Satd. Flow (perm)	954	3535	1381	348	1708	1297	939	3500	1414	682	3433	1371
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	195	710	93	97	189	69	117	419	470	232	302	77
RTOR Reduction (vph)	0	0	64	0	0	48	0	0	197	0	0	49
Lane Group Flow (vph)	195	710	29	97	189	21	117	419	273	232	302	28
Confl. Peds. (#/hr)	6		2	2		6	1		8	8		1
Heavy Vehicles (%)	2%	1%	5%	13%	10%	10%	6%	2%	2%	3%	4%	5%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Actuated Green, G (s)	46.9	36.9	36.9	45.1	36.0	36.0	50.1	39.7	39.7	57.9	43.6	43.6
Effective Green, g (s)	46.9	36.9	36.9	45.1	36.0	36.0	50.1	39.7	39.7	57.9	43.6	43.6
Actuated g/C Ratio	0.39	0.31	0.31	0.38	0.30	0.30	0.42	0.33	0.33	0.48	0.36	0.36
Clearance Time (s)	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	429	1087	424	216	512	389	446	1157	467	440	1247	498
v/s Ratio Prot	c0.04	c0.20		0.03	0.11		0.02	0.12		c0.06	0.09	
v/s Ratio Perm	0.14		0.02	0.13		0.02	0.09		c0.19	0.19		0.02
v/c Ratio	0.45	0.65	0.07	0.45	0.37	0.05	0.26	0.36	0.58	0.53	0.24	0.06
Uniform Delay, d1	25.4	36.0	29.4	26.1	33.1	29.9	22.0	30.5	33.3	19.2	26.7	24.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.24	1.09	1.26	1.00	1.00	1.00
Incremental Delay, d2	0.8	1.4	0.1	1.5	0.5	0.1	0.2	0.6	3.9	1.1	0.5	0.2
Delay (s)	26.2	37.4	29.5	27.6	33.5	29.9	27.6	34.0	45.8	20.4	27.1	25.0
Level of Service	C	D	C	C	C	C	C	C	D	C	C	C
Approach Delay (s)		34.5			31.2			38.8			24.3	
Approach LOS		C			C			D			C	

Intersection Summary			
HCM 2000 Control Delay	33.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	103.7%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group



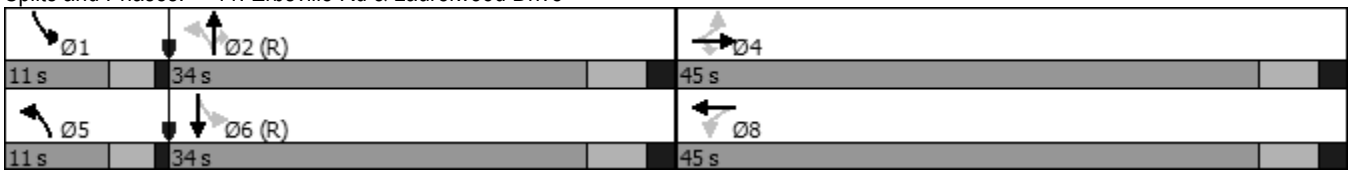
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	15	202	266	56	135	55	210	283	141	89	271	16
Future Volume (vph)	15	202	266	56	135	55	210	283	141	89	271	16
Ideal Flow (vphpl)	1775	1900	1750	1775	1650	1650	1775	1900	1750	1775	1650	1650
Storage Length (m)	27.0		0.0	20.0		0.0	65.0		29.0	19.0		0.0
Storage Lanes	1		1	1		0	1		1	1		0
Taper Length (m)	22.0			18.0			73.0			49.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor	0.77		0.92	0.95	0.91		0.98		0.88	0.94	1.00	
Frt			0.850		0.957				0.850		0.992	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1558	1824	1414	1502	1347	0	1619	1663	1471	1603	1464	0
Flt Permitted	0.538			0.509			0.517			0.586		
Satd. Flow (perm)	680	1824	1297	766	1347	0	861	1663	1296	928	1464	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			266		29				139		3	
Link Speed (k/h)		50			50			60			60	
Link Distance (m)		270.4			1189.4			1422.7			1517.5	
Travel Time (s)		19.5			85.6			85.4			91.1	
Confl. Peds. (#/hr)	259		56	56		259	24		63	63		24
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	7%	3%	4%	11%	6%	4%	3%	13%	0%	4%	10%	13%
Adj. Flow (vph)	15	202	266	56	135	55	210	283	141	89	271	16
Shared Lane Traffic (%)												
Lane Group Flow (vph)	15	202	266	56	190	0	210	283	141	89	287	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.11	1.01	1.13	1.11	1.21	1.21	1.11	1.01	1.13	1.11	1.21	1.21
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2	1	1	2		1	2	1	1	2	
Detector Template	Left	Thru	Right	Left	Thru		Left	Thru	Right	Left	Thru	
Leading Detector (m)	6.1	30.5	6.1	6.1	30.5		6.1	30.5	6.1	6.1	30.5	
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Size(m)	6.1	1.8	6.1	6.1	1.8		6.1	1.8	6.1	6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

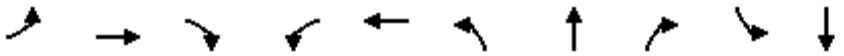
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Perm	NA	Perm	Perm	NA		pm+pt	NA	Perm	pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8			2		2	6		
Detector Phase	4	4	4	8	8		5	2	2	1	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0		5.0	28.0	28.0	5.0	28.0	
Minimum Split (s)	45.0	45.0	45.0	45.0	45.0		9.5	34.0	34.0	9.0	34.0	
Total Split (s)	45.0	45.0	45.0	45.0	45.0		11.0	34.0	34.0	11.0	34.0	
Total Split (%)	50.0%	50.0%	50.0%	50.0%	50.0%		12.2%	37.8%	37.8%	12.2%	37.8%	
Maximum Green (s)	39.0	39.0	39.0	39.0	39.0		7.0	28.0	28.0	7.0	28.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		3.0	4.0	4.0	3.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		1.0	2.0	2.0	1.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0		4.0	6.0	6.0	4.0	6.0	
Lead/Lag							Lead	Lag	Lag	Lead	Lag	
Lead-Lag Optimize?							Yes	Yes	Yes	Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None	None	None	None		None	C-Max	C-Max	None	C-Max	
Walk Time (s)	15.0	15.0	15.0	15.0	15.0			10.0	10.0		10.0	
Flash Dont Walk (s)	24.0	24.0	24.0	24.0	24.0			18.0	18.0		18.0	
Pedestrian Calls (#/hr)	0	0	0	0	0			0	0		0	
Act Effct Green (s)	16.8	16.8	16.8	16.8	16.8		62.3	51.9	51.9	56.6	47.4	
Actuated g/C Ratio	0.19	0.19	0.19	0.19	0.19		0.69	0.58	0.58	0.63	0.53	
v/c Ratio	0.12	0.60	0.58	0.39	0.69		0.31	0.30	0.17	0.14	0.37	
Control Delay	29.4	39.8	9.2	38.3	41.3		12.0	21.1	11.0	6.3	16.5	
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Delay	29.4	39.8	9.2	38.3	41.3		12.0	21.1	11.0	6.3	16.5	
LOS	C	D	A	D	D		B	C	B	A	B	
Approach Delay		22.6			40.6			15.9			14.1	
Approach LOS		C			D			B			B	

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 3.6 (4%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.69
Intersection Signal Delay: 20.9 Intersection LOS: C
Intersection Capacity Utilization 93.3% ICU Level of Service F
Analysis Period (min) 15

Splits and Phases: 11: Erbsville Rd & Laurelwood Drive





Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	15	202	266	56	190	210	283	141	89	287
v/c Ratio	0.12	0.60	0.58	0.39	0.69	0.31	0.30	0.17	0.14	0.37
Control Delay	29.4	39.8	9.2	38.3	41.3	12.0	21.1	11.0	6.3	16.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.4	39.8	9.2	38.3	41.3	12.0	21.1	11.0	6.3	16.5
Queue Length 50th (m)	2.2	32.4	0.0	8.6	26.3	24.5	37.9	8.6	4.1	26.8
Queue Length 95th (m)	6.8	47.9	17.9	18.1	43.3	m37.6	m69.4	m17.4	11.3	59.5
Internal Link Dist (m)		246.4			1165.4		1398.7			1493.5
Turn Bay Length (m)	27.0			20.0		65.0		29.0	19.0	
Base Capacity (vph)	294	790	712	331	600	679	959	806	645	771
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.05	0.26	0.37	0.17	0.32	0.31	0.30	0.17	0.14	0.37

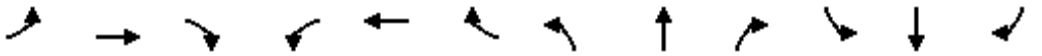
Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	15	202	266	56	135	55	210	283	141	89	271	16
Future Volume (vph)	15	202	266	56	135	55	210	283	141	89	271	16
Ideal Flow (vphpl)	1775	1900	1750	1775	1650	1650	1775	1900	1750	1775	1650	1650
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0		4.0	6.0	6.0	4.0	6.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00	0.92	1.00	0.91		1.00	1.00	0.88	1.00	1.00	
Flpb, ped/bikes	0.78	1.00	1.00	0.95	1.00		0.99	1.00	1.00	0.96	1.00	
Frt	1.00	1.00	0.85	1.00	0.96		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1213	1824	1297	1432	1346		1601	1663	1296	1542	1464	
Flt Permitted	0.54	1.00	1.00	0.51	1.00		0.52	1.00	1.00	0.59	1.00	
Satd. Flow (perm)	687	1824	1297	767	1346		870	1663	1296	951	1464	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	15	202	266	56	135	55	210	283	141	89	271	16
RTOR Reduction (vph)	0	0	216	0	24	0	0	0	60	0	1	0
Lane Group Flow (vph)	15	202	50	56	166	0	210	283	81	89	286	0
Confl. Peds. (#/hr)	259		56	56		259	24		63	63		24
Heavy Vehicles (%)	7%	3%	4%	11%	6%	4%	3%	13%	0%	4%	10%	13%
Turn Type	Perm	NA	Perm	Perm	NA		pm+pt	NA	Perm	pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8			2		2	6		
Actuated Green, G (s)	16.8	16.8	16.8	16.8	16.8		61.0	51.1	51.1	53.4	47.3	
Effective Green, g (s)	16.8	16.8	16.8	16.8	16.8		61.0	51.1	51.1	53.4	47.3	
Actuated g/C Ratio	0.19	0.19	0.19	0.19	0.19		0.68	0.57	0.57	0.59	0.53	
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0		4.0	6.0	6.0	4.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	128	340	242	143	251		670	944	735	604	769	
v/s Ratio Prot		0.11			c0.12		c0.03	0.17		0.01	c0.20	
v/s Ratio Perm	0.02		0.04	0.07			0.18		0.06	0.08		
v/c Ratio	0.12	0.59	0.21	0.39	0.66		0.31	0.30	0.11	0.15	0.37	
Uniform Delay, d1	30.4	33.5	31.0	32.1	34.0		5.6	10.1	9.0	7.9	12.6	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.95	1.66	3.85	1.00	1.00	
Incremental Delay, d2	0.4	2.8	0.4	1.8	6.4		0.2	0.7	0.3	0.1	1.4	
Delay (s)	30.8	36.3	31.4	33.9	40.4		11.2	17.5	34.8	8.0	14.0	
Level of Service	C	D	C	C	D		B	B	C	A	B	
Approach Delay (s)		33.4			38.9			19.2			12.6	
Approach LOS		C			D			B			B	

Intersection Summary			
HCM 2000 Control Delay	24.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.43		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	93.3%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

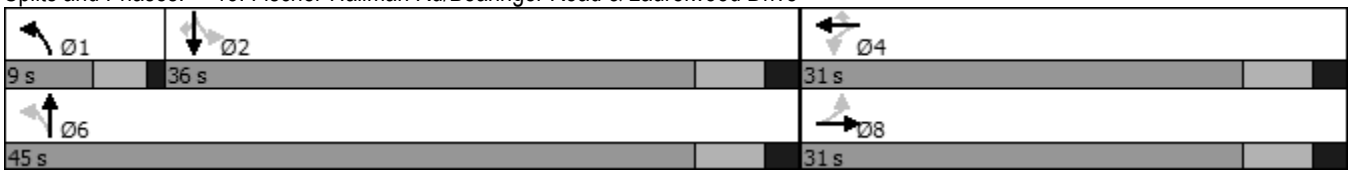


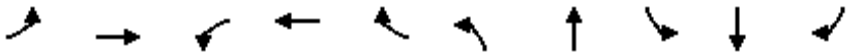
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	271	120	240	25	16	8	108	548	57	14	231	73
Future Volume (vph)	271	120	240	25	16	8	108	548	57	14	231	73
Ideal Flow (vphpl)	1775	1650	1650	1775	1900	1750	1775	1650	1650	1775	1900	1750
Storage Length (m)	100.0		0.0	50.0		40.0	70.0		0.0	70.0		0.0
Storage Lanes	1		0	1		1	1		0	1		1
Taper Length (m)	30.0			30.0			80.0			60.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor	1.00	0.99		1.00		0.98						
Frt		0.900				0.850		0.986				0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1651	1425	0	1668	1879	1471	1573	1580	0	1558	1807	1428
Flt Permitted	0.747			0.355			0.543			0.423		
Satd. Flow (perm)	1296	1425	0	622	1879	1439	899	1580	0	694	1807	1428
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		141				100		10				100
Link Speed (k/h)		50			50			60			60	
Link Distance (m)		691.0			190.4			968.6			146.9	
Travel Time (s)		49.8			13.7			58.1			8.8	
Confl. Peds. (#/hr)	1		4	4		1						
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	1%	0%	3%	0%	0%	0%	6%	2%	0%	7%	4%	3%
Adj. Flow (vph)	271	120	240	25	16	8	108	548	57	14	231	73
Shared Lane Traffic (%)												
Lane Group Flow (vph)	271	360	0	25	16	8	108	605	0	14	231	73
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.11	1.21	1.21	1.11	1.01	1.13	1.11	1.21	1.21	1.11	1.01	1.13
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2	1	1	2		1	2	1
Detector Template	Left	Thru		Left	Thru	Right	Left	Thru		Left	Thru	Right
Leading Detector (m)	6.1	30.5		6.1	30.5	6.1	6.1	30.5		6.1	30.5	6.1
Trailing Detector (m)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 1 Size(m)	6.1	1.8		6.1	1.8	6.1	6.1	1.8		6.1	1.8	6.1
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Perm	NA		Perm	NA	Perm	pm+pt	NA		Perm	NA	Perm
Protected Phases		8			4		1	6			2	
Permitted Phases	8			4		4	6			2		2
Detector Phase	8	8		4	4	4	1	6		2	2	2
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0	8.0	5.0	30.0		30.0	30.0	30.0
Minimum Split (s)	31.0	31.0		31.0	31.0	31.0	9.0	36.0		36.0	36.0	36.0
Total Split (s)	31.0	31.0		31.0	31.0	31.0	9.0	45.0		36.0	36.0	36.0
Total Split (%)	40.8%	40.8%		40.8%	40.8%	40.8%	11.8%	59.2%		47.4%	47.4%	47.4%
Maximum Green (s)	25.0	25.0		25.0	25.0	25.0	5.0	39.0		30.0	30.0	30.0
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	3.0	4.0		4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	1.0	2.0		2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0	6.0	4.0	6.0		6.0	6.0	6.0
Lead/Lag							Lead			Lag	Lag	Lag
Lead-Lag Optimize?							Yes			Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Recall Mode	None	None		None	None	None	Max	None		None	None	None
Walk Time (s)	12.0	12.0		12.0	12.0	12.0		9.0		9.0	9.0	9.0
Flash Dont Walk (s)	13.0	13.0		13.0	13.0	13.0		21.0		21.0	21.0	21.0
Pedestrian Calls (#/hr)	0	0		0	0	0		0		0	0	0
Act Effct Green (s)	19.4	19.4		19.4	19.4	19.4	41.2	39.2		30.2	30.2	30.2
Actuated g/C Ratio	0.27	0.27		0.27	0.27	0.27	0.58	0.55		0.43	0.43	0.43
v/c Ratio	0.76	0.73		0.15	0.03	0.02	0.19	0.69		0.05	0.30	0.11
Control Delay	37.9	22.9		20.7	17.8	0.1	8.9	17.6		14.6	16.0	2.4
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	37.9	22.9		20.7	17.8	0.1	8.9	17.6		14.6	16.0	2.4
LOS	D	C		C	B	A	A	B		B	B	A
Approach Delay		29.3			16.4			16.3			12.8	
Approach LOS		C			B			B			B	

Intersection Summary			
Area Type:	Other		
Cycle Length: 76			
Actuated Cycle Length: 70.7			
Natural Cycle: 80			
Control Type: Semi Act-Uncoord			
Maximum v/c Ratio: 0.76			
Intersection Signal Delay: 20.5		Intersection LOS: C	
Intersection Capacity Utilization 101.7%		ICU Level of Service G	
Analysis Period (min) 15			

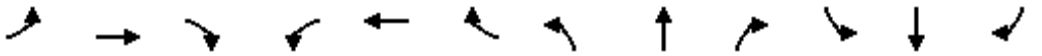
Splits and Phases: 13: Fischer-Hallman Rd/Bearinger Road & Laurelwood Drive





Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	271	360	25	16	8	108	605	14	231	73
v/c Ratio	0.76	0.73	0.15	0.03	0.02	0.19	0.69	0.05	0.30	0.11
Control Delay	37.9	22.9	20.7	17.8	0.1	8.9	17.6	14.6	16.0	2.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	37.9	22.9	20.7	17.8	0.1	8.9	17.6	14.6	16.0	2.4
Queue Length 50th (m)	32.5	25.4	2.5	1.5	0.0	6.0	53.9	1.1	19.9	0.0
Queue Length 95th (m)	57.2	53.4	8.0	5.4	0.0	14.3	103.4	4.5	38.4	4.7
Internal Link Dist (m)		667.0		166.4			944.6		122.9	
Turn Bay Length (m)	100.0		50.0		40.0	70.0		70.0		
Base Capacity (vph)	460	597	221	668	576	571	880	295	770	666
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.59	0.60	0.11	0.02	0.01	0.19	0.69	0.05	0.30	0.11

Intersection Summary



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	271	120	240	25	16	8	108	548	57	14	231	73
Future Volume (vph)	271	120	240	25	16	8	108	548	57	14	231	73
Ideal Flow (vphpl)	1775	1650	1650	1775	1900	1750	1775	1650	1650	1775	1900	1750
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	4.0	6.0		6.0	6.0	6.0
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.98	1.00	1.00		1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.90		1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1649	1425		1665	1879	1440	1573	1580		1558	1807	1428
Flt Permitted	0.75	1.00		0.35	1.00	1.00	0.54	1.00		0.42	1.00	1.00
Satd. Flow (perm)	1296	1425		622	1879	1440	899	1580		694	1807	1428
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	271	120	240	25	16	8	108	548	57	14	231	73
RTOR Reduction (vph)	0	102	0	0	0	6	0	4	0	0	0	42
Lane Group Flow (vph)	271	258	0	25	16	2	108	601	0	14	231	31
Confl. Peds. (#/hr)	1		4	4		1						
Heavy Vehicles (%)	1%	0%	3%	0%	0%	0%	6%	2%	0%	7%	4%	3%
Turn Type	Perm	NA		Perm	NA	Perm	pm+pt	NA		Perm	NA	Perm
Protected Phases		8			4		1	6			2	
Permitted Phases	8			4		4	6			2		2
Actuated Green, G (s)	19.4	19.4		19.4	19.4	19.4	39.2	39.2		30.2	30.2	30.2
Effective Green, g (s)	19.4	19.4		19.4	19.4	19.4	39.2	39.2		30.2	30.2	30.2
Actuated g/C Ratio	0.27	0.27		0.27	0.27	0.27	0.56	0.56		0.43	0.43	0.43
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0	4.0	6.0		6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	356	391		170	516	395	546	877		296	772	610
v/s Ratio Prot		0.18			0.01		0.01	c0.38			0.13	
v/s Ratio Perm	c0.21			0.04		0.00	0.10			0.02		0.02
v/c Ratio	0.76	0.66		0.15	0.03	0.01	0.20	0.68		0.05	0.30	0.05
Uniform Delay, d1	23.5	22.7		19.3	18.7	18.6	7.6	11.3		11.8	13.3	11.8
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	9.3	4.0		0.4	0.0	0.0	0.2	2.2		0.1	0.2	0.0
Delay (s)	32.7	26.7		19.7	18.7	18.6	7.8	13.5		11.9	13.5	11.9
Level of Service	C	C		B	B	B	A	B		B	B	B
Approach Delay (s)		29.3			19.2			12.6			13.0	
Approach LOS		C			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	19.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	70.6	Sum of lost time (s)	16.0
Intersection Capacity Utilization	101.7%	ICU Level of Service	G
Analysis Period (min)	15		

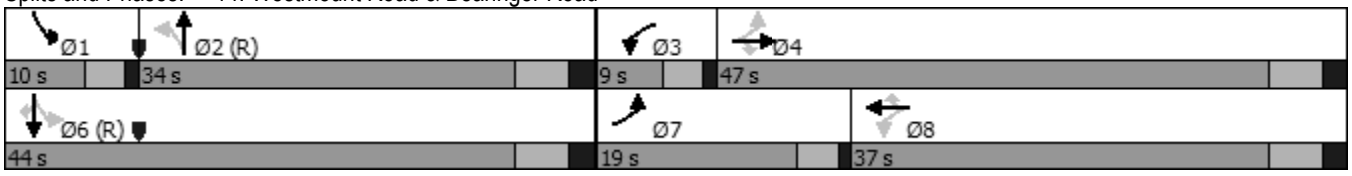
c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	516	332	2	60	106	51	1	274	74	144	254	220
Future Volume (vph)	516	332	2	60	106	51	1	274	74	144	254	220
Ideal Flow (vphpl)	1775	1900	1750	1775	1900	1750	1775	1900	1650	1775	1900	1750
Storage Length (m)	70.0		20.0	30.0		87.0	66.0		0.0	60.0		60.0
Storage Lanes	1		1	1		1	1		0	1		1
Taper Length (m)	75.0			48.0			81.0			72.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	1.00
Ped Bike Factor								1.00		1.00		
Frt			0.850			0.850		0.968				0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1635	1860	1471	1668	1789	1442	1668	3379	0	1668	3466	1401
Flt Permitted	0.593			0.560			0.595			0.450		
Satd. Flow (perm)	1020	1860	1471	983	1789	1442	1044	3379	0	789	3466	1401
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			120			164		34				220
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		377.1			304.5			303.0			839.6	
Travel Time (s)		22.6			18.3			18.2			50.4	
Confl. Peds. (#/hr)									1	1		
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	2%	1%	0%	0%	5%	2%	0%	2%	1%	0%	3%	5%
Adj. Flow (vph)	516	332	2	60	106	51	1	274	74	144	254	220
Shared Lane Traffic (%)												
Lane Group Flow (vph)	516	332	2	60	106	51	1	348	0	144	254	220
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.11	1.01	1.13	1.11	1.01	1.13	1.11	1.01	1.21	1.11	1.01	1.13
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2	1	1	2	1	1	2		1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru		Left	Thru	Right
Leading Detector (m)	6.1	30.5	6.1	6.1	30.5	6.1	6.1	30.5		6.1	30.5	6.1
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 1 Size(m)	6.1	1.8	6.1	6.1	1.8	6.1	6.1	1.8		6.1	1.8	6.1
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA		pm+pt	NA	Perm
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases	4		4	8		8	2			6		6
Detector Phase	7	4	4	3	8	8	2	2		1	6	6
Switch Phase												
Minimum Initial (s)	5.0	31.0	31.0	5.0	31.0	31.0	28.0	28.0		5.0	28.0	28.0
Minimum Split (s)	9.0	37.0	37.0	9.0	37.0	37.0	34.0	34.0		9.0	34.0	34.0
Total Split (s)	19.0	47.0	47.0	9.0	37.0	37.0	34.0	34.0		10.0	44.0	44.0
Total Split (%)	19.0%	47.0%	47.0%	9.0%	37.0%	37.0%	34.0%	34.0%		10.0%	44.0%	44.0%
Maximum Green (s)	15.0	41.0	41.0	5.0	31.0	31.0	28.0	28.0		6.0	38.0	38.0
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	4.0	4.0	4.0		3.0	4.0	4.0
All-Red Time (s)	1.0	2.0	2.0	1.0	2.0	2.0	2.0	2.0		1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	6.0	4.0	6.0	6.0	6.0	6.0		4.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lag	Lag		Lead		
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes		
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Recall Mode	None	None	None	None	None	None	C-Max	C-Max		None	C-Max	C-Max
Walk Time (s)		11.0	11.0		11.0	11.0	10.0	10.0			10.0	10.0
Flash Dont Walk (s)		20.0	20.0		20.0	20.0	18.0	18.0			18.0	18.0
Pedestrian Calls (#/hr)		0	0		0	0	0	0			0	0
Act Effct Green (s)	48.2	39.0	39.0	31.4	31.0	31.0	31.6	31.6		43.8	41.8	41.8
Actuated g/C Ratio	0.48	0.39	0.39	0.31	0.31	0.31	0.32	0.32		0.44	0.42	0.42
v/c Ratio	0.85	0.46	0.00	0.18	0.19	0.09	0.00	0.32		0.36	0.18	0.31
Control Delay	35.4	24.6	0.0	14.3	26.5	0.3	26.0	25.7		22.2	20.1	4.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	35.4	24.6	0.0	14.3	26.5	0.3	26.0	25.7		22.2	20.1	4.2
LOS	D	C	A	B	C	A	C	C		C	C	A
Approach Delay		31.1			17.0			25.7			14.9	
Approach LOS		C			B			C			B	

Intersection Summary			
Area Type:	Other		
Cycle Length: 100			
Actuated Cycle Length: 100			
Offset: 78 (78%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 90			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.85			
Intersection Signal Delay: 23.7		Intersection LOS: C	
Intersection Capacity Utilization 115.0%		ICU Level of Service H	
Analysis Period (min) 15			

Splits and Phases: 14: Westmount Road & Bearinger Road





Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	516	332	2	60	106	51	1	348	144	254	220
v/c Ratio	0.85	0.46	0.00	0.18	0.19	0.09	0.00	0.32	0.36	0.18	0.31
Control Delay	35.4	24.6	0.0	14.3	26.5	0.3	26.0	25.7	22.2	20.1	4.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	35.4	24.6	0.0	14.3	26.5	0.3	26.0	25.7	22.2	20.1	4.2
Queue Length 50th (m)	66.9	45.3	0.0	5.5	15.0	0.0	0.2	25.4	18.0	17.0	0.0
Queue Length 95th (m)	#113.3	68.6	0.0	11.7	27.8	0.0	1.4	37.7	31.3	25.7	14.0
Internal Link Dist (m)		353.1			280.5			279.0		815.6	
Turn Bay Length (m)	70.0		20.0	30.0		87.0	66.0		60.0		60.0
Base Capacity (vph)	605	762	673	342	554	560	330	1092	399	1449	713
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.85	0.44	0.00	0.18	0.19	0.09	0.00	0.32	0.36	0.18	0.31

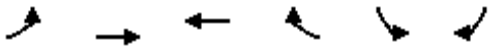
Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	516	332	2	60	106	51	1	274	74	144	254	220
Future Volume (vph)	516	332	2	60	106	51	1	274	74	144	254	220
Ideal Flow (vphpl)	1775	1900	1750	1775	1900	1750	1775	1900	1650	1775	1900	1750
Total Lost time (s)	4.0	6.0	6.0	4.0	6.0	6.0	6.0	6.0		4.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1635	1860	1471	1668	1789	1442	1668	3380		1667	3466	1401
Flt Permitted	0.59	1.00	1.00	0.56	1.00	1.00	0.59	1.00		0.45	1.00	1.00
Satd. Flow (perm)	1020	1860	1471	984	1789	1442	1044	3380		790	3466	1401
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	516	332	2	60	106	51	1	274	74	144	254	220
RTOR Reduction (vph)	0	0	1	0	0	38	0	24	0	0	0	131
Lane Group Flow (vph)	516	332	1	60	106	13	1	324	0	144	254	89
Confl. Peds. (#/hr)									1	1		
Heavy Vehicles (%)	2%	1%	0%	0%	5%	2%	0%	2%	1%	0%	3%	5%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA		pm+pt	NA	Perm
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases	4		4	8		8	2			6		6
Actuated Green, G (s)	47.4	39.4	39.4	28.8	24.8	24.8	30.4	30.4		40.6	40.6	40.6
Effective Green, g (s)	47.4	39.4	39.4	28.8	24.8	24.8	30.4	30.4		40.6	40.6	40.6
Actuated g/C Ratio	0.47	0.39	0.39	0.29	0.25	0.25	0.30	0.30		0.41	0.41	0.41
Clearance Time (s)	4.0	6.0	6.0	4.0	6.0	6.0	6.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	597	732	579	310	443	357	317	1027		375	1407	568
v/s Ratio Prot	c0.16	0.18		0.01	0.06			0.10		c0.02	0.07	
v/s Ratio Perm	c0.25		0.00	0.05		0.01	0.00			c0.13		0.06
v/c Ratio	0.86	0.45	0.00	0.19	0.24	0.04	0.00	0.32		0.38	0.18	0.16
Uniform Delay, d1	21.5	22.4	18.4	26.3	30.1	28.5	24.2	26.8		19.5	19.0	18.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	12.4	0.4	0.0	0.3	0.3	0.0	0.0	0.8		0.7	0.3	0.6
Delay (s)	33.8	22.8	18.4	26.6	30.3	28.6	24.3	27.6		20.2	19.3	19.4
Level of Service	C	C	B	C	C	C	C	C		C	B	B
Approach Delay (s)		29.5			28.9			27.6			19.6	
Approach LOS		C			C			C			B	

Intersection Summary			
HCM 2000 Control Delay	26.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	115.0%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

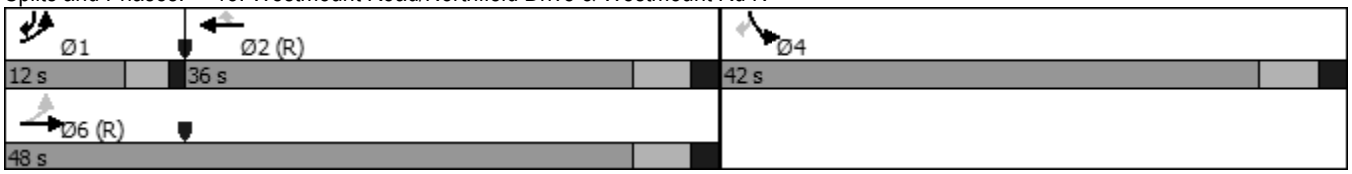


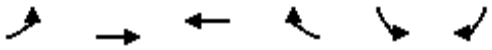
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	169	666	306	72	249	336
Future Volume (vph)	169	666	306	72	249	336
Ideal Flow (vphpl)	1775	1900	1900	1750	1775	1750
Storage Length (m)	94.0			33.0	75.0	0.0
Storage Lanes	1			1	1	1
Taper Length (m)	87.0				25.0	
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	1.00
Ped Bike Factor						0.99
Frt				0.850		0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1635	3535	3535	1375	1635	1471
Flt Permitted	0.499				0.950	
Satd. Flow (perm)	859	3535	3535	1375	1635	1452
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)				72		332
Link Speed (k/h)		60	60		50	
Link Distance (m)		839.6	240.7		534.1	
Travel Time (s)		50.4	14.4		38.5	
Confl. Peds. (#/hr)						1
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	2%	1%	1%	7%	2%	0%
Adj. Flow (vph)	169	666	306	72	249	336
Shared Lane Traffic (%)						
Lane Group Flow (vph)	169	666	306	72	249	336
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.5	3.5		3.5	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.11	1.01	1.01	1.13	1.11	1.13
Turning Speed (k/h)	24			14	24	14
Number of Detectors	1	2	2	1	1	1
Detector Template	Left	Thru	Thru	Right	Left	Right
Leading Detector (m)	6.1	30.5	30.5	6.1	6.1	6.1
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	6.1	1.8	1.8	6.1	6.1	6.1
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		28.7	28.7			
Detector 2 Size(m)		1.8	1.8			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Turn Type	pm+pt	NA	NA	Perm	Prot	pm+ov
Protected Phases	1	6	2		4	1
Permitted Phases	6			2		4
Detector Phase	1	6	2	2	4	1
Switch Phase						
Minimum Initial (s)	5.0	30.0	30.0	30.0	7.0	5.0
Minimum Split (s)	9.0	36.0	36.0	36.0	42.0	9.0
Total Split (s)	12.0	48.0	36.0	36.0	42.0	12.0
Total Split (%)	13.3%	53.3%	40.0%	40.0%	46.7%	13.3%
Maximum Green (s)	8.0	42.0	30.0	30.0	36.0	8.0
Yellow Time (s)	3.0	4.0	4.0	4.0	4.0	3.0
All-Red Time (s)	1.0	2.0	2.0	2.0	2.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	6.0	6.0	6.0	4.0
Lead/Lag	Lead		Lag	Lag		Lead
Lead-Lag Optimize?	Yes		Yes	Yes		Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	C-Max	C-Max	C-Max	Max	None
Walk Time (s)		21.0	21.0	21.0	7.0	
Flash Dont Walk (s)		9.0	9.0	9.0	29.0	
Pedestrian Calls (#/hr)		0	0	0	0	
Act Effct Green (s)	44.0	42.0	30.1	30.1	36.0	45.9
Actuated g/C Ratio	0.49	0.47	0.33	0.33	0.40	0.51
v/c Ratio	0.35	0.40	0.26	0.14	0.38	0.37
Control Delay	15.4	16.7	22.6	6.2	21.3	2.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	15.4	16.7	22.6	6.2	21.3	2.5
LOS	B	B	C	A	C	A
Approach Delay		16.4	19.5		10.5	
Approach LOS		B	B		B	

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 25.2 (28%), Referenced to phase 2:WBT and 6:EBTL, Start of Green			
Natural Cycle: 90			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.40			
Intersection Signal Delay: 15.1		Intersection LOS: B	
Intersection Capacity Utilization 78.4%		ICU Level of Service D	
Analysis Period (min) 15			

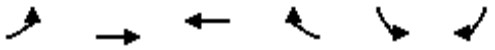
Splits and Phases: 15: Westmount Road/Northfield Drive & Westmount Rd N





Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Group Flow (vph)	169	666	306	72	249	336
v/c Ratio	0.35	0.40	0.26	0.14	0.38	0.37
Control Delay	15.4	16.7	22.6	6.2	21.3	2.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	15.4	16.7	22.6	6.2	21.3	2.5
Queue Length 50th (m)	15.9	38.3	20.1	0.0	29.8	0.3
Queue Length 95th (m)	27.9	51.4	30.1	8.7	48.9	11.3
Internal Link Dist (m)		815.6	216.7		510.1	
Turn Bay Length (m)	94.0			33.0	75.0	
Base Capacity (vph)	488	1649	1183	508	654	906
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.35	0.40	0.26	0.14	0.38	0.37

Intersection Summary



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	169	666	306	72	249	336
Future Volume (vph)	169	666	306	72	249	336
Ideal Flow (vphpl)	1775	1900	1900	1750	1775	1750
Total Lost time (s)	4.0	6.0	6.0	6.0	6.0	4.0
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1635	3535	3535	1375	1635	1456
Flt Permitted	0.50	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	859	3535	3535	1375	1635	1456
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	169	666	306	72	249	336
RTOR Reduction (vph)	0	0	0	48	0	170
Lane Group Flow (vph)	169	666	306	24	249	166
Confl. Peds. (#/hr)						1
Heavy Vehicles (%)	2%	1%	1%	7%	2%	0%
Turn Type	pm+pt	NA	NA	Perm	Prot	pm+ov
Protected Phases	1	6	2		4	1
Permitted Phases	6			2		4
Actuated Green, G (s)	42.0	42.0	30.1	30.1	36.0	43.9
Effective Green, g (s)	42.0	42.0	30.1	30.1	36.0	43.9
Actuated g/C Ratio	0.47	0.47	0.33	0.33	0.40	0.49
Clearance Time (s)	4.0	6.0	6.0	6.0	6.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	468	1649	1182	459	654	710
v/s Ratio Prot	0.03	c0.19	0.09		c0.15	0.02
v/s Ratio Perm	0.14			0.02		0.09
v/c Ratio	0.36	0.40	0.26	0.05	0.38	0.23
Uniform Delay, d1	14.4	15.8	21.8	20.3	19.1	13.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.5	0.7	0.5	0.2	1.7	0.2
Delay (s)	14.9	16.5	22.4	20.5	20.8	13.5
Level of Service	B	B	C	C	C	B
Approach Delay (s)		16.2	22.0		16.6	
Approach LOS		B	C		B	

Intersection Summary			
HCM 2000 Control Delay	17.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.41		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	78.4%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	20	1	21	47	4	15
Future Volume (vph)	20	1	21	47	4	15
Ideal Flow (vphpl)	1765	1765	1650	1650	1650	1650
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.994		0.907			
Flt Protected	0.955					0.990
Satd. Flow (prot)	1450	0	1400	0	0	1395
Flt Permitted	0.955					0.990
Satd. Flow (perm)	1450	0	1400	0	0	1395
Link Speed (k/h)	70		60			60
Link Distance (m)	860.7		462.9			376.8
Travel Time (s)	44.3		27.8			22.6
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	10%	100%	5%	6%	0%	20%
Adj. Flow (vph)	20	1	21	47	4	15
Shared Lane Traffic (%)						
Lane Group Flow (vph)	21	0	68	0	0	19
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Right	Left	Left
Median Width(m)	3.5		0.0			0.0
Link Offset(m)	0.0		0.0			0.0
Crosswalk Width(m)	1.6		1.6			1.6
Two way Left Turn Lane						
Headway Factor	1.12	1.12	1.21	1.21	1.21	1.21
Turning Speed (k/h)	24	14		14	24	
Sign Control	Stop		Free			Free

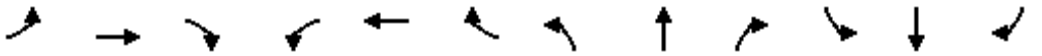
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 14.9%		ICU Level of Service A	
Analysis Period (min) 15			



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	20	1	21	47	4	15
Future Volume (Veh/h)	20	1	21	47	4	15
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	20	1	21	47	4	15
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	68	44			68	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	68	44			68	
tC, single (s)	6.5	7.2			4.1	
tC, 2 stage (s)						
tF (s)	3.6	4.2			2.2	
p0 queue free %	98	100			100	
cM capacity (veh/h)	916	805			1546	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	21	68	19
Volume Left	20	0	4
Volume Right	1	47	0
cSH	910	1700	1546
Volume to Capacity	0.02	0.04	0.00
Queue Length 95th (m)	0.5	0.0	0.1
Control Delay (s)	9.1	0.0	1.6
Lane LOS	A		A
Approach Delay (s)	9.1	0.0	1.6
Approach LOS	A		

Intersection Summary			
Average Delay	2.0		
Intersection Capacity Utilization	14.9%	ICU Level of Service	A
Analysis Period (min)	15		



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Volume (vph)	5	45	5	63	15	22	0	130	141	50	129	1
Future Volume (vph)	5	45	5	63	15	22	0	130	141	50	129	1
Ideal Flow (vphpl)	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.988			0.970			0.930			0.999	
Flt Protected		0.995			0.969						0.986	
Satd. Flow (prot)	0	1434	0	0	1362	0	0	1322	0	0	1341	0
Flt Permitted		0.995			0.969						0.986	
Satd. Flow (perm)	0	1434	0	0	1362	0	0	1322	0	0	1341	0
Link Speed (k/h)		70			70			60			60	
Link Distance (m)		610.1			1289.9			1517.5			172.2	
Travel Time (s)		31.4			66.3			91.1			10.3	
Confl. Peds. (#/hr)	4		2	2		4			2	2		
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	4%	20%	6%	0%	9%	0%	12%	4%	4%	16%	0%
Adj. Flow (vph)	5	45	5	63	15	22	0	130	141	50	129	1
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	55	0	0	100	0	0	271	0	0	180	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Free			Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	54.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Volume (veh/h)	5	45	5	63	15	22	0	130	141	50	129	1
Future Volume (Veh/h)	5	45	5	63	15	22	0	130	141	50	129	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	5	45	5	63	15	22	0	130	141	50	129	1
Pedestrians					2			2			4	
Lane Width (m)					3.5			3.5			3.5	
Walking Speed (m/s)					1.1			1.1			1.1	
Percent Blockage					0			0			0	
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	464	502	132	462	432	206	130			273		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	464	502	132	462	432	206	130			273		
tC, single (s)	7.1	6.5	6.4	7.2	6.5	6.3	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.5	3.6	4.0	3.4	2.2			2.2		
p0 queue free %	99	90	99	86	97	97	100			96		
cM capacity (veh/h)	470	449	870	447	498	812	1468			1276		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	55	100	271	180
Volume Left	5	63	0	50
Volume Right	5	22	141	1
cSH	472	504	1468	1276
Volume to Capacity	0.12	0.20	0.00	0.04
Queue Length 95th (m)	3.0	5.6	0.0	0.9
Control Delay (s)	13.6	13.9	0.0	2.4
Lane LOS	B	B		A
Approach Delay (s)	13.6	13.9	0.0	2.4
Approach LOS	B	B		

Intersection Summary				
Average Delay	4.3			
Intersection Capacity Utilization	54.5%	ICU Level of Service	A	
Analysis Period (min)	15			

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	199	8	60	94	11	99
Future Volume (vph)	199	8	60	94	11	99
Ideal Flow (vphpl)	1650	1650	1650	1650	1765	1765
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.995				0.878	
Flt Protected				0.981	0.995	
Satd. Flow (prot)	1549	0	0	1475	1472	0
Flt Permitted				0.981	0.995	
Satd. Flow (perm)	1549	0	0	1475	1472	0
Link Speed (k/h)	70			70	60	
Link Distance (m)	1289.9			1914.1	213.7	
Travel Time (s)	66.3			98.4	12.8	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	5%	0%	3%	12%	9%	3%
Adj. Flow (vph)	199	8	60	94	11	99
Shared Lane Traffic (%)						
Lane Group Flow (vph)	207	0	0	154	110	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	0.0			0.0	3.5	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	1.21	1.21	1.21	1.21	1.12	1.12
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 39.4%		ICU Level of Service A	
Analysis Period (min) 15			



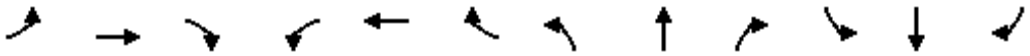
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	199	8	60	94	11	99
Future Volume (Veh/h)	199	8	60	94	11	99
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	199	8	60	94	11	99
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			207		417	203
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			207		417	203
tC, single (s)			4.1		6.5	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.6	3.3
p0 queue free %			96		98	88
cM capacity (veh/h)			1358		554	835

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	207	154	110
Volume Left	0	60	11
Volume Right	8	0	99
cSH	1700	1358	795
Volume to Capacity	0.12	0.04	0.14
Queue Length 95th (m)	0.0	1.1	3.6
Control Delay (s)	0.0	3.3	10.3
Lane LOS		A	B
Approach Delay (s)	0.0	3.3	10.3
Approach LOS			B

Intersection Summary			
Average Delay	3.5		
Intersection Capacity Utilization	39.4%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	114	26	247	35	26	12	74	162	17	12	190	17
Future Volume (vph)	114	26	247	35	26	12	74	162	17	12	190	17
Ideal Flow (vphpl)	1650	1650	1750	1550	1550	1550	1775	1650	1650	1550	1550	1550
Storage Length (m)	0.0		65.0	0.0		0.0	35.0		0.0	0.0		0.0
Storage Lanes	0		1	0		0	1		0	0		0
Taper Length (m)	2.5			2.5			25.0			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850		0.978			0.986			0.990	
Flt Protected		0.961			0.977		0.950				0.997	
Satd. Flow (prot)	0	1424	1428	0	1390	0	1390	1536	0	0	1407	0
Flt Permitted		0.961			0.977		0.950				0.997	
Satd. Flow (perm)	0	1424	1428	0	1390	0	1390	1536	0	0	1407	0
Link Speed (k/h)		70			50			50			50	
Link Distance (m)		1914.1			162.1			534.1			164.9	
Travel Time (s)		98.4			11.7			38.5			11.9	
Confl. Peds. (#/hr)	4		1	1		4	3		1	1		3
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	9%	15%	3%	0%	15%	0%	20%	4%	12%	17%	5%	29%
Adj. Flow (vph)	114	26	247	35	26	12	74	162	17	12	190	17
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	140	247	0	73	0	74	179	0	0	219	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.21	1.21	1.13	1.31	1.31	1.31	1.11	1.21	1.21	1.31	1.31	1.31
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 49.8%		ICU Level of Service A	
Analysis Period (min) 15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	114	26	247	35	26	12	74	162	17	12	190	17
Future Volume (vph)	114	26	247	35	26	12	74	162	17	12	190	17
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	114	26	247	35	26	12	74	162	17	12	190	17

Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2	SB 1
Volume Total (vph)	140	247	73	74	179	219
Volume Left (vph)	114	0	35	74	0	12
Volume Right (vph)	0	247	12	0	17	17
Hadj (s)	0.58	-0.65	0.09	0.84	0.01	0.09
Departure Headway (s)	6.6	5.4	6.7	7.0	6.2	6.3
Degree Utilization, x	0.26	0.37	0.14	0.14	0.31	0.38
Capacity (veh/h)	514	631	490	486	550	542
Control Delay (s)	10.7	10.4	10.7	10.0	10.7	13.1
Approach Delay (s)	10.5		10.7	10.5		13.1
Approach LOS	B		B	B		B

Intersection Summary				
Delay	11.1			
Level of Service	B			
Intersection Capacity Utilization	49.8%	ICU Level of Service	A	
Analysis Period (min)	15			

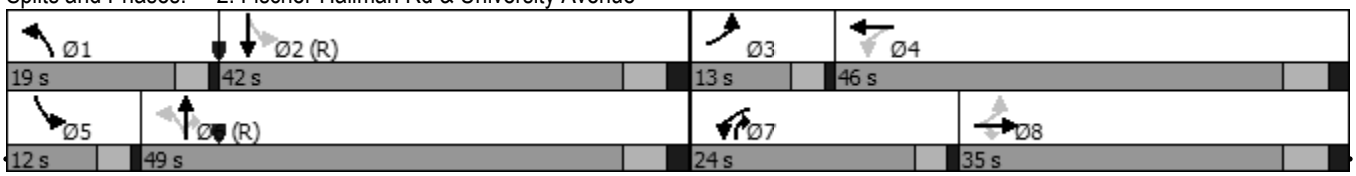
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	109	241	195	400	486	12	287	758	120	16	768	129
Future Volume (vph)	109	241	195	400	486	12	287	758	120	16	768	129
Ideal Flow (vphpl)	1775	1900	1750	1775	1775	1775	1775	1900	1750	1775	1775	1775
Storage Length (m)	35.0		35.0	100.0		0.0	80.0		125.0	50.0		0.0
Storage Lanes	1		1	1		0	1		1	1		0
Taper Length (m)	30.0			65.0			30.0			60.0		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	0.95	1.00	0.95	1.00	1.00	0.95	0.95
Ped Bike Factor	1.00		0.98	1.00	1.00		1.00				1.00	
Frt			0.850		0.996				0.850		0.978	
Flt Protected	0.950			0.950						0.950		
Satd. Flow (prot)	1668	3570	1442	1651	3321	0	1738	3535	1442	1668	3216	0
Flt Permitted	0.470			0.513			*0.125			0.343		
Satd. Flow (perm)	824	3570	1416	888	3321	0	216	3535	1442	602	3216	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			195		2				120		16	
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		701.9			786.3			349.5			1136.8	
Travel Time (s)		42.1			47.2			21.0			68.2	
Confl. Peds. (#/hr)	1		5	5		1	17					17
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	2%	1%	0%	0%	1%	1%	2%	0%	1%	1%
Adj. Flow (vph)	109	241	195	400	486	12	287	758	120	16	768	129
Shared Lane Traffic (%)												
Lane Group Flow (vph)	109	241	195	400	498	0	287	758	120	16	897	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.11	1.01	1.13	1.11	1.11	1.11	1.11	1.01	1.13	1.11	1.11	1.11
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2	1	1	2		1	2	1	1	2	
Detector Template	Left	Thru	Right	Left	Thru		Left	Thru	Right	Left	Thru	
Leading Detector (m)	6.1	30.5	6.1	6.1	30.5		6.1	30.5	6.1	6.1	30.5	
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Size(m)	6.1	1.8	6.1	6.1	1.8		6.1	1.8	6.1	6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

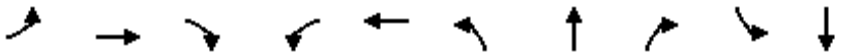
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	pm+ov	pm+pt	NA	
Protected Phases	3	8		7	4		1	6	7	5	2	
Permitted Phases	8		8	4			6		6	2		
Detector Phase	3	8	8	7	4		1	6	7	5	2	
Switch Phase												
Minimum Initial (s)	5.0	29.0	29.0	5.0	29.0		5.0	36.0	5.0	5.0	36.0	
Minimum Split (s)	9.0	35.0	35.0	9.0	35.0		9.0	42.0	9.0	9.0	42.0	
Total Split (s)	13.0	35.0	35.0	24.0	46.0		19.0	49.0	24.0	12.0	42.0	
Total Split (%)	10.8%	29.2%	29.2%	20.0%	38.3%		15.8%	40.8%	20.0%	10.0%	35.0%	
Maximum Green (s)	9.0	29.0	29.0	20.0	40.0		15.0	43.0	20.0	8.0	36.0	
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0		3.0	4.0	3.0	3.0	4.0	
All-Red Time (s)	1.0	2.0	2.0	1.0	2.0		1.0	2.0	1.0	1.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	4.0	6.0	6.0	4.0	6.0		4.0	6.0	4.0	4.0	6.0	
Lead/Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lead	Lead	Lag	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None	None	None	None		None	C-Max	None	None	C-Max	
Walk Time (s)		7.0	7.0		7.0			11.0			11.0	
Flash Dont Walk (s)		22.0	22.0		22.0			25.0			25.0	
Pedestrian Calls (#/hr)		0	0		0			0			0	
Act Effct Green (s)	39.5	29.0	29.0	55.0	40.5		57.0	50.7	76.7	44.2	36.0	
Actuated g/C Ratio	0.33	0.24	0.24	0.46	0.34		0.48	0.42	0.64	0.37	0.30	
v/c Ratio	0.33	0.28	0.40	0.75	0.44		0.98	0.51	0.12	0.06	0.92	
Control Delay	22.9	38.1	7.6	33.9	32.5		78.3	27.9	2.2	15.7	55.2	
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Delay	22.9	38.1	7.6	33.9	32.5		78.3	27.9	2.2	15.7	55.2	
LOS	C	D	A	C	C		E	C	A	B	E	
Approach Delay		24.1			33.1			37.7			54.5	
Approach LOS		C			C			D			D	

Intersection Summary			
Area Type:	Other		
Cycle Length: 120			
Actuated Cycle Length: 120			
Offset: 18 (15%), Referenced to phase 2:SBTL and 6:NBTL, Start of Green			
Natural Cycle: 95			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.98			
Intersection Signal Delay: 38.8		Intersection LOS: D	
Intersection Capacity Utilization 111.6%		ICU Level of Service H	
Analysis Period (min) 15			

* User Entered Value

Splits and Phases: 2: Fischer-Hallman Rd & University Avenue





Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	109	241	195	400	498	287	758	120	16	897
v/c Ratio	0.33	0.28	0.40	0.75	0.44	0.98	0.51	0.12	0.06	0.92
Control Delay	22.9	38.1	7.6	33.9	32.5	78.3	27.9	2.2	15.7	55.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	22.9	38.1	7.6	33.9	32.5	78.3	27.9	2.2	15.7	55.2
Queue Length 50th (m)	14.5	24.4	0.0	65.8	47.9	48.9	63.3	0.0	2.8	115.8
Queue Length 95th (m)	25.6	35.8	18.1	95.2	63.5	#104.0	95.0	7.6	m3.8	m#138.1
Internal Link Dist (m)		677.9			762.3		325.5			1112.8
Turn Bay Length (m)	35.0		35.0	100.0		80.0		125.0	50.0	
Base Capacity (vph)	337	862	490	534	1121	292	1492	964	301	976
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.32	0.28	0.40	0.75	0.44	0.98	0.51	0.12	0.05	0.92

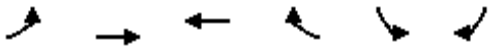
Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	109	241	195	400	486	12	287	758	120	16	768	129
Future Volume (vph)	109	241	195	400	486	12	287	758	120	16	768	129
Ideal Flow (vphpl)	1775	1900	1750	1775	1775	1775	1775	1900	1750	1775	1775	1775
Total Lost time (s)	4.0	6.0	6.0	4.0	6.0		4.0	6.0	4.0	4.0	6.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00		1.00	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1667	3570	1416	1648	3322		1737	3535	1442	1668	3217	
Flt Permitted	0.47	1.00	1.00	0.51	1.00		0.12	1.00	1.00	0.34	1.00	
Satd. Flow (perm)	824	3570	1416	889	3322		217	3535	1442	602	3217	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	109	241	195	400	486	12	287	758	120	16	768	129
RTOR Reduction (vph)	0	0	148	0	1	0	0	0	52	0	11	0
Lane Group Flow (vph)	109	241	47	400	497	0	287	758	68	16	886	0
Confl. Peds. (#/hr)	1		5	5		1	17					17
Heavy Vehicles (%)	0%	0%	2%	1%	0%	0%	1%	1%	2%	0%	1%	1%
Turn Type	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	pm+ov	pm+pt	NA	
Protected Phases	3	8		7	4		1	6	7	5	2	
Permitted Phases	8		8	4			6		6	2		
Actuated Green, G (s)	37.5	29.0	29.0	53.0	40.5		55.0	48.3	68.3	38.7	36.0	
Effective Green, g (s)	37.5	29.0	29.0	53.0	40.5		55.0	48.3	68.3	38.7	36.0	
Actuated g/C Ratio	0.31	0.24	0.24	0.44	0.34		0.46	0.40	0.57	0.32	0.30	
Clearance Time (s)	4.0	6.0	6.0	4.0	6.0		4.0	6.0	4.0	4.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	317	862	342	519	1121		289	1422	820	218	965	
v/s Ratio Prot	0.02	0.07		c0.13	0.15		c0.12	0.21	0.01	0.00	0.28	
v/s Ratio Perm	0.08		0.03	c0.21			c0.33		0.03	0.02		
v/c Ratio	0.34	0.28	0.14	0.77	0.44		0.99	0.53	0.08	0.07	0.92	
Uniform Delay, d1	30.3	37.0	35.7	25.2	31.0		29.1	27.3	11.7	27.8	40.6	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	0.88	1.12	
Incremental Delay, d2	0.7	0.2	0.2	7.0	0.3		50.8	1.4	0.0	0.1	10.1	
Delay (s)	31.0	37.2	35.9	32.2	31.2		79.9	28.7	11.7	24.6	55.7	
Level of Service	C	D	D	C	C		E	C	B	C	E	
Approach Delay (s)		35.5			31.7			39.6			55.2	
Approach LOS		D			C			D			E	

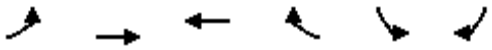
Intersection Summary			
HCM 2000 Control Delay	41.0	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	111.6%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	6	320	571	50	24	3
Future Volume (vph)	6	320	571	50	24	3
Ideal Flow (vphpl)	1650	1650	1650	1650	1765	1765
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor						
Frt			0.989		0.985	
Flt Protected		0.999			0.957	
Satd. Flow (prot)	0	1614	1614	0	1645	0
Flt Permitted		0.999			0.957	
Satd. Flow (perm)	0	1614	1614	0	1645	0
Link Speed (k/h)		60	60		60	
Link Distance (m)		291.4	304.6		335.6	
Travel Time (s)		17.5	18.3		20.1	
Confl. Peds. (#/hr)	1			1		
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	1%	0%	0%	0%	0%
Adj. Flow (vph)	6	320	571	50	24	3
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	326	621	0	27	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.5	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.21	1.21	1.21	1.21	1.12	1.12
Turning Speed (k/h)	24			14	24	14
Sign Control		Free	Free		Stop	

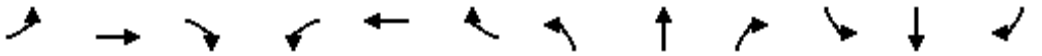
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	48.1%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	6	320	571	50	24	3
Future Volume (Veh/h)	6	320	571	50	24	3
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	6	320	571	50	24	3
Pedestrians					1	
Lane Width (m)					3.5	
Walking Speed (m/s)					1.1	
Percent Blockage					0	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	622				929	597
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	622				929	597
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				92	99
cM capacity (veh/h)	968				297	506

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	326	621	27
Volume Left	6	0	24
Volume Right	0	50	3
cSH	968	1700	312
Volume to Capacity	0.01	0.37	0.09
Queue Length 95th (m)	0.1	0.0	2.1
Control Delay (s)	0.2	0.0	17.6
Lane LOS	A		C
Approach Delay (s)	0.2	0.0	17.6
Approach LOS			C

Intersection Summary			
Average Delay	0.6		
Intersection Capacity Utilization	48.1%	ICU Level of Service	A
Analysis Period (min)	15		

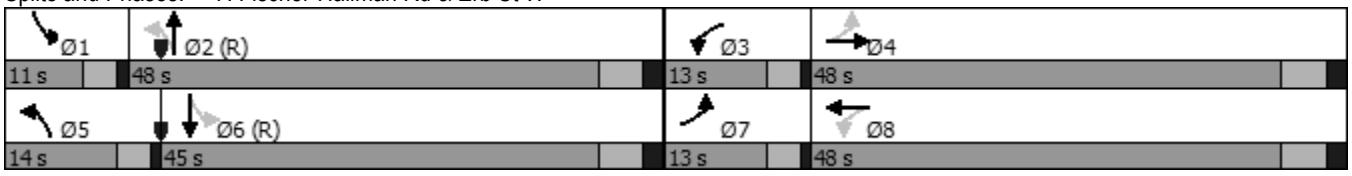


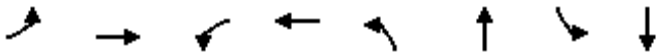
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	129	330	101	99	711	141	186	473	85	125	733	206
Future Volume (vph)	129	330	101	99	711	141	186	473	85	125	733	206
Ideal Flow (vphpl)	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775
Storage Length (m)	40.0		0.0	50.0		0.0	78.0		0.0	170.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	50.0			75.0			78.0			35.0		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	0.95	0.95	1.00	0.95	0.95
Ped Bike Factor	0.99	0.99		0.99	0.99		1.00	1.00		1.00	0.99	
Frt		0.965			0.975			0.977			0.967	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1668	3145	0	1635	3165	0	1668	3215	0	1619	3173	0
Flt Permitted	0.174			0.443			0.103			0.375		
Satd. Flow (perm)	302	3145	0	758	3165	0	180	3215	0	636	3173	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		37			21			19			32	
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		1168.2			343.1			1136.8			2051.4	
Travel Time (s)		70.1			20.6			68.2			123.1	
Confl. Peds. (#/hr)	48		14	14		48	19		12	12		19
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	2%	1%	2%	2%	1%	0%	1%	1%	3%	1%	1%
Adj. Flow (vph)	129	330	101	99	711	141	186	473	85	125	733	206
Shared Lane Traffic (%)												
Lane Group Flow (vph)	129	431	0	99	852	0	186	558	0	125	939	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8			2			6		
Detector Phase	7	4		3	8		5	2		1	6	
Switch Phase												
Minimum Initial (s)	5.0	42.0		5.0	42.0		5.0	39.0		5.0	39.0	
Minimum Split (s)	9.0	48.0		9.0	48.0		9.0	45.0		9.0	45.0	
Total Split (s)	13.0	48.0		13.0	48.0		14.0	48.0		11.0	45.0	
Total Split (%)	10.8%	40.0%		10.8%	40.0%		11.7%	40.0%		9.2%	37.5%	
Maximum Green (s)	9.0	42.0		9.0	42.0		10.0	42.0		7.0	39.0	
Yellow Time (s)	3.0	4.0		3.0	4.0		3.0	4.0		3.0	4.0	
All-Red Time (s)	1.0	2.0		1.0	2.0		1.0	2.0		1.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	4.0	6.0		4.0	6.0		4.0	6.0		4.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		None	C-Max		None	C-Max	
Walk Time (s)		20.0			20.0			24.0			24.0	
Flash Dont Walk (s)		22.0			22.0			15.0			15.0	
Pedestrian Calls (#/hr)		0			0			0			0	
Act Effct Green (s)	53.0	42.3		52.4	42.0		54.5	42.3		48.1	39.0	
Actuated g/C Ratio	0.44	0.35		0.44	0.35		0.45	0.35		0.40	0.32	
v/c Ratio	0.56	0.38		0.25	0.76		0.89	0.49		0.40	0.89	
Control Delay	27.8	27.6		19.6	38.9		74.5	48.1		18.2	43.1	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	27.8	27.6		19.6	38.9		74.5	48.1		18.2	43.1	
LOS	C	C		B	D		E	D		B	D	
Approach Delay		27.7			36.9			54.7			40.1	
Approach LOS		C			D			D			D	

Intersection Summary			
Area Type:	Other		
Cycle Length: 120			
Actuated Cycle Length: 120			
Offset: 15.6 (13%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 115			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.89			
Intersection Signal Delay: 40.4		Intersection LOS: D	
Intersection Capacity Utilization 102.8%		ICU Level of Service G	
Analysis Period (min) 15			

Splits and Phases: 7: Fischer-Hallman Rd & Erb St W





Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	129	431	99	852	186	558	125	939
v/c Ratio	0.56	0.38	0.25	0.76	0.89	0.49	0.40	0.89
Control Delay	27.8	27.6	19.6	38.9	74.5	48.1	18.2	43.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	27.8	27.6	19.6	38.9	74.5	48.1	18.2	43.1
Queue Length 50th (m)	16.8	36.2	12.7	90.7	41.0	69.1	19.5	116.6
Queue Length 95th (m)	28.6	50.1	22.8	115.0	#70.0	86.3	m32.8	#145.3
Internal Link Dist (m)		1144.2		319.1		1112.8		2027.4
Turn Bay Length (m)	40.0		50.0		78.0		170.0	
Base Capacity (vph)	236	1132	400	1121	210	1144	312	1052
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.55	0.38	0.25	0.76	0.89	0.49	0.40	0.89

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	129	330	101	99	711	141	186	473	85	125	733	206
Future Volume (vph)	129	330	101	99	711	141	186	473	85	125	733	206
Ideal Flow (vphpl)	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775
Total Lost time (s)	4.0	6.0		4.0	6.0		4.0	6.0		4.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.96		1.00	0.98		1.00	0.98		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1665	3144		1631	3166		1667	3215		1616	3173	
Flt Permitted	0.17	1.00		0.44	1.00		0.10	1.00		0.38	1.00	
Satd. Flow (perm)	304	3144		760	3166		182	3215		638	3173	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	129	330	101	99	711	141	186	473	85	125	733	206
RTOR Reduction (vph)	0	24	0	0	14	0	0	12	0	0	22	0
Lane Group Flow (vph)	129	407	0	99	838	0	186	546	0	125	917	0
Confl. Peds. (#/hr)	48		14	14		48	19		12	12		19
Heavy Vehicles (%)	0%	2%	1%	2%	2%	1%	0%	1%	1%	3%	1%	1%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	51.0	42.3		50.4	42.0		52.5	42.2		46.1	39.0	
Effective Green, g (s)	51.0	42.3		50.4	42.0		52.5	42.2		46.1	39.0	
Actuated g/C Ratio	0.42	0.35		0.42	0.35		0.44	0.35		0.38	0.32	
Clearance Time (s)	4.0	6.0		4.0	6.0		4.0	6.0		4.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	227	1108		380	1108		207	1130		302	1031	
v/s Ratio Prot	c0.04	0.13		0.02	c0.26		c0.08	0.17		0.02	0.29	
v/s Ratio Perm	0.20			0.09			c0.32			0.13		
v/c Ratio	0.57	0.37		0.26	0.76		0.90	0.48		0.41	0.89	
Uniform Delay, d1	23.7	28.9		21.6	34.5		27.0	30.4		24.8	38.5	
Progression Factor	1.00	1.00		1.00	1.00		1.62	1.58		0.74	0.87	
Incremental Delay, d2	3.2	0.2		0.4	3.0		32.8	1.3		0.8	10.2	
Delay (s)	26.9	29.1		22.0	37.5		76.4	49.3		19.1	43.6	
Level of Service	C	C		C	D		E	D		B	D	
Approach Delay (s)		28.6			35.9			56.1			40.7	
Approach LOS		C			D			E			D	

Intersection Summary			
HCM 2000 Control Delay	40.7	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	102.8%	ICU Level of Service	G
Analysis Period (min)	15		

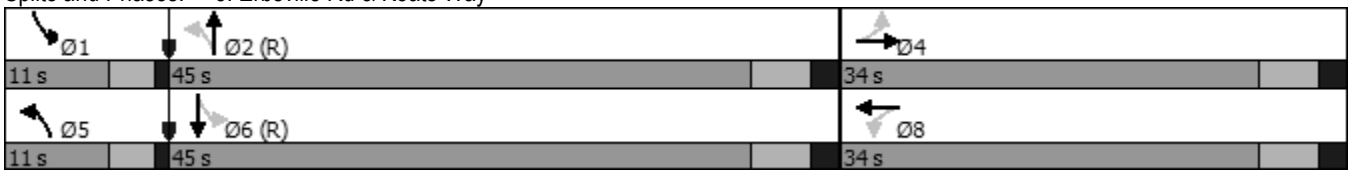
c Critical Lane Group

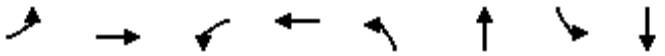
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	34	39	30	71	55	55	38	562	81	39	766	26
Future Volume (vph)	34	39	30	71	55	55	38	562	81	39	766	26
Ideal Flow (vphpl)	1775	1650	1650	1775	1650	1650	1775	1650	1650	1775	1650	1650
Storage Length (m)	35.0		0.0	36.0		0.0	22.0		0.0	23.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	5.0			21.0			49.0			50.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor	0.99	0.99		0.99	0.98		1.00	1.00		1.00	1.00	
Frt		0.935			0.925			0.981			0.995	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1668	1505	0	1619	1469	0	1668	1547	0	1668	1606	0
Flt Permitted	0.686			0.712			0.263			0.349		
Satd. Flow (perm)	1189	1505	0	1201	1469	0	460	1547	0	612	1606	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		30			55			10			2	
Link Speed (k/h)		50			50			60			60	
Link Distance (m)		272.1			461.3			764.8			946.8	
Travel Time (s)		19.6			33.2			45.9			56.8	
Confl. Peds. (#/hr)	9		7	7		9	12		5	5		12
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	0%	3%	0%	2%	0%	3%	4%	0%	1%	0%
Adj. Flow (vph)	34	39	30	71	55	55	38	562	81	39	766	26
Shared Lane Traffic (%)												
Lane Group Flow (vph)	34	69	0	71	110	0	38	643	0	39	792	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.11	1.21	1.21	1.11	1.21	1.21	1.11	1.21	1.21	1.11	1.21	1.21
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		5	2		1	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0		5.0	39.0		5.0	39.0	
Minimum Split (s)	34.0	34.0		34.0	34.0		9.0	45.0		9.0	45.0	
Total Split (s)	34.0	34.0		34.0	34.0		11.0	45.0		11.0	45.0	
Total Split (%)	37.8%	37.8%		37.8%	37.8%		12.2%	50.0%		12.2%	50.0%	
Maximum Green (s)	28.0	28.0		28.0	28.0		7.0	39.0		7.0	39.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		3.0	4.0		3.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		1.0	2.0		1.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		4.0	6.0		4.0	6.0	
Lead/Lag							Lead	Lag		Lead	Lag	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		None	C-Max		None	C-Max	
Walk Time (s)	10.0	10.0		10.0	10.0			26.0			26.0	
Flash Dont Walk (s)	18.0	18.0		18.0	18.0			13.0			13.0	
Pedestrian Calls (#/hr)	0	0		0	0			0			0	
Act Effct Green (s)	11.2	11.2		11.2	11.2		69.2	64.6		69.2	64.6	
Actuated g/C Ratio	0.12	0.12		0.12	0.12		0.77	0.72		0.77	0.72	
v/c Ratio	0.23	0.33		0.48	0.48		0.09	0.58		0.07	0.69	
Control Delay	38.0	26.1		46.7	26.4		3.7	12.4		2.7	13.3	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	38.0	26.1		46.7	26.4		3.7	12.4		2.7	13.3	
LOS	D	C		D	C		A	B		A	B	
Approach Delay		30.0			34.4			11.9			12.8	
Approach LOS		C			C			B			B	

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 1.8 (2%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 90			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.69			
Intersection Signal Delay: 15.6		Intersection LOS: B	
Intersection Capacity Utilization 72.4%		ICU Level of Service C	
Analysis Period (min) 15			

Splits and Phases: 8: Erbsville Rd & Keats Way





Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	34	69	71	110	38	643	39	792
v/c Ratio	0.23	0.33	0.48	0.48	0.09	0.58	0.07	0.69
Control Delay	38.0	26.1	46.7	26.4	3.7	12.4	2.7	13.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	38.0	26.1	46.7	26.4	3.7	12.4	2.7	13.3
Queue Length 50th (m)	5.4	6.2	11.7	8.9	1.2	60.7	0.5	81.4
Queue Length 95th (m)	13.4	17.1	23.4	22.9	4.1	117.3	m1.9	#187.9
Internal Link Dist (m)		248.1		437.3		740.8		922.8
Turn Bay Length (m)	35.0		36.0		22.0		23.0	
Base Capacity (vph)	369	488	373	494	449	1113	555	1153
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.09	0.14	0.19	0.22	0.08	0.58	0.07	0.69

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	34	39	30	71	55	55	38	562	81	39	766	26
Future Volume (vph)	34	39	30	71	55	55	38	562	81	39	766	26
Ideal Flow (vphpl)	1775	1650	1650	1775	1650	1650	1775	1650	1650	1775	1650	1650
Total Lost time (s)	6.0	6.0		6.0	6.0		4.0	6.0		4.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	0.99		1.00	0.98		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	0.99	1.00		0.99	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.93		1.00	0.93		1.00	0.98		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1647	1505		1602	1469		1666	1547		1666	1606	
Flt Permitted	0.69	1.00		0.71	1.00		0.26	1.00		0.35	1.00	
Satd. Flow (perm)	1189	1505		1201	1469		461	1547		612	1606	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	34	39	30	71	55	55	38	562	81	39	766	26
RTOR Reduction (vph)	0	27	0	0	49	0	0	3	0	0	1	0
Lane Group Flow (vph)	34	42	0	71	61	0	38	640	0	39	791	0
Confl. Peds. (#/hr)	9		7	7		9	12		5	5		12
Heavy Vehicles (%)	0%	0%	0%	3%	0%	2%	0%	3%	4%	0%	1%	0%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	9.6	9.6		9.6	9.6		64.4	60.6		64.4	60.6	
Effective Green, g (s)	9.6	9.6		9.6	9.6		64.4	60.6		64.4	60.6	
Actuated g/C Ratio	0.11	0.11		0.11	0.11		0.72	0.67		0.72	0.67	
Clearance Time (s)	6.0	6.0		6.0	6.0		4.0	6.0		4.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	126	160		128	156		380	1041		482	1081	
v/s Ratio Prot		0.03			0.04		c0.00	0.41		0.00	c0.49	
v/s Ratio Perm	0.03			c0.06			0.07			0.05		
v/c Ratio	0.27	0.26		0.55	0.39		0.10	0.61		0.08	0.73	
Uniform Delay, d1	37.0	37.0		38.2	37.5		5.5	8.2		4.4	9.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		0.79	0.87	
Incremental Delay, d2	1.2	0.9		5.1	1.6		0.1	2.7		0.0	2.9	
Delay (s)	38.1	37.8		43.3	39.1		5.6	10.9		3.5	11.2	
Level of Service	D	D		D	D		A	B		A	B	
Approach Delay (s)		37.9			40.7			10.6			10.9	
Approach LOS		D			D			B			B	

Intersection Summary			
HCM 2000 Control Delay	15.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	72.4%	ICU Level of Service	C
Analysis Period (min)	15		

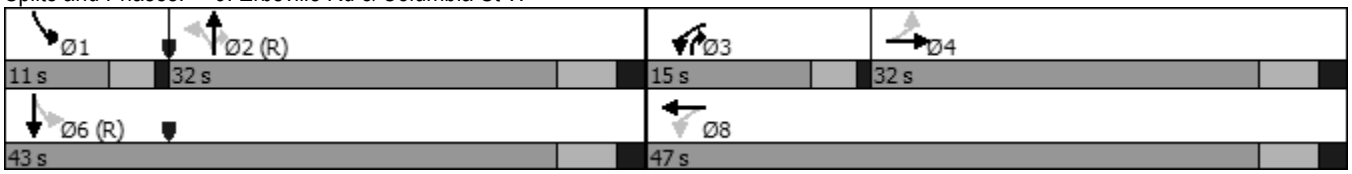
c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	50	114	46	431	178	279	46	387	197	188	413	62
Future Volume (vph)	50	114	46	431	178	279	46	387	197	188	413	62
Ideal Flow (vphpl)	1775	1650	1650	1775	1650	1650	1775	1900	1750	1775	1650	1650
Storage Length (m)	80.0		0.0	50.0		0.0	43.0		45.0	45.0		0.0
Storage Lanes	1		0	1		0	1		1	1		0
Taper Length (m)	57.0			82.0			30.0			45.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor	1.00	0.99		1.00	0.99		0.99				1.00	
Frt		0.957			0.908				0.850		0.980	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1668	1519	0	1668	1442	0	1668	1807	1414	1651	1575	0
Flt Permitted	0.500			0.563			0.454			0.257		
Satd. Flow (perm)	877	1519	0	986	1442	0	792	1807	1414	447	1575	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		23			115				197		10	
Link Speed (k/h)		50			60			60			60	
Link Distance (m)		309.3			1370.2			946.8			1422.7	
Travel Time (s)		22.3			82.2			56.8			85.4	
Confl. Peds. (#/hr)	1		2	2		1	7					7
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	3%	0%	0%	2%	1%	0%	4%	4%	1%	1%	2%
Adj. Flow (vph)	50	114	46	431	178	279	46	387	197	188	413	62
Shared Lane Traffic (%)												
Lane Group Flow (vph)	50	160	0	431	457	0	46	387	197	188	475	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.11	1.21	1.21	1.11	1.21	1.21	1.11	1.01	1.13	1.11	1.21	1.21
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2	1	1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru	Right	Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5	6.1	6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8	6.1	6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	pm+ov	pm+pt	NA	
Protected Phases		4		3	8			2	3	1	6	
Permitted Phases	4			8			2		2	6		
Detector Phase	4	4		3	8		2	2	3	1	6	
Switch Phase												
Minimum Initial (s)	26.0	26.0		5.0	26.0		26.0	26.0	5.0	5.0	26.0	
Minimum Split (s)	32.0	32.0		9.0	32.0		32.0	32.0	9.0	9.0	32.0	
Total Split (s)	32.0	32.0		15.0	47.0		32.0	32.0	15.0	11.0	43.0	
Total Split (%)	35.6%	35.6%		16.7%	52.2%		35.6%	35.6%	16.7%	12.2%	47.8%	
Maximum Green (s)	26.0	26.0		11.0	41.0		26.0	26.0	11.0	7.0	37.0	
Yellow Time (s)	4.0	4.0		3.0	4.0		4.0	4.0	3.0	3.0	4.0	
All-Red Time (s)	2.0	2.0		1.0	2.0		2.0	2.0	1.0	1.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	6.0	6.0		4.0	6.0		6.0	6.0	4.0	4.0	6.0	
Lead/Lag	Lag	Lag		Lead			Lag	Lag	Lead	Lead		
Lead-Lag Optimize?	Yes	Yes		Yes			Yes	Yes	Yes	Yes		
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None		None	None		C-Max	C-Max	None	None	C-Max	
Walk Time (s)	12.0	12.0			12.0		11.0	11.0			11.0	
Flash Dont Walk (s)	14.0	14.0			14.0		15.0	15.0			15.0	
Pedestrian Calls (#/hr)	0	0			0		0	0			0	
Act Effct Green (s)	26.0	26.0		43.0	41.0		26.0	26.0	43.0	39.0	37.0	
Actuated g/C Ratio	0.29	0.29		0.48	0.46		0.29	0.29	0.48	0.43	0.41	
v/c Ratio	0.20	0.35		0.78	0.64		0.20	0.74	0.25	0.66	0.73	
Control Delay	26.7	24.2		29.3	18.5		19.5	32.1	3.4	29.2	29.6	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Delay	26.7	24.2		29.3	18.5		19.5	32.1	3.4	29.2	29.6	
LOS	C	C		C	B		B	C	A	C	C	
Approach Delay		24.8			23.7			22.2			29.5	
Approach LOS		C			C			C			C	

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 63 (70%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 85			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.78			
Intersection Signal Delay: 25.0		Intersection LOS: C	
Intersection Capacity Utilization 123.3%		ICU Level of Service H	
Analysis Period (min) 15			

Splits and Phases: 9: Erbsville Rd & Columbia St W





Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	50	160	431	457	46	387	197	188	475
v/c Ratio	0.20	0.35	0.78	0.64	0.20	0.74	0.25	0.66	0.73
Control Delay	26.7	24.2	29.3	18.5	19.5	32.1	3.4	29.2	29.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	26.7	24.2	29.3	18.5	19.5	32.1	3.4	29.2	29.6
Queue Length 50th (m)	6.5	18.5	50.4	43.4	6.0	62.2	9.3	20.2	65.9
Queue Length 95th (m)	15.7	35.2	#84.4	75.6	m8.2	#87.0	8.6	#36.7	102.9
Internal Link Dist (m)		285.3		1346.2		922.8			1398.7
Turn Bay Length (m)	80.0		50.0		43.0		45.0	45.0	
Base Capacity (vph)	253	455	554	719	228	522	778	287	653
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.20	0.35	0.78	0.64	0.20	0.74	0.25	0.66	0.73

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	50	114	46	431	178	279	46	387	197	188	413	62
Future Volume (vph)	50	114	46	431	178	279	46	387	197	188	413	62
Ideal Flow (vphpl)	1775	1650	1650	1775	1650	1650	1775	1900	1750	1775	1650	1650
Total Lost time (s)	6.0	6.0		4.0	6.0		6.0	6.0	4.0	4.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		0.99	1.00	1.00	1.00	1.00	
Frt	1.00	0.96		1.00	0.91		1.00	1.00	0.85	1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1666	1518		1665	1443		1657	1807	1414	1651	1575	
Flt Permitted	0.50	1.00		0.56	1.00		0.45	1.00	1.00	0.26	1.00	
Satd. Flow (perm)	876	1518		987	1443		791	1807	1414	447	1575	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	50	114	46	431	178	279	46	387	197	188	413	62
RTOR Reduction (vph)	0	16	0	0	63	0	0	0	116	0	6	0
Lane Group Flow (vph)	50	144	0	431	394	0	46	387	81	188	469	0
Confl. Peds. (#/hr)	1		2	2		1	7					7
Heavy Vehicles (%)	0%	3%	0%	0%	2%	1%	0%	4%	4%	1%	1%	2%
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	pm+ov	pm+pt	NA	
Protected Phases		4		3	8			2	3	1	6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)	26.0	26.0		41.0	41.0		26.0	26.0	37.0	37.0	37.0	
Effective Green, g (s)	26.0	26.0		41.0	41.0		26.0	26.0	37.0	37.0	37.0	
Actuated g/C Ratio	0.29	0.29		0.46	0.46		0.29	0.29	0.41	0.41	0.41	
Clearance Time (s)	6.0	6.0		4.0	6.0		6.0	6.0	4.0	4.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	253	438		532	657		228	522	581	277	647	
v/s Ratio Prot		0.09		c0.10	0.27			0.21	0.02	0.05	c0.30	
v/s Ratio Perm	0.06			c0.27			0.06		0.04	0.23		
v/c Ratio	0.20	0.33		0.81	0.60		0.20	0.74	0.14	0.68	0.73	
Uniform Delay, d1	24.1	25.1		19.9	18.4		24.2	29.0	16.6	19.3	22.2	
Progression Factor	1.00	1.00		1.00	1.00		0.71	0.80	1.24	1.00	1.00	
Incremental Delay, d2	0.4	0.4		9.1	1.6		1.7	8.0	0.1	6.5	6.9	
Delay (s)	24.5	25.6		29.0	19.9		18.8	31.1	20.7	25.8	29.2	
Level of Service	C	C		C	B		B	C	C	C	C	
Approach Delay (s)		25.3			24.3			27.0			28.2	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	26.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	123.3%	ICU Level of Service	H
Analysis Period (min)	15		

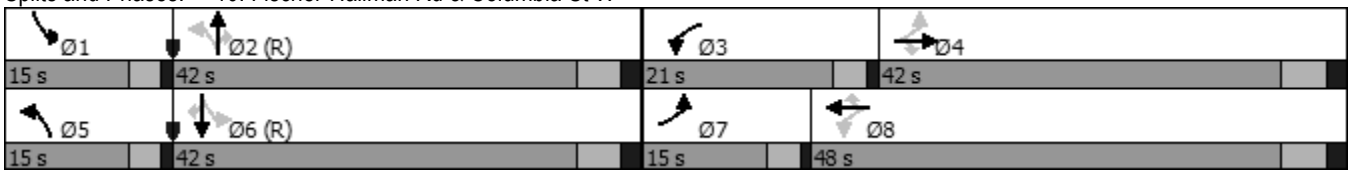
c Critical Lane Group

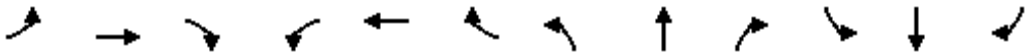
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	99	269	74	346	656	262	147	281	124	126	579	230
Future Volume (vph)	99	269	74	346	656	262	147	281	124	126	579	230
Ideal Flow (vphpl)	1775	1900	1750	1775	1900	1750	1775	1900	1750	1775	1900	1750
Storage Length (m)	24.0		82.0	82.0		0.0	95.0		72.0	70.0		53.0
Storage Lanes	1		1	1		1	1		1	1		1
Taper Length (m)	73.0			100.0			36.0			33.0		
Lane Util. Factor	1.00	0.95	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Ped Bike Factor	0.99		0.98	1.00		0.94	0.98		0.98	0.99		0.94
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1635	3500	1456	1635	1879	1442	1651	3570	1388	1588	3535	1456
Flt Permitted	0.110			0.512			0.302			0.561		
Satd. Flow (perm)	188	3500	1430	878	1879	1359	517	3570	1360	933	3535	1370
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			136			203			136			230
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		1370.2			231.9			2051.4			968.6	
Travel Time (s)		82.2			13.9			123.1			58.1	
Confl. Peds. (#/hr)	23		6	6		23	24		8	8		24
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	2%	2%	1%	2%	0%	2%	1%	0%	6%	5%	1%	1%
Adj. Flow (vph)	99	269	74	346	656	262	147	281	124	126	579	230
Shared Lane Traffic (%)												
Lane Group Flow (vph)	99	269	74	346	656	262	147	281	124	126	579	230
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.11	1.01	1.13	1.11	1.01	1.13	1.11	1.01	1.13	1.11	1.01	1.13
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2	1	1	2	1	1	2	1	1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Leading Detector (m)	6.1	30.5	6.1	6.1	30.5	6.1	6.1	30.5	6.1	6.1	30.5	6.1
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	6.1	1.8	6.1	6.1	1.8	6.1	6.1	1.8	6.1	6.1	1.8	6.1
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	5.0	36.0	36.0	5.0	36.0	36.0	5.0	36.0	36.0	5.0	36.0	36.0
Minimum Split (s)	9.0	42.0	42.0	9.0	42.0	42.0	9.0	42.0	42.0	9.0	42.0	42.0
Total Split (s)	15.0	42.0	42.0	21.0	48.0	48.0	15.0	42.0	42.0	15.0	42.0	42.0
Total Split (%)	12.5%	35.0%	35.0%	17.5%	40.0%	40.0%	12.5%	35.0%	35.0%	12.5%	35.0%	35.0%
Maximum Green (s)	11.0	36.0	36.0	17.0	42.0	42.0	11.0	36.0	36.0	11.0	36.0	36.0
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes		
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	None	None	None	None	None	C-Max	C-Max	None	C-Max	C-Max
Walk Time (s)		15.0	15.0		15.0	15.0		15.0	15.0		15.0	15.0
Flash Dont Walk (s)		21.0	21.0		21.0	21.0		21.0	21.0		21.0	21.0
Pedestrian Calls (#/hr)		0	0		0	0		0	0		0	0
Act Effct Green (s)	47.6	36.5	36.5	59.0	43.8	43.8	49.2	37.0	37.0	48.8	36.7	36.7
Actuated g/C Ratio	0.40	0.30	0.30	0.49	0.36	0.36	0.41	0.31	0.31	0.41	0.31	0.31
v/c Ratio	0.54	0.25	0.14	0.65	0.96	0.42	0.48	0.26	0.24	0.29	0.54	0.40
Control Delay	30.4	32.5	0.6	26.4	63.3	9.6	45.0	54.4	23.1	22.4	37.0	6.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	30.4	32.5	0.6	26.4	63.3	9.6	45.0	54.4	23.1	22.4	37.0	6.2
LOS	C	C	A	C	E	A	D	D	C	C	D	A
Approach Delay		26.6			42.1			44.9			27.4	
Approach LOS		C			D			D			C	

Intersection Summary			
Area Type:	Other		
Cycle Length: 120			
Actuated Cycle Length: 120			
Offset: 98.4 (82%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 105			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.96			
Intersection Signal Delay: 36.1		Intersection LOS: D	
Intersection Capacity Utilization 105.9%		ICU Level of Service G	
Analysis Period (min) 15			

Splits and Phases: 10: Fischer-Hallman Rd & Columbia St W

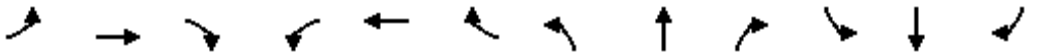




Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	99	269	74	346	656	262	147	281	124	126	579	230
v/c Ratio	0.54	0.25	0.14	0.65	0.96	0.42	0.48	0.26	0.24	0.29	0.54	0.40
Control Delay	30.4	32.5	0.6	26.4	63.3	9.6	45.0	54.4	23.1	22.4	37.0	6.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	30.4	32.5	0.6	26.4	63.3	9.6	45.0	54.4	23.1	22.4	37.0	6.2
Queue Length 50th (m)	12.3	25.2	0.0	51.0	149.8	9.2	29.3	34.5	11.9	17.6	60.0	0.0
Queue Length 95th (m)	24.2	36.4	0.2	75.0	#229.9	30.6	m46.1	m47.1	m23.0	30.1	77.8	17.8
Internal Link Dist (m)		1346.2			207.9			2027.4			944.6	
Turn Bay Length (m)	24.0		82.0	82.0			95.0		72.0	70.0		53.0
Base Capacity (vph)	210	1063	529	538	686	625	319	1099	513	446	1081	579
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.47	0.25	0.14	0.64	0.96	0.42	0.46	0.26	0.24	0.28	0.54	0.40

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	99	269	74	346	656	262	147	281	124	126	579	230
Future Volume (vph)	99	269	74	346	656	262	147	281	124	126	579	230
Ideal Flow (vphpl)	1775	1900	1750	1775	1900	1750	1775	1900	1750	1775	1900	1750
Total Lost time (s)	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00	0.94	1.00	1.00	0.98	1.00	1.00	0.94
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1634	3500	1430	1632	1879	1359	1644	3570	1360	1584	3535	1370
Flt Permitted	0.11	1.00	1.00	0.51	1.00	1.00	0.30	1.00	1.00	0.56	1.00	1.00
Satd. Flow (perm)	188	3500	1430	879	1879	1359	522	3570	1360	936	3535	1370
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	99	269	74	346	656	262	147	281	124	126	579	230
RTOR Reduction (vph)	0	0	51	0	0	129	0	0	86	0	0	160
Lane Group Flow (vph)	99	269	23	346	656	133	147	281	38	126	579	70
Confl. Peds. (#/hr)	23		6	6		23	24		8	8		24
Heavy Vehicles (%)	2%	2%	1%	2%	0%	2%	1%	0%	6%	5%	1%	1%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Actuated Green, G (s)	45.7	36.5	36.5	57.0	43.8	43.8	47.3	37.0	37.0	46.7	36.7	36.7
Effective Green, g (s)	45.7	36.5	36.5	57.0	43.8	43.8	47.3	37.0	37.0	46.7	36.7	36.7
Actuated g/C Ratio	0.38	0.30	0.30	0.48	0.36	0.36	0.39	0.31	0.31	0.39	0.31	0.31
Clearance Time (s)	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	182	1064	434	521	685	496	302	1100	419	418	1081	418
v/s Ratio Prot	0.04	0.08		c0.09	c0.35		c0.04	0.08		0.03	c0.16	
v/s Ratio Perm	0.16		0.02	0.22		0.10	0.15		0.03	0.09		0.05
v/c Ratio	0.54	0.25	0.05	0.66	0.96	0.27	0.49	0.26	0.09	0.30	0.54	0.17
Uniform Delay, d1	28.7	31.5	29.5	21.3	37.2	26.8	24.8	31.2	29.5	24.3	34.6	30.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.94	1.70	5.20	1.00	1.00	1.00
Incremental Delay, d2	3.3	0.1	0.0	3.2	24.1	0.3	1.0	0.5	0.4	0.4	1.9	0.9
Delay (s)	32.0	31.6	29.6	24.5	61.3	27.1	49.1	53.5	153.8	24.7	36.5	31.4
Level of Service	C	C	C	C	E	C	D	D	F	C	D	C
Approach Delay (s)		31.3			44.1			74.9			33.6	
Approach LOS		C			D			E			C	

Intersection Summary			
HCM 2000 Control Delay	44.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	105.9%	ICU Level of Service	G
Analysis Period (min)	15		

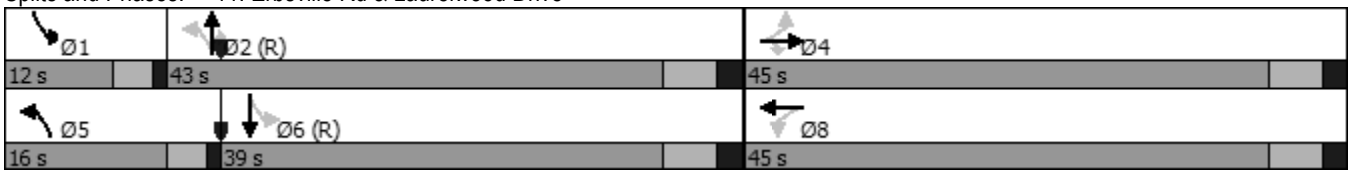
c Critical Lane Group

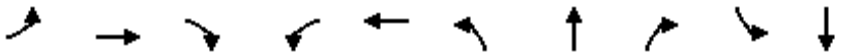
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	19	88	134	140	168	81	142	271	107	53	300	20
Future Volume (vph)	19	88	134	140	168	81	142	271	107	53	300	20
Ideal Flow (vphpl)	1775	1900	1750	1775	1650	1650	1775	1900	1750	1775	1650	1650
Storage Length (m)	27.0		0.0	20.0		0.0	65.0		29.0	19.0		0.0
Storage Lanes	1		1	1		0	1		1	1		0
Taper Length (m)	22.0			18.0			73.0			49.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor	0.95		0.95	0.97	0.97		0.99		0.95	0.98	1.00	
Frt			0.850		0.951				0.850		0.991	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1588	1789	1401	1668	1476	0	1619	1807	1456	1668	1593	0
Flt Permitted	0.412			0.700			0.496			0.593		
Satd. Flow (perm)	655	1789	1327	1192	1476	0	834	1807	1388	1022	1593	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			134		28				107		4	
Link Speed (k/h)		50			50			60			60	
Link Distance (m)		270.4			1189.4			1422.7			1517.5	
Travel Time (s)		19.5			85.6			85.4			91.1	
Confl. Peds. (#/hr)	56		26	26		56	17		18	18		17
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	5%	5%	5%	0%	3%	0%	3%	4%	1%	0%	1%	5%
Adj. Flow (vph)	19	88	134	140	168	81	142	271	107	53	300	20
Shared Lane Traffic (%)												
Lane Group Flow (vph)	19	88	134	140	249	0	142	271	107	53	320	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.11	1.01	1.13	1.11	1.21	1.21	1.11	1.01	1.13	1.11	1.21	1.21
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2	1	1	2		1	2	1	1	2	
Detector Template	Left	Thru	Right	Left	Thru		Left	Thru	Right	Left	Thru	
Leading Detector (m)	6.1	30.5	6.1	6.1	30.5		6.1	30.5	6.1	6.1	30.5	
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Size(m)	6.1	1.8	6.1	6.1	1.8		6.1	1.8	6.1	6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Perm	NA	Perm	Perm	NA		pm+pt	NA	Perm	pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8			2		2	6		
Detector Phase	4	4	4	8	8		5	2	2	1	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0		5.0	33.0	33.0	5.0	33.0	
Minimum Split (s)	45.0	45.0	45.0	45.0	45.0		9.0	39.0	39.0	9.0	39.0	
Total Split (s)	45.0	45.0	45.0	45.0	45.0		16.0	43.0	43.0	12.0	39.0	
Total Split (%)	45.0%	45.0%	45.0%	45.0%	45.0%		16.0%	43.0%	43.0%	12.0%	39.0%	
Maximum Green (s)	39.0	39.0	39.0	39.0	39.0		12.0	37.0	37.0	8.0	33.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		3.0	4.0	4.0	3.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		1.0	2.0	2.0	1.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0		4.0	6.0	6.0	4.0	6.0	
Lead/Lag							Lead	Lag	Lag	Lead	Lag	
Lead-Lag Optimize?							Yes	Yes	Yes	Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None	None	None	None		None	C-Max	C-Max	None	C-Max	
Walk Time (s)	15.0	15.0	15.0	15.0	15.0			15.0	15.0		15.0	
Flash Dont Walk (s)	24.0	24.0	24.0	24.0	24.0			18.0	18.0		18.0	
Pedestrian Calls (#/hr)	0	0	0	0	0			0	0		0	
Act Effct Green (s)	21.0	21.0	21.0	21.0	21.0		67.8	58.2	58.2	62.9	54.2	
Actuated g/C Ratio	0.21	0.21	0.21	0.21	0.21		0.68	0.58	0.58	0.63	0.54	
v/c Ratio	0.14	0.23	0.35	0.56	0.75		0.22	0.26	0.13	0.08	0.37	
Control Delay	31.1	32.0	7.6	42.7	46.1		7.4	13.4	3.4	7.1	16.7	
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Delay	31.1	32.0	7.6	42.7	46.1		7.4	13.4	3.4	7.1	16.7	
LOS	C	C	A	D	D		A	B	A	A	B	
Approach Delay		18.4			44.9			9.7			15.3	
Approach LOS		B			D			A			B	

Intersection Summary			
Area Type:	Other		
Cycle Length: 100			
Actuated Cycle Length: 100			
Offset: 64.8 (65%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 95			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.75			
Intersection Signal Delay: 21.4		Intersection LOS: C	
Intersection Capacity Utilization 79.4%		ICU Level of Service D	
Analysis Period (min) 15			

Splits and Phases: 11: Erbsville Rd & Laurelwood Drive





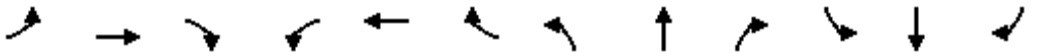
Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	19	88	134	140	249	142	271	107	53	320
v/c Ratio	0.14	0.23	0.35	0.56	0.75	0.22	0.26	0.13	0.08	0.37
Control Delay	31.1	32.0	7.6	42.7	46.1	7.4	13.4	3.4	7.1	16.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	31.1	32.0	7.6	42.7	46.1	7.4	13.4	3.4	7.1	16.7
Queue Length 50th (m)	3.0	14.3	0.0	24.5	40.6	8.2	25.2	0.0	2.9	32.8
Queue Length 95th (m)	8.3	24.2	12.9	38.7	59.9	19.7	50.9	8.8	8.8	68.0
Internal Link Dist (m)		246.4			1165.4		1398.7			1493.5
Turn Bay Length (m)	27.0			20.0		65.0		29.0	19.0	
Base Capacity (vph)	255	697	599	464	592	669	1051	852	708	865
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.07	0.13	0.22	0.30	0.42	0.21	0.26	0.13	0.07	0.37

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	19	88	134	140	168	81	142	271	107	53	300	20
Future Volume (vph)	19	88	134	140	168	81	142	271	107	53	300	20
Ideal Flow (vphpl)	1775	1900	1750	1775	1650	1650	1775	1900	1750	1775	1650	1650
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0		4.0	6.0	6.0	4.0	6.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00	0.95	1.00	0.97		1.00	1.00	0.95	1.00	1.00	
Flpb, ped/bikes	0.95	1.00	1.00	0.97	1.00		0.99	1.00	1.00	0.99	1.00	
Frt	1.00	1.00	0.85	1.00	0.95		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1514	1789	1327	1618	1477		1608	1807	1388	1650	1592	
Flt Permitted	0.41	1.00	1.00	0.70	1.00		0.50	1.00	1.00	0.59	1.00	
Satd. Flow (perm)	657	1789	1327	1192	1477		840	1807	1388	1029	1592	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	19	88	134	140	168	81	142	271	107	53	300	20
RTOR Reduction (vph)	0	0	106	0	22	0	0	0	46	0	2	0
Lane Group Flow (vph)	19	88	28	140	227	0	142	271	61	53	318	0
Confl. Peds. (#/hr)	56		26	26		56	17		18	18		17
Heavy Vehicles (%)	5%	5%	5%	0%	3%	0%	3%	4%	1%	0%	1%	5%
Turn Type	Perm	NA	Perm	Perm	NA		pm+pt	NA	Perm	pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8			2		2	6		
Actuated Green, G (s)	21.0	21.0	21.0	21.0	21.0		66.2	57.4	57.4	59.8	54.2	
Effective Green, g (s)	21.0	21.0	21.0	21.0	21.0		66.2	57.4	57.4	59.8	54.2	
Actuated g/C Ratio	0.21	0.21	0.21	0.21	0.21		0.66	0.57	0.57	0.60	0.54	
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0		4.0	6.0	6.0	4.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	137	375	278	250	310		623	1037	796	650	862	
v/s Ratio Prot		0.05			c0.15		c0.02	0.15		0.00	c0.20	
v/s Ratio Perm	0.03		0.02	0.12			0.13		0.04	0.04		
v/c Ratio	0.14	0.23	0.10	0.56	0.73		0.23	0.26	0.08	0.08	0.37	
Uniform Delay, d1	32.1	32.8	31.9	35.4	36.9		6.6	10.7	9.5	8.3	13.1	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.5	0.3	0.2	2.9	8.6		0.2	0.6	0.2	0.1	1.2	
Delay (s)	32.6	33.1	32.0	38.2	45.5		6.7	11.3	9.7	8.4	14.3	
Level of Service	C	C	C	D	D		A	B	A	A	B	
Approach Delay (s)		32.5			42.9			9.7			13.5	
Approach LOS		C			D			A			B	

Intersection Summary			
HCM 2000 Control Delay	22.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	79.4%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

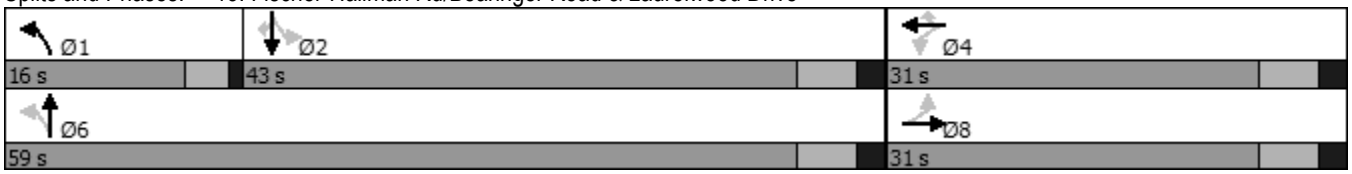


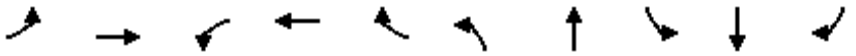
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	112	55	121	98	98	27	201	250	75	36	630	243
Future Volume (vph)	112	55	121	98	98	27	201	250	75	36	630	243
Ideal Flow (vphpl)	1775	1650	1650	1775	1900	1750	1775	1650	1650	1775	1900	1750
Storage Length (m)	100.0		0.0	50.0		40.0	70.0		0.0	70.0		0.0
Storage Lanes	1		0	1		1	1		0	1		1
Taper Length (m)	30.0			30.0			80.0			60.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor		0.98		0.99								
Frt		0.897				0.850		0.965				0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1668	1387	0	1668	1879	1471	1635	1563	0	1668	1879	1471
Flt Permitted	0.694			0.593			0.219			0.564		
Satd. Flow (perm)	1218	1387	0	1027	1879	1471	377	1563	0	990	1879	1471
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		121				85		29				243
Link Speed (k/h)		50			50			60			60	
Link Distance (m)		691.0			190.4			968.6			146.9	
Travel Time (s)		49.8			13.7			58.1			8.8	
Confl. Peds. (#/hr)			16	16								
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	5%	0%	0%	0%	2%	1%	0%	0%	0%	0%
Adj. Flow (vph)	112	55	121	98	98	27	201	250	75	36	630	243
Shared Lane Traffic (%)												
Lane Group Flow (vph)	112	176	0	98	98	27	201	325	0	36	630	243
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.11	1.21	1.21	1.11	1.01	1.13	1.11	1.21	1.21	1.11	1.01	1.13
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2	1	1	2		1	2	1
Detector Template	Left	Thru		Left	Thru	Right	Left	Thru		Left	Thru	Right
Leading Detector (m)	6.1	30.5		6.1	30.5	6.1	6.1	30.5		6.1	30.5	6.1
Trailing Detector (m)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 1 Size(m)	6.1	1.8		6.1	1.8	6.1	6.1	1.8		6.1	1.8	6.1
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Perm	NA		Perm	NA	Perm	pm+pt	NA		Perm	NA	Perm
Protected Phases		8			4		1	6			2	
Permitted Phases	8			4		4	6			2		2
Detector Phase	8	8		4	4	4	1	6		2	2	2
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0	8.0	5.0	37.0		37.0	37.0	37.0
Minimum Split (s)	31.0	31.0		31.0	31.0	31.0	9.0	43.0		43.0	43.0	43.0
Total Split (s)	31.0	31.0		31.0	31.0	31.0	16.0	59.0		43.0	43.0	43.0
Total Split (%)	34.4%	34.4%		34.4%	34.4%	34.4%	17.8%	65.6%		47.8%	47.8%	47.8%
Maximum Green (s)	25.0	25.0		25.0	25.0	25.0	12.0	53.0		37.0	37.0	37.0
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	3.0	4.0		4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	1.0	2.0		2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0	6.0	4.0	6.0		6.0	6.0	6.0
Lead/Lag							Lead			Lag	Lag	Lag
Lead-Lag Optimize?							Yes			Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Recall Mode	None	None		None	None	None	Max	None		None	None	None
Walk Time (s)	12.0	12.0		12.0	12.0	12.0		16.0		16.0	16.0	16.0
Flash Dont Walk (s)	13.0	13.0		13.0	13.0	13.0		21.0		21.0	21.0	21.0
Pedestrian Calls (#/hr)	0	0		0	0	0		0		0	0	0
Act Effct Green (s)	12.8	12.8		12.8	12.8	12.8	55.1	53.1		37.1	37.1	37.1
Actuated g/C Ratio	0.16	0.16		0.16	0.16	0.16	0.71	0.68		0.48	0.48	0.48
v/c Ratio	0.56	0.54		0.58	0.32	0.09	0.44	0.30		0.08	0.70	0.29
Control Delay	41.0	17.1		44.3	31.0	0.6	7.6	6.0		13.2	22.5	3.1
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	41.0	17.1		44.3	31.0	0.6	7.6	6.0		13.2	22.5	3.1
LOS	D	B		D	C	A	A	A		B	C	A
Approach Delay		26.4			33.2			6.6			16.9	
Approach LOS		C			C			A			B	

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 77.9			
Natural Cycle: 85			
Control Type: Semi Act-Uncoord			
Maximum v/c Ratio: 0.70			
Intersection Signal Delay: 17.4		Intersection LOS: B	
Intersection Capacity Utilization 104.6%		ICU Level of Service G	
Analysis Period (min) 15			

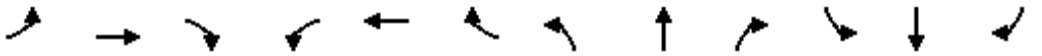
Splits and Phases: 13: Fischer-Hallman Rd/Bearinger Road & Laurelwood Drive





Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	112	176	98	98	27	201	325	36	630	243
v/c Ratio	0.56	0.54	0.58	0.32	0.09	0.44	0.30	0.08	0.70	0.29
Control Delay	41.0	17.1	44.3	31.0	0.6	7.6	6.0	13.2	22.5	3.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	41.0	17.1	44.3	31.0	0.6	7.6	6.0	13.2	22.5	3.1
Queue Length 50th (m)	15.4	7.1	13.5	12.9	0.0	7.9	14.2	2.7	68.7	0.0
Queue Length 95th (m)	30.4	24.0	27.9	25.4	0.0	19.7	33.2	8.7	124.8	12.1
Internal Link Dist (m)		667.0		166.4			944.6		122.9	
Turn Bay Length (m)	100.0		50.0		40.0	70.0		70.0		
Base Capacity (vph)	391	528	330	604	530	460	1074	471	894	827
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.29	0.33	0.30	0.16	0.05	0.44	0.30	0.08	0.70	0.29

Intersection Summary



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	112	55	121	98	98	27	201	250	75	36	630	243
Future Volume (vph)	112	55	121	98	98	27	201	250	75	36	630	243
Ideal Flow (vphpl)	1775	1650	1650	1775	1900	1750	1775	1650	1650	1775	1900	1750
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	4.0	6.0		6.0	6.0	6.0
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.98		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00		0.99	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.90		1.00	1.00	0.85	1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1668	1389		1648	1879	1471	1635	1563		1668	1879	1471
Flt Permitted	0.69	1.00		0.59	1.00	1.00	0.22	1.00		0.56	1.00	1.00
Satd. Flow (perm)	1217	1389		1029	1879	1471	377	1563		990	1879	1471
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	112	55	121	98	98	27	201	250	75	36	630	243
RTOR Reduction (vph)	0	101	0	0	0	23	0	9	0	0	0	127
Lane Group Flow (vph)	112	75	0	98	98	4	201	316	0	36	630	116
Confl. Peds. (#/hr)			16	16								
Heavy Vehicles (%)	0%	0%	5%	0%	0%	0%	2%	1%	0%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA	Perm	pm+pt	NA		Perm	NA	Perm
Protected Phases		8			4		1	6			2	
Permitted Phases	8			4		4	6			2		2
Actuated Green, G (s)	12.8	12.8		12.8	12.8	12.8	53.1	53.1		37.1	37.1	37.1
Effective Green, g (s)	12.8	12.8		12.8	12.8	12.8	53.1	53.1		37.1	37.1	37.1
Actuated g/C Ratio	0.16	0.16		0.16	0.16	0.16	0.68	0.68		0.48	0.48	0.48
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0	4.0	6.0		6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	199	228		169	308	241	450	1065		471	894	700
v/s Ratio Prot		0.05			0.05		c0.07	0.20			c0.34	
v/s Ratio Perm	0.09			c0.10		0.00	0.24			0.04		0.08
v/c Ratio	0.56	0.33		0.58	0.32	0.02	0.45	0.30		0.08	0.70	0.17
Uniform Delay, d1	30.0	28.8		30.1	28.7	27.3	8.0	4.9		11.1	16.1	11.6
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	3.6	0.8		4.8	0.6	0.0	0.7	0.2		0.1	2.5	0.1
Delay (s)	33.6	29.6		34.8	29.3	27.3	8.7	5.1		11.2	18.6	11.7
Level of Service	C	C		C	C	C	A	A		B	B	B
Approach Delay (s)		31.2			31.5			6.5			16.5	
Approach LOS		C			C			A			B	

Intersection Summary			
HCM 2000 Control Delay	17.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	77.9	Sum of lost time (s)	16.0
Intersection Capacity Utilization	104.6%	ICU Level of Service	G
Analysis Period (min)	15		

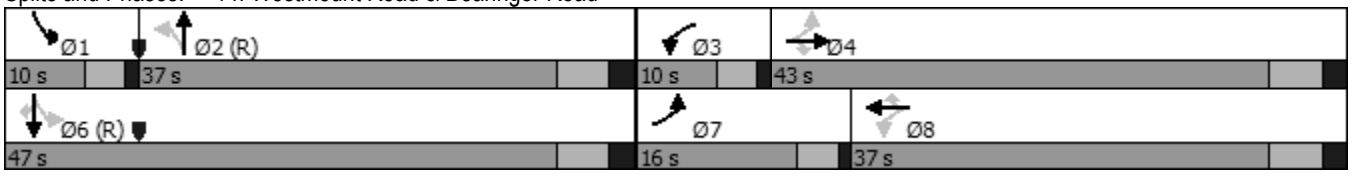
c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	266	177	2	84	334	120	3	294	81	48	433	597
Future Volume (vph)	266	177	2	84	334	120	3	294	81	48	433	597
Ideal Flow (vphpl)	1775	1900	1750	1775	1900	1750	1775	1900	1650	1775	1900	1750
Storage Length (m)	70.0		20.0	30.0		87.0	66.0		0.0	60.0		60.0
Storage Lanes	1		1	1		1	1		0	1		1
Taper Length (m)	75.0			48.0			81.0			72.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	1.00
Ped Bike Factor								0.99		1.00		
Frt			0.850			0.850		0.968				0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1635	1879	1471	1668	1879	1471	1668	3410	0	1668	3570	1456
Flt Permitted	0.348			0.646			0.500			0.438		
Satd. Flow (perm)	599	1879	1471	1134	1879	1471	878	3410	0	767	3570	1456
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			120			164		36				437
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		377.1			304.5			303.0			839.6	
Travel Time (s)		22.6			18.3			18.2			50.4	
Confl. Peds. (#/hr)									3	3		
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	2%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	1%
Adj. Flow (vph)	266	177	2	84	334	120	3	294	81	48	433	597
Shared Lane Traffic (%)												
Lane Group Flow (vph)	266	177	2	84	334	120	3	375	0	48	433	597
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.11	1.01	1.13	1.11	1.01	1.13	1.11	1.01	1.21	1.11	1.01	1.13
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2	1	1	2	1	1	2		1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru		Left	Thru	Right
Leading Detector (m)	6.1	30.5	6.1	6.1	30.5	6.1	6.1	30.5		6.1	30.5	6.1
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 1 Size(m)	6.1	1.8	6.1	6.1	1.8	6.1	6.1	1.8		6.1	1.8	6.1
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA		pm+pt	NA	Perm
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases	4		4	8		8	2			6		6
Detector Phase	7	4	4	3	8	8	2	2		1	6	6
Switch Phase												
Minimum Initial (s)	5.0	31.0	31.0	5.0	31.0	31.0	31.0	31.0		5.0	31.0	31.0
Minimum Split (s)	9.0	37.0	37.0	9.0	37.0	37.0	37.0	37.0		9.0	37.0	37.0
Total Split (s)	16.0	43.0	43.0	10.0	37.0	37.0	37.0	37.0		10.0	47.0	47.0
Total Split (%)	16.0%	43.0%	43.0%	10.0%	37.0%	37.0%	37.0%	37.0%		10.0%	47.0%	47.0%
Maximum Green (s)	12.0	37.0	37.0	6.0	31.0	31.0	31.0	31.0		6.0	41.0	41.0
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	4.0	4.0	4.0		3.0	4.0	4.0
All-Red Time (s)	1.0	2.0	2.0	1.0	2.0	2.0	2.0	2.0		1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	6.0	4.0	6.0	6.0	6.0	6.0		4.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lag	Lag		Lead		
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes		
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Recall Mode	None	None	None	None	None	None	C-Max	C-Max		None	C-Max	C-Max
Walk Time (s)		11.0	11.0		11.0	11.0	13.0	13.0			13.0	13.0
Flash Dont Walk (s)		20.0	20.0		20.0	20.0	18.0	18.0			18.0	18.0
Pedestrian Calls (#/hr)		0	0		0	0	0	0			0	0
Act Effct Green (s)	49.0	39.0	39.0	39.0	31.0	31.0	35.0	35.0		43.0	41.0	41.0
Actuated g/C Ratio	0.49	0.39	0.39	0.39	0.31	0.31	0.35	0.35		0.43	0.41	0.41
v/c Ratio	0.64	0.24	0.00	0.18	0.57	0.21	0.01	0.31		0.13	0.30	0.70
Control Delay	23.6	22.6	0.0	15.3	33.6	2.5	24.3	23.1		17.6	20.5	11.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	23.6	22.6	0.0	15.3	33.6	2.5	24.3	23.1		17.6	20.5	11.2
LOS	C	C	A	B	C	A	C	C		B	C	B
Approach Delay		23.1			23.8			23.1			15.2	
Approach LOS		C			C			C			B	

Intersection Summary			
Area Type:	Other		
Cycle Length: 100			
Actuated Cycle Length: 100			
Offset: 56 (56%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 95			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.70			
Intersection Signal Delay: 19.8		Intersection LOS: B	
Intersection Capacity Utilization 106.8%		ICU Level of Service G	
Analysis Period (min) 15			

Splits and Phases: 14: Westmount Road & Bearinger Road





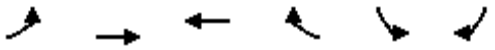
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	266	177	2	84	334	120	3	375	48	433	597
v/c Ratio	0.64	0.24	0.00	0.18	0.57	0.21	0.01	0.31	0.13	0.30	0.70
Control Delay	23.6	22.6	0.0	15.3	33.6	2.5	24.3	23.1	17.6	20.5	11.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.6	22.6	0.0	15.3	33.6	2.5	24.3	23.1	17.6	20.5	11.2
Queue Length 50th (m)	30.2	23.5	0.0	8.4	54.0	0.0	0.4	26.4	5.3	29.0	21.0
Queue Length 95th (m)	47.7	39.1	0.0	16.5	81.8	5.6	2.5	38.6	11.9	40.3	62.3
Internal Link Dist (m)		353.1			280.5			279.0		815.6	
Turn Bay Length (m)	70.0		20.0	30.0		87.0	66.0		60.0		60.0
Base Capacity (vph)	417	732	646	474	582	569	307	1218	383	1464	854
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.64	0.24	0.00	0.18	0.57	0.21	0.01	0.31	0.13	0.30	0.70

Intersection Summary

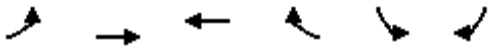
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	266	177	2	84	334	120	3	294	81	48	433	597
Future Volume (vph)	266	177	2	84	334	120	3	294	81	48	433	597
Ideal Flow (vphpl)	1775	1900	1750	1775	1900	1750	1775	1900	1650	1775	1900	1750
Total Lost time (s)	4.0	6.0	6.0	4.0	6.0	6.0	6.0	6.0		4.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99		1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1635	1879	1471	1668	1879	1471	1668	3409		1666	3570	1456
Flt Permitted	0.35	1.00	1.00	0.65	1.00	1.00	0.50	1.00		0.44	1.00	1.00
Satd. Flow (perm)	599	1879	1471	1133	1879	1471	878	3409		768	3570	1456
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	266	177	2	84	334	120	3	294	81	48	433	597
RTOR Reduction (vph)	0	0	1	0	0	82	0	24	0	0	0	261
Lane Group Flow (vph)	266	177	1	84	334	38	3	351	0	48	433	336
Confl. Peds. (#/hr)									3	3		
Heavy Vehicles (%)	2%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	1%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA		pm+pt	NA	Perm
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases	4		4	8		8	2			6		6
Actuated Green, G (s)	47.8	39.0	39.0	36.6	31.8	31.8	32.6	32.6		40.2	40.2	40.2
Effective Green, g (s)	47.8	39.0	39.0	36.6	31.8	31.8	32.6	32.6		40.2	40.2	40.2
Actuated g/C Ratio	0.48	0.39	0.39	0.37	0.32	0.32	0.33	0.33		0.40	0.40	0.40
Clearance Time (s)	4.0	6.0	6.0	4.0	6.0	6.0	6.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	410	732	573	440	597	467	286	1111		341	1435	585
v/s Ratio Prot	c0.08	0.09		0.01	0.18			0.10		0.01	0.12	
v/s Ratio Perm	c0.23		0.00	0.06		0.03	0.00			0.05		c0.23
v/c Ratio	0.65	0.24	0.00	0.19	0.56	0.08	0.01	0.32		0.14	0.30	0.57
Uniform Delay, d1	17.5	20.5	18.6	21.2	28.3	23.9	22.8	25.3		18.6	20.3	23.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	3.5	0.2	0.0	0.2	1.1	0.1	0.1	0.7		0.2	0.5	4.1
Delay (s)	21.1	20.7	18.6	21.4	29.4	24.0	22.9	26.1		18.8	20.9	27.3
Level of Service	C	C	B	C	C	C	C	C		B	C	C
Approach Delay (s)		20.9			27.0			26.0			24.3	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	24.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	106.8%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group



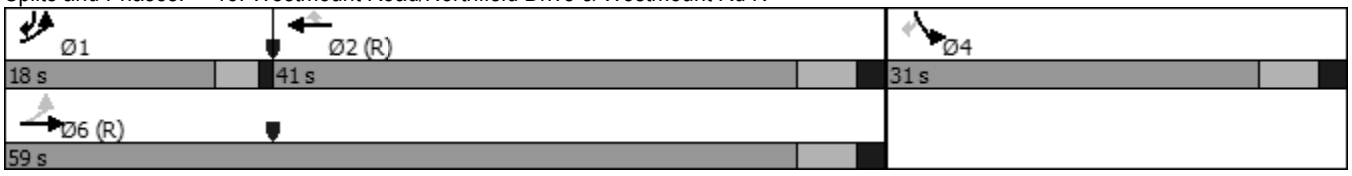
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	295	400	934	253	93	254
Future Volume (vph)	295	400	934	253	93	254
Ideal Flow (vphpl)	1775	1900	1900	1750	1775	1750
Storage Length (m)	94.0			33.0	75.0	0.0
Storage Lanes	1			1	1	1
Taper Length (m)	87.0				25.0	
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	1.00
Ped Bike Factor	1.00			0.98		
Frt				0.850		0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1668	3570	3570	1471	1668	1471
Flt Permitted	0.167				0.950	
Satd. Flow (perm)	293	3570	3570	1440	1668	1471
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)				180		43
Link Speed (k/h)		60	60		50	
Link Distance (m)		839.6	240.7		534.1	
Travel Time (s)		50.4	14.4		38.5	
Confl. Peds. (#/hr)	1			1		
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	295	400	934	253	93	254
Shared Lane Traffic (%)						
Lane Group Flow (vph)	295	400	934	253	93	254
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.5	3.5		3.5	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.11	1.01	1.01	1.13	1.11	1.13
Turning Speed (k/h)	24			14	24	14
Number of Detectors	1	2	2	1	1	1
Detector Template	Left	Thru	Thru	Right	Left	Right
Leading Detector (m)	6.1	30.5	30.5	6.1	6.1	6.1
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	6.1	1.8	1.8	6.1	6.1	6.1
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		28.7	28.7			
Detector 2 Size(m)		1.8	1.8			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			

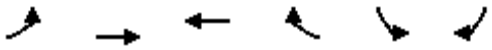


Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Turn Type	pm+pt	NA	NA	Perm	Prot	pm+ov
Protected Phases	1	6	2		4	1
Permitted Phases	6			2		4
Detector Phase	1	6	2	2	4	1
Switch Phase						
Minimum Initial (s)	5.0	30.0	30.0	30.0	7.0	5.0
Minimum Split (s)	9.0	41.0	41.0	41.0	31.0	9.0
Total Split (s)	18.0	59.0	41.0	41.0	31.0	18.0
Total Split (%)	20.0%	65.6%	45.6%	45.6%	34.4%	20.0%
Maximum Green (s)	14.0	53.0	35.0	35.0	25.0	14.0
Yellow Time (s)	3.0	4.0	4.0	4.0	4.0	3.0
All-Red Time (s)	1.0	2.0	2.0	2.0	2.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	6.0	6.0	6.0	4.0
Lead/Lag	Lead		Lag	Lag		Lead
Lead-Lag Optimize?	Yes		Yes	Yes		Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	C-Max	C-Max	C-Max	Max	None
Walk Time (s)		26.0	26.0	26.0	7.0	
Flash Dont Walk (s)		9.0	9.0	9.0	18.0	
Pedestrian Calls (#/hr)		0	0	0	0	
Act Effct Green (s)	55.0	53.0	36.2	36.2	25.0	43.8
Actuated g/C Ratio	0.61	0.59	0.40	0.40	0.28	0.49
v/c Ratio	0.79	0.19	0.65	0.37	0.20	0.34
Control Delay	28.8	8.8	24.7	7.8	26.3	12.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	28.8	8.8	24.7	7.8	26.3	12.9
LOS	C	A	C	A	C	B
Approach Delay		17.3	21.1		16.5	
Approach LOS		B	C		B	

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 6.3 (7%), Referenced to phase 2:WBT and 6:EBTL, Start of Green			
Natural Cycle: 85			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.79			
Intersection Signal Delay: 19.2		Intersection LOS: B	
Intersection Capacity Utilization 65.8%		ICU Level of Service C	
Analysis Period (min) 15			

Splits and Phases: 15: Westmount Road/Northfield Drive & Westmount Rd N

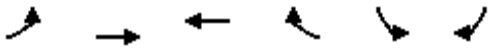




Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Group Flow (vph)	295	400	934	253	93	254
v/c Ratio	0.79	0.19	0.65	0.37	0.20	0.34
Control Delay	28.8	8.8	24.7	7.8	26.3	12.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	28.8	8.8	24.7	7.8	26.3	12.9
Queue Length 50th (m)	22.1	15.5	68.8	8.0	12.3	20.4
Queue Length 95th (m)	#58.7	22.2	89.7	24.4	24.2	36.4
Internal Link Dist (m)		815.6	216.7		510.1	
Turn Bay Length (m)	94.0			33.0	75.0	
Base Capacity (vph)	392	2102	1437	687	463	757
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.75	0.19	0.65	0.37	0.20	0.34

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	295	400	934	253	93	254
Future Volume (vph)	295	400	934	253	93	254
Ideal Flow (vphpl)	1775	1900	1900	1750	1775	1750
Total Lost time (s)	4.0	6.0	6.0	6.0	6.0	4.0
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00	0.98	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1667	3570	3570	1440	1668	1471
Flt Permitted	0.17	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	294	3570	3570	1440	1668	1471
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	295	400	934	253	93	254
RTOR Reduction (vph)	0	0	0	108	0	25
Lane Group Flow (vph)	295	400	934	145	93	229
Confl. Peds. (#/hr)	1			1		
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%
Turn Type	pm+pt	NA	NA	Perm	Prot	pm+ov
Protected Phases	1	6	2		4	1
Permitted Phases	6			2		4
Actuated Green, G (s)	53.0	53.0	36.2	36.2	25.0	37.8
Effective Green, g (s)	53.0	53.0	36.2	36.2	25.0	37.8
Actuated g/C Ratio	0.59	0.59	0.40	0.40	0.28	0.42
Clearance Time (s)	4.0	6.0	6.0	6.0	6.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	368	2102	1435	579	463	617
v/s Ratio Prot	c0.11	0.11	0.26		0.06	c0.05
v/s Ratio Perm	c0.36			0.10		0.10
v/c Ratio	0.80	0.19	0.65	0.25	0.20	0.37
Uniform Delay, d1	13.4	8.6	21.8	17.9	24.9	17.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	11.9	0.2	2.3	1.0	1.0	0.4
Delay (s)	25.3	8.8	24.1	18.9	25.8	18.3
Level of Service	C	A	C	B	C	B
Approach Delay (s)		15.8	23.0		20.3	
Approach LOS		B	C		C	

Intersection Summary			
HCM 2000 Control Delay	20.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	65.8%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	62	2	11	18	1	17
Future Volume (vph)	62	2	11	18	1	17
Ideal Flow (vphpl)	1765	1765	1650	1650	1650	1650
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.996		0.916			
Flt Protected	0.954					0.997
Satd. Flow (prot)	1512	0	1445	0	0	1627
Flt Permitted	0.954					0.997
Satd. Flow (perm)	1512	0	1445	0	0	1627
Link Speed (k/h)	70		60			60
Link Distance (m)	860.7		462.9			376.8
Travel Time (s)	44.3		27.8			22.6
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	10%	0%	9%	0%	0%	0%
Adj. Flow (vph)	62	2	11	18	1	17
Shared Lane Traffic (%)						
Lane Group Flow (vph)	64	0	29	0	0	18
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Right	Left	Left
Median Width(m)	3.5		0.0			0.0
Link Offset(m)	0.0		0.0			0.0
Crosswalk Width(m)	1.6		1.6			1.6
Two way Left Turn Lane						
Headway Factor	1.12	1.12	1.21	1.21	1.21	1.21
Turning Speed (k/h)	24	14		14	24	
Sign Control	Stop		Free			Free

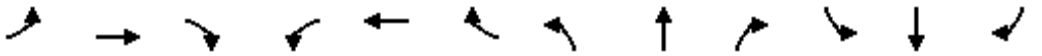
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 13.8%		ICU Level of Service A	
Analysis Period (min) 15			



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	62	2	11	18	1	17
Future Volume (Veh/h)	62	2	11	18	1	17
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	62	2	11	18	1	17
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	39	20			29	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	39	20			29	
tC, single (s)	6.5	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.6	3.3			2.2	
p0 queue free %	93	100			100	
cM capacity (veh/h)	952	1064			1597	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	64	29	18
Volume Left	62	0	1
Volume Right	2	18	0
cSH	955	1700	1597
Volume to Capacity	0.07	0.02	0.00
Queue Length 95th (m)	1.6	0.0	0.0
Control Delay (s)	9.0	0.0	0.4
Lane LOS	A		A
Approach Delay (s)	9.0	0.0	0.4
Approach LOS	A		

Intersection Summary			
Average Delay	5.3		
Intersection Capacity Utilization	13.8%	ICU Level of Service	A
Analysis Period (min)	15		



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Volume (vph)	1	18	5	146	46	45	6	137	131	29	137	4
Future Volume (vph)	1	18	5	146	46	45	6	137	131	29	137	4
Ideal Flow (vphpl)	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.972			0.974			0.935			0.997	
Flt Protected		0.998			0.970			0.999			0.992	
Satd. Flow (prot)	0	1427	0	0	1443	0	0	1372	0	0	1504	0
Flt Permitted		0.998			0.970			0.999			0.992	
Satd. Flow (perm)	0	1427	0	0	1443	0	0	1372	0	0	1504	0
Link Speed (k/h)		70			70			60			60	
Link Distance (m)		610.1			1289.9			1517.5			172.2	
Travel Time (s)		31.4			66.3			91.1			10.3	
Confl. Peds. (#/hr)			1	1			1					1
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	20%	0%	0%	2%	17%	6%	2%	0%	1%	0%
Adj. Flow (vph)	1	18	5	146	46	45	6	137	131	29	137	4
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	24	0	0	237	0	0	274	0	0	170	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Free			Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	58.3%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Volume (veh/h)	1	18	5	146	46	45	6	137	131	29	137	4
Future Volume (Veh/h)	1	18	5	146	46	45	6	137	131	29	137	4
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	1	18	5	146	46	45	6	137	131	29	137	4
Pedestrians		1						1				
Lane Width (m)		3.5						3.5				
Walking Speed (m/s)		1.1						1.1				
Percent Blockage		0						0				
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	480	478	141	426	414	202	142			268		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	480	478	141	426	414	202	142			268		
tC, single (s)	7.1	6.5	6.4	7.1	6.5	6.2	4.3			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.5	3.5	4.0	3.3	2.4			2.2		
p0 queue free %	100	96	99	71	91	95	100			98		
cM capacity (veh/h)	431	476	860	512	517	838	1353			1307		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	24	237	274	170
Volume Left	1	146	6	29
Volume Right	5	45	131	4
cSH	522	554	1353	1307
Volume to Capacity	0.05	0.43	0.00	0.02
Queue Length 95th (m)	1.1	16.2	0.1	0.5
Control Delay (s)	12.2	16.3	0.2	1.5
Lane LOS	B	C	A	A
Approach Delay (s)	12.2	16.3	0.2	1.5
Approach LOS	B	C		

Intersection Summary				
Average Delay	6.3			
Intersection Capacity Utilization	58.3%	ICU Level of Service	B	
Analysis Period (min)	15			



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	114	17	104	133	13	60
Future Volume (vph)	114	17	104	133	13	60
Ideal Flow (vphpl)	1650	1650	1650	1650	1765	1765
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.982				0.889	
Flt Protected				0.979	0.991	
Satd. Flow (prot)	1486	0	0	1541	1525	0
Flt Permitted				0.979	0.991	
Satd. Flow (perm)	1486	0	0	1541	1525	0
Link Speed (k/h)	70			70	60	
Link Distance (m)	1289.9			1914.1	213.7	
Travel Time (s)	66.3			98.4	12.8	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	9%	0%	2%	5%	0%	1%
Adj. Flow (vph)	114	17	104	133	13	60
Shared Lane Traffic (%)						
Lane Group Flow (vph)	131	0	0	237	73	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	0.0			0.0	3.5	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	1.21	1.21	1.21	1.21	1.12	1.12
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 37.5%		ICU Level of Service A	
Analysis Period (min) 15			



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	114	17	104	133	13	60
Future Volume (Veh/h)	114	17	104	133	13	60
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	114	17	104	133	13	60
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			131		464	122
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			131		464	122
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			93		98	94
cM capacity (veh/h)			1454		520	931

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	131	237	73
Volume Left	0	104	13
Volume Right	17	0	60
cSH	1700	1454	816
Volume to Capacity	0.08	0.07	0.09
Queue Length 95th (m)	0.0	1.8	2.2
Control Delay (s)	0.0	3.7	9.8
Lane LOS		A	A
Approach Delay (s)	0.0	3.7	9.8
Approach LOS			A

Intersection Summary			
Average Delay	3.6		
Intersection Capacity Utilization	37.5%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	58	16	94	12	25	3	299	207	21	10	203	122
Future Volume (vph)	58	16	94	12	25	3	299	207	21	10	203	122
Ideal Flow (vphpl)	1650	1650	1750	1550	1550	1550	1775	1650	1650	1550	1550	1550
Storage Length (m)	0.0		65.0	0.0		0.0	35.0		0.0	0.0		0.0
Storage Lanes	0		1	0		0	1		0	0		0
Taper Length (m)	2.5			2.5			25.0			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850		0.990			0.986			0.951	
Flt Protected		0.962			0.985		0.950				0.999	
Satd. Flow (prot)	0	1570	1442	0	1424	0	1651	1609	0	0	1448	0
Flt Permitted		0.962			0.985		0.950				0.999	
Satd. Flow (perm)	0	1570	1442	0	1424	0	1651	1609	0	0	1448	0
Link Speed (k/h)		70			50			50			50	
Link Distance (m)		1914.1			162.1			534.1			164.9	
Travel Time (s)		98.4			11.7			38.5			11.9	
Confl. Peds. (#/hr)			2	2			2		1	1		2
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	2%	0%	8%	0%	1%	0%	0%	20%	0%	0%
Adj. Flow (vph)	58	16	94	12	25	3	299	207	21	10	203	122
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	74	94	0	40	0	299	228	0	0	335	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.21	1.21	1.13	1.31	1.31	1.31	1.11	1.21	1.21	1.31	1.31	1.31
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 61.5%		ICU Level of Service B	
Analysis Period (min) 15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	58	16	94	12	25	3	299	207	21	10	203	122
Future Volume (vph)	58	16	94	12	25	3	299	207	21	10	203	122
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	58	16	94	12	25	3	299	207	21	10	203	122

Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2	SB 1
Volume Total (vph)	74	94	40	299	228	335
Volume Left (vph)	58	0	12	299	0	10
Volume Right (vph)	0	94	3	0	21	122
Hadj (s)	0.39	-0.67	0.10	0.52	-0.06	-0.20
Departure Headway (s)	7.1	6.1	7.1	6.1	5.5	5.6
Degree Utilization, x	0.15	0.16	0.08	0.51	0.35	0.52
Capacity (veh/h)	464	540	446	576	633	622
Control Delay (s)	10.2	9.0	10.7	14.1	10.3	14.6
Approach Delay (s)	9.5		10.7	12.4		14.6
Approach LOS	A		B	B		B

Intersection Summary				
Delay	12.6			
Level of Service	B			
Intersection Capacity Utilization	61.5%	ICU Level of Service	B	
Analysis Period (min)	15			

APPENDIX

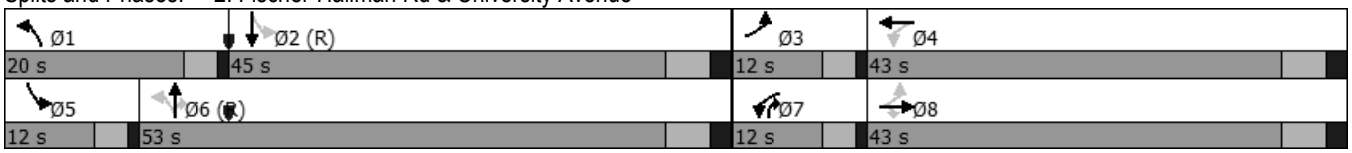
B-2 *2031 CONDITIONS – WITH PLANNED IMPROVEMENTS*

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	196	577	246	115	142	14	191	1039	443	25	843	75
Future Volume (vph)	196	577	246	115	142	14	191	1039	443	25	843	75
Ideal Flow (vphpl)	1775	1900	1750	1775	1775	1775	1775	1900	1750	1775	1775	1775
Storage Length (m)	35.0		35.0	100.0		0.0	80.0		125.0	50.0		0.0
Storage Lanes	1		1	1		0	1		1	1		0
Taper Length (m)	30.0			65.0			30.0			60.0		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	0.95	1.00	0.95	1.00	1.00	0.95	0.95
Ped Bike Factor			0.98	1.00			1.00				1.00	
Frt			0.850		0.987				0.850		0.988	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1668	3535	1428	1619	3174	0	1619	3466	1456	1668	3205	0
Flt Permitted	0.653			0.307			0.110			0.149		
Satd. Flow (perm)	1146	3535	1396	521	3174	0	187	3466	1456	262	3205	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			197		9				216		8	
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		701.9			786.3			349.5			1136.8	
Travel Time (s)		42.1			47.2			21.0			68.2	
Confl. Peds. (#/hr)			11	11			5					5
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	1%	3%	3%	3%	11%	3%	3%	1%	0%	2%	10%
Adj. Flow (vph)	196	577	246	115	142	14	191	1039	443	25	843	75
Shared Lane Traffic (%)												
Lane Group Flow (vph)	196	577	246	115	156	0	191	1039	443	25	918	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.11	1.01	1.13	1.11	1.11	1.11	1.11	1.01	1.13	1.11	1.11	1.11
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	pm+ov	pm+pt	NA	
Protected Phases	3	8		7	4		1	6	7	5	2	
Permitted Phases	8		8	4			6		6	2		
Minimum Split (s)	9.0	43.0	43.0	9.0	43.0		9.0	45.0	9.0	9.0	45.0	
Total Split (s)	12.0	43.0	43.0	12.0	43.0		20.0	53.0	12.0	12.0	45.0	
Total Split (%)	10.0%	35.8%	35.8%	10.0%	35.8%		16.7%	44.2%	10.0%	10.0%	37.5%	
Maximum Green (s)	8.0	37.0	37.0	8.0	37.0		16.0	47.0	8.0	8.0	39.0	
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0		3.0	4.0	3.0	3.0	4.0	
All-Red Time (s)	1.0	2.0	2.0	1.0	2.0		1.0	2.0	1.0	1.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	4.0	6.0	6.0	4.0	6.0		4.0	6.0	4.0	4.0	6.0	
Lead/Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lead	Lead	Lag	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	
Walk Time (s)		15.0	15.0		15.0			14.0			14.0	
Flash Dont Walk (s)		22.0	22.0		22.0			25.0			25.0	
Pedestrian Calls (#/hr)		0	0		0			0			0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Act Effct Green (s)	47.0	37.0	37.0	47.0	37.0		61.0	47.0	61.0	49.0	39.0	
Actuated g/C Ratio	0.39	0.31	0.31	0.39	0.31		0.51	0.39	0.51	0.41	0.32	
v/c Ratio	0.41	0.53	0.43	0.42	0.16		0.67	0.77	0.52	0.12	0.88	
Control Delay	26.4	36.5	10.4	26.5	28.9		34.2	36.3	11.9	24.2	56.9	
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Delay	26.4	36.5	10.4	26.5	28.9		34.2	36.3	11.9	24.2	56.9	
LOS	C	D	B	C	C		C	D	B	C	E	
Approach Delay		28.2			27.9			29.6			56.0	
Approach LOS		C			C			C			E	

Intersection Summary			
Area Type:	Other		
Cycle Length: 120			
Actuated Cycle Length: 120			
Offset: 42 (35%), Referenced to phase 2:SBTL and 6:NBTL, Start of Green			
Natural Cycle: 110			
Control Type: Pretimed			
Maximum v/c Ratio: 0.88			
Intersection Signal Delay: 35.5		Intersection LOS: D	
Intersection Capacity Utilization 103.0%		ICU Level of Service G	
Analysis Period (min) 15			

Splits and Phases: 2: Fischer-Hallman Rd & University Avenue



Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	196	577	246	115	156	191	1039	443	25	918
v/c Ratio	0.41	0.53	0.43	0.42	0.16	0.67	0.77	0.52	0.12	0.88
Control Delay	26.4	36.5	10.4	26.5	28.9	34.2	36.3	11.9	24.2	56.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	26.4	36.5	10.4	26.5	28.9	34.2	36.3	11.9	24.2	56.9
Queue Length 50th (m)	29.6	58.9	8.3	16.5	13.2	24.7	110.5	32.6	3.1	101.7
Queue Length 95th (m)	46.7	76.6	29.4	28.8	21.5	49.7	136.0	60.7	m5.9	#128.0
Internal Link Dist (m)		677.9			762.3		325.5			1112.8
Turn Bay Length (m)	35.0		35.0	100.0		80.0		125.0	50.0	
Base Capacity (vph)	483	1089	566	277	984	285	1357	846	200	1047
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.41	0.53	0.43	0.42	0.16	0.67	0.77	0.52	0.13	0.88

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	196	577	246	115	142	14	191	1039	443	25	843	75
Future Volume (vph)	196	577	246	115	142	14	191	1039	443	25	843	75
Ideal Flow (vphpl)	1775	1900	1750	1775	1775	1775	1775	1900	1750	1775	1775	1775
Total Lost time (s)	4.0	6.0	6.0	4.0	6.0		4.0	6.0	4.0	4.0	6.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1668	3535	1396	1617	3172		1619	3466	1456	1668	3205	
Flt Permitted	0.65	1.00	1.00	0.31	1.00		0.11	1.00	1.00	0.15	1.00	
Satd. Flow (perm)	1146	3535	1396	523	3172		188	3466	1456	262	3205	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	196	577	246	115	142	14	191	1039	443	25	843	75
RTOR Reduction (vph)	0	0	136	0	6	0	0	0	117	0	5	0
Lane Group Flow (vph)	196	577	110	115	150	0	191	1039	326	25	913	0
Confl. Peds. (#/hr)			11	11			5					5
Heavy Vehicles (%)	0%	1%	3%	3%	3%	11%	3%	3%	1%	0%	2%	10%
Turn Type	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	pm+ov	pm+pt	NA	
Protected Phases	3	8		7	4		1	6	7	5	2	
Permitted Phases	8		8	4			6		6	2		
Actuated Green, G (s)	45.0	37.0	37.0	45.0	37.0		59.0	47.0	55.0	47.0	39.0	
Effective Green, g (s)	45.0	37.0	37.0	45.0	37.0		59.0	47.0	55.0	47.0	39.0	
Actuated g/C Ratio	0.38	0.31	0.31	0.38	0.31		0.49	0.39	0.46	0.39	0.32	
Clearance Time (s)	4.0	6.0	6.0	4.0	6.0		4.0	6.0	4.0	4.0	6.0	
Lane Grp Cap (vph)	464	1089	430	269	978		283	1357	667	196	1041	
v/s Ratio Prot	0.03	c0.16		0.03	0.05		c0.09	0.30	c0.03	0.01	c0.28	
v/s Ratio Perm	0.13		0.08	0.13			0.24		0.19	0.04		
v/c Ratio	0.42	0.53	0.26	0.43	0.15		0.67	0.77	0.49	0.13	0.88	
Uniform Delay, d1	26.6	34.3	31.2	25.8	30.1		22.9	31.7	22.7	23.9	38.2	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.48	1.26	
Incremental Delay, d2	2.8	1.8	1.4	4.9	0.3		12.2	4.2	2.6	1.1	8.8	
Delay (s)	29.4	36.2	32.6	30.7	30.5		35.1	35.9	25.2	36.6	57.1	
Level of Service	C	D	C	C	C		D	D	C	D	E	
Approach Delay (s)		34.0			30.6			33.0			56.5	
Approach LOS		C			C			C			E	

Intersection Summary			
HCM 2000 Control Delay	38.8	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	103.0%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	9	800	200	9	76	4
Future Volume (vph)	9	800	200	9	76	4
Ideal Flow (vphpl)	1650	1650	1650	1650	1765	1765
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.994		0.993	
Flt Protected		0.999			0.955	
Satd. Flow (prot)	0	1614	1548	0	1655	0
Flt Permitted		0.999			0.955	
Satd. Flow (perm)	0	1614	1548	0	1655	0
Link Speed (k/h)		60	60		60	
Link Distance (m)		400.5	434.2		345.8	
Travel Time (s)		24.0	26.1		20.7	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	1%	5%	0%	0%	0%
Adj. Flow (vph)	9	800	200	9	76	4
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	809	209	0	80	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.5	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.21	1.21	1.21	1.21	1.12	1.12
Turning Speed (k/h)	24			14	24	14
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 68.2%		ICU Level of Service C	
Analysis Period (min) 15			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	9	800	200	9	76	4
Future Volume (Veh/h)	9	800	200	9	76	4
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	9	800	200	9	76	4
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	209				1022	204
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	209				1022	204
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				71	100
cM capacity (veh/h)	1374				262	841

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	809	209	80
Volume Left	9	0	76
Volume Right	0	9	4
cSH	1374	1700	271
Volume to Capacity	0.01	0.12	0.29
Queue Length 95th (m)	0.2	0.0	9.1
Control Delay (s)	0.2	0.0	23.7
Lane LOS	A		C
Approach Delay (s)	0.2	0.0	23.7
Approach LOS			C

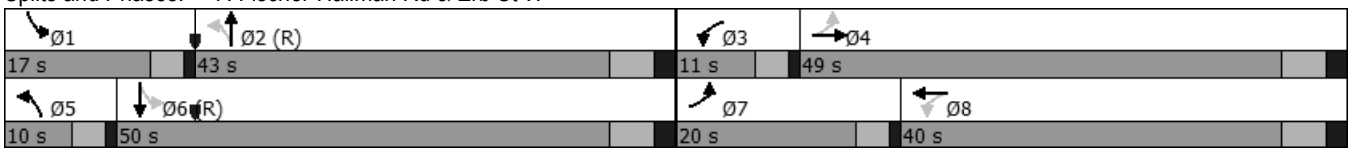
Intersection Summary			
Average Delay	1.9		
Intersection Capacity Utilization	68.2%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	277	705	208	87	390	79	220	945	135	180	562	136
Future Volume (vph)	277	705	208	87	390	79	220	945	135	180	562	136
Ideal Flow (vphpl)	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775
Storage Length (m)	40.0		0.0	50.0		0.0	78.0		0.0	170.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	50.0			75.0			78.0			35.0		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	0.95	0.95	1.00	0.95	0.95
Ped Bike Factor	0.99	0.99		1.00	0.99		1.00	1.00			1.00	
Frt		0.966			0.975			0.981			0.971	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1651	3134	0	1603	3064	0	1588	3216	0	1635	3156	0
Flt Permitted	0.331			0.183			0.304			0.093		
Satd. Flow (perm)	570	3134	0	308	3064	0	507	3216	0	160	3156	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		36			20			14			28	
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		819.0			343.1			1136.8			2051.4	
Travel Time (s)		49.1			20.6			68.2			123.1	
Confl. Peds. (#/hr)	21		11	11		21	8		17	17		8
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	1%	2%	3%	4%	4%	13%	5%	1%	4%	2%	2%	3%
Adj. Flow (vph)	277	705	208	87	390	79	220	945	135	180	562	136
Shared Lane Traffic (%)												
Lane Group Flow (vph)	277	913	0	87	469	0	220	1080	0	180	698	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8			2			6		
Detector Phase	7	4		3	8		5	2		1	6	
Switch Phase												
Minimum Initial (s)	5.0	33.0		5.0	33.0		5.0	35.0		5.0	35.0	
Minimum Split (s)	9.0	39.0		9.0	39.0		9.0	41.0		9.0	41.0	
Total Split (s)	20.0	49.0		11.0	40.0		10.0	43.0		17.0	50.0	
Total Split (%)	16.7%	40.8%		9.2%	33.3%		8.3%	35.8%		14.2%	41.7%	
Maximum Green (s)	16.0	43.0		7.0	34.0		6.0	37.0		13.0	44.0	
Yellow Time (s)	3.0	4.0		3.0	4.0		3.0	4.0		3.0	4.0	
All-Red Time (s)	1.0	2.0		1.0	2.0		1.0	2.0		1.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	4.0	6.0		4.0	6.0		4.0	6.0		4.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		None	C-Max		None	C-Max	
Walk Time (s)		11.0			11.0			20.0			20.0	
Flash Dont Walk (s)		22.0			22.0			15.0			15.0	
Pedestrian Calls (#/hr)		0			0			0			0	
Act Effct Green (s)	54.9	42.0		42.3	33.4		47.9	38.8		56.3	44.0	
Actuated g/C Ratio	0.46	0.35		0.35	0.28		0.40	0.32		0.47	0.37	
v/c Ratio	0.69	0.81		0.48	0.54		0.83	1.03		0.80	0.59	
Control Delay	31.3	40.8		28.4	37.8		37.4	62.0		45.4	31.0	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	31.3	40.8		28.4	37.8		37.4	62.0		45.4	31.0	
LOS	C	D		C	D		D	E		D	C	
Approach Delay		38.6			36.3			57.9			33.9	
Approach LOS		D			D			E			C	

Intersection Summary			
Area Type:	Other		
Cycle Length: 120			
Actuated Cycle Length: 120			
Offset: 13.2 (11%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 100			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 1.03			
Intersection Signal Delay: 43.6		Intersection LOS: D	
Intersection Capacity Utilization 104.0%		ICU Level of Service G	
Analysis Period (min) 15			

Splits and Phases: 7: Fischer-Hallman Rd & Erb St W



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	277	913	87	469	220	1080	180	698
v/c Ratio	0.69	0.81	0.48	0.54	0.83	1.03	0.80	0.59
Control Delay	31.3	40.8	28.4	37.8	37.4	62.0	45.4	31.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	31.3	40.8	28.4	37.8	37.4	62.0	45.4	31.0
Queue Length 50th (m)	41.5	98.6	11.5	47.5	19.8	~149.7	19.9	71.8
Queue Length 95th (m)	61.3	123.0	20.9	63.6	m#52.3	#192.6	m#45.7	m86.1
Internal Link Dist (m)		795.0		319.1		1112.8		2027.4
Turn Bay Length (m)	40.0		50.0		78.0		170.0	
Base Capacity (vph)	405	1146	184	882	266	1048	238	1174
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.68	0.80	0.47	0.53	0.83	1.03	0.76	0.59

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	277	705	208	87	390	79	220	945	135	180	562	136
Future Volume (vph)	277	705	208	87	390	79	220	945	135	180	562	136
Ideal Flow (vphpl)	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775
Total Lost time (s)	4.0	6.0		4.0	6.0		4.0	6.0		4.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.97		1.00	0.97		1.00	0.98		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1646	3134		1603	3063		1587	3216		1635	3156	
Flt Permitted	0.33	1.00		0.18	1.00		0.30	1.00		0.09	1.00	
Satd. Flow (perm)	574	3134		309	3063		507	3216		161	3156	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	277	705	208	87	390	79	220	945	135	180	562	136
RTOR Reduction (vph)	0	23	0	0	14	0	0	9	0	0	18	0
Lane Group Flow (vph)	277	890	0	87	455	0	220	1071	0	180	680	0
Confl. Peds. (#/hr)	21		11	11		21	8		17	17		8
Heavy Vehicles (%)	1%	2%	3%	4%	4%	13%	5%	1%	4%	2%	2%	3%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	52.9	42.0		40.3	33.4		45.9	38.8		55.1	44.0	
Effective Green, g (s)	52.9	42.0		40.3	33.4		45.9	38.8		55.1	44.0	
Actuated g/C Ratio	0.44	0.35		0.34	0.28		0.38	0.32		0.46	0.37	
Clearance Time (s)	4.0	6.0		4.0	6.0		4.0	6.0		4.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	391	1096		178	852		257	1039		225	1157	
v/s Ratio Prot	c0.09	c0.28		0.03	0.15		0.05	c0.33		c0.08	0.22	
v/s Ratio Perm	0.22			0.14			0.28			0.29		
v/c Ratio	0.71	0.81		0.49	0.53		0.86	1.03		0.80	0.59	
Uniform Delay, d1	23.4	35.4		28.9	36.7		31.5	40.6		29.0	30.7	
Progression Factor	1.00	1.00		1.00	1.00		0.57	0.71		0.81	0.97	
Incremental Delay, d2	5.8	4.7		2.1	0.6		18.1	32.0		17.1	2.0	
Delay (s)	29.2	40.1		31.0	37.3		36.0	61.0		40.6	31.8	
Level of Service	C	D		C	D		D	E		D	C	
Approach Delay (s)		37.5			36.4			56.7			33.6	
Approach LOS		D			D			E			C	

Intersection Summary			
HCM 2000 Control Delay	42.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	104.0%	ICU Level of Service	G
Analysis Period (min)	15		

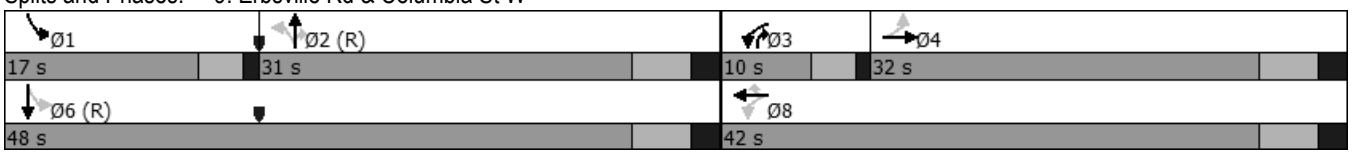
c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	151	371	68	171	204	147	115	441	529	377	441	156
Future Volume (vph)	151	371	68	171	204	147	115	441	529	377	441	156
Ideal Flow (vphpl)	1775	1650	1650	1775	1650	1650	1775	1900	1750	1775	1650	1650
Lane Width (m)	3.5	3.5	3.5	3.2	3.5	4.8	3.5	3.5	3.5	3.5	3.5	3.5
Storage Length (m)	80.0		0.0	145.0		45.0	60.0		0.0	140.0		0.0
Storage Lanes	1		0	1		1	1		1	1		0
Taper Length (m)	57.0			90.0			30.0			45.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor		1.00		1.00			0.99				0.99	
Frt		0.977				0.850			0.850		0.961	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1588	1548	0	1564	1525	1472	1450	1708	1401	1635	1443	0
Flt Permitted	0.630			0.192			0.425			0.173		
Satd. Flow (perm)	1053	1548	0	316	1525	1472	645	1708	1401	298	1443	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		10				147			167		27	
Link Speed (k/h)		50			60			60			60	
Link Distance (m)		309.3			820.7			946.8			1422.7	
Travel Time (s)		22.3			49.2			56.8			85.4	
Confl. Peds. (#/hr)			1	1			8					8
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	5%	2%	7%	3%	7%	8%	15%	10%	5%	2%	9%	4%
Adj. Flow (vph)	151	371	68	171	204	147	115	441	529	377	441	156
Shared Lane Traffic (%)												
Lane Group Flow (vph)	151	439	0	171	204	147	115	441	529	377	597	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.11	1.21	1.21	1.16	1.21	1.02	1.11	1.01	1.13	1.11	1.21	1.21
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2	1	1	2	1	1	2	
Detector Template	Left	Thru		Left	Thru	Right	Left	Thru	Right	Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5	6.1	6.1	30.5	6.1	6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8	6.1	6.1	1.8	6.1	6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		pm+pt	NA	Perm	Perm	NA	pm+ov	pm+pt	NA	
Protected Phases		4		3	8			2	3	1	6	
Permitted Phases	4			8		8	2		2	6		
Detector Phase	4	4		3	8	8	2	2	3	1	6	
Switch Phase												
Minimum Initial (s)	24.0	24.0		5.0	24.0	24.0	25.0	25.0	5.0	5.0	25.0	
Minimum Split (s)	30.0	30.0		9.0	30.0	30.0	31.0	31.0	9.0	9.0	31.0	
Total Split (s)	32.0	32.0		10.0	42.0	42.0	31.0	31.0	10.0	17.0	48.0	
Total Split (%)	35.6%	35.6%		11.1%	46.7%	46.7%	34.4%	34.4%	11.1%	18.9%	53.3%	
Maximum Green (s)	26.0	26.0		6.0	36.0	36.0	25.0	25.0	6.0	13.0	42.0	
Yellow Time (s)	4.0	4.0		3.0	4.0	4.0	4.0	4.0	3.0	3.0	4.0	
All-Red Time (s)	2.0	2.0		1.0	2.0	2.0	2.0	2.0	1.0	1.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	6.0	6.0		4.0	6.0	6.0	6.0	6.0	4.0	4.0	6.0	
Lead/Lag	Lag	Lag		Lead			Lag	Lag	Lead	Lead		
Lead-Lag Optimize?	Yes	Yes		Yes			Yes	Yes	Yes	Yes		
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None		None	None	None	C-Max	C-Max	None	None	C-Max	
Walk Time (s)	10.0	10.0			10.0	10.0	10.0	10.0			10.0	
Flash Dont Walk (s)	14.0	14.0			14.0	14.0	15.0	15.0			15.0	
Pedestrian Calls (#/hr)	0	0			0	0	0	0			0	
Act Effct Green (s)	26.0	26.0		38.0	36.0	36.0	25.0	25.0	37.0	44.0	42.0	
Actuated g/C Ratio	0.29	0.29		0.42	0.40	0.40	0.28	0.28	0.41	0.49	0.47	
v/c Ratio	0.50	0.97		0.79	0.33	0.22	0.64	0.93	0.78	1.12	0.87	
Control Delay	33.3	67.7		46.2	20.7	4.0	37.9	51.8	18.0	107.6	40.1	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	33.3	67.7		46.2	20.7	4.0	37.9	51.8	18.0	107.6	40.1	
LOS	C	E		D	C	A	D	D	B	F	D	
Approach Delay		58.9			24.3			33.9			66.2	
Approach LOS		E			C			C			E	

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 44.1 (49%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 90			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 1.12			
Intersection Signal Delay: 46.9		Intersection LOS: D	
Intersection Capacity Utilization 118.7%		ICU Level of Service H	
Analysis Period (min) 15			

Splits and Phases: 9: Erbsville Rd & Columbia St W



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	151	439	171	204	147	115	441	529	377	597
v/c Ratio	0.50	0.97	0.79	0.33	0.22	0.64	0.93	0.78	1.12	0.87
Control Delay	33.3	67.7	46.2	20.7	4.0	37.9	51.8	18.0	107.6	40.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	33.3	67.7	46.2	20.7	4.0	37.9	51.8	18.0	107.6	40.1
Queue Length 50th (m)	21.6	73.1	18.7	23.9	0.0	18.0	75.7	59.2	~55.2	100.5
Queue Length 95th (m)	40.4	#132.0	#44.7	40.7	10.8	#40.0	#125.9	#111.3	#107.9	#155.1
Internal Link Dist (m)		285.3		796.7			922.8			1398.7
Turn Bay Length (m)	80.0		145.0		45.0	60.0			140.0	
Base Capacity (vph)	304	454	216	610	677	179	474	674	338	687
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.50	0.97	0.79	0.33	0.22	0.64	0.93	0.78	1.12	0.87

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	151	371	68	171	204	147	115	441	529	377	441	156
Future Volume (vph)	151	371	68	171	204	147	115	441	529	377	441	156
Ideal Flow (vphpl)	1775	1650	1650	1775	1650	1650	1775	1900	1750	1775	1650	1650
Lane Width	3.5	3.5	3.5	3.2	3.5	4.8	3.5	3.5	3.5	3.5	3.5	3.5
Total Lost time (s)	6.0	6.0		4.0	6.0	6.0	6.0	6.0	4.0	4.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	0.99	1.00	1.00	1.00	1.00	
Frt	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1588	1548		1564	1525	1472	1441	1708	1401	1635	1443	
Flt Permitted	0.63	1.00		0.19	1.00	1.00	0.42	1.00	1.00	0.17	1.00	
Satd. Flow (perm)	1053	1548		317	1525	1472	644	1708	1401	298	1443	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	151	371	68	171	204	147	115	441	529	377	441	156
RTOR Reduction (vph)	0	7	0	0	0	88	0	0	109	0	14	0
Lane Group Flow (vph)	151	432	0	171	204	59	115	441	420	377	583	0
Confl. Peds. (#/hr)			1	1			8					8
Heavy Vehicles (%)	5%	2%	7%	3%	7%	8%	15%	10%	5%	2%	9%	4%
Turn Type	Perm	NA		pm+pt	NA	Perm	Perm	NA	pm+ov	pm+pt	NA	
Protected Phases		4		3	8			2	3	1	6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)	26.0	26.0		36.0	36.0	36.0	25.0	25.0	31.0	42.0	42.0	
Effective Green, g (s)	26.0	26.0		36.0	36.0	36.0	25.0	25.0	31.0	42.0	42.0	
Actuated g/C Ratio	0.29	0.29		0.40	0.40	0.40	0.28	0.28	0.34	0.47	0.47	
Clearance Time (s)	6.0	6.0		4.0	6.0	6.0	6.0	6.0	4.0	4.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	304	447		209	610	588	178	474	482	332	673	
v/s Ratio Prot		c0.28		0.05	0.13			0.26	c0.06	c0.16	0.40	
v/s Ratio Perm	0.14			0.27		0.04	0.18		0.24	c0.37		
v/c Ratio	0.50	0.97		0.82	0.33	0.10	0.65	0.93	0.87	1.14	0.87	
Uniform Delay, d1	26.6	31.6		22.0	18.7	16.9	28.6	31.7	27.6	21.3	21.5	
Progression Factor	1.00	1.00		1.00	1.00	1.00	0.73	0.78	0.60	1.25	1.23	
Incremental Delay, d2	1.3	33.6		21.4	0.3	0.1	14.7	24.7	13.9	90.1	13.4	
Delay (s)	27.8	65.2		43.4	19.0	16.9	35.7	49.3	30.5	116.7	39.8	
Level of Service	C	E		D	B	B	D	D	C	F	D	
Approach Delay (s)		55.6			26.4			38.7			69.6	
Approach LOS		E			C			D			E	

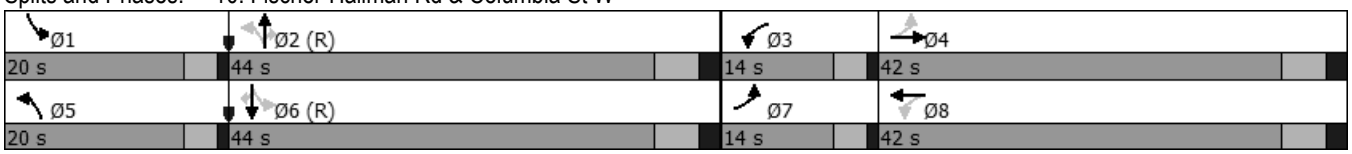
Intersection Summary			
HCM 2000 Control Delay	49.3	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.09		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	118.7%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	335	1007	174	107	263	70	189	490	470	235	324	104
Future Volume (vph)	335	1007	174	107	263	70	189	490	470	235	324	104
Ideal Flow (vphpl)	1775	1900	1750	1775	1900	1750	1775	1900	1750	1775	1900	1750
Lane Width (m)	3.0	3.4	3.4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Storage Length (m)	115.0		82.0	82.0		0.0	95.0		72.0	70.0		53.0
Storage Lanes	1		0	1		0	1		1	1		1
Taper Length (m)	73.0			100.0			36.0			33.0		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	0.95	1.00	1.00	0.95	1.00
Ped Bike Factor	1.00	1.00		1.00	1.00		1.00		0.98	1.00		0.99
Frt		0.978			0.968				0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1543	3391	0	1476	3130	0	1573	3500	1442	1619	3433	1401
Flt Permitted	0.494			0.111			0.539			0.374		
Satd. Flow (perm)	799	3391	0	172	3130	0	892	3500	1414	635	3433	1383
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		17			29				271			104
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		555.6			231.9			2051.4			968.6	
Travel Time (s)		33.3			13.9			123.1			58.1	
Confl. Peds. (#/hr)	6		2	2		6	1		8	8		1
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	2%	1%	5%	13%	10%	10%	6%	2%	2%	3%	4%	5%
Adj. Flow (vph)	335	1007	174	107	263	70	189	490	470	235	324	104
Shared Lane Traffic (%)												
Lane Group Flow (vph)	335	1181	0	107	333	0	189	490	470	235	324	104
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.19	1.03	1.14	1.11	1.01	1.13	1.11	1.01	1.13	1.11	1.01	1.13
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2	1	1	2	1
Detector Template	Left	Thru		Left	Thru		Left	Thru	Right	Left	Thru	Right
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5	6.1	6.1	30.5	6.1
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8	6.1	6.1	1.8	6.1
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8			2		2	6		6
Detector Phase	7	4		3	8		5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	5.0	36.0		5.0	36.0		5.0	38.0	38.0	5.0	38.0	38.0
Minimum Split (s)	9.0	42.0		9.0	42.0		9.0	44.0	44.0	9.0	44.0	44.0
Total Split (s)	14.0	42.0		14.0	42.0		20.0	44.0	44.0	20.0	44.0	44.0
Total Split (%)	11.7%	35.0%		11.7%	35.0%		16.7%	36.7%	36.7%	16.7%	36.7%	36.7%
Maximum Green (s)	10.0	36.0		10.0	36.0		16.0	38.0	38.0	16.0	38.0	38.0
Yellow Time (s)	3.0	4.0		3.0	4.0		3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	2.0		1.0	2.0		1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0		4.0	6.0		4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes			Yes	Yes	Yes		
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None		None	None		None	C-Max	C-Max	None	C-Max	C-Max
Walk Time (s)		15.0			15.0			17.0	17.0		17.0	17.0
Flash Dont Walk (s)		21.0			21.0			21.0	21.0		21.0	21.0
Pedestrian Calls (#/hr)		0			0			0	0		0	0
Act Effct Green (s)	48.7	36.7		47.3	36.0		54.9	39.7	39.7	57.1	40.8	40.8
Actuated g/C Ratio	0.41	0.31		0.39	0.30		0.46	0.33	0.33	0.48	0.34	0.34
v/c Ratio	0.87	1.13		0.64	0.35		0.39	0.42	0.73	0.56	0.28	0.19
Control Delay	52.6	107.5		40.1	31.0		25.1	39.1	24.5	23.3	30.2	6.5
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	52.6	107.5		40.1	31.0		25.1	39.1	24.5	23.3	30.2	6.5
LOS	D	F		D	C		C	D	C	C	C	A
Approach Delay		95.4			33.2			30.9			24.1	
Approach LOS		F			C			C			C	

Intersection Summary			
Area Type:	Other		
Cycle Length: 120			
Actuated Cycle Length: 120			
Offset: 115.2 (96%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 105			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 1.13			
Intersection Signal Delay: 55.9		Intersection LOS: E	
Intersection Capacity Utilization 112.1%		ICU Level of Service H	
Analysis Period (min) 15			

Splits and Phases: 10: Fischer-Hallman Rd & Columbia St W





Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	335	1181	107	333	189	490	470	235	324	104
v/c Ratio	0.87	1.13	0.64	0.35	0.39	0.42	0.73	0.56	0.28	0.19
Control Delay	52.6	107.5	40.1	31.0	25.1	39.1	24.5	23.3	30.2	6.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	52.6	107.5	40.1	31.0	25.1	39.1	24.5	23.3	30.2	6.5
Queue Length 50th (m)	56.1	~170.9	15.1	29.2	28.3	43.7	43.5	31.3	29.2	0.0
Queue Length 95th (m)	#105.5	#213.1	#30.0	42.0	m30.8	m46.0	m44.8	48.4	42.2	12.2
Internal Link Dist (m)		531.6		207.9		2027.4			944.6	
Turn Bay Length (m)	115.0		82.0		95.0		72.0	70.0		53.0
Base Capacity (vph)	386	1049	177	959	517	1156	648	438	1166	538
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.87	1.13	0.60	0.35	0.37	0.42	0.73	0.54	0.28	0.19

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	335	1007	174	107	263	70	189	490	470	235	324	104
Future Volume (vph)	335	1007	174	107	263	70	189	490	470	235	324	104
Ideal Flow (vphpl)	1775	1900	1750	1775	1900	1750	1775	1900	1750	1775	1900	1750
Lane Width	3.0	3.4	3.4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Total Lost time (s)	4.0	6.0		4.0	6.0		4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	0.98	1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.98		1.00	0.97		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1540	3391		1476	3131		1573	3500	1414	1617	3433	1383
Flt Permitted	0.49	1.00		0.11	1.00		0.54	1.00	1.00	0.37	1.00	1.00
Satd. Flow (perm)	802	3391		173	3131		892	3500	1414	637	3433	1383
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	335	1007	174	107	263	70	189	490	470	235	324	104
RTOR Reduction (vph)	0	12	0	0	20	0	0	0	181	0	0	69
Lane Group Flow (vph)	335	1169	0	107	313	0	189	490	289	235	324	35
Confl. Peds. (#/hr)	6		2	2		6	1		8	8		1
Heavy Vehicles (%)	2%	1%	5%	13%	10%	10%	6%	2%	2%	3%	4%	5%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8			2		2	6		6
Actuated Green, G (s)	46.7	36.7		45.3	36.0		52.9	39.7	39.7	55.1	40.8	40.8
Effective Green, g (s)	46.7	36.7		45.3	36.0		52.9	39.7	39.7	55.1	40.8	40.8
Actuated g/C Ratio	0.39	0.31		0.38	0.30		0.44	0.33	0.33	0.46	0.34	0.34
Clearance Time (s)	4.0	6.0		4.0	6.0		4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	373	1037		166	939		468	1157	467	409	1167	470
v/s Ratio Prot	c0.07	c0.34		0.05	0.10		0.04	0.14		c0.07	0.09	
v/s Ratio Perm	0.27			0.19			0.13		c0.20	0.20		0.03
v/c Ratio	0.90	1.13		0.64	0.33		0.40	0.42	0.62	0.57	0.28	0.08
Uniform Delay, d1	32.4	41.6		29.7	32.7		21.3	31.2	33.8	21.0	28.9	26.8
Progression Factor	1.00	1.00		1.00	1.00		1.39	1.21	1.44	1.00	1.00	1.00
Incremental Delay, d2	23.3	70.0		8.3	0.2		0.2	0.4	2.3	2.0	0.6	0.3
Delay (s)	55.7	111.6		38.0	32.9		29.8	38.3	51.0	22.9	29.5	27.1
Level of Service	E	F		D	C		C	D	D	C	C	C
Approach Delay (s)		99.3			34.1			42.1			26.8	
Approach LOS		F			C			D			C	

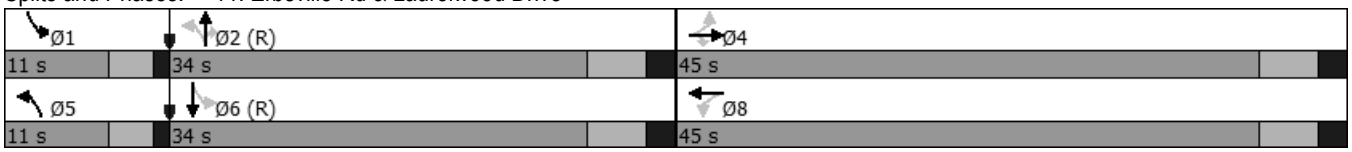
Intersection Summary			
HCM 2000 Control Delay	61.5	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	112.1%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	18	202	331	70	136	65	216	343	145	98	372	18
Future Volume (vph)	18	202	331	70	136	65	216	343	145	98	372	18
Ideal Flow (vphpl)	1775	1900	1750	1775	1650	1650	1775	1900	1750	1775	1650	1650
Storage Length (m)	27.0		0.0	20.0		0.0	65.0		29.0	19.0		0.0
Storage Lanes	1		1	1		0	1		1	1		0
Taper Length (m)	22.0			18.0			73.0			49.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor	0.78		0.92	0.95	0.90		0.98		0.88	0.95	1.00	
Frt			0.850		0.951				0.850		0.993	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1558	1824	1414	1502	1324	0	1619	1663	1471	1603	1467	0
Flt Permitted	0.518			0.516			0.424			0.555		
Satd. Flow (perm)	659	1824	1297	776	1324	0	710	1663	1296	887	1467	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			331		34				118		3	
Link Speed (k/h)		50			50			60			60	
Link Distance (m)		270.4			1189.4			1422.7			1517.5	
Travel Time (s)		19.5			85.6			85.4			91.1	
Confl. Peds. (#/hr)	259		56	56		259	24		63	63		24
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	7%	3%	4%	11%	6%	4%	3%	13%	0%	4%	10%	13%
Adj. Flow (vph)	18	202	331	70	136	65	216	343	145	98	372	18
Shared Lane Traffic (%)												
Lane Group Flow (vph)	18	202	331	70	201	0	216	343	145	98	390	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.11	1.01	1.13	1.11	1.21	1.21	1.11	1.01	1.13	1.11	1.21	1.21
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2	1	1	2		1	2	1	1	2	
Detector Template	Left	Thru	Right	Left	Thru		Left	Thru	Right	Left	Thru	
Leading Detector (m)	6.1	30.5	6.1	6.1	30.5		6.1	30.5	6.1	6.1	30.5	
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Size(m)	6.1	1.8	6.1	6.1	1.8		6.1	1.8	6.1	6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Perm	NA	Perm	Perm	NA		pm+pt	NA	Perm	pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8			2		2	6		
Detector Phase	4	4	4	8	8		5	2	2	1	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0		5.0	28.0	28.0	5.0	28.0	
Minimum Split (s)	45.0	45.0	45.0	45.0	45.0		9.0	34.0	34.0	9.0	34.0	
Total Split (s)	45.0	45.0	45.0	45.0	45.0		11.0	34.0	34.0	11.0	34.0	
Total Split (%)	50.0%	50.0%	50.0%	50.0%	50.0%		12.2%	37.8%	37.8%	12.2%	37.8%	
Maximum Green (s)	39.0	39.0	39.0	39.0	39.0		7.0	28.0	28.0	7.0	28.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		3.0	4.0	4.0	3.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		1.0	2.0	2.0	1.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0		4.0	6.0	6.0	4.0	6.0	
Lead/Lag							Lead	Lag	Lag	Lead	Lag	
Lead-Lag Optimize?							Yes	Yes	Yes	Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None	None	None	None		None	C-Max	C-Max	None	C-Max	
Walk Time (s)	15.0	15.0	15.0	15.0	15.0			10.0	10.0		10.0	
Flash Dont Walk (s)	24.0	24.0	24.0	24.0	24.0			18.0	18.0		18.0	
Pedestrian Calls (#/hr)	0	0	0	0	0			0	0		0	
Act Effct Green (s)	17.4	17.4	17.4	17.4	17.4		62.0	51.1	51.1	55.6	46.1	
Actuated g/C Ratio	0.19	0.19	0.19	0.19	0.19		0.69	0.57	0.57	0.62	0.51	
v/c Ratio	0.14	0.57	0.64	0.47	0.71		0.36	0.36	0.18	0.16	0.52	
Control Delay	29.4	38.3	9.4	40.6	41.0		12.3	22.5	12.6	6.7	20.2	
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Delay	29.4	38.3	9.4	40.6	41.0		12.3	22.5	12.6	6.7	20.2	
LOS	C	D	A	D	D		B	C	B	A	C	
Approach Delay		20.7			40.9			17.4			17.5	
Approach LOS		C			D			B			B	

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 3.6 (4%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 90			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.71			
Intersection Signal Delay: 21.5		Intersection LOS: C	
Intersection Capacity Utilization 94.2%		ICU Level of Service F	
Analysis Period (min) 15			

Splits and Phases: 11: Erbsville Rd & Laurelwood Drive



Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	18	202	331	70	201	216	343	145	98	390
v/c Ratio	0.14	0.57	0.64	0.47	0.71	0.36	0.36	0.18	0.16	0.52
Control Delay	29.4	38.3	9.4	40.6	41.0	12.3	22.5	12.6	6.7	20.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.4	38.3	9.4	40.6	41.0	12.3	22.5	12.6	6.7	20.2
Queue Length 50th (m)	2.6	32.1	0.0	10.9	27.3	26.7	45.8	10.8	4.7	41.5
Queue Length 95th (m)	7.5	47.0	20.0	21.2	44.7	m35.7	m72.7	m16.7	12.7	89.2
Internal Link Dist (m)		246.4			1165.4		1398.7			1493.5
Turn Bay Length (m)	27.0			20.0		65.0		29.0	19.0	
Base Capacity (vph)	285	790	749	336	593	595	943	786	613	752
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.06	0.26	0.44	0.21	0.34	0.36	0.36	0.18	0.16	0.52

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	18	202	331	70	136	65	216	343	145	98	372	18
Future Volume (vph)	18	202	331	70	136	65	216	343	145	98	372	18
Ideal Flow (vphpl)	1775	1900	1750	1775	1650	1650	1775	1900	1750	1775	1650	1650
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0		4.0	6.0	6.0	4.0	6.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00	0.92	1.00	0.90		1.00	1.00	0.88	1.00	1.00	
Flpb, ped/bikes	0.78	1.00	1.00	0.95	1.00		0.99	1.00	1.00	0.97	1.00	
Frt	1.00	1.00	0.85	1.00	0.95		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1220	1824	1297	1432	1325		1607	1663	1296	1550	1467	
Flt Permitted	0.52	1.00	1.00	0.52	1.00		0.42	1.00	1.00	0.55	1.00	
Satd. Flow (perm)	666	1824	1297	777	1325		717	1663	1296	905	1467	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	18	202	331	70	136	65	216	343	145	98	372	18
RTOR Reduction (vph)	0	0	267	0	27	0	0	0	52	0	1	0
Lane Group Flow (vph)	18	202	64	70	174	0	216	343	93	98	389	0
Confl. Peds. (#/hr)	259		56	56		259	24		63	63		24
Heavy Vehicles (%)	7%	3%	4%	11%	6%	4%	3%	13%	0%	4%	10%	13%
Turn Type	Perm	NA	Perm	Perm	NA		pm+pt	NA	Perm	pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8			2		2	6		
Actuated Green, G (s)	17.4	17.4	17.4	17.4	17.4		60.6	50.2	50.2	52.5	46.1	
Effective Green, g (s)	17.4	17.4	17.4	17.4	17.4		60.6	50.2	50.2	52.5	46.1	
Actuated g/C Ratio	0.19	0.19	0.19	0.19	0.19		0.67	0.56	0.56	0.58	0.51	
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0		4.0	6.0	6.0	4.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	128	352	250	150	256		586	927	722	573	751	
v/s Ratio Prot		0.11			c0.13		c0.04	0.21		0.01	c0.26	
v/s Ratio Perm	0.03		0.05	0.09			0.20		0.07	0.09		
v/c Ratio	0.14	0.57	0.26	0.47	0.68		0.37	0.37	0.13	0.17	0.52	
Uniform Delay, d1	30.1	32.9	30.8	32.2	33.7		6.3	11.1	9.5	8.3	14.6	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.86	1.61	2.87	1.00	1.00	
Incremental Delay, d2	0.5	2.3	0.5	2.3	7.0		0.3	0.8	0.3	0.1	2.5	
Delay (s)	30.6	35.2	31.4	34.5	40.7		12.0	18.6	27.4	8.5	17.1	
Level of Service	C	D	C	C	D		B	B	C	A	B	
Approach Delay (s)		32.7			39.1			18.4			15.4	
Approach LOS		C			D			B			B	

Intersection Summary			
HCM 2000 Control Delay	24.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	94.2%	ICU Level of Service	F
Analysis Period (min)	15		

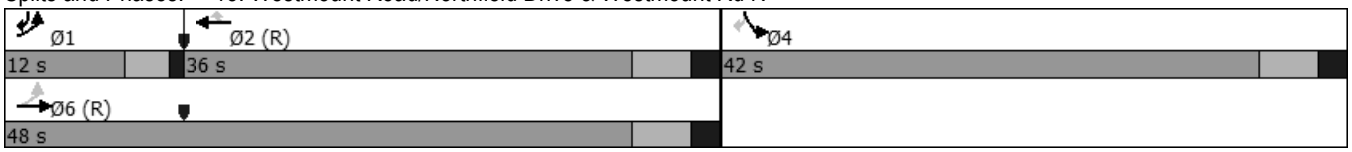
c Critical Lane Group

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	207	930	404	84	335	450
Future Volume (vph)	207	930	404	84	335	450
Ideal Flow (vphpl)	1775	1900	1900	1750	1775	1750
Storage Length (m)	94.0			33.0	75.0	0.0
Storage Lanes	1			1	1	1
Taper Length (m)	87.0				25.0	
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	1.00
Ped Bike Factor						0.99
Frt				0.850		0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1635	3535	3535	1375	1635	1471
Flt Permitted	0.423				0.950	
Satd. Flow (perm)	728	3535	3535	1375	1635	1452
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)				84		224
Link Speed (k/h)		60	60		50	
Link Distance (m)		839.6	240.7		534.1	
Travel Time (s)		50.4	14.4		38.5	
Confl. Peds. (#/hr)						1
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	2%	1%	1%	7%	2%	0%
Adj. Flow (vph)	207	930	404	84	335	450
Shared Lane Traffic (%)						
Lane Group Flow (vph)	207	930	404	84	335	450
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.5	3.5		3.5	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.11	1.01	1.01	1.13	1.11	1.13
Turning Speed (k/h)	24			14	24	14
Number of Detectors	1	2	2	1	1	1
Detector Template	Left	Thru	Thru	Right	Left	Right
Leading Detector (m)	6.1	30.5	30.5	6.1	6.1	6.1
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	6.1	1.8	1.8	6.1	6.1	6.1
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		28.7	28.7			
Detector 2 Size(m)		1.8	1.8			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Turn Type	pm+pt	NA	NA	Perm	Prot	pm+ov
Protected Phases	1	6	2		4	1
Permitted Phases	6			2		4
Detector Phase	1	6	2	2	4	1
Switch Phase						
Minimum Initial (s)	5.0	30.0	30.0	30.0	7.0	5.0
Minimum Split (s)	9.0	36.0	36.0	36.0	42.0	9.0
Total Split (s)	12.0	48.0	36.0	36.0	42.0	12.0
Total Split (%)	13.3%	53.3%	40.0%	40.0%	46.7%	13.3%
Maximum Green (s)	8.0	42.0	30.0	30.0	36.0	8.0
Yellow Time (s)	3.0	4.0	4.0	4.0	4.0	3.0
All-Red Time (s)	1.0	2.0	2.0	2.0	2.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	6.0	6.0	6.0	4.0
Lead/Lag	Lead		Lag	Lag		Lead
Lead-Lag Optimize?	Yes		Yes	Yes		Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	C-Max	C-Max	C-Max	Max	None
Walk Time (s)		21.0	21.0	21.0	7.0	
Flash Dont Walk (s)		9.0	9.0	9.0	29.0	
Pedestrian Calls (#/hr)		0	0	0	0	
Act Effct Green (s)	44.0	42.0	30.0	30.0	36.0	46.0
Actuated g/C Ratio	0.49	0.47	0.33	0.33	0.40	0.51
v/c Ratio	0.47	0.56	0.34	0.16	0.51	0.53
Control Delay	17.6	19.0	23.6	5.9	23.8	8.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	17.6	19.0	23.6	5.9	23.8	8.3
LOS	B	B	C	A	C	A
Approach Delay		18.8	20.6		14.9	
Approach LOS		B	C		B	

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 25.2 (28%), Referenced to phase 2:WBT and 6:EBTL, Start of Green			
Natural Cycle: 90			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.56			
Intersection Signal Delay: 17.9		Intersection LOS: B	
Intersection Capacity Utilization 80.6%		ICU Level of Service D	
Analysis Period (min) 15			

Splits and Phases: 15: Westmount Road/Northfield Drive & Westmount Rd N





Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Group Flow (vph)	207	930	404	84	335	450
v/c Ratio	0.47	0.56	0.34	0.16	0.51	0.53
Control Delay	17.6	19.0	23.6	5.9	23.8	8.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	17.6	19.0	23.6	5.9	23.8	8.3
Queue Length 50th (m)	20.1	58.9	27.3	0.0	42.8	19.3
Queue Length 95th (m)	33.8	76.7	39.2	9.3	67.5	41.6
Internal Link Dist (m)		815.6	216.7		510.1	
Turn Bay Length (m)	94.0			33.0	75.0	
Base Capacity (vph)	436	1649	1178	514	654	853
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.47	0.56	0.34	0.16	0.51	0.53

Intersection Summary

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	207	930	404	84	335	450
Future Volume (vph)	207	930	404	84	335	450
Ideal Flow (vphpl)	1775	1900	1900	1750	1775	1750
Total Lost time (s)	4.0	6.0	6.0	6.0	6.0	4.0
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1635	3535	3535	1375	1635	1456
Flt Permitted	0.42	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	728	3535	3535	1375	1635	1456
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	207	930	404	84	335	450
RTOR Reduction (vph)	0	0	0	56	0	114
Lane Group Flow (vph)	207	930	404	28	335	336
Confl. Peds. (#/hr)						1
Heavy Vehicles (%)	2%	1%	1%	7%	2%	0%
Turn Type	pm+pt	NA	NA	Perm	Prot	pm+ov
Protected Phases	1	6	2		4	1
Permitted Phases	6			2		4
Actuated Green, G (s)	42.0	42.0	30.0	30.0	36.0	44.0
Effective Green, g (s)	42.0	42.0	30.0	30.0	36.0	44.0
Actuated g/C Ratio	0.47	0.47	0.33	0.33	0.40	0.49
Clearance Time (s)	4.0	6.0	6.0	6.0	6.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	420	1649	1178	458	654	711
v/s Ratio Prot	0.04	c0.26	0.11		c0.20	0.04
v/s Ratio Perm	0.19			0.02		0.19
v/c Ratio	0.49	0.56	0.34	0.06	0.51	0.47
Uniform Delay, d1	14.9	17.4	22.6	20.4	20.4	15.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.9	1.4	0.8	0.3	2.9	0.5
Delay (s)	15.8	18.8	23.4	20.7	23.2	15.8
Level of Service	B	B	C	C	C	B
Approach Delay (s)		18.2	22.9		19.0	
Approach LOS		B	C		B	

Intersection Summary			
HCM 2000 Control Delay	19.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	80.6%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	39	1	25	124	10	42
Future Volume (vph)	39	1	25	124	10	42
Ideal Flow (vphpl)	1765	1765	1650	1650	1650	1650
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.997		0.888			
Flt Protected	0.954					0.990
Satd. Flow (prot)	1479	0	1369	0	0	1391
Flt Permitted	0.954					0.990
Satd. Flow (perm)	1479	0	1369	0	0	1391
Link Speed (k/h)	70		60			60
Link Distance (m)	860.7		462.9			376.8
Travel Time (s)	44.3		27.8			22.6
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	10%	100%	5%	6%	0%	20%
Adj. Flow (vph)	39	1	25	124	10	42
Shared Lane Traffic (%)						
Lane Group Flow (vph)	40	0	149	0	0	52
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Right	Left	Left
Median Width(m)	3.5		0.0			0.0
Link Offset(m)	0.0		0.0			0.0
Crosswalk Width(m)	1.6		1.6			1.6
Two way Left Turn Lane						
Headway Factor	1.12	1.12	1.21	1.21	1.21	1.21
Turning Speed (k/h)	24	14		14	24	
Sign Control	Stop		Free			Free

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 22.5%		ICU Level of Service A	
Analysis Period (min) 15			



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	39	1	25	124	10	42
Future Volume (Veh/h)	39	1	25	124	10	42
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	39	1	25	124	10	42
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	149	87			149	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	149	87			149	
tC, single (s)	6.5	7.2			4.1	
tC, 2 stage (s)						
tF (s)	3.6	4.2			2.2	
p0 queue free %	95	100			99	
cM capacity (veh/h)	819	757			1445	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	40	149	52
Volume Left	39	0	10
Volume Right	1	124	0
cSH	817	1700	1445
Volume to Capacity	0.05	0.09	0.01
Queue Length 95th (m)	1.2	0.0	0.2
Control Delay (s)	9.6	0.0	1.5
Lane LOS	A		A
Approach Delay (s)	9.6	0.0	1.5
Approach LOS	A		

Intersection Summary			
Average Delay	1.9		
Intersection Capacity Utilization	22.5%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	26	101	16	64	30	37	0	203	145	52	186	3
Future Volume (vph)	26	101	16	64	30	37	0	203	145	52	186	3
Ideal Flow (vphpl)	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550
Storage Length (m)	0.0		0.0	30.0		0.0	0.0		0.0	0.0		0.0
Storage Lanes	0		0	1		0	0		0	0		0
Taper Length (m)	2.5			45.0			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.985			0.917			0.944			0.998	
Flt Protected		0.991		0.950							0.989	
Satd. Flow (prot)	0	1424	0	1374	1339	0	0	1332	0	0	1336	0
Flt Permitted		0.991		0.950							0.989	
Satd. Flow (perm)	0	1424	0	1374	1339	0	0	1332	0	0	1336	0
Link Speed (k/h)		70			70			60			60	
Link Distance (m)		610.1			3203.9			1517.5			172.2	
Travel Time (s)		31.4			164.8			91.1			10.3	
Confl. Peds. (#/hr)	4		2	2		4			2	2		
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	4%	20%	6%	0%	9%	0%	12%	4%	4%	16%	0%
Adj. Flow (vph)	26	101	16	64	30	37	0	203	145	52	186	3
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	143	0	64	67	0	0	348	0	0	241	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	65.9%	ICU Level of Service	C
Analysis Period (min)	15		

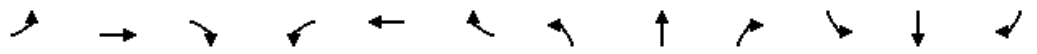
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	26	101	16	64	30	37	0	203	145	52	186	3
Future Volume (vph)	26	101	16	64	30	37	0	203	145	52	186	3
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	26	101	16	64	30	37	0	203	145	52	186	3

Direction, Lane #	EB 1	WB 1	WB 2	NB 1	SB 1
Volume Total (vph)	143	64	67	348	241
Volume Left (vph)	26	64	0	0	52
Volume Right (vph)	16	0	37	145	3
Hadj (s)	0.06	0.60	-0.30	-0.10	0.26
Departure Headway (s)	5.9	6.9	6.0	5.0	5.5
Degree Utilization, x	0.23	0.12	0.11	0.48	0.37
Capacity (veh/h)	547	468	535	678	615
Control Delay (s)	10.7	9.7	8.6	12.6	11.7
Approach Delay (s)	10.7	9.1		12.6	11.7
Approach LOS	B	A		B	B

Intersection Summary				
Delay	11.5			
Level of Service	B			
Intersection Capacity Utilization	65.9%	ICU Level of Service		C
Analysis Period (min)	15			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	148	45	353	47	52	15	118	165	22	20	258	34
Future Volume (vph)	148	45	353	47	52	15	118	165	22	20	258	34
Ideal Flow (vphpl)	1650	1650	1750	1550	1550	1550	1775	1650	1650	1550	1550	1550
Storage Length (m)	0.0		65.0	0.0		0.0	35.0		0.0	0.0		0.0
Storage Lanes	0		1	0		0	1		0	0		0
Taper Length (m)	2.5			2.5			25.0			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850		0.982			0.982			0.985	
Flt Protected		0.963			0.980		0.950				0.997	
Satd. Flow (prot)	0	1423	1428	0	1381	0	1390	1527	0	0	1389	0
Flt Permitted		0.963			0.980		0.950				0.997	
Satd. Flow (perm)	0	1423	1428	0	1381	0	1390	1527	0	0	1389	0
Link Speed (k/h)		70			50			50			50	
Link Distance (m)		3203.9			162.1			534.1			164.9	
Travel Time (s)		164.8			11.7			38.5			11.9	
Confl. Peds. (#/hr)	4		1	1		4	3		1	1		3
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	9%	15%	3%	0%	15%	0%	20%	4%	12%	17%	5%	29%
Adj. Flow (vph)	148	45	353	47	52	15	118	165	22	20	258	34
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	193	353	0	114	0	118	187	0	0	312	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.21	1.21	1.13	1.31	1.31	1.31	1.11	1.21	1.21	1.31	1.31	1.31
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 62.8%		ICU Level of Service B	
Analysis Period (min) 15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	148	45	353	47	52	15	118	165	22	20	258	34
Future Volume (vph)	148	45	353	47	52	15	118	165	22	20	258	34
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	148	45	353	47	52	15	118	165	22	20	258	34

Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2	SB 1
Volume Total (vph)	193	353	114	118	187	312
Volume Left (vph)	148	0	47	118	0	20
Volume Right (vph)	0	353	15	0	22	34
Hadj (s)	0.56	-0.65	0.12	0.84	0.00	0.09
Departure Headway (s)	7.4	6.2	7.8	8.1	7.2	7.2
Degree Utilization, x	0.40	0.61	0.25	0.26	0.37	0.62
Capacity (veh/h)	466	552	404	414	462	484
Control Delay (s)	14.1	17.3	13.4	12.7	13.3	21.1
Approach Delay (s)	16.1		13.4	13.0		21.1
Approach LOS	C		B	B		C

Intersection Summary				
Delay	16.4			
Level of Service	C			
Intersection Capacity Utilization	62.8%	ICU Level of Service		B
Analysis Period (min)	15			

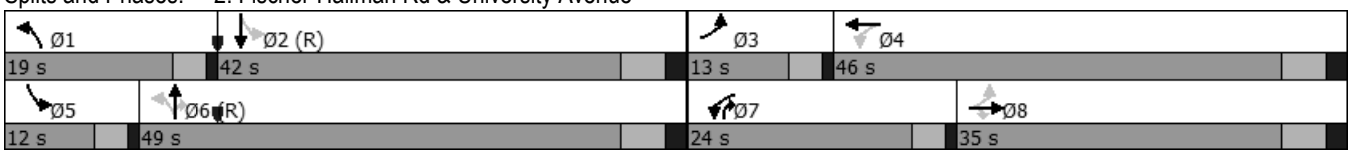
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	136	340	229	554	490	18	290	1046	187	31	1243	152
Future Volume (vph)	136	340	229	554	490	18	290	1046	187	31	1243	152
Ideal Flow (vphpl)	1775	1900	1750	1775	1775	1775	1775	1900	1750	1775	1775	1775
Storage Length (m)	35.0		35.0	100.0		0.0	80.0		125.0	50.0		0.0
Storage Lanes	1		1	1		0	1		1	1		0
Taper Length (m)	30.0			65.0			30.0			60.0		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	0.95	1.00	0.95	1.00	1.00	0.95	0.95
Ped Bike Factor	1.00		0.98	1.00	1.00		1.00				1.00	
Frt			0.850		0.995				0.850		0.984	
Flt Protected	0.950			0.950						0.950		
Satd. Flow (prot)	1668	3570	1442	1651	3317	0	1738	3535	1442	1668	3239	0
Flt Permitted	0.465			0.414			*0.125			0.154		
Satd. Flow (perm)	816	3570	1416	717	3317	0	217	3535	1442	270	3239	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			215		3				187		11	
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		701.9			786.3			349.5			1136.8	
Travel Time (s)		42.1			47.2			21.0			68.2	
Confl. Peds. (#/hr)	1		5	5		1	17					17
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	2%	1%	0%	0%	1%	1%	2%	0%	1%	1%
Adj. Flow (vph)	136	340	229	554	490	18	290	1046	187	31	1243	152
Shared Lane Traffic (%)												
Lane Group Flow (vph)	136	340	229	554	508	0	290	1046	187	31	1395	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.11	1.01	1.13	1.11	1.11	1.11	1.11	1.01	1.13	1.11	1.11	1.11
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2	1	1	2		1	2	1	1	2	
Detector Template	Left	Thru	Right	Left	Thru		Left	Thru	Right	Left	Thru	
Leading Detector (m)	6.1	30.5	6.1	6.1	30.5		6.1	30.5	6.1	6.1	30.5	
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Size(m)	6.1	1.8	6.1	6.1	1.8		6.1	1.8	6.1	6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	pm+ov	pm+pt	NA	
Protected Phases	3	8		7	4		1	6	7	5	2	
Permitted Phases	8		8	4			6		6	2		
Detector Phase	3	8	8	7	4		1	6	7	5	2	
Switch Phase												
Minimum Initial (s)	5.0	29.0	29.0	5.0	29.0		5.0	36.0	5.0	5.0	36.0	
Minimum Split (s)	9.0	35.0	35.0	9.0	35.0		9.0	42.0	9.0	9.0	42.0	
Total Split (s)	13.0	35.0	35.0	24.0	46.0		19.0	49.0	24.0	12.0	42.0	
Total Split (%)	10.8%	29.2%	29.2%	20.0%	38.3%		15.8%	40.8%	20.0%	10.0%	35.0%	
Maximum Green (s)	9.0	29.0	29.0	20.0	40.0		15.0	43.0	20.0	8.0	36.0	
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0		3.0	4.0	3.0	3.0	4.0	
All-Red Time (s)	1.0	2.0	2.0	1.0	2.0		1.0	2.0	1.0	1.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	4.0	6.0	6.0	4.0	6.0		4.0	6.0	4.0	4.0	6.0	
Lead/Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lead	Lead	Lag	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None	None	None	None		None	C-Max	None	None	C-Max	
Walk Time (s)		7.0	7.0		7.0			11.0			11.0	
Flash Dont Walk (s)		22.0	22.0		22.0			25.0			25.0	
Pedestrian Calls (#/hr)		0	0		0			0			0	
Act Effct Green (s)	39.7	29.0	29.0	55.0	40.3		57.0	48.2	74.2	44.7	36.0	
Actuated g/C Ratio	0.33	0.24	0.24	0.46	0.34		0.48	0.40	0.62	0.37	0.30	
v/c Ratio	0.41	0.39	0.45	1.14	0.46		0.99	0.74	0.19	0.17	1.42	
Control Delay	24.7	39.8	9.2	114.7	32.8		80.0	35.4	2.1	16.2	228.0	
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Delay	24.7	39.8	9.2	114.7	32.8		80.0	35.4	2.1	16.2	228.0	
LOS	C	D	A	F	C		E	D	A	B	F	
Approach Delay		26.9			75.5			39.8			223.4	
Approach LOS		C			E			D			F	

Intersection Summary			
Area Type:	Other		
Cycle Length: 120			
Actuated Cycle Length: 120			
Offset: 18 (15%), Referenced to phase 2:SBTL and 6:NBTL, Start of Green			
Natural Cycle: 145			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 1.42			
Intersection Signal Delay: 101.4		Intersection LOS: F	
Intersection Capacity Utilization 133.0%		ICU Level of Service H	
Analysis Period (min) 15			

* User Entered Value

Splits and Phases: 2: Fischer-Hallman Rd & University Avenue



Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	136	340	229	554	508	290	1046	187	31	1395
v/c Ratio	0.41	0.39	0.45	1.14	0.46	0.99	0.74	0.19	0.17	1.42
Control Delay	24.7	39.8	9.2	114.7	32.8	80.0	35.4	2.1	16.2	228.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	24.7	39.8	9.2	114.7	32.8	80.0	35.4	2.1	16.2	228.0
Queue Length 50th (m)	18.5	35.4	2.5	~128.0	49.0	49.7	114.8	0.0	4.8	~238.8
Queue Length 95th (m)	31.1	49.2	23.1	#219.0	64.8	#105.3	143.8	9.3	m6.0	m#212.0
Internal Link Dist (m)		677.9			762.3		325.5			1112.8
Turn Bay Length (m)	35.0		35.0	100.0		80.0		125.0	50.0	
Base Capacity (vph)	335	862	505	484	1115	293	1420	963	196	979
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.41	0.39	0.45	1.14	0.46	0.99	0.74	0.19	0.16	1.42

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	136	340	229	554	490	18	290	1046	187	31	1243	152
Future Volume (vph)	136	340	229	554	490	18	290	1046	187	31	1243	152
Ideal Flow (vphpl)	1775	1900	1750	1775	1775	1775	1775	1900	1750	1775	1775	1775
Total Lost time (s)	4.0	6.0	6.0	4.0	6.0		4.0	6.0	4.0	4.0	6.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85	1.00	0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00		1.00	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1667	3570	1416	1649	3316		1738	3535	1442	1668	3238	
Flt Permitted	0.47	1.00	1.00	0.41	1.00		0.12	1.00	1.00	0.15	1.00	
Satd. Flow (perm)	816	3570	1416	718	3316		217	3535	1442	270	3238	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	136	340	229	554	490	18	290	1046	187	31	1243	152
RTOR Reduction (vph)	0	0	163	0	2	0	0	0	83	0	8	0
Lane Group Flow (vph)	136	340	66	554	506	0	290	1046	104	31	1387	0
Confl. Peds. (#/hr)	1		5	5		1	17					17
Heavy Vehicles (%)	0%	0%	2%	1%	0%	0%	1%	1%	2%	0%	1%	1%
Turn Type	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	pm+ov	pm+pt	NA	
Protected Phases	3	8		7	4		1	6	7	5	2	
Permitted Phases	8		8	4			6		6	2		
Actuated Green, G (s)	37.7	29.0	29.0	53.0	40.3		55.0	46.6	66.6	40.4	36.0	
Effective Green, g (s)	37.7	29.0	29.0	53.0	40.3		55.0	46.6	66.6	40.4	36.0	
Actuated g/C Ratio	0.31	0.24	0.24	0.44	0.34		0.46	0.39	0.55	0.34	0.30	
Clearance Time (s)	4.0	6.0	6.0	4.0	6.0		4.0	6.0	4.0	4.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	318	862	342	472	1113		289	1372	800	142	971	
v/s Ratio Prot	0.03	0.10		c0.20	0.15		c0.13	0.30	0.02	0.01	c0.43	
v/s Ratio Perm	0.10		0.05	c0.32			0.33		0.05	0.07		
v/c Ratio	0.43	0.39	0.19	1.17	0.45		1.00	0.76	0.13	0.22	1.43	
Uniform Delay, d1	30.7	38.1	36.2	29.7	31.2		29.3	31.9	12.8	28.0	42.0	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	0.87	1.07	
Incremental Delay, d2	0.9	0.3	0.3	98.6	0.3		53.8	4.1	0.1	0.3	195.3	
Delay (s)	31.7	38.4	36.5	128.3	31.5		83.1	35.9	12.9	24.6	240.3	
Level of Service	C	D	D	F	C		F	D	B	C	F	
Approach Delay (s)		36.5			82.0			42.1			235.6	
Approach LOS		D			F			D			F	

Intersection Summary			
HCM 2000 Control Delay	108.8	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.28		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	133.0%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	12	348	701	120	27	3
Future Volume (vph)	12	348	701	120	27	3
Ideal Flow (vphpl)	1650	1650	1650	1650	1765	1765
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor						
Frt			0.980		0.986	
Flt Protected		0.998			0.957	
Satd. Flow (prot)	0	1613	1599	0	1647	0
Flt Permitted		0.998			0.957	
Satd. Flow (perm)	0	1613	1599	0	1647	0
Link Speed (k/h)		60	60		60	
Link Distance (m)		291.4	304.6		335.6	
Travel Time (s)		17.5	18.3		20.1	
Confl. Peds. (#/hr)	1			1		
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	1%	0%	0%	0%	0%
Adj. Flow (vph)	12	348	701	120	27	3
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	360	821	0	30	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.5	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.21	1.21	1.21	1.21	1.12	1.12
Turning Speed (k/h)	24			14	24	14
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 60.9%		ICU Level of Service B	
Analysis Period (min) 15			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	12	348	701	120	27	3
Future Volume (Veh/h)	12	348	701	120	27	3
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	12	348	701	120	27	3
Pedestrians					1	
Lane Width (m)					3.5	
Walking Speed (m/s)					1.1	
Percent Blockage					0	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	822				1134	762
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	822				1134	762
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				88	99
cM capacity (veh/h)	816				223	408

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	360	821	30
Volume Left	12	0	27
Volume Right	0	120	3
cSH	816	1700	233
Volume to Capacity	0.01	0.48	0.13
Queue Length 95th (m)	0.3	0.0	3.3
Control Delay (s)	0.5	0.0	22.7
Lane LOS	A		C
Approach Delay (s)	0.5	0.0	22.7
Approach LOS			C

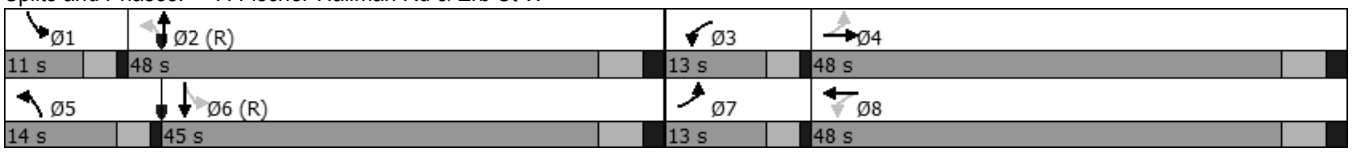
Intersection Summary			
Average Delay	0.7		
Intersection Capacity Utilization	60.9%	ICU Level of Service	B
Analysis Period (min)	15		

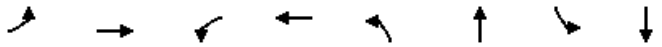
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	160	452	154	116	728	145	287	682	135	153	1000	245
Future Volume (vph)	160	452	154	116	728	145	287	682	135	153	1000	245
Ideal Flow (vphpl)	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775
Storage Length (m)	40.0		0.0	50.0		0.0	78.0		0.0	170.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	50.0			75.0			78.0			35.0		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	0.95	0.95	1.00	0.95	0.95
Ped Bike Factor	0.99	0.99		1.00	0.99			1.00		1.00	0.99	
Frt		0.962			0.975			0.975			0.970	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1668	3134	0	1635	3165	0	1668	3207	0	1619	3185	0
Flt Permitted	0.164			0.318			0.095			0.207		
Satd. Flow (perm)	285	3134	0	545	3165	0	167	3207	0	352	3185	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		43			21			21			27	
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		1168.2			343.1			1136.8			2051.4	
Travel Time (s)		70.1			20.6			68.2			123.1	
Confl. Peds. (#/hr)	48		14	14		48	19		12	12		19
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	2%	1%	2%	2%	1%	0%	1%	1%	3%	1%	1%
Adj. Flow (vph)	160	452	154	116	728	145	287	682	135	153	1000	245
Shared Lane Traffic (%)												
Lane Group Flow (vph)	160	606	0	116	873	0	287	817	0	153	1245	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8			2			6		
Detector Phase	7	4		3	8		5	2		1	6	
Switch Phase												
Minimum Initial (s)	5.0	42.0		5.0	42.0		5.0	39.0		5.0	39.0	
Minimum Split (s)	9.0	48.0		9.0	48.0		9.0	45.0		9.0	45.0	
Total Split (s)	13.0	48.0		13.0	48.0		14.0	48.0		11.0	45.0	
Total Split (%)	10.8%	40.0%		10.8%	40.0%		11.7%	40.0%		9.2%	37.5%	
Maximum Green (s)	9.0	42.0		9.0	42.0		10.0	42.0		7.0	39.0	
Yellow Time (s)	3.0	4.0		3.0	4.0		3.0	4.0		3.0	4.0	
All-Red Time (s)	1.0	2.0		1.0	2.0		1.0	2.0		1.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	4.0	6.0		4.0	6.0		4.0	6.0		4.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		None	C-Max		None	C-Max	
Walk Time (s)		20.0			20.0			24.0			24.0	
Flash Dont Walk (s)		22.0			22.0			15.0			15.0	
Pedestrian Calls (#/hr)		0			0			0			0	
Act Effct Green (s)	53.3	42.4		52.6	42.0		54.1	42.0		48.1	39.0	
Actuated g/C Ratio	0.44	0.35		0.44	0.35		0.45	0.35		0.40	0.32	
v/c Ratio	0.70	0.53		0.37	0.78		1.43	0.72		0.71	1.18	
Control Delay	36.5	30.8		21.4	39.8		242.5	50.4		33.1	122.2	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	36.5	30.8		21.4	39.8		242.5	50.4		33.1	122.2	
LOS	D	C		C	D		F	D		C	F	
Approach Delay		32.0			37.6			100.4			112.5	
Approach LOS		C			D			F			F	

Intersection Summary			
Area Type:	Other		
Cycle Length: 120			
Actuated Cycle Length: 120			
Offset: 15.6 (13%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 135			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 1.43			
Intersection Signal Delay: 77.5		Intersection LOS: E	
Intersection Capacity Utilization 116.5%		ICU Level of Service H	
Analysis Period (min) 15			

Splits and Phases: 7: Fischer-Hallman Rd & Erb St W





Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	160	606	116	873	287	817	153	1245
v/c Ratio	0.70	0.53	0.37	0.78	1.43	0.72	0.71	1.18
Control Delay	36.5	30.8	21.4	39.8	242.5	50.4	33.1	122.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	36.5	30.8	21.4	39.8	242.5	50.4	33.1	122.2
Queue Length 50th (m)	21.3	55.4	15.0	93.8	~76.4	102.3	23.3	~183.3
Queue Length 95th (m)	#38.3	73.3	26.2	118.6	m#129.7	121.4	m32.2	m#212.9
Internal Link Dist (m)		1144.2		319.1		1112.8		2027.4
Turn Bay Length (m)	40.0		50.0		78.0		170.0	
Base Capacity (vph)	230	1133	322	1121	201	1136	215	1053
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.70	0.53	0.36	0.78	1.43	0.72	0.71	1.18

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	160	452	154	116	728	145	287	682	135	153	1000	245
Future Volume (vph)	160	452	154	116	728	145	287	682	135	153	1000	245
Ideal Flow (vphpl)	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775
Total Lost time (s)	4.0	6.0		4.0	6.0		4.0	6.0		4.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.96		1.00	0.98		1.00	0.98		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1666	3134		1633	3166		1668	3208		1618	3186	
Flt Permitted	0.16	1.00		0.32	1.00		0.10	1.00		0.21	1.00	
Satd. Flow (perm)	288	3134		547	3166		168	3208		352	3186	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	160	452	154	116	728	145	287	682	135	153	1000	245
RTOR Reduction (vph)	0	28	0	0	14	0	0	14	0	0	18	0
Lane Group Flow (vph)	160	578	0	116	859	0	287	803	0	153	1227	0
Confl. Peds. (#/hr)	48		14	14		48	19		12	12		19
Heavy Vehicles (%)	0%	2%	1%	2%	2%	1%	0%	1%	1%	3%	1%	1%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	51.3	42.4		50.7	42.1		52.0	41.9		46.0	38.9	
Effective Green, g (s)	51.3	42.4		50.7	42.1		52.0	41.9		46.0	38.9	
Actuated g/C Ratio	0.43	0.35		0.42	0.35		0.43	0.35		0.38	0.32	
Clearance Time (s)	4.0	6.0		4.0	6.0		4.0	6.0		4.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	225	1107		308	1110		199	1120		209	1032	
v/s Ratio Prot	c0.05	0.18		0.03	c0.27		c0.12	0.25		0.04	0.39	
v/s Ratio Perm	0.25			0.13			c0.50			0.24		
v/c Ratio	0.71	0.52		0.38	0.77		1.44	0.72		0.73	1.19	
Uniform Delay, d1	24.3	30.8		22.1	34.7		32.9	33.9		27.6	40.5	
Progression Factor	1.00	1.00		1.00	1.00		1.36	1.43		0.79	0.87	
Incremental Delay, d2	10.1	0.4		0.8	3.4		218.0	2.8		9.6	92.6	
Delay (s)	34.4	31.2		22.9	38.1		262.7	51.2		31.5	127.9	
Level of Service	C	C		C	D		F	D		C	F	
Approach Delay (s)		31.9			36.4			106.2			117.3	
Approach LOS		C			D			F			F	

Intersection Summary			
HCM 2000 Control Delay	80.3	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.13		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	116.5%	ICU Level of Service	H
Analysis Period (min)	15		

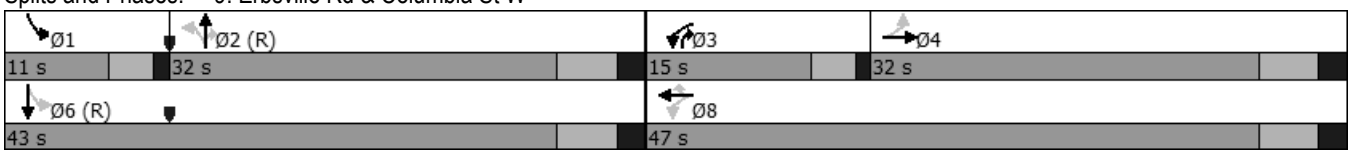
c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	153	336	138	568	333	375	72	435	214	235	525	112
Future Volume (vph)	153	336	138	568	333	375	72	435	214	235	525	112
Ideal Flow (vphpl)	1775	1650	1650	1775	1650	1650	1775	1900	1750	1775	1650	1650
Lane Width (m)	3.5	3.5	3.5	3.2	3.5	4.8	3.5	3.5	3.5	3.5	3.5	3.5
Storage Length (m)	80.0		0.0	145.0		45.0	60.0		0.0	140.0		0.0
Storage Lanes	1		0	1		1	1		1	1		0
Taper Length (m)	57.0			90.0			30.0			45.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor	1.00	1.00		1.00		0.98	1.00				0.99	
Frt		0.956				0.850			0.850		0.974	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1668	1521	0	1611	1600	1574	1668	1807	1414	1651	1562	0
Flt Permitted	0.560			0.150			0.227			0.197		
Satd. Flow (perm)	982	1521	0	254	1600	1540	397	1807	1414	342	1562	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		23				350			214		14	
Link Speed (k/h)		50			60			60			60	
Link Distance (m)		309.3			718.2			946.8			1422.7	
Travel Time (s)		22.3			43.1			56.8			85.4	
Confl. Peds. (#/hr)	1		2	2		1	7					7
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	3%	0%	0%	2%	1%	0%	4%	4%	1%	1%	2%
Adj. Flow (vph)	153	336	138	568	333	375	72	435	214	235	525	112
Shared Lane Traffic (%)												
Lane Group Flow (vph)	153	474	0	568	333	375	72	435	214	235	637	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.11	1.21	1.21	1.16	1.21	1.02	1.11	1.01	1.13	1.11	1.21	1.21
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2	1	1	2	1	1	2	
Detector Template	Left	Thru		Left	Thru	Right	Left	Thru	Right	Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5	6.1	6.1	30.5	6.1	6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8	6.1	6.1	1.8	6.1	6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		pm+pt	NA	Perm	Perm	NA	pm+ov	pm+pt	NA	
Protected Phases		4		3	8			2	3	1	6	
Permitted Phases	4			8		8	2		2	6		
Detector Phase	4	4		3	8	8	2	2	3	1	6	
Switch Phase												
Minimum Initial (s)	26.0	26.0		5.0	26.0	26.0	26.0	26.0	5.0	5.0	26.0	
Minimum Split (s)	32.0	32.0		9.0	32.0	32.0	32.0	32.0	9.0	9.0	32.0	
Total Split (s)	32.0	32.0		15.0	47.0	47.0	32.0	32.0	15.0	11.0	43.0	
Total Split (%)	35.6%	35.6%		16.7%	52.2%	52.2%	35.6%	35.6%	16.7%	12.2%	47.8%	
Maximum Green (s)	26.0	26.0		11.0	41.0	41.0	26.0	26.0	11.0	7.0	37.0	
Yellow Time (s)	4.0	4.0		3.0	4.0	4.0	4.0	4.0	3.0	3.0	4.0	
All-Red Time (s)	2.0	2.0		1.0	2.0	2.0	2.0	2.0	1.0	1.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	6.0	6.0		4.0	6.0	6.0	6.0	6.0	4.0	4.0	6.0	
Lead/Lag	Lag	Lag		Lead			Lag	Lag	Lead	Lead		
Lead-Lag Optimize?	Yes	Yes		Yes			Yes	Yes	Yes	Yes		
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None		None	None	None	C-Max	C-Max	None	None	C-Max	
Walk Time (s)	12.0	12.0			12.0	12.0	11.0	11.0			11.0	
Flash Dont Walk (s)	14.0	14.0			14.0	14.0	15.0	15.0			15.0	
Pedestrian Calls (#/hr)	0	0			0	0	0	0			0	
Act Effct Green (s)	26.0	26.0		43.0	41.0	41.0	26.0	26.0	43.0	39.0	37.0	
Actuated g/C Ratio	0.29	0.29		0.48	0.46	0.46	0.29	0.29	0.48	0.43	0.41	
v/c Ratio	0.54	1.04		1.98	0.46	0.42	0.63	0.83	0.27	0.94	0.98	
Control Delay	35.4	85.4		472.5	19.4	3.8	49.8	40.7	5.2	66.3	58.2	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	35.4	85.4		472.5	19.4	3.8	49.8	40.7	5.2	66.3	58.2	
LOS	D	F		F	B	A	D	D	A	E	E	
Approach Delay		73.2			216.5			31.1			60.4	
Approach LOS		E			F			C			E	

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 63 (70%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 135			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 1.98			
Intersection Signal Delay: 113.6		Intersection LOS: F	
Intersection Capacity Utilization 143.6%		ICU Level of Service H	
Analysis Period (min) 15			

Splits and Phases: 9: Erbsville Rd & Columbia St W



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	153	474	568	333	375	72	435	214	235	637
v/c Ratio	0.54	1.04	1.98	0.46	0.42	0.63	0.83	0.27	0.94	0.98
Control Delay	35.4	85.4	472.5	19.4	3.8	49.8	40.7	5.2	66.3	58.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	35.4	85.4	472.5	19.4	3.8	49.8	40.7	5.2	66.3	58.2
Queue Length 50th (m)	22.2	~86.5	~139.4	38.1	2.3	11.2	72.3	8.5	26.1	104.1
Queue Length 95th (m)	42.0	#144.8	#201.1	60.6	17.1	#31.9	#119.7	20.3	#65.4	#175.9
Internal Link Dist (m)		285.3		694.2			922.8			1398.7
Turn Bay Length (m)	80.0		145.0		45.0	60.0			140.0	
Base Capacity (vph)	283	455	287	728	892	114	522	787	250	650
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.54	1.04	1.98	0.46	0.42	0.63	0.83	0.27	0.94	0.98

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	153	336	138	568	333	375	72	435	214	235	525	112
Future Volume (vph)	153	336	138	568	333	375	72	435	214	235	525	112
Ideal Flow (vphpl)	1775	1650	1650	1775	1650	1650	1775	1900	1750	1775	1650	1650
Lane Width	3.5	3.5	3.5	3.2	3.5	4.8	3.5	3.5	3.5	3.5	3.5	3.5
Total Lost time (s)	6.0	6.0		4.0	6.0	6.0	6.0	6.0	4.0	4.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.98	1.00	1.00	1.00	1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.96		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1666	1522		1611	1600	1540	1661	1807	1414	1651	1561	
Flt Permitted	0.56	1.00		0.15	1.00	1.00	0.23	1.00	1.00	0.20	1.00	
Satd. Flow (perm)	982	1522		254	1600	1540	397	1807	1414	343	1561	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	153	336	138	568	333	375	72	435	214	235	525	112
RTOR Reduction (vph)	0	16	0	0	0	191	0	0	126	0	8	0
Lane Group Flow (vph)	153	458	0	568	333	184	72	435	88	235	629	0
Confl. Peds. (#/hr)	1		2	2		1	7					7
Heavy Vehicles (%)	0%	3%	0%	0%	2%	1%	0%	4%	4%	1%	1%	2%
Turn Type	Perm	NA		pm+pt	NA	Perm	Perm	NA	pm+ov	pm+pt	NA	
Protected Phases		4		3	8			2	3	1	6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)	26.0	26.0		41.0	41.0	41.0	26.0	26.0	37.0	37.0	37.0	
Effective Green, g (s)	26.0	26.0		41.0	41.0	41.0	26.0	26.0	37.0	37.0	37.0	
Actuated g/C Ratio	0.29	0.29		0.46	0.46	0.46	0.29	0.29	0.41	0.41	0.41	
Clearance Time (s)	6.0	6.0		4.0	6.0	6.0	6.0	6.0	4.0	4.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	283	439		281	728	701	114	522	581	242	641	
v/s Ratio Prot		0.30		c0.25	0.21			0.24	0.02	0.08	c0.40	
v/s Ratio Perm	0.16			c0.67		0.12	0.18		0.04	0.32		
v/c Ratio	0.54	1.04		2.02	0.46	0.26	0.63	0.83	0.15	0.97	0.98	
Uniform Delay, d1	27.0	32.0		21.7	16.9	15.2	27.8	30.0	16.6	23.9	26.2	
Progression Factor	1.00	1.00		1.00	1.00	1.00	0.83	0.85	2.11	1.00	1.00	
Incremental Delay, d2	2.1	54.4		472.0	0.5	0.2	22.6	13.8	0.1	49.5	31.2	
Delay (s)	29.1	86.4		493.7	17.3	15.4	45.6	39.2	35.3	73.4	57.3	
Level of Service	C	F		F	B	B	D	D	D	E	E	
Approach Delay (s)		72.4			228.8			38.7			61.7	
Approach LOS		E			F			D			E	

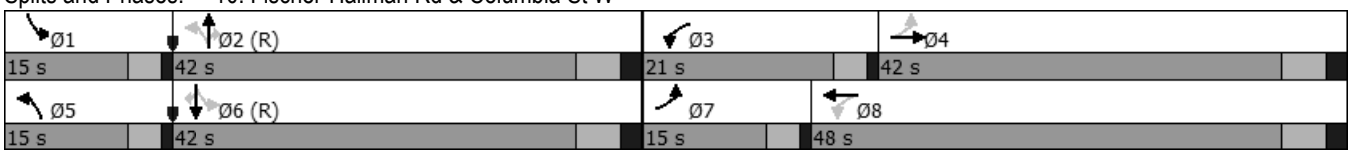
Intersection Summary			
HCM 2000 Control Delay	119.9	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.66		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	143.6%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	189	427	160	397	944	266	266	358	131	130	656	326
Future Volume (vph)	189	427	160	397	944	266	266	358	131	130	656	326
Ideal Flow (vphpl)	1775	1900	1750	1775	1900	1750	1775	1900	1750	1775	1900	1750
Lane Width (m)	3.0	3.4	3.4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Storage Length (m)	115.0		82.0	82.0		0.0	95.0		72.0	70.0		53.0
Storage Lanes	1		0	1		0	1		1	1		1
Taper Length (m)	73.0			100.0			36.0			33.0		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	0.95	1.00	1.00	0.95	1.00
Ped Bike Factor	1.00	1.00		1.00	0.99		0.99		0.98	1.00		0.96
Frt		0.959			0.967				0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1543	3311	0	1635	3411	0	1651	3570	1388	1588	3535	1456
Flt Permitted	0.111			0.265			0.241			0.496		
Satd. Flow (perm)	180	3311	0	455	3411	0	416	3570	1360	825	3535	1405
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		46			33				136			241
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		658.0			231.9			2051.4			968.6	
Travel Time (s)		39.5			13.9			123.1			58.1	
Confl. Peds. (#/hr)	23		6	6		23	24		8	8		24
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	2%	2%	1%	2%	0%	2%	1%	0%	6%	5%	1%	1%
Adj. Flow (vph)	189	427	160	397	944	266	266	358	131	130	656	326
Shared Lane Traffic (%)												
Lane Group Flow (vph)	189	587	0	397	1210	0	266	358	131	130	656	326
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.19	1.03	1.14	1.11	1.01	1.13	1.11	1.01	1.13	1.11	1.01	1.13
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2	1	1	2	1
Detector Template	Left	Thru		Left	Thru		Left	Thru	Right	Left	Thru	Right
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5	6.1	6.1	30.5	6.1
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8	6.1	6.1	1.8	6.1
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8			2		2	6		6
Detector Phase	7	4		3	8		5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	5.0	36.0		5.0	36.0		5.0	36.0	36.0	5.0	36.0	36.0
Minimum Split (s)	9.0	42.0		9.0	42.0		9.0	42.0	42.0	9.0	42.0	42.0
Total Split (s)	15.0	42.0		21.0	48.0		15.0	42.0	42.0	15.0	42.0	42.0
Total Split (%)	12.5%	35.0%		17.5%	40.0%		12.5%	35.0%	35.0%	12.5%	35.0%	35.0%
Maximum Green (s)	11.0	36.0		17.0	42.0		11.0	36.0	36.0	11.0	36.0	36.0
Yellow Time (s)	3.0	4.0		3.0	4.0		3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	2.0		1.0	2.0		1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0		4.0	6.0		4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes			Yes	Yes	Yes		
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None		None	None		None	C-Max	C-Max	None	C-Max	C-Max
Walk Time (s)		15.0			15.0			15.0	15.0		15.0	15.0
Flash Dont Walk (s)		21.0			21.0			21.0	21.0		21.0	21.0
Pedestrian Calls (#/hr)		0			0			0	0		0	0
Act Effct Green (s)	49.0	36.0		59.0	42.0		49.9	36.9	36.9	48.1	36.0	36.0
Actuated g/C Ratio	0.41	0.30		0.49	0.35		0.42	0.31	0.31	0.40	0.30	0.30
v/c Ratio	0.95	0.57		1.02	1.00		0.93	0.33	0.26	0.33	0.62	0.55
Control Delay	83.8	35.1		74.7	63.0		79.1	55.7	24.0	23.0	39.2	13.4
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	83.8	35.1		74.7	63.0		79.1	55.7	24.0	23.0	39.2	13.4
LOS	F	D		E	E		E	E	C	C	D	B
Approach Delay		47.0			65.9			58.5			29.7	
Approach LOS		D			E			E			C	

Intersection Summary			
Area Type:	Other		
Cycle Length: 120			
Actuated Cycle Length: 120			
Offset: 98.4 (82%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 115			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 1.02			
Intersection Signal Delay: 51.7		Intersection LOS: D	
Intersection Capacity Utilization 116.0%		ICU Level of Service H	
Analysis Period (min) 15			

Splits and Phases: 10: Fischer-Hallman Rd & Columbia St W



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	189	587	397	1210	266	358	131	130	656	326
v/c Ratio	0.95	0.57	1.02	1.00	0.93	0.33	0.26	0.33	0.62	0.55
Control Delay	83.8	35.1	74.7	63.0	79.1	55.7	24.0	23.0	39.2	13.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	83.8	35.1	74.7	63.0	79.1	55.7	24.0	23.0	39.2	13.4
Queue Length 50th (m)	30.4	56.5	~62.8	145.6	59.7	45.2	13.1	18.3	69.7	14.9
Queue Length 95th (m)	#75.8	74.9	#119.3	#194.6	m#78.0	m59.2	m20.5	31.2	89.3	43.3
Internal Link Dist (m)		634.0		207.9		2027.4			944.6	
Turn Bay Length (m)	115.0		82.0		95.0		72.0	70.0		53.0
Base Capacity (vph)	198	1025	390	1215	286	1098	512	406	1060	590
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.95	0.57	1.02	1.00	0.93	0.33	0.26	0.32	0.62	0.55

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	189	427	160	397	944	266	266	358	131	130	656	326
Future Volume (vph)	189	427	160	397	944	266	266	358	131	130	656	326
Ideal Flow (vphpl)	1775	1900	1750	1775	1900	1750	1775	1900	1750	1775	1900	1750
Lane Width	3.0	3.4	3.4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Total Lost time (s)	4.0	6.0		4.0	6.0		4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	0.99		1.00	1.00	0.98	1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.96		1.00	0.97		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1543	3312		1634	3411		1648	3570	1360	1585	3535	1405
Flt Permitted	0.11	1.00		0.26	1.00		0.24	1.00	1.00	0.50	1.00	1.00
Satd. Flow (perm)	180	3312		455	3411		418	3570	1360	827	3535	1405
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	189	427	160	397	944	266	266	358	131	130	656	326
RTOR Reduction (vph)	0	32	0	0	21	0	0	0	91	0	0	169
Lane Group Flow (vph)	189	555	0	397	1189	0	266	358	40	130	656	157
Confl. Peds. (#/hr)	23		6	6		23	24		8	8		24
Heavy Vehicles (%)	2%	2%	1%	2%	0%	2%	1%	0%	6%	5%	1%	1%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8			2		2	6		6
Actuated Green, G (s)	47.0	36.0		57.0	42.0		47.9	36.9	36.9	46.1	36.0	36.0
Effective Green, g (s)	47.0	36.0		57.0	42.0		47.9	36.9	36.9	46.1	36.0	36.0
Actuated g/C Ratio	0.39	0.30		0.48	0.35		0.40	0.31	0.31	0.38	0.30	0.30
Clearance Time (s)	4.0	6.0		4.0	6.0		4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	195	993		383	1193		279	1097	418	381	1060	421
v/s Ratio Prot	0.09	0.17		c0.15	0.35		c0.09	0.10		0.03	0.19	
v/s Ratio Perm	0.29			c0.35			c0.29		0.03	0.10		0.11
v/c Ratio	0.97	0.56		1.04	1.00		0.95	0.33	0.10	0.34	0.62	0.37
Uniform Delay, d1	31.1	35.3		25.8	38.9		30.7	32.0	29.7	24.8	36.1	33.1
Progression Factor	1.00	1.00		1.00	1.00		2.04	1.70	4.77	1.00	1.00	1.00
Incremental Delay, d2	54.9	0.7		55.8	25.0		32.2	0.5	0.3	0.5	2.7	2.5
Delay (s)	85.9	36.0		81.6	63.9		94.7	54.9	141.8	25.4	38.8	35.6
Level of Service	F	D		F	E		F	D	F	C	D	D
Approach Delay (s)		48.2			68.3			84.0			36.3	
Approach LOS		D			E			F			D	

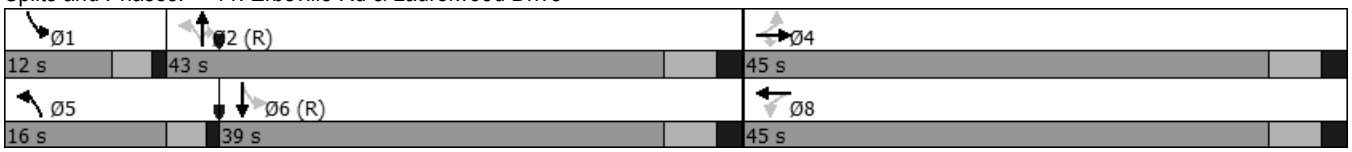
Intersection Summary			
HCM 2000 Control Delay	59.0	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	116.0%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	20	89	167	146	187	85	233	346	132	59	413	30
Future Volume (vph)	20	89	167	146	187	85	233	346	132	59	413	30
Ideal Flow (vphpl)	1775	1900	1750	1775	1650	1650	1775	1900	1750	1775	1650	1650
Storage Length (m)	27.0		0.0	20.0		0.0	65.0		29.0	19.0		0.0
Storage Lanes	1		1	1		0	1		1	1		0
Taper Length (m)	22.0			18.0			73.0			49.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor	0.95		0.95	0.97	0.97		0.99		0.95	0.98	1.00	
Frt			0.850		0.953				0.850		0.990	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1588	1789	1401	1668	1481	0	1619	1807	1456	1668	1590	0
Flt Permitted	0.390			0.699			0.371			0.553		
Satd. Flow (perm)	622	1789	1327	1191	1481	0	626	1807	1388	956	1590	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			167		27				105		4	
Link Speed (k/h)		50			50			60			60	
Link Distance (m)		270.4			1189.4			1422.7			1517.5	
Travel Time (s)		19.5			85.6			85.4			91.1	
Confl. Peds. (#/hr)	56		26	26		56	17		18	18		17
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	5%	5%	5%	0%	3%	0%	3%	4%	1%	0%	1%	5%
Adj. Flow (vph)	20	89	167	146	187	85	233	346	132	59	413	30
Shared Lane Traffic (%)												
Lane Group Flow (vph)	20	89	167	146	272	0	233	346	132	59	443	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.11	1.01	1.13	1.11	1.21	1.21	1.11	1.01	1.13	1.11	1.21	1.21
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2	1	1	2		1	2	1	1	2	
Detector Template	Left	Thru	Right	Left	Thru		Left	Thru	Right	Left	Thru	
Leading Detector (m)	6.1	30.5	6.1	6.1	30.5		6.1	30.5	6.1	6.1	30.5	
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Size(m)	6.1	1.8	6.1	6.1	1.8		6.1	1.8	6.1	6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Perm	NA	Perm	Perm	NA		pm+pt	NA	Perm	pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8			2		2	6		
Detector Phase	4	4	4	8	8		5	2	2	1	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0		5.0	33.0	33.0	5.0	33.0	
Minimum Split (s)	45.0	45.0	45.0	45.0	45.0		9.0	39.0	39.0	9.0	39.0	
Total Split (s)	45.0	45.0	45.0	45.0	45.0		16.0	43.0	43.0	12.0	39.0	
Total Split (%)	45.0%	45.0%	45.0%	45.0%	45.0%		16.0%	43.0%	43.0%	12.0%	39.0%	
Maximum Green (s)	39.0	39.0	39.0	39.0	39.0		12.0	37.0	37.0	8.0	33.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		3.0	4.0	4.0	3.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		1.0	2.0	2.0	1.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0		4.0	6.0	6.0	4.0	6.0	
Lead/Lag							Lead	Lag	Lag	Lead	Lag	
Lead-Lag Optimize?							Yes	Yes	Yes	Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None	None	None	None		None	C-Max	C-Max	None	C-Max	
Walk Time (s)	15.0	15.0	15.0	15.0	15.0			15.0	15.0		15.0	
Flash Dont Walk (s)	24.0	24.0	24.0	24.0	24.0			18.0	18.0		18.0	
Pedestrian Calls (#/hr)	0	0	0	0	0			0	0		0	
Act Effct Green (s)	22.7	22.7	22.7	22.7	22.7		67.1	56.3	56.3	58.6	49.7	
Actuated g/C Ratio	0.23	0.23	0.23	0.23	0.23		0.67	0.56	0.56	0.59	0.50	
v/c Ratio	0.14	0.22	0.39	0.54	0.76		0.44	0.34	0.16	0.10	0.56	
Control Delay	29.7	30.3	7.0	40.0	45.4		10.2	15.5	5.2	8.3	24.0	
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Delay	29.7	30.3	7.0	40.0	45.4		10.2	15.5	5.2	8.3	24.0	
LOS	C	C	A	D	D		B	B	A	A	C	
Approach Delay		16.2			43.5			11.9			22.1	
Approach LOS		B			D			B			C	

Intersection Summary			
Area Type:	Other		
Cycle Length: 100			
Actuated Cycle Length: 100			
Offset: 64.8 (65%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 95			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.76			
Intersection Signal Delay: 22.1		Intersection LOS: C	
Intersection Capacity Utilization 85.0%		ICU Level of Service E	
Analysis Period (min) 15			

Splits and Phases: 11: Erbsville Rd & Laurelwood Drive



Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	20	89	167	146	272	233	346	132	59	443
v/c Ratio	0.14	0.22	0.39	0.54	0.76	0.44	0.34	0.16	0.10	0.56
Control Delay	29.7	30.3	7.0	40.0	45.4	10.2	15.5	5.2	8.3	24.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.7	30.3	7.0	40.0	45.4	10.2	15.5	5.2	8.3	24.0
Queue Length 50th (m)	3.1	14.2	0.0	25.1	44.9	15.2	35.3	2.3	3.4	55.8
Queue Length 95th (m)	8.4	23.6	14.0	39.1	64.5	33.5	69.3	13.5	10.0	#124.0
Internal Link Dist (m)		246.4			1165.4		1398.7			1493.5
Turn Bay Length (m)	27.0			20.0		65.0		29.0	19.0	
Base Capacity (vph)	242	697	619	464	594	552	1017	827	630	793
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.08	0.13	0.27	0.31	0.46	0.42	0.34	0.16	0.09	0.56

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	20	89	167	146	187	85	233	346	132	59	413	30
Future Volume (vph)	20	89	167	146	187	85	233	346	132	59	413	30
Ideal Flow (vphpl)	1775	1900	1750	1775	1650	1650	1775	1900	1750	1775	1650	1650
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0		4.0	6.0	6.0	4.0	6.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00	0.95	1.00	0.97		1.00	1.00	0.95	1.00	1.00	
Flpb, ped/bikes	0.96	1.00	1.00	0.97	1.00		1.00	1.00	1.00	0.99	1.00	
Frt	1.00	1.00	0.85	1.00	0.95		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1518	1789	1327	1618	1481		1613	1807	1388	1653	1590	
Flt Permitted	0.39	1.00	1.00	0.70	1.00		0.37	1.00	1.00	0.55	1.00	
Satd. Flow (perm)	622	1789	1327	1191	1481		629	1807	1388	962	1590	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	20	89	167	146	187	85	233	346	132	59	413	30
RTOR Reduction (vph)	0	0	129	0	21	0	0	0	47	0	2	0
Lane Group Flow (vph)	20	89	38	146	251	0	233	346	85	59	441	0
Confl. Peds. (#/hr)	56		26	26		56	17		18	18		17
Heavy Vehicles (%)	5%	5%	5%	0%	3%	0%	3%	4%	1%	0%	1%	5%
Turn Type	Perm	NA	Perm	Perm	NA		pm+pt	NA	Perm	pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8			2		2	6		
Actuated Green, G (s)	22.7	22.7	22.7	22.7	22.7		65.3	55.6	55.6	55.5	49.8	
Effective Green, g (s)	22.7	22.7	22.7	22.7	22.7		65.3	55.6	55.6	55.5	49.8	
Actuated g/C Ratio	0.23	0.23	0.23	0.23	0.23		0.65	0.56	0.56	0.56	0.50	
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0		4.0	6.0	6.0	4.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	141	406	301	270	336		523	1004	771	573	791	
v/s Ratio Prot		0.05			c0.17		c0.05	0.19		0.01	c0.28	
v/s Ratio Perm	0.03		0.03	0.12			0.24		0.06	0.05		
v/c Ratio	0.14	0.22	0.13	0.54	0.75		0.45	0.34	0.11	0.10	0.56	
Uniform Delay, d1	30.9	31.4	30.8	34.1	36.0		8.5	12.2	10.5	10.3	17.4	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.5	0.3	0.2	2.2	8.8		0.6	0.9	0.3	0.1	2.8	
Delay (s)	31.3	31.7	30.9	36.3	44.8		9.1	13.1	10.8	10.3	20.3	
Level of Service	C	C	C	D	D		A	B	B	B	C	
Approach Delay (s)		31.2			41.8			11.4			19.1	
Approach LOS		C			D			B			B	

Intersection Summary			
HCM 2000 Control Delay	22.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	85.0%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

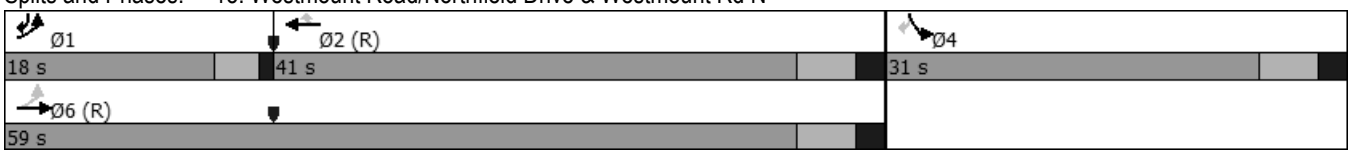


Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	348	671	1150	353	195	330
Future Volume (vph)	348	671	1150	353	195	330
Ideal Flow (vphpl)	1775	1900	1900	1750	1775	1750
Storage Length (m)	94.0			33.0	75.0	0.0
Storage Lanes	1			1	1	1
Taper Length (m)	87.0				25.0	
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	1.00
Ped Bike Factor	1.00			0.98		
Frt				0.850		0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1668	3570	3570	1471	1668	1471
Flt Permitted	0.103				0.950	
Satd. Flow (perm)	181	3570	3570	1440	1668	1471
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)				204		19
Link Speed (k/h)		60	60		50	
Link Distance (m)		839.6	240.7		534.1	
Travel Time (s)		50.4	14.4		38.5	
Confl. Peds. (#/hr)	1			1		
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	348	671	1150	353	195	330
Shared Lane Traffic (%)						
Lane Group Flow (vph)	348	671	1150	353	195	330
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.5	3.5		3.5	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.11	1.01	1.01	1.13	1.11	1.13
Turning Speed (k/h)	24			14	24	14
Number of Detectors	1	2	2	1	1	1
Detector Template	Left	Thru	Thru	Right	Left	Right
Leading Detector (m)	6.1	30.5	30.5	6.1	6.1	6.1
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	6.1	1.8	1.8	6.1	6.1	6.1
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		28.7	28.7			
Detector 2 Size(m)		1.8	1.8			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Turn Type	pm+pt	NA	NA	Perm	Prot	pm+ov
Protected Phases	1	6	2		4	1
Permitted Phases	6			2		4
Detector Phase	1	6	2	2	4	1
Switch Phase						
Minimum Initial (s)	5.0	30.0	30.0	30.0	7.0	5.0
Minimum Split (s)	9.0	41.0	41.0	41.0	31.0	9.0
Total Split (s)	18.0	59.0	41.0	41.0	31.0	18.0
Total Split (%)	20.0%	65.6%	45.6%	45.6%	34.4%	20.0%
Maximum Green (s)	14.0	53.0	35.0	35.0	25.0	14.0
Yellow Time (s)	3.0	4.0	4.0	4.0	4.0	3.0
All-Red Time (s)	1.0	2.0	2.0	2.0	2.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	6.0	6.0	6.0	4.0
Lead/Lag	Lead		Lag	Lag		Lead
Lead-Lag Optimize?	Yes		Yes	Yes		Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	C-Max	C-Max	C-Max	Max	None
Walk Time (s)		26.0	26.0	26.0	7.0	
Flash Dont Walk (s)		9.0	9.0	9.0	18.0	
Pedestrian Calls (#/hr)		0	0	0	0	
Act Effct Green (s)	55.0	53.0	35.0	35.0	25.0	45.0
Actuated g/C Ratio	0.61	0.59	0.39	0.39	0.28	0.50
v/c Ratio	1.02	0.32	0.83	0.52	0.42	0.44
Control Delay	79.3	9.9	31.2	11.5	30.0	15.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	79.3	9.9	31.2	11.5	30.0	15.9
LOS	E	A	C	B	C	B
Approach Delay		33.6	26.5		21.1	
Approach LOS		C	C		C	

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 6.3 (7%), Referenced to phase 2:WBT and 6:EBTL, Start of Green			
Natural Cycle: 85			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 1.02			
Intersection Signal Delay: 28.0		Intersection LOS: C	
Intersection Capacity Utilization 77.3%		ICU Level of Service D	
Analysis Period (min) 15			

Splits and Phases: 15: Westmount Road/Northfield Drive & Westmount Rd N





Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Group Flow (vph)	348	671	1150	353	195	330
v/c Ratio	1.02	0.32	0.83	0.52	0.42	0.44
Control Delay	79.3	9.9	31.2	11.5	30.0	15.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	79.3	9.9	31.2	11.5	30.0	15.9
Queue Length 50th (m)	~46.7	28.4	92.4	17.2	27.5	32.7
Queue Length 95th (m)	#100.8	38.2	118.6	41.5	46.8	53.8
Internal Link Dist (m)		815.6	216.7		510.1	
Turn Bay Length (m)	94.0			33.0	75.0	
Base Capacity (vph)	341	2102	1388	684	463	745
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	1.02	0.32	0.83	0.52	0.42	0.44

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	348	671	1150	353	195	330
Future Volume (vph)	348	671	1150	353	195	330
Ideal Flow (vphpl)	1775	1900	1900	1750	1775	1750
Total Lost time (s)	4.0	6.0	6.0	6.0	6.0	4.0
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00	0.98	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1667	3570	3570	1440	1668	1471
Flt Permitted	0.10	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	180	3570	3570	1440	1668	1471
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	348	671	1150	353	195	330
RTOR Reduction (vph)	0	0	0	125	0	11
Lane Group Flow (vph)	348	671	1150	228	195	319
Confl. Peds. (#/hr)	1			1		
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%
Turn Type	pm+pt	NA	NA	Perm	Prot	pm+ov
Protected Phases	1	6	2		4	1
Permitted Phases	6			2		4
Actuated Green, G (s)	53.0	53.0	35.0	35.0	25.0	39.0
Effective Green, g (s)	53.0	53.0	35.0	35.0	25.0	39.0
Actuated g/C Ratio	0.59	0.59	0.39	0.39	0.28	0.43
Clearance Time (s)	4.0	6.0	6.0	6.0	6.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	337	2102	1388	560	463	637
v/s Ratio Prot	c0.16	0.19	0.32		0.12	c0.08
v/s Ratio Perm	c0.45			0.16		0.14
v/c Ratio	1.03	0.32	0.83	0.41	0.42	0.50
Uniform Delay, d1	26.3	9.4	24.8	20.0	26.6	18.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	57.7	0.4	5.8	2.2	2.8	0.6
Delay (s)	84.0	9.8	30.6	22.2	29.4	19.1
Level of Service	F	A	C	C	C	B
Approach Delay (s)		35.1	28.6		22.9	
Approach LOS		D	C		C	

Intersection Summary			
HCM 2000 Control Delay	29.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	77.3%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	162	11	35	39	1	17
Future Volume (vph)	162	11	35	39	1	17
Ideal Flow (vphpl)	1765	1765	1650	1650	1650	1650
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.991		0.929			
Flt Protected	0.955					0.997
Satd. Flow (prot)	1510	0	1454	0	0	1627
Flt Permitted	0.955					0.997
Satd. Flow (perm)	1510	0	1454	0	0	1627
Link Speed (k/h)	70		60			60
Link Distance (m)	860.7		462.9			376.8
Travel Time (s)	44.3		27.8			22.6
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	10%	0%	9%	0%	0%	0%
Adj. Flow (vph)	162	11	35	39	1	17
Shared Lane Traffic (%)						
Lane Group Flow (vph)	173	0	74	0	0	18
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Right	Left	Left
Median Width(m)	3.5		0.0			0.0
Link Offset(m)	0.0		0.0			0.0
Crosswalk Width(m)	1.6		1.6			1.6
Two way Left Turn Lane						
Headway Factor	1.12	1.12	1.21	1.21	1.21	1.21
Turning Speed (k/h)	24	14		14	24	
Sign Control	Stop		Free			Free

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 21.9%		ICU Level of Service A	
Analysis Period (min) 15			



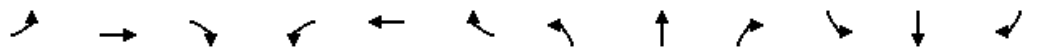
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	162	11	35	39	1	17
Future Volume (Veh/h)	162	11	35	39	1	17
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	162	11	35	39	1	17
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	74	54			74	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	74	54			74	
tC, single (s)	6.5	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.6	3.3			2.2	
p0 queue free %	82	99			100	
cM capacity (veh/h)	910	1018			1538	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	173	74	18
Volume Left	162	0	1
Volume Right	11	39	0
cSH	916	1700	1538
Volume to Capacity	0.19	0.04	0.00
Queue Length 95th (m)	5.3	0.0	0.0
Control Delay (s)	9.8	0.0	0.4
Lane LOS	A		A
Approach Delay (s)	9.8	0.0	0.4
Approach LOS	A		

Intersection Summary			
Average Delay	6.5		
Intersection Capacity Utilization	21.9%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	3	31	9	150	117	45	25	222	135	57	276	39
Future Volume (vph)	3	31	9	150	117	45	25	222	135	57	276	39
Ideal Flow (vphpl)	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550
Storage Length (m)	0.0		0.0	30.0		0.0	0.0		0.0	0.0		0.0
Storage Lanes	0		0	1		0	0		0	0		0
Taper Length (m)	2.5			45.0			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.972			0.958			0.952			0.986	
Flt Protected		0.997		0.950				0.997			0.992	
Satd. Flow (prot)	0	1426	0	1456	1460	0	0	1382	0	0	1488	0
Flt Permitted		0.997		0.950				0.997			0.992	
Satd. Flow (perm)	0	1426	0	1456	1460	0	0	1382	0	0	1488	0
Link Speed (k/h)		70			70			60			60	
Link Distance (m)		610.1			3203.9			1517.5			172.2	
Travel Time (s)		31.4			164.8			91.1			10.3	
Confl. Peds. (#/hr)			1	1			1					1
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	20%	0%	0%	2%	17%	6%	2%	0%	1%	0%
Adj. Flow (vph)	3	31	9	150	117	45	25	222	135	57	276	39
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	43	0	150	162	0	0	382	0	0	372	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	66.6%	ICU Level of Service	C
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	3	31	9	150	117	45	25	222	135	57	276	39
Future Volume (vph)	3	31	9	150	117	45	25	222	135	57	276	39
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	3	31	9	150	117	45	25	222	135	57	276	39

Direction, Lane #	EB 1	WB 1	WB 2	NB 1	SB 1
Volume Total (vph)	43	150	162	382	372
Volume Left (vph)	3	150	0	25	57
Volume Right (vph)	9	0	45	135	39
Hadj (s)	-0.04	0.50	-0.18	-0.11	-0.02
Departure Headway (s)	6.8	7.1	6.4	5.5	5.6
Degree Utilization, x	0.08	0.30	0.29	0.58	0.58
Capacity (veh/h)	426	467	517	622	616
Control Delay (s)	10.4	11.9	10.9	15.9	16.0
Approach Delay (s)	10.4	11.4		15.9	16.0
Approach LOS	B	B		C	C

Intersection Summary				
Delay	14.5			
Level of Service	B			
Intersection Capacity Utilization	66.6%	ICU Level of Service	C	
Analysis Period (min)	15			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	138	20	162	50	74	17	300	375	25	10	259	125
Future Volume (vph)	138	20	162	50	74	17	300	375	25	10	259	125
Ideal Flow (vphpl)	1650	1650	1750	1550	1550	1550	1775	1650	1650	1550	1550	1550
Storage Length (m)	0.0		65.0	0.0		0.0	35.0		0.0	0.0		0.0
Storage Lanes	0		1	0		0	1		0	0		0
Taper Length (m)	2.5			2.5			25.0			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850		0.984			0.991			0.957	
Flt Protected		0.958			0.983		0.950				0.999	
Satd. Flow (prot)	0	1563	1442	0	1423	0	1651	1617	0	0	1458	0
Flt Permitted		0.958			0.983		0.950				0.999	
Satd. Flow (perm)	0	1563	1442	0	1423	0	1651	1617	0	0	1458	0
Link Speed (k/h)		70			50			50			50	
Link Distance (m)		3203.9			162.1			534.1			164.9	
Travel Time (s)		164.8			11.7			38.5			11.9	
Confl. Peds. (#/hr)			2	2			2		1	1		2
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	2%	0%	8%	0%	1%	0%	0%	20%	0%	0%
Adj. Flow (vph)	138	20	162	50	74	17	300	375	25	10	259	125
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	158	162	0	141	0	300	400	0	0	394	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.21	1.21	1.13	1.31	1.31	1.31	1.11	1.21	1.21	1.31	1.31	1.31
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 78.0%		ICU Level of Service D	
Analysis Period (min) 15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	138	20	162	50	74	17	300	375	25	10	259	125
Future Volume (vph)	138	20	162	50	74	17	300	375	25	10	259	125
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	138	20	162	50	74	17	300	375	25	10	259	125

Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2	SB 1
Volume Total (vph)	158	162	141	300	400	394
Volume Left (vph)	138	0	50	300	0	10
Volume Right (vph)	0	162	17	0	25	125
Hadj (s)	0.44	-0.67	0.07	0.52	-0.04	-0.18
Departure Headway (s)	8.5	7.4	8.6	7.7	7.1	7.2
Degree Utilization, x	0.37	0.33	0.34	0.64	0.79	0.79
Capacity (veh/h)	390	457	367	456	497	486
Control Delay (s)	15.3	12.8	16.0	22.0	30.3	32.1
Approach Delay (s)	14.0		16.0	26.8		32.1
Approach LOS	B		C	D		D

Intersection Summary			
Delay	24.5		
Level of Service	C		
Intersection Capacity Utilization	78.0%	ICU Level of Service	D
Analysis Period (min)	15		

APPENDIX

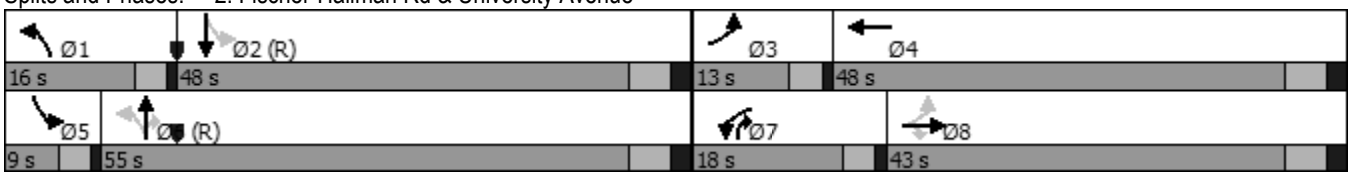
B-3 *2031 CONDITIONS – WITH RECOMMENDED IMPROVEMENTS*

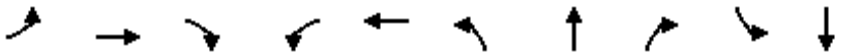
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	196	577	246	115	142	14	191	1039	443	25	843	75
Future Volume (vph)	196	577	246	115	142	14	191	1039	443	25	843	75
Ideal Flow (vphpl)	1775	1900	1750	1775	1775	1775	1775	1900	1750	1775	1775	1775
Storage Length (m)	35.0		35.0	100.0		0.0	80.0		125.0	50.0		0.0
Storage Lanes	1		1	2		0	1		1	1		0
Taper Length (m)	30.0			65.0			30.0			60.0		
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	0.95	1.00	0.95	1.00	1.00	0.95	0.95
Ped Bike Factor			0.98	0.99			1.00				1.00	
Frt			0.850		0.987				0.850		0.988	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1668	3535	1428	3141	3174	0	1619	3466	1456	1668	3205	0
Flt Permitted	0.653			0.950			0.119			0.143		
Satd. Flow (perm)	1146	3535	1395	3115	3174	0	203	3466	1456	251	3205	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			186		9				157		8	
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		701.9			786.3			349.5			1136.8	
Travel Time (s)		42.1			47.2			21.0			68.2	
Confl. Peds. (#/hr)			11	11			5					5
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	1%	3%	3%	3%	11%	3%	3%	1%	0%	2%	10%
Adj. Flow (vph)	196	577	246	115	142	14	191	1039	443	25	843	75
Shared Lane Traffic (%)												
Lane Group Flow (vph)	196	577	246	115	156	0	191	1039	443	25	918	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		7.0			7.0			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.11	1.01	1.13	1.11	1.11	1.11	1.11	1.01	1.13	1.11	1.11	1.11
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type	pm+pt	NA	Perm	Prot	NA		pm+pt	NA	pm+ov	pm+pt	NA	
Protected Phases	3	8		7	4		1	6	7	5	2	
Permitted Phases	8		8				6		6	2		
Minimum Split (s)	9.0	43.0	43.0	9.0	43.0		9.0	45.0	9.0	9.0	45.0	
Total Split (s)	13.0	43.0	43.0	18.0	48.0		16.0	55.0	18.0	9.0	48.0	
Total Split (%)	10.4%	34.4%	34.4%	14.4%	38.4%		12.8%	44.0%	14.4%	7.2%	38.4%	
Maximum Green (s)	9.0	37.0	37.0	14.0	42.0		12.0	49.0	14.0	5.0	42.0	
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0		3.0	4.0	3.0	3.0	4.0	
All-Red Time (s)	1.0	2.0	2.0	1.0	2.0		1.0	2.0	1.0	1.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	4.0	6.0	6.0	4.0	6.0		4.0	6.0	4.0	4.0	6.0	
Lead/Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lead	Lead	Lag	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	
Walk Time (s)		15.0	15.0		15.0			14.0			14.0	
Flash Dont Walk (s)		22.0	22.0		22.0			25.0			25.0	
Pedestrian Calls (#/hr)		0	0		0			0			0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Act Effct Green (s)	48.0	37.0	37.0	14.0	42.0		60.0	49.0	69.0	49.0	42.0	
Actuated g/C Ratio	0.38	0.30	0.30	0.11	0.34		0.48	0.39	0.55	0.39	0.34	
v/c Ratio	0.41	0.55	0.45	0.33	0.15		0.82	0.77	0.51	0.16	0.85	
Control Delay	25.5	39.4	12.5	54.0	27.7		50.3	37.6	12.9	20.2	47.0	
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Delay	25.5	39.4	12.5	54.0	27.7		50.3	37.6	12.9	20.2	47.0	
LOS	C	D	B	D	C		D	D	B	C	D	
Approach Delay		30.2			38.9			32.5			46.2	
Approach LOS		C			D			C			D	

Intersection Summary			
Area Type:	Other		
Cycle Length: 125			
Actuated Cycle Length: 125			
Offset: 42 (34%), Referenced to phase 2:SBTL and 6:NBTL, Start of Green			
Natural Cycle: 110			
Control Type: Pretimed			
Maximum v/c Ratio: 0.85			
Intersection Signal Delay: 35.7		Intersection LOS: D	
Intersection Capacity Utilization 103.0%		ICU Level of Service G	
Analysis Period (min) 15			

Splits and Phases: 2: Fischer-Hallman Rd & University Avenue





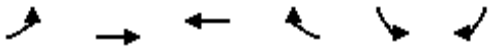
Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	196	577	246	115	156	191	1039	443	25	918
v/c Ratio	0.41	0.55	0.45	0.33	0.15	0.82	0.77	0.51	0.16	0.85
Control Delay	25.5	39.4	12.5	54.0	27.7	50.3	37.6	12.9	20.2	47.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	25.5	39.4	12.5	54.0	27.7	50.3	37.6	12.9	20.2	47.0
Queue Length 50th (m)	29.1	62.7	10.9	13.6	13.2	27.0	115.5	40.6	3.2	109.0
Queue Length 95th (m)	45.6	81.0	33.7	22.9	21.2	#64.3	141.3	67.4	8.0	135.8
Internal Link Dist (m)		677.9			762.3		325.5			1112.8
Turn Bay Length (m)	35.0		35.0	100.0		80.0		125.0	50.0	
Base Capacity (vph)	477	1046	543	351	1072	233	1358	874	155	1082
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.41	0.55	0.45	0.33	0.15	0.82	0.77	0.51	0.16	0.85

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

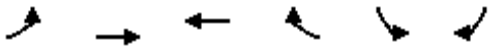
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	196	577	246	115	142	14	191	1039	443	25	843	75
Future Volume (vph)	196	577	246	115	142	14	191	1039	443	25	843	75
Ideal Flow (vphpl)	1775	1900	1750	1775	1775	1775	1775	1900	1750	1775	1775	1775
Total Lost time (s)	4.0	6.0	6.0	4.0	6.0		4.0	6.0	4.0	4.0	6.0	
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95		1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1668	3535	1395	3141	3172		1619	3466	1456	1668	3205	
Flt Permitted	0.65	1.00	1.00	0.95	1.00		0.12	1.00	1.00	0.14	1.00	
Satd. Flow (perm)	1146	3535	1395	3141	3172		202	3466	1456	252	3205	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	196	577	246	115	142	14	191	1039	443	25	843	75
RTOR Reduction (vph)	0	0	131	0	6	0	0	0	78	0	5	0
Lane Group Flow (vph)	196	577	115	115	150	0	191	1039	365	25	913	0
Confl. Peds. (#/hr)			11	11			5					5
Heavy Vehicles (%)	0%	1%	3%	3%	3%	11%	3%	3%	1%	0%	2%	10%
Turn Type	pm+pt	NA	Perm	Prot	NA		pm+pt	NA	pm+ov	pm+pt	NA	
Protected Phases	3	8		7	4		1	6	7	5	2	
Permitted Phases	8		8				6		6	2		
Actuated Green, G (s)	46.0	37.0	37.0	14.0	42.0		58.0	49.0	63.0	47.0	42.0	
Effective Green, g (s)	46.0	37.0	37.0	14.0	42.0		58.0	49.0	63.0	47.0	42.0	
Actuated g/C Ratio	0.37	0.30	0.30	0.11	0.34		0.46	0.39	0.50	0.38	0.34	
Clearance Time (s)	4.0	6.0	6.0	4.0	6.0		4.0	6.0	4.0	4.0	6.0	
Lane Grp Cap (vph)	459	1046	412	351	1065		229	1358	733	151	1076	
v/s Ratio Prot	0.03	c0.16		0.04	0.05		c0.08	0.30	c0.06	0.01	0.28	
v/s Ratio Perm	0.13		0.08				c0.31		0.19	0.06		
v/c Ratio	0.43	0.55	0.28	0.33	0.14		0.83	0.77	0.50	0.17	0.85	
Uniform Delay, d1	28.3	37.0	33.8	51.2	28.9		25.4	33.0	20.5	26.4	38.5	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	2.9	2.1	1.7	2.5	0.3		28.6	4.2	2.4	2.4	8.3	
Delay (s)	31.2	39.1	35.5	53.6	29.2		54.0	37.2	22.9	28.8	46.9	
Level of Service	C	D	D	D	C		D	D	C	C	D	
Approach Delay (s)		36.7			39.6			35.3			46.4	
Approach LOS		D			D			D			D	

Intersection Summary			
HCM 2000 Control Delay	38.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	125.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	103.0%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	9	800	200	9	76	4
Future Volume (vph)	9	800	200	9	76	4
Ideal Flow (vphpl)	1650	1650	1650	1650	1765	1765
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.994		0.993	
Flt Protected		0.999			0.955	
Satd. Flow (prot)	0	1614	1548	0	1655	0
Flt Permitted		0.999			0.955	
Satd. Flow (perm)	0	1614	1548	0	1655	0
Link Speed (k/h)		60	60		60	
Link Distance (m)		400.5	434.2		345.8	
Travel Time (s)		24.0	26.1		20.7	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	1%	5%	0%	0%	0%
Adj. Flow (vph)	9	800	200	9	76	4
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	809	209	0	80	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.5	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.21	1.21	1.21	1.21	1.12	1.12
Turning Speed (k/h)	24			14	24	14
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 68.2%		ICU Level of Service C	
Analysis Period (min) 15			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	9	800	200	9	76	4
Future Volume (Veh/h)	9	800	200	9	76	4
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	9	800	200	9	76	4
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	209				1022	204
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	209				1022	204
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				71	100
cM capacity (veh/h)	1374				262	841

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	809	209	80
Volume Left	9	0	76
Volume Right	0	9	4
cSH	1374	1700	271
Volume to Capacity	0.01	0.12	0.29
Queue Length 95th (m)	0.2	0.0	9.1
Control Delay (s)	0.2	0.0	23.7
Lane LOS	A		C
Approach Delay (s)	0.2	0.0	23.7
Approach LOS			C

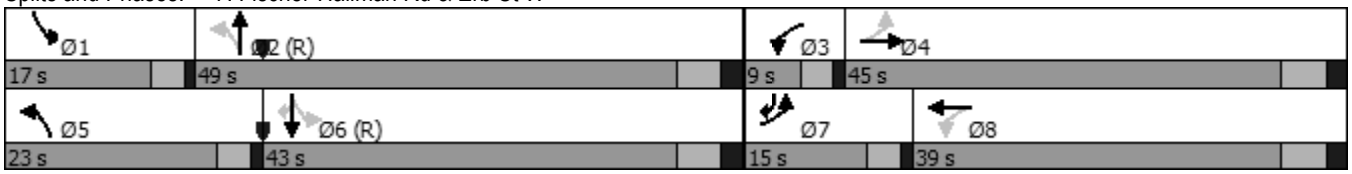
Intersection Summary			
Average Delay	1.9		
Intersection Capacity Utilization	68.2%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	277	705	208	87	390	79	220	945	135	180	562	136
Future Volume (vph)	277	705	208	87	390	79	220	945	135	180	562	136
Ideal Flow (vphpl)	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775
Storage Length (m)	40.0		0.0	50.0		0.0	78.0		0.0	170.0		40.0
Storage Lanes	1		0	1		0	1		0	1		1
Taper Length (m)	50.0			75.0			78.0			35.0		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	0.95	0.95	1.00	0.95	1.00
Ped Bike Factor	0.99	0.99		1.00	0.99		1.00	1.00		1.00		0.98
Frt		0.966			0.975			0.981				0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1651	3134	0	1603	3064	0	1588	3216	0	1635	3270	1449
Flt Permitted	0.329			0.147			0.319			0.097		
Satd. Flow (perm)	566	3134	0	247	3064	0	532	3216	0	166	3270	1419
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		34			19			15				136
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		819.0			343.1			1136.8			2051.4	
Travel Time (s)		49.1			20.6			68.2			123.1	
Confl. Peds. (#/hr)	21		11	11		21	8		17	17		8
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	1%	2%	3%	4%	4%	13%	5%	1%	4%	2%	2%	3%
Adj. Flow (vph)	277	705	208	87	390	79	220	945	135	180	562	136
Shared Lane Traffic (%)												
Lane Group Flow (vph)	277	913	0	87	469	0	220	1080	0	180	562	136
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	1
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	Right
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	6.1
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	6.1
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	pm+ov
Protected Phases	7	4		3	8		5	2		1	6	7
Permitted Phases	4			8			2			6		6
Detector Phase	7	4		3	8		5	2		1	6	7
Switch Phase												
Minimum Initial (s)	5.0	33.0		5.0	33.0		5.0	35.0		5.0	35.0	5.0
Minimum Split (s)	9.0	39.0		9.0	39.0		9.0	41.0		9.0	41.0	9.0
Total Split (s)	15.0	45.0		9.0	39.0		23.0	49.0		17.0	43.0	15.0
Total Split (%)	12.5%	37.5%		7.5%	32.5%		19.2%	40.8%		14.2%	35.8%	12.5%
Maximum Green (s)	11.0	39.0		5.0	33.0		19.0	43.0		13.0	37.0	11.0
Yellow Time (s)	3.0	4.0		3.0	4.0		3.0	4.0		3.0	4.0	3.0
All-Red Time (s)	1.0	2.0		1.0	2.0		1.0	2.0		1.0	2.0	1.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0		4.0	6.0		4.0	6.0		4.0	6.0	4.0
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	Lead
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Recall Mode	None	None		None	None		None	C-Max		None	C-Max	None
Walk Time (s)		11.0			11.0			20.0			20.0	
Flash Dont Walk (s)		22.0			22.0			15.0			15.0	
Pedestrian Calls (#/hr)		0			0			0			0	
Act Effct Green (s)	50.0	39.0		40.0	33.0		60.3	44.0		55.3	41.3	54.3
Actuated g/C Ratio	0.42	0.32		0.33	0.28		0.50	0.37		0.46	0.34	0.45
v/c Ratio	0.83	0.88		0.63	0.55		0.56	0.91		0.81	0.50	0.19
Control Delay	48.2	47.6		45.3	38.4		22.1	48.1		52.0	31.8	4.5
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	48.2	47.6		45.3	38.4		22.1	48.1		52.0	31.8	4.5
LOS	D	D		D	D		C	D		D	C	A
Approach Delay		47.7			39.5			43.7			31.7	
Approach LOS		D			D			D			C	

Intersection Summary			
Area Type:	Other		
Cycle Length: 120			
Actuated Cycle Length: 120			
Offset: 13.2 (11%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 100			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.91			
Intersection Signal Delay: 41.6		Intersection LOS: D	
Intersection Capacity Utilization 104.0%		ICU Level of Service G	
Analysis Period (min) 15			

Splits and Phases: 7: Fischer-Hallman Rd & Erb St W

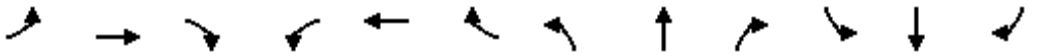




Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	277	913	87	469	220	1080	180	562	136
v/c Ratio	0.83	0.88	0.63	0.55	0.56	0.91	0.81	0.50	0.19
Control Delay	48.2	47.6	45.3	38.4	22.1	48.1	52.0	31.8	4.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	48.2	47.6	45.3	38.4	22.1	48.1	52.0	31.8	4.5
Queue Length 50th (m)	45.0	103.1	12.5	47.6	28.1	126.3	20.2	59.8	3.3
Queue Length 95th (m)	#82.4	#137.9	#26.9	64.6	43.8	#168.4	m#50.0	m76.3	m13.9
Internal Link Dist (m)		795.0		319.1		1112.8		2027.4	
Turn Bay Length (m)	40.0		50.0		78.0		170.0		40.0
Base Capacity (vph)	335	1041	138	856	442	1188	236	1125	719
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.83	0.88	0.63	0.55	0.50	0.91	0.76	0.50	0.19

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	277	705	208	87	390	79	220	945	135	180	562	136
Future Volume (vph)	277	705	208	87	390	79	220	945	135	180	562	136
Ideal Flow (vphpl)	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775
Total Lost time (s)	4.0	6.0		4.0	6.0		4.0	6.0		4.0	6.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	1.00		1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.97		1.00	0.97		1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1646	3134		1603	3063		1587	3216		1635	3270	1426
Flt Permitted	0.33	1.00		0.15	1.00		0.32	1.00		0.10	1.00	1.00
Satd. Flow (perm)	569	3134		248	3063		533	3216		167	3270	1426
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	277	705	208	87	390	79	220	945	135	180	562	136
RTOR Reduction (vph)	0	23	0	0	14	0	0	10	0	0	0	77
Lane Group Flow (vph)	277	890	0	87	455	0	220	1071	0	180	562	59
Confl. Peds. (#/hr)	21		11	11		21	8		17	17		8
Heavy Vehicles (%)	1%	2%	3%	4%	4%	13%	5%	1%	4%	2%	2%	3%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	pm+ov
Protected Phases	7	4		3	8		5	2		1	6	7
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	48.0	39.0		38.0	33.0		58.7	44.0		53.3	41.3	52.3
Effective Green, g (s)	48.0	39.0		38.0	33.0		58.7	44.0		53.3	41.3	52.3
Actuated g/C Ratio	0.40	0.32		0.32	0.28		0.49	0.37		0.44	0.34	0.44
Clearance Time (s)	4.0	6.0		4.0	6.0		4.0	6.0		4.0	6.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	326	1018		134	842		389	1179		220	1125	621
v/s Ratio Prot	c0.08	c0.28		0.03	0.15		c0.07	c0.33		c0.08	0.17	0.01
v/s Ratio Perm	0.26			0.18			0.21			0.28		0.03
v/c Ratio	0.85	0.87		0.65	0.54		0.57	0.91		0.82	0.50	0.10
Uniform Delay, d1	29.8	38.2		31.2	37.0		19.1	36.1		27.5	31.2	19.9
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		0.98	0.94	1.21
Incremental Delay, d2	18.3	8.5		10.4	0.7		1.9	11.7		19.5	1.5	0.1
Delay (s)	48.1	46.7		41.5	37.8		20.9	47.8		46.6	30.8	24.2
Level of Service	D	D		D	D		C	D		D	C	C
Approach Delay (s)		47.0			38.3			43.3			33.0	
Approach LOS		D			D			D			C	

Intersection Summary			
HCM 2000 Control Delay	41.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	104.0%	ICU Level of Service	G
Analysis Period (min)	15		

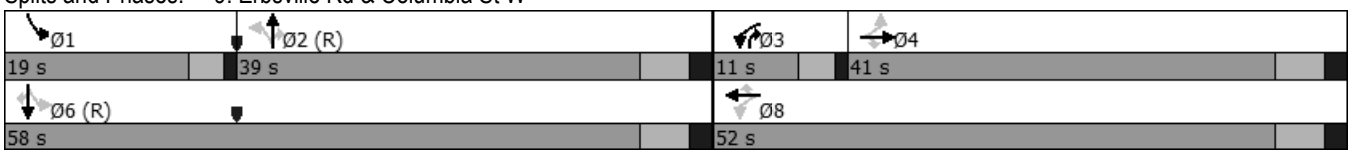
c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	151	371	68	171	204	147	115	441	529	377	441	156
Future Volume (vph)	151	371	68	171	204	147	115	441	529	377	441	156
Ideal Flow (vphpl)	1775	1650	1650	1775	1650	1650	1775	1900	1750	1775	1650	1650
Lane Width (m)	3.5	3.5	3.5	3.2	3.5	4.8	3.5	3.5	3.5	3.5	3.5	3.5
Storage Length (m)	80.0		45.0	145.0		45.0	60.0		40.0	140.0		45.0
Storage Lanes	1		1	1		1	1		1	1		1
Taper Length (m)	57.0			90.0			30.0			45.0		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00
Ped Bike Factor			0.99	1.00			0.99					0.98
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1588	3039	1296	1564	2897	1472	1450	3245	1401	1635	1497	1334
Flt Permitted	0.624			0.388			0.507			0.394		
Satd. Flow (perm)	1043	3039	1279	638	2897	1472	769	3245	1401	678	1497	1304
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			109			147			223			152
Link Speed (k/h)		50			60			60			60	
Link Distance (m)		309.3			820.7			946.8			1422.7	
Travel Time (s)		22.3			49.2			56.8			85.4	
Confl. Peds. (#/hr)			1	1			8					8
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	5%	2%	7%	3%	7%	8%	15%	10%	5%	2%	9%	4%
Adj. Flow (vph)	151	371	68	171	204	147	115	441	529	377	441	156
Shared Lane Traffic (%)												
Lane Group Flow (vph)	151	371	68	171	204	147	115	441	529	377	441	156
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.11	1.21	1.21	1.16	1.21	1.02	1.11	1.01	1.13	1.11	1.21	1.21
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2	1	1	2	1	1	2	1	1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Leading Detector (m)	6.1	30.5	6.1	6.1	30.5	6.1	6.1	30.5	6.1	6.1	30.5	6.1
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	6.1	1.8	6.1	6.1	1.8	6.1	6.1	1.8	6.1	6.1	1.8	6.1
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	Perm	NA	pm+ov	pm+pt	NA	Perm
Protected Phases		4		3	8			2	3	1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Detector Phase	4	4	4	3	8	8	2	2	3	1	6	6
Switch Phase												
Minimum Initial (s)	24.0	24.0	24.0	5.0	24.0	24.0	25.0	25.0	5.0	5.0	25.0	25.0
Minimum Split (s)	30.0	30.0	30.0	9.0	30.0	30.0	31.0	31.0	9.0	9.0	31.0	31.0
Total Split (s)	41.0	41.0	41.0	11.0	52.0	52.0	39.0	39.0	11.0	19.0	58.0	58.0
Total Split (%)	37.3%	37.3%	37.3%	10.0%	47.3%	47.3%	35.5%	35.5%	10.0%	17.3%	52.7%	52.7%
Maximum Green (s)	35.0	35.0	35.0	7.0	46.0	46.0	33.0	33.0	7.0	15.0	52.0	52.0
Yellow Time (s)	4.0	4.0	4.0	3.0	4.0	4.0	4.0	4.0	3.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	1.0	2.0	2.0	2.0	2.0	1.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	4.0	6.0	6.0	6.0	6.0	4.0	4.0	6.0	6.0
Lead/Lag	Lag	Lag	Lag	Lead			Lag	Lag	Lead	Lead		
Lead-Lag Optimize?	Yes	Yes	Yes	Yes			Yes	Yes	Yes	Yes		
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	None	None	None	None	C-Max	C-Max	None	None	C-Max	C-Max
Walk Time (s)	10.0	10.0	10.0		10.0	10.0	10.0	10.0			10.0	10.0
Flash Dont Walk (s)	14.0	14.0	14.0		14.0	14.0	15.0	15.0			15.0	15.0
Pedestrian Calls (#/hr)	0	0	0		0	0	0	0			0	0
Act Effct Green (s)	26.3	26.3	26.3	39.3	37.3	37.3	38.0	38.0	51.0	62.7	60.7	60.7
Actuated g/C Ratio	0.24	0.24	0.24	0.36	0.34	0.34	0.35	0.35	0.46	0.57	0.55	0.55
v/c Ratio	0.61	0.51	0.18	0.60	0.21	0.25	0.43	0.39	0.69	0.69	0.53	0.20
Control Delay	47.8	38.5	2.5	35.0	25.9	4.8	36.0	29.6	19.2	22.0	19.4	3.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	47.8	38.5	2.5	35.0	25.9	4.8	36.0	29.6	19.2	22.0	19.4	3.1
LOS	D	D	A	D	C	A	D	C	B	C	B	A
Approach Delay		36.7			22.9			25.2			17.8	
Approach LOS		D			C			C			B	

Intersection Summary			
Area Type:	Other		
Cycle Length: 110			
Actuated Cycle Length: 110			
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 80			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.69			
Intersection Signal Delay: 24.7		Intersection LOS: C	
Intersection Capacity Utilization 107.6%		ICU Level of Service G	
Analysis Period (min) 15			

Splits and Phases: 9: Erbsville Rd & Columbia St W



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	151	371	68	171	204	147	115	441	529	377	441	156
v/c Ratio	0.61	0.51	0.18	0.60	0.21	0.25	0.43	0.39	0.69	0.69	0.53	0.20
Control Delay	47.8	38.5	2.5	35.0	25.9	4.8	36.0	29.6	19.2	22.0	19.4	3.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	47.8	38.5	2.5	35.0	25.9	4.8	36.0	29.6	19.2	22.0	19.4	3.1
Queue Length 50th (m)	29.8	37.5	0.0	27.2	16.8	0.0	18.7	37.2	50.1	40.3	54.2	0.4
Queue Length 95th (m)	46.9	47.1	3.4	39.3	22.7	11.9	38.9	55.1	99.8	#75.4	98.0	10.8
Internal Link Dist (m)		285.3			796.7			922.8			1398.7	
Turn Bay Length (m)	80.0		45.0	145.0		45.0	60.0		40.0	140.0		45.0
Base Capacity (vph)	331	966	481	286	1211	701	265	1120	768	550	826	787
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.46	0.38	0.14	0.60	0.17	0.21	0.43	0.39	0.69	0.69	0.53	0.20

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	151	371	68	171	204	147	115	441	529	377	441	156
Future Volume (vph)	151	371	68	171	204	147	115	441	529	377	441	156
Ideal Flow (vphpl)	1775	1650	1650	1775	1650	1650	1775	1900	1750	1775	1650	1650
Lane Width	3.5	3.5	3.5	3.2	3.5	4.8	3.5	3.5	3.5	3.5	3.5	3.5
Total Lost time (s)	6.0	6.0	6.0	4.0	6.0	6.0	6.0	6.0	4.0	4.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1588	3039	1279	1564	2897	1472	1442	3245	1401	1635	1497	1304
Flt Permitted	0.62	1.00	1.00	0.39	1.00	1.00	0.51	1.00	1.00	0.39	1.00	1.00
Satd. Flow (perm)	1043	3039	1279	638	2897	1472	769	3245	1401	678	1497	1304
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	151	371	68	171	204	147	115	441	529	377	441	156
RTOR Reduction (vph)	0	0	52	0	0	97	0	0	132	0	0	68
Lane Group Flow (vph)	151	371	16	171	204	50	115	441	397	377	441	88
Confl. Peds. (#/hr)			1	1			8					8
Heavy Vehicles (%)	5%	2%	7%	3%	7%	8%	15%	10%	5%	2%	9%	4%
Turn Type	Perm	NA	Perm	pm+pt	NA	Perm	Perm	NA	pm+ov	pm+pt	NA	Perm
Protected Phases		4		3	8			2	3	1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Actuated Green, G (s)	26.3	26.3	26.3	37.3	37.3	37.3	38.0	38.0	45.0	60.7	60.7	60.7
Effective Green, g (s)	26.3	26.3	26.3	37.3	37.3	37.3	38.0	38.0	45.0	60.7	60.7	60.7
Actuated g/C Ratio	0.24	0.24	0.24	0.34	0.34	0.34	0.35	0.35	0.41	0.55	0.55	0.55
Clearance Time (s)	6.0	6.0	6.0	4.0	6.0	6.0	6.0	6.0	4.0	4.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	249	726	305	275	982	499	265	1121	573	536	826	719
v/s Ratio Prot		0.12		0.04	0.07			0.14	c0.04	c0.12	0.29	
v/s Ratio Perm	0.14		0.01	c0.17		0.03	0.15		0.24	c0.27		0.07
v/c Ratio	0.61	0.51	0.05	0.62	0.21	0.10	0.43	0.39	0.69	0.70	0.53	0.12
Uniform Delay, d1	37.2	36.3	32.3	28.9	25.8	24.9	27.7	27.3	26.8	15.0	15.7	11.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.1	0.6	0.1	4.3	0.1	0.1	5.1	1.0	3.6	4.2	2.5	0.3
Delay (s)	41.4	36.9	32.3	33.3	26.0	25.0	32.8	28.3	30.4	19.1	18.1	12.2
Level of Service	D	D	C	C	C	C	C	C	C	B	B	B
Approach Delay (s)		37.5			28.1			29.8			17.6	
Approach LOS		D			C			C			B	

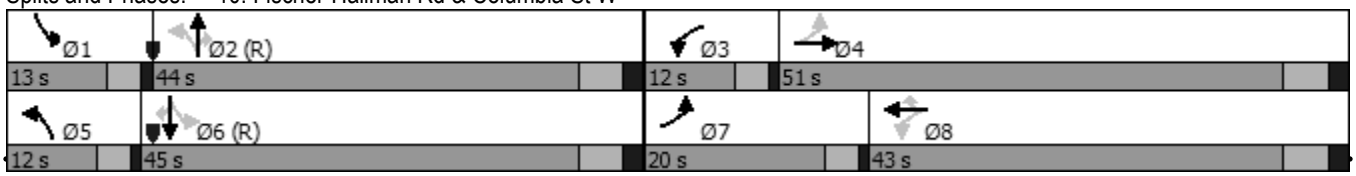
Intersection Summary			
HCM 2000 Control Delay	27.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	107.6%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	335	1007	174	107	263	70	189	490	470	235	324	104
Future Volume (vph)	335	1007	174	107	263	70	189	490	470	235	324	104
Ideal Flow (vphpl)	1775	1900	1750	1775	1900	1750	1775	1900	1750	1775	1900	1750
Lane Width (m)	3.0	3.4	3.4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Storage Length (m)	115.0		82.0	82.0		45.0	95.0		72.0	70.0		53.0
Storage Lanes	1		0	1		1	1		1	1		1
Taper Length (m)	73.0			100.0			36.0			33.0		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Ped Bike Factor	1.00	1.00		1.00		0.98	1.00		0.98	1.00		0.99
Frt		0.978				0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1543	3391	0	1476	3245	1337	1573	3500	1442	1619	3433	1401
Flt Permitted	0.518			0.109			0.534			0.367		
Satd. Flow (perm)	838	3391	0	169	3245	1313	884	3500	1414	623	3433	1383
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		19				136			208			136
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		555.6			231.9			2051.4			968.6	
Travel Time (s)		33.3			13.9			123.1			58.1	
Confl. Peds. (#/hr)	6		2	2		6	1		8	8		1
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	2%	1%	5%	13%	10%	10%	6%	2%	2%	3%	4%	5%
Adj. Flow (vph)	335	1007	174	107	263	70	189	490	470	235	324	104
Shared Lane Traffic (%)												
Lane Group Flow (vph)	335	1181	0	107	263	70	189	490	470	235	324	104
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.19	1.03	1.14	1.11	1.01	1.13	1.11	1.01	1.13	1.11	1.01	1.13
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2	1	1	2	1	1	2	1
Detector Template	Left	Thru		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Leading Detector (m)	6.1	30.5		6.1	30.5	6.1	6.1	30.5	6.1	6.1	30.5	6.1
Trailing Detector (m)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	6.1	1.8		6.1	1.8	6.1	6.1	1.8	6.1	6.1	1.8	6.1
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8		8	2		2	6		6
Detector Phase	7	4		3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	5.0	36.0		5.0	36.0	36.0	5.0	38.0	38.0	5.0	38.0	38.0
Minimum Split (s)	9.0	42.0		9.0	42.0	42.0	9.0	44.0	44.0	9.0	44.0	44.0
Total Split (s)	20.0	51.0		12.0	43.0	43.0	12.0	44.0	44.0	13.0	45.0	45.0
Total Split (%)	16.7%	42.5%		10.0%	35.8%	35.8%	10.0%	36.7%	36.7%	10.8%	37.5%	37.5%
Maximum Green (s)	16.0	45.0		8.0	37.0	37.0	8.0	38.0	38.0	9.0	39.0	39.0
Yellow Time (s)	3.0	4.0		3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	2.0		1.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0		4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes		Yes	Yes	Yes		
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None		None	None	None	None	C-Max	C-Max	None	C-Max	C-Max
Walk Time (s)		15.0			15.0	15.0		17.0	17.0		17.0	17.0
Flash Dont Walk (s)		21.0			21.0	21.0		21.0	21.0		21.0	21.0
Pedestrian Calls (#/hr)		0			0	0		0	0		0	0
Act Effct Green (s)	58.7	44.8		46.7	36.8	36.8	48.3	38.0	38.0	50.3	39.0	39.0
Actuated g/C Ratio	0.49	0.37		0.39	0.31	0.31	0.40	0.32	0.32	0.42	0.32	0.32
v/c Ratio	0.67	0.92		0.71	0.26	0.14	0.47	0.44	0.80	0.70	0.29	0.19
Control Delay	27.8	48.3		47.4	32.2	0.6	27.0	34.7	26.7	36.1	31.1	3.0
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	27.8	48.3		47.4	32.2	0.6	27.0	34.7	26.7	36.1	31.1	3.0
LOS	C	D		D	C	A	C	C	C	D	C	A
Approach Delay		43.8			30.9			30.2			28.5	
Approach LOS		D			C			C			C	

Intersection Summary			
Area Type:	Other		
Cycle Length: 120			
Actuated Cycle Length: 120			
Offset: 115.2 (96%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 105			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.92			
Intersection Signal Delay: 35.4		Intersection LOS: D	
Intersection Capacity Utilization 112.1%		ICU Level of Service H	
Analysis Period (min) 15			

Splits and Phases: 10: Fischer-Hallman Rd & Columbia St W

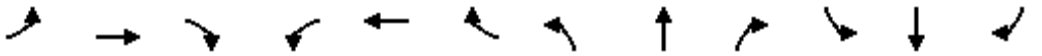




Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	335	1181	107	263	70	189	490	470	235	324	104
v/c Ratio	0.67	0.92	0.71	0.26	0.14	0.47	0.44	0.80	0.70	0.29	0.19
Control Delay	27.8	48.3	47.4	32.2	0.6	27.0	34.7	26.7	36.1	31.1	3.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	27.8	48.3	47.4	32.2	0.6	27.0	34.7	26.7	36.1	31.1	3.0
Queue Length 50th (m)	49.8	136.5	13.4	24.5	0.0	25.7	38.2	41.7	35.4	29.8	0.0
Queue Length 95th (m)	73.8	#179.2	#36.9	35.5	0.0	m31.2	m45.5	m50.5	#55.1	41.7	6.5
Internal Link Dist (m)		531.6		207.9			2027.4			944.6	
Turn Bay Length (m)	115.0		82.0		45.0	95.0		72.0	70.0		53.0
Base Capacity (vph)	504	1283	153	1000	498	403	1108	589	338	1115	541
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.66	0.92	0.70	0.26	0.14	0.47	0.44	0.80	0.70	0.29	0.19

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	335	1007	174	107	263	70	189	490	470	235	324	104
Future Volume (vph)	335	1007	174	107	263	70	189	490	470	235	324	104
Ideal Flow (vphpl)	1775	1900	1750	1775	1900	1750	1775	1900	1750	1775	1900	1750
Lane Width	3.0	3.4	3.4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.98	1.00	1.00	0.98	1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1540	3391		1476	3245	1313	1573	3500	1414	1617	3433	1383
Flt Permitted	0.52	1.00		0.11	1.00	1.00	0.53	1.00	1.00	0.37	1.00	1.00
Satd. Flow (perm)	840	3391		169	3245	1313	884	3500	1414	626	3433	1383
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	335	1007	174	107	263	70	189	490	470	235	324	104
RTOR Reduction (vph)	0	12	0	0	0	49	0	0	142	0	0	70
Lane Group Flow (vph)	335	1169	0	107	263	21	189	490	328	235	324	34
Confl. Peds. (#/hr)	6		2	2		6	1		8	8		1
Heavy Vehicles (%)	2%	1%	5%	13%	10%	10%	6%	2%	2%	3%	4%	5%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8		8	2		2	6		6
Actuated Green, G (s)	56.7	44.8		44.7	36.8	36.8	46.3	38.0	38.0	48.3	39.0	39.0
Effective Green, g (s)	56.7	44.8		44.7	36.8	36.8	46.3	38.0	38.0	48.3	39.0	39.0
Actuated g/C Ratio	0.47	0.37		0.37	0.31	0.31	0.39	0.32	0.32	0.40	0.32	0.32
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	489	1265		148	995	402	388	1108	447	328	1115	449
v/s Ratio Prot	c0.09	c0.34		0.05	0.08		0.03	0.14		c0.06	0.09	
v/s Ratio Perm	0.23			0.22		0.02	0.15		0.23	c0.23		0.02
v/c Ratio	0.69	0.92		0.72	0.26	0.05	0.49	0.44	0.73	0.72	0.29	0.08
Uniform Delay, d1	21.9	36.0		28.9	31.4	29.3	26.0	32.6	36.5	27.5	30.2	28.0
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.09	1.04	1.02	1.00	1.00	1.00
Incremental Delay, d2	4.0	11.3		16.0	0.1	0.1	0.5	0.6	5.0	7.3	0.7	0.3
Delay (s)	25.9	47.3		44.8	31.5	29.4	28.9	34.4	42.1	34.8	30.8	28.3
Level of Service	C	D		D	C	C	C	C	D	C	C	C
Approach Delay (s)		42.6			34.4			36.7			31.9	
Approach LOS		D			C			D			C	

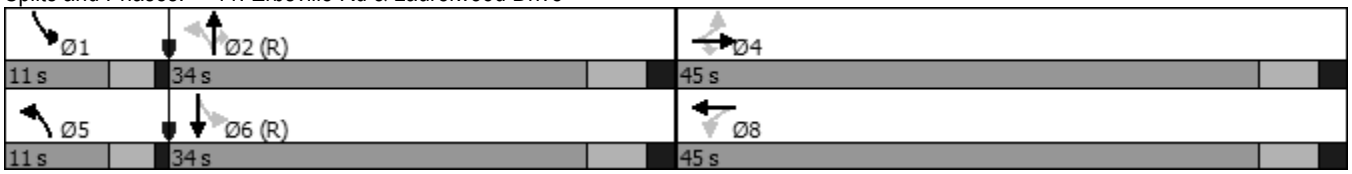
Intersection Summary			
HCM 2000 Control Delay	37.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	112.1%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

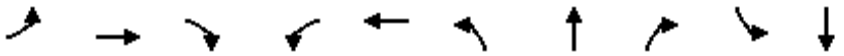
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	18	202	331	70	136	65	216	343	145	98	372	18
Future Volume (vph)	18	202	331	70	136	65	216	343	145	98	372	18
Ideal Flow (vphpl)	1775	1900	1750	1775	1650	1650	1775	1900	1750	1775	1650	1650
Storage Length (m)	27.0		0.0	20.0		0.0	65.0		29.0	19.0		0.0
Storage Lanes	1		1	1		0	1		1	1		0
Taper Length (m)	22.0			18.0			73.0			49.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor	0.78		0.92	0.95	0.90		0.98		0.88	0.95	1.00	
Frt			0.850		0.951				0.850		0.993	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1558	1824	1414	1502	1324	0	1619	1663	1471	1603	1467	0
Flt Permitted	0.518			0.516			0.424			0.555		
Satd. Flow (perm)	659	1824	1297	776	1324	0	710	1663	1296	887	1467	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			331		34				118		3	
Link Speed (k/h)		50			50			60			60	
Link Distance (m)		270.4			1189.4			1422.7			1517.5	
Travel Time (s)		19.5			85.6			85.4			91.1	
Confl. Peds. (#/hr)	259		56	56		259	24		63	63		24
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	7%	3%	4%	11%	6%	4%	3%	13%	0%	4%	10%	13%
Adj. Flow (vph)	18	202	331	70	136	65	216	343	145	98	372	18
Shared Lane Traffic (%)												
Lane Group Flow (vph)	18	202	331	70	201	0	216	343	145	98	390	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.11	1.01	1.13	1.11	1.21	1.21	1.11	1.01	1.13	1.11	1.21	1.21
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2	1	1	2		1	2	1	1	2	
Detector Template	Left	Thru	Right	Left	Thru		Left	Thru	Right	Left	Thru	
Leading Detector (m)	6.1	30.5	6.1	6.1	30.5		6.1	30.5	6.1	6.1	30.5	
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Size(m)	6.1	1.8	6.1	6.1	1.8		6.1	1.8	6.1	6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Perm	NA	Perm	Perm	NA		pm+pt	NA	Perm	pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8			2		2	6		
Detector Phase	4	4	4	8	8		5	2	2	1	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0		5.0	28.0	28.0	5.0	28.0	
Minimum Split (s)	45.0	45.0	45.0	45.0	45.0		9.0	34.0	34.0	9.0	34.0	
Total Split (s)	45.0	45.0	45.0	45.0	45.0		11.0	34.0	34.0	11.0	34.0	
Total Split (%)	50.0%	50.0%	50.0%	50.0%	50.0%		12.2%	37.8%	37.8%	12.2%	37.8%	
Maximum Green (s)	39.0	39.0	39.0	39.0	39.0		7.0	28.0	28.0	7.0	28.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		3.0	4.0	4.0	3.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		1.0	2.0	2.0	1.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0		4.0	6.0	6.0	4.0	6.0	
Lead/Lag							Lead	Lag	Lag	Lead	Lag	
Lead-Lag Optimize?							Yes	Yes	Yes	Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None	None	None	None		None	C-Max	C-Max	None	C-Max	
Walk Time (s)	15.0	15.0	15.0	15.0	15.0			10.0	10.0		10.0	
Flash Dont Walk (s)	24.0	24.0	24.0	24.0	24.0			18.0	18.0		18.0	
Pedestrian Calls (#/hr)	0	0	0	0	0			0	0		0	
Act Effct Green (s)	17.4	17.4	17.4	17.4	17.4		62.0	51.1	51.1	55.6	46.1	
Actuated g/C Ratio	0.19	0.19	0.19	0.19	0.19		0.69	0.57	0.57	0.62	0.51	
v/c Ratio	0.14	0.57	0.64	0.47	0.71		0.36	0.36	0.18	0.16	0.52	
Control Delay	29.4	38.3	9.4	40.6	41.0		7.7	14.6	4.8	6.7	20.2	
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Delay	29.4	38.3	9.4	40.6	41.0		7.7	14.6	4.8	6.7	20.2	
LOS	C	D	A	D	D		A	B	A	A	C	
Approach Delay		20.7			40.9			10.5			17.5	
Approach LOS		C			D			B			B	

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 3.6 (4%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 90			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.71			
Intersection Signal Delay: 19.1		Intersection LOS: B	
Intersection Capacity Utilization 94.2%		ICU Level of Service F	
Analysis Period (min) 15			

Splits and Phases: 11: Erbsville Rd & Laurelwood Drive





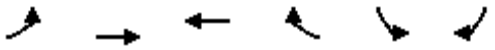
Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	18	202	331	70	201	216	343	145	98	390
v/c Ratio	0.14	0.57	0.64	0.47	0.71	0.36	0.36	0.18	0.16	0.52
Control Delay	29.4	38.3	9.4	40.6	41.0	7.7	14.6	4.8	6.7	20.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.4	38.3	9.4	40.6	41.0	7.7	14.6	4.8	6.7	20.2
Queue Length 50th (m)	2.6	32.1	0.0	10.9	27.3	11.2	31.4	2.0	4.7	41.5
Queue Length 95th (m)	7.5	47.0	20.0	21.2	44.7	26.1	65.3	13.3	12.7	89.2
Internal Link Dist (m)		246.4			1165.4		1398.7			1493.5
Turn Bay Length (m)	27.0			20.0		65.0		29.0	19.0	
Base Capacity (vph)	285	790	749	336	593	595	943	786	613	752
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.06	0.26	0.44	0.21	0.34	0.36	0.36	0.18	0.16	0.52

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	18	202	331	70	136	65	216	343	145	98	372	18
Future Volume (vph)	18	202	331	70	136	65	216	343	145	98	372	18
Ideal Flow (vphpl)	1775	1900	1750	1775	1650	1650	1775	1900	1750	1775	1650	1650
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0		4.0	6.0	6.0	4.0	6.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00	0.92	1.00	0.90		1.00	1.00	0.88	1.00	1.00	
Flpb, ped/bikes	0.78	1.00	1.00	0.95	1.00		0.99	1.00	1.00	0.97	1.00	
Frt	1.00	1.00	0.85	1.00	0.95		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1220	1824	1297	1432	1325		1607	1663	1296	1550	1467	
Flt Permitted	0.52	1.00	1.00	0.52	1.00		0.42	1.00	1.00	0.55	1.00	
Satd. Flow (perm)	666	1824	1297	777	1325		717	1663	1296	905	1467	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	18	202	331	70	136	65	216	343	145	98	372	18
RTOR Reduction (vph)	0	0	267	0	27	0	0	0	52	0	1	0
Lane Group Flow (vph)	18	202	64	70	174	0	216	343	93	98	389	0
Confl. Peds. (#/hr)	259		56	56		259	24		63	63		24
Heavy Vehicles (%)	7%	3%	4%	11%	6%	4%	3%	13%	0%	4%	10%	13%
Turn Type	Perm	NA	Perm	Perm	NA		pm+pt	NA	Perm	pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8			2		2	6		
Actuated Green, G (s)	17.4	17.4	17.4	17.4	17.4		60.6	50.2	50.2	52.5	46.1	
Effective Green, g (s)	17.4	17.4	17.4	17.4	17.4		60.6	50.2	50.2	52.5	46.1	
Actuated g/C Ratio	0.19	0.19	0.19	0.19	0.19		0.67	0.56	0.56	0.58	0.51	
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0		4.0	6.0	6.0	4.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	128	352	250	150	256		586	927	722	573	751	
v/s Ratio Prot		0.11			c0.13		c0.04	0.21		0.01	c0.26	
v/s Ratio Perm	0.03		0.05	0.09			0.20		0.07	0.09		
v/c Ratio	0.14	0.57	0.26	0.47	0.68		0.37	0.37	0.13	0.17	0.52	
Uniform Delay, d1	30.1	32.9	30.8	32.2	33.7		6.3	11.1	9.5	8.3	14.6	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.5	2.3	0.5	2.3	7.0		0.4	1.1	0.4	0.1	2.5	
Delay (s)	30.6	35.2	31.4	34.5	40.7		6.7	12.2	9.8	8.5	17.1	
Level of Service	C	D	C	C	D		A	B	A	A	B	
Approach Delay (s)		32.7			39.1			10.0			15.4	
Approach LOS		C			D			B			B	

Intersection Summary			
HCM 2000 Control Delay	21.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	94.2%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

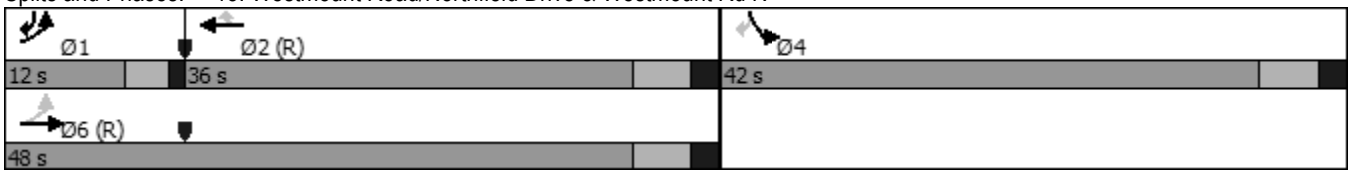


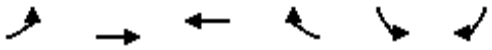
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	207	930	404	84	335	450
Future Volume (vph)	207	930	404	84	335	450
Ideal Flow (vphpl)	1775	1900	1900	1750	1775	1750
Storage Length (m)	94.0			33.0	75.0	0.0
Storage Lanes	1			1	1	1
Taper Length (m)	87.0				25.0	
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	1.00
Ped Bike Factor						0.99
Frt				0.850		0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1635	3535	3535	1375	1635	1471
Flt Permitted	0.423				0.950	
Satd. Flow (perm)	728	3535	3535	1375	1635	1452
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)				84		224
Link Speed (k/h)		60	60		50	
Link Distance (m)		839.6	240.7		534.1	
Travel Time (s)		50.4	14.4		38.5	
Confl. Peds. (#/hr)						1
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	2%	1%	1%	7%	2%	0%
Adj. Flow (vph)	207	930	404	84	335	450
Shared Lane Traffic (%)						
Lane Group Flow (vph)	207	930	404	84	335	450
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.5	3.5		3.5	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.11	1.01	1.01	1.13	1.11	1.13
Turning Speed (k/h)	24			14	24	14
Number of Detectors	1	2	2	1	1	1
Detector Template	Left	Thru	Thru	Right	Left	Right
Leading Detector (m)	6.1	30.5	30.5	6.1	6.1	6.1
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	6.1	1.8	1.8	6.1	6.1	6.1
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		28.7	28.7			
Detector 2 Size(m)		1.8	1.8			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Turn Type	pm+pt	NA	NA	Perm	Prot	pm+ov
Protected Phases	1	6	2		4	1
Permitted Phases	6			2		4
Detector Phase	1	6	2	2	4	1
Switch Phase						
Minimum Initial (s)	5.0	30.0	30.0	30.0	7.0	5.0
Minimum Split (s)	9.0	36.0	36.0	36.0	42.0	9.0
Total Split (s)	12.0	48.0	36.0	36.0	42.0	12.0
Total Split (%)	13.3%	53.3%	40.0%	40.0%	46.7%	13.3%
Maximum Green (s)	8.0	42.0	30.0	30.0	36.0	8.0
Yellow Time (s)	3.0	4.0	4.0	4.0	4.0	3.0
All-Red Time (s)	1.0	2.0	2.0	2.0	2.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	6.0	6.0	6.0	4.0
Lead/Lag	Lead		Lag	Lag		Lead
Lead-Lag Optimize?	Yes		Yes	Yes		Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	C-Max	C-Max	C-Max	Max	None
Walk Time (s)		21.0	21.0	21.0	7.0	
Flash Dont Walk (s)		9.0	9.0	9.0	29.0	
Pedestrian Calls (#/hr)		0	0	0	0	
Act Effct Green (s)	44.0	42.0	30.0	30.0	36.0	46.0
Actuated g/C Ratio	0.49	0.47	0.33	0.33	0.40	0.51
v/c Ratio	0.47	0.56	0.34	0.16	0.51	0.53
Control Delay	17.6	19.0	23.6	5.9	23.8	8.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	17.6	19.0	23.6	5.9	23.8	8.3
LOS	B	B	C	A	C	A
Approach Delay		18.8	20.6		14.9	
Approach LOS		B	C		B	

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 25.2 (28%), Referenced to phase 2:WBT and 6:EBTL, Start of Green			
Natural Cycle: 90			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.56			
Intersection Signal Delay: 17.9		Intersection LOS: B	
Intersection Capacity Utilization 80.6%		ICU Level of Service D	
Analysis Period (min) 15			

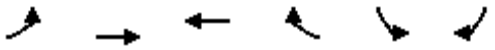
Splits and Phases: 15: Westmount Road/Northfield Drive & Westmount Rd N





Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Group Flow (vph)	207	930	404	84	335	450
v/c Ratio	0.47	0.56	0.34	0.16	0.51	0.53
Control Delay	17.6	19.0	23.6	5.9	23.8	8.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	17.6	19.0	23.6	5.9	23.8	8.3
Queue Length 50th (m)	20.1	58.9	27.3	0.0	42.8	19.3
Queue Length 95th (m)	33.8	76.7	39.2	9.3	67.5	41.6
Internal Link Dist (m)		815.6	216.7		510.1	
Turn Bay Length (m)	94.0			33.0	75.0	
Base Capacity (vph)	436	1649	1178	514	654	853
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.47	0.56	0.34	0.16	0.51	0.53

Intersection Summary



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	207	930	404	84	335	450
Future Volume (vph)	207	930	404	84	335	450
Ideal Flow (vphpl)	1775	1900	1900	1750	1775	1750
Total Lost time (s)	4.0	6.0	6.0	6.0	6.0	4.0
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1635	3535	3535	1375	1635	1456
Flt Permitted	0.42	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	728	3535	3535	1375	1635	1456
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	207	930	404	84	335	450
RTOR Reduction (vph)	0	0	0	56	0	114
Lane Group Flow (vph)	207	930	404	28	335	336
Confl. Peds. (#/hr)						1
Heavy Vehicles (%)	2%	1%	1%	7%	2%	0%
Turn Type	pm+pt	NA	NA	Perm	Prot	pm+ov
Protected Phases	1	6	2		4	1
Permitted Phases	6			2		4
Actuated Green, G (s)	42.0	42.0	30.0	30.0	36.0	44.0
Effective Green, g (s)	42.0	42.0	30.0	30.0	36.0	44.0
Actuated g/C Ratio	0.47	0.47	0.33	0.33	0.40	0.49
Clearance Time (s)	4.0	6.0	6.0	6.0	6.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	420	1649	1178	458	654	711
v/s Ratio Prot	0.04	c0.26	0.11		c0.20	0.04
v/s Ratio Perm	0.19			0.02		0.19
v/c Ratio	0.49	0.56	0.34	0.06	0.51	0.47
Uniform Delay, d1	14.9	17.4	22.6	20.4	20.4	15.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.9	1.4	0.8	0.3	2.9	0.5
Delay (s)	15.8	18.8	23.4	20.7	23.2	15.8
Level of Service	B	B	C	C	C	B
Approach Delay (s)		18.2	22.9		19.0	
Approach LOS		B	C		B	

Intersection Summary			
HCM 2000 Control Delay	19.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	80.6%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	39	1	25	124	10	42
Future Volume (vph)	39	1	25	124	10	42
Ideal Flow (vphpl)	1765	1765	1650	1650	1650	1650
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.997		0.888			
Flt Protected	0.954					0.990
Satd. Flow (prot)	1479	0	1369	0	0	1391
Flt Permitted	0.954					0.990
Satd. Flow (perm)	1479	0	1369	0	0	1391
Link Speed (k/h)	70		60			60
Link Distance (m)	860.7		462.9			376.8
Travel Time (s)	44.3		27.8			22.6
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	10%	100%	5%	6%	0%	20%
Adj. Flow (vph)	39	1	25	124	10	42
Shared Lane Traffic (%)						
Lane Group Flow (vph)	40	0	149	0	0	52
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Right	Left	Left
Median Width(m)	3.5		0.0			0.0
Link Offset(m)	0.0		0.0			0.0
Crosswalk Width(m)	1.6		1.6			1.6
Two way Left Turn Lane						
Headway Factor	1.12	1.12	1.21	1.21	1.21	1.21
Turning Speed (k/h)	24	14		14	24	
Sign Control	Stop		Free			Free

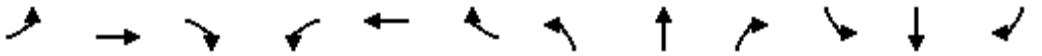
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 22.5%		ICU Level of Service A	
Analysis Period (min) 15			



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	39	1	25	124	10	42
Future Volume (Veh/h)	39	1	25	124	10	42
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	39	1	25	124	10	42
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	149	87			149	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	149	87			149	
tC, single (s)	6.5	7.2			4.1	
tC, 2 stage (s)						
tF (s)	3.6	4.2			2.2	
p0 queue free %	95	100			99	
cM capacity (veh/h)	819	757			1445	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	40	149	52
Volume Left	39	0	10
Volume Right	1	124	0
cSH	817	1700	1445
Volume to Capacity	0.05	0.09	0.01
Queue Length 95th (m)	1.2	0.0	0.2
Control Delay (s)	9.6	0.0	1.5
Lane LOS	A		A
Approach Delay (s)	9.6	0.0	1.5
Approach LOS	A		

Intersection Summary			
Average Delay	1.9		
Intersection Capacity Utilization	22.5%	ICU Level of Service	A
Analysis Period (min)	15		



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	26	101	16	64	30	37	0	203	145	52	186	3
Future Volume (vph)	26	101	16	64	30	37	0	203	145	52	186	3
Ideal Flow (vphpl)	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550
Storage Length (m)	0.0		0.0	30.0		0.0	0.0		0.0	0.0		0.0
Storage Lanes	0		0	1		0	0		0	0		0
Taper Length (m)	2.5			45.0			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.985			0.917			0.944			0.998	
Flt Protected		0.991		0.950							0.989	
Satd. Flow (prot)	0	1424	0	1374	1339	0	0	1332	0	0	1336	0
Flt Permitted		0.991		0.950							0.989	
Satd. Flow (perm)	0	1424	0	1374	1339	0	0	1332	0	0	1336	0
Link Speed (k/h)		70			70			60			60	
Link Distance (m)		610.1			3203.9			1517.5			172.2	
Travel Time (s)		31.4			164.8			91.1			10.3	
Confl. Peds. (#/hr)	4		2	2		4			2	2		
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	4%	20%	6%	0%	9%	0%	12%	4%	4%	16%	0%
Adj. Flow (vph)	26	101	16	64	30	37	0	203	145	52	186	3
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	143	0	64	67	0	0	348	0	0	241	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 65.9%		ICU Level of Service C	
Analysis Period (min) 15			

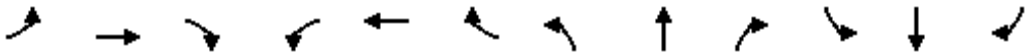
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	26	101	16	64	30	37	0	203	145	52	186	3
Future Volume (vph)	26	101	16	64	30	37	0	203	145	52	186	3
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	26	101	16	64	30	37	0	203	145	52	186	3

Direction, Lane #	EB 1	WB 1	WB 2	NB 1	SB 1
Volume Total (vph)	143	64	67	348	241
Volume Left (vph)	26	64	0	0	52
Volume Right (vph)	16	0	37	145	3
Hadj (s)	0.06	0.60	-0.30	-0.10	0.26
Departure Headway (s)	5.9	6.9	6.0	5.0	5.5
Degree Utilization, x	0.23	0.12	0.11	0.48	0.37
Capacity (veh/h)	547	468	535	678	615
Control Delay (s)	10.7	9.7	8.6	12.6	11.7
Approach Delay (s)	10.7	9.1		12.6	11.7
Approach LOS	B	A		B	B

Intersection Summary				
Delay	11.5			
Level of Service	B			
Intersection Capacity Utilization	65.9%	ICU Level of Service	C	
Analysis Period (min)	15			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	148	45	353	47	52	15	118	165	22	20	258	34
Future Volume (vph)	148	45	353	47	52	15	118	165	22	20	258	34
Ideal Flow (vphpl)	1650	1650	1750	1550	1550	1550	1775	1650	1650	1550	1550	1550
Storage Length (m)	0.0		65.0	0.0		0.0	35.0		0.0	0.0		0.0
Storage Lanes	0		1	0		0	1		0	0		0
Taper Length (m)	2.5			2.5			25.0			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850		0.982			0.982			0.985	
Flt Protected		0.963			0.980		0.950				0.997	
Satd. Flow (prot)	0	1423	1428	0	1381	0	1390	1527	0	0	1389	0
Flt Permitted		0.963			0.980		0.950				0.997	
Satd. Flow (perm)	0	1423	1428	0	1381	0	1390	1527	0	0	1389	0
Link Speed (k/h)		70			50			50			50	
Link Distance (m)		3203.9			162.1			534.1			164.9	
Travel Time (s)		164.8			11.7			38.5			11.9	
Confl. Peds. (#/hr)	4		1	1		4	3		1	1		3
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	9%	15%	3%	0%	15%	0%	20%	4%	12%	17%	5%	29%
Adj. Flow (vph)	148	45	353	47	52	15	118	165	22	20	258	34
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	193	353	0	114	0	118	187	0	0	312	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.21	1.21	1.13	1.31	1.31	1.31	1.11	1.21	1.21	1.31	1.31	1.31
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 62.8%		ICU Level of Service B	
Analysis Period (min) 15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	148	45	353	47	52	15	118	165	22	20	258	34
Future Volume (vph)	148	45	353	47	52	15	118	165	22	20	258	34
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	148	45	353	47	52	15	118	165	22	20	258	34

Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2	SB 1
Volume Total (vph)	193	353	114	118	187	312
Volume Left (vph)	148	0	47	118	0	20
Volume Right (vph)	0	353	15	0	22	34
Hadj (s)	0.56	-0.65	0.12	0.84	0.00	0.09
Departure Headway (s)	7.4	6.2	7.8	8.1	7.2	7.2
Degree Utilization, x	0.40	0.61	0.25	0.26	0.37	0.62
Capacity (veh/h)	466	552	404	414	462	484
Control Delay (s)	14.1	17.3	13.4	12.7	13.3	21.1
Approach Delay (s)	16.1		13.4	13.0		21.1
Approach LOS	C		B	B		C

Intersection Summary				
Delay	16.4			
Level of Service	C			
Intersection Capacity Utilization	62.8%	ICU Level of Service	B	
Analysis Period (min)	15			

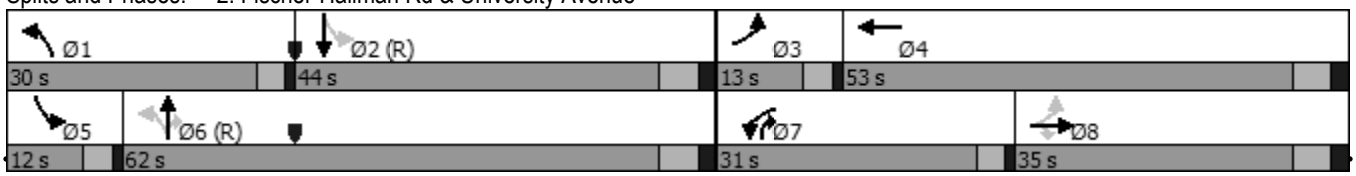
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	136	340	229	554	490	18	290	1046	187	31	1243	152
Future Volume (vph)	136	340	229	554	490	18	290	1046	187	31	1243	152
Ideal Flow (vphpl)	1775	1900	1750	1775	1775	1775	1775	1900	1750	1775	1775	1775
Storage Length (m)	35.0		35.0	100.0		0.0	80.0		125.0	50.0		0.0
Storage Lanes	1		1	2		0	1		1	1		0
Taper Length (m)	30.0			65.0			30.0			60.0		
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	0.95	1.00	0.95	1.00	1.00	0.95	0.95
Ped Bike Factor	1.00		0.98	0.99	1.00		1.00				1.00	
Frt			0.850		0.995				0.850		0.984	
Flt Protected	0.950			0.950						0.950		
Satd. Flow (prot)	1668	3570	1442	3203	3317	0	1738	3535	1442	1668	3238	0
Flt Permitted	0.465			0.950			*0.125			0.196		
Satd. Flow (perm)	816	3570	1415	3179	3317	0	217	3535	1442	344	3238	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			229		3				187		9	
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		701.9			786.3			349.5			1136.8	
Travel Time (s)		42.1			47.2			21.0			68.2	
Confl. Peds. (#/hr)	1		5	5		1	17					17
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	2%	1%	0%	0%	1%	1%	2%	0%	1%	1%
Adj. Flow (vph)	136	340	229	554	490	18	290	1046	187	31	1243	152
Shared Lane Traffic (%)												
Lane Group Flow (vph)	136	340	229	554	508	0	290	1046	187	31	1395	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		7.0			7.0			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.11	1.01	1.13	1.11	1.11	1.11	1.11	1.01	1.13	1.11	1.11	1.11
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2	1	1	2		1	2	1	1	2	
Detector Template	Left	Thru	Right	Left	Thru		Left	Thru	Right	Left	Thru	
Leading Detector (m)	6.1	30.5	6.1	6.1	30.5		6.1	30.5	6.1	6.1	30.5	
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Size(m)	6.1	1.8	6.1	6.1	1.8		6.1	1.8	6.1	6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

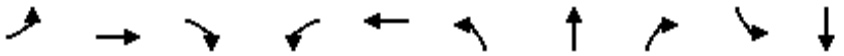
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	pm+pt	NA	Perm	Prot	NA		pm+pt	NA	pm+ov	pm+pt	NA	
Protected Phases	3	8		7	4		1	6	7	5	2	
Permitted Phases	8		8				6		6	2		
Detector Phase	3	8	8	7	4		1	6	7	5	2	
Switch Phase												
Minimum Initial (s)	5.0	29.0	29.0	5.0	29.0		5.0	36.0	5.0	5.0	36.0	
Minimum Split (s)	9.0	35.0	35.0	9.0	35.0		9.0	42.0	9.0	9.0	42.0	
Total Split (s)	13.0	35.0	35.0	31.0	53.0		30.0	62.0	31.0	12.0	44.0	
Total Split (%)	9.3%	25.0%	25.0%	22.1%	37.9%		21.4%	44.3%	22.1%	8.6%	31.4%	
Maximum Green (s)	9.0	29.0	29.0	27.0	47.0		26.0	56.0	27.0	8.0	38.0	
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0		3.0	4.0	3.0	3.0	4.0	
All-Red Time (s)	1.0	2.0	2.0	1.0	2.0		1.0	2.0	1.0	1.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	4.0	6.0	6.0	4.0	6.0		4.0	6.0	4.0	4.0	6.0	
Lead/Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lead	Lead	Lag	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None	None	None	None		None	C-Max	None	None	C-Max	
Walk Time (s)		7.0	7.0		7.0			11.0			11.0	
Flash Dont Walk (s)		22.0	22.0		22.0			25.0			25.0	
Pedestrian Calls (#/hr)		0	0		0			0			0	
Act Effct Green (s)	39.9	29.0	29.0	26.4	46.5		70.6	61.8	94.2	52.2	43.4	
Actuated g/C Ratio	0.28	0.21	0.21	0.19	0.33		0.50	0.44	0.67	0.37	0.31	
v/c Ratio	0.48	0.46	0.48	0.92	0.46		0.86	0.67	0.18	0.16	1.38	
Control Delay	33.0	51.0	9.2	76.8	38.2		54.4	34.8	1.7	21.7	214.6	
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Delay	33.0	51.0	9.2	76.8	38.2		54.4	34.8	1.7	21.7	214.6	
LOS	C	D	A	E	D		D	C	A	C	F	
Approach Delay		33.9			58.3			34.4			210.4	
Approach LOS		C			E			C			F	

Intersection Summary			
Area Type:	Other		
Cycle Length: 140			
Actuated Cycle Length: 140			
Offset: 18 (13%), Referenced to phase 2:SBTL and 6:NBTL, Start of Green			
Natural Cycle: 145			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 1.38			
Intersection Signal Delay: 92.9		Intersection LOS: F	
Intersection Capacity Utilization 117.1%		ICU Level of Service H	
Analysis Period (min) 15			

* User Entered Value

Splits and Phases: 2: Fischer-Hallman Rd & University Avenue



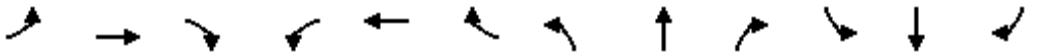


Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	136	340	229	554	508	290	1046	187	31	1395
v/c Ratio	0.48	0.46	0.48	0.92	0.46	0.86	0.67	0.18	0.16	1.38
Control Delay	33.0	51.0	9.2	76.8	38.2	54.4	34.8	1.7	21.7	214.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	33.0	51.0	9.2	76.8	38.2	54.4	34.8	1.7	21.7	214.6
Queue Length 50th (m)	22.5	43.8	0.0	78.0	57.6	55.9	126.7	0.0	4.3	~275.8
Queue Length 95th (m)	36.6	59.3	22.4	#108.4	74.2	88.3	154.3	8.5	9.7	#332.3
Internal Link Dist (m)		677.9			762.3		325.5			1112.8
Turn Bay Length (m)	35.0		35.0	100.0		80.0		125.0	50.0	
Base Capacity (vph)	287	739	474	617	1115	391	1559	1036	206	1010
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.47	0.46	0.48	0.90	0.46	0.74	0.67	0.18	0.15	1.38

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

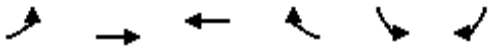
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	136	340	229	554	490	18	290	1046	187	31	1243	152
Future Volume (vph)	136	340	229	554	490	18	290	1046	187	31	1243	152
Ideal Flow (vphpl)	1775	1900	1750	1775	1775	1775	1775	1900	1750	1775	1775	1775
Total Lost time (s)	4.0	6.0	6.0	4.0	6.0		4.0	6.0	4.0	4.0	6.0	
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95		1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85	1.00	0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00		1.00	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1667	3570	1415	3203	3316		1738	3535	1442	1668	3237	
Flt Permitted	0.47	1.00	1.00	0.95	1.00		0.12	1.00	1.00	0.20	1.00	
Satd. Flow (perm)	816	3570	1415	3203	3316		217	3535	1442	344	3237	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	136	340	229	554	490	18	290	1046	187	31	1243	152
RTOR Reduction (vph)	0	0	182	0	2	0	0	0	71	0	6	0
Lane Group Flow (vph)	136	340	47	554	506	0	290	1046	116	31	1389	0
Confl. Peds. (#/hr)	1		5	5		1	17					17
Heavy Vehicles (%)	0%	0%	2%	1%	0%	0%	1%	1%	2%	0%	1%	1%
Turn Type	pm+pt	NA	Perm	Prot	NA		pm+pt	NA	pm+ov	pm+pt	NA	
Protected Phases	3	8		7	4		1	6	7	5	2	
Permitted Phases	8		8				6		6	2		
Actuated Green, G (s)	37.9	29.0	29.0	26.4	46.5		68.6	60.2	86.6	47.8	43.4	
Effective Green, g (s)	37.9	29.0	29.0	26.4	46.5		68.6	60.2	86.6	47.8	43.4	
Actuated g/C Ratio	0.27	0.21	0.21	0.19	0.33		0.49	0.43	0.62	0.34	0.31	
Clearance Time (s)	4.0	6.0	6.0	4.0	6.0		4.0	6.0	4.0	4.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	275	739	293	603	1101		336	1520	891	159	1003	
v/s Ratio Prot	0.03	0.10		c0.17	c0.15		c0.13	0.30	0.02	0.01	c0.43	
v/s Ratio Perm	0.10		0.03				0.29		0.06	0.06		
v/c Ratio	0.49	0.46	0.16	0.92	0.46		0.86	0.69	0.13	0.19	1.38	
Uniform Delay, d1	40.5	48.6	45.5	55.7	36.8		31.3	32.3	11.1	31.5	48.3	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	1.4	0.5	0.3	19.0	0.3		19.8	2.6	0.1	0.6	179.3	
Delay (s)	41.9	49.1	45.8	74.8	37.2		51.1	34.9	11.1	32.1	227.6	
Level of Service	D	D	D	E	D		D	C	B	C	F	
Approach Delay (s)		46.6			56.8			35.0			223.4	
Approach LOS		D			E			D			F	

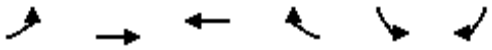
Intersection Summary			
HCM 2000 Control Delay	98.6	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	117.1%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	12	348	701	120	27	3
Future Volume (vph)	12	348	701	120	27	3
Ideal Flow (vphpl)	1650	1650	1650	1650	1765	1765
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor						
Frt			0.980		0.986	
Flt Protected		0.998			0.957	
Satd. Flow (prot)	0	1613	1599	0	1647	0
Flt Permitted		0.998			0.957	
Satd. Flow (perm)	0	1613	1599	0	1647	0
Link Speed (k/h)		60	60		60	
Link Distance (m)		291.4	304.6		335.6	
Travel Time (s)		17.5	18.3		20.1	
Confl. Peds. (#/hr)	1			1		
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	1%	0%	0%	0%	0%
Adj. Flow (vph)	12	348	701	120	27	3
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	360	821	0	30	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.5	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.21	1.21	1.21	1.21	1.12	1.12
Turning Speed (k/h)	24			14	24	14
Sign Control		Free	Free		Stop	

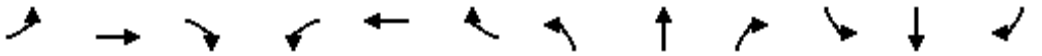
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	60.9%	ICU Level of Service	B
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	12	348	701	120	27	3
Future Volume (Veh/h)	12	348	701	120	27	3
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	12	348	701	120	27	3
Pedestrians					1	
Lane Width (m)					3.5	
Walking Speed (m/s)					1.1	
Percent Blockage					0	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	822				1134	762
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	822				1134	762
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				88	99
cM capacity (veh/h)	816				223	408

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	360	821	30
Volume Left	12	0	27
Volume Right	0	120	3
cSH	816	1700	233
Volume to Capacity	0.01	0.48	0.13
Queue Length 95th (m)	0.3	0.0	3.3
Control Delay (s)	0.5	0.0	22.7
Lane LOS	A		C
Approach Delay (s)	0.5	0.0	22.7
Approach LOS			C

Intersection Summary			
Average Delay	0.7		
Intersection Capacity Utilization	60.9%	ICU Level of Service	B
Analysis Period (min)	15		

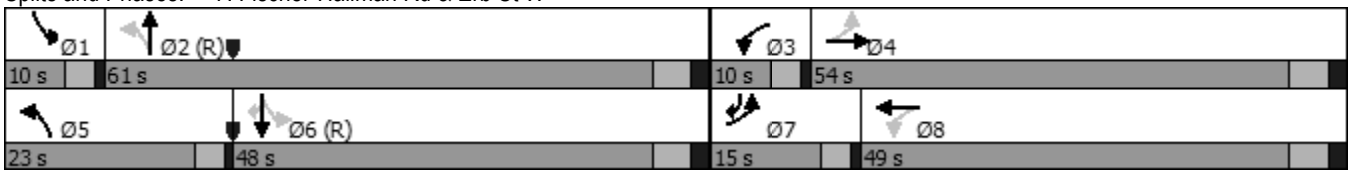


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	160	452	154	116	728	145	287	682	135	153	1000	245
Future Volume (vph)	160	452	154	116	728	145	287	682	135	153	1000	245
Ideal Flow (vphpl)	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775
Storage Length (m)	40.0		0.0	50.0		0.0	78.0		0.0	170.0		40.0
Storage Lanes	1		0	1		0	1		0	1		1
Taper Length (m)	50.0			75.0			78.0			35.0		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	0.95	0.95	1.00	0.95	1.00
Ped Bike Factor	0.99	0.99		0.99	0.99		1.00	1.00		1.00		0.97
Frt		0.962			0.975			0.975				0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1668	3133	0	1635	3163	0	1668	3207	0	1619	3302	1477
Flt Permitted	0.118			0.343			0.087			0.294		
Satd. Flow (perm)	205	3133	0	587	3163	0	152	3207	0	499	3302	1431
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		39			18			21				89
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		1168.2			343.1			1136.8			2051.4	
Travel Time (s)		70.1			20.6			68.2			123.1	
Confl. Peds. (#/hr)	48		14	14		48	19		12	12		19
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	2%	1%	2%	2%	1%	0%	1%	1%	3%	1%	1%
Adj. Flow (vph)	160	452	154	116	728	145	287	682	135	153	1000	245
Shared Lane Traffic (%)												
Lane Group Flow (vph)	160	606	0	116	873	0	287	817	0	153	1000	245
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	1
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	Right
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	6.1
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	6.1
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	pm+ov
Protected Phases	7	4		3	8		5	2		1	6	7
Permitted Phases	4			8			2			6		6
Detector Phase	7	4		3	8		5	2		1	6	7
Switch Phase												
Minimum Initial (s)	5.0	42.0		5.0	42.0		5.0	39.0		5.0	39.0	5.0
Minimum Split (s)	9.0	48.0		9.0	48.0		9.0	45.0		9.0	45.0	9.0
Total Split (s)	15.0	54.0		10.0	49.0		23.0	61.0		10.0	48.0	15.0
Total Split (%)	11.1%	40.0%		7.4%	36.3%		17.0%	45.2%		7.4%	35.6%	11.1%
Maximum Green (s)	11.0	48.0		6.0	43.0		19.0	55.0		6.0	42.0	11.0
Yellow Time (s)	3.0	4.0		3.0	4.0		3.0	4.0		3.0	4.0	3.0
All-Red Time (s)	1.0	2.0		1.0	2.0		1.0	2.0		1.0	2.0	1.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0		4.0	6.0		4.0	6.0		4.0	6.0	4.0
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	Lead
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Recall Mode	None	None		None	None		None	C-Max		None	C-Max	None
Walk Time (s)		20.0			20.0			24.0			24.0	
Flash Dont Walk (s)		22.0			22.0			15.0			15.0	
Pedestrian Calls (#/hr)		0			0			0			0	
Act Effct Green (s)	59.4	47.4		50.6	42.6		67.6	55.0		50.6	42.0	54.8
Actuated g/C Ratio	0.44	0.35		0.37	0.32		0.50	0.41		0.37	0.31	0.41
v/c Ratio	0.77	0.54		0.44	0.86		0.97	0.62		0.63	0.97	0.38
Control Delay	49.3	34.6		30.0	52.7		83.7	33.3		37.7	68.3	17.7
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	49.3	34.6		30.0	52.7		83.7	33.3		37.7	68.3	17.7
LOS	D	C		C	D		F	C		D	E	B
Approach Delay		37.7			50.0			46.4			56.1	
Approach LOS		D			D			D			E	

Intersection Summary			
Area Type:	Other		
Cycle Length: 135			
Actuated Cycle Length: 135			
Offset: 15.6 (12%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 115			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.97			
Intersection Signal Delay: 48.9		Intersection LOS: D	
Intersection Capacity Utilization 110.7%		ICU Level of Service H	
Analysis Period (min) 15			

Splits and Phases: 7: Fischer-Hallman Rd & Erb St W

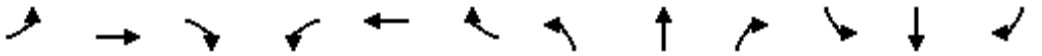




Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	160	606	116	873	287	817	153	1000	245
v/c Ratio	0.77	0.54	0.44	0.86	0.97	0.62	0.63	0.97	0.38
Control Delay	49.3	34.6	30.0	52.7	83.7	33.3	37.7	68.3	17.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	49.3	34.6	30.0	52.7	83.7	33.3	37.7	68.3	17.7
Queue Length 50th (m)	25.8	63.0	18.2	112.6	61.9	87.6	22.1	138.6	26.3
Queue Length 95th (m)	#53.7	81.4	30.6	139.5	#120.2	109.0	35.4	#183.0	46.7
Internal Link Dist (m)		1144.2		319.1		1112.8		2027.4	
Turn Bay Length (m)	40.0		50.0		78.0		170.0		40.0
Base Capacity (vph)	209	1139	266	1019	296	1319	241	1027	639
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.77	0.53	0.44	0.86	0.97	0.62	0.63	0.97	0.38

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	160	452	154	116	728	145	287	682	135	153	1000	245
Future Volume (vph)	160	452	154	116	728	145	287	682	135	153	1000	245
Ideal Flow (vphpl)	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775
Total Lost time (s)	4.0	6.0		4.0	6.0		4.0	6.0		4.0	6.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	1.00		1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.96		1.00	0.98		1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1666	3133		1632	3163		1667	3207		1617	3302	1440
Flt Permitted	0.12	1.00		0.34	1.00		0.09	1.00		0.29	1.00	1.00
Satd. Flow (perm)	207	3133		589	3163		153	3207		500	3302	1440
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	160	452	154	116	728	145	287	682	135	153	1000	245
RTOR Reduction (vph)	0	25	0	0	12	0	0	12	0	0	0	54
Lane Group Flow (vph)	160	581	0	116	861	0	287	805	0	153	1000	191
Confl. Peds. (#/hr)	48		14	14		48	19		12	12		19
Heavy Vehicles (%)	0%	2%	1%	2%	2%	1%	0%	1%	1%	3%	1%	1%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	pm+ov
Protected Phases	7	4		3	8		5	2		1	6	7
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	57.4	47.4		48.6	42.6		65.6	55.0		48.6	42.0	52.8
Effective Green, g (s)	57.4	47.4		48.6	42.6		65.6	55.0		48.6	42.0	52.8
Actuated g/C Ratio	0.43	0.35		0.36	0.32		0.49	0.41		0.36	0.31	0.39
Clearance Time (s)	4.0	6.0		4.0	6.0		4.0	6.0		4.0	6.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	204	1100		258	998		294	1306		234	1027	563
v/s Ratio Prot	c0.06	0.19		0.02	c0.27		c0.14	0.25		0.03	0.30	0.03
v/s Ratio Perm	0.27			0.14			c0.33			0.20		0.11
v/c Ratio	0.78	0.53		0.45	0.86		0.98	0.62		0.65	0.97	0.34
Uniform Delay, d1	29.2	34.9		30.6	43.4		42.2	31.6		32.6	46.0	28.8
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	17.7	0.5		1.2	7.8		45.5	2.2		6.4	22.4	0.4
Delay (s)	46.9	35.3		31.9	51.2		87.8	33.8		39.1	68.4	29.2
Level of Service	D	D		C	D		F	C		D	E	C
Approach Delay (s)		37.8			49.0			47.9			58.3	
Approach LOS		D			D			D			E	

Intersection Summary			
HCM 2000 Control Delay	49.7	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	135.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	110.7%	ICU Level of Service	H
Analysis Period (min)	15		

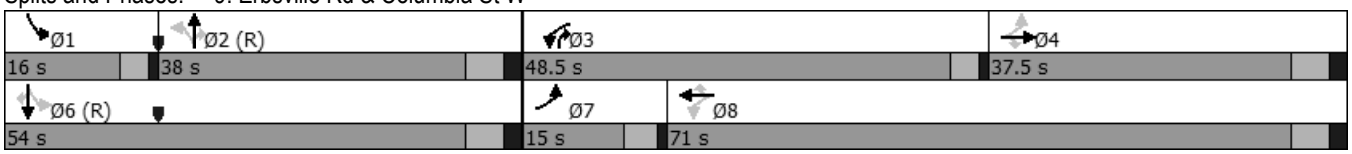
c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	153	336	138	568	333	375	72	435	214	235	525	112
Future Volume (vph)	153	336	138	568	333	375	72	435	214	235	525	112
Ideal Flow (vphpl)	1775	1650	1650	1775	1650	1650	1775	1900	1750	1775	1650	1650
Lane Width (m)	3.5	3.5	3.5	3.2	3.5	4.8	3.5	3.5	3.5	3.5	3.5	3.5
Storage Length (m)	80.0		45.0	145.0		45.0	60.0		40.0	140.0		45.0
Storage Lanes	1		1	1		1	1		1	1		1
Taper Length (m)	57.0			90.0			30.0			45.0		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00
Ped Bike Factor	1.00		0.98	1.00		0.98	1.00					0.98
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1668	3010	1387	1611	3039	1574	1668	3433	1414	1651	1616	1360
Flt Permitted	0.551			0.363			0.358			0.333		
Satd. Flow (perm)	966	3010	1366	615	3039	1538	626	3433	1414	579	1616	1328
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			138			374			163			90
Link Speed (k/h)		50			60			60			60	
Link Distance (m)		309.3			718.2			946.8			1422.7	
Travel Time (s)		22.3			43.1			56.8			85.4	
Confl. Peds. (#/hr)	1		2	2		1	7					7
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	3%	0%	0%	2%	1%	0%	4%	4%	1%	1%	2%
Adj. Flow (vph)	153	336	138	568	333	375	72	435	214	235	525	112
Shared Lane Traffic (%)												
Lane Group Flow (vph)	153	336	138	568	333	375	72	435	214	235	525	112
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.11	1.21	1.21	1.16	1.21	1.02	1.11	1.01	1.13	1.11	1.21	1.21
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2	1	1	2	1	1	2	1	1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Leading Detector (m)	6.1	30.5	6.1	6.1	30.5	6.1	6.1	30.5	6.1	6.1	30.5	6.1
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	6.1	1.8	6.1	6.1	1.8	6.1	6.1	1.8	6.1	6.1	1.8	6.1
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	pm+ov	pm+pt	NA	Perm
Protected Phases	7	4		3	8			2	3	1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Detector Phase	7	4	4	3	8	8	2	2	3	1	6	6
Switch Phase												
Minimum Initial (s)	5.0	26.0	26.0	5.0	26.0	26.0	26.0	26.0	5.0	5.0	26.0	26.0
Minimum Split (s)	9.5	32.0	32.0	9.0	32.0	32.0	32.0	32.0	9.0	9.0	32.0	32.0
Total Split (s)	15.0	37.5	37.5	48.5	71.0	71.0	38.0	38.0	48.5	16.0	54.0	54.0
Total Split (%)	10.7%	26.8%	26.8%	34.6%	50.7%	50.7%	27.1%	27.1%	34.6%	11.4%	38.6%	38.6%
Maximum Green (s)	10.5	31.5	31.5	44.5	65.0	65.0	32.0	32.0	44.5	12.0	48.0	48.0
Yellow Time (s)	3.5	4.0	4.0	3.0	4.0	4.0	4.0	4.0	3.0	3.0	4.0	4.0
All-Red Time (s)	1.0	2.0	2.0	1.0	2.0	2.0	2.0	2.0	1.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	6.0	6.0	4.0	6.0	6.0	6.0	6.0	4.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lag	Lag	Lead	Lead		
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	None	None	None	None	C-Max	C-Max	None	None	C-Max	C-Max
Walk Time (s)		12.0	12.0		12.0	12.0	11.0	11.0			11.0	11.0
Flash Dont Walk (s)		14.0	14.0		14.0	14.0	15.0	15.0			15.0	15.0
Pedestrian Calls (#/hr)		0	0		0	0	0	0			0	0
Act Effct Green (s)	38.1	26.4	26.4	74.1	57.5	57.5	35.6	35.6	83.4	57.9	55.9	55.9
Actuated g/C Ratio	0.27	0.19	0.19	0.53	0.41	0.41	0.25	0.25	0.60	0.41	0.40	0.40
v/c Ratio	0.49	0.59	0.37	0.91	0.27	0.44	0.45	0.50	0.24	0.65	0.82	0.19
Control Delay	28.1	56.6	10.3	45.0	27.5	4.0	57.0	47.9	4.2	38.9	49.9	9.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	28.1	56.6	10.3	45.0	27.5	4.0	57.0	47.9	4.2	38.9	49.9	9.2
LOS	C	E	B	D	C	A	E	D	A	D	D	A
Approach Delay		39.5			28.4			35.9			41.7	
Approach LOS		D			C			D			D	

Intersection Summary			
Area Type:	Other		
Cycle Length: 140			
Actuated Cycle Length: 140			
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 85			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.91			
Intersection Signal Delay: 35.3		Intersection LOS: D	
Intersection Capacity Utilization 127.2%		ICU Level of Service H	
Analysis Period (min) 15			

Splits and Phases: 9: Erbsville Rd & Columbia St W



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	153	336	138	568	333	375	72	435	214	235	525	112
v/c Ratio	0.49	0.59	0.37	0.91	0.27	0.44	0.45	0.50	0.24	0.65	0.82	0.19
Control Delay	28.1	56.6	10.3	45.0	27.5	4.0	57.0	47.9	4.2	38.9	49.9	9.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	28.1	56.6	10.3	45.0	27.5	4.0	57.0	47.9	4.2	38.9	49.9	9.2
Queue Length 50th (m)	20.6	45.4	0.0	106.6	31.0	0.2	17.5	56.4	5.8	45.4	132.3	3.8
Queue Length 95th (m)	31.6	60.6	17.5	#162.5	41.1	18.0	35.0	73.9	16.8	69.3	#199.2	16.8
Internal Link Dist (m)		285.3			694.2			922.8			1398.7	
Turn Bay Length (m)	80.0		45.0	145.0		45.0	60.0		40.0	140.0		45.0
Base Capacity (vph)	317	677	414	642	1410	914	159	873	932	363	644	584
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.48	0.50	0.33	0.88	0.24	0.41	0.45	0.50	0.23	0.65	0.82	0.19

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	153	336	138	568	333	375	72	435	214	235	525	112
Future Volume (vph)	153	336	138	568	333	375	72	435	214	235	525	112
Ideal Flow (vphpl)	1775	1650	1650	1775	1650	1650	1775	1900	1750	1775	1650	1650
Lane Width	3.5	3.5	3.5	3.2	3.5	4.8	3.5	3.5	3.5	3.5	3.5	3.5
Total Lost time (s)	4.5	6.0	6.0	4.0	6.0	6.0	6.0	6.0	4.0	4.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00	0.98	1.00	1.00	1.00	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1666	3010	1366	1610	3039	1538	1660	3433	1414	1651	1616	1328
Flt Permitted	0.55	1.00	1.00	0.36	1.00	1.00	0.36	1.00	1.00	0.33	1.00	1.00
Satd. Flow (perm)	966	3010	1366	615	3039	1538	625	3433	1414	578	1616	1328
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	153	336	138	568	333	375	72	435	214	235	525	112
RTOR Reduction (vph)	0	0	112	0	0	220	0	0	73	0	0	54
Lane Group Flow (vph)	153	336	26	568	333	155	72	435	141	235	525	58
Confl. Peds. (#/hr)	1		2	2		1	7					7
Heavy Vehicles (%)	0%	3%	0%	0%	2%	1%	0%	4%	4%	1%	1%	2%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	pm+ov	pm+pt	NA	Perm
Protected Phases	7	4		3	8			2	3	1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Actuated Green, G (s)	36.7	26.5	26.5	72.2	57.5	57.5	35.6	35.6	77.3	55.8	55.8	55.8
Effective Green, g (s)	36.7	26.5	26.5	72.2	57.5	57.5	35.6	35.6	77.3	55.8	55.8	55.8
Actuated g/C Ratio	0.26	0.19	0.19	0.52	0.41	0.41	0.25	0.25	0.55	0.40	0.40	0.40
Clearance Time (s)	4.5	6.0	6.0	4.0	6.0	6.0	6.0	6.0	4.0	4.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	304	569	258	613	1248	631	158	872	780	354	644	529
v/s Ratio Prot	0.04	0.11		c0.28	0.11			0.13	0.05	0.08	c0.32	
v/s Ratio Perm	0.10		0.02	c0.20		0.10	0.12		0.05	0.19		0.04
v/c Ratio	0.50	0.59	0.10	0.93	0.27	0.25	0.46	0.50	0.18	0.66	0.82	0.11
Uniform Delay, d1	42.0	51.8	46.9	26.3	27.3	27.0	44.0	44.6	15.6	30.4	37.5	26.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.3	1.6	0.2	20.1	0.1	0.2	9.2	2.0	0.1	4.6	10.9	0.4
Delay (s)	43.3	53.4	47.1	46.4	27.4	27.2	53.2	46.6	15.7	35.0	48.4	26.9
Level of Service	D	D	D	D	C	C	D	D	B	D	D	C
Approach Delay (s)		49.6			35.8			38.1			42.0	
Approach LOS		D			D			D			D	

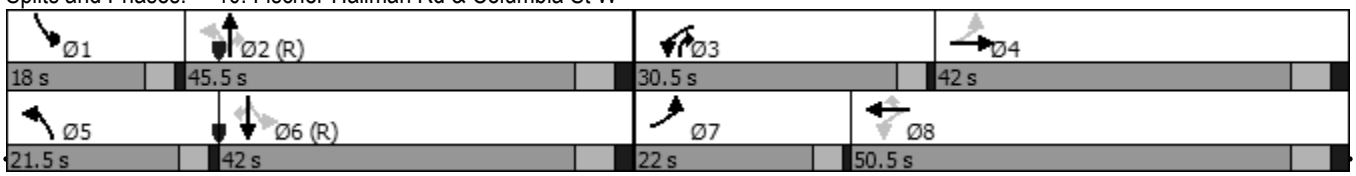
Intersection Summary			
HCM 2000 Control Delay	40.3	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	20.5
Intersection Capacity Utilization	127.2%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	189	427	160	397	944	266	266	358	131	130	656	326
Future Volume (vph)	189	427	160	397	944	266	266	358	131	130	656	326
Ideal Flow (vphpl)	1775	1900	1750	1775	1900	1750	1775	1900	1750	1775	1900	1750
Lane Width (m)	3.0	3.4	3.4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Storage Length (m)	115.0		82.0	82.0		45.0	95.0		72.0	70.0		53.0
Storage Lanes	1		0	1		1	1		1	1		1
Taper Length (m)	73.0			100.0			36.0			33.0		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Ped Bike Factor	0.99	0.99		1.00		0.96	0.99		0.98	0.99		0.96
Frt		0.959				0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1543	3311	0	1635	3570	1442	1651	3570	1388	1588	3535	1456
Flt Permitted	0.152			0.229			0.193			0.538		
Satd. Flow (perm)	246	3311	0	393	3570	1388	333	3570	1359	895	3535	1400
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		39				146			131			271
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		658.0			231.9			2051.4			968.6	
Travel Time (s)		39.5			13.9			123.1			58.1	
Confl. Peds. (#/hr)	23		6	6		23	24		8	8		24
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	2%	2%	1%	2%	0%	2%	1%	0%	6%	5%	1%	1%
Adj. Flow (vph)	189	427	160	397	944	266	266	358	131	130	656	326
Shared Lane Traffic (%)												
Lane Group Flow (vph)	189	587	0	397	944	266	266	358	131	130	656	326
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.19	1.03	1.14	1.11	1.01	1.13	1.11	1.01	1.13	1.11	1.01	1.13
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2	1	1	2	1	1	2	1
Detector Template	Left	Thru		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Leading Detector (m)	6.1	30.5		6.1	30.5	6.1	6.1	30.5	6.1	6.1	30.5	6.1
Trailing Detector (m)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	6.1	1.8		6.1	1.8	6.1	6.1	1.8	6.1	6.1	1.8	6.1
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	pm+ov	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2	3	1	6	
Permitted Phases	4			8		8	2		2	6		6
Detector Phase	7	4		3	8	8	5	2	3	1	6	6
Switch Phase												
Minimum Initial (s)	5.0	36.0		5.0	36.0	36.0	5.0	36.0	5.0	5.0	36.0	36.0
Minimum Split (s)	9.0	42.0		9.0	42.0	42.0	9.0	42.0	9.0	9.0	42.0	42.0
Total Split (s)	22.0	42.0		30.5	50.5	50.5	21.5	45.5	30.5	18.0	42.0	42.0
Total Split (%)	16.2%	30.9%		22.4%	37.1%	37.1%	15.8%	33.5%	22.4%	13.2%	30.9%	30.9%
Maximum Green (s)	18.0	36.0		26.5	44.5	44.5	17.5	39.5	26.5	14.0	36.0	36.0
Yellow Time (s)	3.0	4.0		3.0	4.0	4.0	3.0	4.0	3.0	3.0	4.0	4.0
All-Red Time (s)	1.0	2.0		1.0	2.0	2.0	1.0	2.0	1.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0		4.0	6.0	6.0	4.0	6.0	4.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag	Lead	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes		Yes	Yes	Yes		
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None		None	None	None	None	C-Max	None	None	C-Max	C-Max
Walk Time (s)		15.0			15.0	15.0		15.0			15.0	15.0
Flash Dont Walk (s)		21.0			21.0	21.0		21.0			21.0	21.0
Pedestrian Calls (#/hr)		0			0	0		0			0	0
Act Effct Green (s)	53.5	36.0		67.8	46.3	46.3	60.0	42.5	70.2	51.0	37.2	37.2
Actuated g/C Ratio	0.39	0.26		0.50	0.34	0.34	0.44	0.31	0.52	0.38	0.27	0.27
v/c Ratio	0.77	0.65		0.92	0.78	0.47	0.85	0.32	0.17	0.33	0.68	0.56
Control Delay	48.7	45.2		53.7	45.9	18.5	51.6	37.4	3.1	26.2	48.6	12.6
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	48.7	45.2		53.7	45.9	18.5	51.6	37.4	3.1	26.2	48.6	12.6
LOS	D	D		D	D	B	D	D	A	C	D	B
Approach Delay		46.1			43.3			36.4			35.4	
Approach LOS		D			D			D			D	

Intersection Summary			
Area Type:	Other		
Cycle Length: 136			
Actuated Cycle Length: 136			
Offset: 98.4 (72%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 115			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.92			
Intersection Signal Delay: 40.5		Intersection LOS: D	
Intersection Capacity Utilization 116.0%		ICU Level of Service H	
Analysis Period (min) 15			

Splits and Phases: 10: Fischer-Hallman Rd & Columbia St W

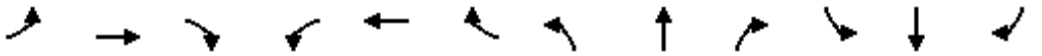




Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	189	587	397	944	266	266	358	131	130	656	326
v/c Ratio	0.77	0.65	0.92	0.78	0.47	0.85	0.32	0.17	0.33	0.68	0.56
Control Delay	48.7	45.2	53.7	45.9	18.5	51.6	37.4	3.1	26.2	48.6	12.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	48.7	45.2	53.7	45.9	18.5	51.6	37.4	3.1	26.2	48.6	12.6
Queue Length 50th (m)	28.8	69.2	68.5	120.3	24.2	47.2	39.2	0.0	21.1	84.0	11.4
Queue Length 95th (m)	#55.9	89.4	#126.9	147.8	50.9	#86.7	53.8	9.6	34.6	105.5	41.0
Internal Link Dist (m)		634.0		207.9			2027.4			944.6	
Turn Bay Length (m)	115.0		82.0		45.0	95.0		72.0	70.0		53.0
Base Capacity (vph)	272	905	437	1215	568	316	1114	777	421	967	579
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.69	0.65	0.91	0.78	0.47	0.84	0.32	0.17	0.31	0.68	0.56

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	189	427	160	397	944	266	266	358	131	130	656	326
Future Volume (vph)	189	427	160	397	944	266	266	358	131	130	656	326
Ideal Flow (vphpl)	1775	1900	1750	1775	1900	1750	1775	1900	1750	1775	1900	1750
Lane Width	3.0	3.4	3.4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	4.0	6.0	4.0	4.0	6.0	6.0
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.96	1.00	1.00	0.99	1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.96		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1542	3311		1634	3570	1388	1649	3570	1370	1584	3535	1400
Flt Permitted	0.15	1.00		0.23	1.00	1.00	0.19	1.00	1.00	0.54	1.00	1.00
Satd. Flow (perm)	247	3311		394	3570	1388	335	3570	1370	896	3535	1400
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	189	427	160	397	944	266	266	358	131	130	656	326
RTOR Reduction (vph)	0	29	0	0	0	96	0	0	65	0	0	197
Lane Group Flow (vph)	189	558	0	397	944	170	266	358	66	130	656	129
Confl. Peds. (#/hr)	23		6	6		23	24		8	8		24
Heavy Vehicles (%)	2%	2%	1%	2%	0%	2%	1%	0%	6%	5%	1%	1%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	pm+ov	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2	3	1	6	
Permitted Phases	4			8		8	2		2	6		6
Actuated Green, G (s)	51.5	36.0		65.8	46.3	46.3	58.2	42.4	68.2	49.0	37.2	37.2
Effective Green, g (s)	51.5	36.0		65.8	46.3	46.3	58.2	42.4	68.2	49.0	37.2	37.2
Actuated g/C Ratio	0.38	0.26		0.48	0.34	0.34	0.43	0.31	0.50	0.36	0.27	0.27
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	4.0	6.0	4.0	4.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	241	876		425	1215	472	307	1113	687	382	966	382
v/s Ratio Prot	0.09	0.17		c0.18	0.26		c0.11	0.10	0.02	0.03	0.19	
v/s Ratio Perm	0.21			c0.27		0.12	c0.26		0.03	0.09		0.09
v/c Ratio	0.78	0.64		0.93	0.78	0.36	0.87	0.32	0.10	0.34	0.68	0.34
Uniform Delay, d1	31.8	44.2		26.9	40.2	33.7	29.3	35.8	17.8	30.3	44.1	39.5
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	15.3	1.5		27.6	3.2	0.5	21.7	0.8	0.1	0.5	3.8	2.4
Delay (s)	47.1	45.8		54.5	43.4	34.2	51.0	36.6	17.8	30.8	47.9	41.9
Level of Service	D	D		D	D	C	D	D	B	C	D	D
Approach Delay (s)		46.1			44.6			38.4			44.2	
Approach LOS		D			D			D			D	

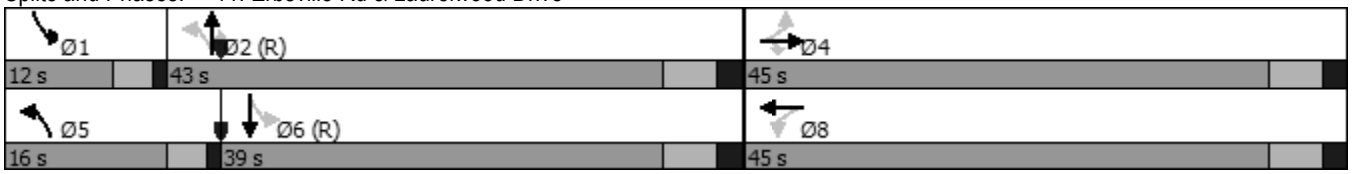
Intersection Summary			
HCM 2000 Control Delay	43.7	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	136.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	116.0%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

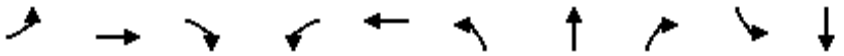
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	20	89	167	146	187	85	233	346	132	59	413	30
Future Volume (vph)	20	89	167	146	187	85	233	346	132	59	413	30
Ideal Flow (vphpl)	1775	1900	1750	1775	1650	1650	1775	1900	1750	1775	1650	1650
Storage Length (m)	27.0		0.0	20.0		0.0	65.0		29.0	19.0		0.0
Storage Lanes	1		1	1		0	1		1	1		0
Taper Length (m)	22.0			18.0			73.0			49.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor	0.95		0.95	0.97	0.97		0.99		0.95	0.98	1.00	
Frt			0.850		0.953				0.850		0.990	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1588	1789	1401	1668	1481	0	1619	1807	1456	1668	1590	0
Flt Permitted	0.390			0.699			0.371			0.553		
Satd. Flow (perm)	622	1789	1327	1191	1481	0	626	1807	1388	956	1590	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			167		27				105		4	
Link Speed (k/h)		50			50			60			60	
Link Distance (m)		270.4			1189.4			1422.7			1517.5	
Travel Time (s)		19.5			85.6			85.4			91.1	
Confl. Peds. (#/hr)	56		26	26		56	17		18	18		17
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	5%	5%	5%	0%	3%	0%	3%	4%	1%	0%	1%	5%
Adj. Flow (vph)	20	89	167	146	187	85	233	346	132	59	413	30
Shared Lane Traffic (%)												
Lane Group Flow (vph)	20	89	167	146	272	0	233	346	132	59	443	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.11	1.01	1.13	1.11	1.21	1.21	1.11	1.01	1.13	1.11	1.21	1.21
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2	1	1	2		1	2	1	1	2	
Detector Template	Left	Thru	Right	Left	Thru		Left	Thru	Right	Left	Thru	
Leading Detector (m)	6.1	30.5	6.1	6.1	30.5		6.1	30.5	6.1	6.1	30.5	
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Size(m)	6.1	1.8	6.1	6.1	1.8		6.1	1.8	6.1	6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Perm	NA	Perm	Perm	NA		pm+pt	NA	Perm	pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8			2		2	6		
Detector Phase	4	4	4	8	8		5	2	2	1	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0		5.0	33.0	33.0	5.0	33.0	
Minimum Split (s)	45.0	45.0	45.0	45.0	45.0		9.0	39.0	39.0	9.0	39.0	
Total Split (s)	45.0	45.0	45.0	45.0	45.0		16.0	43.0	43.0	12.0	39.0	
Total Split (%)	45.0%	45.0%	45.0%	45.0%	45.0%		16.0%	43.0%	43.0%	12.0%	39.0%	
Maximum Green (s)	39.0	39.0	39.0	39.0	39.0		12.0	37.0	37.0	8.0	33.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		3.0	4.0	4.0	3.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		1.0	2.0	2.0	1.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0		4.0	6.0	6.0	4.0	6.0	
Lead/Lag							Lead	Lag	Lag	Lead	Lag	
Lead-Lag Optimize?							Yes	Yes	Yes	Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None	None	None	None		None	C-Max	C-Max	None	C-Max	
Walk Time (s)	15.0	15.0	15.0	15.0	15.0			15.0	15.0		15.0	
Flash Dont Walk (s)	24.0	24.0	24.0	24.0	24.0			18.0	18.0		18.0	
Pedestrian Calls (#/hr)	0	0	0	0	0			0	0		0	
Act Effct Green (s)	22.7	22.7	22.7	22.7	22.7		67.1	56.3	56.3	58.6	49.7	
Actuated g/C Ratio	0.23	0.23	0.23	0.23	0.23		0.67	0.56	0.56	0.59	0.50	
v/c Ratio	0.14	0.22	0.39	0.54	0.76		0.44	0.34	0.16	0.10	0.56	
Control Delay	29.7	30.3	7.0	40.0	45.4		10.2	15.5	5.2	8.3	24.0	
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Delay	29.7	30.3	7.0	40.0	45.4		10.2	15.5	5.2	8.3	24.0	
LOS	C	C	A	D	D		B	B	A	A	C	
Approach Delay		16.2			43.5			11.9			22.1	
Approach LOS		B			D			B			C	

Intersection Summary			
Area Type:	Other		
Cycle Length: 100			
Actuated Cycle Length: 100			
Offset: 64.8 (65%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 95			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.76			
Intersection Signal Delay: 22.1		Intersection LOS: C	
Intersection Capacity Utilization 85.0%		ICU Level of Service E	
Analysis Period (min) 15			

Splits and Phases: 11: Erbsville Rd & Laurelwood Drive





Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	20	89	167	146	272	233	346	132	59	443
v/c Ratio	0.14	0.22	0.39	0.54	0.76	0.44	0.34	0.16	0.10	0.56
Control Delay	29.7	30.3	7.0	40.0	45.4	10.2	15.5	5.2	8.3	24.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.7	30.3	7.0	40.0	45.4	10.2	15.5	5.2	8.3	24.0
Queue Length 50th (m)	3.1	14.2	0.0	25.1	44.9	15.2	35.3	2.3	3.4	55.8
Queue Length 95th (m)	8.4	23.6	14.0	39.1	64.5	33.5	69.3	13.5	10.0	#124.0
Internal Link Dist (m)		246.4			1165.4		1398.7			1493.5
Turn Bay Length (m)	27.0			20.0		65.0		29.0	19.0	
Base Capacity (vph)	242	697	619	464	594	552	1017	827	630	793
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.08	0.13	0.27	0.31	0.46	0.42	0.34	0.16	0.09	0.56

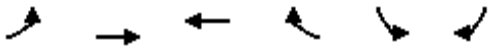
Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	20	89	167	146	187	85	233	346	132	59	413	30
Future Volume (vph)	20	89	167	146	187	85	233	346	132	59	413	30
Ideal Flow (vphpl)	1775	1900	1750	1775	1650	1650	1775	1900	1750	1775	1650	1650
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0		4.0	6.0	6.0	4.0	6.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00	0.95	1.00	0.97		1.00	1.00	0.95	1.00	1.00	
Flpb, ped/bikes	0.96	1.00	1.00	0.97	1.00		1.00	1.00	1.00	0.99	1.00	
Frt	1.00	1.00	0.85	1.00	0.95		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1518	1789	1327	1618	1481		1613	1807	1388	1653	1590	
Flt Permitted	0.39	1.00	1.00	0.70	1.00		0.37	1.00	1.00	0.55	1.00	
Satd. Flow (perm)	622	1789	1327	1191	1481		629	1807	1388	962	1590	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	20	89	167	146	187	85	233	346	132	59	413	30
RTOR Reduction (vph)	0	0	129	0	21	0	0	0	47	0	2	0
Lane Group Flow (vph)	20	89	38	146	251	0	233	346	85	59	441	0
Confl. Peds. (#/hr)	56		26	26		56	17		18	18		17
Heavy Vehicles (%)	5%	5%	5%	0%	3%	0%	3%	4%	1%	0%	1%	5%
Turn Type	Perm	NA	Perm	Perm	NA		pm+pt	NA	Perm	pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8			2		2	6		
Actuated Green, G (s)	22.7	22.7	22.7	22.7	22.7		65.3	55.6	55.6	55.5	49.8	
Effective Green, g (s)	22.7	22.7	22.7	22.7	22.7		65.3	55.6	55.6	55.5	49.8	
Actuated g/C Ratio	0.23	0.23	0.23	0.23	0.23		0.65	0.56	0.56	0.56	0.50	
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0		4.0	6.0	6.0	4.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	141	406	301	270	336		523	1004	771	573	791	
v/s Ratio Prot		0.05			c0.17		c0.05	0.19		0.01	c0.28	
v/s Ratio Perm	0.03		0.03	0.12			0.24		0.06	0.05		
v/c Ratio	0.14	0.22	0.13	0.54	0.75		0.45	0.34	0.11	0.10	0.56	
Uniform Delay, d1	30.9	31.4	30.8	34.1	36.0		8.5	12.2	10.5	10.3	17.4	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.5	0.3	0.2	2.2	8.8		0.6	0.9	0.3	0.1	2.8	
Delay (s)	31.3	31.7	30.9	36.3	44.8		9.1	13.1	10.8	10.3	20.3	
Level of Service	C	C	C	D	D		A	B	B	B	C	
Approach Delay (s)		31.2			41.8			11.4			19.1	
Approach LOS		C			D			B			B	

Intersection Summary			
HCM 2000 Control Delay	22.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	85.0%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

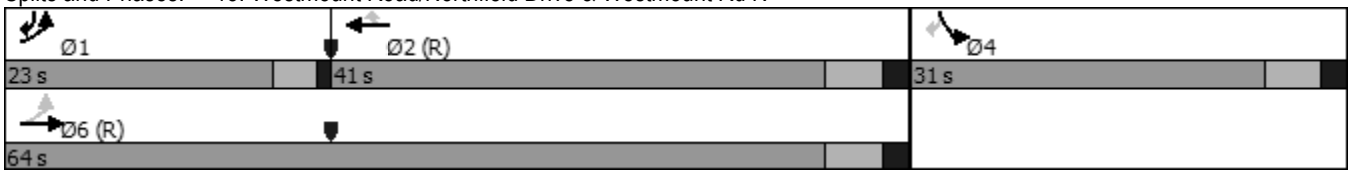


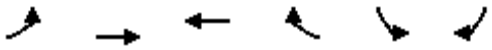
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	348	671	1150	353	195	330
Future Volume (vph)	348	671	1150	353	195	330
Ideal Flow (vphpl)	1775	1900	1900	1750	1775	1750
Storage Length (m)	94.0			33.0	75.0	0.0
Storage Lanes	1			1	1	1
Taper Length (m)	87.0				25.0	
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	1.00
Ped Bike Factor	1.00			0.98		
Frt				0.850		0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1668	3570	3570	1471	1668	1471
Flt Permitted	0.099				0.950	
Satd. Flow (perm)	174	3570	3570	1440	1668	1471
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)				187		15
Link Speed (k/h)		60	60		50	
Link Distance (m)		839.6	240.7		534.1	
Travel Time (s)		50.4	14.4		38.5	
Confl. Peds. (#/hr)	1			1		
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	348	671	1150	353	195	330
Shared Lane Traffic (%)						
Lane Group Flow (vph)	348	671	1150	353	195	330
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.5	3.5		3.5	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.11	1.01	1.01	1.13	1.11	1.13
Turning Speed (k/h)	24			14	24	14
Number of Detectors	1	2	2	1	1	1
Detector Template	Left	Thru	Thru	Right	Left	Right
Leading Detector (m)	6.1	30.5	30.5	6.1	6.1	6.1
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	6.1	1.8	1.8	6.1	6.1	6.1
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(m)		28.7	28.7			
Detector 2 Size(m)		1.8	1.8			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Turn Type	pm+pt	NA	NA	Perm	Prot	pm+ov
Protected Phases	1	6	2		4	1
Permitted Phases	6			2		4
Detector Phase	1	6	2	2	4	1
Switch Phase						
Minimum Initial (s)	5.0	30.0	30.0	30.0	7.0	5.0
Minimum Split (s)	9.0	41.0	41.0	41.0	31.0	9.0
Total Split (s)	23.0	64.0	41.0	41.0	31.0	23.0
Total Split (%)	24.2%	67.4%	43.2%	43.2%	32.6%	24.2%
Maximum Green (s)	19.0	58.0	35.0	35.0	25.0	19.0
Yellow Time (s)	3.0	4.0	4.0	4.0	4.0	3.0
All-Red Time (s)	1.0	2.0	2.0	2.0	2.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	6.0	6.0	6.0	4.0
Lead/Lag	Lead		Lag	Lag		Lead
Lead-Lag Optimize?	Yes		Yes	Yes		Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	C-Max	C-Max	C-Max	Max	None
Walk Time (s)		26.0	26.0	26.0	7.0	
Flash Dont Walk (s)		9.0	9.0	9.0	18.0	
Pedestrian Calls (#/hr)		0	0	0	0	
Act Effct Green (s)	60.0	58.0	36.4	36.4	25.0	48.6
Actuated g/C Ratio	0.63	0.61	0.38	0.38	0.26	0.51
v/c Ratio	0.90	0.31	0.84	0.53	0.45	0.43
Control Delay	51.1	9.3	34.0	13.9	33.1	15.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	51.1	9.3	34.0	13.9	33.1	15.7
LOS	D	A	C	B	C	B
Approach Delay		23.6	29.3		22.2	
Approach LOS		C	C		C	

Intersection Summary			
Area Type:	Other		
Cycle Length: 95			
Actuated Cycle Length: 95			
Offset: 6.3 (7%), Referenced to phase 2:WBT and 6:EBTL, Start of Green			
Natural Cycle: 85			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.90			
Intersection Signal Delay: 26.2		Intersection LOS: C	
Intersection Capacity Utilization 77.3%		ICU Level of Service D	
Analysis Period (min) 15			

Splits and Phases: 15: Westmount Road/Northfield Drive & Westmount Rd N

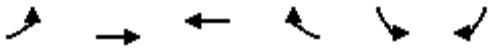




Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Group Flow (vph)	348	671	1150	353	195	330
v/c Ratio	0.90	0.31	0.84	0.53	0.45	0.43
Control Delay	51.1	9.3	34.0	13.9	33.1	15.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	51.1	9.3	34.0	13.9	33.1	15.7
Queue Length 50th (m)	46.0	28.4	101.8	22.0	29.8	33.2
Queue Length 95th (m)	#92.7	37.8	#134.0	48.6	49.8	53.6
Internal Link Dist (m)		815.6	216.7		510.1	
Turn Bay Length (m)	94.0			33.0	75.0	
Base Capacity (vph)	408	2179	1369	667	438	781
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.85	0.31	0.84	0.53	0.45	0.42

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	348	671	1150	353	195	330
Future Volume (vph)	348	671	1150	353	195	330
Ideal Flow (vphpl)	1775	1900	1900	1750	1775	1750
Total Lost time (s)	4.0	6.0	6.0	6.0	6.0	4.0
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00	0.98	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1667	3570	3570	1440	1668	1471
Flt Permitted	0.10	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	174	3570	3570	1440	1668	1471
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	348	671	1150	353	195	330
RTOR Reduction (vph)	0	0	0	115	0	8
Lane Group Flow (vph)	348	671	1150	238	195	322
Confl. Peds. (#/hr)	1			1		
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%
Turn Type	pm+pt	NA	NA	Perm	Prot	pm+ov
Protected Phases	1	6	2		4	1
Permitted Phases	6			2		4
Actuated Green, G (s)	58.0	58.0	36.4	36.4	25.0	42.6
Effective Green, g (s)	58.0	58.0	36.4	36.4	25.0	42.6
Actuated g/C Ratio	0.61	0.61	0.38	0.38	0.26	0.45
Clearance Time (s)	4.0	6.0	6.0	6.0	6.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	382	2179	1367	551	438	659
v/s Ratio Prot	c0.17	0.19	0.32		0.12	c0.09
v/s Ratio Perm	c0.39			0.17		0.13
v/c Ratio	0.91	0.31	0.84	0.43	0.45	0.49
Uniform Delay, d1	26.9	8.9	26.7	21.7	29.2	18.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	25.3	0.4	6.4	2.5	3.3	0.6
Delay (s)	52.2	9.2	33.1	24.1	32.5	19.1
Level of Service	D	A	C	C	C	B
Approach Delay (s)		23.9	31.0		24.0	
Approach LOS		C	C		C	

Intersection Summary			
HCM 2000 Control Delay	27.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	95.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	77.3%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	162	11	35	39	1	17
Future Volume (vph)	162	11	35	39	1	17
Ideal Flow (vphpl)	1765	1765	1650	1650	1650	1650
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.991		0.929			
Flt Protected	0.955					0.997
Satd. Flow (prot)	1510	0	1454	0	0	1627
Flt Permitted	0.955					0.997
Satd. Flow (perm)	1510	0	1454	0	0	1627
Link Speed (k/h)	70		60			60
Link Distance (m)	860.7		462.9			376.8
Travel Time (s)	44.3		27.8			22.6
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	10%	0%	9%	0%	0%	0%
Adj. Flow (vph)	162	11	35	39	1	17
Shared Lane Traffic (%)						
Lane Group Flow (vph)	173	0	74	0	0	18
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Right	Left	Left
Median Width(m)	3.5		0.0			0.0
Link Offset(m)	0.0		0.0			0.0
Crosswalk Width(m)	1.6		1.6			1.6
Two way Left Turn Lane						
Headway Factor	1.12	1.12	1.21	1.21	1.21	1.21
Turning Speed (k/h)	24	14		14	24	
Sign Control	Stop		Free			Free

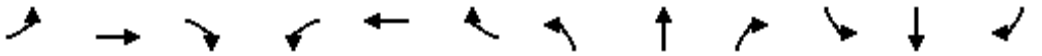
Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 21.9%		ICU Level of Service A	
Analysis Period (min) 15			



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	162	11	35	39	1	17
Future Volume (Veh/h)	162	11	35	39	1	17
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	162	11	35	39	1	17
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	74	54			74	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	74	54			74	
tC, single (s)	6.5	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.6	3.3			2.2	
p0 queue free %	82	99			100	
cM capacity (veh/h)	910	1018			1538	

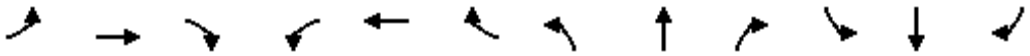
Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	173	74	18
Volume Left	162	0	1
Volume Right	11	39	0
cSH	916	1700	1538
Volume to Capacity	0.19	0.04	0.00
Queue Length 95th (m)	5.3	0.0	0.0
Control Delay (s)	9.8	0.0	0.4
Lane LOS	A		A
Approach Delay (s)	9.8	0.0	0.4
Approach LOS	A		

Intersection Summary			
Average Delay	6.5		
Intersection Capacity Utilization	21.9%	ICU Level of Service	A
Analysis Period (min)	15		



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	3	31	9	150	117	45	25	222	135	57	276	39
Future Volume (vph)	3	31	9	150	117	45	25	222	135	57	276	39
Ideal Flow (vphpl)	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550
Storage Length (m)	0.0		0.0	30.0		0.0	0.0		0.0	0.0		0.0
Storage Lanes	0		0	1		0	0		0	0		0
Taper Length (m)	2.5			45.0			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.972			0.958			0.952			0.986	
Flt Protected		0.997		0.950				0.997			0.992	
Satd. Flow (prot)	0	1426	0	1456	1460	0	0	1382	0	0	1488	0
Flt Permitted		0.997		0.950				0.997			0.992	
Satd. Flow (perm)	0	1426	0	1456	1460	0	0	1382	0	0	1488	0
Link Speed (k/h)		70			70			60			60	
Link Distance (m)		610.1			3203.9			1517.5			172.2	
Travel Time (s)		31.4			164.8			91.1			10.3	
Confl. Peds. (#/hr)			1	1			1					1
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	20%	0%	0%	2%	17%	6%	2%	0%	1%	0%
Adj. Flow (vph)	3	31	9	150	117	45	25	222	135	57	276	39
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	43	0	150	162	0	0	382	0	0	372	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 66.6%		ICU Level of Service C	
Analysis Period (min) 15			



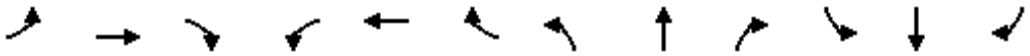
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	3	31	9	150	117	45	25	222	135	57	276	39
Future Volume (vph)	3	31	9	150	117	45	25	222	135	57	276	39
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	3	31	9	150	117	45	25	222	135	57	276	39

Direction, Lane #	EB 1	WB 1	WB 2	NB 1	SB 1
Volume Total (vph)	43	150	162	382	372
Volume Left (vph)	3	150	0	25	57
Volume Right (vph)	9	0	45	135	39
Hadj (s)	-0.04	0.50	-0.18	-0.11	-0.02
Departure Headway (s)	6.8	7.1	6.4	5.5	5.6
Degree Utilization, x	0.08	0.30	0.29	0.58	0.58
Capacity (veh/h)	426	467	517	622	616
Control Delay (s)	10.4	11.9	10.9	15.9	16.0
Approach Delay (s)	10.4	11.4		15.9	16.0
Approach LOS	B	B		C	C

Intersection Summary				
Delay	14.5			
Level of Service	B			
Intersection Capacity Utilization	66.6%	ICU Level of Service	C	
Analysis Period (min)	15			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	138	20	162	50	74	17	300	375	25	10	259	125
Future Volume (vph)	138	20	162	50	74	17	300	375	25	10	259	125
Ideal Flow (vphpl)	1650	1650	1750	1550	1550	1550	1775	1650	1650	1550	1550	1550
Storage Length (m)	0.0		65.0	0.0		0.0	35.0		0.0	0.0		0.0
Storage Lanes	0		1	0		0	1		0	0		0
Taper Length (m)	2.5			2.5			25.0			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850		0.984			0.991			0.957	
Flt Protected		0.958			0.983		0.950				0.999	
Satd. Flow (prot)	0	1563	1442	0	1423	0	1651	1617	0	0	1458	0
Flt Permitted		0.958			0.983		0.950				0.999	
Satd. Flow (perm)	0	1563	1442	0	1423	0	1651	1617	0	0	1458	0
Link Speed (k/h)		70			50			50			50	
Link Distance (m)		3203.9			162.1			534.1			164.9	
Travel Time (s)		164.8			11.7			38.5			11.9	
Confl. Peds. (#/hr)			2	2			2		1	1		2
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	2%	0%	8%	0%	1%	0%	0%	20%	0%	0%
Adj. Flow (vph)	138	20	162	50	74	17	300	375	25	10	259	125
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	158	162	0	141	0	300	400	0	0	394	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.5			3.5			3.5			3.5	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.21	1.21	1.13	1.31	1.31	1.31	1.11	1.21	1.21	1.31	1.31	1.31
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 78.0%		ICU Level of Service D	
Analysis Period (min) 15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	138	20	162	50	74	17	300	375	25	10	259	125
Future Volume (vph)	138	20	162	50	74	17	300	375	25	10	259	125
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	138	20	162	50	74	17	300	375	25	10	259	125

Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2	SB 1
Volume Total (vph)	158	162	141	300	400	394
Volume Left (vph)	138	0	50	300	0	10
Volume Right (vph)	0	162	17	0	25	125
Hadj (s)	0.44	-0.67	0.07	0.52	-0.04	-0.18
Departure Headway (s)	8.5	7.4	8.6	7.7	7.1	7.2
Degree Utilization, x	0.37	0.33	0.34	0.64	0.79	0.79
Capacity (veh/h)	390	457	367	456	497	486
Control Delay (s)	15.3	12.8	16.0	22.0	30.3	32.1
Approach Delay (s)	14.0		16.0	26.8		32.1
Approach LOS	B		C	D		D

Intersection Summary				
Delay	24.5			
Level of Service	C			
Intersection Capacity Utilization	78.0%	ICU Level of Service	D	
Analysis Period (min)	15			

APPENDIX

C REGION OF WATERLOO ROUNDABOUT TRAFFIC FLOW SHEETS

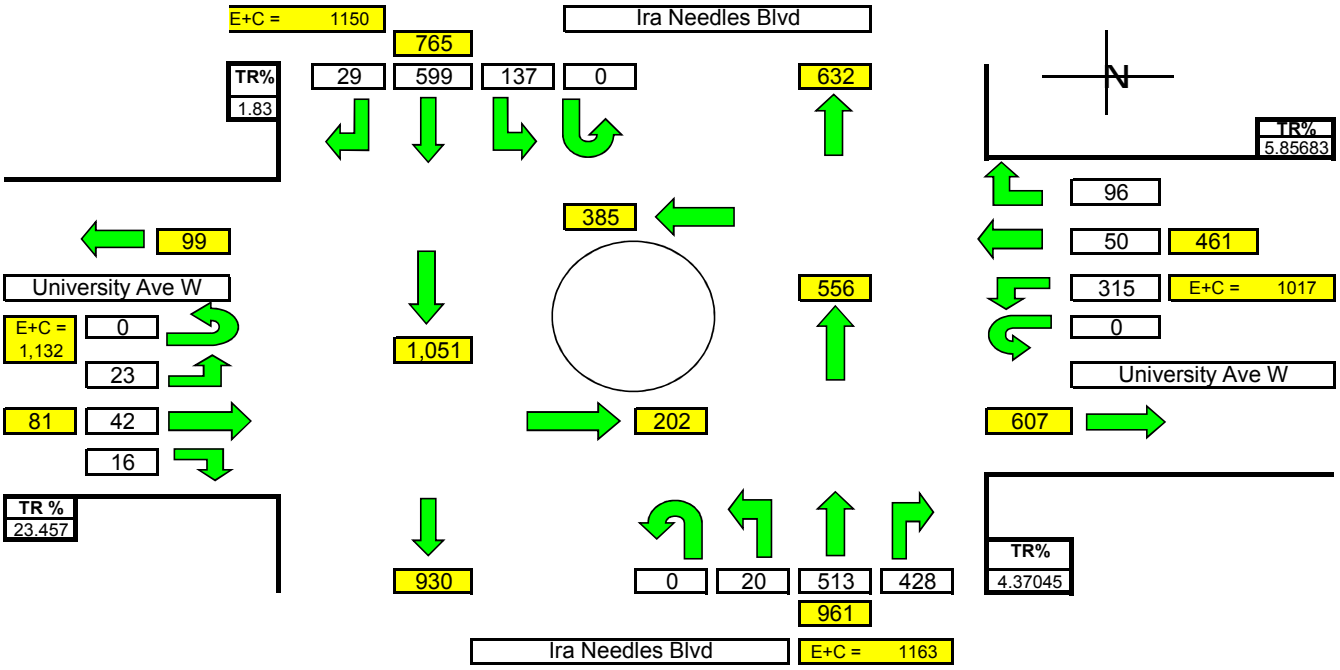
APPENDIX

C-1 EXISTING CONDITIONS

REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali
Project No.: **Sheet** 1 **of** 2
Intersection: Ira Needles Blvd/University Ave W
Time Period: AM PEAK

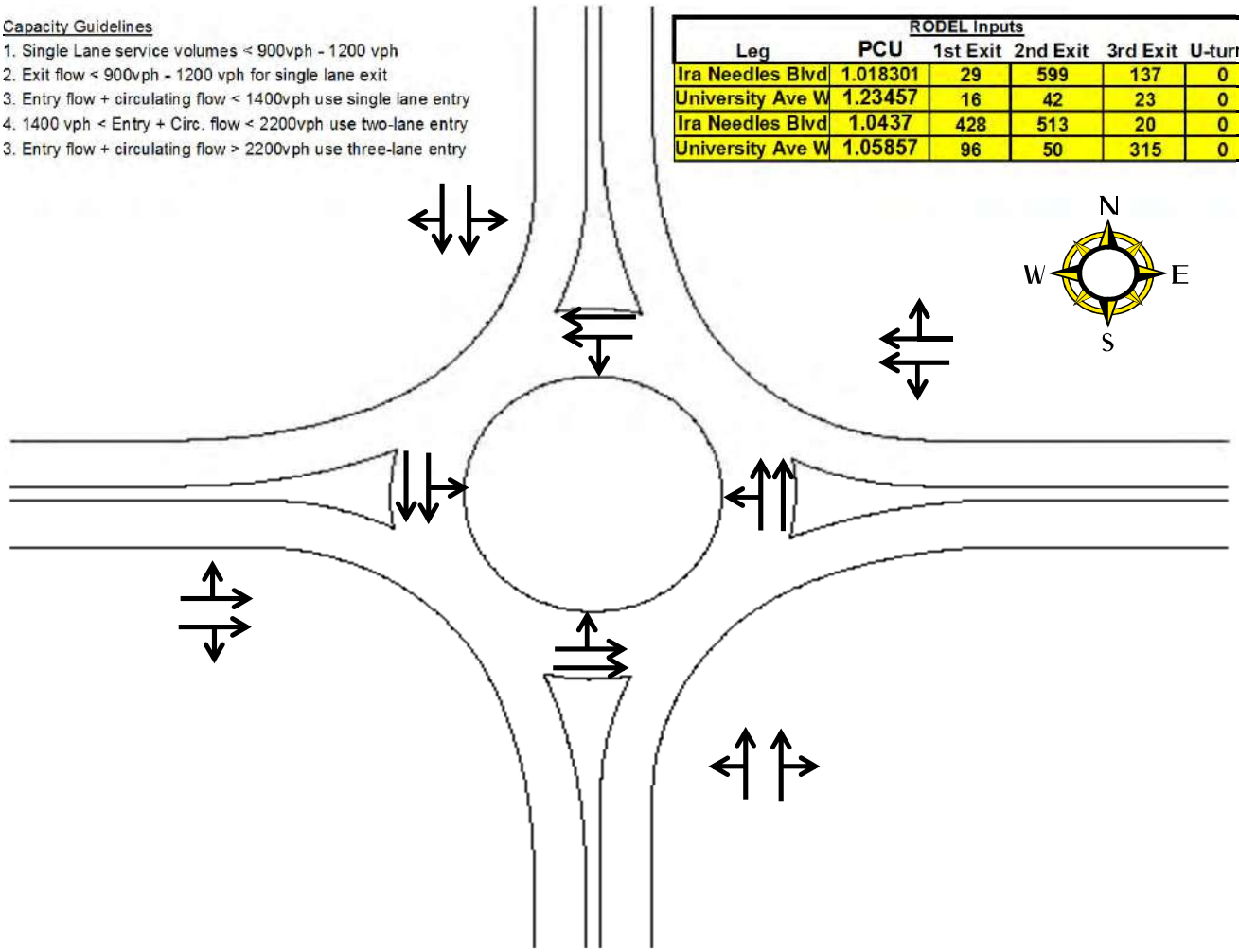


Capacity Guidelines

1. Single Lane service volumes ≤ 900vph - 1200 vph
2. Exit flow < 900vph - 1200 vph for single lane exit
3. Entry flow + circulating flow < 1400vph use single lane entry
4. 1400 vph < Entry + Circ. flow < 2200vph use two-lane entry
3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

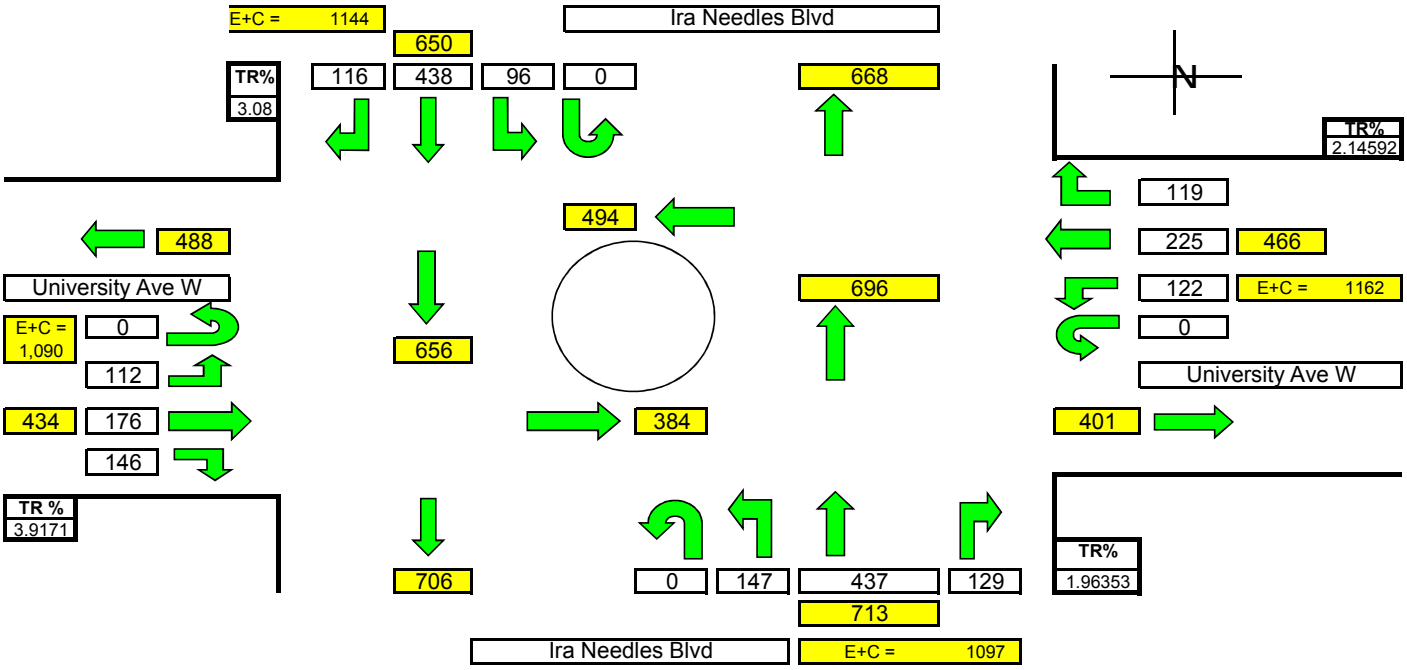
Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Ira Needles Blvd	1.018301	29	599	137	0
University Ave W	1.23457	16	42	23	0
Ira Needles Blvd	1.0437	428	513	20	0
University Ave W	1.05857	96	50	315	0



REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali
Project No.: **Sheet** 2 of 2
Intersection: Ira Needles Blvd/University Ave W
Time Period: PM PEAK

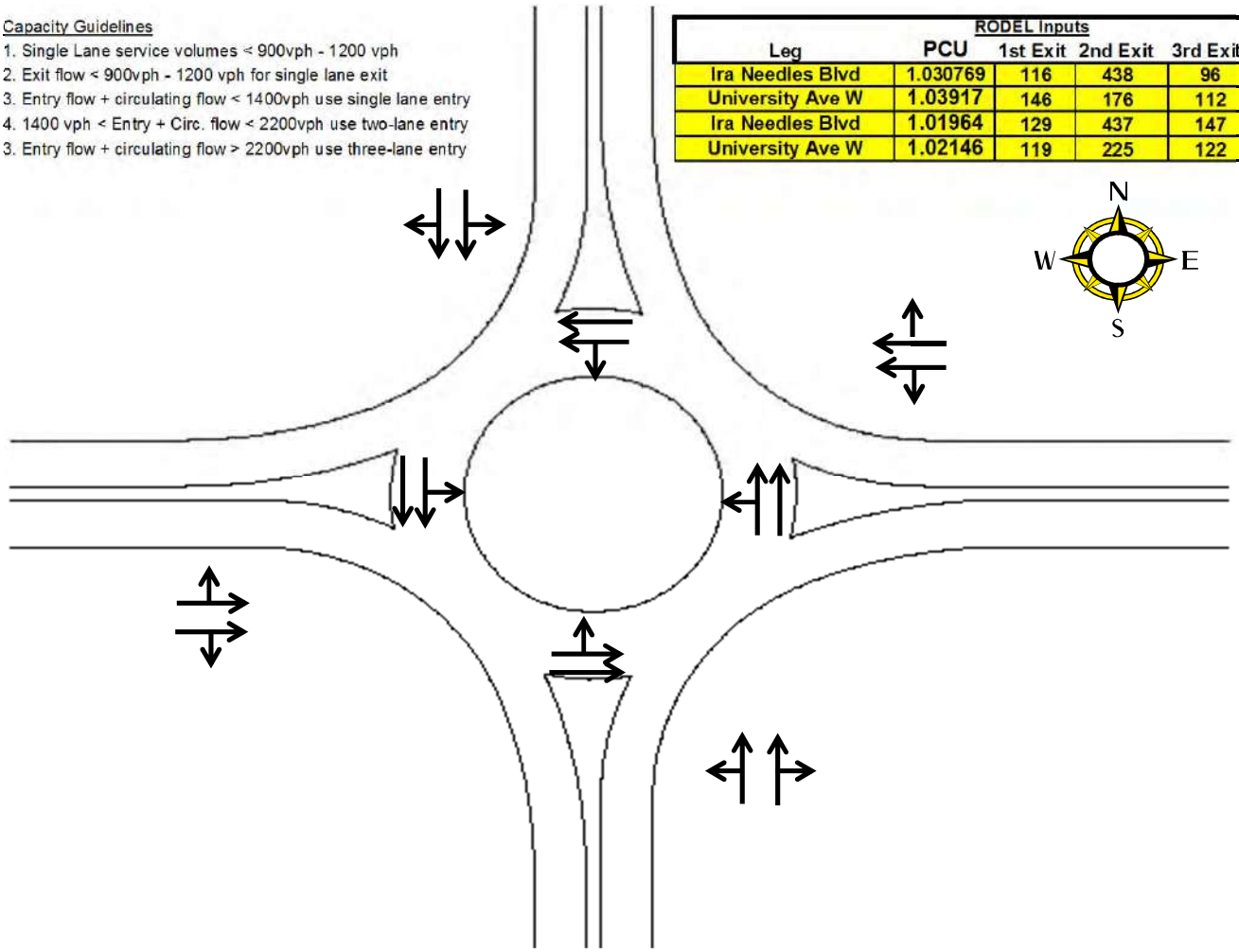


Capacity Guidelines

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3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Ira Needles Blvd	1.030769	116	438	96	0
University Ave W	1.03917	146	176	112	0
Ira Needles Blvd	1.01964	129	437	147	0
University Ave W	1.02146	119	225	122	0



REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

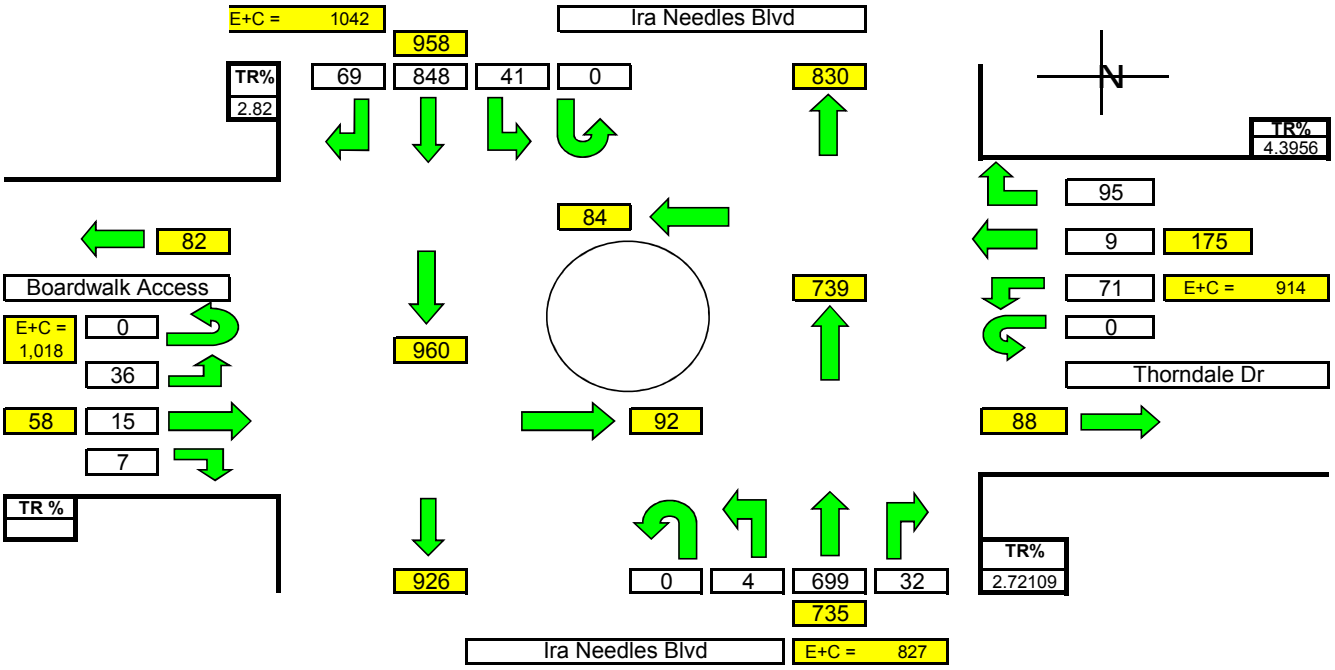
VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali

Project No.: **Sheet** 1 **of** 2

Intersection: Ira Needles Blvd/Thorndale Dr

Time Period: AM PEAK

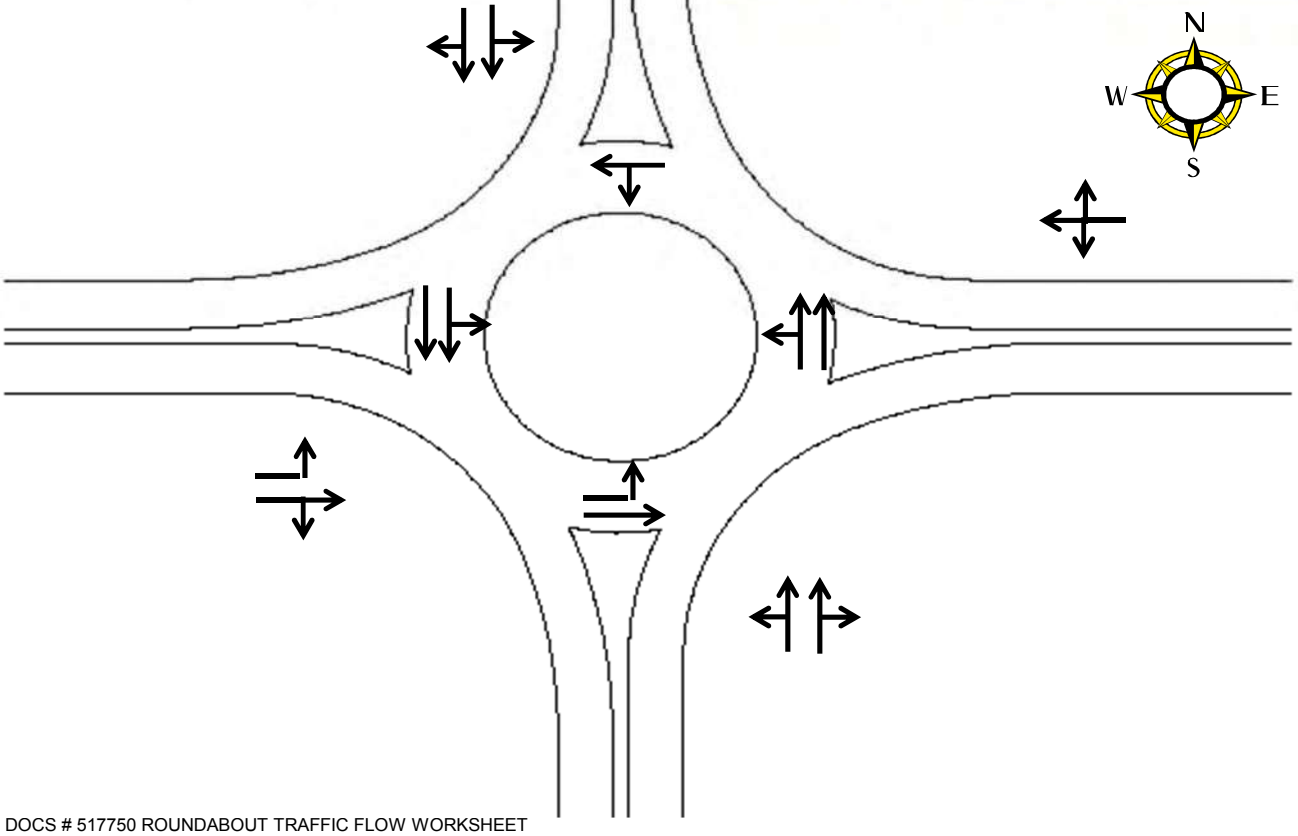


Capacity Guidelines

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4. 1400 vph < Entry + Circ. flow < 2200vph use two-lane entry
3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Ira Needles Blvd	1.028184	69	848	41	0
Boardwalk Acces	1	7	15	36	0
Ira Needles Blvd	1.02721	32	699	4	0
Thorndale Dr	1.04396	95	9	71	0



REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

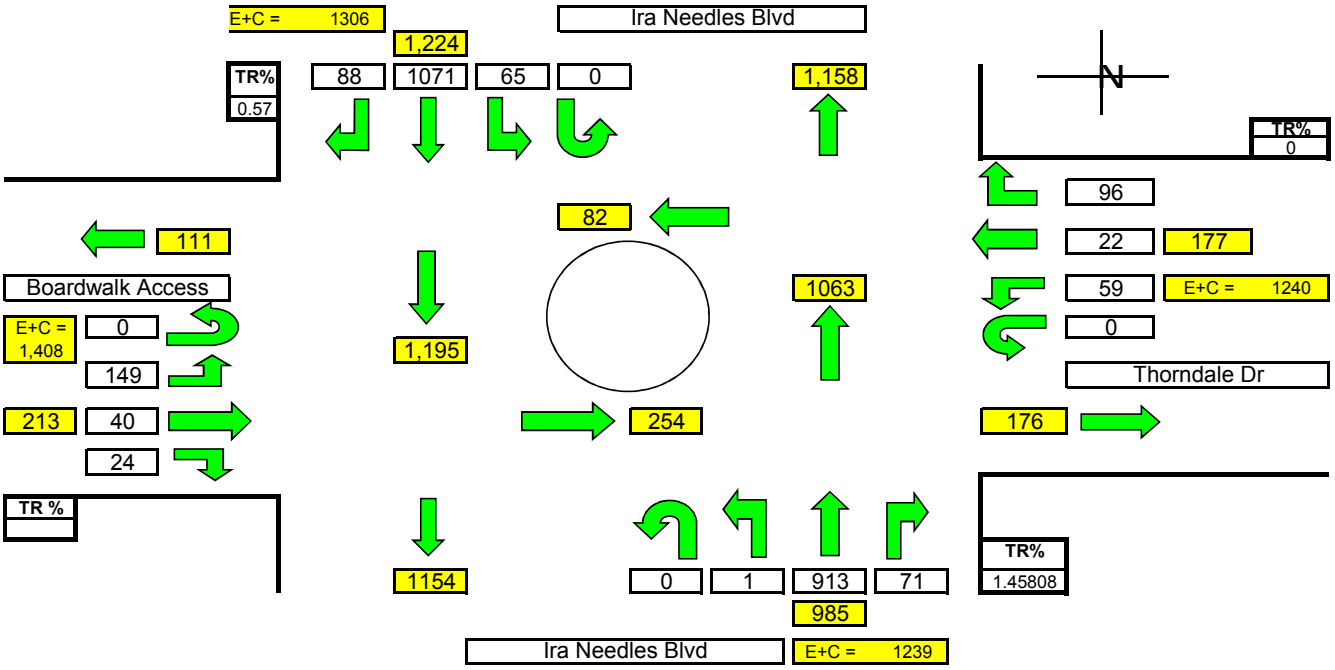
VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali

Project No.: **Sheet** 2 **of** 2

Intersection: Ira Needles Blvd/Thorndale Dr

Time Period: PM PEAK

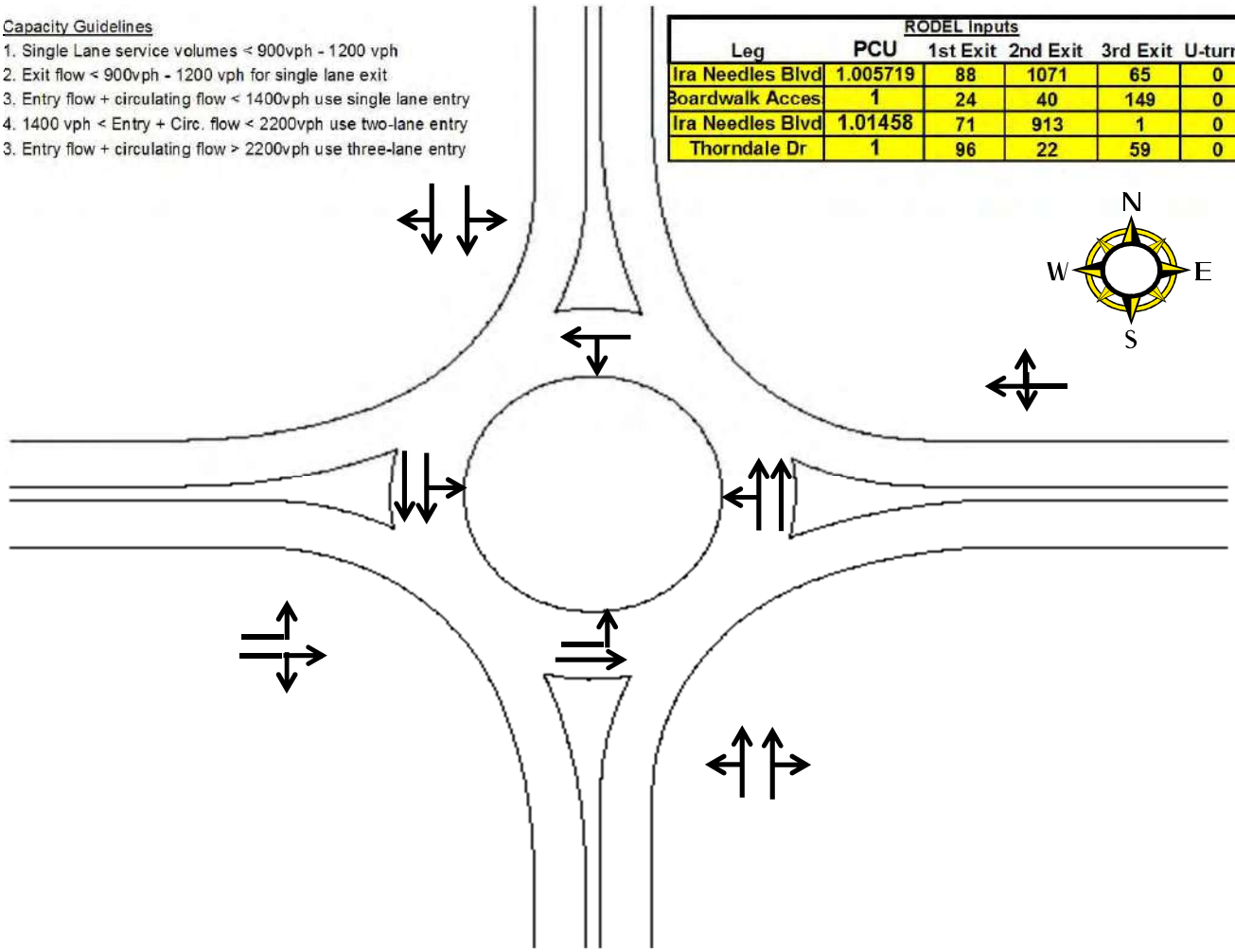


Capacity Guidelines

1. Single Lane service volumes < 900vph - 1200 vph
2. Exit flow < 900vph - 1200 vph for single lane exit
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4. 1400 vph < Entry + Circ. flow < 2200vph use two-lane entry
3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Ira Needles Blvd	1.005719	88	1071	65	0
Boardwalk Acces	1	24	40	149	0
Ira Needles Blvd	1.01458	71	913	1	0
Thorndale Dr	1	96	22	59	0

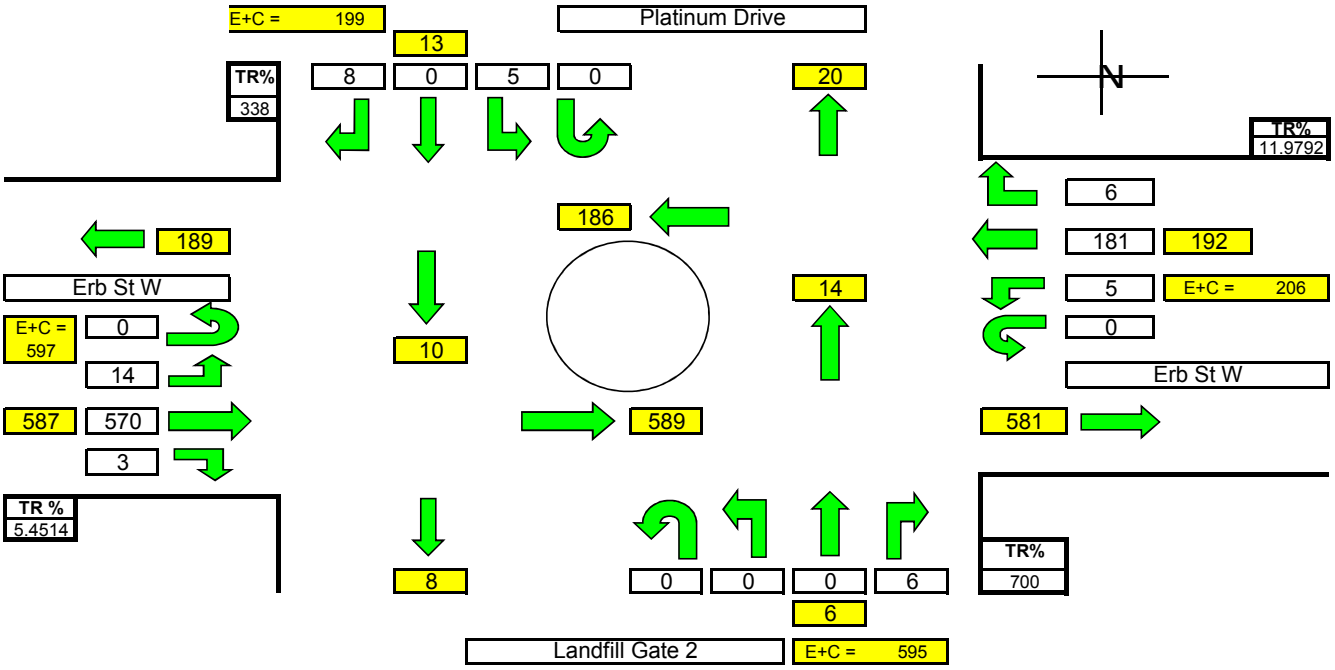


REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME
Project No.:
Intersection: Erb St W/Platinum Drive
Time Period: AM PEAK

Drawn By: Ubaid Ali
Sheet 1 **of** 2

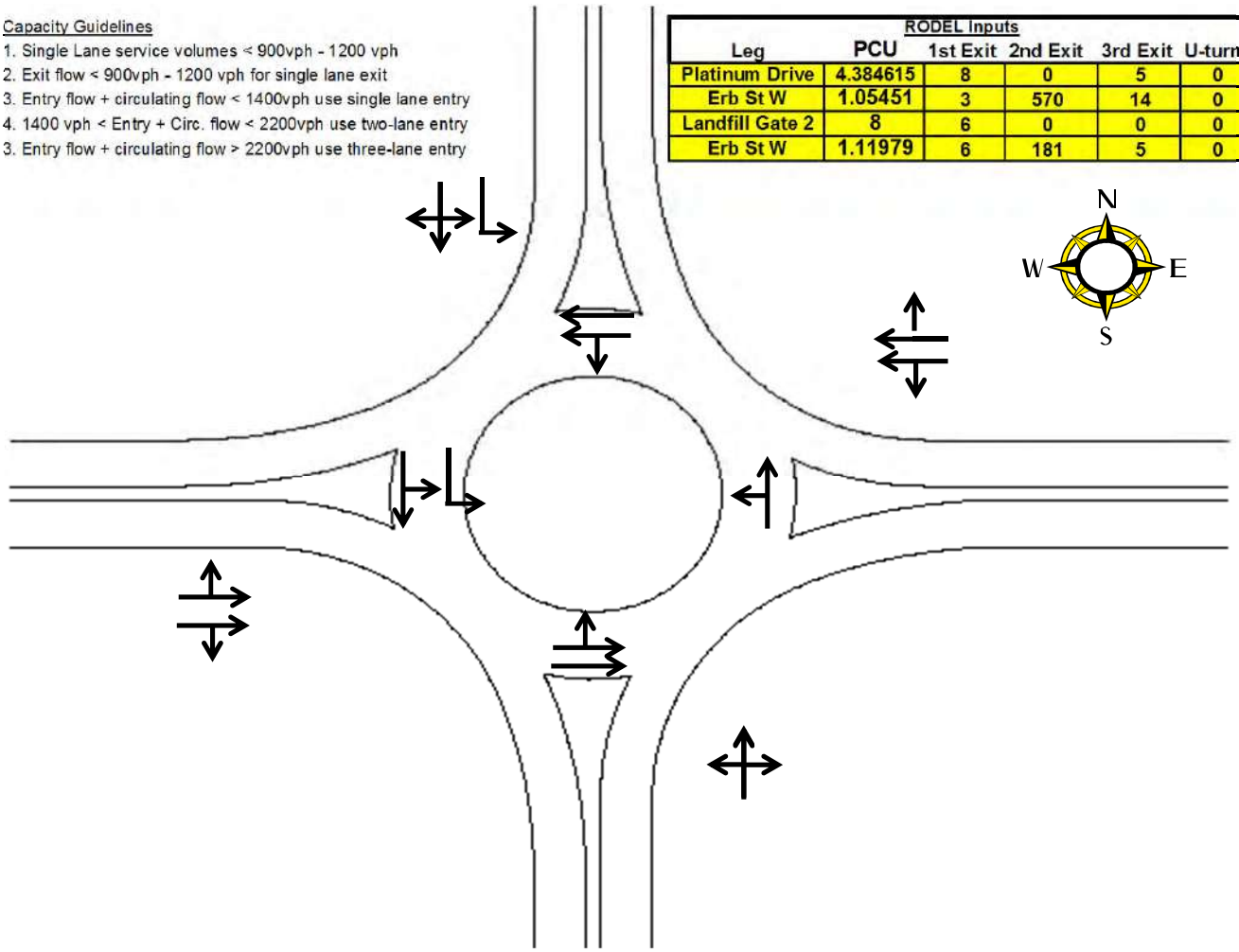


Capacity Guidelines

1. Single Lane service volumes ≤ 900vph - 1200 vph
2. Exit flow < 900vph - 1200 vph for single lane exit
3. Entry flow + circulating flow < 1400vph use single lane entry
4. 1400 vph < Entry + Circ. flow < 2200vph use two-lane entry
3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Platinum Drive	4.384615	8	0	5	0
Erb St W	1.05451	3	570	14	0
Landfill Gate 2	8	6	0	0	0
Erb St W	1.11979	6	181	5	0

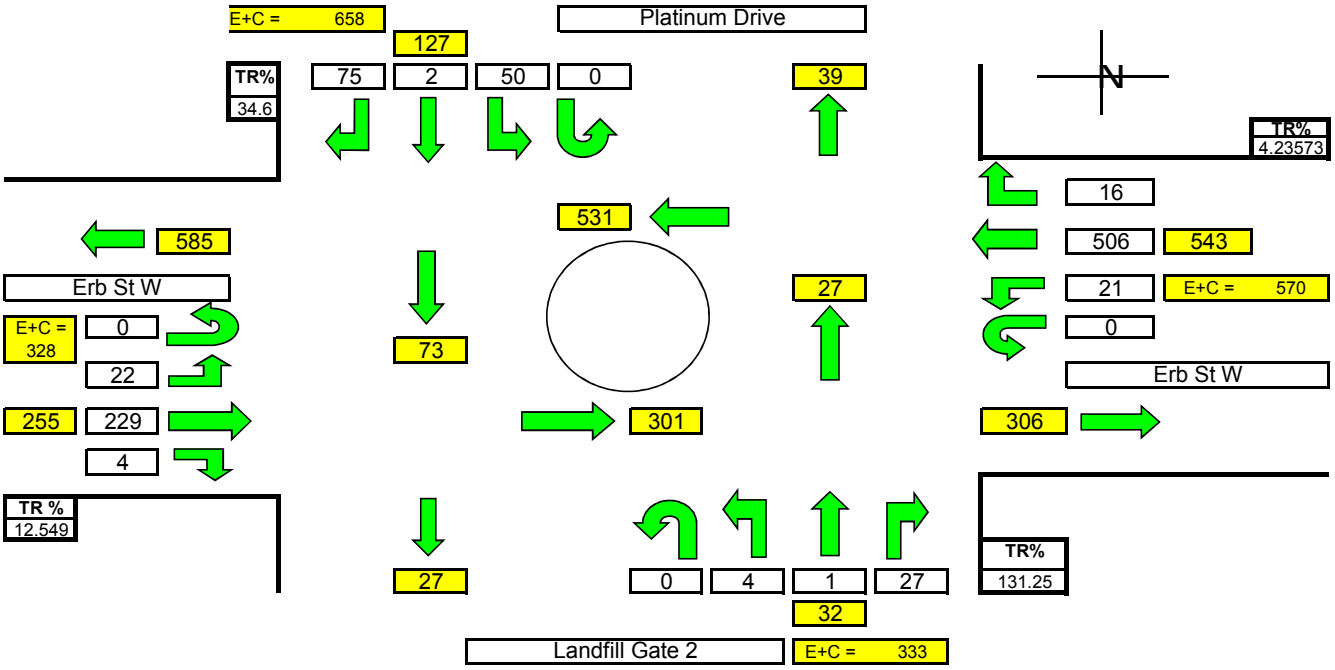


REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME
Project No.:
Intersection: Erb St W/Platinum Drive
Time Period: PM PEAK

Drawn By: Ubaid Ali
Sheet 1 **of** 2

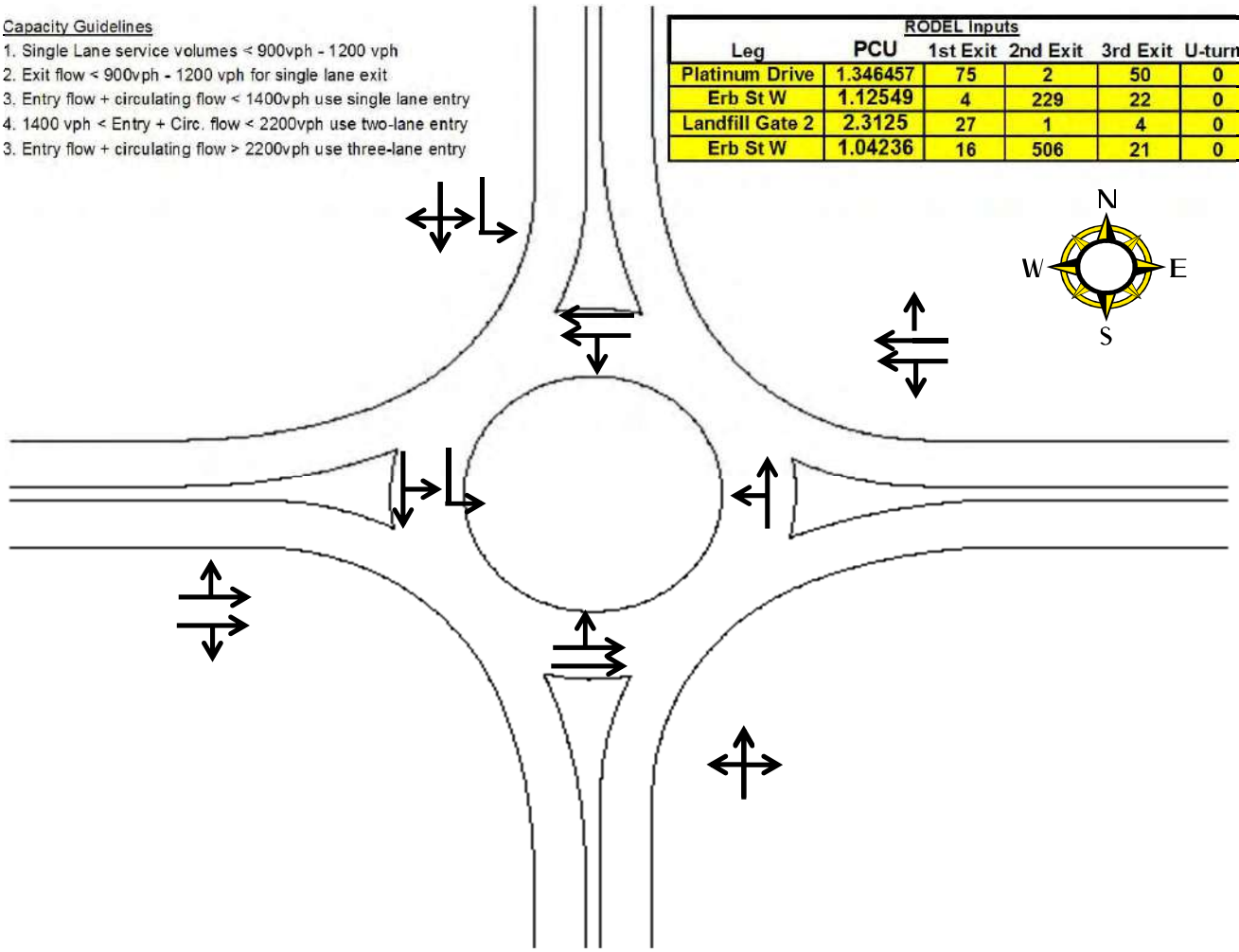


Capacity Guidelines

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2. Exit flow < 900vph - 1200 vph for single lane exit
3. Entry flow + circulating flow < 1400vph use single lane entry
4. 1400 vph < Entry + Circ. flow < 2200vph use two-lane entry
3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Platinum Drive	1.346457	75	2	50	0
Erb St W	1.12549	4	229	22	0
Landfill Gate 2	2.3125	27	1	4	0
Erb St W	1.04236	16	506	21	0



REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

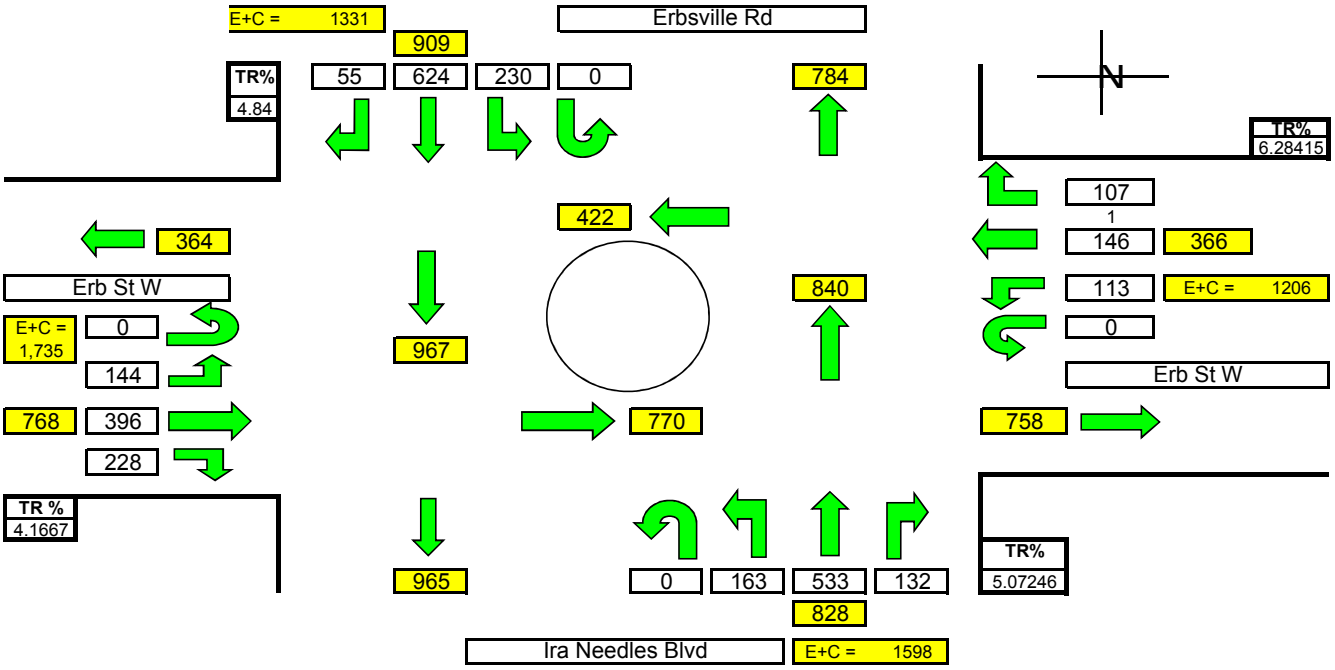
VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali

Project No.: **Sheet** 1 **of** 2

Intersection: Erb St W/Erbsville Rd-Ira Needles Blvd

Time Period: AM PEAK

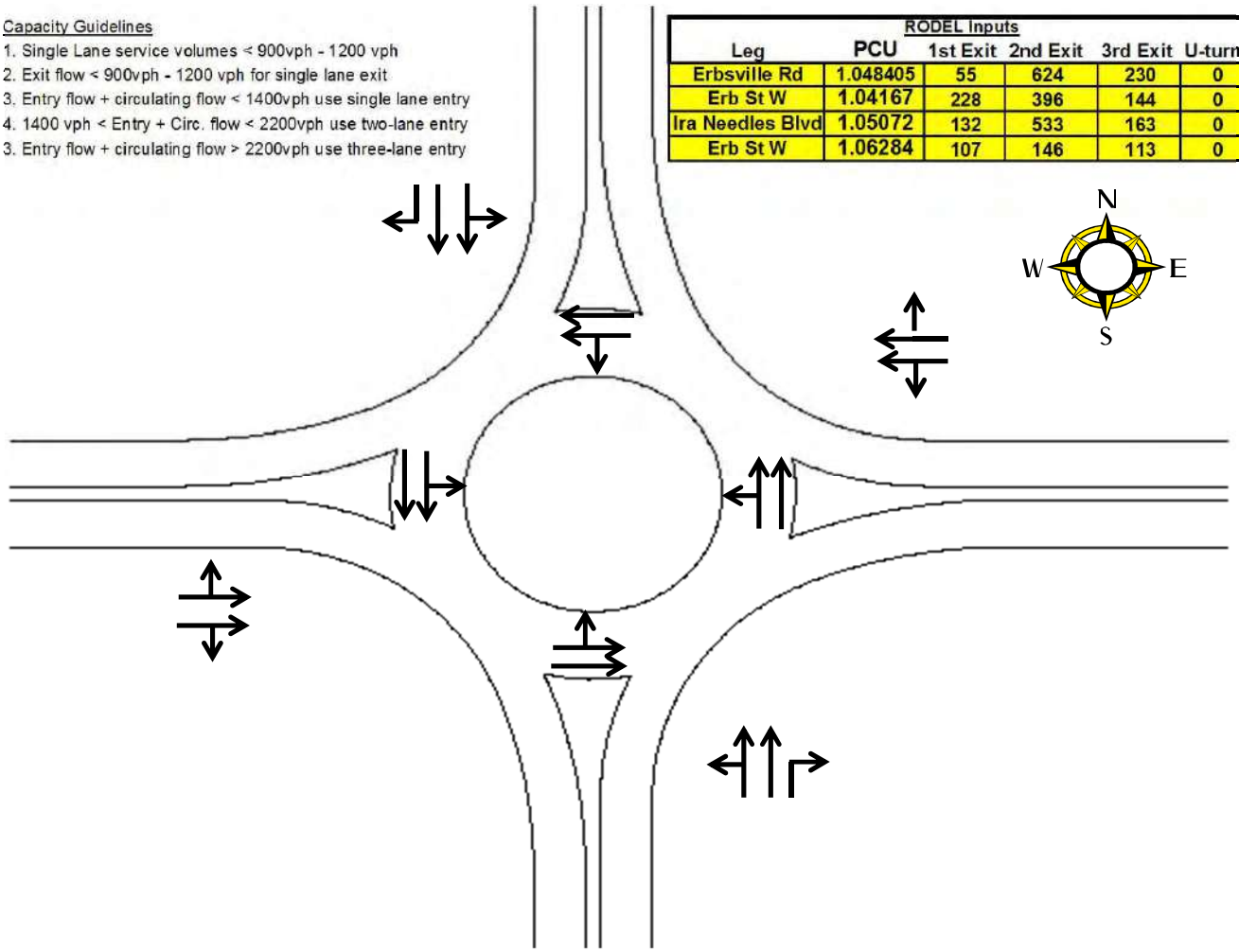


Capacity Guidelines

1. Single Lane service volumes < 900vph - 1200 vph
2. Exit flow < 900vph - 1200 vph for single lane exit
3. Entry flow + circulating flow < 1400vph use single lane entry
4. 1400 vph < Entry + Circ. flow < 2200vph use two-lane entry
3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Erbsville Rd	1.048405	55	624	230	0
Erb St W	1.04167	228	396	144	0
Ira Needles Blvd	1.05072	132	533	163	0
Erb St W	1.06284	107	146	113	0



REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

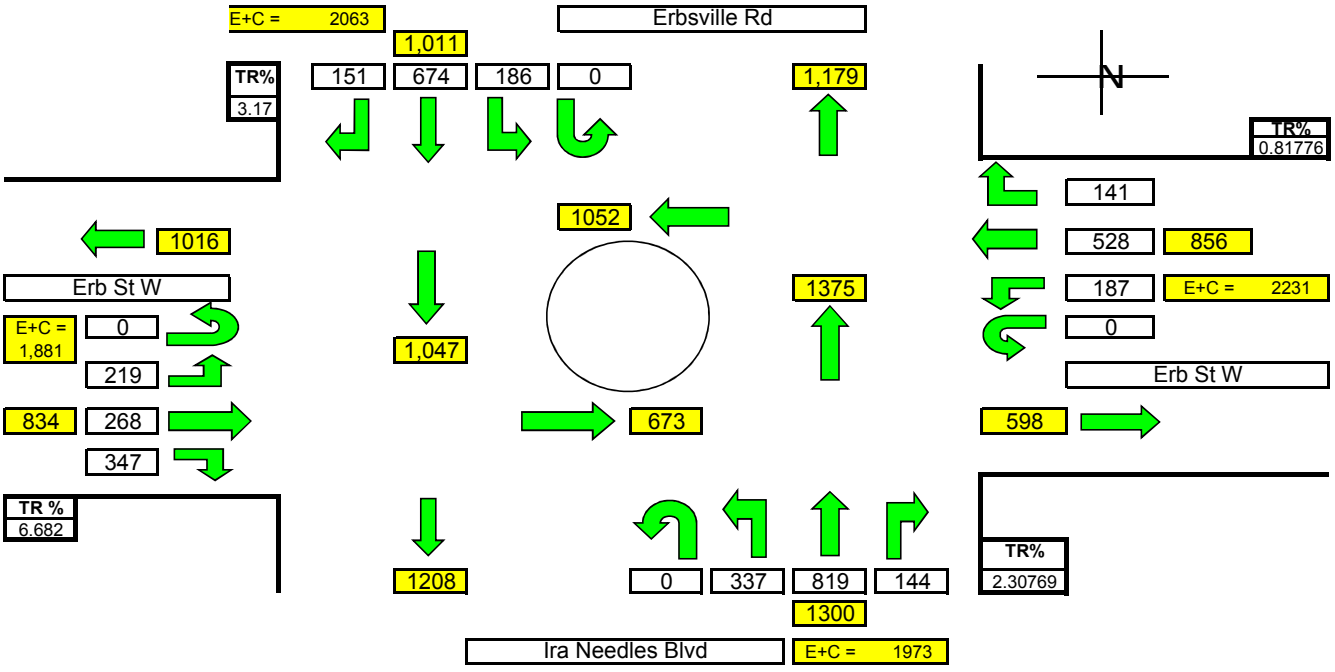
VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali

Project No.: **Sheet** 2 **of** 2

Intersection: Erb St W/Erbsville Rd-Ira Needles Blvd

Time Period: PM PEAK

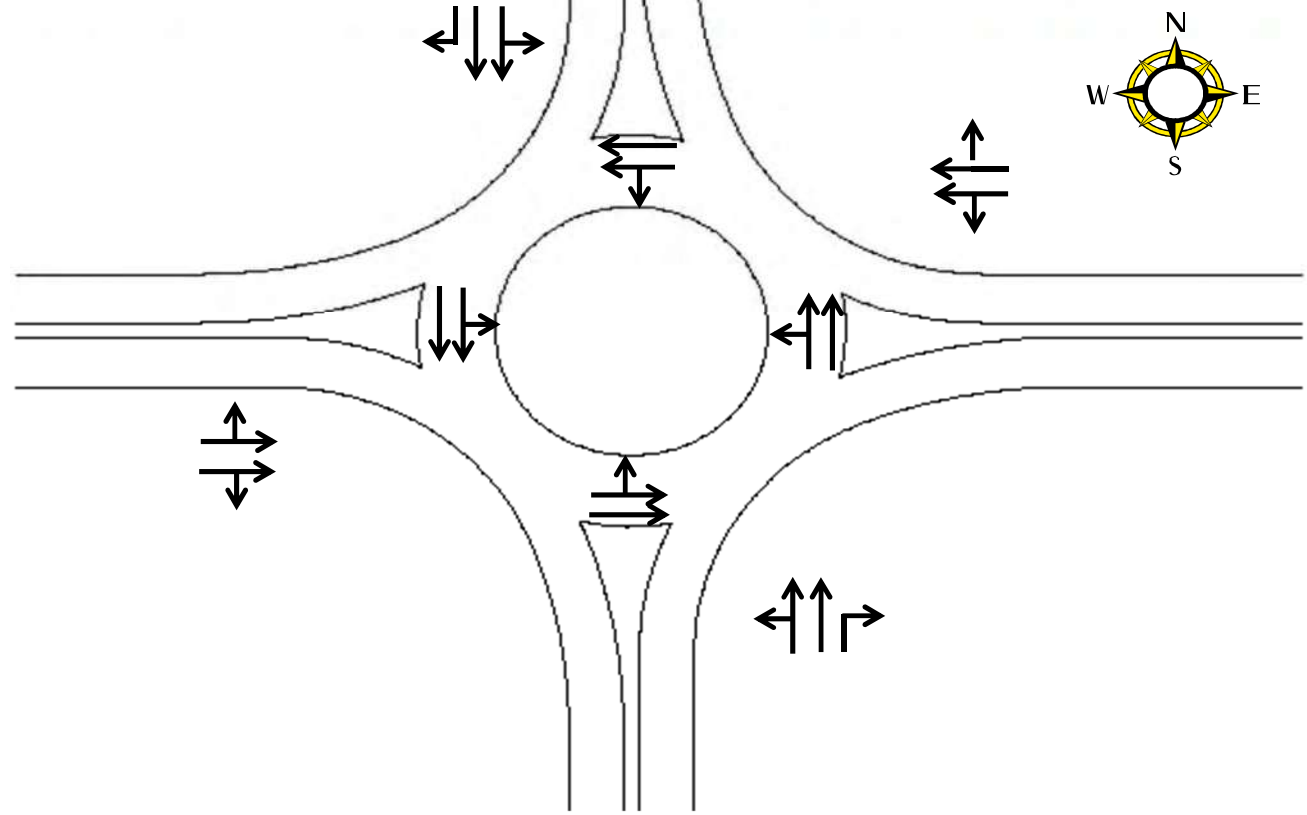


Capacity Guidelines

1. Single Lane service volumes < 900vph - 1200 vph
2. Exit flow < 900vph - 1200 vph for single lane exit
3. Entry flow + circulating flow < 1400vph use single lane entry
4. 1400 vph < Entry + Circ. flow < 2200vph use two-lane entry
3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Erbsville Rd	1.031652	151	674	186	0
Erb St W	1.06682	347	268	219	0
Ira Needles Blvd	1.02308	144	819	337	0
Erb St W	1.00818	141	528	187	0



REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

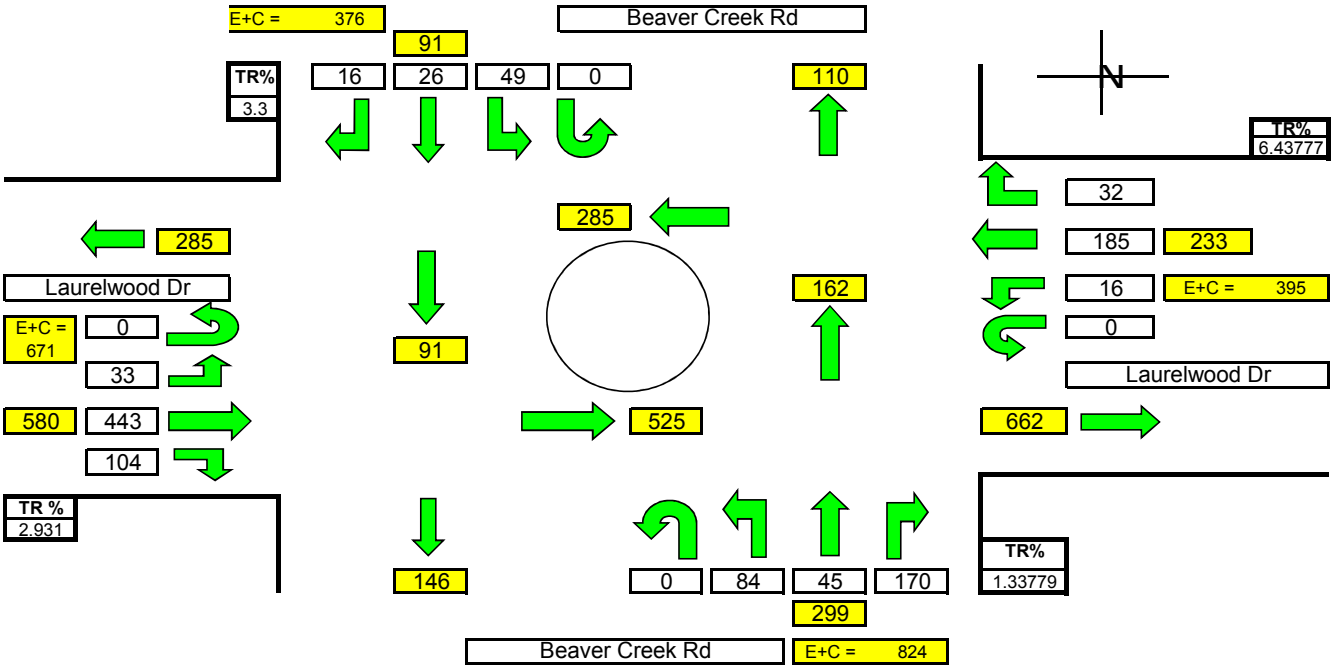
VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali

Project No.: **Sheet** 1 **of** 2

Intersection: Beaver Creek Rd/Laurelwood Dr

Time Period: AM PEAK

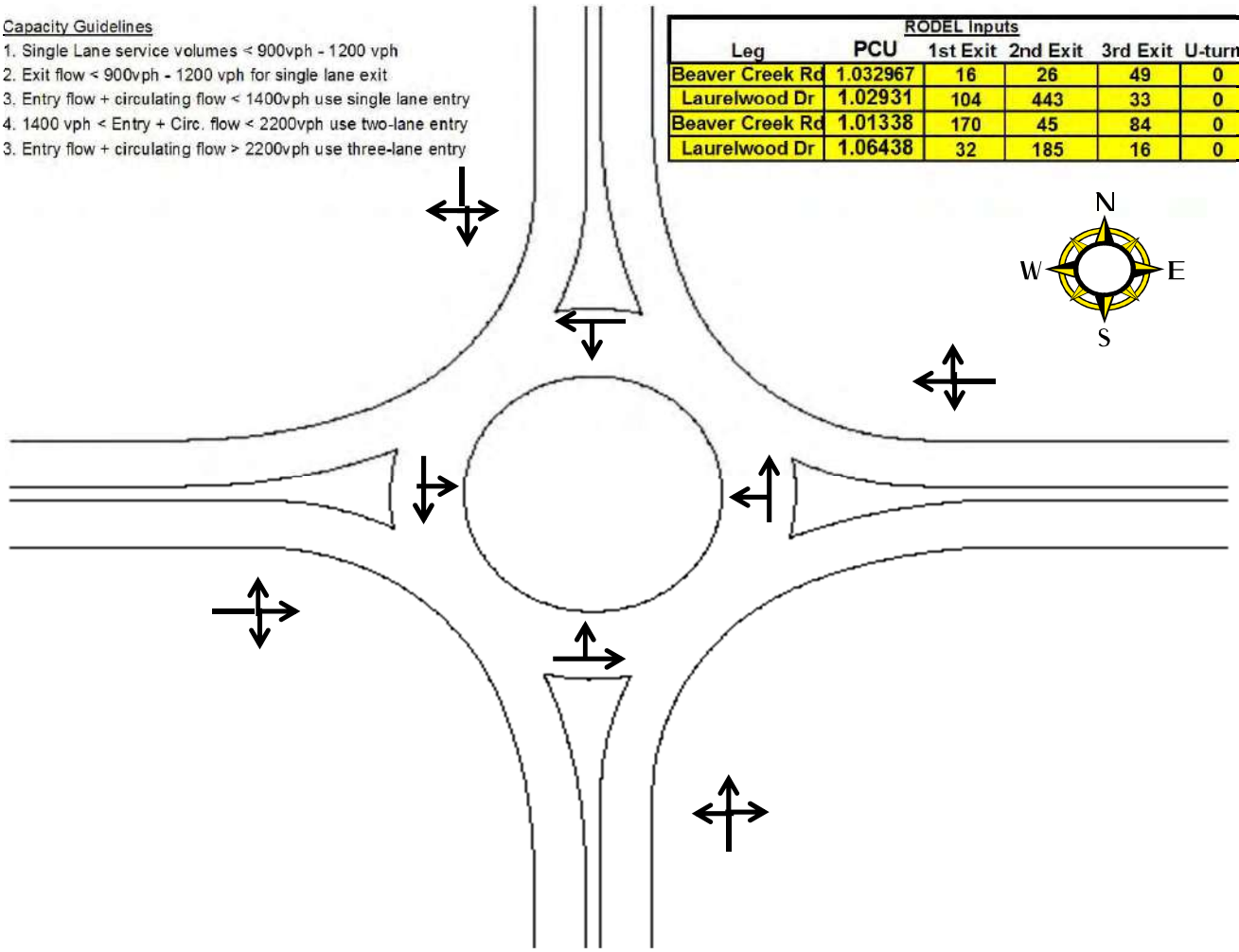


Capacity Guidelines

1. Single Lane service volumes < 900vph - 1200 vph
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4. 1400 vph < Entry + Circ. flow < 2200vph use two-lane entry
3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Beaver Creek Rd	1.032967	16	26	49	0
Laurelwood Dr	1.02931	104	443	33	0
Beaver Creek Rd	1.01338	170	45	84	0
Laurelwood Dr	1.06438	32	185	16	0



REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

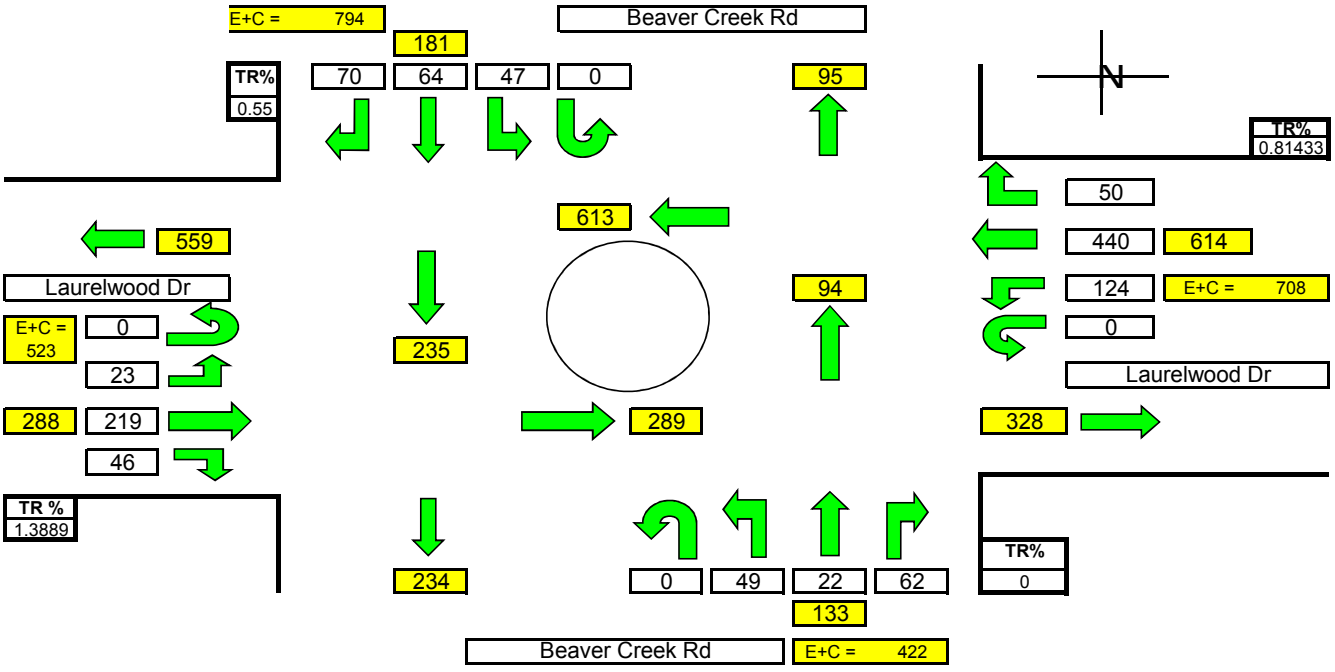
VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali

Project No.: **Sheet** 2 **of** 2

Intersection: Beaver Creek Rd/Laurelwood Dr

Time Period: PM PEAK

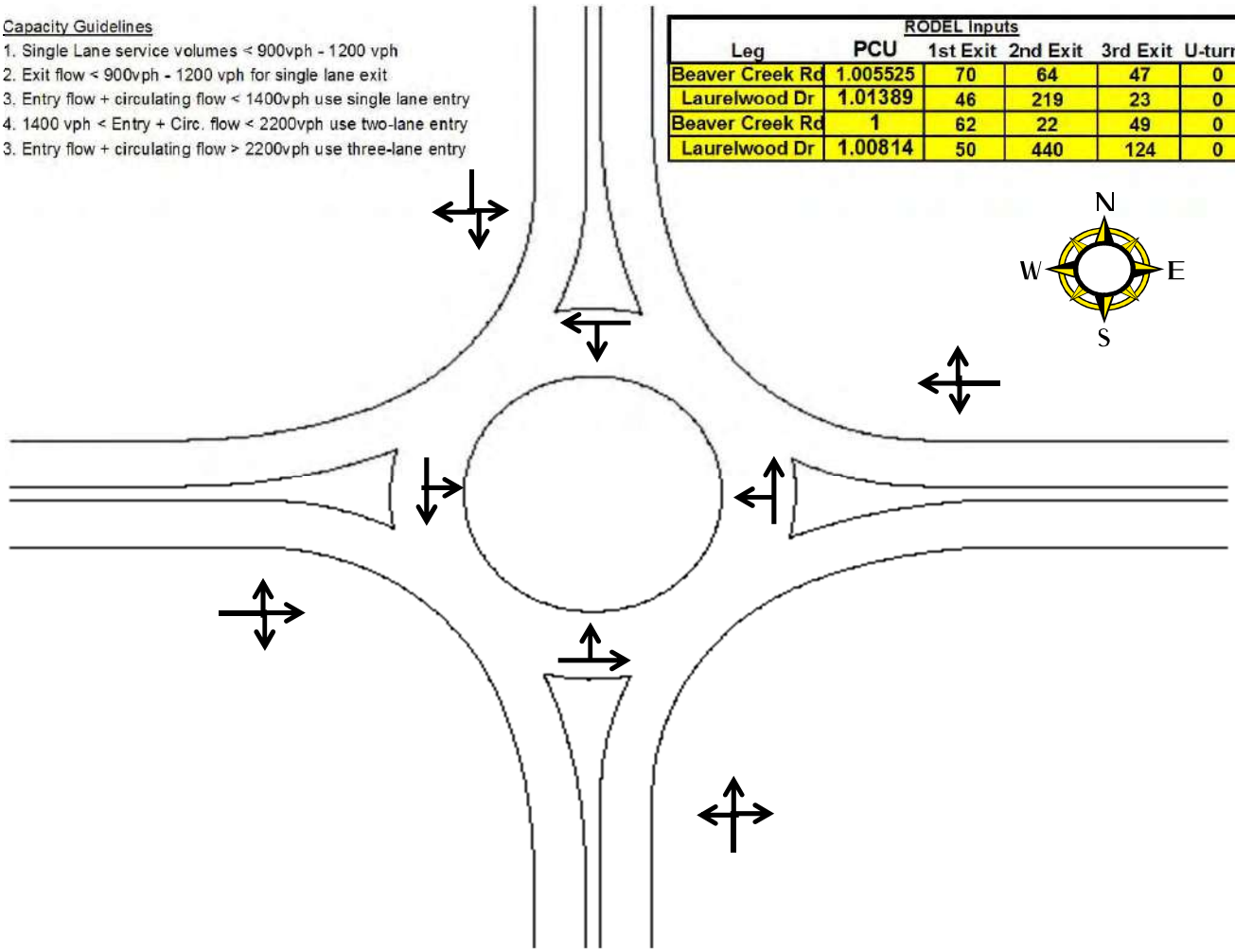


Capacity Guidelines

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3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Beaver Creek Rd	1.005525	70	64	47	0
Laurelwood Dr	1.01389	46	219	23	0
Beaver Creek Rd	1	62	22	49	0
Laurelwood Dr	1.00814	50	440	124	0



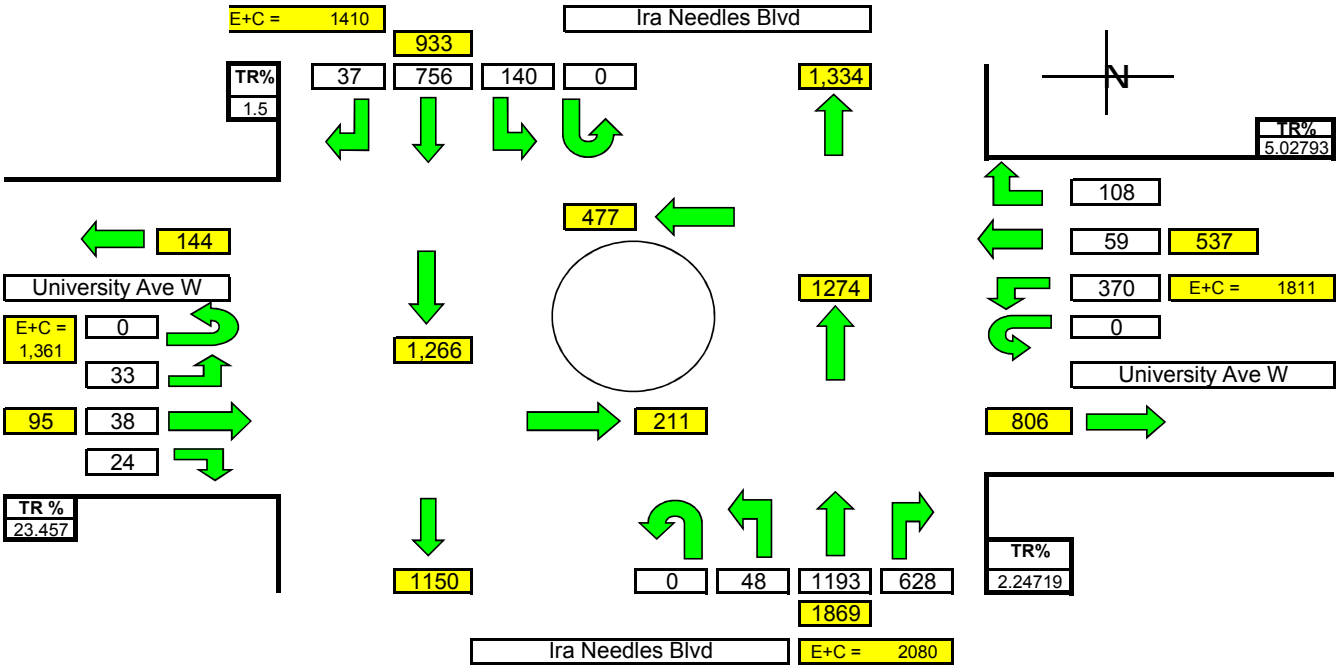
APPENDIX

C-2 *2031 CONDITIONS – WITH PLANNED IMPROVEMENTS*

REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali
Project No.: **Sheet** 1 **of** 2
Intersection: Ira Needles Blvd/University Ave W
Time Period: AM PEAK

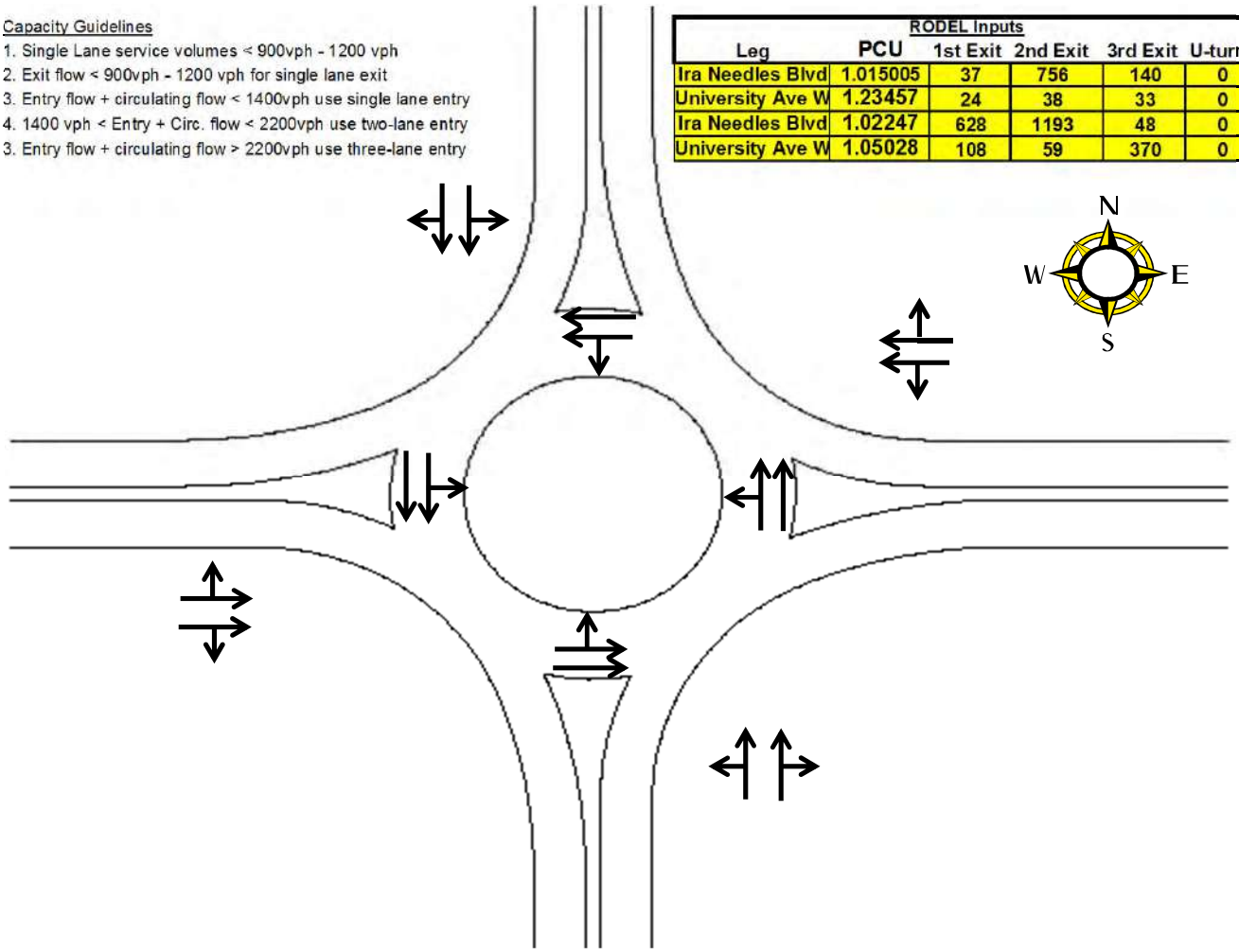


Capacity Guidelines

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RODEL Inputs

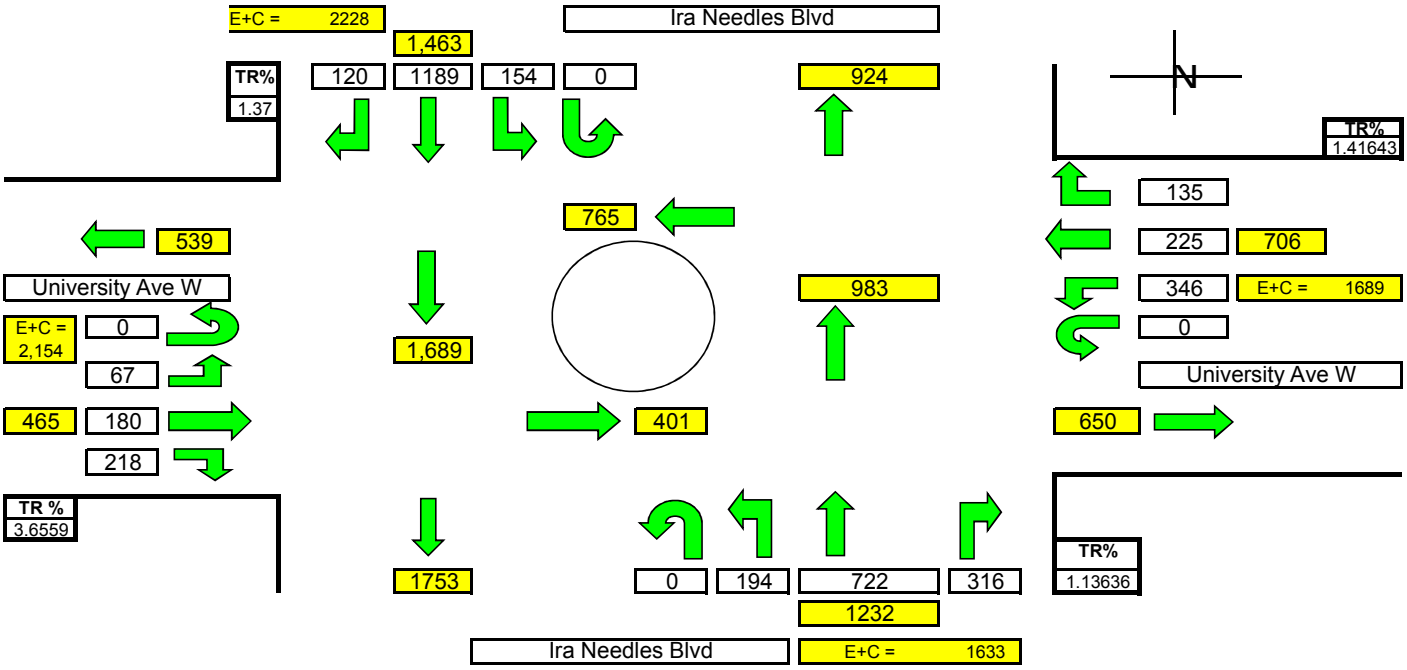
Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Ira Needles Blvd	1.015005	37	756	140	0
University Ave W	1.23457	24	38	33	0
Ira Needles Blvd	1.02247	628	1193	48	0
University Ave W	1.05028	108	59	370	0



REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali
Project No.: **Sheet** 2 of 2
Intersection: Ira Needles Blvd/University Ave W
Time Period: PM PEAK

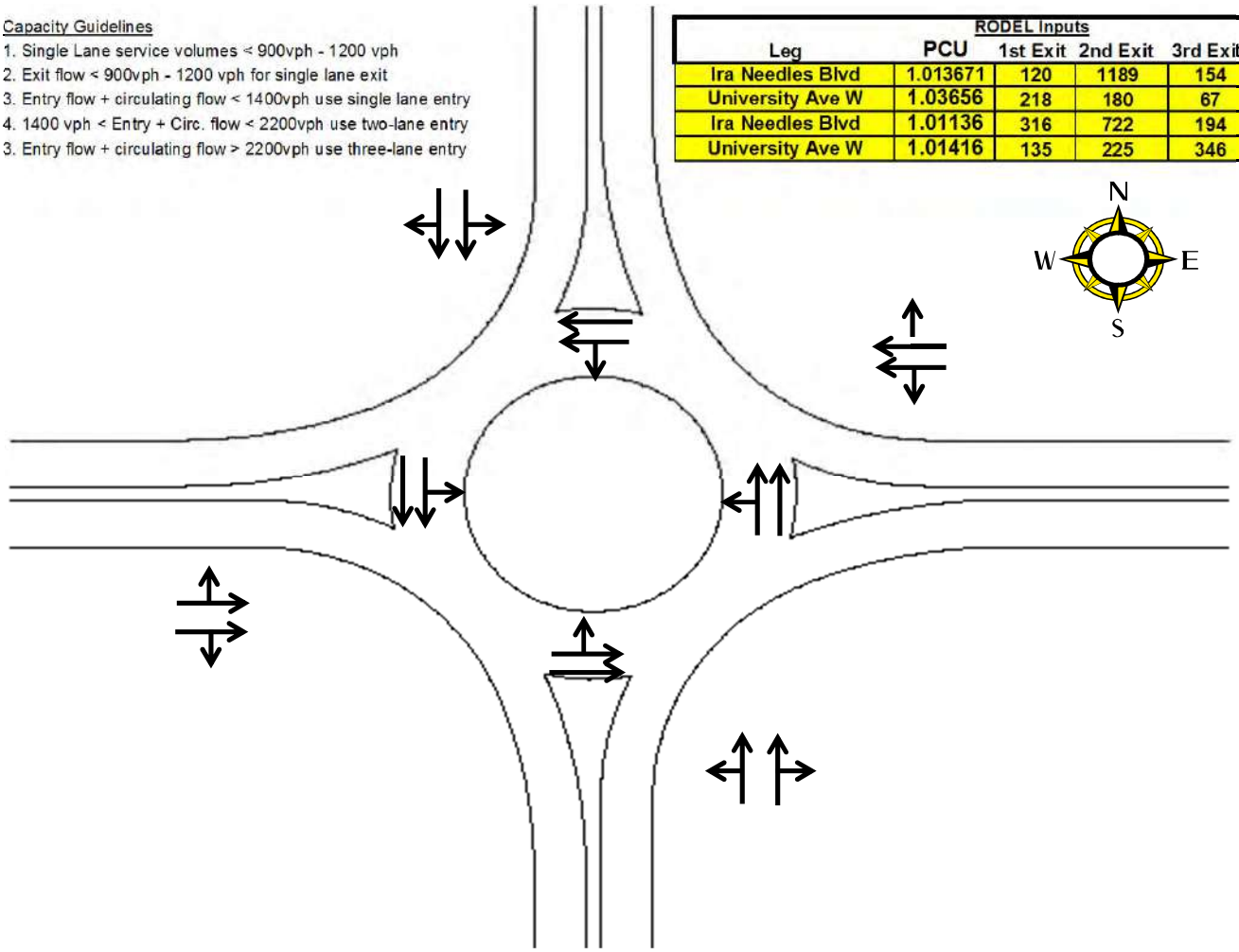


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RODEL Inputs

Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Ira Needles Blvd	1.013671	120	1189	154	0
University Ave W	1.03656	218	180	67	0
Ira Needles Blvd	1.01136	316	722	194	0
University Ave W	1.01416	135	225	346	0



REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

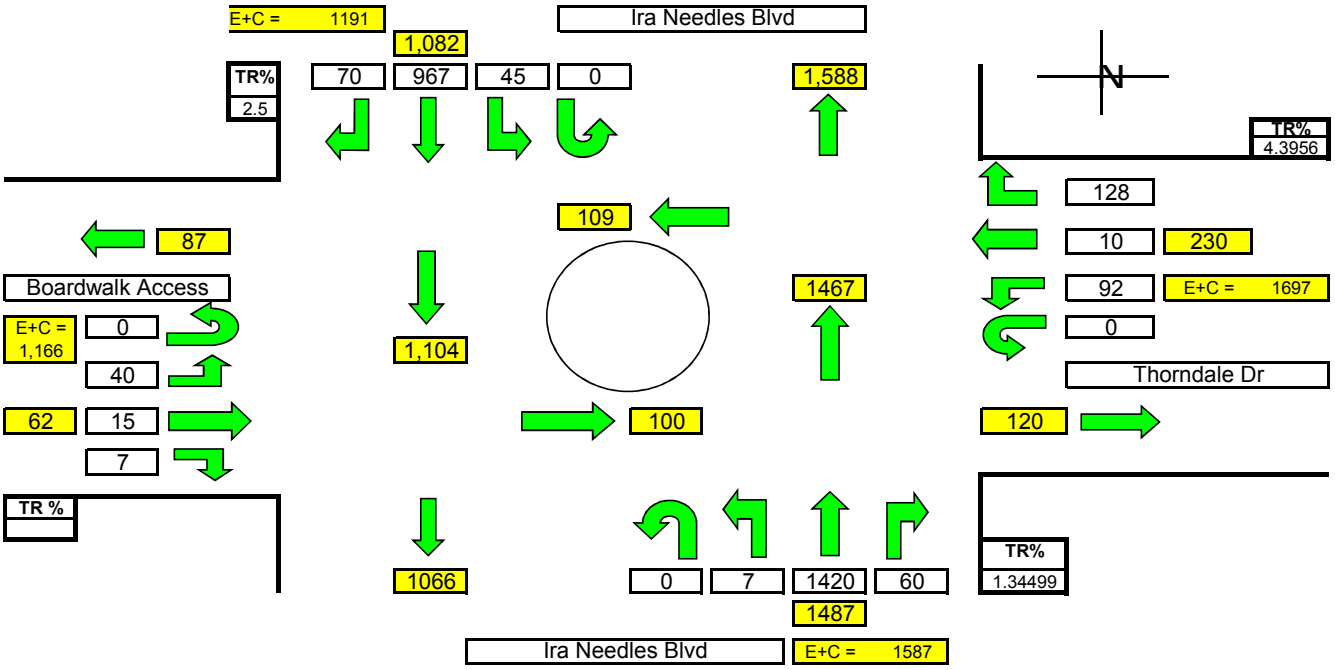
VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali

Project No.: **Sheet** 1 **of** 2

Intersection: Ira Needles Blvd/Thorndale Dr

Time Period: AM PEAK

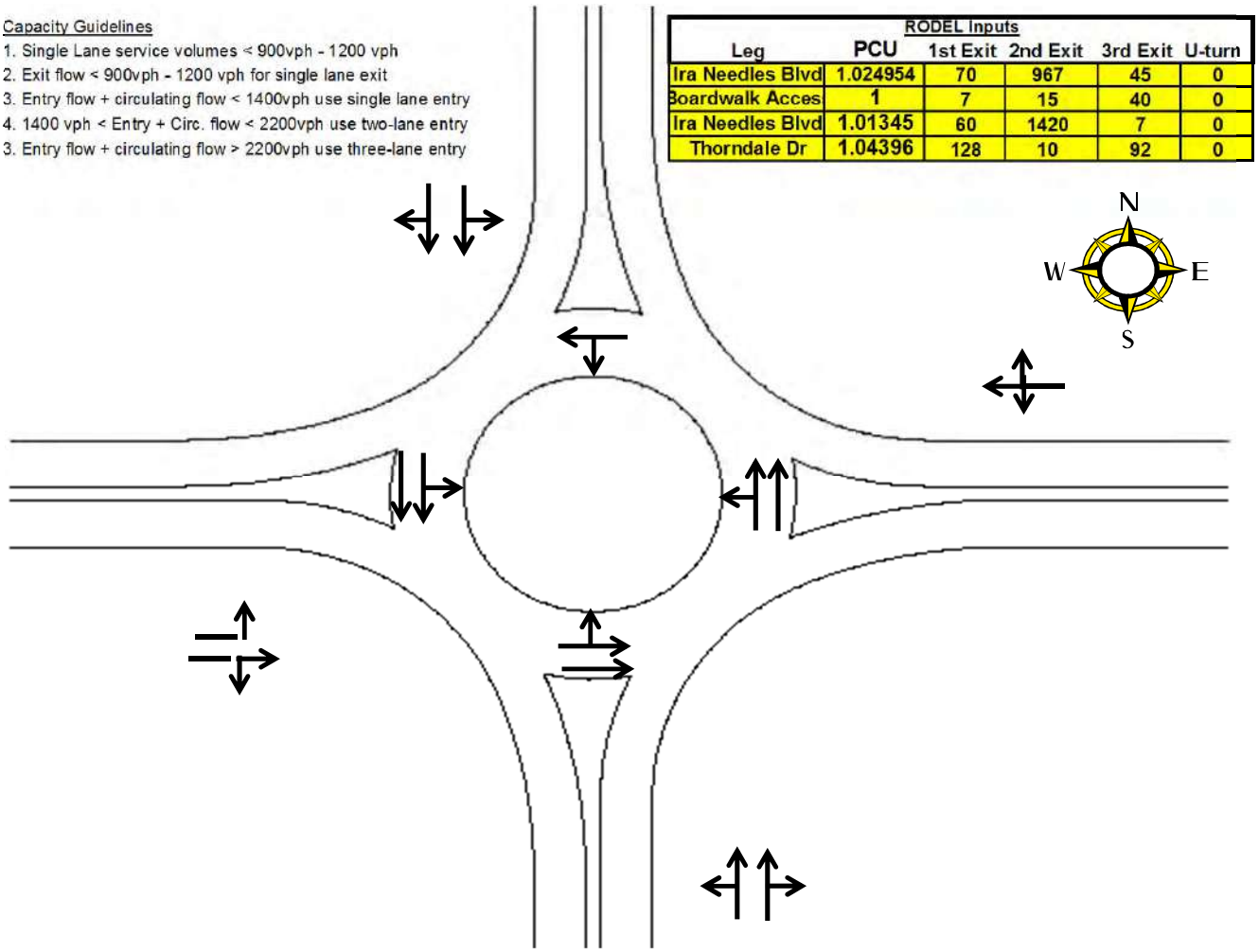


Capacity Guidelines

1. Single Lane service volumes < 900vph - 1200 vph
2. Exit flow < 900vph - 1200 vph for single lane exit
3. Entry flow + circulating flow < 1400vph use single lane entry
4. 1400 vph < Entry + Circ. flow < 2200vph use two-lane entry
3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Ira Needles Blvd	1.024954	70	967	45	0
Boardwalk Acces	1	7	15	40	0
Ira Needles Blvd	1.01345	60	1420	7	0
Thorndale Dr	1.04396	128	10	92	0



REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

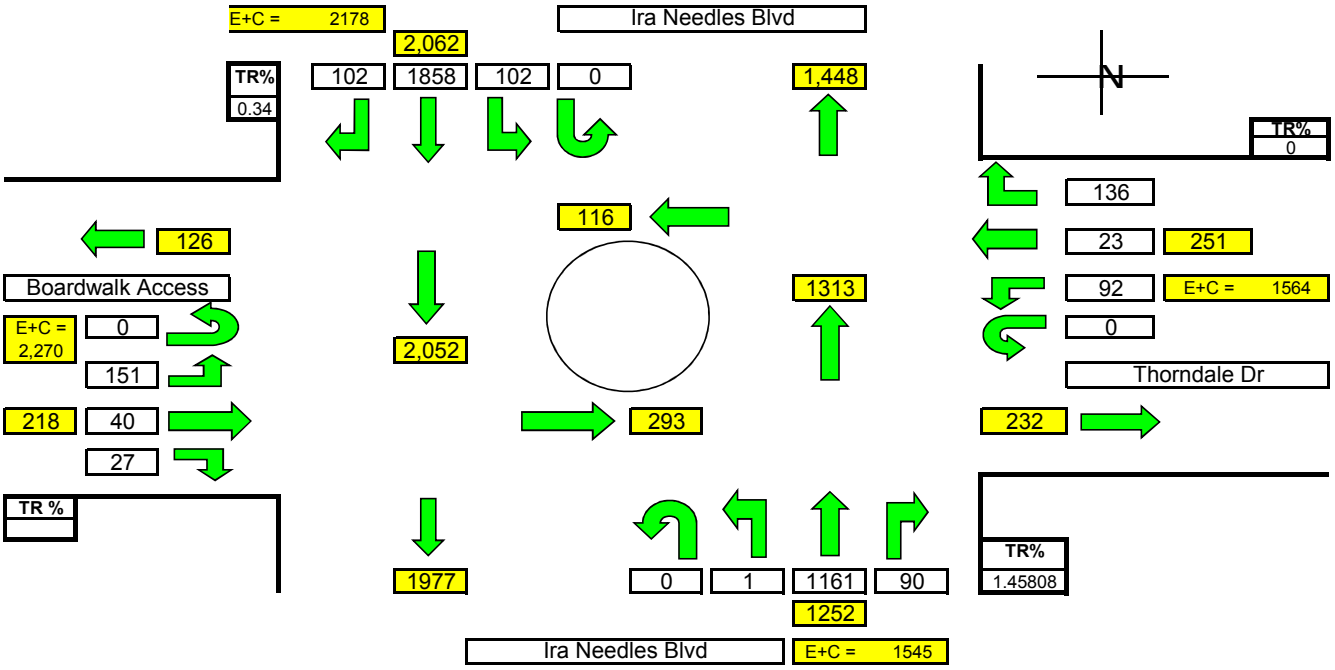
VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali

Project No.: **Sheet** 2 **of** 2

Intersection: Ira Needles Blvd/Thorndale Dr

Time Period: PM PEAK

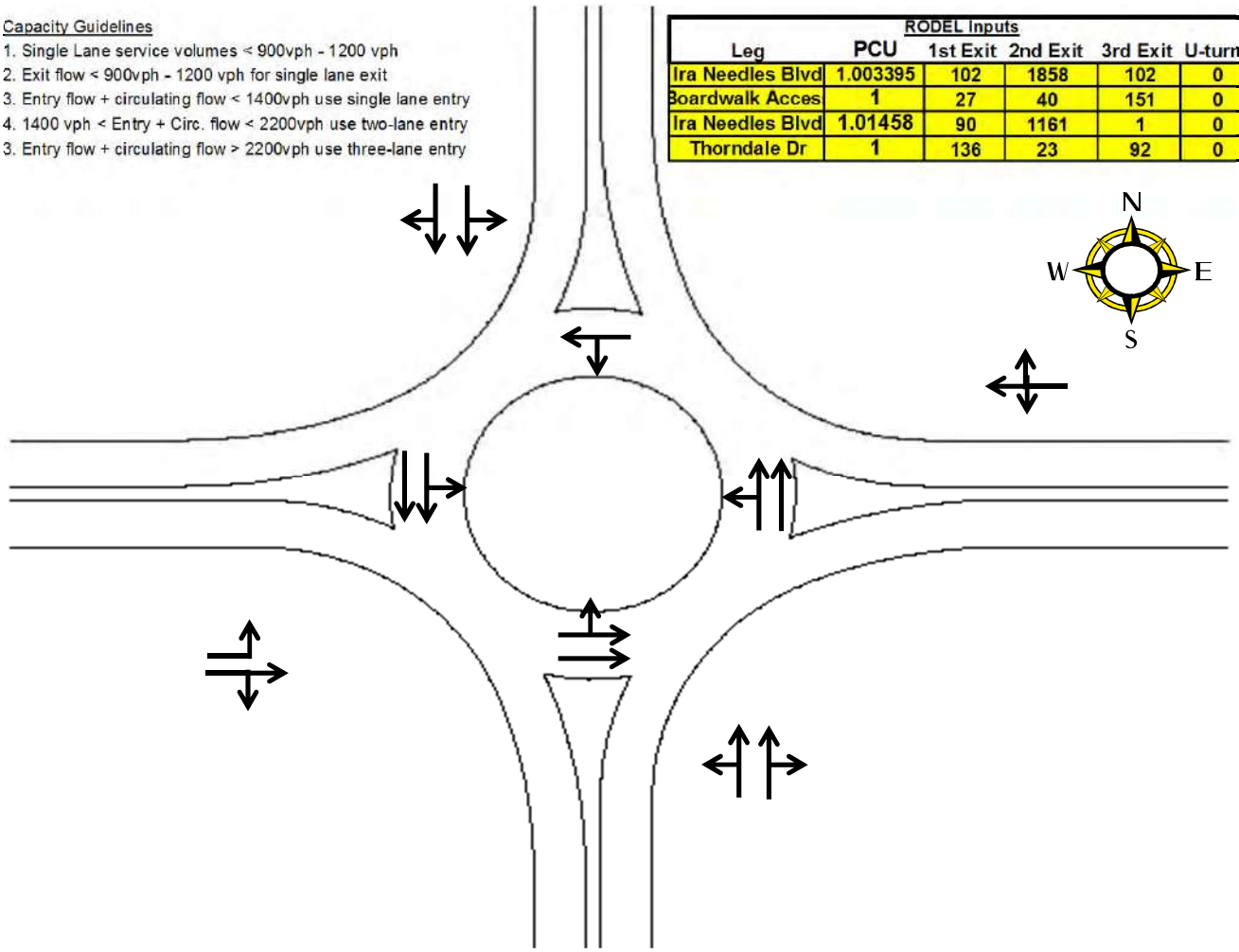


Capacity Guidelines

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4. 1400 vph < Entry + Circ. flow < 2200vph use two-lane entry
3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Ira Needles Blvd	1.003395	102	1858	102	0
Boardwalk Acces	1	27	40	151	0
Ira Needles Blvd	1.01458	90	1161	1	0
Thorndale Dr	1	136	23	92	0

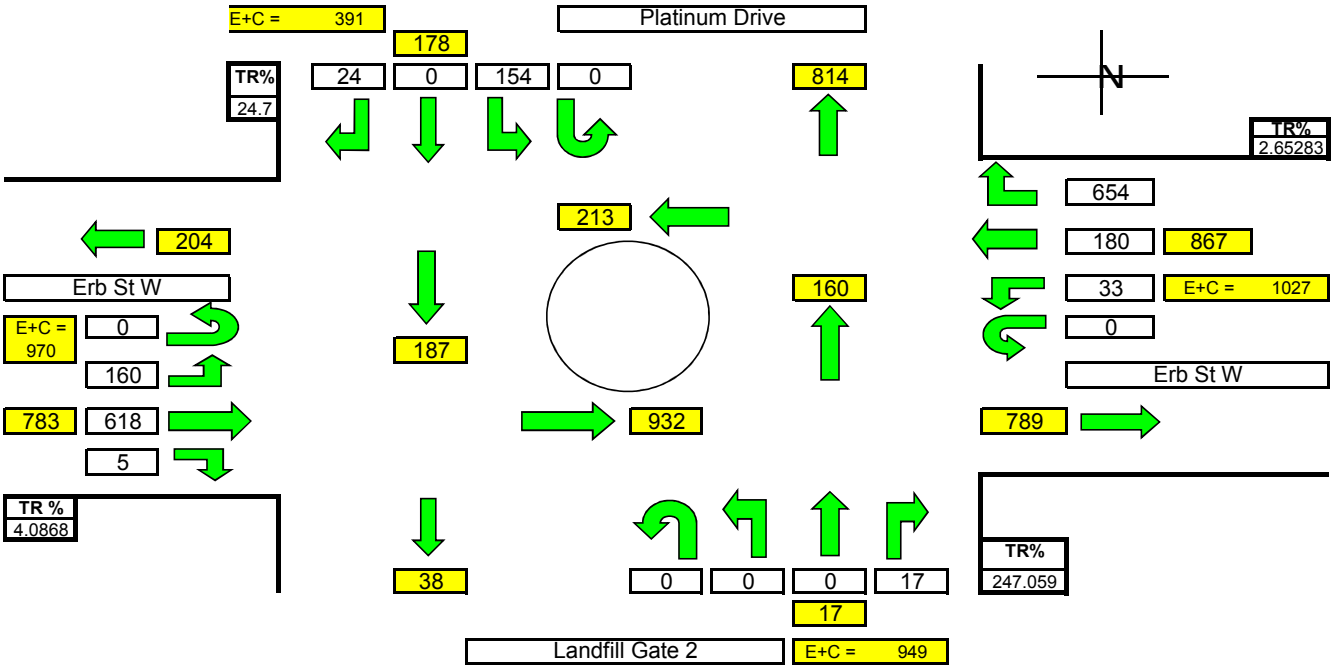


REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME
Project No.:
Intersection: Erb St W/Platinum Drive
Time Period: AM PEAK

Drawn By: Ubaid Ali
Sheet 1 **of** 2

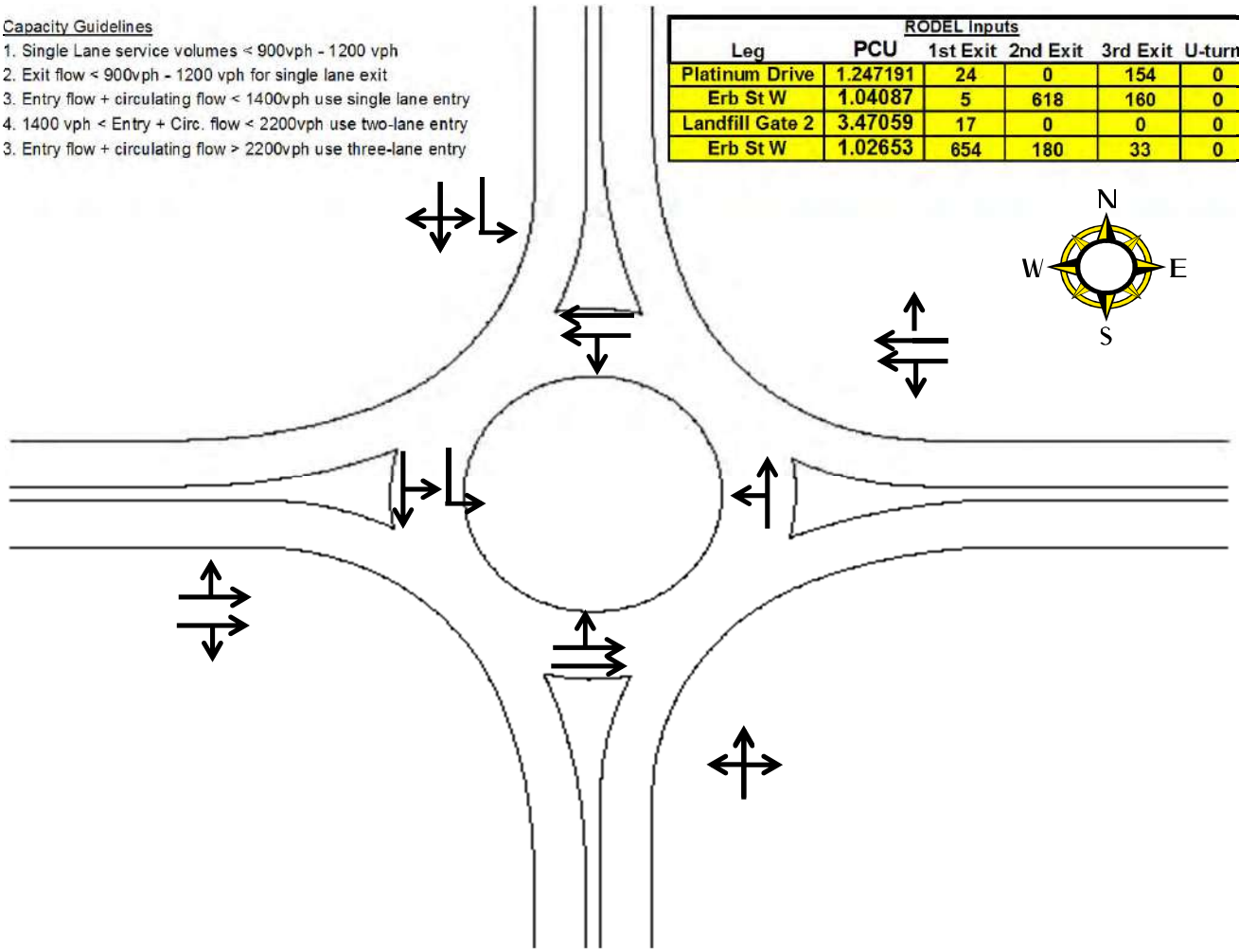


Capacity Guidelines

1. Single Lane service volumes < 900vph - 1200 vph
2. Exit flow < 900vph - 1200 vph for single lane exit
3. Entry flow + circulating flow < 1400vph use single lane entry
4. 1400 vph < Entry + Circ. flow < 2200vph use two-lane entry
3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Platinum Drive	1.247191	24	0	154	0
Erb St W	1.04087	5	618	160	0
Landfill Gate 2	3.47059	17	0	0	0
Erb St W	1.02653	654	180	33	0

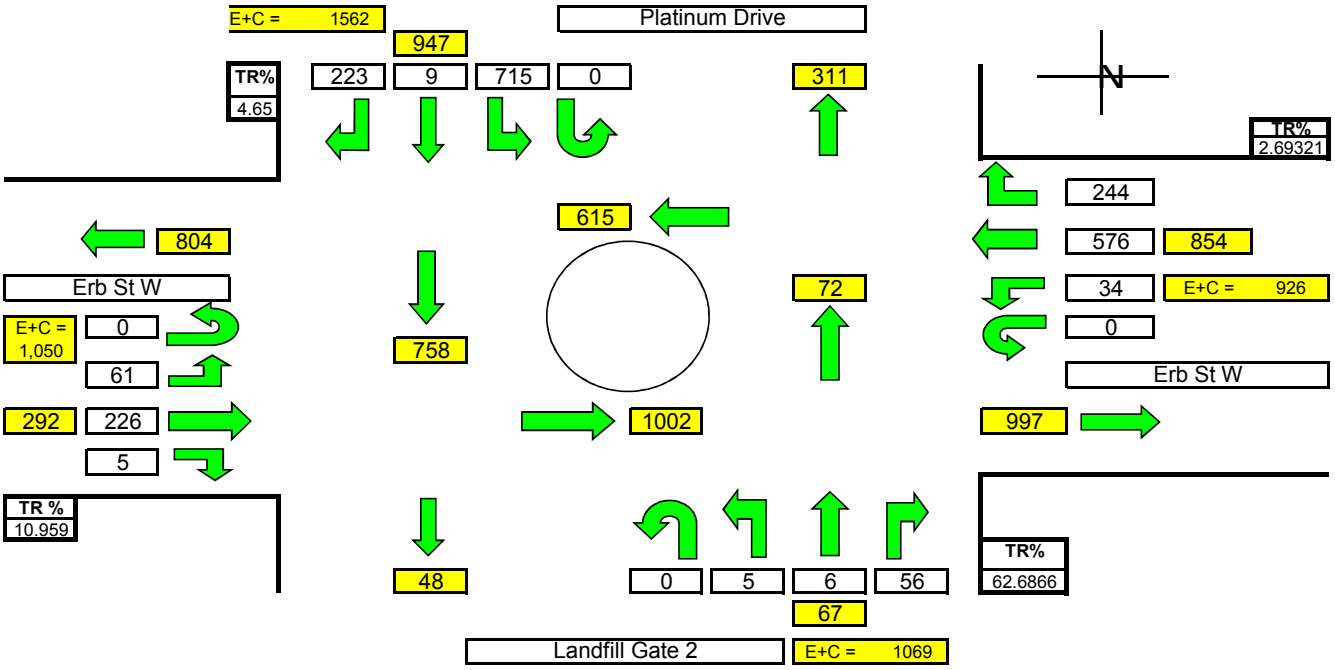


REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME
Project No.:
Intersection: Erb St W/Platinum Drive
Time Period: PM PEAK

Drawn By: Ubaid Ali
Sheet 1 **of** 2

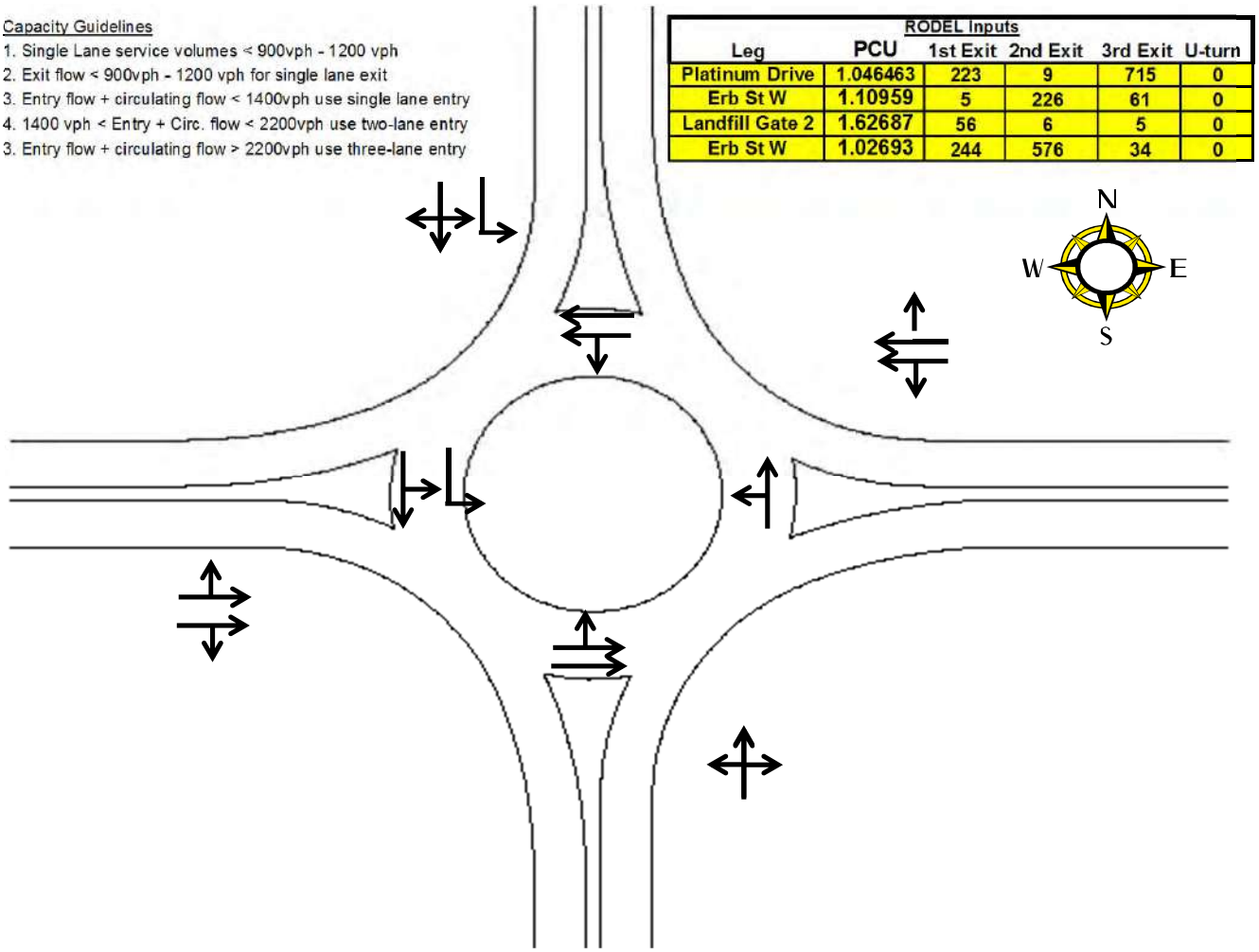


Capacity Guidelines

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3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Platinum Drive	1.046463	223	9	715	0
Erb St W	1.10959	5	226	61	0
Landfill Gate 2	1.62687	56	6	5	0
Erb St W	1.02693	244	576	34	0



REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

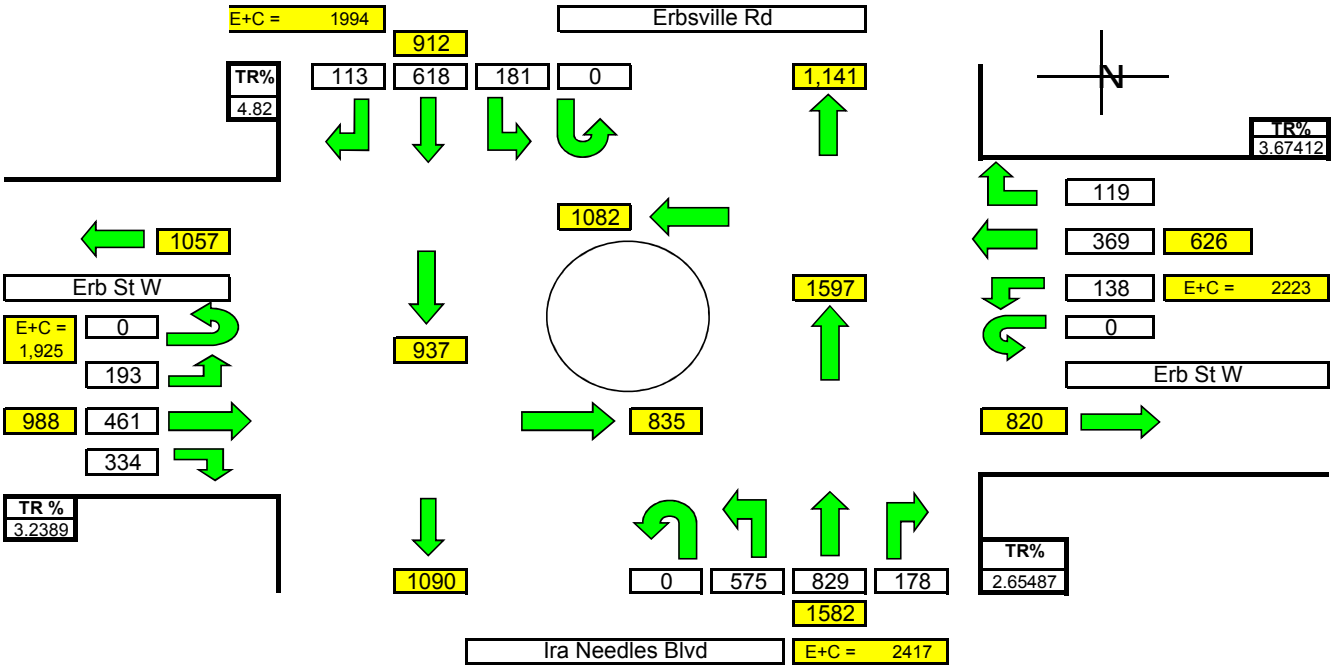
VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali

Project No.: **Sheet** 1 **of** 2

Intersection: Erb St W/Erbsville Rd-Ira Needles Blvd

Time Period: AM PEAK

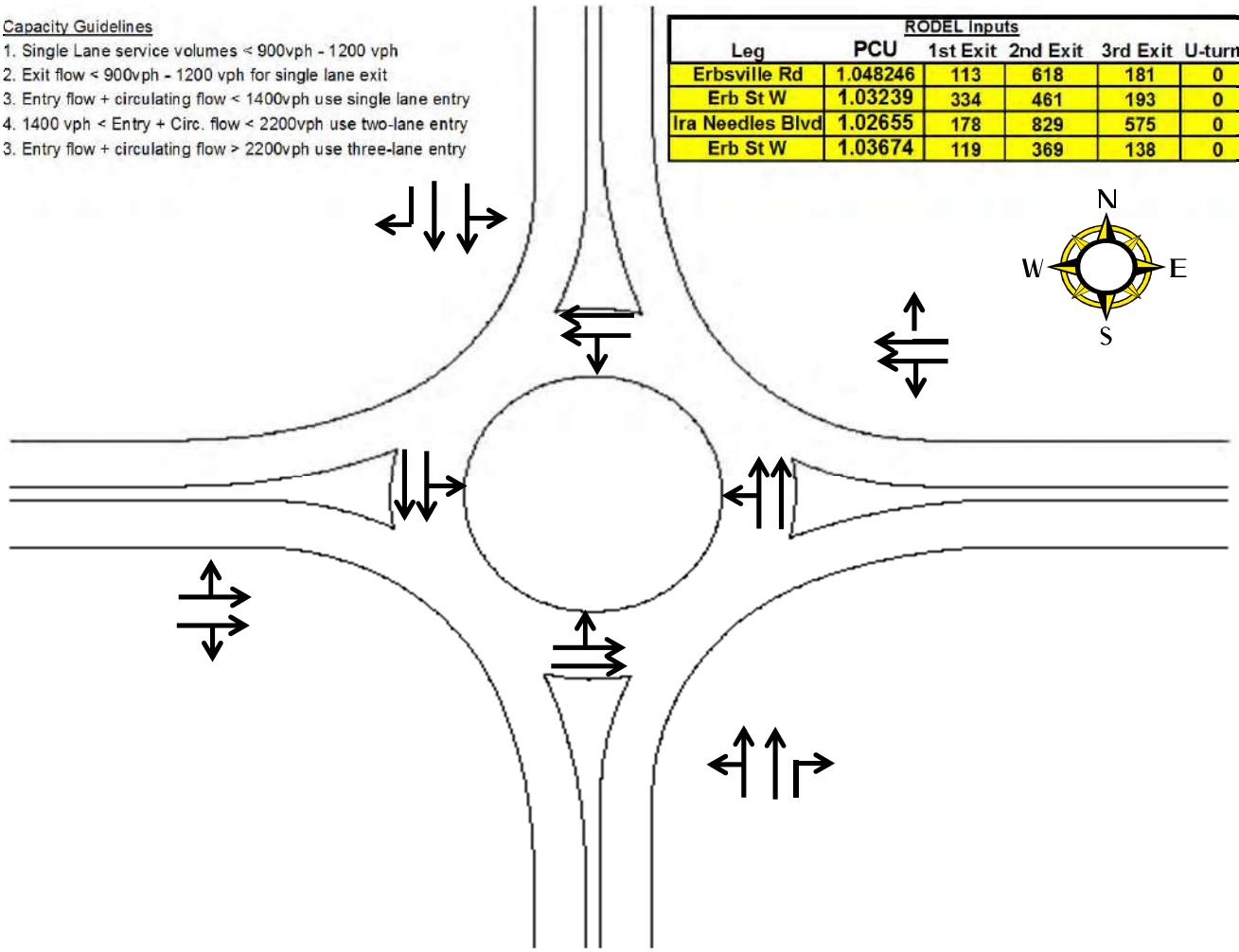


Capacity Guidelines

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3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Erbsville Rd	1.048246	113	618	181	0
Erb St W	1.03239	334	461	193	0
Ira Needles Blvd	1.02655	178	829	575	0
Erb St W	1.03674	119	369	138	0



REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

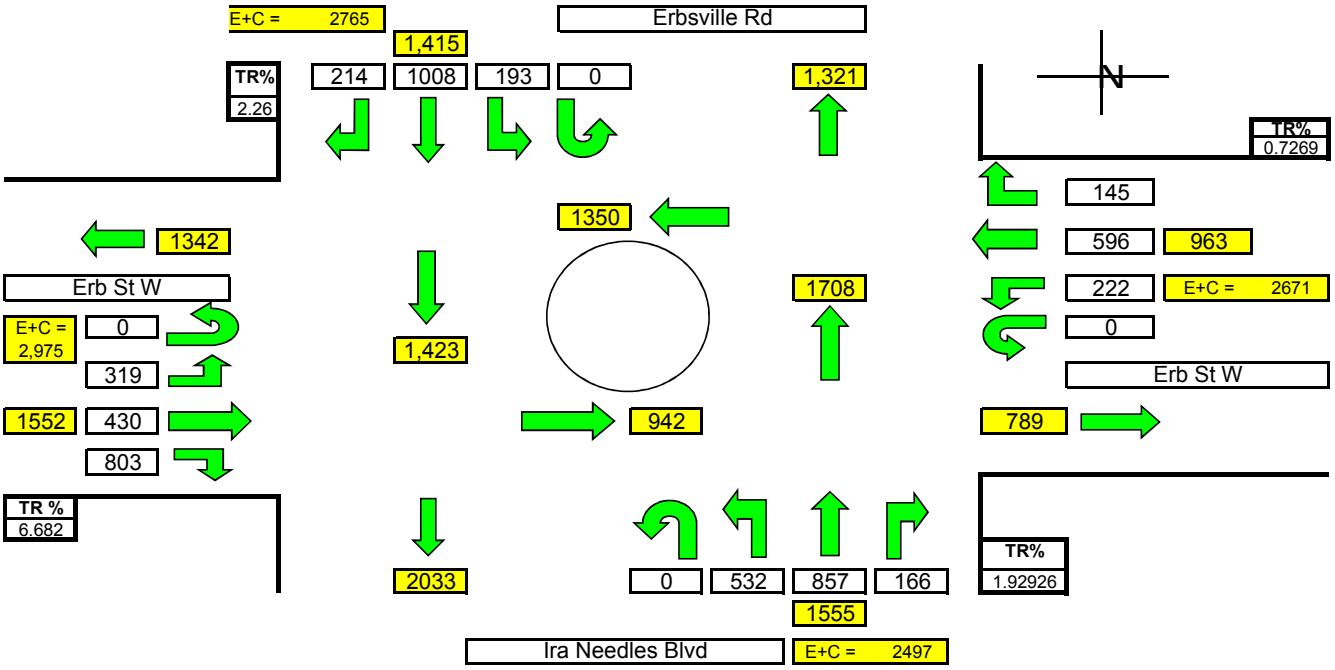
VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali

Project No.: **Sheet** 2 **of** 2

Intersection: Erb St W/Erbsville Rd-Ira Needles Blvd

Time Period: PM PEAK

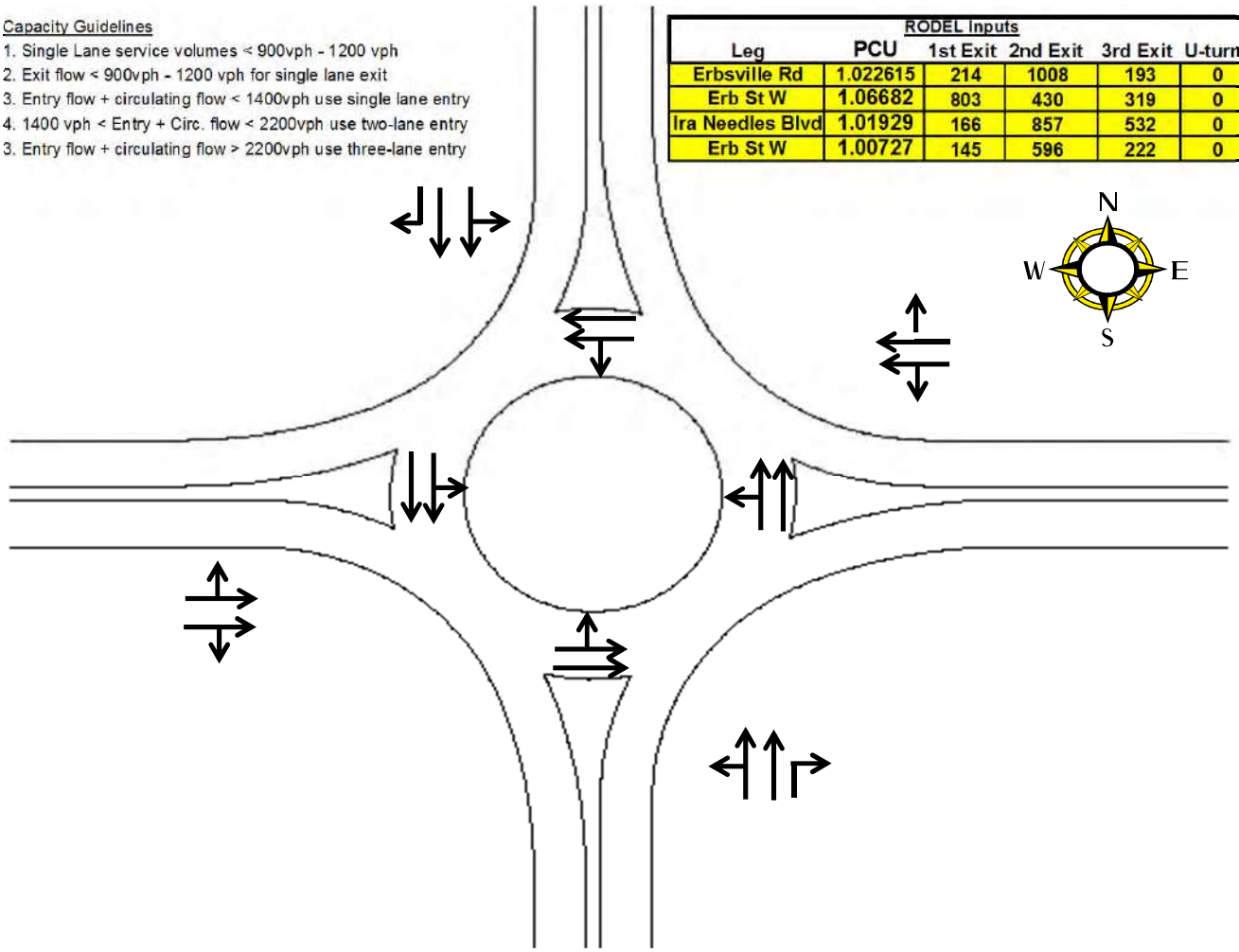


Capacity Guidelines

1. Single Lane service volumes < 900vph - 1200 vph
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4. 1400 vph < Entry + Circ. flow < 2200vph use two-lane entry
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RODEL Inputs

Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Erbsville Rd	1.022615	214	1008	193	0
Erb St W	1.06682	803	430	319	0
Ira Needles Blvd	1.01929	166	857	532	0
Erb St W	1.00727	145	596	222	0

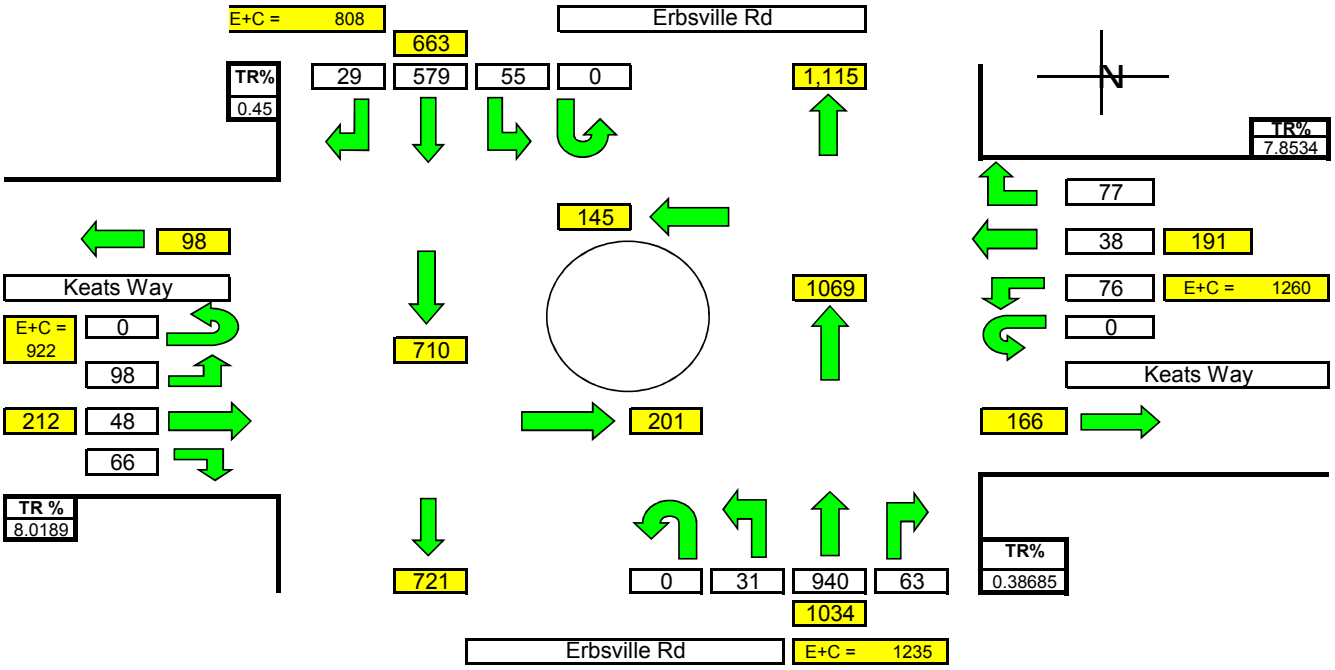


REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME
Project No.:
Intersection: Erbsville Rd/Keats Way
Time Period: AM PEAK

Drawn By: Ubaid Ali
Sheet 1 **of** 2

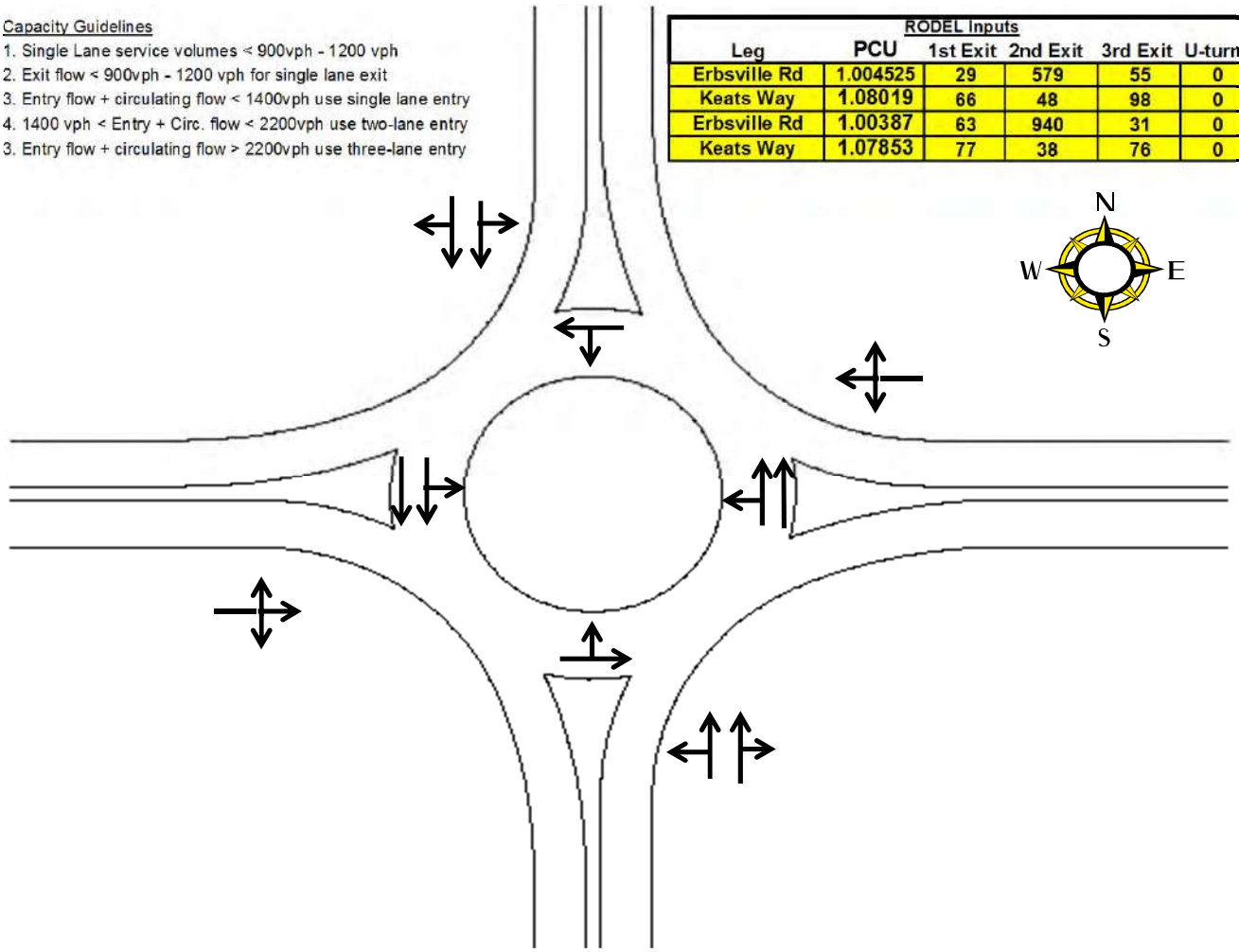


Capacity Guidelines

1. Single Lane service volumes < 900vph - 1200 vph
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4. 1400 vph < Entry + Circ. flow < 2200vph use two-lane entry
3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Erbsville Rd	1.004525	29	579	55	0
Keats Way	1.08019	66	48	98	0
Erbsville Rd	1.00387	63	940	31	0
Keats Way	1.07853	77	38	76	0

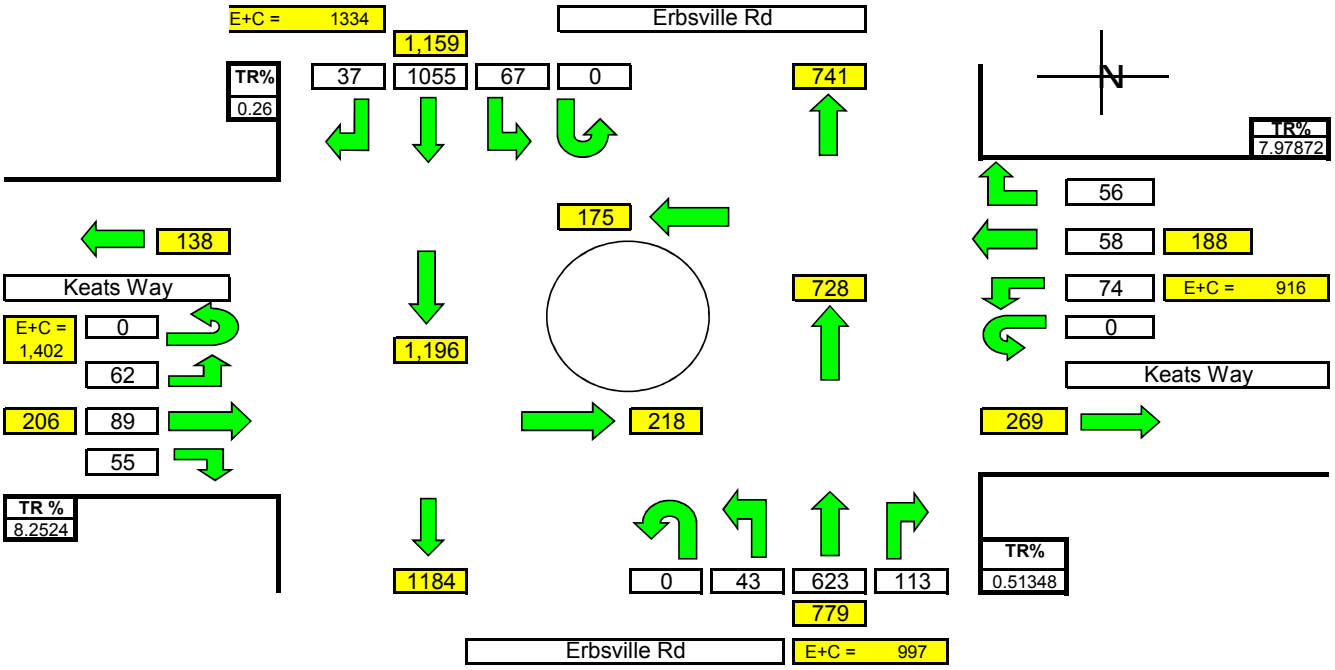


REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME
Project No.:
Intersection: Erbsville Rd/Keats Way
Time Period: PM PEAK

Drawn By: Ubaid Ali
Sheet 1 **of** 2

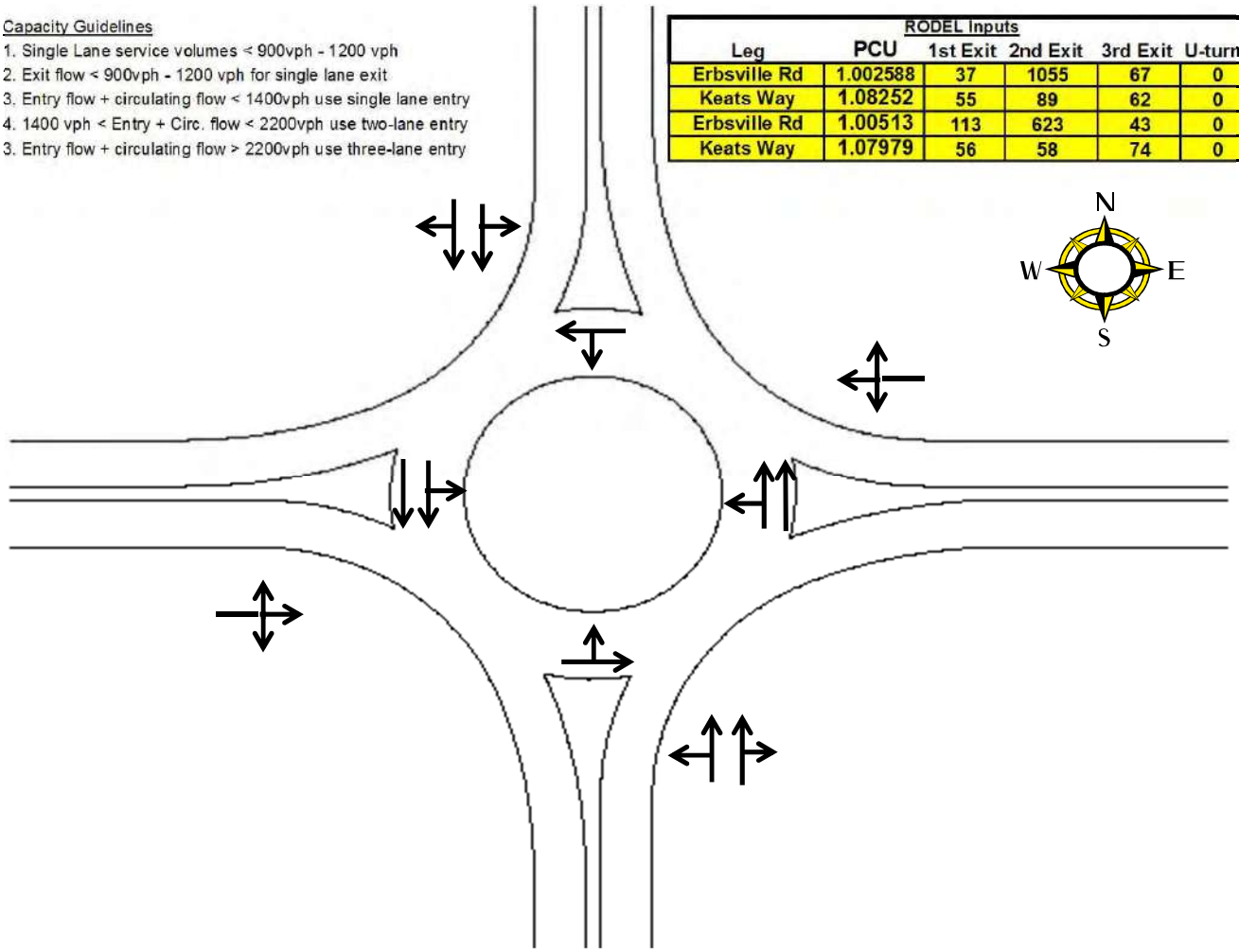


Capacity Guidelines

1. Single Lane service volumes < 900vph - 1200 vph
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4. 1400 vph < Entry + Circ. flow < 2200vph use two-lane entry
3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Erbsville Rd	1.002588	37	1055	67	0
Keats Way	1.08252	55	89	62	0
Erbsville Rd	1.00513	113	623	43	0
Keats Way	1.07979	56	58	74	0



REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

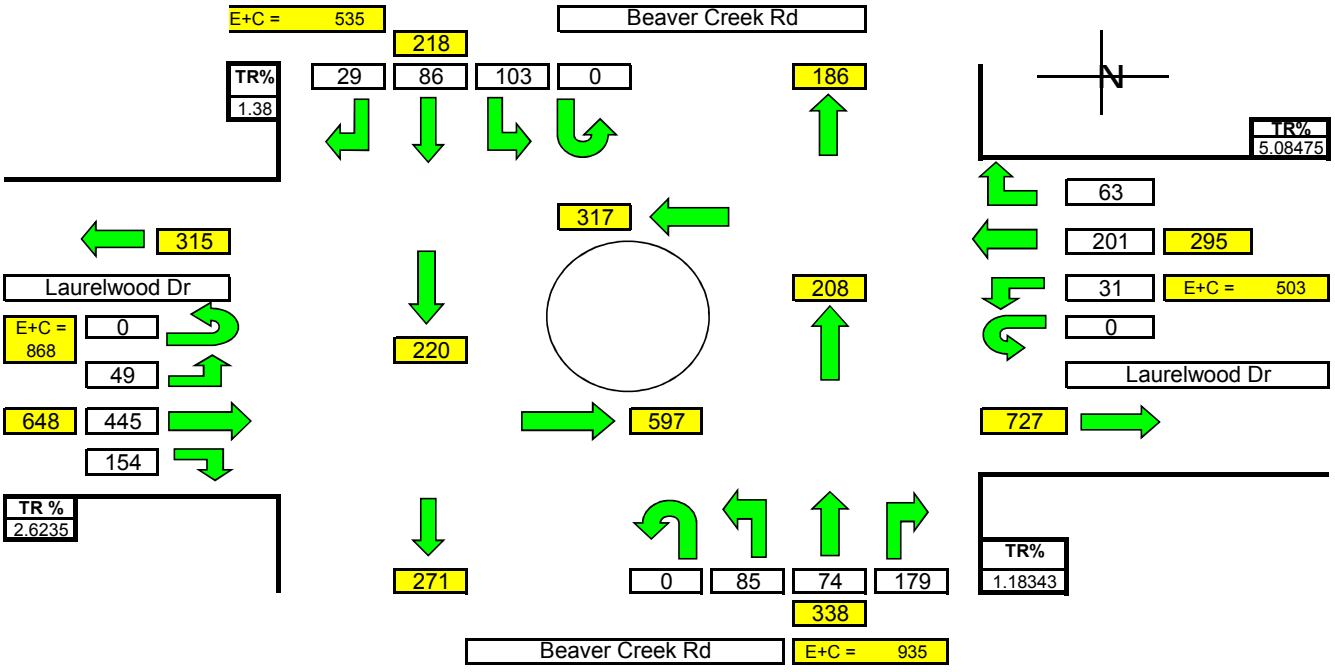
VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali

Project No.: **Sheet** 1 **of** 2

Intersection: Beaver Creek Rd/Laurelwood Dr

Time Period: AM PEAK

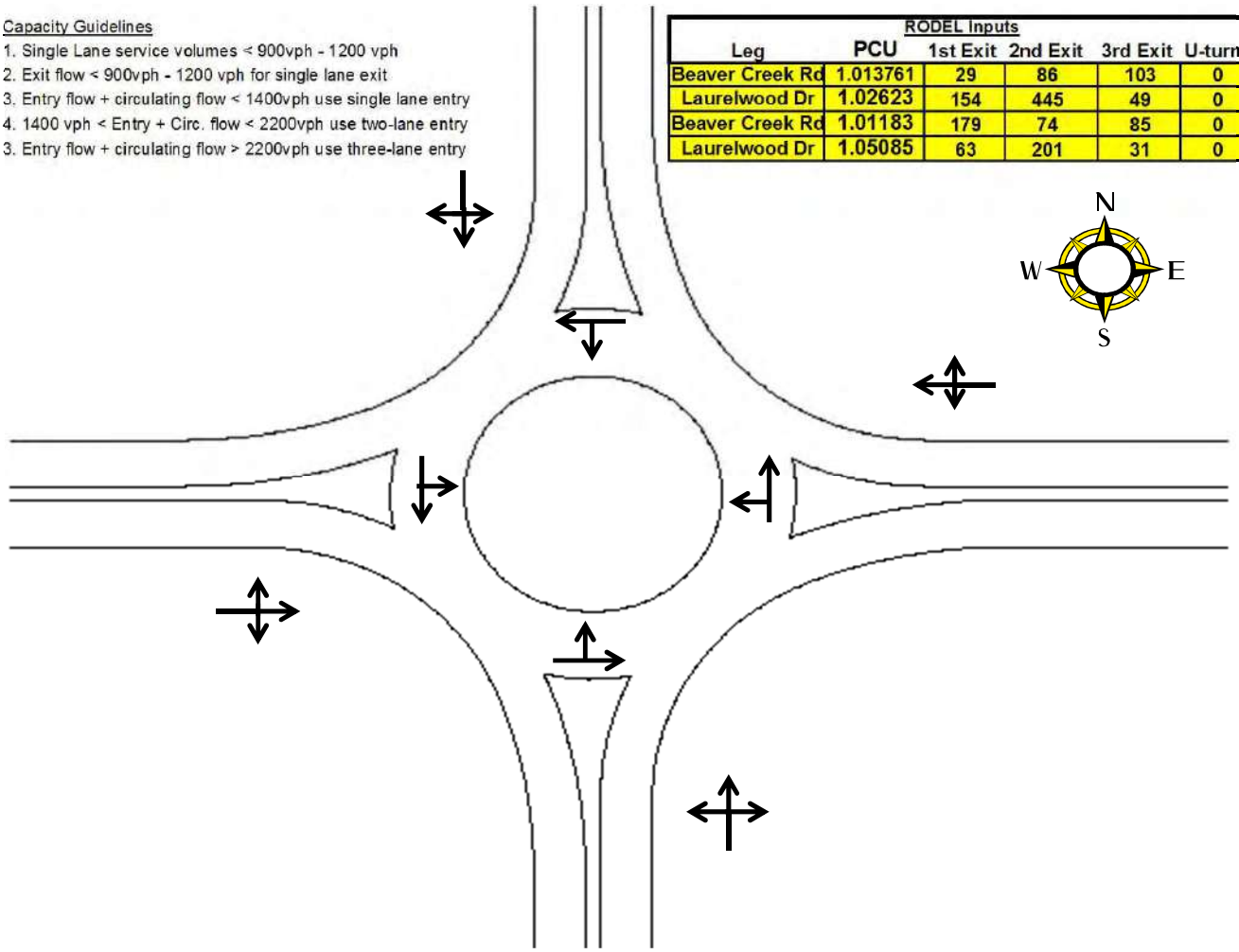


Capacity Guidelines

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4. 1400 vph < Entry + Circ. flow < 2200vph use two-lane entry
3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Beaver Creek Rd	1.013761	29	86	103	0
Laurelwood Dr	1.02623	154	445	49	0
Beaver Creek Rd	1.01183	179	74	85	0
Laurelwood Dr	1.05085	63	201	31	0



REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

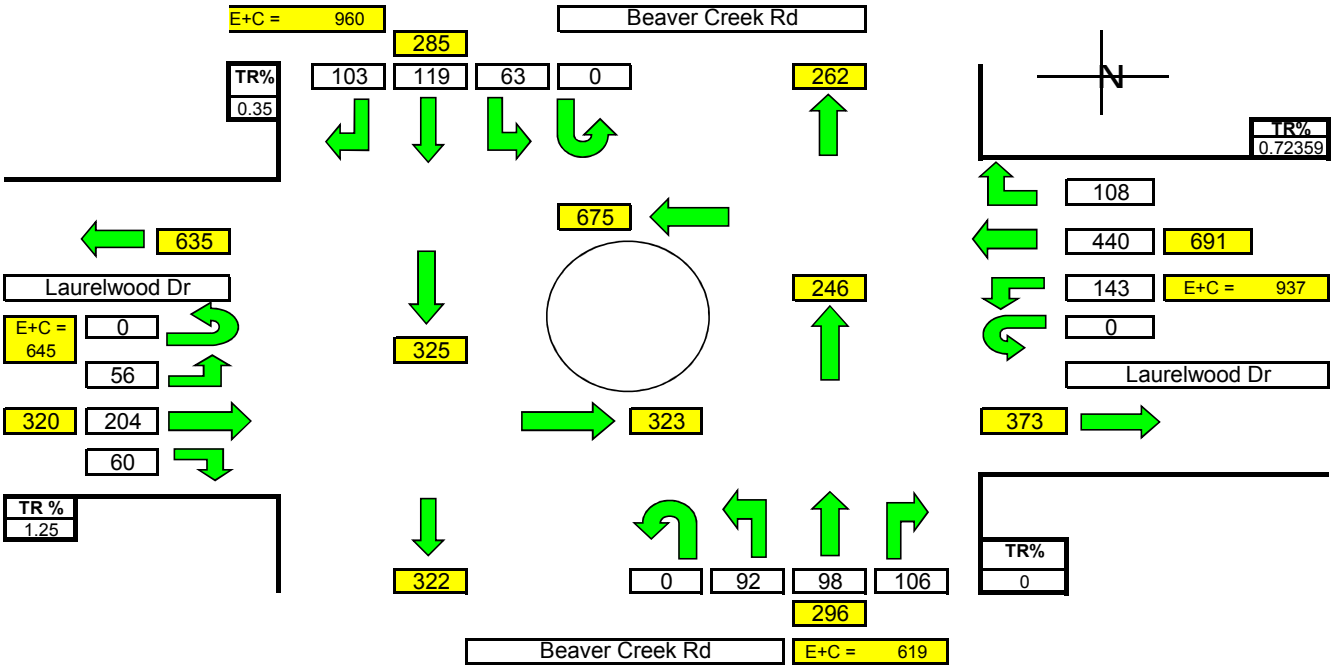
VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali

Project No.: **Sheet** 2 **of** 2

Intersection: Beaver Creek Rd/Laurelwood Dr

Time Period: PM PEAK

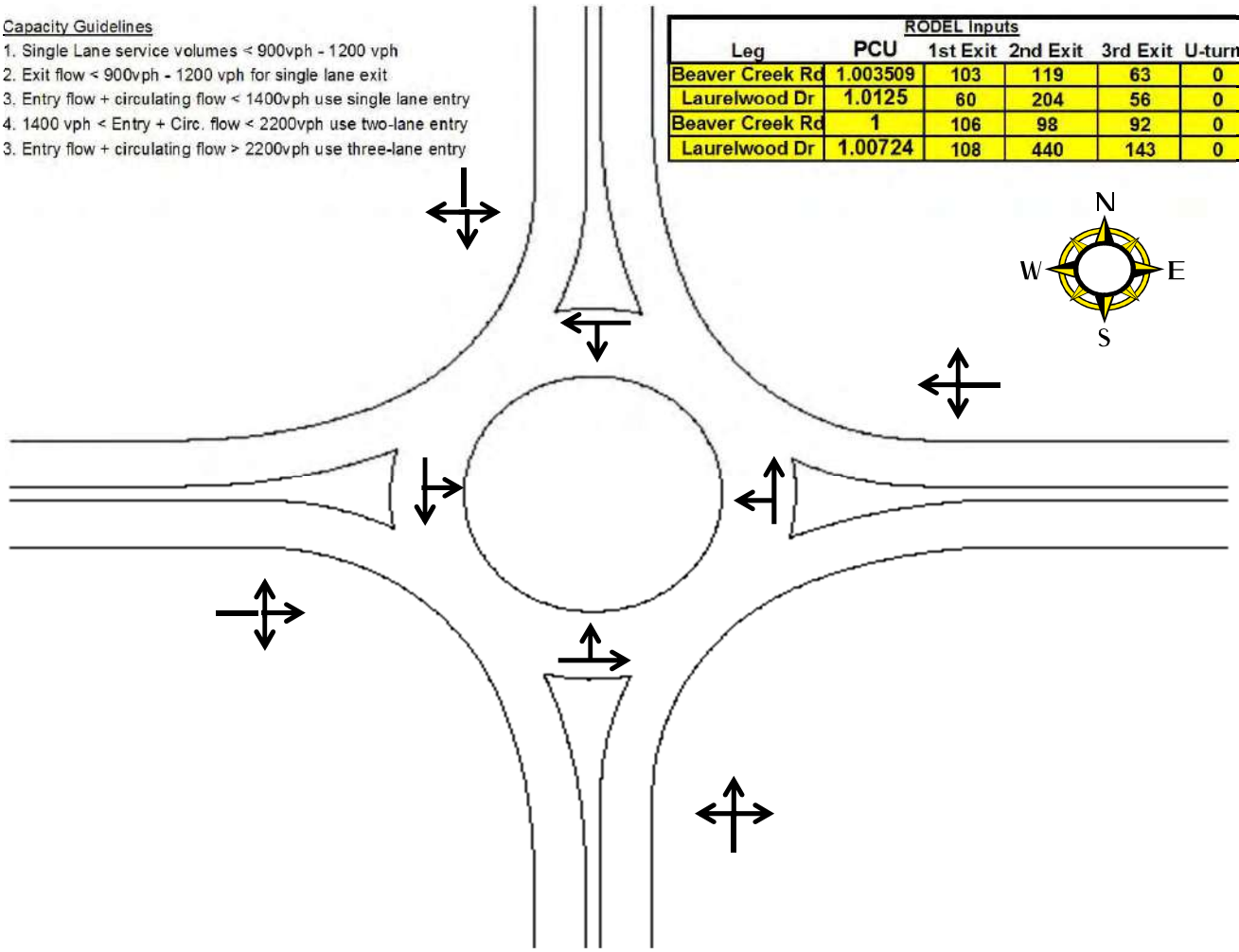


Capacity Guidelines

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4. 1400 vph < Entry + Circ. flow < 2200vph use two-lane entry
3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Beaver Creek Rd	1.003509	103	119	63	0
Laurelwood Dr	1.0125	60	204	56	0
Beaver Creek Rd	1	106	98	92	0
Laurelwood Dr	1.00724	108	440	143	0



REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

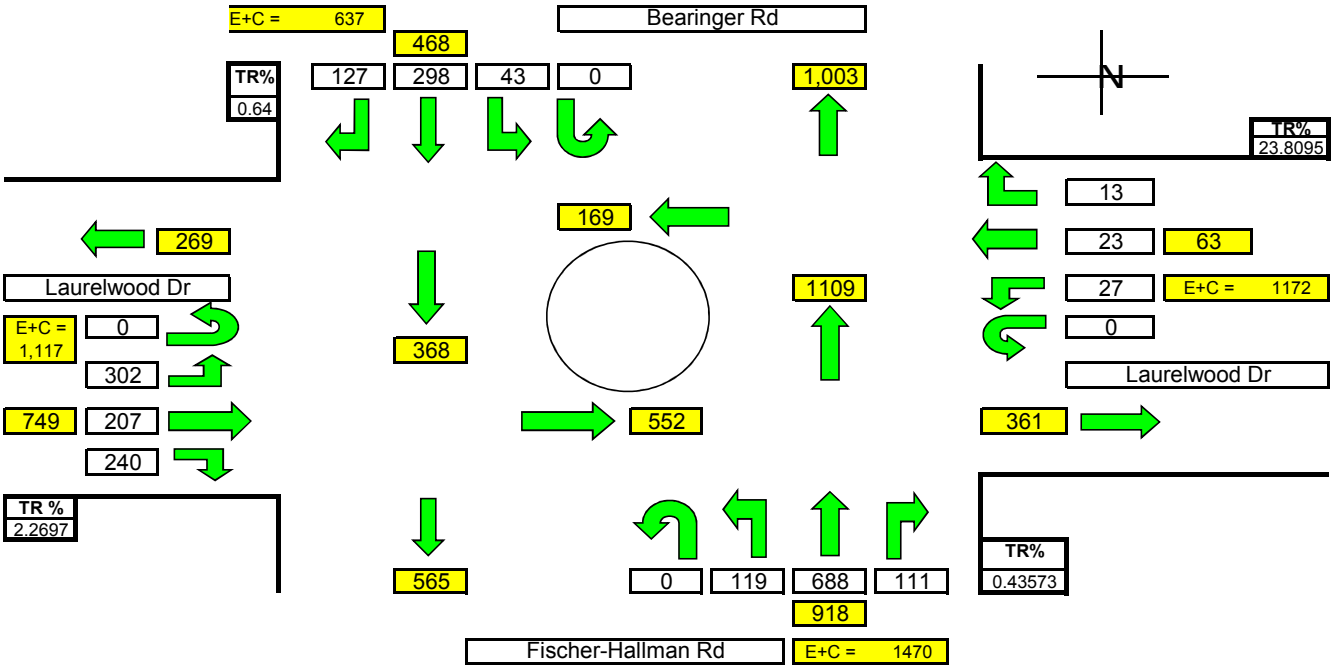
VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali

Project No.: **Sheet** 1 **of** 2

Intersection: Fischer-Hallman Rd/Bearinger Rd/Laurelwood Dr

Time Period: AM PEAK

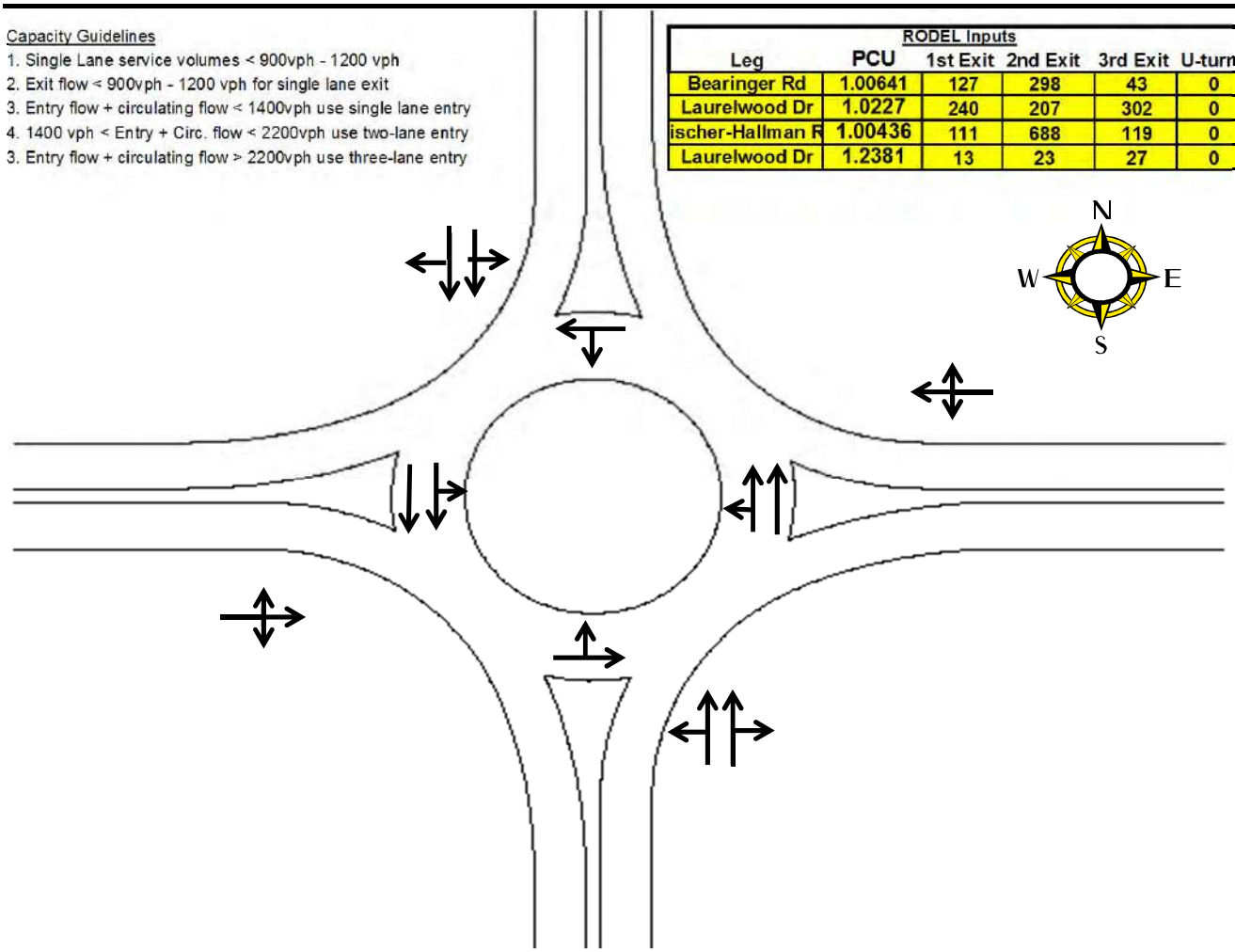


Capacity Guidelines

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3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Bearinger Rd	1.00641	127	298	43	0
Laurelwood Dr	1.0227	240	207	302	0
ischer-Hallman R	1.00436	111	688	119	0
Laurelwood Dr	1.2381	13	23	27	0



REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

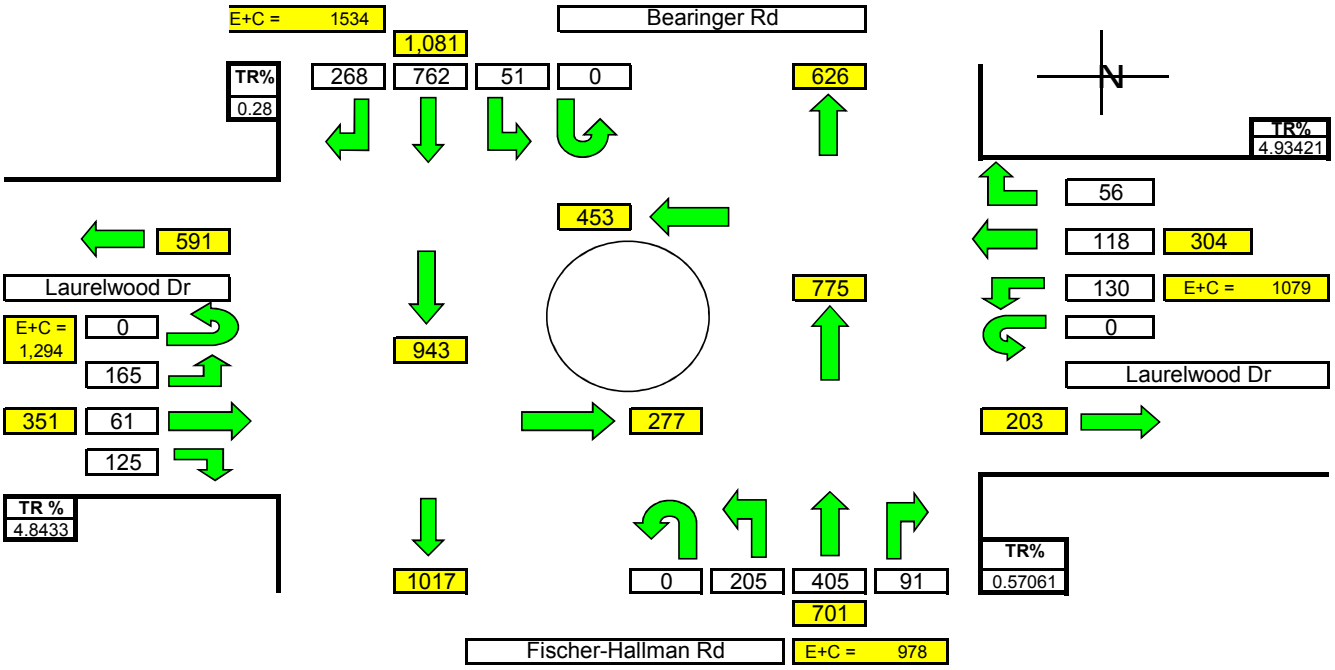
VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali

Project No.: **Sheet** 1 **of** 2

Intersection: Fischer-Hallman Rd/Bearinger Rd/Laurelwood Dr

Time Period: PM PEAK

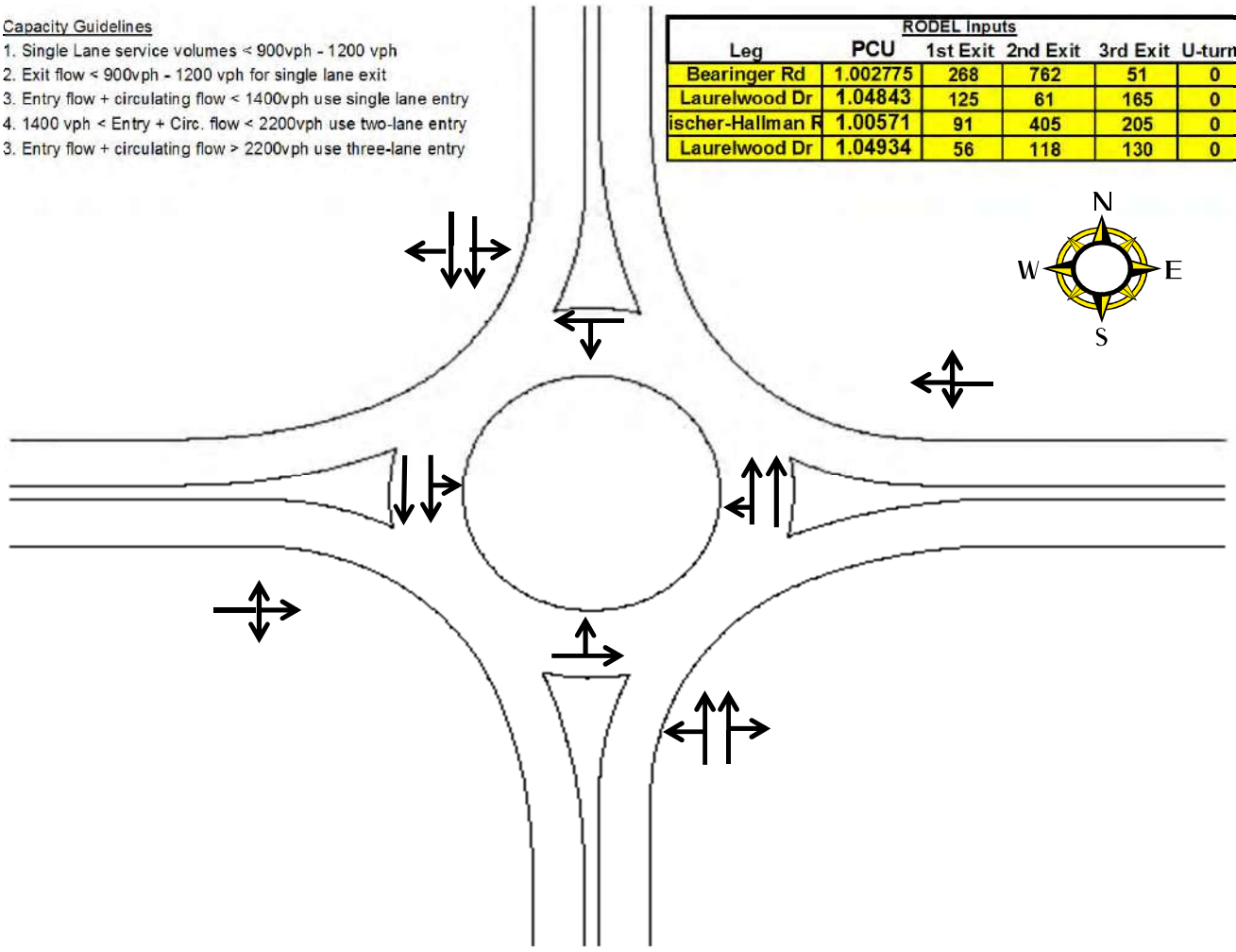


Capacity Guidelines

1. Single Lane service volumes < 900vph - 1200 vph
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3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Bearinger Rd	1.002775	268	762	51	0
Laurelwood Dr	1.04843	125	61	165	0
ischer-Hallman R	1.00571	91	405	205	0
Laurelwood Dr	1.04934	56	118	130	0



REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

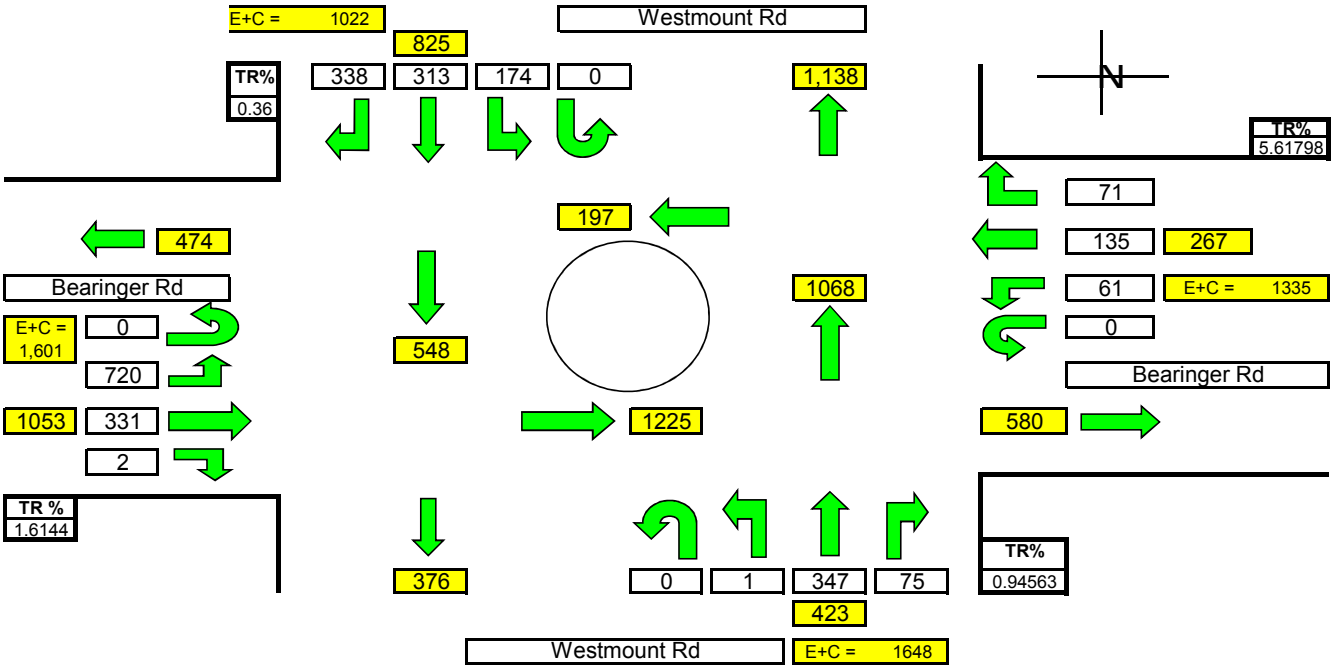
VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali

Project No.: **Sheet** 1 **of** 2

Intersection: Bearinger Rd/Westmount Rd

Time Period: AM PEAK

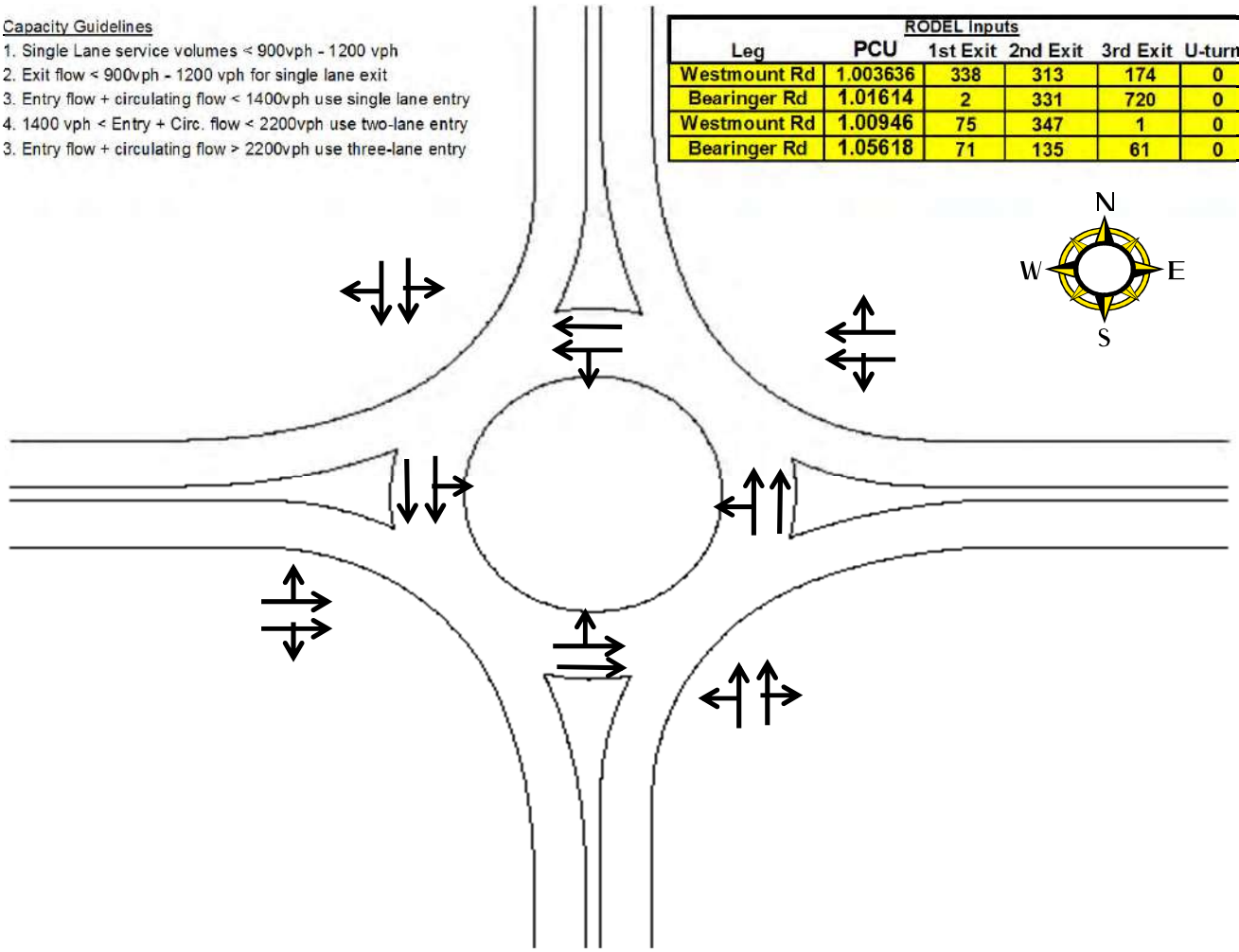


Capacity Guidelines

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3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Westmount Rd	1.003636	338	313	174	0
Bearinger Rd	1.01614	2	331	720	0
Westmount Rd	1.00946	75	347	1	0
Bearinger Rd	1.05618	71	135	61	0



REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

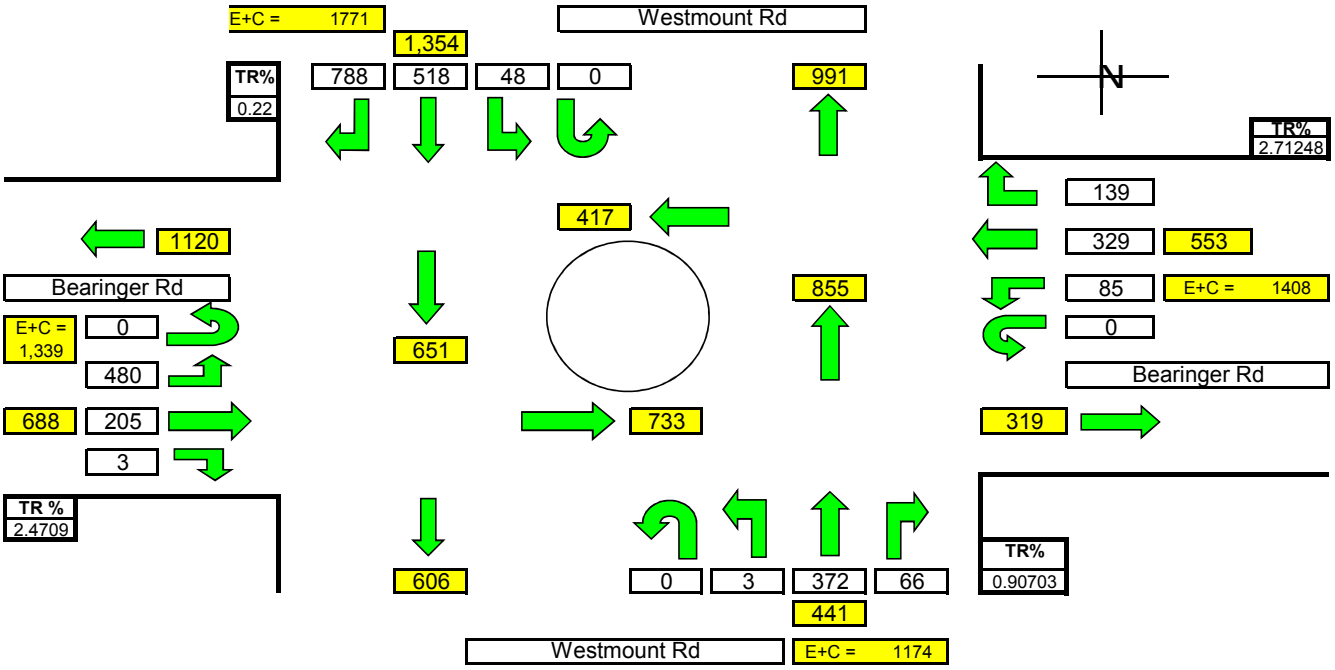
VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali

Project No.: **Sheet** 1 **of** 2

Intersection: Bearinger Rd/Westmount Rd

Time Period: PM PEAK

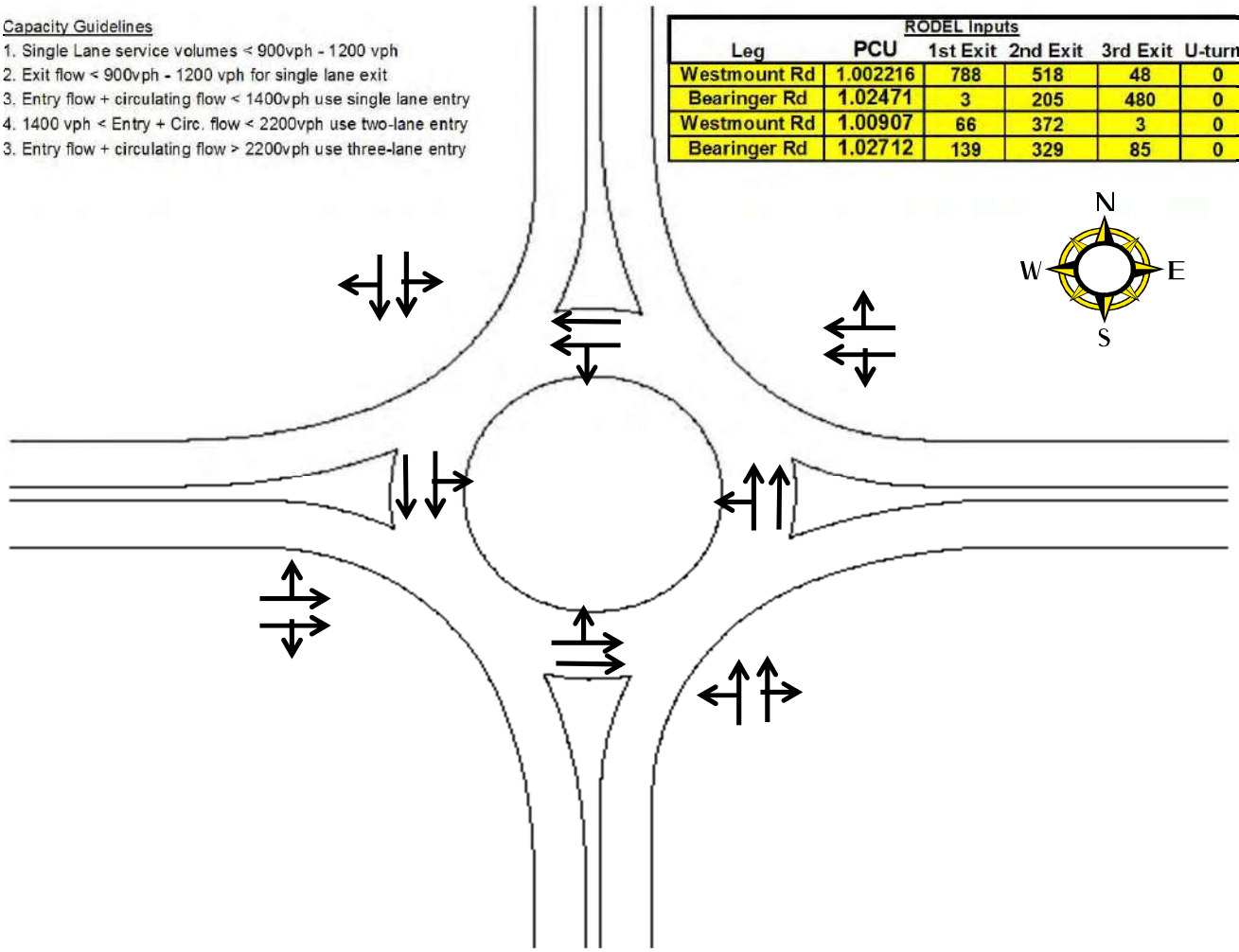


Capacity Guidelines

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RODEL Inputs

Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Westmount Rd	1.002216	788	518	48	0
Bearinger Rd	1.02471	3	205	480	0
Westmount Rd	1.00907	66	372	3	0
Bearinger Rd	1.02712	139	329	85	0



REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

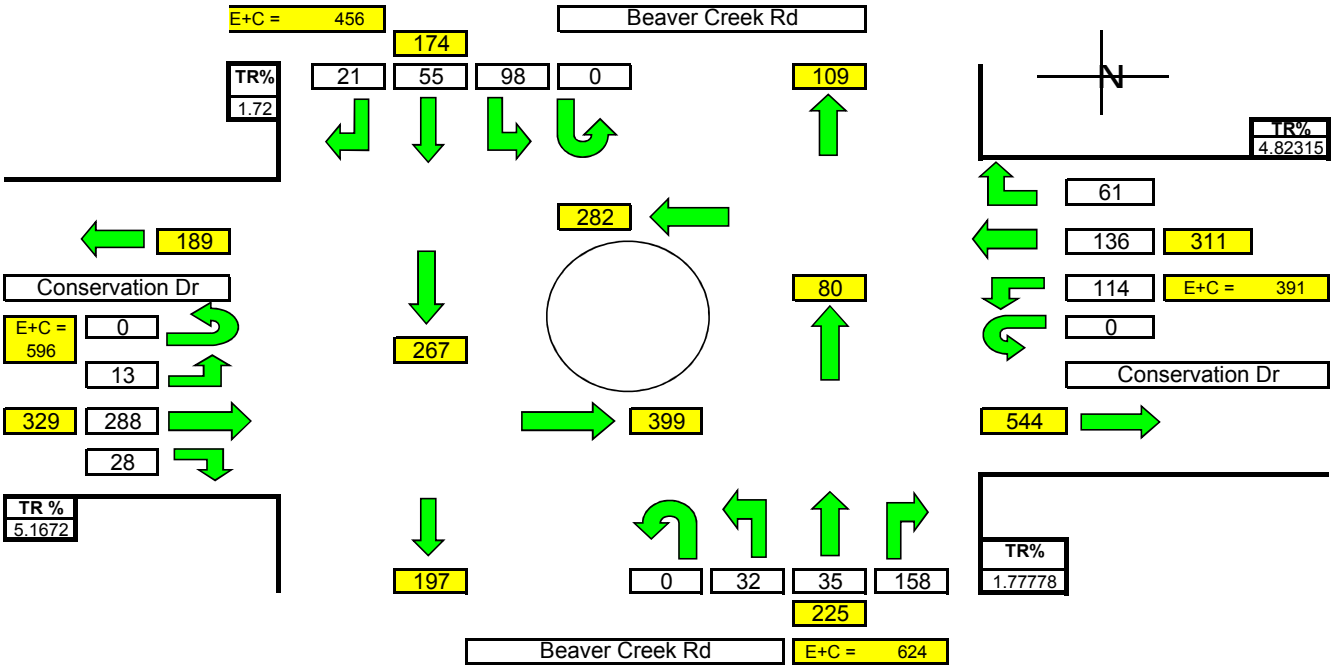
VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali

Project No.: **Sheet** 1 **of** 2

Intersection: Conservation Dr/Beaver Creek Rd

Time Period: AM PEAK

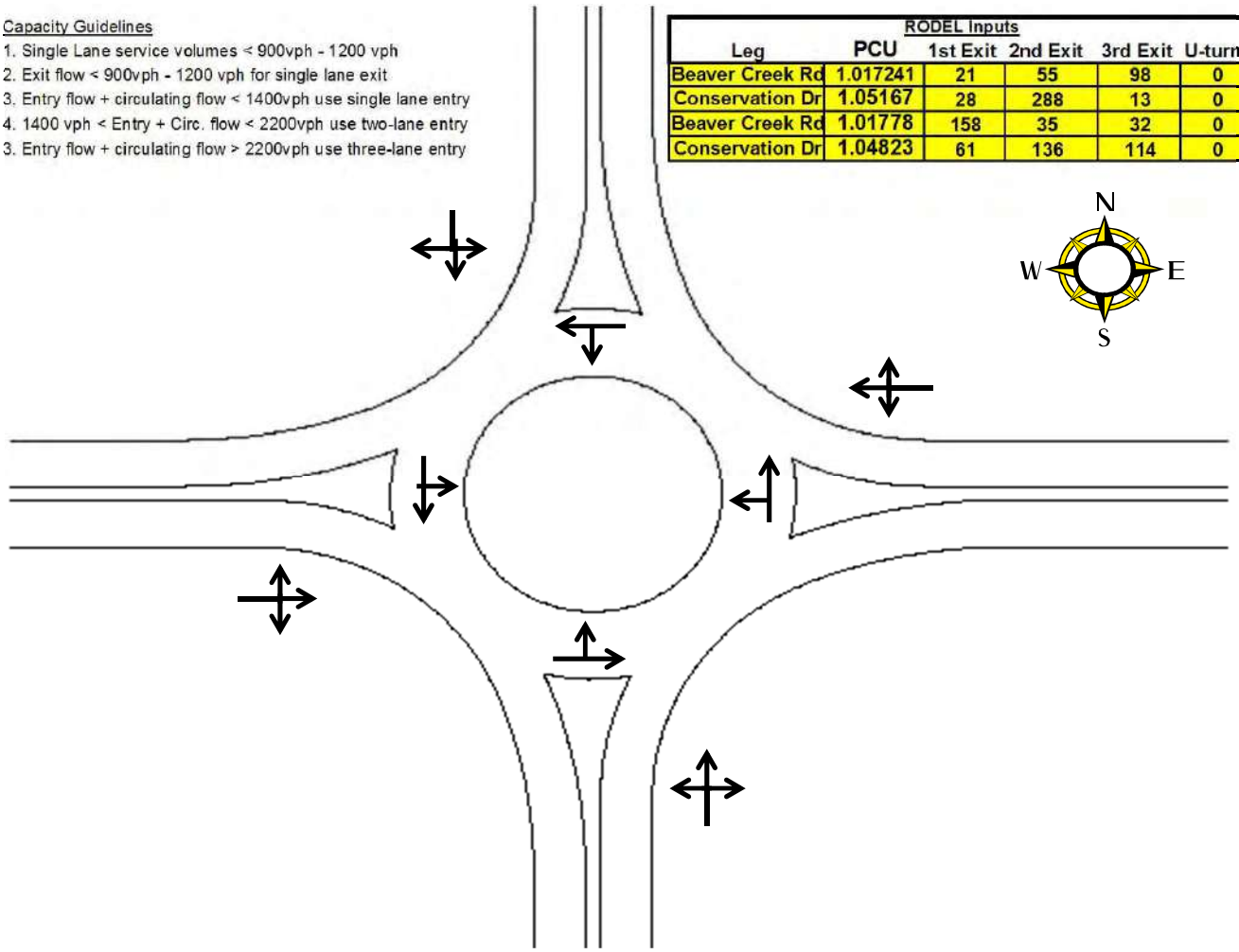


Capacity Guidelines

1. Single Lane service volumes < 900vph - 1200 vph
2. Exit flow < 900vph - 1200 vph for single lane exit
3. Entry flow + circulating flow < 1400vph use single lane entry
4. 1400 vph < Entry + Circ. flow < 2200vph use two-lane entry
3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Beaver Creek Rd	1.017241	21	55	98	0
Conservation Dr	1.05167	28	288	13	0
Beaver Creek Rd	1.01778	158	35	32	0
Conservation Dr	1.04823	61	136	114	0



REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

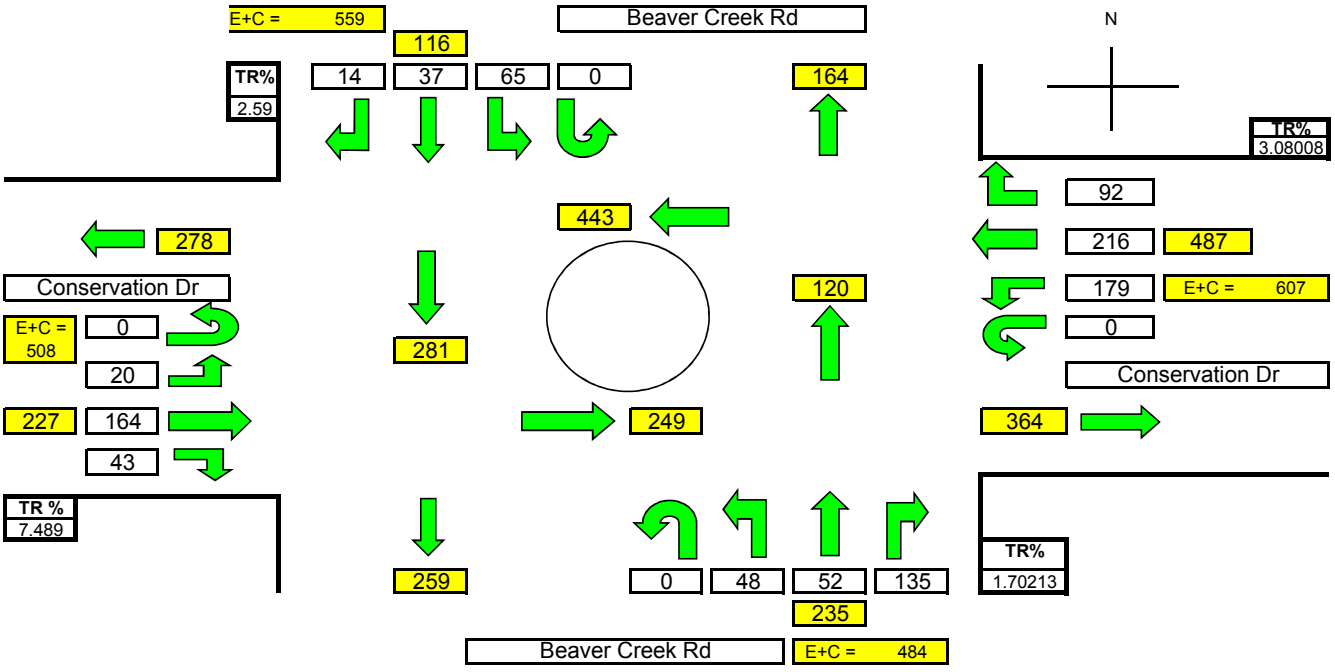
VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali

Project No.: **Sheet** 1 **of** 2

Intersection: Conservation Dr/Beaver Creek Rd

Time Period: PM PEAK

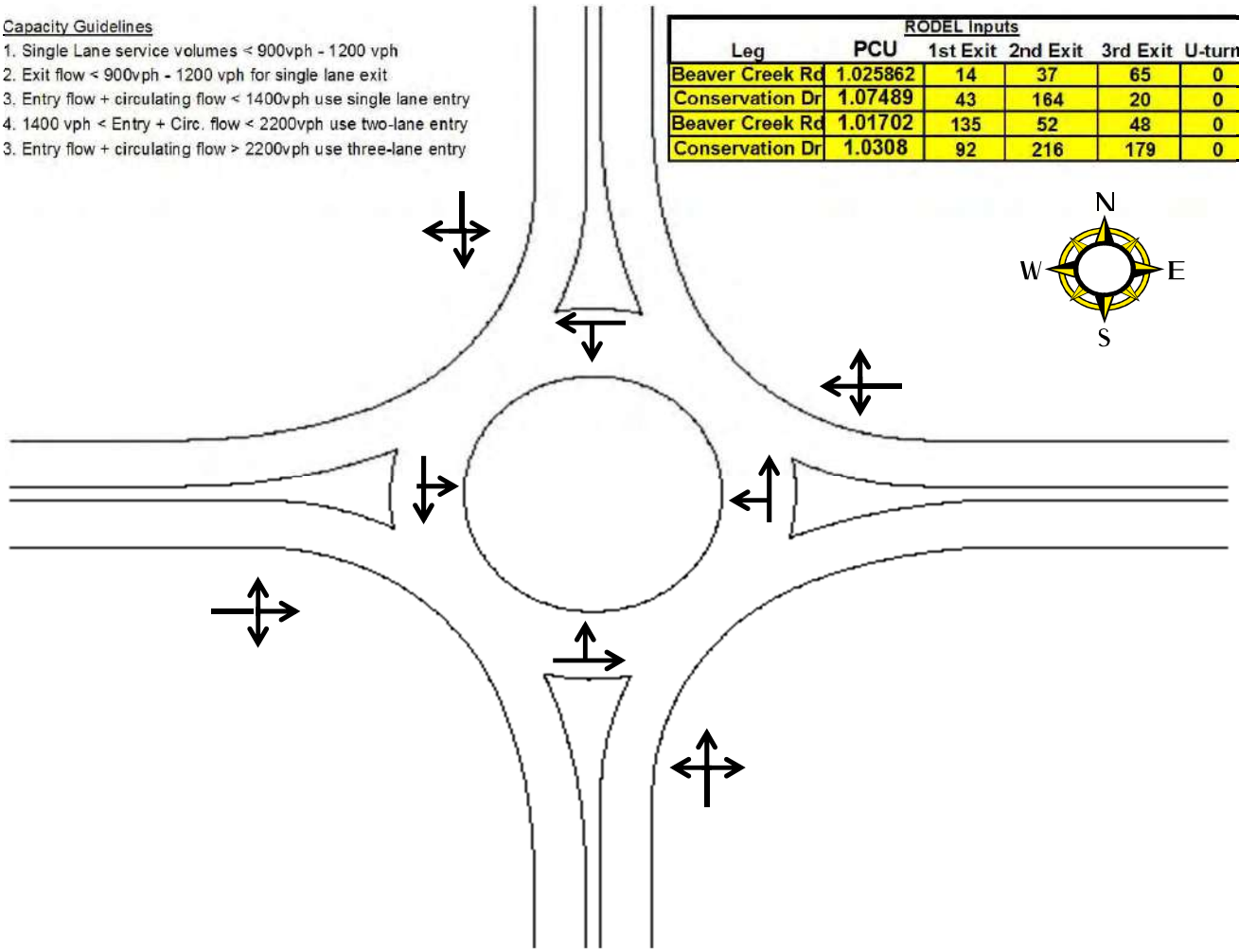


Capacity Guidelines

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2. Exit flow < 900vph - 1200 vph for single lane exit
3. Entry flow + circulating flow < 1400vph use single lane entry
4. 1400 vph < Entry + Circ. flow < 2200vph use two-lane entry
3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

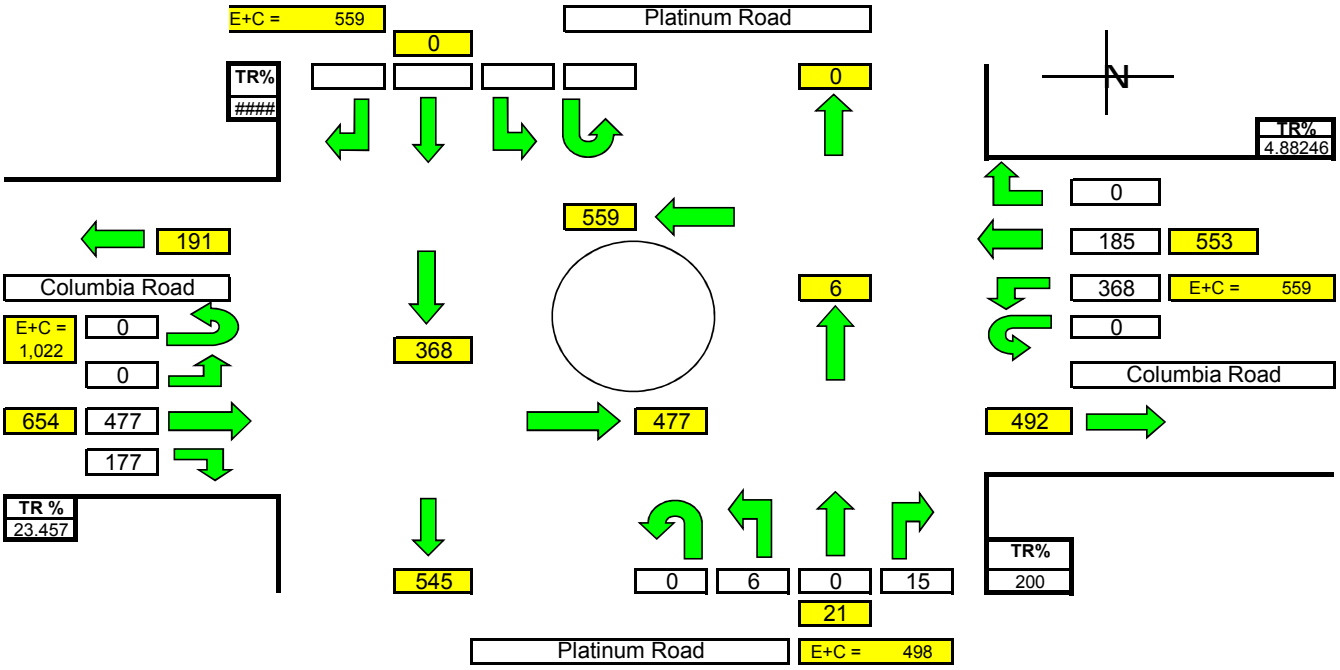
Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Beaver Creek Rd	1.025862	14	37	65	0
Conservation Dr	1.07489	43	164	20	0
Beaver Creek Rd	1.01702	135	52	48	0
Conservation Dr	1.0308	92	216	179	0



REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali
Project No.: **Sheet** 1 **of** 2
Intersection: Columbia Road and Platinum Road
Time Period: AM PEAK

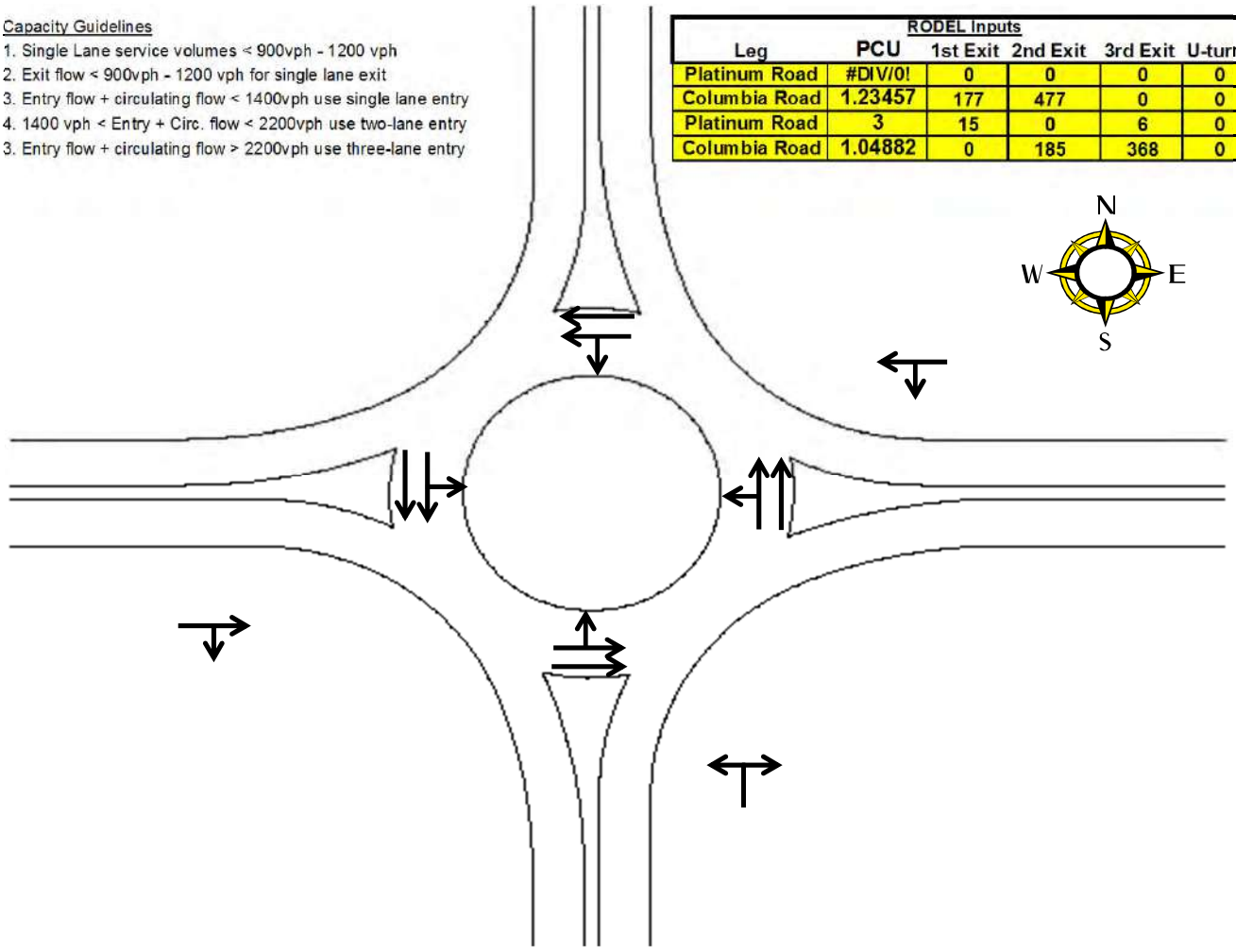


Capacity Guidelines

1. Single Lane service volumes ≤ 900vph - 1200 vph
2. Exit flow < 900vph - 1200 vph for single lane exit
3. Entry flow + circulating flow < 1400vph use single lane entry
4. 1400 vph < Entry + Circ. flow < 2200vph use two-lane entry
3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

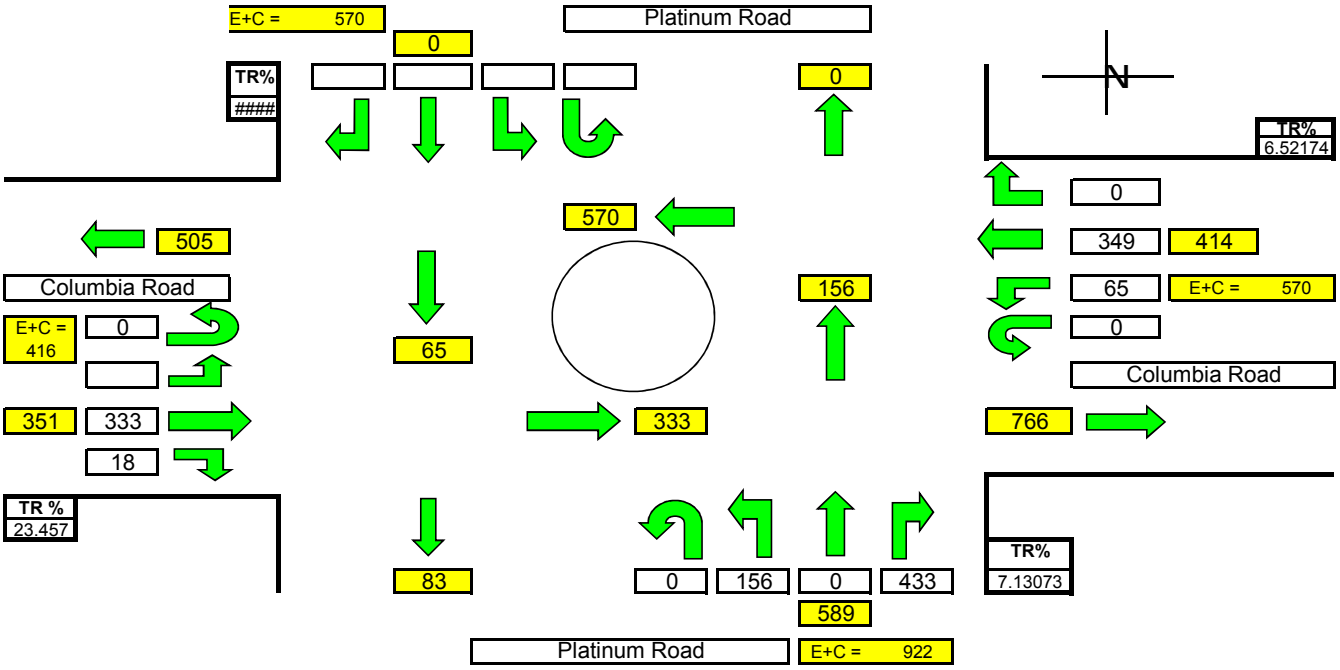
Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Platinum Road	#DIV/0!	0	0	0	0
Columbia Road	1.23457	177	477	0	0
Platinum Road	3	15	0	6	0
Columbia Road	1.04882	0	185	368	0



REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali
Project No.: **Sheet** 1 **of** 2
Intersection: Columbia Road and Platinum Road
Time Period: PM PEAK

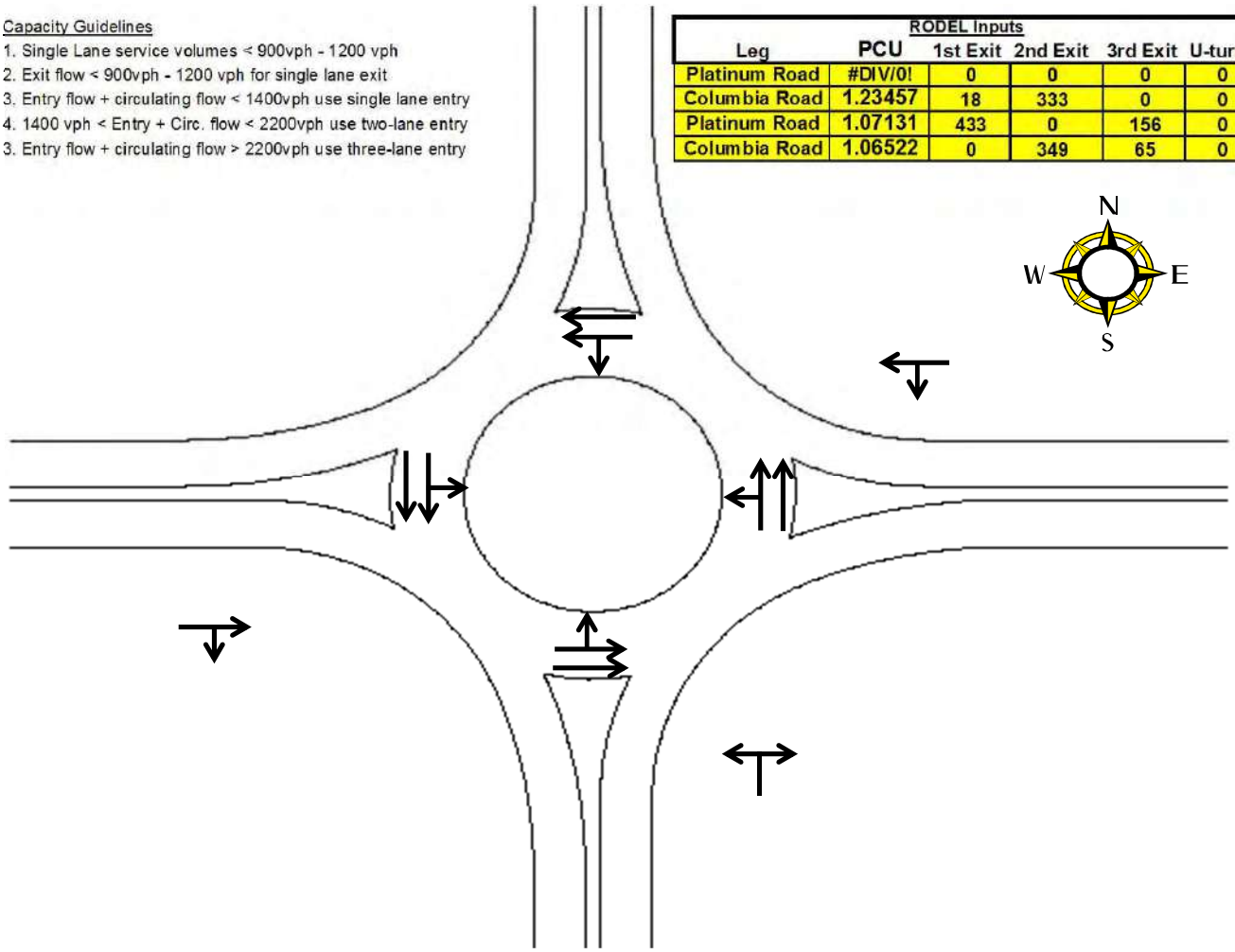


Capacity Guidelines

1. Single Lane service volumes < 900vph - 1200 vph
2. Exit flow < 900vph - 1200 vph for single lane exit
3. Entry flow + circulating flow < 1400vph use single lane entry
4. 1400 vph < Entry + Circ. flow < 2200vph use two-lane entry
3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Platinum Road	#DIV/0!	0	0	0	0
Columbia Road	1.23457	18	333	0	0
Platinum Road	1.07131	433	0	156	0
Columbia Road	1.06522	0	349	65	0



APPENDIX

C-3 *2031 CONDITIONS – WITH RECOMMENDED IMPROVEMENTS*

REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

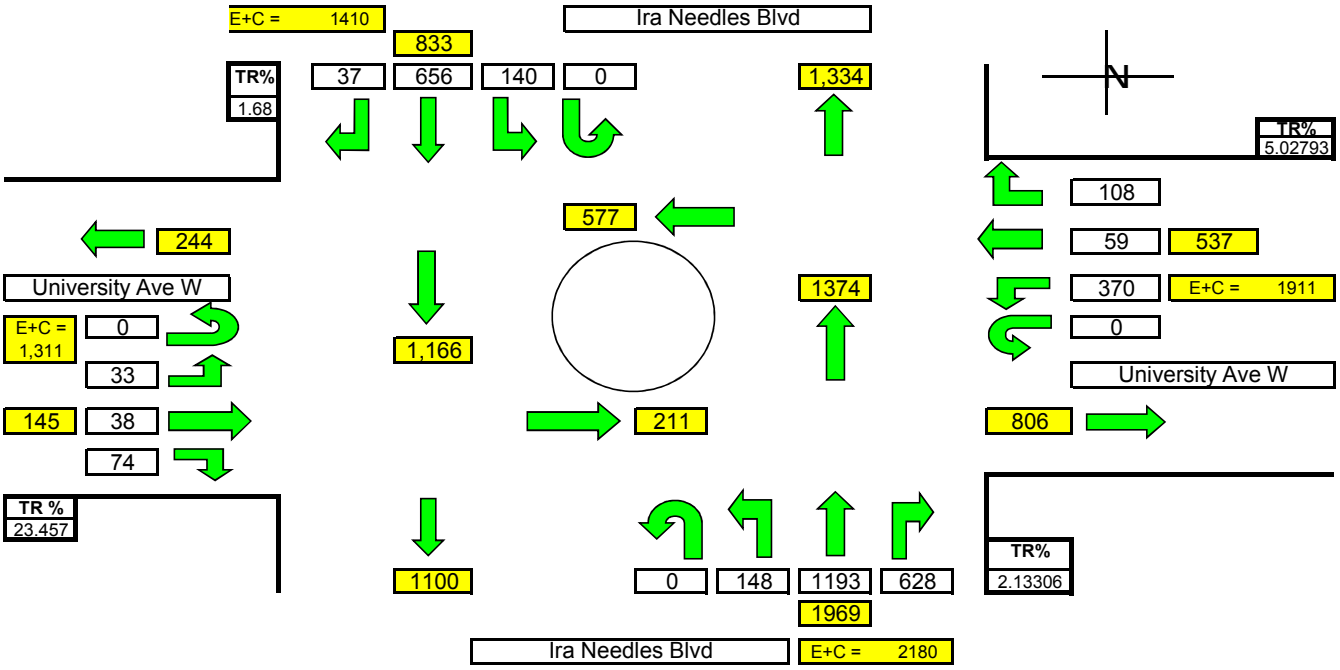
VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali

Project No.: **Sheet** 1 **of** 2

Intersection: Ira Needles Blvd/University Ave W

Time Period: AM PEAK

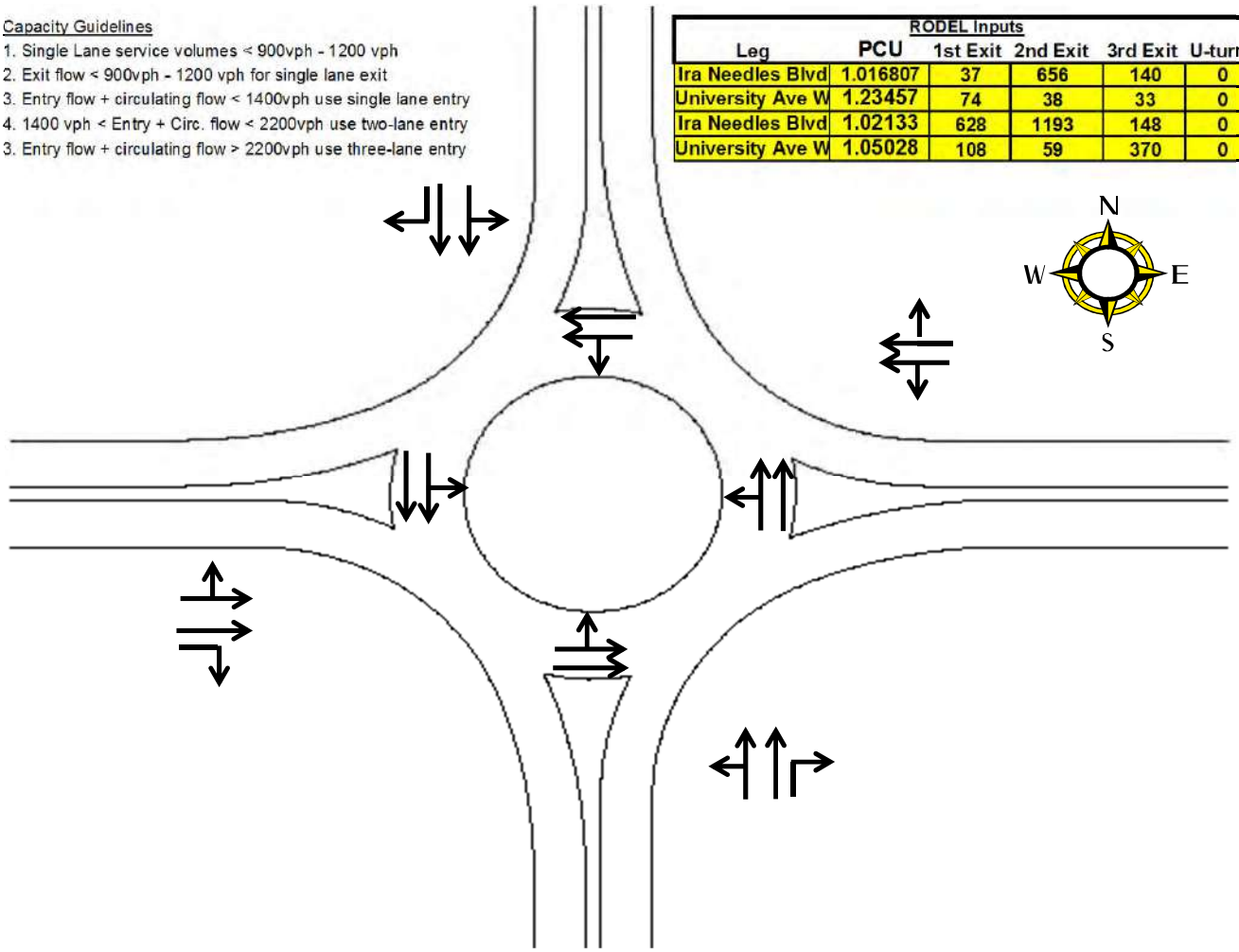


Capacity Guidelines

1. Single Lane service volumes < 900vph - 1200 vph
2. Exit flow < 900vph - 1200 vph for single lane exit
3. Entry flow + circulating flow < 1400vph use single lane entry
4. 1400 vph < Entry + Circ. flow < 2200vph use two-lane entry
3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

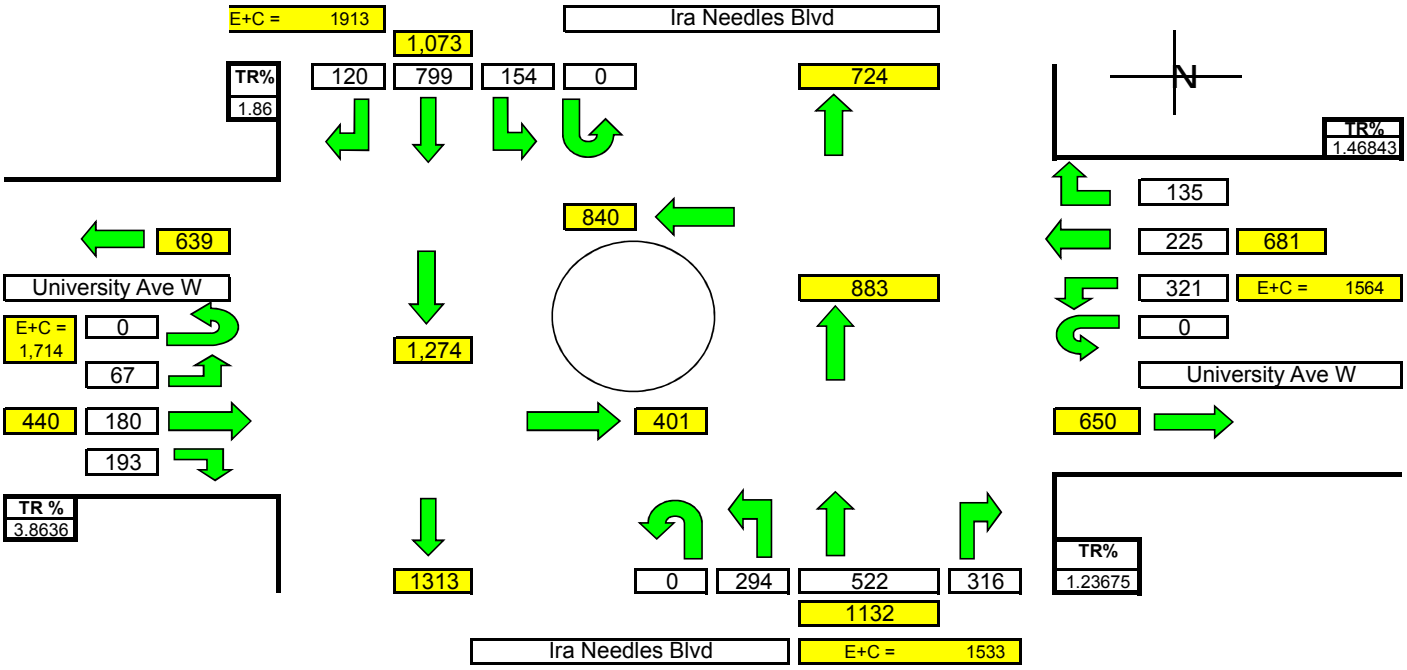
Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Ira Needles Blvd	1.016807	37	656	140	0
University Ave W	1.23457	74	38	33	0
Ira Needles Blvd	1.02133	628	1193	148	0
University Ave W	1.05028	108	59	370	0



REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali
Project No.: **Sheet** 2 of 2
Intersection: Ira Needles Blvd/University Ave W
Time Period: PM PEAK

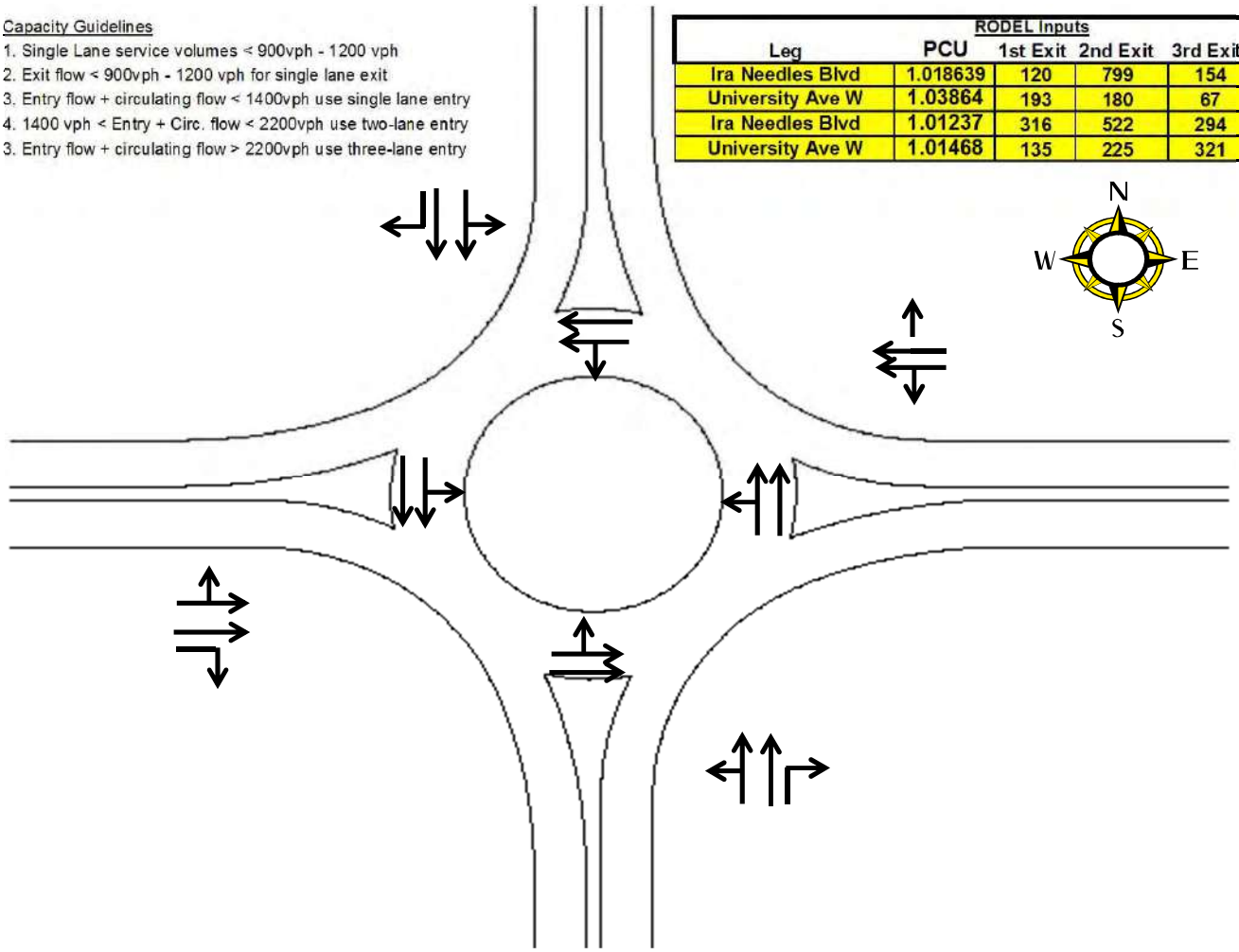


Capacity Guidelines

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3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Ira Needles Blvd	1.018639	120	799	154	0
University Ave W	1.03864	193	180	67	0
Ira Needles Blvd	1.01237	316	522	294	0
University Ave W	1.01468	135	225	321	0



REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

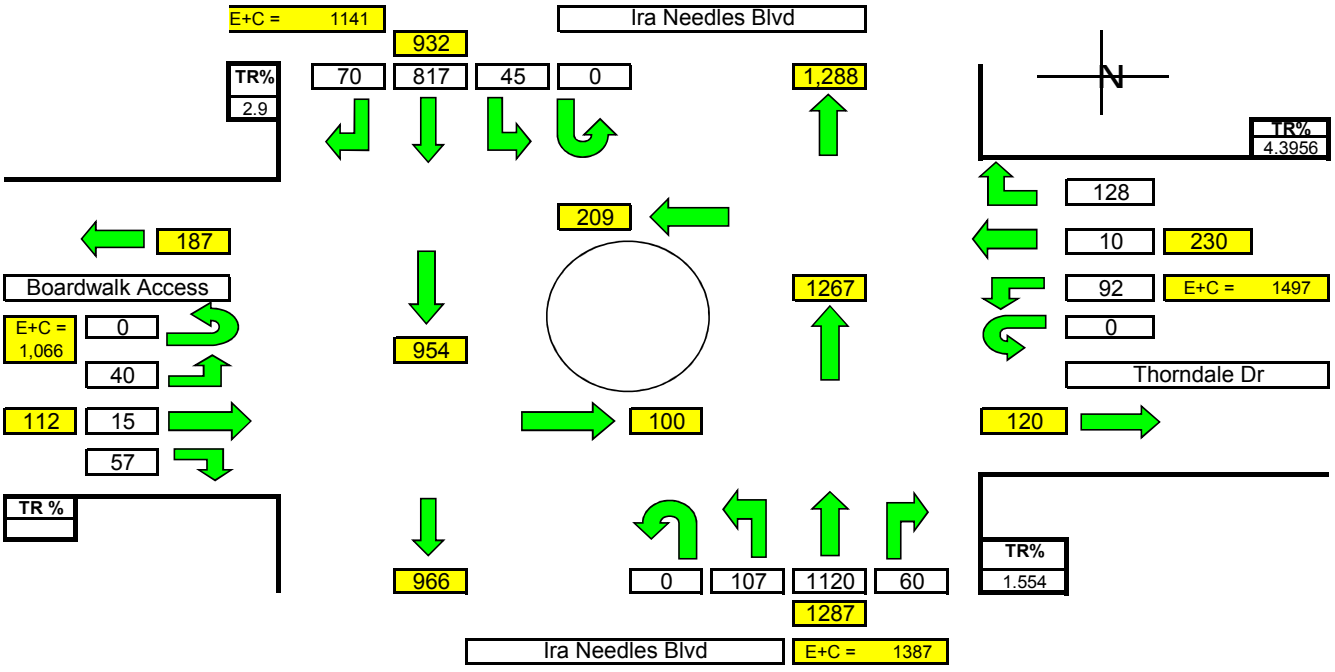
VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali

Project No.: **Sheet** 1 **of** 2

Intersection: Ira Needles Blvd/Thorndale Dr

Time Period: AM PEAK

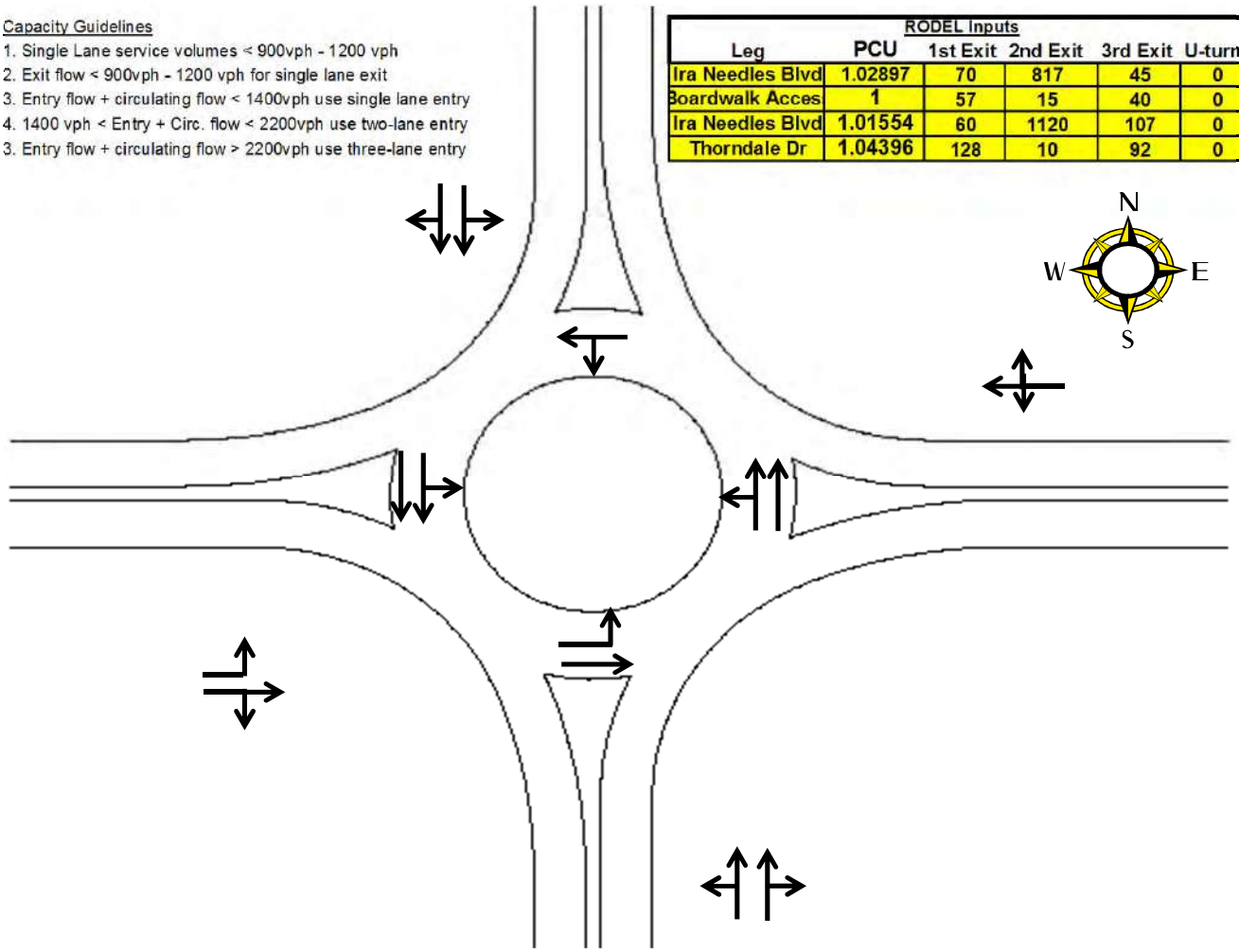


Capacity Guidelines

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2. Exit flow < 900vph - 1200 vph for single lane exit
3. Entry flow + circulating flow < 1400vph use single lane entry
4. 1400 vph < Entry + Circ. flow < 2200vph use two-lane entry
3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Ira Needles Blvd	1.02897	70	817	45	0
Boardwalk Acces	1	57	15	40	0
Ira Needles Blvd	1.01554	60	1120	107	0
Thorndale Dr	1.04396	128	10	92	0



REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

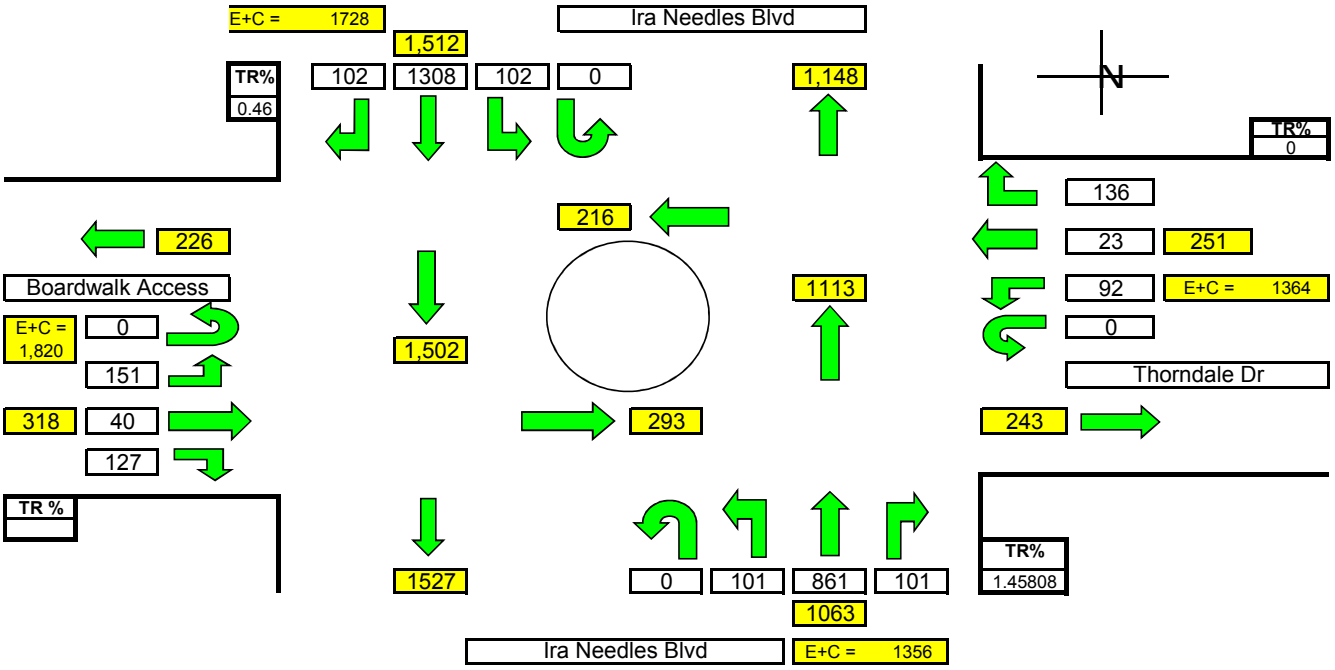
VERSION 1.1 MARCH 12, 2009

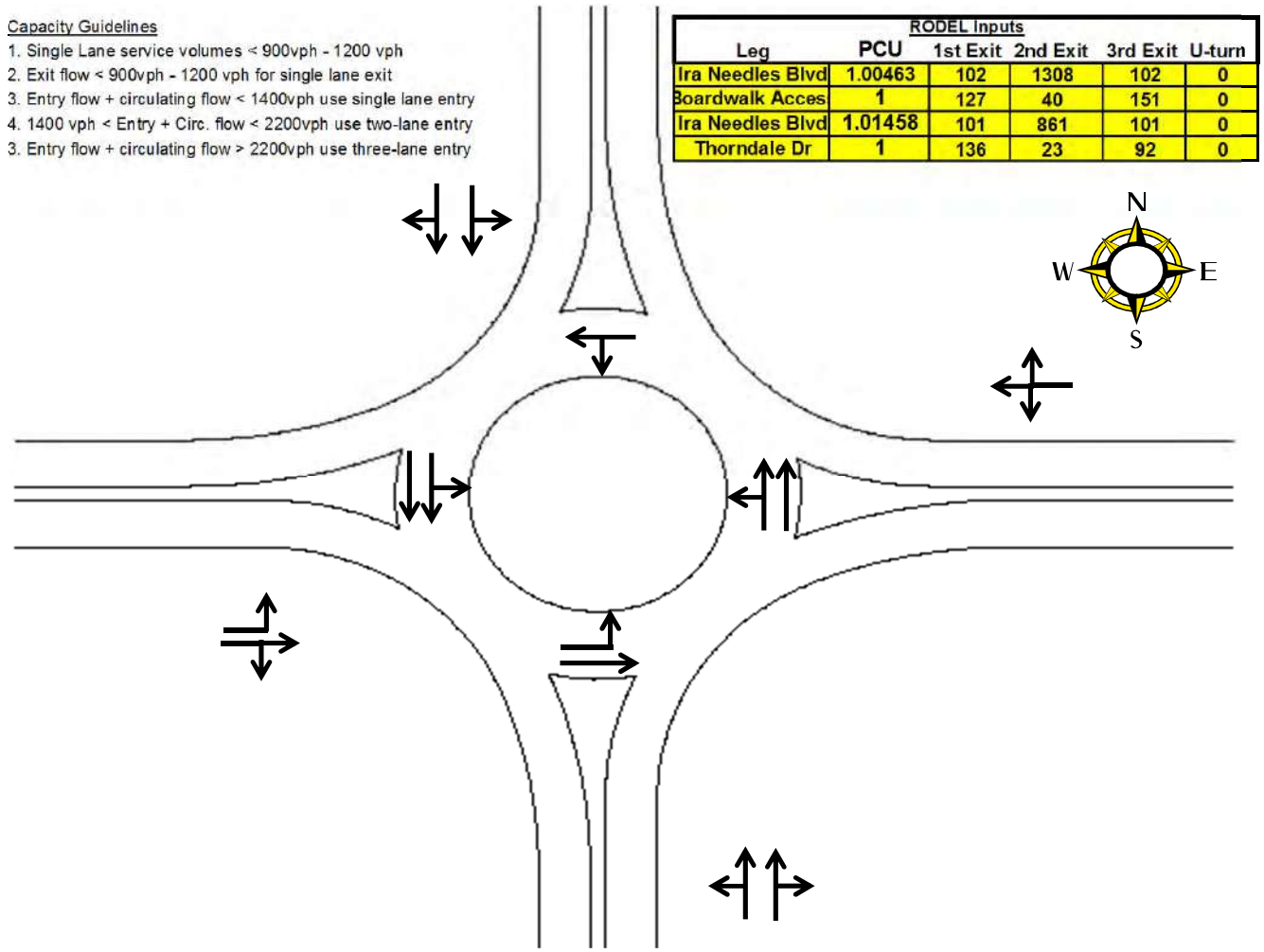
Project: PROJECT NAME **Drawn By:** Ubaid Ali

Project No.: **Sheet** 2 **of** 2

Intersection: Ira Needles Blvd/Thorndale Dr

Time Period: PM PEAK





Capacity Guidelines

1. Single Lane service volumes ≤ 900vph - 1200 vph
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4. 1400 vph < Entry + Circ. flow < 2200vph use two-lane entry
3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Ira Needles Blvd	1.00463	102	1308	102	0
Boardwalk Acces	1	127	40	151	0
Ira Needles Blvd	1.01458	101	861	101	0
Thorndale Dr	1	136	23	92	0

REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

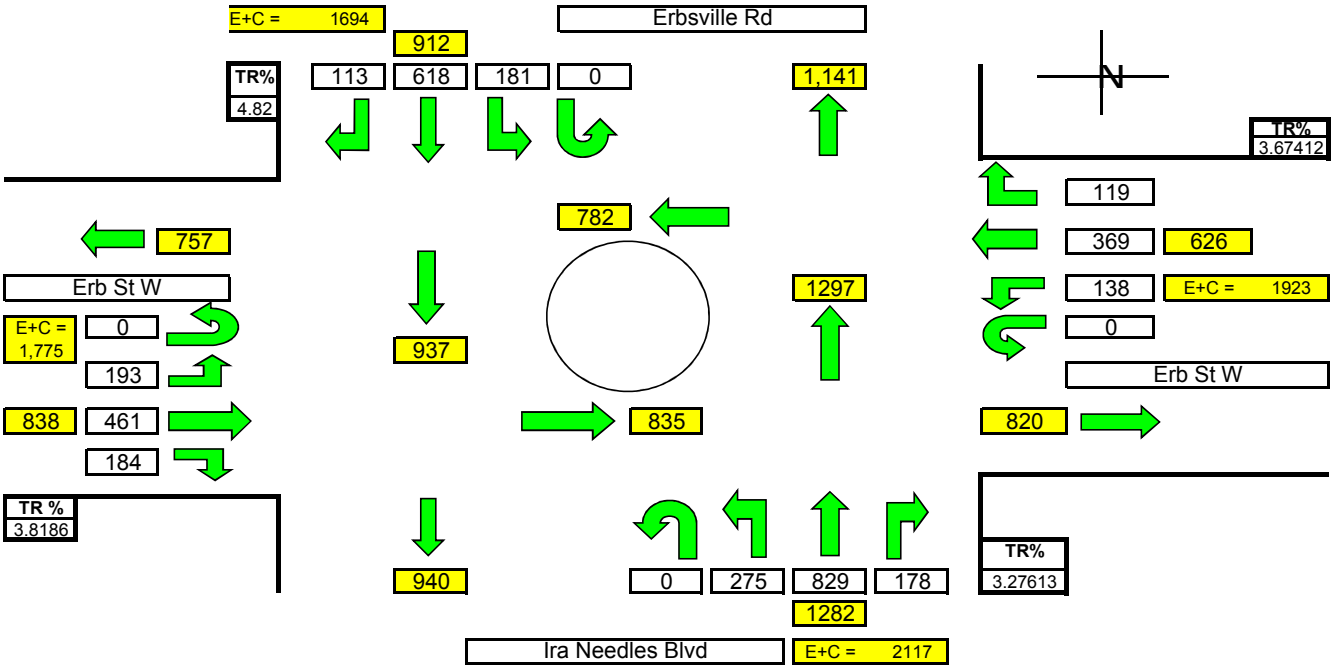
VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali

Project No.: **Sheet** 1 **of** 2

Intersection: Erb St W/Erbsville Rd-Ira Needles Blvd

Time Period: AM PEAK

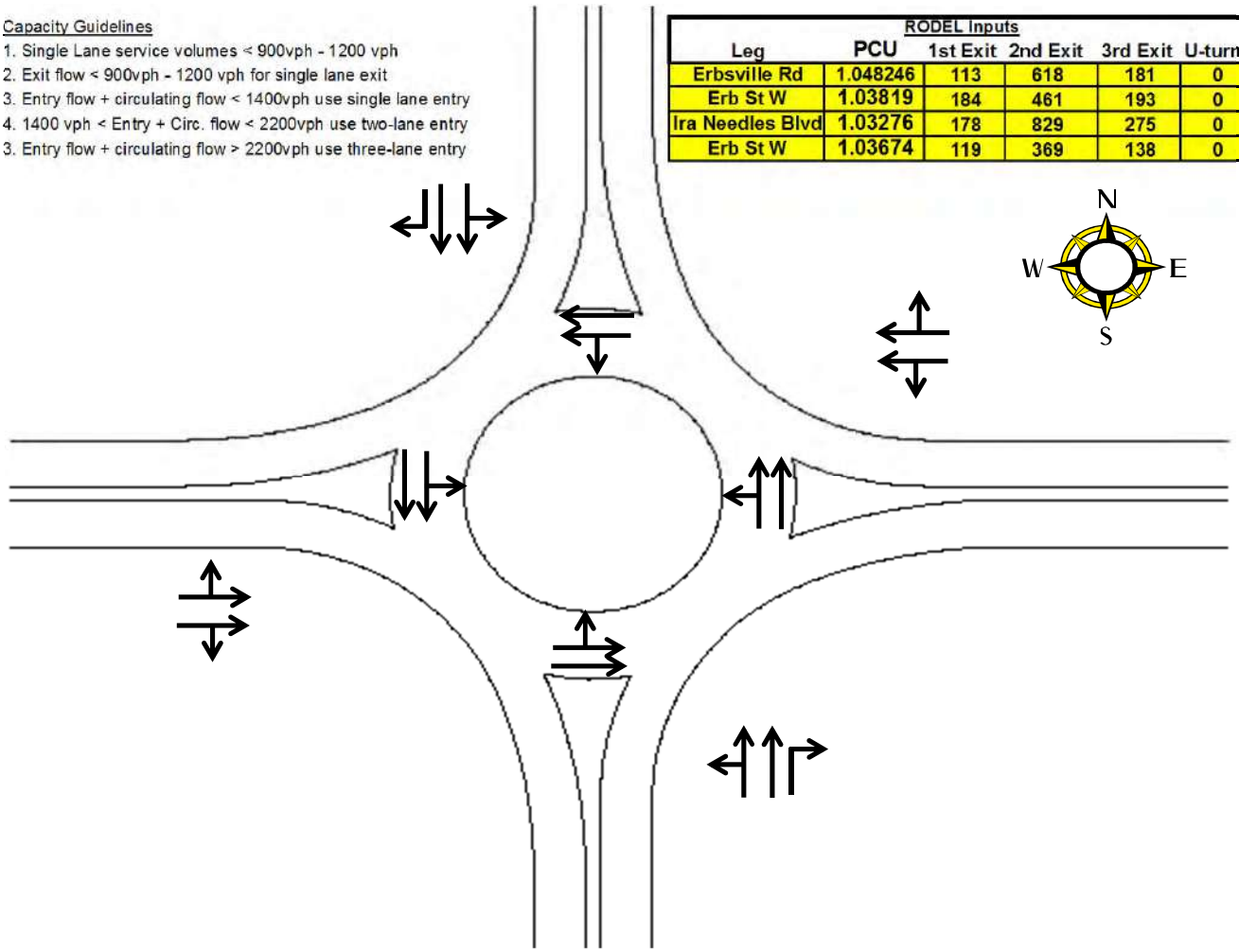


Capacity Guidelines

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4. 1400 vph < Entry + Circ. flow < 2200vph use two-lane entry
3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Erbsville Rd	1.048246	113	618	181	0
Erb St W	1.03819	184	461	193	0
Ira Needles Blvd	1.03276	178	829	275	0
Erb St W	1.03674	119	369	138	0



REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

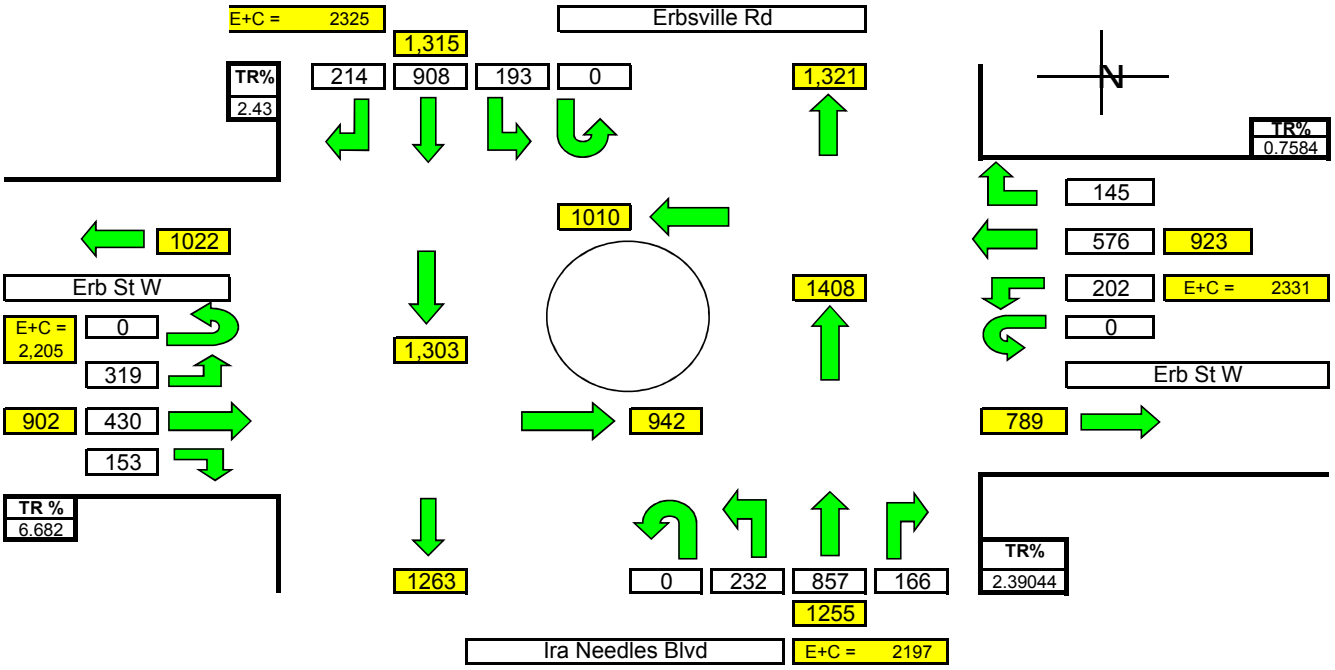
VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali

Project No.: **Sheet** 2 **of** 2

Intersection: Erb St W/Erbsville Rd-Ira Needles Blvd

Time Period: PM PEAK

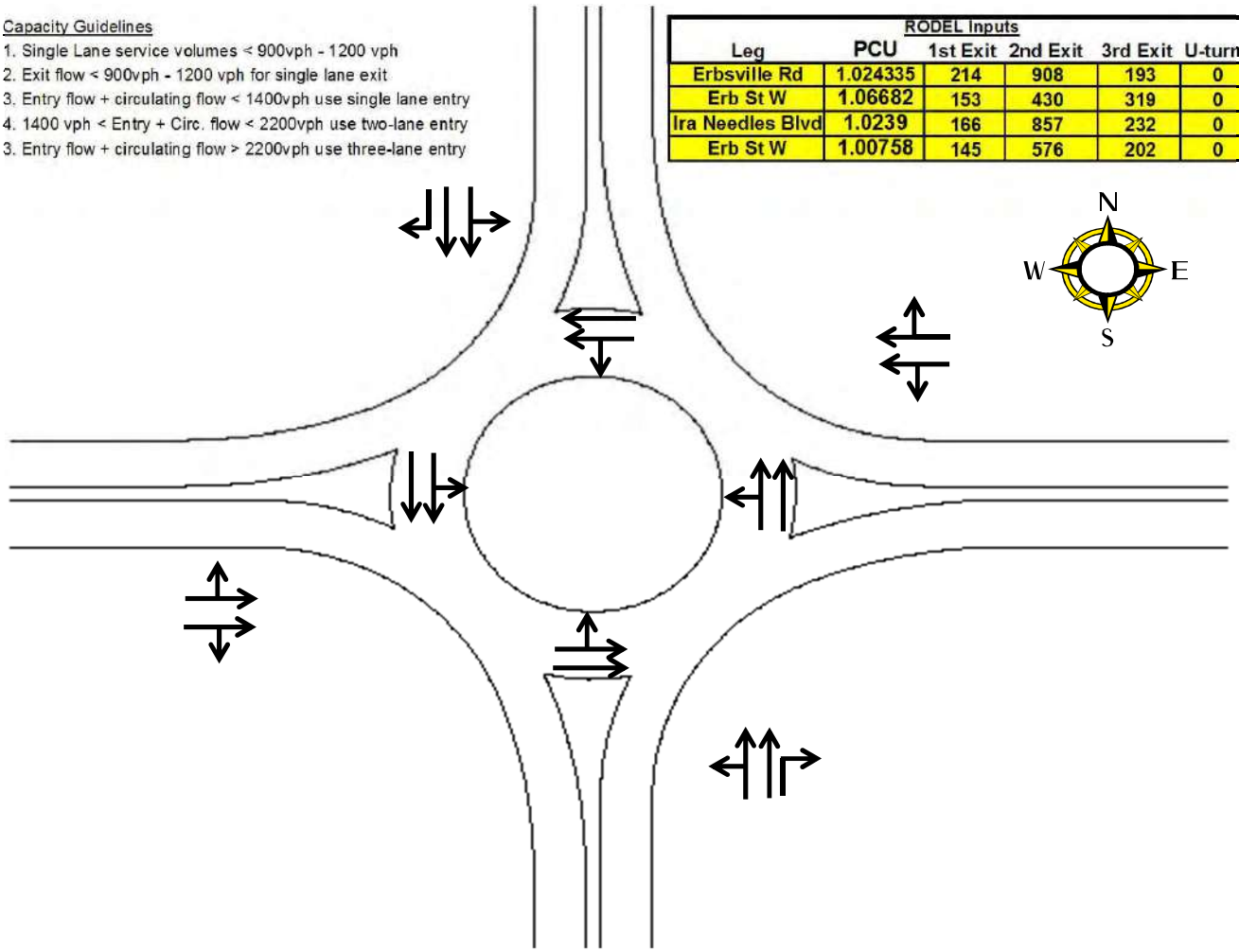


Capacity Guidelines

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RODEL Inputs

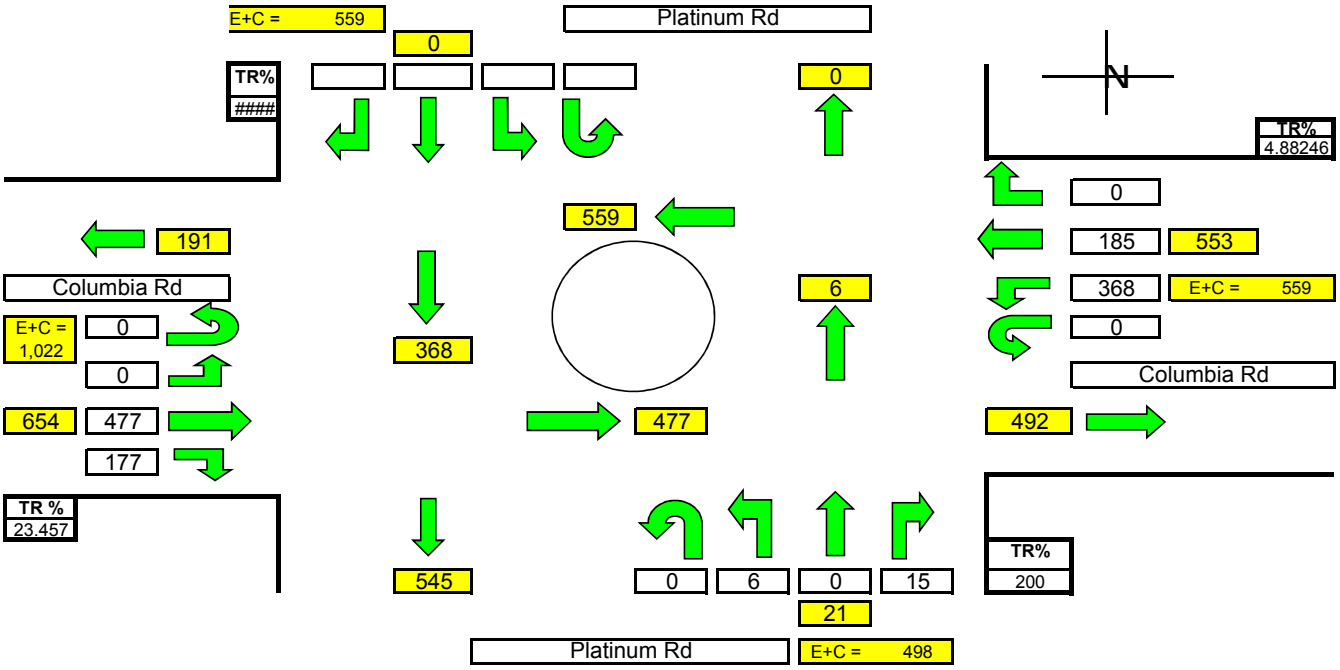
Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Erbsville Rd	1.024335	214	908	193	0
Erb St W	1.06682	153	430	319	0
Ira Needles Blvd	1.0239	166	857	232	0
Erb St W	1.00758	145	576	202	0



REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali
Project No.: **Sheet** 1 **of** 2
Intersection: Columbia Road and Platinum Road
Time Period: AM PEAK

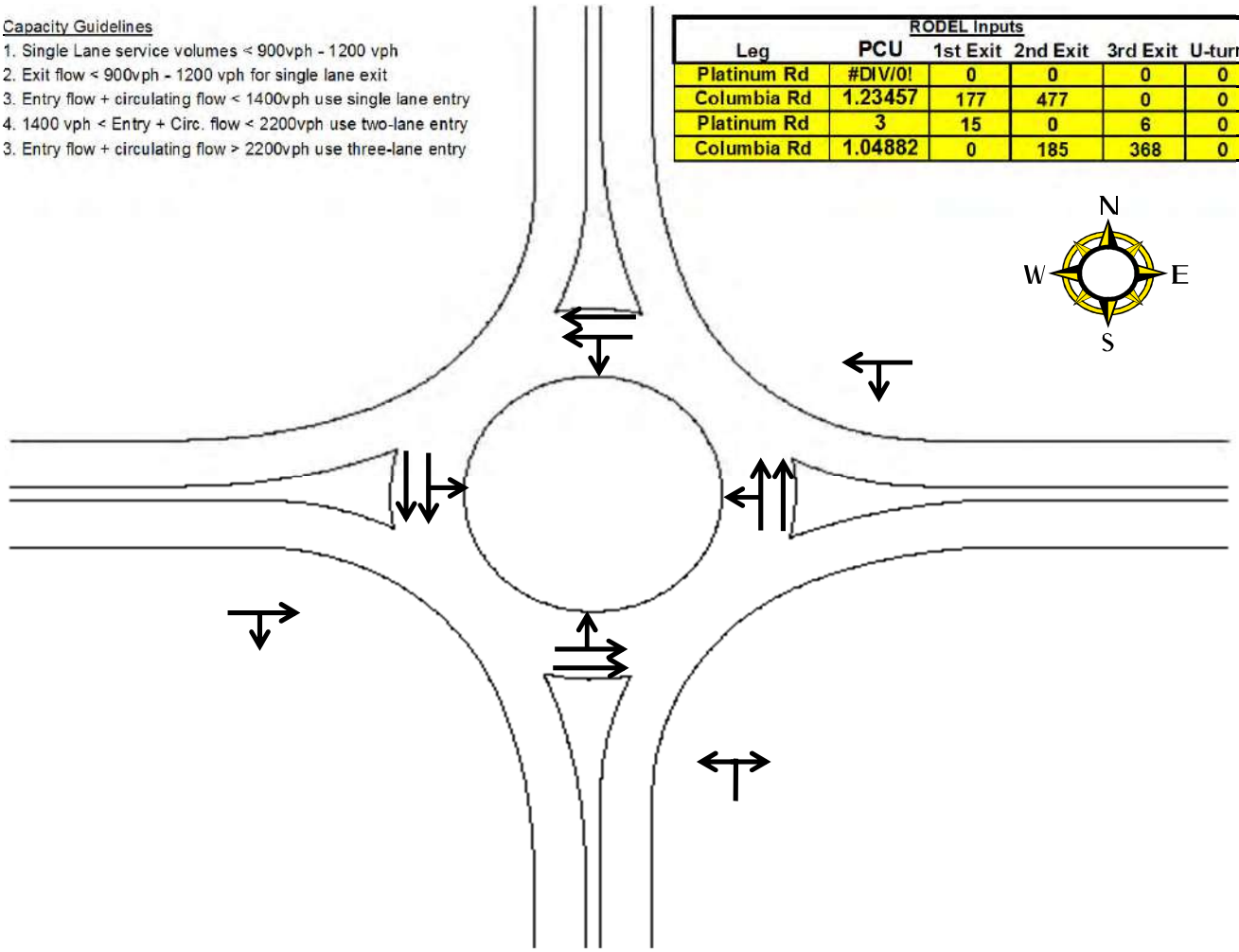


Capacity Guidelines

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3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

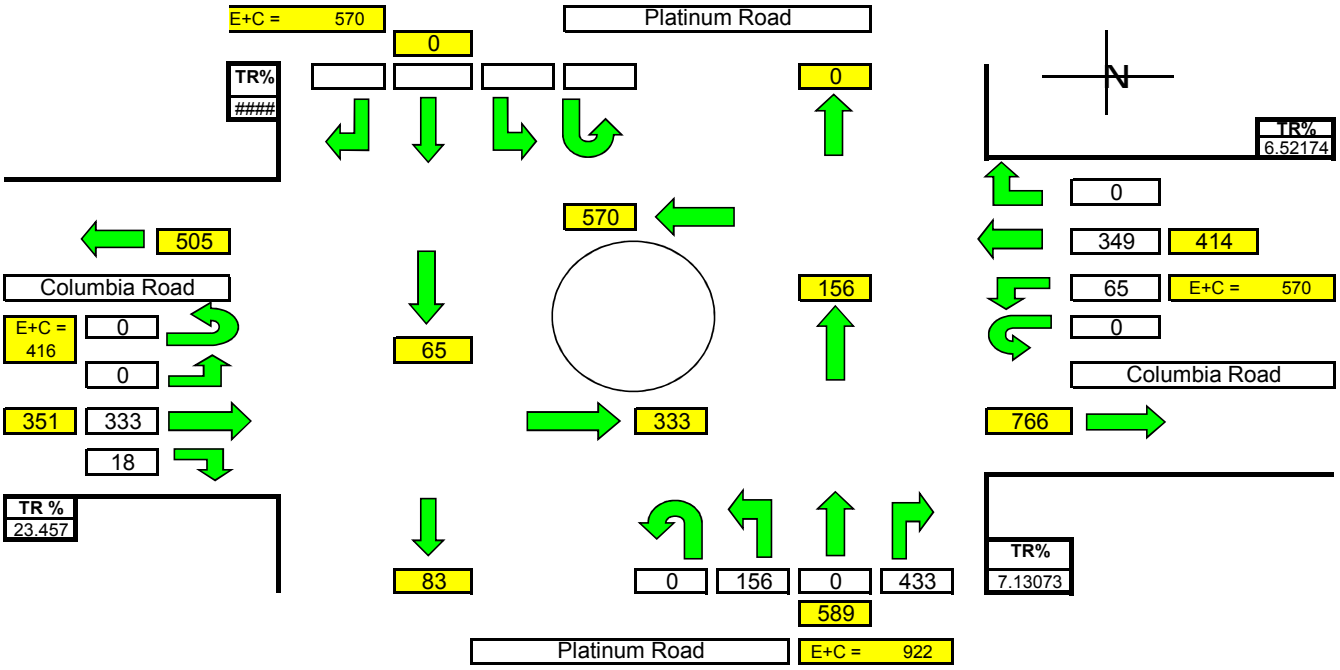
Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Platinum Rd	#DIV/0!	0	0	0	0
Columbia Rd	1.23457	177	477	0	0
Platinum Rd	3	15	0	6	0
Columbia Rd	1.04882	0	185	368	0



REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali
Project No.: **Sheet** 1 **of** 2
Intersection: Columbia Road and Platinum Road
Time Period: PM PEAK

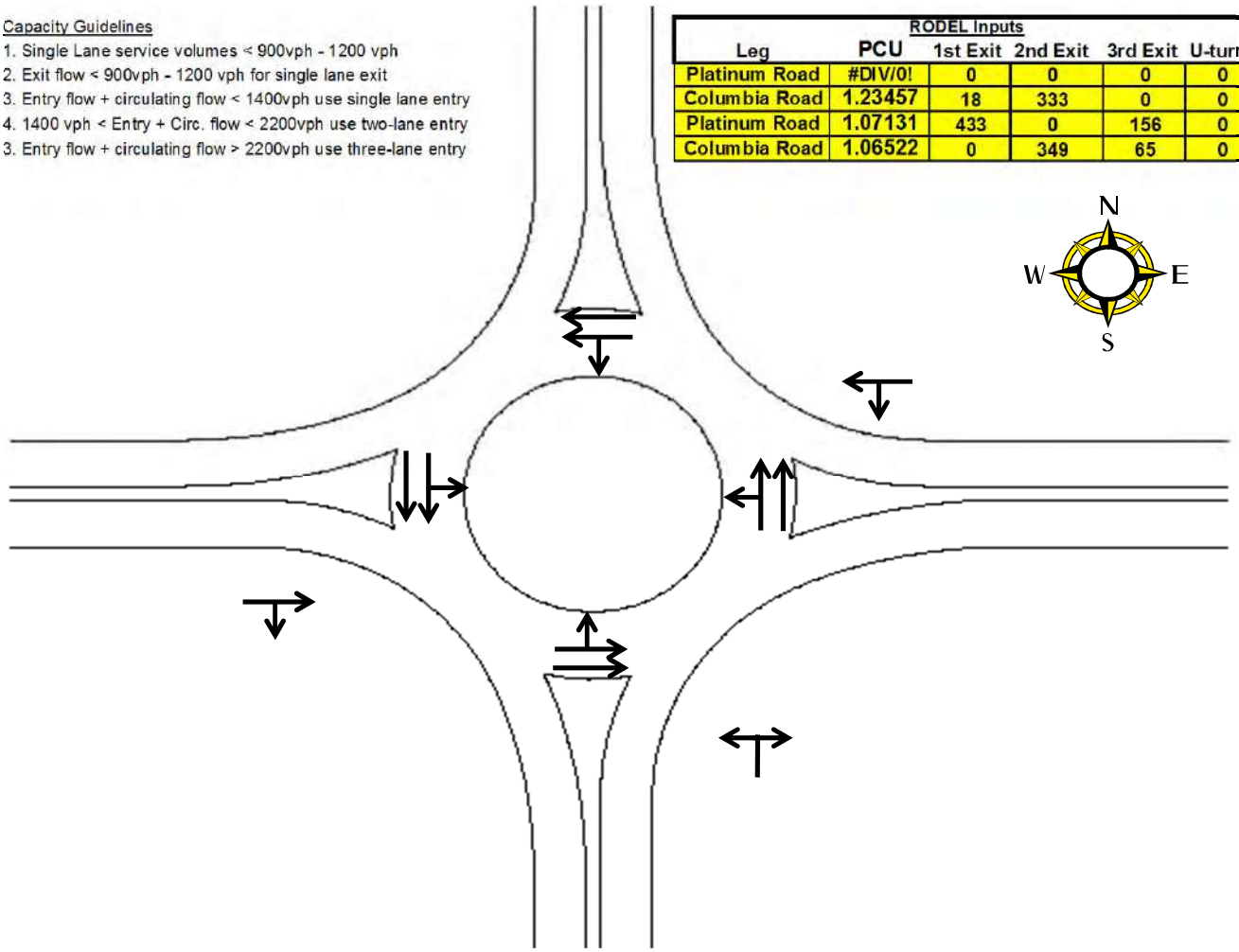


Capacity Guidelines

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RODEL Inputs

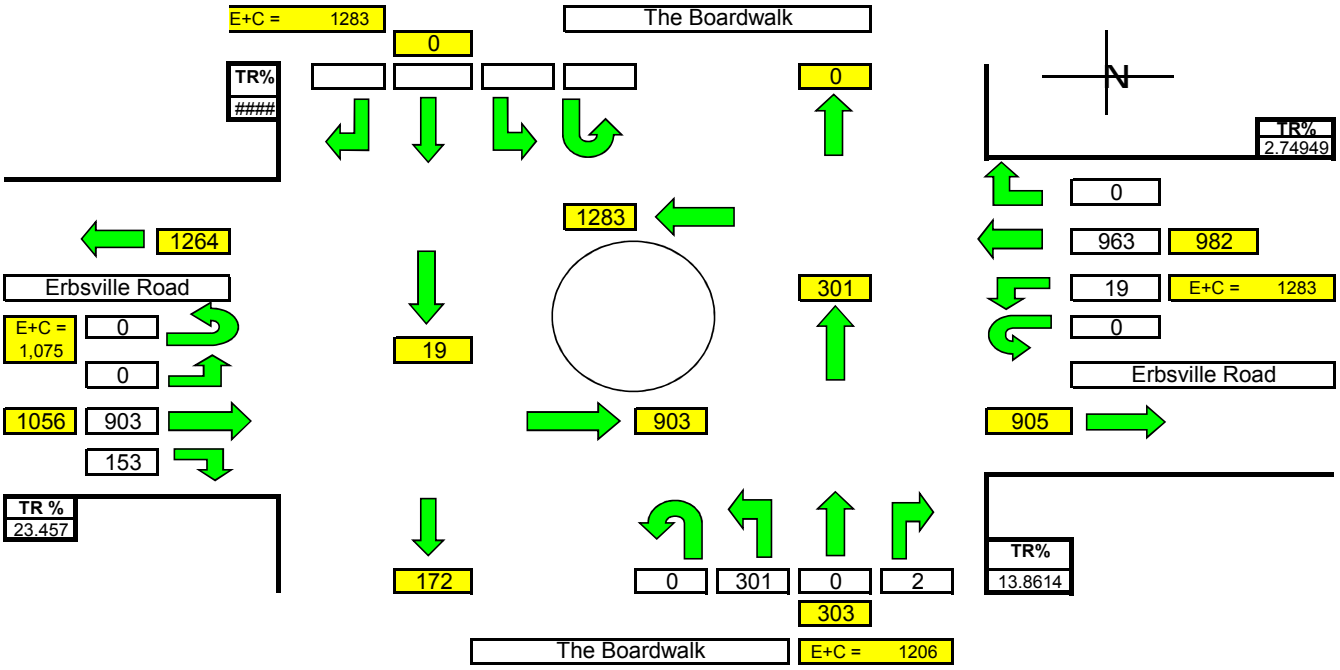
Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
Platinum Road	#DIV/0!	0	0	0	0
Columbia Road	1.23457	18	333	0	0
Platinum Road	1.07131	433	0	156	0
Columbia Road	1.06522	0	349	65	0



REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali
Project No.: **Sheet** 1 **of** 2
Intersection: Erbsville Road and The Boardwalk
Time Period: AM PEAK

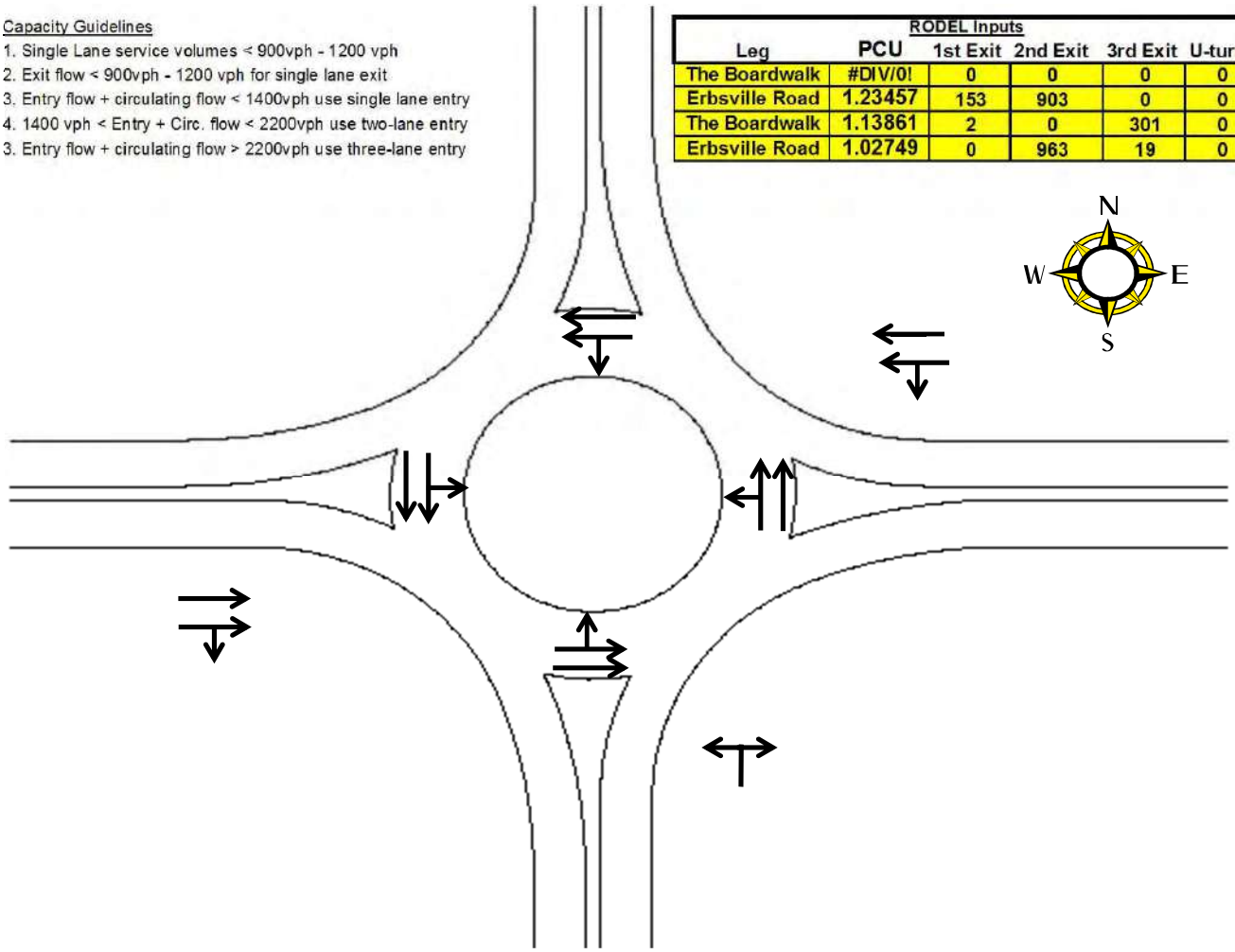


Capacity Guidelines

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RODEL Inputs

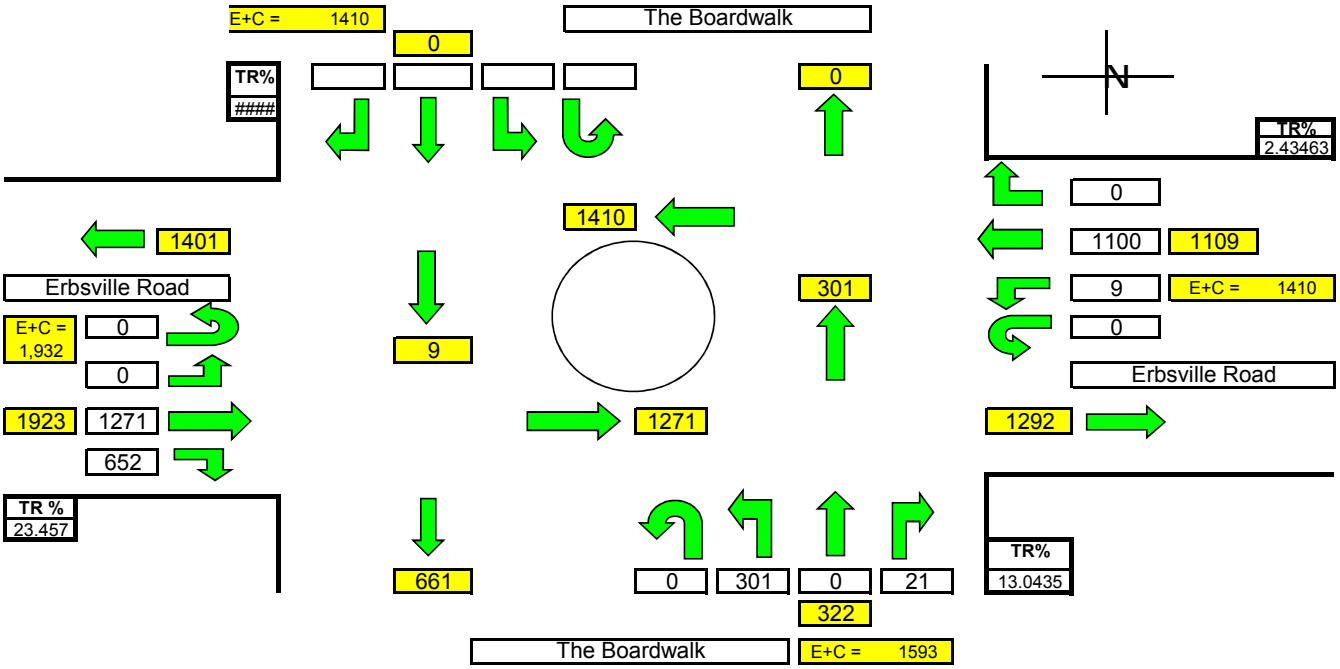
Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
The Boardwalk	#DIV/0!	0	0	0	0
Erbsville Road	1.23457	153	903	0	0
The Boardwalk	1.13861	2	0	301	0
Erbsville Road	1.02749	0	963	19	0



REGION OF WATERLOO
ROUNDABOUT TRAFFIC FLOW SHEET

VERSION 1.1 MARCH 12, 2009

Project: PROJECT NAME **Drawn By:** Ubaid Ali
Project No.: **Sheet** 1 **of** 2
Intersection: Erbsville Road and The Boardwalk
Time Period: PM PEAK

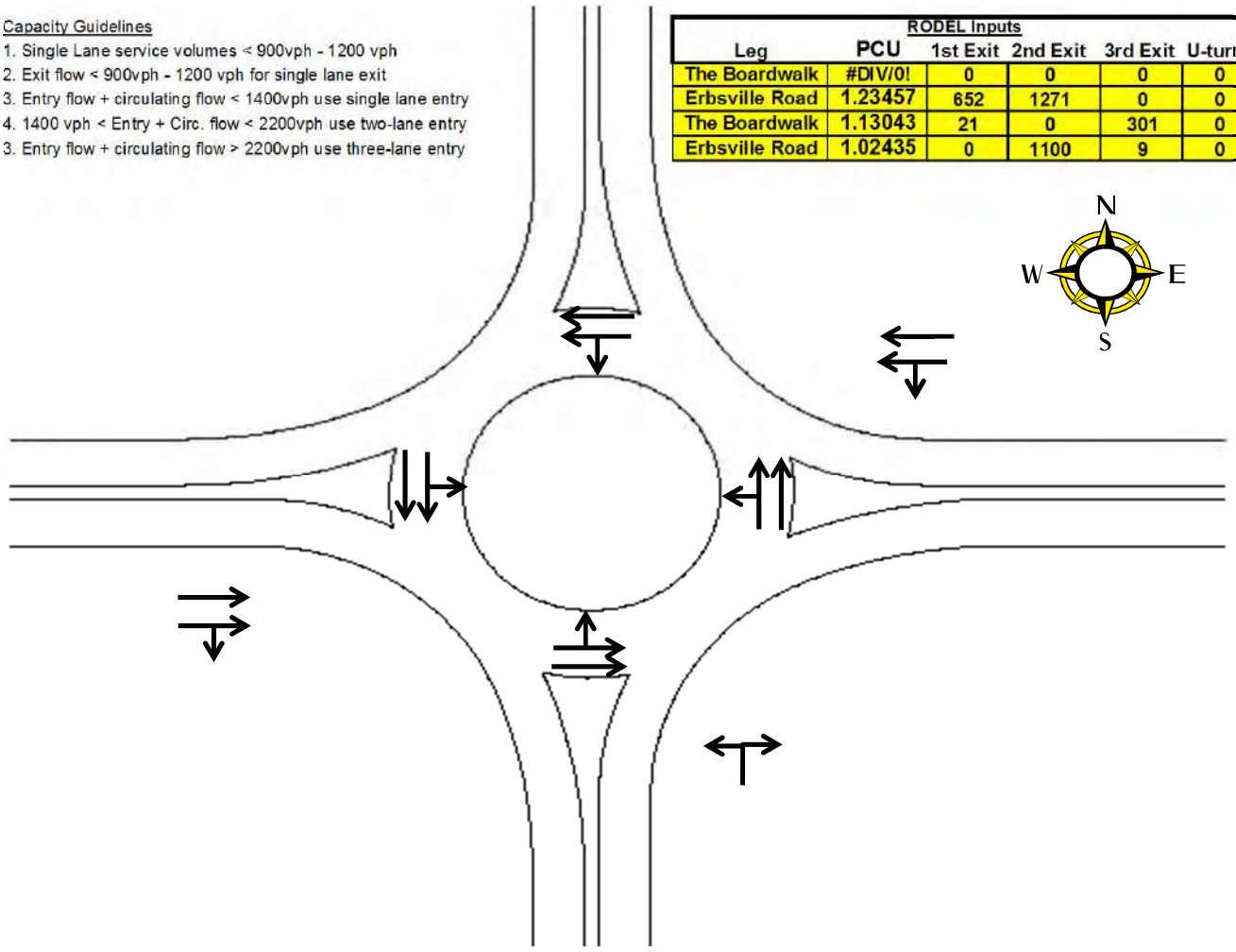


Capacity Guidelines

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3. Entry flow + circulating flow > 2200vph use three-lane entry

RODEL Inputs

Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
The Boardwalk	#DIV/0!	0	0	0	0
Erbsville Road	1.23457	652	1271	0	0
The Boardwalk	1.13043	21	0	301	0
Erbsville Road	1.02435	0	1100	9	0



APPENDIX

D ARCADY REPORTS

APPENDIX

D-1 EXISTING CONDITIONS

ARCADY 7

Version: 7.1.1.245 [9th June 2011]
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Tel: +44 (0)1344 770758 E-mail: software@trl.co.uk Web: http://www.trlsoftware.co.uk

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File: J:\04 STAFF FOLDERS\Ubaid\Roundabout Analysis Lukezic\Updated Analysis\Existing Conditions\Existing - Updated.arc7
Report generation date: 07/06/2018 3:53:14 PM

Summary of roundabout performance

There are warnings associated with one or more model runs - see the 'Data Errors and Warnings' tables for each Analysis or Demand Set.

	AM				PM			
	Queue (Veh)	Delay (s)	RFC	LOS	Queue (Veh)	Delay (s)	RFC	LOS
	Existing Conditions - AM Peak Period							
Ira Needles Blvd/University Avenue - East - University Ave	0.46	3.31	0.32	A	0.69	4.87	0.41	A
Ira Needles Blvd/University Avenue - North - Ira Needles Blvd	1.23	5.28	0.55	A	1.18	5.96	0.54	A
Ira Needles Blvd/University Avenue - West - Private Access	0.21	8.36	0.17	A	1.06	8.04	0.52	A

Ira Needles Blvd/University Avenue - South - Ira Needles Blvd	2.10	7.23	0.68	A	1.15	5.31	0.54	A
Ira Needles Blvd/Thorndale Dr - East - Thorndale Dr	0.28	5.19	0.22	A	0.37	6.90	0.27	A
Ira Needles Blvd/Thorndale Dr - North - Ira Needles Blvd	1.26	4.32	0.56	A	2.36	6.38	0.70	A
Ira Needles Blvd/Thorndale Dr - West - Boardwalk Access	0.05	3.10	0.05	A	0.24	3.75	0.20	A
Ira Needles Blvd/Thorndale Dr - South - Ira Needles Blvd	0.72	3.19	0.42	A	1.40	4.68	0.58	A
Erb St./Platinum Dr - East - Erb St. W	0.12	2.11	0.11	A	0.42	2.55	0.30	A
Erb St./Platinum Dr - North - Platinum Dr	0.01	2.45	0.01	A	0.09	2.32	0.08	A
Erb St./Platinum Dr - West - Erb St.	0.48	2.68	0.33	A	0.17	2.13	0.14	A
Erb St./Platinum Dr - South - Landfill Gate 2	0.01	5.31	0.01	A	0.04	4.07	0.04	A
Ira Needles Blvd/Erb St. - East - Erb St. W	0.34	3.02	0.25	A	2.86	11.21	0.75	B
Ira Needles Blvd/Erb St. - North - Erbsville Rd	1.09	3.95	0.52	A	2.93	9.68	0.75	A
Ira Needles Blvd/Erb St. - West - Erb St.	1.57	6.73	0.61	A	3.46	14.01	0.78	B
Ira Needles Blvd/Erb St. - South - Ira Needles Blvd	1.28	5.11	0.56	A	4.78	12.43	0.83	B
Beaver Creek Rd/Laurelwood Dr - East - Laurelwood Dr.	0.35	4.89	0.26	A	1.84	9.93	0.65	A
Beaver Creek Rd/Laurelwood Dr - North - Beaver Creek Rd	0.11	4.08	0.10	A	0.35	6.43	0.26	A
Beaver Creek Rd/Laurelwood Dr - West - Laurelwood Dr.	1.47	8.35	0.60	A	0.51	5.84	0.34	A
Beaver Creek Rd/Laurelwood Dr - South - Beaver Creek Rd	0.83	9.20	0.46	A	0.35	4.89	0.26	A

Values shown are the maximum values over all time segments. Delay is the maximum value of average delay per arriving vehicle.

AM Peak Period - AM runs from 08:00:00 to 09:30:00
PM Peak Period - PM runs from 16:00:00 to 17:30:00

File summary

File Description

Title	Roundabout Analysis Waterloo LRT
Location	Waterloo
Site Number	
Date	13/02/2017
Version	
Status	(new file)
Identifier	
Client	

Jobnumber	
Analyst	Ubaid Ali
Description	

Analysis Options

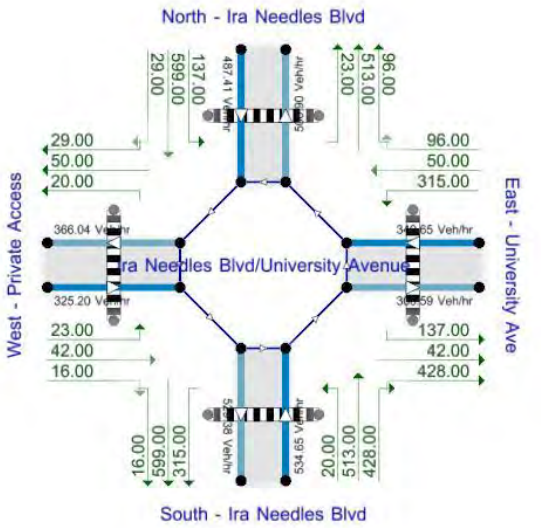
RFC Threshold	Vehicle Length (m)	Do Queue Variations
0.85	5.75	

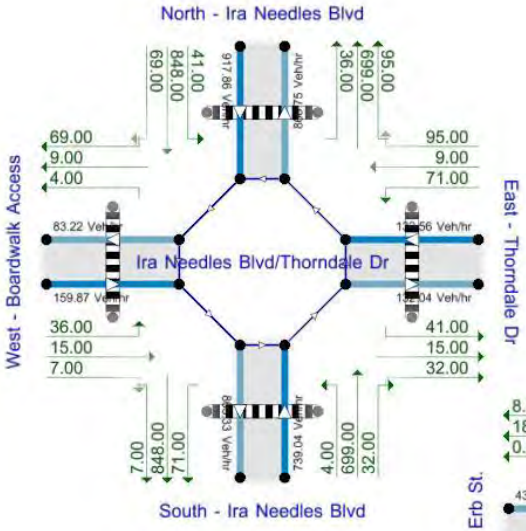
Sorting and Display

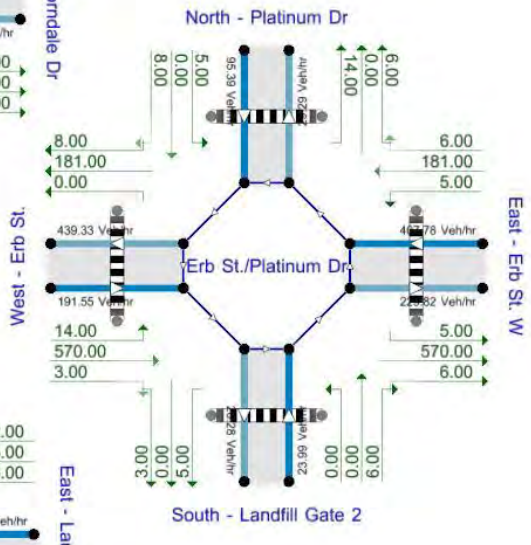
Show Arm Names	Arm Grouping	Sorting Direction	Sorting Type	Data Matrix Style	Time Style
Yes	Order	Ascending	Numerical	By Destination	Absolute Time

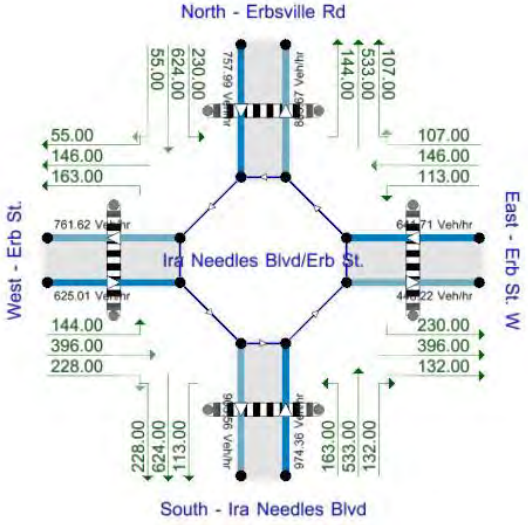
Units

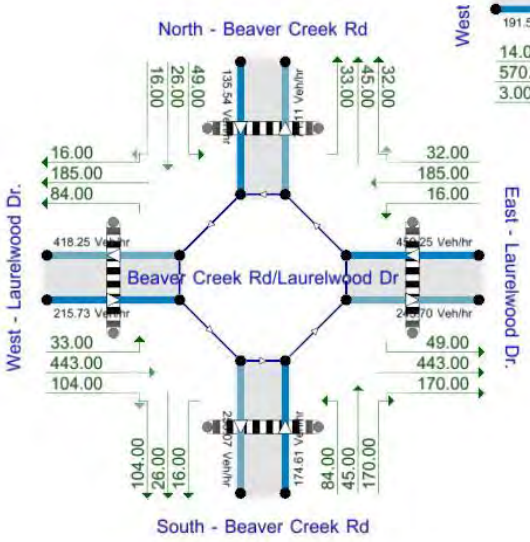
Distance Units	Speed Units	Traffic Units Input	Traffic Units Results	Flow Units	Average Delay Units	Total Delay Units	Rate Of Delay Units
m	kph	Veh	Veh	perHour	s	-Min	perMin











20.00 m

Turn Boxes - Turning Count or Proportion (Veh) - Veh/hr
Entry Arm (Text A) - Entry Flow - Veh/hr
Exit Arm (Text B) - Exit Flow - Veh/hr

ounout Anlysis terloo T
Current Time Segment: (8:00 AM-8:15 AM)
Anlysis Set A1 - Existing Conitions emn Set 1 - AM Pe Perio AM
igrm proue using ACA igrm

The intersection diagram reflects the last run of ARCADY.

A1 - Existing Conditions - D1 - AM Peak Period, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Geometry	Ira Needles Blvd/University Avenue - East - University Ave - Standard Geometry	Effective flare length is over 30m, which is outside the normal range. Treat capacities with increasing caution.
Warning	Geometry	Ira Needles Blvd/University Avenue - North - Ira Needles Blvd - Standard Geometry	Effective flare length is over 30m, which is outside the normal range. Treat capacities with increasing caution.
Warning	Geometry	Ira Needles Blvd/University Avenue - South - Ira Needles Blvd - Standard Geometry	Effective flare length is over 30m, which is outside the normal range. Treat capacities with increasing caution.
Last Run	Last Run	Ira Needles Blvd/University Avenue - South - Ira Needles Blvd - Capacity	Pedestrian Crossing causes blocking on previous arm due to traffic queing to leave the junction in 6 timesegment(s).
Warning	Pedestrian Crossing	Ira Needles Blvd/University Avenue - East - University Ave - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/University Avenue - East - University Ave - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/University Avenue - North - Ira Needles Blvd -	Pedestrian crossing uses default settings only. Is this correct?

		Unsignalled Pedestrian Crossing Details	
Warning	Pedestrian Crossing	Ira Needles Blvd/University Avenue - North - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/University Avenue - West - Private Access - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/University Avenue - West - Private Access - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/University Avenue - South - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - East - Thorndale Dr - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - East - Thorndale Dr - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - North - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - North - Ira Needles Blvd -	Pedestrian crossing uses default flow of 0. Is this correct?

		Unsignalled Pedestrian Crossing Details	
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - West - Boardwalk Access - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - West - Boardwalk Access - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - South - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - South - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - East - Erb St. W - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - East - Erb St. W - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - North - Erbsville Rd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - North - Erbsville Rd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - West - Erb St. -	Pedestrian crossing uses default settings only. Is this correct?

		Unsignalled Pedestrian Crossing Details	
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - West - Erb St. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - South - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - South - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Beaver Creek Rd/Laurelwood Dr - East - Laurelwood Dr. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Beaver Creek Rd/Laurelwood Dr - North - Beaver Creek Rd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Beaver Creek Rd/Laurelwood Dr - West - Laurelwood Dr. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Beaver Creek Rd/Laurelwood Dr - West - Laurelwood Dr. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Beaver Creek Rd/Laurelwood Dr - South - Beaver Creek Rd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - East - Erb St. W - Unsignalled	Pedestrian crossing uses default settings only. Is this correct?

		Pedestrian Crossing Details	
Warning	Pedestrian Crossing	Erb St./Platinum Dr - East - Erb St. W - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - North - Platinum Dr - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - North - Platinum Dr - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - West - Erb St. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - West - Erb St. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - South - Landfill Gate 2 - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - South - Landfill Gate 2 - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?

Analysis Set Details

Name	Description	Include In Report	Use Specific Demand Set	Demand Set	Locked	Network Flow Scaling Factor (%)	Network Capacity Scaling Factor (%)	Reason For Scaling Factors
Existing Conditions		Yes		(D1)		100.000	100.000	

Demand Set Details

Name	Scenario Name	Time Period Name	Description	Locked	Run Automatically	Use Relationship	Relationship	Start Time (HH:mm)	Finish Time (HH:mm)	Time Period Length (min)	Time Segment Length (min)	Traffic Profile Type
AM Peak Period, AM	AM Peak Period	AM			Yes			08:00	09:30	90	15	ONE HOUR

Roundabout Network

Roundabout Type(s)

Roundabout	ID	Name	Arm Order	Roundabout Type	Grade Separated	Large Roundabout	Do Geometric Delay
1	1	Ira Needles Blvd/University Avenue	1,2,3,4	Standard			
3	3	Ira Needles Blvd/Thorndale Dr	1,2,3,4	Standard			
5	5	Erb St./Platinum Dr	1,2,3,4	Standard			
6	6	Ira Needles Blvd/Erb St.	1,2,3,4	Standard			
12	12	Beaver Creek Rd/Laurelwood Dr	1,2,3,4	Standard			

Roundabout Network Options

Driving Side	Lighting	Road Surface	In London
Right	Normal/unknown	((Mini-roundabouts only))	

Arms

Arms

ID	Name	Description
1	East - University Ave	
2	North - Ira Needles Blvd	
3	West - Private Access	
4	South - Ira Needles Blvd	
1	East - Thorndale Dr	
2	North - Ira Needles Blvd	
3	West - Boardwalk Access	
4	South - Ira Needles Blvd	

1	East - Erb St. W	
2	North - Platinum Dr	
3	West - Erb St.	
4	South - Landfill Gate 2	
1	East - Erb St. W	
2	North - Erbsville Rd	
3	West - Erb St.	
4	South - Ira Needles Blvd	
1	East - Laurelwood Dr.	
2	North - Beaver Creek Rd	
3	West - Laurelwood Dr.	
4	South - Beaver Creek Rd	

Capacity Options

Roundabout	Arm	Minimum Capacity (PCE/hr)	Maximum Capacity (PCE/hr)	Assume Flat Start Profile	Initial Queue (PCE)
Ira Needles Blvd/University Avenue	**East - University Ave**	0.00	99999.00		0.00
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	0.00	99999.00		0.00
Ira Needles Blvd/University Avenue	**West - Private Access**	0.00	99999.00		0.00
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	0.00	99999.00		0.00
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	0.00	99999.00		0.00
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	0.00	99999.00		0.00
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	0.00	99999.00		0.00
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	0.00	99999.00		0.00
Erb St./Platinum Dr	**East - Erb St. W**	0.00	99999.00		0.00
Erb St./Platinum Dr	**North - Platinum Dr**	0.00	99999.00		0.00
Erb St./Platinum Dr	**West - Erb St.**	0.00	99999.00		0.00
Erb St./Platinum Dr	**South - Landfill Gate 2**	0.00	99999.00		0.00
Ira Needles Blvd/Erb St.	**East - Erb St. W**	0.00	99999.00		0.00
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	0.00	99999.00		0.00
Ira Needles Blvd/Erb St.	**West - Erb St.**	0.00	99999.00		0.00
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	0.00	99999.00		0.00
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	0.00	99999.00		0.00
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	0.00	99999.00		0.00
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	0.00	99999.00		0.00

Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	0.00	99999.00		0.00

Standard Geometry

Roundabout	Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit Only
Ira Needles Blvd/University Avenue	**East - University Ave**	7.00	7.70	33.22	27.80	55.00	16.36	
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	3.65	7.70	40.78	27.80	55.00	19.60	
Ira Needles Blvd/University Avenue	**West - Private Access**	4.00	7.20	13.78	34.30	55.00	11.79	
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	3.65	7.70	39.60	25.30	55.00	16.84	
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	3.50	6.40	7.65	67.60	55.00	23.37	
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	7.00	8.50	17.60	42.70	44.00	51.42	
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	7.00	8.65	8.60	36.20	50.00	33.36	
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	7.00	8.45	12.74	39.40	50.00	37.81	
Erb St./Platinum Dr	**East - Erb St. W**	7.00	8.00	30.00	20.00	55.00	25.00	
Erb St./Platinum Dr	**North - Platinum Dr**	7.00	8.00	30.00	20.00	55.00	25.00	
Erb St./Platinum Dr	**West - Erb St.**	7.00	8.00	30.00	20.00	55.00	25.00	
Erb St./Platinum Dr	**South - Landfill Gate 2**	3.50	4.50	30.00	20.00	40.00	25.00	
Ira Needles Blvd/Erb St.	**East - Erb St. W**	7.00	8.60	20.00	33.00	56.00	13.00	
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	7.00	9.30	12.00	30.00	56.00	20.00	
Ira Needles Blvd/Erb St.	**West - Erb St.**	6.80	7.80	7.00	23.00	56.00	6.00	
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	7.20	8.60	10.00	29.00	56.00	17.00	
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	3.50	4.50	30.00	20.00	40.00	25.00	
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	3.50	4.50	30.00	20.00	40.00	25.00	
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	3.50	4.50	30.00	20.00	40.00	25.00	
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	3.50	4.50	30.00	20.00	40.00	25.00	

Pedestrian Crossings

Roundabout	Arm	Crossing Type
Ira Needles Blvd/University Avenue	**East - University Ave**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/University Avenue	**West - Private Access**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	Unsignalled Pedestrian Crossing

Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	Unsignalled Pedestrian Crossing
Erb St./Platinum Dr	**East - Erb St. W**	Unsignalled Pedestrian Crossing
Erb St./Platinum Dr	**North - Platinum Dr**	Unsignalled Pedestrian Crossing
Erb St./Platinum Dr	**West - Erb St.**	Unsignalled Pedestrian Crossing
Erb St./Platinum Dr	**South - Landfill Gate 2**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Erb St.	**East - Erb St. W**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Erb St.	**West - Erb St.**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	Unsignalled Pedestrian Crossing
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	Unsignalled Pedestrian Crossing
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	Unsignalled Pedestrian Crossing
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	Unsignalled Pedestrian Crossing
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	Unsignalled Pedestrian Crossing

Unsignalled Pedestrian Crossing Crossings

Roundabout	Arm	Space between crossing and intersection entry (PCE)	Vehicles queueing on exit (PCE)	Central Refuge	Crossing Data Type	Crossing length (m)	Crossing time (s)	Crossing length (entry side) (m)	Crossing time (entry side) (s)	Crossing length (exit side) (m)	Crossing time (exit side) (s)
Ira Needles Blvd/University Avenue	**East - University Ave**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/University Avenue	**West - Private Access**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erb St./Platinum Dr	**East - Erb St. W**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erb St./Platinum Dr	**North - Platinum Dr**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erb St./Platinum Dr	**West - Erb St.**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erb St./Platinum Dr	**South - Landfill Gate 2**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Erb St.	**East - Erb St. W**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00

Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Erb St.	**West - Erb St.**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00

Arm Slope/ Intercept and Capacity

Slope and Intercept used in model

Roundabout	Arm	Enter Directly	Slope	Intercept (PCE/hr)	Final Slope	Final Intercept (PCE/hr)
Ira Needles Blvd/University Avenue	**East - University Ave**		((calculated))	((calculated))	0.740	2461.322
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**		((calculated))	((calculated))	0.678	2138.626
Ira Needles Blvd/University Avenue	**West - Private Access**		((calculated))	((calculated))	0.647	1916.031
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**		((calculated))	((calculated))	0.680	2144.039
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**		((calculated))	((calculated))	0.571	1541.270
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**		((calculated))	((calculated))	0.746	2358.337
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**		((calculated))	((calculated))	0.755	2455.620
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**		((calculated))	((calculated))	0.747	2435.697
Erb St./Platinum Dr	**East - Erb St. W**		((calculated))	((calculated))	0.723	2436.345
Erb St./Platinum Dr	**North - Platinum Dr**		((calculated))	((calculated))	0.723	2436.345
Erb St./Platinum Dr	**West - Erb St.**		((calculated))	((calculated))	0.723	2436.345
Erb St./Platinum Dr	**South - Landfill Gate 2**		((calculated))	((calculated))	0.579	1357.445
Ira Needles Blvd/Erb St.	**East - Erb St. W**		((calculated))	((calculated))	0.781	2703.168
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**		((calculated))	((calculated))	0.770	2683.164
Ira Needles Blvd/Erb St.	**West - Erb St.**		((calculated))	((calculated))	0.743	2471.717
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**		((calculated))	((calculated))	0.762	2623.737
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**		((calculated))	((calculated))	0.579	1357.445
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**		((calculated))	((calculated))	0.579	1357.445
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**		((calculated))	((calculated))	0.579	1357.445
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**		((calculated))	((calculated))	0.579	1357.445

The slope and intercept shown above include any corrections and adjustments.

Arm Capacity Adjustments

Roundabout	Arm	Type	Reason	Direct Capacity Adjustment (PCE/hr)	Percentage Capacity Adjustment (%)
Ira Needles Blvd/University Avenue	East - University Ave	Percentage		N/A	85.00
Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	Percentage		N/A	85.00
Ira Needles Blvd/University Avenue	West - Private Access	Percentage		N/A	85.00
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	Percentage		N/A	85.00
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	Percentage		N/A	85.00
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	Percentage		N/A	85.00
Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	Percentage		N/A	85.00
Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	Percentage		N/A	85.00
Erb St./Platinum Dr	East - Erb St. W	Percentage		N/A	85.00
Erb St./Platinum Dr	North - Platinum Dr	Percentage		N/A	85.00
Erb St./Platinum Dr	West - Erb St.	Percentage		N/A	85.00
Erb St./Platinum Dr	South - Landfill Gate 2	Percentage		N/A	85.00
Ira Needles Blvd/Erb St.	East - Erb St. W	Percentage		N/A	85.00
Ira Needles Blvd/Erb St.	North - Erbsville Rd	Percentage		N/A	85.00
Ira Needles Blvd/Erb St.	West - Erb St.	Percentage		N/A	85.00
Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	Percentage		N/A	85.00
Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	Percentage		N/A	85.00
Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	Percentage		N/A	85.00
Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	Percentage		N/A	85.00
Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	Percentage		N/A	85.00

Traffic Flows

Demand Set Data Options

Default Vehicle Mix	Vehicle Mix Varies Over Time	Vehicle Mix Varies Over Turn	Vehicle Mix Varies Over Entry	Vehicle Mix Source	PCE Factor for a Truck (PCE)	Default Turning Proportions	Estimate from entry/exit counts	Turning Proportions Vary Over Time	Turning Proportions Vary Over Turn	Turning Proportions Vary Over Entry
		Yes	Yes	Truck Percentages	2.00				Yes	Yes

Entry Flows

General Flows Data

Roundabout	Arm	Profile Type	Use Turning Counts	Average Demand Flow (Veh/hr)	Flow Scaling Factor (%)	PHF
Ira Needles Blvd/University Avenue	East - University Ave	ONE HOUR	Yes	461.00	100.000	N/A
Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	ONE HOUR	Yes	765.00	100.000	N/A
Ira Needles Blvd/University Avenue	West - Private Access	ONE HOUR	Yes	81.00	100.000	N/A
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	ONE HOUR	Yes	961.00	100.000	N/A
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	ONE HOUR	Yes	175.00	100.000	N/A
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	ONE HOUR	Yes	958.00	100.000	N/A
Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	ONE HOUR	Yes	58.00	100.000	N/A
Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	ONE HOUR	Yes	735.00	100.000	N/A
Erb St./Platinum Dr	East - Erb St. W	ONE HOUR	Yes	192.00	100.000	N/A
Erb St./Platinum Dr	North - Platinum Dr	ONE HOUR	Yes	13.00	100.000	N/A
Erb St./Platinum Dr	West - Erb St.	ONE HOUR	Yes	587.00	100.000	N/A
Erb St./Platinum Dr	South - Landfill Gate 2	ONE HOUR	Yes	6.00	100.000	N/A
Ira Needles Blvd/Erb St.	East - Erb St. W	ONE HOUR	Yes	366.00	100.000	N/A
Ira Needles Blvd/Erb St.	North - Erbsville Rd	ONE HOUR	Yes	909.00	100.000	N/A
Ira Needles Blvd/Erb St.	West - Erb St.	ONE HOUR	Yes	768.00	100.000	N/A
Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	ONE HOUR	Yes	828.00	100.000	N/A
Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	ONE HOUR	Yes	233.00	100.000	N/A
Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	ONE HOUR	Yes	91.00	100.000	N/A
Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	ONE HOUR	Yes	580.00	100.000	N/A
Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	ONE HOUR	Yes	299.00	100.000	N/A

Pedestrian Flows

General Flows Data

Roundabout	Arm	Profile Type	Average Pedestrian Flow (Ped/hr)
Ira Needles Blvd/University Avenue	East - University Ave	ONE HOUR	0.00
Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	ONE HOUR	0.00
Ira Needles Blvd/University Avenue	West - Private Access	ONE HOUR	0.00
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	ONE HOUR	7.00
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	ONE HOUR	1.00
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	ONE HOUR	0.00

Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	ONE HOUR	0.00
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	ONE HOUR	0.00
Erb St./Platinum Dr	**East - Erb St. W**	ONE HOUR	0.00
Erb St./Platinum Dr	**North - Platinum Dr**	ONE HOUR	0.00
Erb St./Platinum Dr	**West - Erb St.**	ONE HOUR	1.00
Erb St./Platinum Dr	**South - Landfill Gate 2**	ONE HOUR	4.00
Ira Needles Blvd/Erb St.	**East - Erb St. W**	ONE HOUR	0.00
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	ONE HOUR	0.00
Ira Needles Blvd/Erb St.	**West - Erb St.**	ONE HOUR	1.00
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	ONE HOUR	4.00
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	ONE HOUR	17.00
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	ONE HOUR	17.00
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	ONE HOUR	0.00
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	ONE HOUR	12.00

Direct/Resultant Flows

Direct Flows Data

Time Segment	Roundabout	Arm	Direct Demand Entry Flow (Veh/hr)	DirectDemandEntryFlowInPCE (PCE/hr)	Direct Demand Exit Flow (Veh/hr)	Direct Demand Pedestrian Flow (Ped/hr)
1	**Ira Needles Blvd/University Avenue**	**East - University Ave**	347.06	366.96	N/A	0.00
1	**Ira Needles Blvd/University Avenue**	**North - Ira Needles Blvd**	575.93	589.08	N/A	0.00
1	**Ira Needles Blvd/University Avenue**	**West - Private Access**	60.98	75.41	N/A	0.00
1	**Ira Needles Blvd/University Avenue**	**South - Ira Needles Blvd**	723.49	754.95	N/A	5.27
1	**Ira Needles Blvd/Thorndale Dr**	**East - Thorndale Dr**	131.75	133.71	N/A	0.00
1	**Ira Needles Blvd/Thorndale Dr**	**North - Ira Needles Blvd**	721.23	742.56	N/A	0.00
1	**Ira Needles Blvd/Thorndale Dr**	**West - Boardwalk Access**	43.67	49.63	N/A	0.00
1	**Ira Needles Blvd/Thorndale Dr**	**South - Ira Needles Blvd**	553.35	571.33	N/A	0.00
1	**Erb St./Platinum Dr**	**East - Erb St. W**	144.55	155.11	N/A	0.00
1	**Erb St./Platinum Dr**	**North - Platinum Dr**	9.79	12.80	N/A	0.00
1	**Erb St./Platinum Dr**	**West - Erb St.**	441.92	458.47	N/A	0.00
1	**Erb St./Platinum Dr**	**South - Landfill Gate 2**	4.52	5.42	N/A	0.00

1	**Ira Needles Blvd/Erb St.**	**East - Erb St. W**	275.54	287.71	N/A	0.00
1	**Ira Needles Blvd/Erb St.**	**North - Erbsville Rd**	684.34	702.24	N/A	0.00
1	**Ira Needles Blvd/Erb St.**	**West - Erb St.**	578.19	590.84	N/A	0.00
1	**Ira Needles Blvd/Erb St.**	**South - Ira Needles Blvd**	623.36	644.28	N/A	0.00
1	**Beaver Creek Rd/Laurelwood Dr**	**East - Laurelwood Dr.**	175.41	186.58	N/A	12.80
1	**Beaver Creek Rd/Laurelwood Dr**	**North - Beaver Creek Rd**	68.51	68.73	N/A	12.80
1	**Beaver Creek Rd/Laurelwood Dr**	**West - Laurelwood Dr.**	436.65	449.50	N/A	0.00
1	**Beaver Creek Rd/Laurelwood Dr**	**South - Beaver Creek Rd**	225.10	227.97	N/A	9.03
2	**Ira Needles Blvd/University Avenue**	**East - University Ave**	414.43	438.19	N/A	0.00
2	**Ira Needles Blvd/University Avenue**	**North - Ira Needles Blvd**	687.72	703.42	N/A	0.00
2	**Ira Needles Blvd/University Avenue**	**West - Private Access**	72.82	90.05	N/A	0.00
2	**Ira Needles Blvd/University Avenue**	**South - Ira Needles Blvd**	863.92	901.49	N/A	6.29
2	**Ira Needles Blvd/Thorndale Dr**	**East - Thorndale Dr**	157.32	159.67	N/A	0.00
2	**Ira Needles Blvd/Thorndale Dr**	**North - Ira Needles Blvd**	861.22	886.69	N/A	0.00
2	**Ira Needles Blvd/Thorndale Dr**	**West - Boardwalk Access**	52.14	59.26	N/A	0.00
2	**Ira Needles Blvd/Thorndale Dr**	**South - Ira Needles Blvd**	660.75	682.23	N/A	0.00
2	**Erb St./Platinum Dr**	**East - Erb St. W**	172.60	185.22	N/A	0.00
2	**Erb St./Platinum Dr**	**North - Platinum Dr**	11.69	15.28	N/A	0.00
2	**Erb St./Platinum Dr**	**West - Erb St.**	527.70	547.46	N/A	0.00
2	**Erb St./Platinum Dr**	**South - Landfill Gate 2**	5.39	6.47	N/A	0.00
2	**Ira Needles Blvd/Erb St.**	**East - Erb St. W**	329.03	343.55	N/A	0.00
2	**Ira Needles Blvd/Erb St.**	**North - Erbsville Rd**	817.17	838.54	N/A	0.00
2	**Ira Needles Blvd/Erb St.**	**West - Erb St.**	690.42	705.52	N/A	0.00
2	**Ira Needles Blvd/Erb St.**	**South - Ira Needles Blvd**	744.36	769.34	N/A	0.00
2	**Beaver Creek Rd/Laurelwood Dr**	**East - Laurelwood Dr.**	209.46	222.80	N/A	15.28
2	**Beaver Creek Rd/Laurelwood Dr**	**North - Beaver Creek Rd**	81.81	82.07	N/A	15.28
2	**Beaver Creek Rd/Laurelwood Dr**	**West - Laurelwood Dr.**	521.41	536.74	N/A	0.00
2	**Beaver Creek Rd/Laurelwood Dr**	**South - Beaver Creek Rd**	268.79	272.22	N/A	10.79
3	**Ira Needles Blvd/University Avenue**	**East - University Ave**	507.57	536.67	N/A	0.00
3	**Ira Needles Blvd/University Avenue**	**North - Ira Needles Blvd**	842.28	861.50	N/A	0.00
3	**Ira Needles Blvd/University Avenue**	**West - Private Access**	89.18	110.29	N/A	0.00
3	**Ira Needles Blvd/University Avenue**	**South - Ira Needles Blvd**	1058.08	1104.09	N/A	7.71
3	**Ira Needles Blvd/Thorndale Dr**	**East - Thorndale Dr**	192.68	195.55	N/A	0.00
3	**Ira Needles Blvd/Thorndale Dr**	**North - Ira Needles Blvd**	1054.78	1085.97	N/A	0.00

3	**Ira Needles Blvd/Thorndale Dr**	**West - Boardwalk Access**	63.86	72.58	N/A	0.00
3	**Ira Needles Blvd/Thorndale Dr**	**South - Ira Needles Blvd**	809.25	835.55	N/A	0.00
3	**Erb St./Platinum Dr**	**East - Erb St. W**	211.40	226.85	N/A	0.00
3	**Erb St./Platinum Dr**	**North - Platinum Dr**	14.31	18.72	N/A	0.00
3	**Erb St./Platinum Dr**	**West - Erb St.**	646.30	670.49	N/A	0.00
3	**Erb St./Platinum Dr**	**South - Landfill Gate 2**	6.61	7.93	N/A	0.00
3	**Ira Needles Blvd/Erb St.**	**East - Erb St. W**	402.97	420.77	N/A	0.00
3	**Ira Needles Blvd/Erb St.**	**North - Erbsville Rd**	1000.83	1027.00	N/A	0.00
3	**Ira Needles Blvd/Erb St.**	**West - Erb St.**	845.58	864.08	N/A	0.00
3	**Ira Needles Blvd/Erb St.**	**South - Ira Needles Blvd**	911.64	942.24	N/A	0.00
3	**Beaver Creek Rd/Laurelwood Dr**	**East - Laurelwood Dr.**	256.54	272.87	N/A	18.72
3	**Beaver Creek Rd/Laurelwood Dr**	**North - Beaver Creek Rd**	100.19	100.51	N/A	18.72
3	**Beaver Creek Rd/Laurelwood Dr**	**West - Laurelwood Dr.**	638.59	657.37	N/A	0.00
3	**Beaver Creek Rd/Laurelwood Dr**	**South - Beaver Creek Rd**	329.21	333.40	N/A	13.21
4	**Ira Needles Blvd/University Avenue**	**East - University Ave**	507.57	536.67	N/A	0.00
4	**Ira Needles Blvd/University Avenue**	**North - Ira Needles Blvd**	842.28	861.50	N/A	0.00
4	**Ira Needles Blvd/University Avenue**	**West - Private Access**	89.18	110.29	N/A	0.00
4	**Ira Needles Blvd/University Avenue**	**South - Ira Needles Blvd**	1058.08	1104.09	N/A	7.71
4	**Ira Needles Blvd/Thorndale Dr**	**East - Thorndale Dr**	192.68	195.55	N/A	0.00
4	**Ira Needles Blvd/Thorndale Dr**	**North - Ira Needles Blvd**	1054.78	1085.97	N/A	0.00
4	**Ira Needles Blvd/Thorndale Dr**	**West - Boardwalk Access**	63.86	72.58	N/A	0.00
4	**Ira Needles Blvd/Thorndale Dr**	**South - Ira Needles Blvd**	809.25	835.55	N/A	0.00
4	**Erb St./Platinum Dr**	**East - Erb St. W**	211.40	226.85	N/A	0.00
4	**Erb St./Platinum Dr**	**North - Platinum Dr**	14.31	18.72	N/A	0.00
4	**Erb St./Platinum Dr**	**West - Erb St.**	646.30	670.49	N/A	0.00
4	**Erb St./Platinum Dr**	**South - Landfill Gate 2**	6.61	7.93	N/A	0.00
4	**Ira Needles Blvd/Erb St.**	**East - Erb St. W**	402.97	420.77	N/A	0.00
4	**Ira Needles Blvd/Erb St.**	**North - Erbsville Rd**	1000.83	1027.00	N/A	0.00
4	**Ira Needles Blvd/Erb St.**	**West - Erb St.**	845.58	864.08	N/A	0.00
4	**Ira Needles Blvd/Erb St.**	**South - Ira Needles Blvd**	911.64	942.24	N/A	0.00
4	**Beaver Creek Rd/Laurelwood Dr**	**East - Laurelwood Dr.**	256.54	272.87	N/A	18.72
4	**Beaver Creek Rd/Laurelwood Dr**	**North - Beaver Creek Rd**	100.19	100.51	N/A	18.72
4	**Beaver Creek Rd/Laurelwood Dr**	**West - Laurelwood Dr.**	638.59	657.37	N/A	0.00
4	**Beaver Creek Rd/Laurelwood Dr**	**South - Beaver Creek Rd**	329.21	333.40	N/A	13.21

5	**Ira Needles Blvd/University Avenue**	**East - University Ave**	414.43	438.19	N/A	0.00
5	**Ira Needles Blvd/University Avenue**	**North - Ira Needles Blvd**	687.72	703.42	N/A	0.00
5	**Ira Needles Blvd/University Avenue**	**West - Private Access**	72.82	90.05	N/A	0.00
5	**Ira Needles Blvd/University Avenue**	**South - Ira Needles Blvd**	863.92	901.49	N/A	6.29
5	**Ira Needles Blvd/Thorndale Dr**	**East - Thorndale Dr**	157.32	159.67	N/A	0.00
5	**Ira Needles Blvd/Thorndale Dr**	**North - Ira Needles Blvd**	861.22	886.69	N/A	0.00
5	**Ira Needles Blvd/Thorndale Dr**	**West - Boardwalk Access**	52.14	59.26	N/A	0.00
5	**Ira Needles Blvd/Thorndale Dr**	**South - Ira Needles Blvd**	660.75	682.23	N/A	0.00
5	**Erb St./Platinum Dr**	**East - Erb St. W**	172.60	185.22	N/A	0.00
5	**Erb St./Platinum Dr**	**North - Platinum Dr**	11.69	15.28	N/A	0.00
5	**Erb St./Platinum Dr**	**West - Erb St.**	527.70	547.46	N/A	0.00
5	**Erb St./Platinum Dr**	**South - Landfill Gate 2**	5.39	6.47	N/A	0.00
5	**Ira Needles Blvd/Erb St.**	**East - Erb St. W**	329.03	343.55	N/A	0.00
5	**Ira Needles Blvd/Erb St.**	**North - Erbsville Rd**	817.17	838.54	N/A	0.00
5	**Ira Needles Blvd/Erb St.**	**West - Erb St.**	690.42	705.52	N/A	0.00
5	**Ira Needles Blvd/Erb St.**	**South - Ira Needles Blvd**	744.36	769.34	N/A	0.00
5	**Beaver Creek Rd/Laurelwood Dr**	**East - Laurelwood Dr.**	209.46	222.80	N/A	15.28
5	**Beaver Creek Rd/Laurelwood Dr**	**North - Beaver Creek Rd**	81.81	82.07	N/A	15.28
5	**Beaver Creek Rd/Laurelwood Dr**	**West - Laurelwood Dr.**	521.41	536.74	N/A	0.00
5	**Beaver Creek Rd/Laurelwood Dr**	**South - Beaver Creek Rd**	268.79	272.22	N/A	10.79
6	**Ira Needles Blvd/University Avenue**	**East - University Ave**	347.06	366.96	N/A	0.00
6	**Ira Needles Blvd/University Avenue**	**North - Ira Needles Blvd**	575.93	589.08	N/A	0.00
6	**Ira Needles Blvd/University Avenue**	**West - Private Access**	60.98	75.41	N/A	0.00
6	**Ira Needles Blvd/University Avenue**	**South - Ira Needles Blvd**	723.49	754.95	N/A	5.27
6	**Ira Needles Blvd/Thorndale Dr**	**East - Thorndale Dr**	131.75	133.71	N/A	0.00
6	**Ira Needles Blvd/Thorndale Dr**	**North - Ira Needles Blvd**	721.23	742.56	N/A	0.00
6	**Ira Needles Blvd/Thorndale Dr**	**West - Boardwalk Access**	43.67	49.63	N/A	0.00
6	**Ira Needles Blvd/Thorndale Dr**	**South - Ira Needles Blvd**	553.35	571.33	N/A	0.00
6	**Erb St./Platinum Dr**	**East - Erb St. W**	144.55	155.11	N/A	0.00
6	**Erb St./Platinum Dr**	**North - Platinum Dr**	9.79	12.80	N/A	0.00
6	**Erb St./Platinum Dr**	**West - Erb St.**	441.92	458.47	N/A	0.00
6	**Erb St./Platinum Dr**	**South - Landfill Gate 2**	4.52	5.42	N/A	0.00
6	**Ira Needles Blvd/Erb St.**	**East - Erb St. W**	275.54	287.71	N/A	0.00
6	**Ira Needles Blvd/Erb St.**	**North - Erbsville Rd**	684.34	702.24	N/A	0.00

6	Ira Needles Blvd/Erb St.	West - Erb St.	578.19	590.84	N/A	0.00
6	Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	623.36	644.28	N/A	0.00
6	Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	175.41	186.58	N/A	12.80
6	Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	68.51	68.73	N/A	12.80
6	Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	436.65	449.50	N/A	0.00
6	Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	225.10	227.97	N/A	9.03

Turning Proportions

Turning Counts or Proportions (Veh/hr) - Ira Needles Blvd/ University Avenue (for whole period)

		To			
		1	2	3	4
From	1	0.000	96.000	50.000	315.000
	2	137.000	0.000	29.000	599.000
	3	42.000	23.000	0.000	16.000
	4	428.000	513.000	20.000	0.000

Turning Proportions (Veh) - Ira Needles Blvd/ University Avenue (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.21	0.11	0.68
	2	0.18	0.00	0.04	0.78
	3	0.52	0.28	0.00	0.20
	4	0.45	0.53	0.02	0.00

Turning Counts or Proportions (Veh/hr) - Ira Needles Blvd/ Thorndale Dr (for whole period)

		To			
		1	2	3	4
From	1	0.000	95.000	9.000	71.000
	2	41.000	0.000	69.000	848.000
	3	15.000	36.000	0.000	7.000
	4	32.000	699.000	4.000	0.000

Turning Proportions (Veh) - Ira Needles Blvd/ Thorndale Dr (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.54	0.05	0.41
	2	0.04	0.00	0.07	0.89
	3	0.26	0.62	0.00	0.12
	4	0.04	0.95	0.01	0.00

Turning Counts or Proportions (Veh/hr) - Ira Needles Blvd/ Erb St. (for whole period)

		To			
		1	2	3	4
From	1	0.000	107.000	146.000	113.000
	2	230.000	0.000	55.000	624.000
	3	396.000	144.000	0.000	228.000
	4	132.000	533.000	163.000	0.000

Turning Proportions (Veh) - Ira Needles Blvd/ Erb St. (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.29	0.40	0.31
	2	0.25	0.00	0.06	0.69
	3	0.52	0.19	0.00	0.30
	4	0.16	0.64	0.20	0.00

Turning Counts or Proportions (Veh/hr) - Beaver Creek Rd/ Laurelwood Dr (for whole period)

		To			
		1	2	3	4
From	1	0.000	32.000	185.000	16.000
	2	49.000	0.000	16.000	26.000
	3	443.000	33.000	0.000	104.000
	4	170.000	45.000	84.000	0.000

Turning Proportions (Veh) - Beaver Creek Rd/ Laurelwood Dr (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.14	0.79	0.07
	2	0.54	0.00	0.18	0.29
	3	0.76	0.06	0.00	0.18
	4	0.57	0.15	0.28	0.00

Turning Counts or Proportions (Veh/hr) - Erb St./ Platinum Dr (for whole period)

		To			
		1	2	3	4
From	1	0.000	6.000	181.000	5.000
	2	5.000	0.000	8.000	0.000
	3	570.000	14.000	0.000	3.000
	4	6.000	0.000	0.000	0.000

Turning Proportions (Veh) - Erb St./ Platinum Dr (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.03	0.94	0.03
	2	0.38	0.00	0.62	0.00
	3	0.97	0.02	0.00	0.01
	4	1.00	0.00	0.00	0.00

Vehicle Mix

Average PCE Per Vehicle - Ira Needles Blvd/ University Avenue (for whole period)

		To			
		1	2	3	4
From	1	1.000	1.080	1.060	1.050
	2	1.040	1.000	1.000	1.020

	3	1.120	1.350	1.000	1.380
	4	1.050	1.030	1.250	1.000

Truck Percentages - Ira Needles Blvd/ University Avenue (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	0.000	8.000	6.000	5.000
	2	4.000	0.000	0.000	2.000
	3	12.000	35.000	0.000	38.000
	4	5.000	3.000	25.000	0.000

Average PCE Per Vehicle - Ira Needles Blvd/ Thorndale Dr (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	1.000	1.020	1.000	1.010
	2	1.020	1.000	1.030	1.030
	3	1.000	1.220	1.000	1.000
	4	1.060	1.030	1.250	1.000

Truck Percentages - Ira Needles Blvd/ Thorndale Dr (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	0.000	2.000	0.000	1.000
	2	2.000	0.000	3.000	3.000
	3	0.000	22.000	0.000	0.000
	4	6.000	3.000	25.000	0.000

Average PCE Per Vehicle - Ira Needles Blvd/ Erb St. (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	1.000	1.030	1.050	1.050
	2	1.010	1.000	1.050	1.030

	3	1.020	1.030	1.000	1.020
	4	1.040	1.030	1.040	1.000

Truck Percentages - Ira Needles Blvd/ Erb St. (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	0.000	3.000	5.000	5.000
	2	1.000	0.000	5.000	3.000
	3	2.000	3.000	0.000	2.000
	4	4.000	3.000	4.000	0.000

Average PCE Per Vehicle - Beaver Creek Rd/ Laurelwood Dr (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	1.000	1.030	1.075	1.000
	2	1.000	1.000	1.018	1.000
	3	1.025	1.030	1.000	1.048
	4	1.017	1.000	1.011	1.000

Truck Percentages - Beaver Creek Rd/ Laurelwood Dr (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	0.000	3.000	7.500	0.000
	2	0.000	0.000	1.800	0.000
	3	2.500	3.000	0.000	4.800
	4	1.700	0.000	1.100	0.000

Average PCE Per Vehicle - Erb St./ Platinum Dr (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	1.000	1.170	1.065	1.250
	2	1.600	1.000	1.125	1.000

	3	1.037	1.071	1.000	1.000
	4	1.200	1.000	1.000	1.000

Truck Percentages - Erb St./ Platinum Dr (for whole period)

		To			
		1	2	3	4
From	1	0.000	17.000	6.500	25.000
	2	60.000	0.000	12.500	0.000
	3	3.680	7.140	0.000	0.000
	4	20.000	0.000	0.000	0.000

Results

Results Summary

Roundabout	Arm	Max RFC	Max Delay (s)	Max Queue (Veh)	Max LOS	Total Demand (Veh/hr)	Total Arrivals (Veh)	Total Queueing Delay (Veh-min)	Average Queueing Delay (s)	Rate Of Queueing Delay (Veh-min/min)	Inclusive Queueing Total Delay (Veh-min)	Inclusive Queueing Average Delay (s)	Slope	Intercept (PCE/hr)
Ira Needles Blvd/University Avenue	East - University Ave	0.32	3.31	0.46	A	423.02	634.53	31.33	2.96	0.35	31.33	2.96	0.740	2461.322
Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	0.55	5.28	1.23	A	701.98	1052.97	76.29	4.35	0.85	76.30	4.35	0.678	2138.626
Ira Needles Blvd/University Avenue	West - Private Access	0.17	8.36	0.21	A	74.33	111.49	11.96	6.43	0.13	11.96	6.43	0.647	1916.031
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	0.68	7.23	2.10	A	881.83	1322.74	124.58	5.65	1.38	124.60	5.65	0.680	2144.039
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	0.22	5.19	0.28	A	160.58	240.88	18.56	4.62	0.21	18.56	4.62	0.571	1541.270
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	0.56	4.32	1.26	A	879.08	1318.62	80.22	3.65	0.89	80.22	3.65	0.746	2358.337
Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	0.05	3.10	0.05	A	53.22	79.83	3.81	2.86	0.04	3.81	2.86	0.755	2455.620
Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	0.42	3.19	0.72	A	674.45	1011.68	48.42	2.87	0.54	48.42	2.87	0.747	2435.697
Erb St./Platinum Dr	East - Erb St. W	0.11	2.11	0.12	A	176.18	264.27	9.08	2.06	0.10	9.08	2.06	0.723	2436.345
Erb St./Platinum Dr	North - Platinum Dr	0.01	2.45	0.01	A	11.93	17.89	0.72	2.42	0.01	0.72	2.42	0.723	2436.345

Erb St./Platinum Dr	West - Erb St.	0.33	2.68	0.48	A	538.64	807.96	33.70	2.50	0.37	33.71	2.50	0.723	2436.345
Erb St./Platinum Dr	South - Landfill Gate 2	0.01	5.31	0.01	A	5.51	8.26	0.69	4.99	0.01	0.69	4.99	0.579	1357.445
Ira Needles Blvd/Erb St.	East - Erb St. W	0.25	3.02	0.34	A	335.85	503.77	22.68	2.70	0.25	22.68	2.70	0.781	2703.168
Ira Needles Blvd/Erb St.	North - Erbsville Rd	0.52	3.95	1.09	A	834.11	1251.17	69.03	3.31	0.77	69.03	3.31	0.770	2683.164
Ira Needles Blvd/Erb St.	West - Erb St.	0.61	6.73	1.57	A	704.73	1057.09	88.22	5.01	0.98	88.22	5.01	0.743	2471.717
Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	0.56	5.11	1.28	A	759.79	1139.68	76.79	4.04	0.85	76.79	4.04	0.762	2623.737
Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	0.26	4.89	0.35	A	213.80	320.71	24.34	4.55	0.27	24.34	4.55	0.579	1357.445
Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	0.10	4.08	0.11	A	83.50	125.26	8.13	3.89	0.09	8.13	3.89	0.579	1357.445
Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	0.60	8.35	1.47	A	532.22	798.33	90.88	6.83	1.01	90.90	6.83	0.579	1357.445
Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	0.46	9.20	0.83	A	274.37	411.55	49.20	7.17	0.55	49.20	7.17	0.579	1357.445

Main Results

Main results: (8:00 AM-8:15 AM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)
Ira Needles Blvd/University Avenue	East - University Ave	347.07	86.77	346.06	454.88	416.58	0.00	1718.35	1434.62	0.202	0.00	0.25
Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	575.93	143.98	573.71	473.67	288.98	0.00	1604.47	1081.82	0.359	0.00	0.56
Ira Needles Blvd/University Avenue	West - Private Access	60.98	15.25	60.66	74.27	788.42	0.00	824.36	49.90	0.074	0.00	0.08
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	723.49	180.87	720.04	697.66	151.42	5.27	1555.97	1555.97	0.465	0.00	0.86
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	131.75	32.94	131.16	66.05	554.78	0.00	1014.65	316.26	0.130	0.00	0.15
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	721.23	180.31	718.82	622.97	62.96	0.00	1907.45	1851.01	0.378	0.00	0.60
Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	43.67	10.92	43.54	61.52	720.25	0.00	1418.66	765.50	0.031	0.00	0.03
Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	553.35	138.34	551.78	694.74	69.05	0.00	1958.68	1477.31	0.283	0.00	0.39
Erb St./Platinum Dr	East - Erb St. W	144.55	36.14	144.22	436.27	10.51	0.00	1923.37	1904.65	0.075	0.00	0.08
Erb St./Platinum Dr	North - Platinum Dr	9.79	2.45	9.76	15.02	139.72	0.00	1513.38	655.90	0.006	0.00	0.01
Erb St./Platinum Dr	West - Erb St.	441.92	110.48	440.78	141.97	7.51	0.00	1989.82	1720.35	0.222	0.00	0.28
Erb St./Platinum Dr	South - Landfill Gate 2	4.52	1.13	4.49	6.01	442.29	0.00	772.52	67.99	0.006	0.00	0.01
Ira Needles Blvd/Erb St.	East - Erb St. W	275.54	68.89	274.82	568.64	630.18	0.00	1787.05	1256.37	0.154	0.00	0.18
Ira Needles Blvd/Erb St.	North - Erbsville Rd	684.34	171.09	682.29	588.23	316.77	0.00	2011.20	1431.37	0.340	0.00	0.51
Ira Needles Blvd/Erb St.	West - Erb St.	578.19	144.55	575.93	273.21	725.86	0.00	1595.31	953.44	0.362	0.00	0.56
Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	623.36	155.84	621.24	724.20	577.59	0.00	1789.03	1499.01	0.348	0.00	0.53

Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	175.41	43.85	174.59	495.44	121.23	12.80	1022.46	978.78	0.172	0.00	0.21
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	68.51	17.13	68.23	82.35	213.47	12.80	1035.50	656.33	0.066	0.00	0.07
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	436.65	109.16	434.00	213.48	68.22	0.00	1086.96	802.69	0.402	0.00	0.66
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	225.10	56.28	223.75	109.30	392.91	9.03	886.67	354.53	0.254	0.00	0.34

Main results: (8:15 AM-8:30 AM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)
Ira Needles Blvd/University Avenue	**East - University Ave**	414.43	103.61	414.12	544.79	498.97	0.00	1666.87	1434.62	0.249	0.25	0.33
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	687.72	171.93	686.86	567.26	345.83	0.00	1570.47	1081.82	0.438	0.56	0.77
Ira Needles Blvd/University Avenue	**West - Private Access**	72.82	18.20	72.67	88.90	943.78	0.00	697.19	49.90	0.104	0.08	0.12
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	863.92	215.98	862.43	835.14	181.32	6.29	1555.97	1555.97	0.555	0.86	1.23
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	157.32	39.33	157.14	79.04	663.87	0.00	960.34	316.26	0.164	0.15	0.19
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	861.22	215.31	860.35	745.58	75.43	0.00	1899.62	1851.01	0.453	0.60	0.82
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	52.14	13.04	52.11	73.64	862.14	0.00	1336.36	765.50	0.039	0.03	0.04
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	660.75	165.19	660.28	831.60	82.64	0.00	1949.53	1477.31	0.339	0.39	0.51
Erb St./Platinum Dr	**East - Erb St. W**	172.60	43.15	172.53	522.01	12.58	0.00	1922.11	1904.65	0.090	0.08	0.10
Erb St./Platinum Dr	**North - Platinum Dr**	11.69	2.92	11.68	17.97	167.14	0.00	1499.59	655.90	0.008	0.01	0.01
Erb St./Platinum Dr	**West - Erb St.**	527.70	131.92	527.40	169.84	8.99	0.00	1988.57	1720.35	0.265	0.28	0.36
Erb St./Platinum Dr	**South - Landfill Gate 2**	5.39	1.35	5.39	7.19	529.20	0.00	735.38	67.99	0.007	0.01	0.01
Ira Needles Blvd/Erb St.	**East - Erb St. W**	329.03	82.26	328.80	680.52	754.17	0.00	1705.69	1256.37	0.193	0.18	0.24
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	817.17	204.29	816.41	703.94	379.03	0.00	1969.65	1431.37	0.415	0.51	0.70
Ira Needles Blvd/Erb St.	**West - Erb St.**	690.41	172.60	689.31	326.91	868.52	0.00	1504.77	953.44	0.459	0.56	0.84
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	744.36	186.09	743.44	866.59	691.25	0.00	1716.48	1499.01	0.434	0.53	0.76
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	209.46	52.37	209.25	593.97	145.32	15.28	1010.02	977.93	0.207	0.21	0.26
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	81.81	20.45	81.74	98.71	255.86	15.28	1012.98	656.37	0.081	0.07	0.09
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	521.41	130.35	520.38	255.86	81.74	0.00	1079.72	802.70	0.483	0.66	0.92
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	268.79	67.20	268.21	131.03	471.08	10.79	819.68	354.45	0.328	0.34	0.48

Main results: (8:30 AM-8:45 AM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)
Ira Needles Blvd/University Avenue	**East - University Ave**	507.57	126.89	507.04	666.32	610.20	0.00	1597.36	1434.62	0.318	0.33	0.46

Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	842.28	210.57	840.50	693.84	423.40	0.00	1524.08	1081.82	0.553	0.77	1.22
Ira Needles Blvd/University Avenue	West - Private Access	89.18	22.30	88.83	108.81	1155.09	0.00	521.69	49.90	0.171	0.12	0.20
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	1058.08	264.52	1054.71	1022.11	221.80	7.71	1555.97	1555.97	0.680	1.23	2.08
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	192.68	48.17	192.36	96.77	812.84	0.00	886.17	316.26	0.217	0.19	0.28
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	1054.78	263.69	1053.07	912.86	92.33	0.00	1889.00	1851.01	0.558	0.82	1.25
Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	63.86	15.96	63.80	90.14	1055.27	0.00	1224.32	765.50	0.052	0.04	0.05
Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	809.25	202.31	808.44	1017.89	101.17	0.00	1937.05	1477.31	0.418	0.51	0.71
Erb St./Platinum Dr	East - Erb St. W	211.40	52.85	211.30	639.22	15.40	0.00	1920.37	1904.65	0.110	0.10	0.12
Erb St./Platinum Dr	North - Platinum Dr	14.31	3.58	14.31	22.01	204.69	0.00	1480.71	655.90	0.010	0.01	0.01
Erb St./Platinum Dr	West - Erb St.	646.30	161.57	645.82	207.99	11.00	0.00	1986.87	1720.35	0.325	0.36	0.48
Erb St./Platinum Dr	South - Landfill Gate 2	6.61	1.65	6.60	8.80	648.02	0.00	684.60	67.99	0.010	0.01	0.01
Ira Needles Blvd/Erb St.	East - Erb St. W	402.97	100.74	402.58	832.39	922.60	0.00	1595.18	1256.37	0.253	0.24	0.34
Ira Needles Blvd/Erb St.	North - Erbsville Rd	1000.83	250.21	999.30	861.23	463.95	0.00	1912.99	1431.37	0.523	0.70	1.09
Ira Needles Blvd/Erb St.	West - Erb St.	845.58	211.39	842.74	400.12	1063.13	0.00	1381.26	953.44	0.612	0.84	1.55
Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	911.65	227.91	909.59	1060.48	845.40	0.00	1618.06	1499.01	0.563	0.76	1.27
Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	256.54	64.13	256.19	726.44	177.66	18.72	993.22	976.75	0.258	0.26	0.35
Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	100.19	25.05	100.09	120.74	313.11	18.72	982.65	656.42	0.102	0.09	0.11
Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	638.59	159.65	636.48	313.12	100.09	0.00	1069.54	802.73	0.597	0.92	1.45
Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	329.20	82.30	327.84	160.32	576.24	13.21	722.20	354.34	0.456	0.48	0.82

Main results: (8:45 AM-9:00 AM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)
Ira Needles Blvd/University Avenue	East - University Ave	507.57	126.89	507.56	668.26	612.11	0.00	1596.16	1434.62	0.318	0.46	0.46
Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	842.28	210.57	842.25	695.79	423.88	0.00	1523.79	1081.82	0.553	1.22	1.23
Ira Needles Blvd/University Avenue	West - Private Access	89.18	22.30	89.18	109.00	1157.14	0.00	520.01	49.90	0.172	0.20	0.21
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	1058.08	264.52	1057.98	1023.92	222.39	7.71	1555.97	1555.97	0.680	2.08	2.10
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	192.68	48.17	192.67	96.89	813.64	0.00	885.77	316.26	0.218	0.28	0.28
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	1054.78	263.69	1054.75	913.83	92.48	0.00	1888.90	1851.01	0.558	1.25	1.26
Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	63.86	15.96	63.86	90.28	1056.96	0.00	1223.34	765.50	0.052	0.05	0.05
Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	809.25	202.31	809.24	1019.52	101.29	0.00	1936.97	1477.31	0.418	0.71	0.72
Erb St./Platinum Dr	East - Erb St. W	211.40	52.85	211.40	639.69	15.41	0.00	1920.37	1904.65	0.110	0.12	0.12
Erb St./Platinum Dr	North - Platinum Dr	14.31	3.58	14.31	22.02	204.79	0.00	1480.66	655.90	0.010	0.01	0.01

Erb St./Platinum Dr	**West - Erb St.**	646.30	161.57	646.29	208.09	11.01	0.00	1986.86	1720.35	0.325	0.48	0.48
Erb St./Platinum Dr	**South - Landfill Gate 2**	6.61	1.65	6.61	8.81	648.50	0.00	684.40	67.99	0.010	0.01	0.01
Ira Needles Blvd/Erb St.	**East - Erb St. W**	402.97	100.74	402.97	834.53	924.81	0.00	1593.73	1256.37	0.253	0.34	0.34
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	1000.83	250.21	1000.81	863.16	464.62	0.00	1912.54	1431.37	0.523	1.09	1.09
Ira Needles Blvd/Erb St.	**West - Erb St.**	845.58	211.39	845.51	400.76	1064.67	0.00	1380.29	953.44	0.613	1.55	1.57
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	911.65	227.91	911.61	1062.45	847.74	0.00	1616.57	1499.01	0.564	1.27	1.28
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	256.54	64.13	256.53	728.80	178.35	18.72	992.89	976.75	0.258	0.35	0.35
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	100.19	25.05	100.19	121.10	313.77	18.72	982.31	656.42	0.102	0.11	0.11
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	638.59	159.65	638.53	313.77	100.19	0.00	1069.46	802.73	0.597	1.45	1.47
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	329.20	82.30	329.16	160.74	577.98	13.21	720.46	354.34	0.457	0.82	0.83

Main results: (9:00 AM-9:15 AM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)
Ira Needles Blvd/University Avenue	**East - University Ave**	414.43	103.61	414.96	547.67	501.79	0.00	1665.10	1434.62	0.249	0.46	0.33
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	687.72	171.93	689.49	570.15	346.60	0.00	1570.00	1081.82	0.438	1.23	0.79
Ira Needles Blvd/University Avenue	**West - Private Access**	72.82	18.20	73.17	89.19	946.89	0.00	694.62	49.90	0.105	0.21	0.12
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	863.92	215.98	867.26	837.87	182.19	6.29	1555.97	1555.97	0.555	2.10	1.26
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	157.32	39.33	157.64	79.23	665.14	0.00	959.70	316.26	0.164	0.28	0.20
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	861.22	215.31	862.91	747.13	75.66	0.00	1899.47	1851.01	0.453	1.26	0.84
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	52.14	13.04	52.20	73.86	864.72	0.00	1334.86	765.50	0.039	0.05	0.04
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	660.75	165.19	661.55	834.09	82.83	0.00	1949.41	1477.31	0.339	0.72	0.52
Erb St./Platinum Dr	**East - Erb St. W**	172.60	43.15	172.70	522.78	12.60	0.00	1922.09	1904.65	0.090	0.12	0.10
Erb St./Platinum Dr	**North - Platinum Dr**	11.69	2.92	11.69	17.99	167.31	0.00	1499.51	655.90	0.008	0.01	0.01
Erb St./Platinum Dr	**West - Erb St.**	527.70	131.92	528.17	170.00	9.00	0.00	1988.56	1720.35	0.265	0.48	0.36
Erb St./Platinum Dr	**South - Landfill Gate 2**	5.39	1.35	5.40	7.20	529.97	0.00	735.05	67.99	0.007	0.01	0.01
Ira Needles Blvd/Erb St.	**East - Erb St. W**	329.03	82.26	329.42	683.60	757.39	0.00	1703.58	1256.37	0.193	0.34	0.24
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	817.17	204.29	818.69	706.76	380.05	0.00	1968.97	1431.37	0.415	1.09	0.71
Ira Needles Blvd/Erb St.	**West - Erb St.**	690.41	172.60	693.25	327.88	870.86	0.00	1503.29	953.44	0.459	1.57	0.86
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	744.36	186.09	746.40	869.52	694.59	0.00	1714.34	1499.01	0.434	1.28	0.77
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	209.46	52.37	209.80	597.53	146.34	15.28	1009.54	977.93	0.207	0.35	0.26
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	81.81	20.45	81.91	99.26	256.88	15.28	1012.47	656.37	0.081	0.11	0.09
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	521.41	130.35	523.48	256.87	81.91	0.00	1079.61	802.70	0.483	1.47	0.95

Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	268.79	67.20	270.14	131.67	473.72	10.79	817.26	354.45	0.329	0.83	0.50

Main results: (9:15 AM-9:30 AM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)
Ira Needles Blvd/University Avenue	**East - University Ave**	347.07	86.77	347.38	457.91	419.49	0.00	1716.54	1434.62	0.202	0.33	0.25
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	575.93	143.98	576.82	476.74	290.13	0.00	1603.77	1081.82	0.359	0.79	0.56
Ira Needles Blvd/University Avenue	**West - Private Access**	60.98	15.25	61.13	74.63	792.32	0.00	821.24	49.90	0.074	0.12	0.08
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	723.49	180.87	725.04	701.09	152.36	5.27	1555.97	1555.97	0.465	1.26	0.88
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	131.75	32.94	131.94	66.32	556.84	0.00	1013.62	316.26	0.130	0.20	0.15
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	721.23	180.31	722.13	625.45	63.33	0.00	1907.22	1851.01	0.378	0.84	0.61
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	43.67	10.92	43.70	61.81	723.65	0.00	1416.70	765.50	0.031	0.04	0.03
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	553.35	138.34	553.83	698.01	69.33	0.00	1958.49	1477.31	0.283	0.52	0.40
Erb St./Platinum Dr	**East - Erb St. W**	144.55	36.14	144.62	437.71	10.55	0.00	1923.35	1904.65	0.075	0.10	0.08
Erb St./Platinum Dr	**North - Platinum Dr**	9.79	2.45	9.79	15.07	140.10	0.00	1513.19	655.90	0.006	0.01	0.01
Erb St./Platinum Dr	**West - Erb St.**	441.92	110.48	442.23	142.36	7.53	0.00	1989.80	1720.35	0.222	0.36	0.29
Erb St./Platinum Dr	**South - Landfill Gate 2**	4.52	1.13	4.52	6.03	443.74	0.00	771.90	67.99	0.006	0.01	0.01
Ira Needles Blvd/Erb St.	**East - Erb St. W**	275.54	68.89	275.77	571.59	633.40	0.00	1784.94	1256.37	0.154	0.24	0.18
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	684.34	171.09	685.12	591.12	318.05	0.00	2010.34	1431.37	0.340	0.71	0.52
Ira Needles Blvd/Erb St.	**West - Erb St.**	578.19	144.55	579.32	274.36	728.81	0.00	1593.44	953.44	0.363	0.86	0.57
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	623.36	155.84	624.30	727.44	580.69	0.00	1787.05	1499.01	0.349	0.77	0.54
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	175.41	43.85	175.63	499.59	122.28	12.80	1021.96	978.78	0.172	0.26	0.21
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	68.51	17.13	68.58	83.00	214.92	12.80	1034.76	656.33	0.066	0.09	0.07
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	436.65	109.16	437.73	214.92	68.58	0.00	1086.76	802.69	0.402	0.95	0.68
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	225.10	56.28	225.71	110.14	396.17	9.03	883.99	354.53	0.255	0.50	0.34

Queueing Delay Results

Queueing Delay results: (8:00 AM-8:15 AM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	**East - University Ave**	3.72	0.25	2.622	A	A
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	8.15	0.54	3.485	A	A

Ira Needles Blvd/University Avenue	**West - Private Access**	1.16	0.08	4.711	A	A
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	12.51	0.83	4.290	A	A
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	2.18	0.15	4.072	A	A
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	8.87	0.59	3.022	A	A
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	0.47	0.03	2.617	A	A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	5.78	0.39	2.557	A	A
Erb St./Platinum Dr	**East - Erb St. W**	1.20	0.08	2.023	A	A
Erb St./Platinum Dr	**North - Platinum Dr**	0.10	0.01	2.393	A	A
Erb St./Platinum Dr	**West - Erb St.**	4.20	0.28	2.323	A	A
Erb St./Platinum Dr	**South - Landfill Gate 2**	0.09	0.01	4.687	A	A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	2.69	0.18	2.379	A	A
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	7.55	0.50	2.706	A	A
Ira Needles Blvd/Erb St.	**West - Erb St.**	8.27	0.55	3.524	A	A
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	7.81	0.52	3.078	A	A
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	3.02	0.20	4.243	A	A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	1.04	0.07	3.721	A	A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	9.62	0.64	5.492	A	A
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	4.91	0.33	5.419	A	A

Queueing Delay results: (8:15 AM-8:30 AM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	**East - University Ave**	4.88	0.33	2.873	A	A
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	11.35	0.76	4.069	A	A
Ira Needles Blvd/University Avenue	**West - Private Access**	1.70	0.11	5.762	A	A
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	17.95	1.20	5.179	A	A
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	2.87	0.19	4.481	A	A
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	12.12	0.81	3.460	A	A
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	0.60	0.04	2.802	A	A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	7.55	0.50	2.792	A	A
Erb St./Platinum Dr	**East - Erb St. W**	1.46	0.10	2.057	A	A
Erb St./Platinum Dr	**North - Platinum Dr**	0.12	0.01	2.419	A	A
Erb St./Platinum Dr	**West - Erb St.**	5.34	0.36	2.463	A	A
Erb St./Platinum Dr	**South - Landfill Gate 2**	0.11	0.01	4.931	A	A

Ira Needles Blvd/Erb St.	**East - Erb St. W**	3.53	0.24	2.614	A	A
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	10.39	0.69	3.120	A	A
Ira Needles Blvd/Erb St.	**West - Erb St.**	12.30	0.82	4.409	A	A
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	11.17	0.74	3.696	A	A
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	3.84	0.26	4.494	A	A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	1.29	0.09	3.865	A	A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	13.41	0.89	6.424	A	A
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	7.05	0.47	6.521	A	A

Queueing Delay results: (8:30 AM-8:45 AM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	**East - University Ave**	6.84	0.46	3.300	A	A
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	17.72	1.18	5.252	A	A
Ira Needles Blvd/University Avenue	**West - Private Access**	2.97	0.20	8.310	A	A
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	29.62	1.97	7.133	A	A
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	4.05	0.27	5.186	A	A
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	18.25	1.22	4.298	A	A
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	0.81	0.05	3.101	A	A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	10.51	0.70	3.188	A	A
Erb St./Platinum Dr	**East - Erb St. W**	1.83	0.12	2.106	A	A
Erb St./Platinum Dr	**North - Platinum Dr**	0.14	0.01	2.454	A	A
Erb St./Platinum Dr	**West - Erb St.**	7.10	0.47	2.684	A	A
Erb St./Platinum Dr	**South - Landfill Gate 2**	0.14	0.01	5.309	A	A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	4.97	0.33	3.018	A	A
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	15.91	1.06	3.934	A	A
Ira Needles Blvd/Erb St.	**West - Erb St.**	22.23	1.48	6.651	A	A
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	18.49	1.23	5.067	A	A
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	5.09	0.34	4.882	A	A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	1.67	0.11	4.079	A	A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	20.78	1.39	8.271	A	A
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	11.83	0.79	9.097	A	A

Queueing Delay results: (8:45 AM-9:00 AM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	East - University Ave	6.96	0.46	3.306	A	A
Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	18.37	1.22	5.281	A	A
Ira Needles Blvd/University Avenue	West - Private Access	3.08	0.21	8.355	A	A
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	31.35	2.09	7.226	A	A
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	4.15	0.28	5.193	A	A
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	18.83	1.26	4.315	A	A
Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	0.82	0.05	3.104	A	A
Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	10.72	0.71	3.191	A	A
Erb St./Platinum Dr	East - Erb St. W	1.85	0.12	2.106	A	A
Erb St./Platinum Dr	North - Platinum Dr	0.15	0.01	2.454	A	A
Erb St./Platinum Dr	West - Erb St.	7.21	0.48	2.684	A	A
Erb St./Platinum Dr	South - Landfill Gate 2	0.15	0.01	5.310	A	A
Ira Needles Blvd/Erb St.	East - Erb St. W	5.06	0.34	3.022	A	A
Ira Needles Blvd/Erb St.	North - Erbsville Rd	16.36	1.09	3.948	A	A
Ira Needles Blvd/Erb St.	West - Erb St.	23.39	1.56	6.729	A	A
Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	19.21	1.28	5.106	A	A
Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	5.20	0.35	4.888	A	A
Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	1.70	0.11	4.080	A	A
Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	21.89	1.46	8.351	A	A
Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	12.44	0.83	9.198	A	A

Queueing Delay results: (9:00 AM-9:15 AM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	East - University Ave	5.07	0.34	2.882	A	A
Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	12.09	0.81	4.098	A	A
Ira Needles Blvd/University Avenue	West - Private Access	1.82	0.12	5.797	A	A
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	19.66	1.31	5.251	A	A
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	3.02	0.20	4.491	A	A
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	12.82	0.85	3.477	A	A
Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	0.62	0.04	2.806	A	A
Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	7.85	0.52	2.796	A	A

Erb St./Platinum Dr	**East - Erb St. W**	1.50	0.10	2.059	A	A
Erb St./Platinum Dr	**North - Platinum Dr**	0.12	0.01	2.421	A	A
Erb St./Platinum Dr	**West - Erb St.**	5.51	0.37	2.465	A	A
Erb St./Platinum Dr	**South - Landfill Gate 2**	0.11	0.01	4.933	A	A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	3.65	0.24	2.622	A	A
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	10.92	0.73	3.133	A	A
Ira Needles Blvd/Erb St.	**West - Erb St.**	13.25	0.88	4.459	A	A
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	11.88	0.79	3.729	A	A
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	4.02	0.27	4.502	A	A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	1.34	0.09	3.870	A	A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	14.72	0.98	6.499	A	A
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	7.68	0.51	6.595	A	A

Queueing Delay results: (9:15 AM-9:30 AM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	**East - University Ave**	3.86	0.26	2.631	A	A
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	8.62	0.57	3.507	A	A
Ira Needles Blvd/University Avenue	**West - Private Access**	1.23	0.08	4.736	A	A
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	13.49	0.90	4.341	A	A
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	2.29	0.15	4.083	A	A
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	9.33	0.62	3.041	A	A
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	0.48	0.03	2.621	A	A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	6.01	0.40	2.563	A	A
Erb St./Platinum Dr	**East - Erb St. W**	1.23	0.08	2.023	A	A
Erb St./Platinum Dr	**North - Platinum Dr**	0.10	0.01	2.394	A	A
Erb St./Platinum Dr	**West - Erb St.**	4.35	0.29	2.326	A	A
Erb St./Platinum Dr	**South - Landfill Gate 2**	0.09	0.01	4.690	A	A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	2.78	0.19	2.387	A	A
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	7.90	0.53	2.717	A	A
Ira Needles Blvd/Erb St.	**West - Erb St.**	8.77	0.58	3.555	A	A
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	8.22	0.55	3.097	A	A
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	3.18	0.21	4.254	A	A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	1.08	0.07	3.725	A	A

Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	10.46	0.70	5.557	A	A
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	5.29	0.35	5.475	A	A

A1 - Existing Conditions - D2 - PM Peak Period, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Geometry	Ira Needles Blvd/University Avenue - East - University Ave - Standard Geometry	Effective flare length is over 30m, which is outside the normal range. Treat capacities with increasing caution.
Warning	Geometry	Ira Needles Blvd/University Avenue - North - Ira Needles Blvd - Standard Geometry	Effective flare length is over 30m, which is outside the normal range. Treat capacities with increasing caution.
Warning	Geometry	Ira Needles Blvd/University Avenue - South - Ira Needles Blvd - Standard Geometry	Effective flare length is over 30m, which is outside the normal range. Treat capacities with increasing caution.
Warning	Pedestrian Crossing	Ira Needles Blvd/University Avenue - East - University Ave - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/University Avenue - North - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/University Avenue - West - Private Access - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/University Avenue - South - Ira Needles Blvd -	Pedestrian crossing uses default settings only. Is this correct?

		Unsignalled Pedestrian Crossing Details	
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - East - Thorndale Dr - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - East - Thorndale Dr - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - North - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - North - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - West - Boardwalk Access - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - West - Boardwalk Access - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - South - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - South - Ira Needles Blvd -	Pedestrian crossing uses default flow of 0. Is this correct?

		Unsignalled Pedestrian Crossing Details	
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - East - Erb St. W - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - East - Erb St. W - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - North - Erbsville Rd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - North - Erbsville Rd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - West - Erb St. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - West - Erb St. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - South - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Beaver Creek Rd/Laurelwood Dr - East - Laurelwood Dr. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Beaver Creek Rd/Laurelwood Dr - East - Laurelwood Dr. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?

Warning	Pedestrian Crossing	Beaver Creek Rd/Laurelwood Dr - North - Beaver Creek Rd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Beaver Creek Rd/Laurelwood Dr - West - Laurelwood Dr. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Beaver Creek Rd/Laurelwood Dr - West - Laurelwood Dr. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Beaver Creek Rd/Laurelwood Dr - South - Beaver Creek Rd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - East - Erb St. W - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - East - Erb St. W - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - North - Platinum Dr - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - North - Platinum Dr - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - West - Erb St. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?

Warning	Pedestrian Crossing	Erb St./Platinum Dr - West - Erb St. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - South - Landfill Gate 2 - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?

Analysis Set Details

Name	Description	Include In Report	Use Specific Demand Set	Demand Set	Locked	Network Flow Scaling Factor (%)	Network Capacity Scaling Factor (%)	Reason For Scaling Factors
Existing Conditions		Yes		(D1)		100.000	100.000	

Demand Set Details

Name	Scenario Name	Time Period Name	Description	Locked	Run Automatically	Use Relationship	Relationship	Start Time (HH:mm)	Finish Time (HH:mm)	Time Period Length (min)	Time Segment Length (min)	Traffic Profile Type
PM Peak Period, PM	PM Peak Period	PM			Yes			16:00	17:30	90	15	ONE HOUR

Roundabout Network

Roundabout Type(s)

Roundabout	ID	Name	Arm Order	Roundabout Type	Grade Separated	Large Roundabout	Do Geometric Delay
1	1	Ira Needles Blvd/University Avenue	1,2,3,4	Standard			
3	3	Ira Needles Blvd/Thorndale Dr	1,2,3,4	Standard			
5	5	Erb St./Platinum Dr	1,2,3,4	Standard			
6	6	Ira Needles Blvd/Erb St.	1,2,3,4	Standard			
12	12	Beaver Creek Rd/Laurelwood Dr	1,2,3,4	Standard			

Roundabout Network Options

Driving Side	Lighting	Road Surface	In London
Right	Normal/unknown	((Mini-roundabouts only))	

Arms

Arms

ID	Name	Description
1	East - University Ave	
2	North - Ira Needles Blvd	
3	West - Private Access	
4	South - Ira Needles Blvd	
1	East - Thorndale Dr	
2	North - Ira Needles Blvd	
3	West - Boardwalk Access	
4	South - Ira Needles Blvd	
1	East - Erb St. W	
2	North - Platinum Dr	
3	West - Erb St.	
4	South - Landfill Gate 2	
1	East - Erb St. W	
2	North - Erbsville Rd	
3	West - Erb St.	
4	South - Ira Needles Blvd	
1	East - Laurelwood Dr.	
2	North - Beaver Creek Rd	
3	West - Laurelwood Dr.	
4	South - Beaver Creek Rd	

Capacity Options

Roundabout	Arm	Minimum Capacity (PCE/hr)	Maximum Capacity (PCE/hr)	Assume Flat Start Profile	Initial Queue (PCE)
Ira Needles Blvd/University Avenue	**East - University Ave**	0.00	99999.00		0.00
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	0.00	99999.00		0.00
Ira Needles Blvd/University Avenue	**West - Private Access**	0.00	99999.00		0.00
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	0.00	99999.00		0.00
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	0.00	99999.00		0.00
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	0.00	99999.00		0.00

Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	0.00	99999.00		0.00
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	0.00	99999.00		0.00
Erb St./Platinum Dr	**East - Erb St. W**	0.00	99999.00		0.00
Erb St./Platinum Dr	**North - Platinum Dr**	0.00	99999.00		0.00
Erb St./Platinum Dr	**West - Erb St.**	0.00	99999.00		0.00
Erb St./Platinum Dr	**South - Landfill Gate 2**	0.00	99999.00		0.00
Ira Needles Blvd/Erb St.	**East - Erb St. W**	0.00	99999.00		0.00
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	0.00	99999.00		0.00
Ira Needles Blvd/Erb St.	**West - Erb St.**	0.00	99999.00		0.00
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	0.00	99999.00		0.00
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	0.00	99999.00		0.00
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	0.00	99999.00		0.00
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	0.00	99999.00		0.00
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	0.00	99999.00		0.00

Standard Geometry

Roundabout	Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit Only
Ira Needles Blvd/University Avenue	**East - University Ave**	7.00	7.70	33.22	27.80	55.00	16.36	
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	3.65	7.70	40.78	27.80	55.00	19.60	
Ira Needles Blvd/University Avenue	**West - Private Access**	4.00	7.20	13.78	34.30	55.00	11.79	
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	3.65	7.70	39.60	25.30	55.00	16.84	
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	3.50	6.40	7.65	67.60	55.00	23.37	
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	7.00	8.50	17.60	42.70	44.00	51.42	
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	7.00	8.65	8.60	36.20	50.00	33.36	
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	7.00	8.45	12.74	39.40	50.00	37.81	
Erb St./Platinum Dr	**East - Erb St. W**	7.00	8.00	30.00	20.00	55.00	25.00	
Erb St./Platinum Dr	**North - Platinum Dr**	7.00	8.00	30.00	20.00	55.00	25.00	
Erb St./Platinum Dr	**West - Erb St.**	7.00	8.00	30.00	20.00	55.00	25.00	
Erb St./Platinum Dr	**South - Landfill Gate 2**	3.50	4.50	30.00	20.00	40.00	25.00	
Ira Needles Blvd/Erb St.	**East - Erb St. W**	7.00	8.60	20.00	33.00	56.00	13.00	
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	7.00	9.30	12.00	30.00	56.00	20.00	
Ira Needles Blvd/Erb St.	**West - Erb St.**	6.80	7.80	7.00	23.00	56.00	6.00	

Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	7.20	8.60	10.00	29.00	56.00	17.00	
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	3.50	4.50	30.00	20.00	40.00	25.00	
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	3.50	4.50	30.00	20.00	40.00	25.00	
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	3.50	4.50	30.00	20.00	40.00	25.00	
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	3.50	4.50	30.00	20.00	40.00	25.00	

Pedestrian Crossings

Roundabout	Arm	Crossing Type
Ira Needles Blvd/University Avenue	**East - University Ave**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/University Avenue	**West - Private Access**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	Unsignalled Pedestrian Crossing
Erb St./Platinum Dr	**East - Erb St. W**	Unsignalled Pedestrian Crossing
Erb St./Platinum Dr	**North - Platinum Dr**	Unsignalled Pedestrian Crossing
Erb St./Platinum Dr	**West - Erb St.**	Unsignalled Pedestrian Crossing
Erb St./Platinum Dr	**South - Landfill Gate 2**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Erb St.	**East - Erb St. W**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Erb St.	**West - Erb St.**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	Unsignalled Pedestrian Crossing
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	Unsignalled Pedestrian Crossing
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	Unsignalled Pedestrian Crossing
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	Unsignalled Pedestrian Crossing
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	Unsignalled Pedestrian Crossing

Unsignalled Pedestrian Crossing Crossings

Roundabout	Arm	Space between crossing and	Vehicles queueing on exit (PCE)	Central Refuge	Crossing Data Type	Crossing length (m)	Crossing time (s)	Crossing length (entry side) (m)	Crossing time (entry side) (s)	Crossing length (exit side) (m)	Crossing time (exit side) (s)

		intersection entry (PCE)									
Ira Needles Blvd/University Avenue	East - University Ave	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/University Avenue	West - Private Access	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erb St./Platinum Dr	East - Erb St. W	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erb St./Platinum Dr	North - Platinum Dr	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erb St./Platinum Dr	West - Erb St.	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erb St./Platinum Dr	South - Landfill Gate 2	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Erb St.	East - Erb St. W	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Erb St.	North - Erbsville Rd	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Erb St.	West - Erb St.	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00

Arm Slope/ Intercept and Capacity

Slope and Intercept used in model

Roundabout	Arm	Enter Directly	Slope	Intercept (PCE/hr)	Final Slope	Final Intercept (PCE/hr)
Ira Needles Blvd/University Avenue	East - University Ave		((calculated))	((calculated))	0.740	2461.322
Ira Needles Blvd/University Avenue	North - Ira Needles Blvd		((calculated))	((calculated))	0.678	2138.626
Ira Needles Blvd/University Avenue	West - Private Access		((calculated))	((calculated))	0.647	1916.031
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd		((calculated))	((calculated))	0.680	2144.039
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr		((calculated))	((calculated))	0.571	1541.270
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd		((calculated))	((calculated))	0.746	2358.337
Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access		((calculated))	((calculated))	0.755	2455.620

Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**		((calculated))	((calculated))	0.747	2435.697
Erb St./Platinum Dr	**East - Erb St. W**		((calculated))	((calculated))	0.723	2436.345
Erb St./Platinum Dr	**North - Platinum Dr**		((calculated))	((calculated))	0.723	2436.345
Erb St./Platinum Dr	**West - Erb St.**		((calculated))	((calculated))	0.723	2436.345
Erb St./Platinum Dr	**South - Landfill Gate 2**		((calculated))	((calculated))	0.579	1357.445
Ira Needles Blvd/Erb St.	**East - Erb St. W**		((calculated))	((calculated))	0.781	2703.168
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**		((calculated))	((calculated))	0.770	2683.164
Ira Needles Blvd/Erb St.	**West - Erb St.**		((calculated))	((calculated))	0.743	2471.717
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**		((calculated))	((calculated))	0.762	2623.737
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**		((calculated))	((calculated))	0.579	1357.445
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**		((calculated))	((calculated))	0.579	1357.445
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**		((calculated))	((calculated))	0.579	1357.445
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**		((calculated))	((calculated))	0.579	1357.445

The slope and intercept shown above include any corrections and adjustments.

Arm Capacity Adjustments

Roundabout	Arm	Type	Reason	Direct Capacity Adjustment (PCE/hr)	Percentage Capacity Adjustment (%)
Ira Needles Blvd/University Avenue	**East - University Ave**	Percentage		N/A	85.00
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	Percentage		N/A	85.00
Ira Needles Blvd/University Avenue	**West - Private Access**	Percentage		N/A	85.00
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	Percentage		N/A	85.00
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	Percentage		N/A	85.00
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	Percentage		N/A	85.00
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	Percentage		N/A	85.00
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	Percentage		N/A	85.00
Erb St./Platinum Dr	**East - Erb St. W**	Percentage		N/A	85.00
Erb St./Platinum Dr	**North - Platinum Dr**	Percentage		N/A	85.00
Erb St./Platinum Dr	**West - Erb St.**	Percentage		N/A	85.00
Erb St./Platinum Dr	**South - Landfill Gate 2**	Percentage		N/A	85.00
Ira Needles Blvd/Erb St.	**East - Erb St. W**	Percentage		N/A	85.00
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	Percentage		N/A	85.00
Ira Needles Blvd/Erb St.	**West - Erb St.**	Percentage		N/A	85.00
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	Percentage		N/A	85.00
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	Percentage		N/A	85.00

Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	Percentage		N/A	85.00
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	Percentage		N/A	85.00
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	Percentage		N/A	85.00

Traffic Flows

Demand Set Data Options

Default Vehicle Mix	Vehicle Mix Varies Over Time	Vehicle Mix Varies Over Turn	Vehicle Mix Varies Over Entry	Vehicle Mix Source	PCE Factor for a Truck (PCE)	Default Turning Proportions	Estimate from entry/exit counts	Turning Proportions Vary Over Time	Turning Proportions Vary Over Turn	Turning Proportions Vary Over Entry
		Yes	Yes	Truck Percentages	2.00				Yes	Yes

Entry Flows

General Flows Data

Roundabout	Arm	Profile Type	Use Turning Counts	Average Demand Flow (Veh/hr)	Flow Scaling Factor (%)	PHF
Ira Needles Blvd/University Avenue	**East - University Ave**	ONE HOUR	Yes	466.00	100.000	N/A
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	ONE HOUR	Yes	650.00	100.000	N/A
Ira Needles Blvd/University Avenue	**West - Private Access**	ONE HOUR	Yes	434.00	100.000	N/A
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	ONE HOUR	Yes	713.00	100.000	N/A
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	ONE HOUR	Yes	177.00	100.000	N/A
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	ONE HOUR	Yes	1224.00	100.000	N/A
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	ONE HOUR	Yes	213.00	100.000	N/A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	ONE HOUR	Yes	985.00	100.000	N/A
Erb St./Platinum Dr	**East - Erb St. W**	ONE HOUR	Yes	543.00	100.000	N/A
Erb St./Platinum Dr	**North - Platinum Dr**	ONE HOUR	Yes	127.00	100.000	N/A
Erb St./Platinum Dr	**West - Erb St.**	ONE HOUR	Yes	255.00	100.000	N/A
Erb St./Platinum Dr	**South - Landfill Gate 2**	ONE HOUR	Yes	32.00	100.000	N/A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	ONE HOUR	Yes	856.00	100.000	N/A
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	ONE HOUR	Yes	1011.00	100.000	N/A
Ira Needles Blvd/Erb St.	**West - Erb St.**	ONE HOUR	Yes	834.00	100.000	N/A

Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	ONE HOUR	Yes	1300.00	100.000	N/A
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	ONE HOUR	Yes	614.00	100.000	N/A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	ONE HOUR	Yes	181.00	100.000	N/A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	ONE HOUR	Yes	288.00	100.000	N/A
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	ONE HOUR	Yes	233.00	100.000	N/A

Pedestrian Flows

General Flows Data

Roundabout	Arm	Profile Type	Average Pedestrian Flow (Ped/hr)
Ira Needles Blvd/University Avenue	**East - University Ave**	ONE HOUR	13.00
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	ONE HOUR	5.00
Ira Needles Blvd/University Avenue	**West - Private Access**	ONE HOUR	7.00
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	ONE HOUR	9.00
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	ONE HOUR	1.00
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	ONE HOUR	1.00
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	ONE HOUR	0.00
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	ONE HOUR	0.00
Erb St./Platinum Dr	**East - Erb St. W**	ONE HOUR	0.00
Erb St./Platinum Dr	**North - Platinum Dr**	ONE HOUR	0.00
Erb St./Platinum Dr	**West - Erb St.**	ONE HOUR	3.00
Erb St./Platinum Dr	**South - Landfill Gate 2**	ONE HOUR	26.00
Ira Needles Blvd/Erb St.	**East - Erb St. W**	ONE HOUR	0.00
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	ONE HOUR	0.00
Ira Needles Blvd/Erb St.	**West - Erb St.**	ONE HOUR	3.00
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	ONE HOUR	26.00
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	ONE HOUR	0.00
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	ONE HOUR	8.00
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	ONE HOUR	0.00
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	ONE HOUR	7.00

Direct/Resultant Flows

Direct Flows Data

Time Segment	Roundabout	Arm	Direct Demand Entry Flow (Veh/hr)	DirectDemandEntryFlowInPCE (PCE/hr)	Direct Demand Exit Flow (Veh/hr)	Direct Demand Pedestrian Flow (Ped/hr)
1	Ira Needles Blvd/University Avenue	East - University Ave	350.83	372.92	N/A	9.79
1	Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	489.35	504.86	N/A	3.76
1	Ira Needles Blvd/University Avenue	West - Private Access	326.74	348.06	N/A	5.27
1	Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	536.78	567.17	N/A	6.78
1	Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	133.25	135.59	N/A	0.00
1	Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	921.49	938.28	N/A	0.00
1	Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	160.36	164.84	N/A	0.00
1	Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	741.56	755.31	N/A	0.00
1	Erb St./Platinum Dr	East - Erb St. W	408.80	417.17	N/A	0.00
1	Erb St./Platinum Dr	North - Platinum Dr	95.61	96.37	N/A	0.00
1	Erb St./Platinum Dr	West - Erb St.	191.98	196.48	N/A	0.00
1	Erb St./Platinum Dr	South - Landfill Gate 2	24.09	25.60	N/A	19.57
1	Ira Needles Blvd/Erb St.	East - Erb St. W	644.44	655.11	N/A	0.00
1	Ira Needles Blvd/Erb St.	North - Erbsville Rd	761.13	775.22	N/A	0.00
1	Ira Needles Blvd/Erb St.	West - Erb St.	627.88	637.36	N/A	0.00
1	Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	978.71	990.66	N/A	19.57
1	Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	462.25	466.50	N/A	0.00
1	Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	136.27	137.00	N/A	6.02
1	Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	216.82	219.79	N/A	0.00
1	Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	175.41	175.41	N/A	5.27
2	Ira Needles Blvd/University Avenue	East - University Ave	418.92	445.30	N/A	11.69
2	Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	584.34	602.86	N/A	4.49
2	Ira Needles Blvd/University Avenue	West - Private Access	390.16	415.62	N/A	6.29
2	Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	640.97	677.26	N/A	8.09
2	Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	159.12	161.91	N/A	0.00
2	Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	1100.35	1120.40	N/A	0.00
2	Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	191.48	196.84	N/A	0.00
2	Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	885.49	901.91	N/A	0.00
2	Erb St./Platinum Dr	East - Erb St. W	488.15	498.14	N/A	0.00
2	Erb St./Platinum Dr	North - Platinum Dr	114.17	115.07	N/A	0.00

2	**Erb St./Platinum Dr**	**West - Erb St.**	229.24	234.62	N/A	0.00
2	**Erb St./Platinum Dr**	**South - Landfill Gate 2**	28.77	30.56	N/A	23.37
2	**Ira Needles Blvd/Erb St.**	**East - Erb St. W**	769.53	782.26	N/A	0.00
2	**Ira Needles Blvd/Erb St.**	**North - Erbsville Rd**	908.87	925.69	N/A	0.00
2	**Ira Needles Blvd/Erb St.**	**West - Erb St.**	749.75	761.08	N/A	0.00
2	**Ira Needles Blvd/Erb St.**	**South - Ira Needles Blvd**	1168.67	1182.95	N/A	23.37
2	**Beaver Creek Rd/Laurelwood Dr**	**East - Laurelwood Dr.**	551.97	557.04	N/A	0.00
2	**Beaver Creek Rd/Laurelwood Dr**	**North - Beaver Creek Rd**	162.72	163.60	N/A	7.19
2	**Beaver Creek Rd/Laurelwood Dr**	**West - Laurelwood Dr.**	258.91	262.45	N/A	0.00
2	**Beaver Creek Rd/Laurelwood Dr**	**South - Beaver Creek Rd**	209.46	209.46	N/A	6.29
3	**Ira Needles Blvd/University Avenue**	**East - University Ave**	513.08	545.38	N/A	14.31
3	**Ira Needles Blvd/University Avenue**	**North - Ira Needles Blvd**	715.66	738.34	N/A	5.51
3	**Ira Needles Blvd/University Avenue**	**West - Private Access**	477.84	509.02	N/A	7.71
3	**Ira Needles Blvd/University Avenue**	**South - Ira Needles Blvd**	785.03	829.46	N/A	9.91
3	**Ira Needles Blvd/Thorndale Dr**	**East - Thorndale Dr**	194.88	198.29	N/A	0.00
3	**Ira Needles Blvd/Thorndale Dr**	**North - Ira Needles Blvd**	1347.65	1372.20	N/A	0.00
3	**Ira Needles Blvd/Thorndale Dr**	**West - Boardwalk Access**	234.52	241.08	N/A	0.00
3	**Ira Needles Blvd/Thorndale Dr**	**South - Ira Needles Blvd**	1084.51	1104.61	N/A	0.00
3	**Erb St./Platinum Dr**	**East - Erb St. W**	597.85	610.10	N/A	0.00
3	**Erb St./Platinum Dr**	**North - Platinum Dr**	139.83	140.93	N/A	0.00
3	**Erb St./Platinum Dr**	**West - Erb St.**	280.76	287.35	N/A	0.00
3	**Erb St./Platinum Dr**	**South - Landfill Gate 2**	35.23	37.43	N/A	28.63
3	**Ira Needles Blvd/Erb St.**	**East - Erb St. W**	942.47	958.08	N/A	0.00
3	**Ira Needles Blvd/Erb St.**	**North - Erbsville Rd**	1113.13	1133.73	N/A	0.00
3	**Ira Needles Blvd/Erb St.**	**West - Erb St.**	918.25	932.12	N/A	0.00
3	**Ira Needles Blvd/Erb St.**	**South - Ira Needles Blvd**	1431.33	1448.81	N/A	28.63
3	**Beaver Creek Rd/Laurelwood Dr**	**East - Laurelwood Dr.**	676.03	682.24	N/A	0.00
3	**Beaver Creek Rd/Laurelwood Dr**	**North - Beaver Creek Rd**	199.28	200.36	N/A	8.81
3	**Beaver Creek Rd/Laurelwood Dr**	**West - Laurelwood Dr.**	317.09	321.43	N/A	0.00
3	**Beaver Creek Rd/Laurelwood Dr**	**South - Beaver Creek Rd**	256.54	256.54	N/A	7.71
4	**Ira Needles Blvd/University Avenue**	**East - University Ave**	513.08	545.38	N/A	14.31
4	**Ira Needles Blvd/University Avenue**	**North - Ira Needles Blvd**	715.66	738.34	N/A	5.51
4	**Ira Needles Blvd/University Avenue**	**West - Private Access**	477.84	509.02	N/A	7.71
4	**Ira Needles Blvd/University Avenue**	**South - Ira Needles Blvd**	785.03	829.46	N/A	9.91

4	**Ira Needles Blvd/Thorndale Dr**	**East - Thorndale Dr**	194.88	198.29	N/A	0.00
4	**Ira Needles Blvd/Thorndale Dr**	**North - Ira Needles Blvd**	1347.65	1372.20	N/A	0.00
4	**Ira Needles Blvd/Thorndale Dr**	**West - Boardwalk Access**	234.52	241.08	N/A	0.00
4	**Ira Needles Blvd/Thorndale Dr**	**South - Ira Needles Blvd**	1084.51	1104.61	N/A	0.00
4	**Erb St./Platinum Dr**	**East - Erb St. W**	597.85	610.10	N/A	0.00
4	**Erb St./Platinum Dr**	**North - Platinum Dr**	139.83	140.93	N/A	0.00
4	**Erb St./Platinum Dr**	**West - Erb St.**	280.76	287.35	N/A	0.00
4	**Erb St./Platinum Dr**	**South - Landfill Gate 2**	35.23	37.43	N/A	28.63
4	**Ira Needles Blvd/Erb St.**	**East - Erb St. W**	942.47	958.08	N/A	0.00
4	**Ira Needles Blvd/Erb St.**	**North - Erbsville Rd**	1113.13	1133.73	N/A	0.00
4	**Ira Needles Blvd/Erb St.**	**West - Erb St.**	918.25	932.12	N/A	0.00
4	**Ira Needles Blvd/Erb St.**	**South - Ira Needles Blvd**	1431.33	1448.81	N/A	28.63
4	**Beaver Creek Rd/Laurelwood Dr**	**East - Laurelwood Dr.**	676.03	682.24	N/A	0.00
4	**Beaver Creek Rd/Laurelwood Dr**	**North - Beaver Creek Rd**	199.28	200.36	N/A	8.81
4	**Beaver Creek Rd/Laurelwood Dr**	**West - Laurelwood Dr.**	317.09	321.43	N/A	0.00
4	**Beaver Creek Rd/Laurelwood Dr**	**South - Beaver Creek Rd**	256.54	256.54	N/A	7.71
5	**Ira Needles Blvd/University Avenue**	**East - University Ave**	418.92	445.30	N/A	11.69
5	**Ira Needles Blvd/University Avenue**	**North - Ira Needles Blvd**	584.34	602.86	N/A	4.49
5	**Ira Needles Blvd/University Avenue**	**West - Private Access**	390.16	415.62	N/A	6.29
5	**Ira Needles Blvd/University Avenue**	**South - Ira Needles Blvd**	640.97	677.26	N/A	8.09
5	**Ira Needles Blvd/Thorndale Dr**	**East - Thorndale Dr**	159.12	161.91	N/A	0.00
5	**Ira Needles Blvd/Thorndale Dr**	**North - Ira Needles Blvd**	1100.35	1120.40	N/A	0.00
5	**Ira Needles Blvd/Thorndale Dr**	**West - Boardwalk Access**	191.48	196.84	N/A	0.00
5	**Ira Needles Blvd/Thorndale Dr**	**South - Ira Needles Blvd**	885.49	901.91	N/A	0.00
5	**Erb St./Platinum Dr**	**East - Erb St. W**	488.15	498.14	N/A	0.00
5	**Erb St./Platinum Dr**	**North - Platinum Dr**	114.17	115.07	N/A	0.00
5	**Erb St./Platinum Dr**	**West - Erb St.**	229.24	234.62	N/A	0.00
5	**Erb St./Platinum Dr**	**South - Landfill Gate 2**	28.77	30.56	N/A	23.37
5	**Ira Needles Blvd/Erb St.**	**East - Erb St. W**	769.53	782.26	N/A	0.00
5	**Ira Needles Blvd/Erb St.**	**North - Erbsville Rd**	908.87	925.69	N/A	0.00
5	**Ira Needles Blvd/Erb St.**	**West - Erb St.**	749.75	761.08	N/A	0.00
5	**Ira Needles Blvd/Erb St.**	**South - Ira Needles Blvd**	1168.67	1182.95	N/A	23.37
5	**Beaver Creek Rd/Laurelwood Dr**	**East - Laurelwood Dr.**	551.97	557.04	N/A	0.00
5	**Beaver Creek Rd/Laurelwood Dr**	**North - Beaver Creek Rd**	162.72	163.60	N/A	7.19

5	Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	258.91	262.45	N/A	0.00
5	Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	209.46	209.46	N/A	6.29
6	Ira Needles Blvd/University Avenue	East - University Ave	350.83	372.92	N/A	9.79
6	Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	489.35	504.86	N/A	3.76
6	Ira Needles Blvd/University Avenue	West - Private Access	326.74	348.06	N/A	5.27
6	Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	536.78	567.17	N/A	6.78
6	Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	133.25	135.59	N/A	0.00
6	Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	921.49	938.28	N/A	0.00
6	Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	160.36	164.84	N/A	0.00
6	Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	741.56	755.31	N/A	0.00
6	Erb St./Platinum Dr	East - Erb St. W	408.80	417.17	N/A	0.00
6	Erb St./Platinum Dr	North - Platinum Dr	95.61	96.37	N/A	0.00
6	Erb St./Platinum Dr	West - Erb St.	191.98	196.48	N/A	0.00
6	Erb St./Platinum Dr	South - Landfill Gate 2	24.09	25.60	N/A	19.57
6	Ira Needles Blvd/Erb St.	East - Erb St. W	644.44	655.11	N/A	0.00
6	Ira Needles Blvd/Erb St.	North - Erbsville Rd	761.13	775.22	N/A	0.00
6	Ira Needles Blvd/Erb St.	West - Erb St.	627.88	637.36	N/A	0.00
6	Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	978.71	990.66	N/A	19.57
6	Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	462.25	466.50	N/A	0.00
6	Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	136.27	137.00	N/A	6.02
6	Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	216.82	219.79	N/A	0.00
6	Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	175.41	175.41	N/A	5.27

Turning Proportions

Turning Counts or Proportions (Veh/hr) - Ira Needles Blvd/ University Avenue (for whole period)

		To			
		1	2	3	4
From	1	0.000	119.000	225.000	122.000
	2	96.000	0.000	116.000	438.000
	3	176.000	112.000	0.000	146.000
	4	129.000	437.000	147.000	0.000

Turning Proportions (Veh) - Ira Needles Blvd/ University Avenue (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.26	0.48	0.26
	2	0.15	0.00	0.18	0.67
	3	0.41	0.26	0.00	0.34
	4	0.18	0.61	0.21	0.00

Turning Counts or Proportions (Veh/hr) - Ira Needles Blvd/ Thorndale Dr (for whole period)

		To			
		1	2	3	4
From	1	0.000	96.000	22.000	59.000
	2	65.000	0.000	88.000	1071.000
	3	40.000	149.000	0.000	24.000
	4	71.000	913.000	1.000	0.000

Turning Proportions (Veh) - Ira Needles Blvd/ Thorndale Dr (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.54	0.12	0.33
	2	0.05	0.00	0.07	0.88
	3	0.19	0.70	0.00	0.11
	4	0.07	0.93	0.00	0.00

Turning Counts or Proportions (Veh/hr) - Ira Needles Blvd/ Erb St. (for whole period)

		To			
		1	2	3	4
From	1	0.000	141.000	528.000	187.000
	2	186.000	0.000	151.000	674.000
	3	268.000	219.000	0.000	347.000
	4	144.000	819.000	337.000	0.000

Turning Proportions (Veh) - Ira Needles Blvd/ Erb St. (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.16	0.62	0.22
	2	0.18	0.00	0.15	0.67
	3	0.32	0.26	0.00	0.42
	4	0.11	0.63	0.26	0.00

Turning Counts or Proportions (Veh/hr) - Beaver Creek Rd/ Laurelwood Dr (for whole period)

		To			
		1	2	3	4
From	1	0.000	50.000	440.000	124.000
	2	47.000	0.000	70.000	64.000
	3	219.000	23.000	0.000	46.000
	4	62.000	22.000	49.000	100.000

Turning Proportions (Veh) - Beaver Creek Rd/ Laurelwood Dr (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.08	0.72	0.20
	2	0.26	0.00	0.39	0.35
	3	0.76	0.08	0.00	0.16
	4	0.27	0.09	0.21	0.43

Turning Counts or Proportions (Veh/hr) - Erb St./ Platinum Dr (for whole period)

		To			
		1	2	3	4
From	1	0.000	16.000	506.000	21.000
	2	50.000	0.000	75.000	2.000
	3	229.000	22.000	0.000	4.000
	4	27.000	1.000	4.000	0.000

Turning Proportions (Veh) - Erb St./ Platinum Dr (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.03	0.93	0.04
	2	0.39	0.00	0.59	0.02
	3	0.90	0.09	0.00	0.02
	4	0.84	0.03	0.13	0.00

Vehicle Mix

Average PCE Per Vehicle - Ira Needles Blvd/ University Avenue (for whole period)

		To			
		1	2	3	4
From	1	1.000	1.070	1.050	1.080
	2	1.020	1.000	1.010	1.040
	3	1.050	1.070	1.000	1.080
	4	1.040	1.020	1.180	1.000

Truck Percentages - Ira Needles Blvd/ University Avenue (for whole period)

		To			
		1	2	3	4
From	1	0.000	7.000	5.000	8.000
	2	2.000	0.000	1.000	4.000
	3	5.000	7.000	0.000	8.000
	4	4.000	2.000	18.000	0.000

Average PCE Per Vehicle - Ira Needles Blvd/ Thorndale Dr (for whole period)

		To			
		1	2	3	4
From	1	1.000	1.020	1.000	1.020
	2	1.000	1.000	1.010	1.020

	3	1.000	1.040	1.000	1.000
	4	1.000	1.020	1.000	1.000

Truck Percentages - Ira Needles Blvd/ Thorndale Dr (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	0.000	2.000	0.000	2.000
	2	0.000	0.000	1.000	2.000
	3	0.000	4.000	0.000	0.000
	4	0.000	2.000	0.000	0.000

Average PCE Per Vehicle - Ira Needles Blvd/ Erb St. (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	1.000	1.010	1.010	1.040
	2	1.020	1.000	1.010	1.020
	3	1.000	1.010	1.000	1.030
	4	1.030	1.010	1.010	1.000

Truck Percentages - Ira Needles Blvd/ Erb St. (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	0.000	1.000	1.000	4.000
	2	2.000	0.000	1.000	2.000
	3	0.000	1.000	0.000	3.000
	4	3.000	1.000	1.000	0.000

Average PCE Per Vehicle - Beaver Creek Rd/ Laurelwood Dr (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	1.000	1.000	1.010	1.010
	2	1.000	1.000	1.014	1.000

	3	1.018	1.000	1.000	1.000
	4	1.000	1.000	1.000	1.000

Truck Percentages - Beaver Creek Rd/ Laurelwood Dr (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	0.000	0.000	1.000	1.000
	2	0.000	0.000	1.400	0.000
	3	1.800	0.000	0.000	0.000
	4	0.000	0.000	0.000	0.000

Average PCE Per Vehicle - Erb St./ Platinum Dr (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	1.000	1.000	1.020	1.048
	2	1.020	1.000	1.000	1.000
	3	1.017	1.045	1.000	1.250
	4	1.074	1.000	1.000	1.000

Truck Percentages - Erb St./ Platinum Dr (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	0.000	0.000	2.000	4.760
	2	2.000	0.000	0.000	0.000
	3	1.740	4.540	0.000	25.000
	4	7.400	0.000	0.000	0.000

Results

Results Summary

Roundabout	Arm	Max RFC	Max Delay (s)	Max Queue (Veh)	Max LOS	Total Demand (Veh/hr)	Total Arrivals (Veh)	Total Queueing Delay (Veh-min)	Average Queueing Delay (s)	Rate Of Queueing Delay (Veh-min/min)	Inclusive Queueing Total Delay (Veh-min)	Inclusive Queueing Average Delay (s)	Slope	Intercept (PCE/hr)
Ira Needles Blvd/University Avenue	East - University Ave	0.41	4.87	0.69	A	427.61	641.42	41.75	3.91	0.46	41.76	3.91	0.740	2461.322
Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	0.54	5.96	1.18	A	596.45	894.68	70.14	4.70	0.78	70.14	4.70	0.678	2138.626
Ira Needles Blvd/University Avenue	West - Private Access	0.52	8.04	1.06	A	398.25	597.37	59.69	6.00	0.66	59.69	6.00	0.647	1916.031
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	0.54	5.31	1.15	A	654.26	981.39	72.03	4.40	0.80	72.03	4.40	0.680	2144.039
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	0.27	6.90	0.37	A	162.42	243.63	23.40	5.76	0.26	23.40	5.76	0.571	1541.270
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	0.70	6.38	2.36	A	1123.16	1684.74	136.28	4.85	1.51	136.29	4.85	0.746	2358.337
Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	0.20	3.75	0.24	A	195.45	293.18	15.90	3.25	0.18	15.90	3.25	0.755	2455.620
Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	0.58	4.68	1.40	A	903.85	1355.78	86.76	3.84	0.96	86.76	3.84	0.747	2435.697
Erb St./Platinum Dr	East - Erb St. W	0.30	2.55	0.42	A	498.27	747.40	29.79	2.39	0.33	29.79	2.39	0.723	2436.345
Erb St./Platinum Dr	North - Platinum Dr	0.08	2.32	0.09	A	116.54	174.81	6.44	2.21	0.07	6.44	2.21	0.723	2436.345
Erb St./Platinum Dr	West - Erb St.	0.14	2.13	0.17	A	233.99	350.99	12.06	2.06	0.13	12.06	2.06	0.723	2436.345
Erb St./Platinum Dr	South - Landfill Gate 2	0.04	4.07	0.04	A	29.36	44.05	2.88	3.92	0.03	2.88	3.92	0.579	1357.445
Ira Needles Blvd/Erb St.	East - Erb St. W	0.75	11.21	2.86	B	785.48	1178.23	135.82	6.92	1.51	135.83	6.92	0.781	2703.168
Ira Needles Blvd/Erb St.	North - Erbsville Rd	0.75	9.68	2.93	A	927.71	1391.56	145.47	6.27	1.62	145.48	6.27	0.770	2683.164
Ira Needles Blvd/Erb St.	West - Erb St.	0.78	14.01	3.46	B	765.29	1147.94	154.84	8.09	1.72	154.85	8.09	0.743	2471.717
Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	0.83	12.43	4.78	B	1192.90	1789.35	221.01	7.41	2.46	221.03	7.41	0.762	2623.737
Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	0.65	9.93	1.84	A	563.41	845.12	108.68	7.72	1.21	108.69	7.72	0.579	1357.445
Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	0.26	6.43	0.35	A	166.09	249.13	23.25	5.60	0.26	23.25	5.60	0.579	1357.445
Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	0.34	5.84	0.51	A	264.27	396.41	34.18	5.17	0.38	34.18	5.17	0.579	1357.445
Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	0.26	4.89	0.35	A	213.80	320.71	24.07	4.50	0.27	24.07	4.50	0.579	1357.445

Main Results

Main results: (4:00 PM-4:15 PM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)
Ira Needles Blvd/University Avenue	East - University Ave	350.83	87.71	349.65	300.59	521.84	9.79	1539.24	647.09	0.228	0.00	0.29
Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	489.36	122.34	487.41	500.90	370.59	3.76	1489.39	1043.78	0.329	0.00	0.49
Ira Needles Blvd/University Avenue	West - Private Access	326.74	81.68	325.20	366.04	491.96	5.27	1169.73	594.80	0.279	0.00	0.39
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	536.78	134.20	534.65	529.38	287.79	6.78	1536.65	1375.01	0.349	0.00	0.53
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	133.26	33.31	132.56	132.04	797.59	0.00	898.20	320.78	0.148	0.00	0.17
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	921.49	230.37	917.86	868.75	61.41	0.00	1929.93	1875.04	0.477	0.00	0.91
Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	160.36	40.09	159.87	83.22	896.06	0.00	1460.87	856.27	0.110	0.00	0.12
Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	741.56	185.39	739.04	865.33	190.60	0.00	1911.06	1482.05	0.388	0.00	0.63
Erb St./Platinum Dr	East - Erb St. W	408.80	102.20	407.78	229.82	20.27	0.00	2016.67	1924.09	0.203	0.00	0.25
Erb St./Platinum Dr	North - Platinum Dr	95.61	23.90	95.39	29.29	398.77	0.00	1806.50	883.97	0.053	0.00	0.06
Erb St./Platinum Dr	West - Erb St.	191.98	47.99	191.55	439.33	54.83	0.00	1989.57	1752.32	0.096	0.00	0.11
Erb St./Platinum Dr	South - Landfill Gate 2	24.09	6.02	23.99	20.28	226.10	19.57	972.33	107.06	0.025	0.00	0.03
Ira Needles Blvd/Erb St.	East - Erb St. W	644.44	161.11	641.71	448.22	1030.56	0.00	1580.50	1111.48	0.408	0.00	0.68
Ira Needles Blvd/Erb St.	North - Erbsville Rd	761.13	190.28	757.99	883.67	788.59	0.00	1724.70	1350.87	0.441	0.00	0.78
Ira Needles Blvd/Erb St.	West - Erb St.	627.88	156.97	625.01	761.62	784.97	0.00	1496.83	974.59	0.419	0.00	0.72
Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	978.70	244.68	974.36	905.56	504.42	19.57	1871.92	1670.73	0.523	0.00	1.09
Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	462.25	115.56	459.25	245.70	145.38	0.00	1072.08	816.99	0.431	0.00	0.75
Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	136.27	34.07	135.54	71.11	533.51	6.02	882.94	514.62	0.154	0.00	0.18
Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	216.82	54.21	215.73	418.25	250.81	0.00	1006.31	597.07	0.215	0.00	0.27
Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	175.41	43.85	174.61	250.07	216.47	5.27	1043.99	836.04	0.168	0.00	0.20

Main results: (4:15 PM-4:30 PM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)
Ira Needles Blvd/University Avenue	East - University Ave	418.92	104.73	418.44	359.93	624.86	11.69	1424.19	647.59	0.294	0.29	0.41
Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	584.34	146.08	583.51	599.73	443.58	4.49	1421.41	1043.40	0.411	0.49	0.69
Ira Needles Blvd/University Avenue	West - Private Access	390.16	97.54	389.43	438.16	588.93	6.29	1071.71	594.81	0.364	0.39	0.57
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	640.97	160.24	640.19	633.75	344.60	8.09	1513.05	1374.17	0.424	0.53	0.73
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	159.12	39.78	158.86	158.03	954.58	0.00	821.57	320.78	0.194	0.17	0.24
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	1100.35	275.09	1098.68	1039.85	73.60	0.00	1922.23	1875.04	0.572	0.91	1.32
Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	191.48	47.87	191.32	99.63	1072.65	0.00	1348.62	856.27	0.142	0.12	0.16

Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	885.49	221.37	884.51	1035.86	228.10	0.00	1887.14	1482.05	0.469	0.63	0.88
Erb St./Platinum Dr	**East - Erb St. W**	488.14	122.04	487.88	274.96	24.26	0.00	2014.18	1924.09	0.242	0.25	0.32
Erb St./Platinum Dr	**North - Platinum Dr**	114.17	28.54	114.12	35.04	477.10	0.00	1757.74	883.97	0.065	0.06	0.07
Erb St./Platinum Dr	**West - Erb St.**	229.24	57.31	229.15	525.62	65.59	0.00	1982.91	1752.32	0.116	0.11	0.13
Erb St./Platinum Dr	**South - Landfill Gate 2**	28.77	7.19	28.74	24.26	270.48	23.37	950.40	107.04	0.030	0.03	0.03
Ira Needles Blvd/Erb St.	**East - Erb St. W**	769.53	192.38	767.77	536.30	1233.05	0.00	1446.93	1111.99	0.532	0.68	1.12
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	908.87	227.22	906.98	1057.30	943.52	0.00	1623.61	1350.74	0.560	0.78	1.26
Ira Needles Blvd/Erb St.	**West - Erb St.**	749.75	187.44	747.80	911.26	939.24	0.00	1363.86	974.58	0.550	0.72	1.20
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	1168.67	292.17	1165.81	1083.51	603.53	23.37	1807.30	1669.86	0.647	1.09	1.80
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	551.97	137.99	550.67	294.48	174.21	0.00	1057.80	817.08	0.522	0.75	1.07
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	162.72	40.68	162.47	85.25	639.64	7.19	830.51	514.56	0.196	0.18	0.24
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	258.91	64.73	258.56	501.46	300.65	0.00	976.54	597.16	0.265	0.27	0.36
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	209.46	52.37	209.24	299.76	259.46	6.29	1022.27	835.77	0.205	0.20	0.26

Main results: (4:30 PM-4:45 PM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)
Ira Needles Blvd/University Avenue	**East - University Ave**	513.08	128.27	511.99	440.16	764.46	14.31	1254.64	648.30	0.409	0.41	0.69
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	715.66	178.92	713.77	733.70	542.76	5.51	1321.14	1042.91	0.542	0.69	1.17
Ira Needles Blvd/University Avenue	**West - Private Access**	477.84	119.46	475.94	536.10	720.43	7.71	927.44	594.81	0.515	0.57	1.04
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	785.02	196.26	783.37	775.12	421.25	9.91	1463.41	1373.02	0.536	0.73	1.14
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	194.88	48.72	194.36	193.36	1168.26	0.00	717.27	320.78	0.272	0.24	0.37
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	1347.65	336.91	1343.61	1272.58	90.04	0.00	1911.84	1875.04	0.705	1.32	2.33
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	234.52	58.63	234.21	121.86	1311.80	0.00	1196.60	856.27	0.196	0.16	0.24
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	1084.50	271.13	1082.45	1266.84	279.17	0.00	1854.56	1482.05	0.585	0.88	1.39
Erb St./Platinum Dr	**East - Erb St. W**	597.85	149.46	597.44	336.72	29.71	0.00	2010.78	1924.09	0.297	0.32	0.42
Erb St./Platinum Dr	**North - Platinum Dr**	139.83	34.96	139.75	42.91	584.24	0.00	1691.05	883.97	0.083	0.07	0.09
Erb St./Platinum Dr	**West - Erb St.**	280.76	70.19	280.62	643.66	80.32	0.00	1973.79	1752.32	0.142	0.13	0.17
Erb St./Platinum Dr	**South - Landfill Gate 2**	35.23	8.81	35.20	29.71	331.24	28.63	920.53	107.02	0.038	0.03	0.04
Ira Needles Blvd/Erb St.	**East - Erb St. W**	942.48	235.62	935.94	653.31	1501.80	0.00	1269.65	1112.70	0.742	1.12	2.76
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	1113.13	278.28	1106.76	1287.81	1149.93	0.00	1488.93	1350.55	0.748	1.26	2.85
Ira Needles Blvd/Erb St.	**West - Erb St.**	918.25	229.56	909.86	1110.77	1145.92	0.00	1179.41	974.57	0.779	1.20	3.30
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	1431.32	357.83	1420.18	1320.87	734.92	28.63	1721.78	1668.66	0.831	1.80	4.58

Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	676.02	169.01	673.08	360.47	213.29	0.00	1038.35	817.21	0.651	1.07	1.81
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	199.29	49.82	198.85	104.27	782.09	8.81	760.22	514.47	0.262	0.24	0.35
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	317.09	79.27	316.49	613.11	367.82	0.00	934.26	597.29	0.339	0.36	0.51
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	256.54	64.13	256.18	366.74	317.57	7.71	992.95	835.40	0.258	0.26	0.35

Main results: (4:45 PM-5:00 PM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)
Ira Needles Blvd/University Avenue	**East - University Ave**	513.08	128.27	513.06	441.48	766.27	14.31	1252.35	648.30	0.410	0.69	0.69
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	715.66	178.92	715.63	735.44	543.88	5.51	1319.93	1042.91	0.542	1.17	1.18
Ira Needles Blvd/University Avenue	**West - Private Access**	477.84	119.46	477.79	537.28	722.23	7.71	925.26	594.81	0.516	1.04	1.06
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	785.02	196.26	784.99	777.27	422.75	9.91	1462.47	1373.02	0.537	1.14	1.15
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	194.88	48.72	194.87	193.77	1170.35	0.00	716.25	320.78	0.272	0.37	0.37
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	1347.65	336.91	1347.54	1274.95	90.28	0.00	1911.69	1875.04	0.705	2.33	2.36
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	234.52	58.63	234.51	122.20	1315.62	0.00	1194.17	856.27	0.196	0.24	0.24
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	1084.50	271.13	1084.47	1270.49	279.65	0.00	1854.25	1482.05	0.585	1.39	1.40
Erb St./Platinum Dr	**East - Erb St. W**	597.85	149.46	597.85	336.91	29.73	0.00	2010.77	1924.09	0.297	0.42	0.42
Erb St./Platinum Dr	**North - Platinum Dr**	139.83	34.96	139.83	42.94	584.64	0.00	1690.80	883.97	0.083	0.09	0.09
Erb St./Platinum Dr	**West - Erb St.**	280.76	70.19	280.76	644.09	80.37	0.00	1973.76	1752.32	0.142	0.17	0.17
Erb St./Platinum Dr	**South - Landfill Gate 2**	35.23	8.81	35.23	29.73	331.41	28.63	920.45	107.02	0.038	0.04	0.04
Ira Needles Blvd/Erb St.	**East - Erb St. W**	942.48	235.62	942.04	658.05	1513.02	0.00	1262.25	1112.70	0.747	2.76	2.86
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	1113.13	278.28	1112.79	1297.36	1157.71	0.00	1483.86	1350.55	0.750	2.85	2.93
Ira Needles Blvd/Erb St.	**West - Erb St.**	918.25	229.56	917.61	1118.11	1152.39	0.00	1173.21	974.57	0.783	3.30	3.46
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	1431.32	357.83	1430.52	1329.44	740.55	28.63	1718.18	1668.66	0.833	4.58	4.78
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	676.02	169.01	675.92	361.12	213.59	0.00	1038.19	817.21	0.651	1.81	1.84
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	199.29	49.82	199.28	104.59	784.93	8.81	758.82	514.47	0.263	0.35	0.35
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	317.09	79.27	317.08	615.39	368.81	0.00	933.62	597.29	0.340	0.51	0.51
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	256.54	64.13	256.53	367.71	318.18	7.71	992.65	835.40	0.258	0.35	0.35

Main results: (5:00 PM-5:15 PM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)
Ira Needles Blvd/University Avenue	**East - University Ave**	418.92	104.73	420.01	361.84	627.52	11.69	1421.10	647.59	0.295	0.69	0.42

Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	584.34	146.08	586.22	602.29	445.24	4.49	1419.78	1043.40	0.412	1.18	0.71
Ira Needles Blvd/University Avenue	West - Private Access	390.16	97.54	392.07	439.90	591.56	6.29	1068.80	594.81	0.365	1.06	0.58
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	640.97	160.24	642.61	636.87	346.75	8.09	1511.73	1374.17	0.424	1.15	0.74
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	159.12	39.78	159.64	158.64	957.72	0.00	820.04	320.78	0.194	0.37	0.24
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	1100.35	275.09	1104.38	1043.40	73.95	0.00	1922.01	1875.04	0.573	2.36	1.35
Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	191.48	47.87	191.79	100.14	1078.19	0.00	1345.09	856.27	0.142	0.24	0.17
Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	885.49	221.37	887.53	1041.16	228.83	0.00	1886.68	1482.05	0.469	1.40	0.89
Erb St./Platinum Dr	East - Erb St. W	488.14	122.04	488.55	275.27	24.29	0.00	2014.16	1924.09	0.242	0.42	0.32
Erb St./Platinum Dr	North - Platinum Dr	114.17	28.54	114.25	35.09	477.76	0.00	1757.33	883.97	0.065	0.09	0.07
Erb St./Platinum Dr	West - Erb St.	229.24	57.31	229.38	526.33	65.67	0.00	1982.86	1752.32	0.116	0.17	0.13
Erb St./Platinum Dr	South - Landfill Gate 2	28.77	7.19	28.80	24.29	270.76	23.37	950.26	107.04	0.030	0.04	0.03
Ira Needles Blvd/Erb St.	East - Erb St. W	769.53	192.38	776.31	542.91	1248.76	0.00	1436.57	1111.99	0.536	2.86	1.17
Ira Needles Blvd/Erb St.	North - Erbsville Rd	908.87	227.22	915.39	1070.66	954.41	0.00	1616.51	1350.74	0.562	2.93	1.30
Ira Needles Blvd/Erb St.	West - Erb St.	749.75	187.44	758.57	921.54	948.26	0.00	1355.53	974.58	0.553	3.46	1.26
Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	1168.67	292.17	1180.30	1095.47	611.37	23.37	1802.28	1669.86	0.648	4.78	1.88
Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	551.97	137.99	554.89	295.52	174.71	0.00	1057.55	817.08	0.522	1.84	1.11
Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	162.72	40.68	163.15	85.72	643.87	7.19	828.43	514.56	0.196	0.35	0.25
Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	258.91	64.73	259.50	504.86	302.16	0.00	975.62	597.16	0.265	0.51	0.36
Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	209.46	52.37	209.81	301.25	260.41	6.29	1021.80	835.77	0.205	0.35	0.26

Main results: (5:15 PM-5:30 PM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)
Ira Needles Blvd/University Avenue	East - University Ave	350.83	87.71	351.32	302.47	524.84	9.79	1536.06	647.08	0.228	0.42	0.30
Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	489.36	122.34	490.20	503.72	372.44	3.76	1487.72	1043.76	0.329	0.71	0.49
Ira Needles Blvd/University Avenue	West - Private Access	326.74	81.68	327.49	367.95	494.70	5.27	1167.04	594.81	0.280	0.58	0.39
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	536.78	134.20	537.59	532.47	289.72	6.78	1536.65	1375.01	0.349	0.74	0.54
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	133.26	33.31	133.52	132.70	801.34	0.00	896.38	320.78	0.149	0.24	0.18
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	921.49	230.37	923.22	873.01	61.86	0.00	1929.65	1875.04	0.478	1.35	0.92
Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	160.36	40.09	160.53	83.73	901.36	0.00	1457.50	856.27	0.110	0.17	0.12
Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	741.56	185.39	742.57	870.42	191.47	0.00	1910.51	1482.05	0.388	0.89	0.64
Erb St./Platinum Dr	East - Erb St. W	408.80	102.20	409.06	230.50	20.34	0.00	2016.63	1924.09	0.203	0.32	0.26
Erb St./Platinum Dr	North - Platinum Dr	95.61	23.90	95.67	29.38	400.02	0.00	1805.72	883.97	0.053	0.07	0.06

Erb St./Platinum Dr	**West - Erb St.**	191.98	47.99	192.07	440.70	54.99	0.00	1989.47	1752.32	0.097	0.13	0.11
Erb St./Platinum Dr	**South - Landfill Gate 2**	24.09	6.02	24.11	20.34	226.72	19.57	972.04	107.06	0.025	0.03	0.03
Ira Needles Blvd/Erb St.	**East - Erb St. W**	644.44	161.11	646.33	451.59	1038.45	0.00	1575.29	1111.48	0.409	1.17	0.70
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	761.13	190.28	763.14	890.41	794.37	0.00	1720.93	1350.87	0.442	1.30	0.80
Ira Needles Blvd/Erb St.	**West - Erb St.**	627.88	156.97	629.97	767.16	790.36	0.00	1492.23	974.59	0.421	1.26	0.73
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	978.70	244.68	981.78	912.07	508.26	19.57	1869.45	1670.73	0.524	1.88	1.11
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	462.25	115.56	463.62	247.32	146.25	0.00	1071.64	816.99	0.431	1.11	0.77
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	136.27	34.07	136.51	71.68	538.19	6.02	880.64	514.62	0.155	0.25	0.18
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	216.82	54.21	217.17	421.97	252.73	0.00	1005.19	597.07	0.216	0.36	0.28
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	175.41	43.85	175.64	251.97	217.93	5.27	1043.26	836.04	0.168	0.26	0.20

Queueing Delay Results

Queueing Delay results: (4:00 PM-4:15 PM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	**East - University Ave**	4.33	0.29	3.023	A	A
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	7.12	0.47	3.587	A	A
Ira Needles Blvd/University Avenue	**West - Private Access**	5.63	0.38	4.255	A	A
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	7.81	0.52	3.585	A	A
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	2.53	0.17	4.698	A	A
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	13.22	0.88	3.543	A	A
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	1.81	0.12	2.767	A	A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	9.25	0.62	3.065	A	A
Erb St./Platinum Dr	**East - Erb St. W**	3.75	0.25	2.236	A	A
Erb St./Platinum Dr	**North - Platinum Dr**	0.83	0.06	2.103	A	A
Erb St./Platinum Dr	**West - Erb St.**	1.58	0.11	2.002	A	A
Erb St./Platinum Dr	**South - Landfill Gate 2**	0.37	0.02	3.795	A	A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	9.97	0.66	3.824	A	A
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	11.44	0.76	3.711	A	A
Ira Needles Blvd/Erb St.	**West - Erb St.**	10.44	0.70	4.116	A	A
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	15.75	1.05	3.992	A	A
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	10.81	0.72	5.847	A	A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	2.65	0.18	4.813	A	A

Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	3.99	0.27	4.547	A	A
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	2.94	0.20	4.137	A	A

Queueing Delay results: (4:15 PM-4:30 PM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	**East - University Ave**	6.11	0.41	3.577	A	A
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	10.16	0.68	4.291	A	A
Ira Needles Blvd/University Avenue	**West - Private Access**	8.30	0.55	5.271	A	A
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	10.71	0.71	4.121	A	A
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	3.50	0.23	5.428	A	A
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	19.32	1.29	4.362	A	A
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	2.44	0.16	3.110	A	A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	12.90	0.86	3.587	A	A
Erb St./Platinum Dr	**East - Erb St. W**	4.73	0.32	2.358	A	A
Erb St./Platinum Dr	**North - Platinum Dr**	1.03	0.07	2.190	A	A
Erb St./Platinum Dr	**West - Erb St.**	1.94	0.13	2.052	A	A
Erb St./Platinum Dr	**South - Landfill Gate 2**	0.46	0.03	3.905	A	A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	16.30	1.09	5.286	A	A
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	18.25	1.22	5.010	A	A
Ira Needles Blvd/Erb St.	**West - Erb St.**	17.43	1.16	5.824	A	A
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	25.93	1.73	5.588	A	A
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	15.56	1.04	7.080	A	A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	3.56	0.24	5.388	A	A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	5.27	0.35	5.012	A	A
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	3.78	0.25	4.426	A	A

Queueing Delay results: (4:30 PM-4:45 PM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	**East - University Ave**	10.02	0.67	4.840	A	A
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	16.87	1.12	5.927	A	A
Ira Needles Blvd/University Avenue	**West - Private Access**	15.00	1.00	7.939	A	A
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	16.61	1.11	5.281	A	A

Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	5.39	0.36	6.877	A	A
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	33.32	2.22	6.290	A	A
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	3.58	0.24	3.740	A	A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	20.23	1.35	4.650	A	A
Erb St./Platinum Dr	**East - Erb St. W**	6.24	0.42	2.547	A	A
Erb St./Platinum Dr	**North - Platinum Dr**	1.34	0.09	2.320	A	A
Erb St./Platinum Dr	**West - Erb St.**	2.46	0.16	2.126	A	A
Erb St./Platinum Dr	**South - Landfill Gate 2**	0.59	0.04	4.066	A	A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	38.06	2.54	10.585	B	B
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	39.60	2.64	9.268	A	A
Ira Needles Blvd/Erb St.	**West - Erb St.**	44.66	2.98	12.973	B	B
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	61.61	4.11	11.531	B	B
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	25.67	1.71	9.776	A	A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	5.15	0.34	6.407	A	A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	7.45	0.50	5.821	A	A
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	5.09	0.34	4.884	A	A

Queueing Delay results: (4:45 PM-5:00 PM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	**East - University Ave**	10.33	0.69	4.869	A	A
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	17.58	1.17	5.957	A	A
Ira Needles Blvd/University Avenue	**West - Private Access**	15.79	1.05	8.042	A	A
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	17.22	1.15	5.313	A	A
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	5.56	0.37	6.904	A	A
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	35.26	2.35	6.379	A	A
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	3.65	0.24	3.750	A	A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	20.95	1.40	4.676	A	A
Erb St./Platinum Dr	**East - Erb St. W**	6.33	0.42	2.547	A	A
Erb St./Platinum Dr	**North - Platinum Dr**	1.35	0.09	2.320	A	A
Erb St./Platinum Dr	**West - Erb St.**	2.48	0.17	2.126	A	A
Erb St./Platinum Dr	**South - Landfill Gate 2**	0.60	0.04	4.066	A	A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	42.38	2.83	11.209	B	B
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	43.51	2.90	9.681	A	A

Ira Needles Blvd/Erb St.	**West - Erb St.**	51.04	3.40	14.005	B	B
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	70.59	4.71	12.428	B	B
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	27.41	1.83	9.929	A	A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	5.30	0.35	6.433	A	A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	7.66	0.51	5.838	A	A
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	5.20	0.35	4.890	A	A

Queueing Delay results: (5:00 PM-5:15 PM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	**East - University Ave**	6.44	0.43	3.601	A	A
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	10.86	0.72	4.328	A	A
Ira Needles Blvd/University Avenue	**West - Private Access**	8.98	0.60	5.334	A	A
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	11.41	0.76	4.151	A	A
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	3.73	0.25	5.457	A	A
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	21.02	1.40	4.424	A	A
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	2.54	0.17	3.121	A	A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	13.69	0.91	3.609	A	A
Erb St./Platinum Dr	**East - Erb St. W**	4.87	0.32	2.359	A	A
Erb St./Platinum Dr	**North - Platinum Dr**	1.06	0.07	2.192	A	A
Erb St./Platinum Dr	**West - Erb St.**	1.98	0.13	2.054	A	A
Erb St./Platinum Dr	**South - Landfill Gate 2**	0.48	0.03	3.908	A	A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	18.38	1.23	5.506	A	A
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	20.39	1.36	5.182	A	A
Ira Needles Blvd/Erb St.	**West - Erb St.**	19.99	1.33	6.116	A	A
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	30.00	2.00	5.891	A	A
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	17.36	1.16	7.201	A	A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	3.78	0.25	5.414	A	A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	5.58	0.37	5.032	A	A
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	3.96	0.26	4.436	A	A

Queueing Delay results: (5:15 PM-5:30 PM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service

Ira Needles Blvd/University Avenue	**East - University Ave**	4.53	0.30	3.039	A	A
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	7.54	0.50	3.613	A	A
Ira Needles Blvd/University Avenue	**West - Private Access**	6.00	0.40	4.293	A	A
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	8.26	0.55	3.608	A	A
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	2.69	0.18	4.720	A	A
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	14.14	0.94	3.582	A	A
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	1.88	0.13	2.775	A	A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	9.74	0.65	3.084	A	A
Erb St./Platinum Dr	**East - Erb St. W**	3.87	0.26	2.241	A	A
Erb St./Platinum Dr	**North - Platinum Dr**	0.85	0.06	2.106	A	A
Erb St./Platinum Dr	**West - Erb St.**	1.62	0.11	2.002	A	A
Erb St./Platinum Dr	**South - Landfill Gate 2**	0.39	0.03	3.799	A	A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	10.72	0.71	3.884	A	A
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	12.28	0.82	3.768	A	A
Ira Needles Blvd/Erb St.	**West - Erb St.**	11.28	0.75	4.184	A	A
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	17.13	1.14	4.070	A	A
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	11.86	0.79	5.933	A	A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	2.82	0.19	4.840	A	A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	4.23	0.28	4.570	A	A
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	3.10	0.21	4.150	A	A

APPENDIX

D-2 *2031 CONDITIONS – WITH PLANNED IMPROVEMENTS*

ARCADY 7

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File: J:\04 STAFF FOLDERS\Ubaid\Roundabout Analysis Lukezic\Updated Analysis\Future Conditions\Future.arc7
Report generation date: 06/06/2018 3:33:27 PM

Summary of roundabout performance

There are warnings associated with one or more model runs - see the 'Data Errors and Warnings' tables for each Analysis or Demand Set.

	AM				PM			
	Queue (Veh)	Delay (s)	RFC	LOS	Queue (Veh)	Delay (s)	RFC	LOS
	Planned 2031 Conditions - AM Peak Period							
Ira Needles Blvd/University Avenue - East - University Ave	0.78	4.75	0.44	A	3.71	17.87	0.80	C
Ira Needles Blvd/University Avenue - North - Ira Needles Blvd	1.92	6.82	0.66	A	219.33	585.40	1.34	F
Ira Needles Blvd/University Avenue - West - Private Access	0.47	16.25	0.32	C	300.97	5560.33	2.40	F
Ira Needles Blvd/University Avenue - South - Ira Needles Blvd	238.04	514.63	1.25	F	4.65	12.74	0.83	B

Ira Needles Blvd/Thorndale Dr - East - Thorndale Dr	0.94	13.54	0.49	B	0.80	10.59	0.45	B
Ira Needles Blvd/Thorndale Dr - North - Ira Needles Blvd	1.50	4.56	0.60	A	148.20	234.12	1.14	F
Ira Needles Blvd/Thorndale Dr - West - Boardwalk Access	0.06	3.20	0.06	A	0.42	6.38	0.30	A
Ira Needles Blvd/Thorndale Dr - South - Ira Needles Blvd	3.92	8.80	0.80	A	2.41	6.36	0.71	A
Erb St./Platinum Dr - East - Erb St. W	1.13	4.27	0.53	A	0.80	3.09	0.45	A
Erb St./Platinum Dr - North - Platinum Dr	0.17	3.20	0.15	A	1.53	5.34	0.61	A
Erb St./Platinum Dr - West - Erb St.	0.82	3.46	0.45	A	0.25	2.83	0.20	A
Erb St./Platinum Dr - South - Landfill Gate 2	0.04	7.29	0.04	A	0.14	6.91	0.12	A
Ira Needles Blvd/Erb St. - East - Erb St. W	1.44	7.63	0.59	A	7.29	26.31	0.89	D
Ira Needles Blvd/Erb St. - North - Erbsville Rd	1.87	6.81	0.66	A	110.30	226.79	1.16	F
Ira Needles Blvd/Erb St. - West - Erb St.	2.70	9.10	0.73	A	604.28	2061.31	1.75	F
Ira Needles Blvd/Erb St. - South - Ira Needles Blvd	55.61	104.38	1.05	F	9.22	20.50	0.91	C
Erbsville/Keats Way - East - Keats Way	0.61	10.53	0.38	B	0.41	7.21	0.29	A
Erbsville/Keats Way - North - Erbsville Road	0.61	2.99	0.38	A	2.01	5.72	0.67	A
Erbsville/Keats Way - West - Keats Way	0.48	7.39	0.32	A	1.13	18.26	0.54	C
Erbsville/Keats Way - South - Erbsville Road	1.50	4.78	0.60	A	0.86	3.62	0.46	A
Beaver Creek Rd/Laurelwood Dr - East - Laurelwood Dr.	0.46	5.12	0.32	A	2.51	12.13	0.72	B
Beaver Creek Rd/Laurelwood Dr - North - Beaver Creek Rd	0.31	4.60	0.23	A	0.61	7.04	0.38	A
Beaver Creek Rd/Laurelwood Dr - West - Laurelwood Dr.	2.11	10.82	0.68	B	0.54	5.57	0.35	A
Beaver Creek Rd/Laurelwood Dr - South - Beaver Creek Rd	1.13	11.08	0.53	B	0.46	5.10	0.32	A
Fischer Hallman Road/Laurelwood Drive - East - Laurelwood Drive	0.15	7.79	0.13	A	0.93	10.08	0.48	B
Fischer Hallman Road/Laurelwood Drive - North - Bearinger Road	0.37	2.57	0.27	A	3.46	10.71	0.78	B
Fischer Hallman Road/Laurelwood Drive - West - Laurelwood Drive	7.72	36.00	0.90	E	2.06	19.76	0.68	C
Fischer Hallman Road/Laurelwood Drive - South - Fischer Hallman Road	1.55	5.57	0.61	A	0.73	3.41	0.42	A
Bearinger Road/Westmount Road - East - Bearinger Road	0.29	3.55	0.22	A	0.83	4.96	0.46	A
Bearinger Road/Westmount Road - North - Westmount Road	0.92	3.64	0.48	A	14.41	36.92	0.95	E
Bearinger Road/Westmount Road - West - Bearinger Road	2.34	7.35	0.70	A	0.94	4.51	0.49	A
Bearinger Road/Westmount Road - South - Westmount Road	0.63	4.90	0.39	A	0.47	3.46	0.32	A
Conservation Drive/Beaver Creek Road - East - Conservation Drive	0.45	4.80	0.31	A	1.01	6.86	0.51	A
Conservation Drive/Beaver Creek Road - North - Beaver Creek Road	0.24	4.57	0.20	A	0.17	4.83	0.15	A
Conservation Drive/Beaver Creek Road - West - Conservation Drive	0.58	5.82	0.37	A	0.35	5.04	0.26	A
Conservation Drive/Beaver Creek Road - South - Beaver Creek Road	0.37	5.39	0.27	A	0.37	5.10	0.27	A

Values shown are the maximum values over all time segments. Delay is the maximum value of average delay per arriving vehicle.

AM Peak Period - AM runs from 08:00:00 to 09:30:00
PM Peak Period - PM runs from 16:00:00 to 17:30:00

File summary

File Description

Title	Roundabout Analysis Waterloo LRT
Location	Waterloo
Site Number	
Date	13/02/2017
Version	
Status	(new file)
Identifier	
Client	
Jobnumber	
Analyst	Ubaid Ali
Description	

Analysis Options

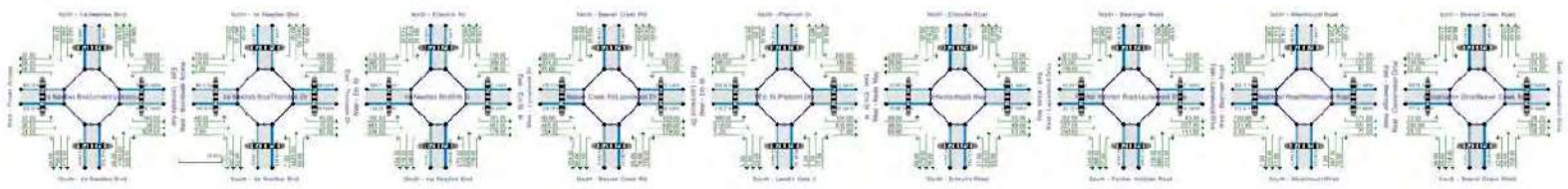
RFC Threshold	Vehicle Length (m)	Do Queue Variations
0.85	5.75	

Sorting and Display

Show Arm Names	Arm Grouping	Sorting Direction	Sorting Type	Data Matrix Style	Time Style
Yes	Order	Ascending	Numerical	By Destination	Absolute Time

Units

Distance Units	Speed Units	Traffic Units Input	Traffic Units Results	Flow Units	Average Delay Units	Total Delay Units	Rate Of Delay Units
m	kph	Veh	Veh	perHour	s	-Min	perMin



Turn Boxes - Turning Count or Proportion (Veh) - Veh/hr
Entry Arm (Text A) - Entry Flow - Veh/hr
Exit Arm (Text B) - Exit Flow - Veh/hr

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Current Time Segment: (8:00 AM-8:15 AM)
Anlysis Set A1 - Pinne 01 Conitions emn Set 1 - AM Pe Perio AM
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The intersection diagram reflects the last run of ARCADY.

A1 - Planned 2031 Conditions - D1 - AM Peak Period, AM

Data Errors and Warnings

Severity	Area	Item	Description

Warning	Geometry	Ira Needles Blvd/University Avenue - East - University Ave - Standard Geometry	Effective flare length is over 30m, which is outside the normal range. Treat capacities with increasing caution.
Warning	Geometry	Ira Needles Blvd/University Avenue - North - Ira Needles Blvd - Standard Geometry	Effective flare length is over 30m, which is outside the normal range. Treat capacities with increasing caution.
Warning	Geometry	Ira Needles Blvd/University Avenue - South - Ira Needles Blvd - Standard Geometry	Effective flare length is over 30m, which is outside the normal range. Treat capacities with increasing caution.
Last Run	Last Run	Ira Needles Blvd/University Avenue - South - Ira Needles Blvd - Capacity	Pedestrian Crossing causes blocking on previous arm due to traffic queing to leave the junction in 6 timesegment(s).
Warning	Pedestrian Crossing	Ira Needles Blvd/University Avenue - East - University Ave - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/University Avenue - East - University Ave - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/University Avenue - North - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/University Avenue - North - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/University Avenue - West - Private Access - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?

Warning	Pedestrian Crossing	Ira Needles Blvd/University Avenue - West - Private Access - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/University Avenue - South - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - East - Thorndale Dr - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - East - Thorndale Dr - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - North - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - North - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - West - Boardwalk Access - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - West - Boardwalk Access - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?

Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - South - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - South - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - East - Erb St. W - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - East - Erb St. W - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - North - Erbsville Rd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - North - Erbsville Rd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - West - Erb St. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - West - Erb St. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - South - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - South - Ira Needles Blvd -	Pedestrian crossing uses default flow of 0. Is this correct?

		Unsignalled Pedestrian Crossing Details	
Warning	Pedestrian Crossing	Beaver Creek Rd/Laurelwood Dr - East - Laurelwood Dr. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Beaver Creek Rd/Laurelwood Dr - North - Beaver Creek Rd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Beaver Creek Rd/Laurelwood Dr - West - Laurelwood Dr. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Beaver Creek Rd/Laurelwood Dr - West - Laurelwood Dr. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Beaver Creek Rd/Laurelwood Dr - South - Beaver Creek Rd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - East - Erb St. W - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - East - Erb St. W - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - North - Platinum Dr - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - North - Platinum Dr -	Pedestrian crossing uses default flow of 0. Is this correct?

		Unsignalled Pedestrian Crossing Details	
Warning	Pedestrian Crossing	Erb St./Platinum Dr - West - Erb St. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - West - Erb St. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - South - Landfill Gate 2 - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - South - Landfill Gate 2 - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Erbsville/Keats Way - East - Keats Way - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erbsville/Keats Way - East - Keats Way - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Erbsville/Keats Way - North - Erbsville Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erbsville/Keats Way - North - Erbsville Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Erbsville/Keats Way - West - Keats Way - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erbsville/Keats Way - West - Keats Way -	Pedestrian crossing uses default flow of 0. Is this correct?

		Unsignalled Pedestrian Crossing Details	
Warning	Pedestrian Crossing	Erbsville/Keats Way - South - Erbsville Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Fischer Hallman Road/Laurelwood Drive - East - Laurelwood Drive - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Fischer Hallman Road/Laurelwood Drive - East - Laurelwood Drive - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Fischer Hallman Road/Laurelwood Drive - North - Bearinger Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Fischer Hallman Road/Laurelwood Drive - North - Bearinger Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Fischer Hallman Road/Laurelwood Drive - West - Laurelwood Drive - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Fischer Hallman Road/Laurelwood Drive - West - Laurelwood Drive - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Fischer Hallman Road/Laurelwood Drive - South - Fischer Hallman Road - Unsignalled	Pedestrian crossing uses default settings only. Is this correct?

		Pedestrian Crossing Details	
Warning	Pedestrian Crossing	Bearinger Road/Westmount Road - East - Bearinger Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Bearinger Road/Westmount Road - East - Bearinger Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Bearinger Road/Westmount Road - North - Westmount Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Bearinger Road/Westmount Road - North - Westmount Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Bearinger Road/Westmount Road - West - Bearinger Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Bearinger Road/Westmount Road - West - Bearinger Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Bearinger Road/Westmount Road - South - Westmount Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Conservation Drive/Beaver Creek Road - East - Conservation Drive - Unsignalled	Pedestrian crossing uses default settings only. Is this correct?

		Pedestrian Crossing Details	
Warning	Pedestrian Crossing	Conservation Drive/Beaver Creek Road - East - Conservation Drive - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Conservation Drive/Beaver Creek Road - North - Beaver Creek Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Conservation Drive/Beaver Creek Road - North - Beaver Creek Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Conservation Drive/Beaver Creek Road - West - Conservation Drive - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Conservation Drive/Beaver Creek Road - West - Conservation Drive - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Conservation Drive/Beaver Creek Road - South - Beaver Creek Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?

Analysis Set Details

Name	Description	Include In Report	Use Specific Demand Set	Demand Set	Locked	Network Flow Scaling Factor (%)	Network Capacity Scaling Factor (%)	Reason For Scaling Factors
Planned 2031 Conditions		Yes		(D1)		100.000	100.000	

Demand Set Details

Name	Scenario Name	Time Period Name	Description	Locked	Run Automatically	Use Relationship	Relationship	Start Time (HH:mm)	Finish Time (HH:mm)	Time Period Length (min)	Time Segment Length (min)	Traffic Profile Type
AM Peak Period, AM	AM Peak Period	AM			Yes			08:00	09:30	90	15	ONE HOUR

Roundabout Network

Roundabout Type(s)

Roundabout	ID	Name	Arm Order	Roundabout Type	Grade Separated	Large Roundabout	Do Geometric Delay
1	1	Ira Needles Blvd/University Avenue	1,2,3,4	Standard			
3	3	Ira Needles Blvd/Thorndale Dr	1,2,3,4	Standard			
5	5	Erb St./Platinum Dr	1,2,3,4	Standard			
6	6	Ira Needles Blvd/Erb St.	1,2,3,4	Standard			
8	8	Erbsville/Keats Way	1,2,3,4	Standard			
12	12	Beaver Creek Rd/Laurelwood Dr	1,2,3,4	Standard			
13	13	Fischer Hallman Road/Laurelwood Drive	1,2,3,4	Standard			
14	14	Bearinger Road/Westmount Road	1,2,3,4	Standard			
18	18	Conservation Drive/Beaver Creek Road	1,2,3,4	Standard			

Roundabout Network Options

Driving Side	Lighting	Road Surface	In London
Right	Normal/unknown	((Mini-roundabouts only))	

Arms

Arms

ID	Name	Description
1	East - University Ave	
2	North - Ira Needles Blvd	
3	West - Private Access	
4	South - Ira Needles Blvd	
1	East - Thorndale Dr	
2	North - Ira Needles Blvd	
3	West - Boardwalk Access	
4	South - Ira Needles Blvd	
1	East - Erb St. W	
2	North - Platinum Dr	
3	West - Erb St.	
4	South - Landfill Gate 2	
1	East - Erb St. W	
2	North - Erbsville Rd	
3	West - Erb St.	
4	South - Ira Needles Blvd	
1	East - Keats Way	
2	North - Erbsville Road	
3	West - Keats Way	
4	South - Erbsville Road	
1	East - Laurelwood Dr.	
2	North - Beaver Creek Rd	
3	West - Laurelwood Dr.	
4	South - Beaver Creek Rd	
1	East - Laurelwood Drive	
2	North - Bearinger Road	
3	West - Laurelwood Drive	
4	South - Fischer Hallman Road	
1	East - Bearinger Road	
2	North - Westmount Road	
3	West - Bearinger Road	
4	South - Westmount Road	
1	East - Conservation Drive	

2	North - Beaver Creek Road	
3	West - Conservation Drive	
4	South - Beaver Creek Road	

Capacity Options

Roundabout	Arm	Minimum Capacity (PCE/hr)	Maximum Capacity (PCE/hr)	Assume Flat Start Profile	Initial Queue (PCE)
Ira Needles Blvd/University Avenue	East - University Ave	0.00	99999.00		0.00
Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	0.00	99999.00		0.00
Ira Needles Blvd/University Avenue	West - Private Access	0.00	99999.00		0.00
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	0.00	99999.00		0.00
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	0.00	99999.00		0.00
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	0.00	99999.00		0.00
Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	0.00	99999.00		0.00
Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	0.00	99999.00		0.00
Erb St./Platinum Dr	East - Erb St. W	0.00	99999.00		0.00
Erb St./Platinum Dr	North - Platinum Dr	0.00	99999.00		0.00
Erb St./Platinum Dr	West - Erb St.	0.00	99999.00		0.00
Erb St./Platinum Dr	South - Landfill Gate 2	0.00	99999.00		0.00
Ira Needles Blvd/Erb St.	East - Erb St. W	0.00	99999.00		0.00
Ira Needles Blvd/Erb St.	North - Erbsville Rd	0.00	99999.00		0.00
Ira Needles Blvd/Erb St.	West - Erb St.	0.00	99999.00		0.00
Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	0.00	99999.00		0.00
Erbsville/Keats Way	East - Keats Way	0.00	99999.00		0.00
Erbsville/Keats Way	North - Erbsville Road	0.00	99999.00		0.00
Erbsville/Keats Way	West - Keats Way	0.00	99999.00		0.00
Erbsville/Keats Way	South - Erbsville Road	0.00	99999.00		0.00
Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	0.00	99999.00		0.00
Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	0.00	99999.00		0.00
Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	0.00	99999.00		0.00
Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	0.00	99999.00		0.00
Fischer Hallman Road/Laurelwood Drive	East - Laurelwood Drive	0.00	99999.00		0.00
Fischer Hallman Road/Laurelwood Drive	North - Bearinger Road	0.00	99999.00		0.00
Fischer Hallman Road/Laurelwood Drive	West - Laurelwood Drive	0.00	99999.00		0.00

Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	0.00	99999.00		0.00
Bearinger Road/Westmount Road	**East - Bearinger Road**	0.00	99999.00		0.00
Bearinger Road/Westmount Road	**North - Westmount Road**	0.00	99999.00		0.00
Bearinger Road/Westmount Road	**West - Bearinger Road**	0.00	99999.00		0.00
Bearinger Road/Westmount Road	**South - Westmount Road**	0.00	99999.00		0.00
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	0.00	99999.00		0.00
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	0.00	99999.00		0.00
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	0.00	99999.00		0.00
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	0.00	99999.00		0.00

Standard Geometry

Roundabout	Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit Only
Ira Needles Blvd/University Avenue	**East - University Ave**	7.00	7.70	33.22	27.80	55.00	16.36	
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	3.65	7.70	40.78	27.80	55.00	19.60	
Ira Needles Blvd/University Avenue	**West - Private Access**	4.00	7.20	13.78	34.30	55.00	11.79	
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	3.65	7.70	39.60	25.30	55.00	16.84	
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	3.50	6.40	7.65	67.60	55.00	23.37	
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	7.00	8.50	17.60	42.70	44.00	51.42	
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	7.00	8.65	8.60	36.20	50.00	33.36	
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	7.00	8.45	12.74	39.40	50.00	37.81	
Erb St./Platinum Dr	**East - Erb St. W**	7.00	8.00	30.00	20.00	55.00	25.00	
Erb St./Platinum Dr	**North - Platinum Dr**	7.00	8.00	30.00	20.00	55.00	25.00	
Erb St./Platinum Dr	**West - Erb St.**	7.00	8.00	30.00	20.00	55.00	25.00	
Erb St./Platinum Dr	**South - Landfill Gate 2**	3.50	4.50	30.00	20.00	40.00	25.00	
Ira Needles Blvd/Erb St.	**East - Erb St. W**	7.00	8.60	20.00	33.00	56.00	13.00	
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	7.00	9.30	12.00	30.00	56.00	20.00	
Ira Needles Blvd/Erb St.	**West - Erb St.**	6.80	7.80	7.00	23.00	56.00	6.00	
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	7.20	8.60	10.00	29.00	56.00	17.00	
Erbsville/Keats Way	**East - Keats Way**	3.50	4.50	30.00	20.00	40.00	25.00	
Erbsville/Keats Way	**North - Erbsville Road**	7.00	8.00	30.00	20.00	55.00	25.00	
Erbsville/Keats Way	**West - Keats Way**	3.50	4.50	30.00	20.00	40.00	25.00	
Erbsville/Keats Way	**South - Erbsville Road**	7.00	8.00	30.00	20.00	55.00	25.00	

Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	3.50	4.50	30.00	20.00	40.00	25.00	
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	3.50	4.50	30.00	20.00	40.00	25.00	
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	3.50	4.50	30.00	20.00	40.00	25.00	
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	3.50	4.50	30.00	20.00	40.00	25.00	
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	3.50	4.50	30.00	20.00	40.00	25.00	
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	7.00	8.00	30.00	20.00	55.00	25.00	
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	3.50	4.50	30.00	20.00	40.00	25.00	
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	7.00	8.00	30.00	20.00	55.00	25.00	
Bearinger Road/Westmount Road	**East - Bearinger Road**	7.00	8.00	30.00	20.00	55.00	25.00	
Bearinger Road/Westmount Road	**North - Westmount Road**	7.00	8.00	30.00	20.00	55.00	25.00	
Bearinger Road/Westmount Road	**West - Bearinger Road**	7.00	8.00	30.00	20.00	55.00	25.00	
Bearinger Road/Westmount Road	**South - Westmount Road**	7.00	8.00	30.00	20.00	55.00	25.00	
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	3.50	4.50	30.00	20.00	40.00	25.00	
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	3.50	4.50	30.00	20.00	40.00	25.00	
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	3.50	4.50	30.00	20.00	40.00	25.00	
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	3.50	4.50	30.00	20.00	40.00	25.00	

Pedestrian Crossings

Roundabout	Arm	Crossing Type
Ira Needles Blvd/University Avenue	**East - University Ave**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/University Avenue	**West - Private Access**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	Unsignalled Pedestrian Crossing
Erb St./Platinum Dr	**East - Erb St. W**	Unsignalled Pedestrian Crossing
Erb St./Platinum Dr	**North - Platinum Dr**	Unsignalled Pedestrian Crossing
Erb St./Platinum Dr	**West - Erb St.**	Unsignalled Pedestrian Crossing
Erb St./Platinum Dr	**South - Landfill Gate 2**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Erb St.	**East - Erb St. W**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Erb St.	**West - Erb St.**	Unsignalled Pedestrian Crossing

Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	Unsignalled Pedestrian Crossing
Erbsville/Keats Way	**East - Keats Way**	Unsignalled Pedestrian Crossing
Erbsville/Keats Way	**North - Erbsville Road**	Unsignalled Pedestrian Crossing
Erbsville/Keats Way	**West - Keats Way**	Unsignalled Pedestrian Crossing
Erbsville/Keats Way	**South - Erbsville Road**	Unsignalled Pedestrian Crossing
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	Unsignalled Pedestrian Crossing
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	Unsignalled Pedestrian Crossing
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	Unsignalled Pedestrian Crossing
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	Unsignalled Pedestrian Crossing
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	Unsignalled Pedestrian Crossing
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	Unsignalled Pedestrian Crossing
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	Unsignalled Pedestrian Crossing
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	Unsignalled Pedestrian Crossing
Bearinger Road/Westmount Road	**East - Bearinger Road**	Unsignalled Pedestrian Crossing
Bearinger Road/Westmount Road	**North - Westmount Road**	Unsignalled Pedestrian Crossing
Bearinger Road/Westmount Road	**West - Bearinger Road**	Unsignalled Pedestrian Crossing
Bearinger Road/Westmount Road	**South - Westmount Road**	Unsignalled Pedestrian Crossing
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	Unsignalled Pedestrian Crossing
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	Unsignalled Pedestrian Crossing
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	Unsignalled Pedestrian Crossing
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	Unsignalled Pedestrian Crossing

Unsignalled Pedestrian Crossing Crossings

Roundabout	Arm	Space between crossing and intersection entry (PCE)	Vehicles queueing on exit (PCE)	Central Refuge	Crossing Data Type	Crossing length (m)	Crossing time (s)	Crossing length (entry side) (m)	Crossing time (entry side) (s)	Crossing length (exit side) (m)	Crossing time (exit side) (s)
Ira Needles Blvd/University Avenue	**East - University Ave**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/University Avenue	**West - Private Access**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00

Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erb St./Platinum Dr	**East - Erb St. W**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erb St./Platinum Dr	**North - Platinum Dr**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erb St./Platinum Dr	**West - Erb St.**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erb St./Platinum Dr	**South - Landfill Gate 2**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Erb St.	**East - Erb St. W**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Erb St.	**West - Erb St.**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erbsville/Keats Way	**East - Keats Way**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erbsville/Keats Way	**North - Erbsville Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erbsville/Keats Way	**West - Keats Way**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erbsville/Keats Way	**South - Erbsville Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Bearinger Road/Westmount Road	**East - Bearinger Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Bearinger Road/Westmount Road	**North - Westmount Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Bearinger Road/Westmount Road	**West - Bearinger Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Bearinger Road/Westmount Road	**South - Westmount Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00

Arm Slope/ Intercept and Capacity

Slope and Intercept used in model

Roundabout	Arm	Enter Directly	Slope	Intercept (PCE/hr)	Final Slope	Final Intercept (PCE/hr)
Ira Needles Blvd/University Avenue	East - University Ave		((calculated))	((calculated))	0.740	2461.322
Ira Needles Blvd/University Avenue	North - Ira Needles Blvd		((calculated))	((calculated))	0.678	2138.626
Ira Needles Blvd/University Avenue	West - Private Access		((calculated))	((calculated))	0.647	1916.031
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd		((calculated))	((calculated))	0.680	2144.039
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr		((calculated))	((calculated))	0.571	1541.270
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd		((calculated))	((calculated))	0.746	2358.337
Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access		((calculated))	((calculated))	0.755	2455.620
Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd		((calculated))	((calculated))	0.747	2435.697
Erb St./Platinum Dr	East - Erb St. W		((calculated))	((calculated))	0.723	2436.345
Erb St./Platinum Dr	North - Platinum Dr		((calculated))	((calculated))	0.723	2436.345
Erb St./Platinum Dr	West - Erb St.		((calculated))	((calculated))	0.723	2436.345
Erb St./Platinum Dr	South - Landfill Gate 2		((calculated))	((calculated))	0.579	1357.445
Ira Needles Blvd/Erb St.	East - Erb St. W		((calculated))	((calculated))	0.781	2703.168
Ira Needles Blvd/Erb St.	North - Erbsville Rd		((calculated))	((calculated))	0.770	2683.164
Ira Needles Blvd/Erb St.	West - Erb St.		((calculated))	((calculated))	0.743	2471.717
Ira Needles Blvd/Erb St.	South - Ira Needles Blvd		((calculated))	((calculated))	0.762	2623.737
Erbsville/Keats Way	East - Keats Way		((calculated))	((calculated))	0.579	1357.445
Erbsville/Keats Way	North - Erbsville Road		((calculated))	((calculated))	0.723	2436.345
Erbsville/Keats Way	West - Keats Way		((calculated))	((calculated))	0.579	1357.445
Erbsville/Keats Way	South - Erbsville Road		((calculated))	((calculated))	0.723	2436.345
Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.		((calculated))	((calculated))	0.579	1357.445
Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd		((calculated))	((calculated))	0.579	1357.445
Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.		((calculated))	((calculated))	0.579	1357.445
Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd		((calculated))	((calculated))	0.579	1357.445
Fischer Hallman Road/Laurelwood Drive	East - Laurelwood Drive		((calculated))	((calculated))	0.579	1357.445
Fischer Hallman Road/Laurelwood Drive	North - Bearinger Road		((calculated))	((calculated))	0.723	2436.345
Fischer Hallman Road/Laurelwood Drive	West - Laurelwood Drive		((calculated))	((calculated))	0.579	1357.445
Fischer Hallman Road/Laurelwood Drive	South - Fischer Hallman Road		((calculated))	((calculated))	0.723	2436.345
Bearinger Road/Westmount Road	East - Bearinger Road		((calculated))	((calculated))	0.723	2436.345
Bearinger Road/Westmount Road	North - Westmount Road		((calculated))	((calculated))	0.723	2436.345

Bearinger Road/Westmount Road	**West - Bearinger Road**		((calculated))	((calculated))	0.723	2436.345
Bearinger Road/Westmount Road	**South - Westmount Road**		((calculated))	((calculated))	0.723	2436.345
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**		((calculated))	((calculated))	0.579	1357.445
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**		((calculated))	((calculated))	0.579	1357.445
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**		((calculated))	((calculated))	0.579	1357.445
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**		((calculated))	((calculated))	0.579	1357.445

The slope and intercept shown above include any corrections and adjustments.

Arm Capacity Adjustments

Roundabout	Arm	Type	Reason	Direct Capacity Adjustment (PCE/hr)	Percentage Capacity Adjustment (%)
Ira Needles Blvd/University Avenue	**East - University Ave**	Percentage		N/A	90.00
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	Percentage		N/A	90.00
Ira Needles Blvd/University Avenue	**West - Private Access**	Percentage		N/A	90.00
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	Percentage		N/A	90.00
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	Percentage		N/A	90.00
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	Percentage		N/A	90.00
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	Percentage		N/A	90.00
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	Percentage		N/A	90.00
Erb St./Platinum Dr	**East - Erb St. W**	Percentage		N/A	90.00
Erb St./Platinum Dr	**North - Platinum Dr**	Percentage		N/A	90.00
Erb St./Platinum Dr	**West - Erb St.**	Percentage		N/A	90.00
Erb St./Platinum Dr	**South - Landfill Gate 2**	Percentage		N/A	90.00
Ira Needles Blvd/Erb St.	**East - Erb St. W**	Percentage		N/A	90.00
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	Percentage		N/A	90.00
Ira Needles Blvd/Erb St.	**West - Erb St.**	Percentage		N/A	90.00
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	Percentage		N/A	90.00
Erbsville/Keats Way	**East - Keats Way**	Percentage		N/A	85.00
Erbsville/Keats Way	**North - Erbsville Road**	Percentage		N/A	85.00
Erbsville/Keats Way	**West - Keats Way**	Percentage		N/A	85.00
Erbsville/Keats Way	**South - Erbsville Road**	Percentage		N/A	85.00
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	Percentage		N/A	90.00
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	Percentage		N/A	90.00
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	Percentage		N/A	90.00
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	Percentage		N/A	90.00

Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	Percentage		N/A	85.00
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	Percentage		N/A	85.00
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	Percentage		N/A	85.00
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	Percentage		N/A	85.00
Bearinger Road/Westmount Road	**East - Bearinger Road**	Percentage		N/A	85.00
Bearinger Road/Westmount Road	**North - Westmount Road**	Percentage		N/A	85.00
Bearinger Road/Westmount Road	**West - Bearinger Road**	Percentage		N/A	85.00
Bearinger Road/Westmount Road	**South - Westmount Road**	Percentage		N/A	85.00
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	Percentage		N/A	85.00
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	Percentage		N/A	85.00
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	Percentage		N/A	85.00
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	Percentage		N/A	85.00

Traffic Flows

Demand Set Data Options

Default Vehicle Mix	Vehicle Mix Varies Over Time	Vehicle Mix Varies Over Turn	Vehicle Mix Varies Over Entry	Vehicle Mix Source	PCE Factor for a Truck (PCE)	Default Turning Proportions	Estimate from entry/exit counts	Turning Proportions Vary Over Time	Turning Proportions Vary Over Turn	Turning Proportions Vary Over Entry
		Yes	Yes	Truck Percentages	2.00				Yes	Yes

Entry Flows

General Flows Data

Roundabout	Arm	Profile Type	Use Turning Counts	Average Demand Flow (Veh/hr)	Flow Scaling Factor (%)	PHF
Ira Needles Blvd/University Avenue	**East - University Ave**	ONE HOUR	Yes	537.00	100.000	N/A
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	ONE HOUR	Yes	933.00	100.000	N/A
Ira Needles Blvd/University Avenue	**West - Private Access**	ONE HOUR	Yes	95.00	100.000	N/A
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	ONE HOUR	Yes	1869.00	100.000	N/A
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	ONE HOUR	Yes	230.00	100.000	N/A
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	ONE HOUR	Yes	1082.00	100.000	N/A

Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	ONE HOUR	Yes	62.00	100.000	N/A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	ONE HOUR	Yes	1487.00	100.000	N/A
Erb St./Platinum Dr	**East - Erb St. W**	ONE HOUR	Yes	867.00	100.000	N/A
Erb St./Platinum Dr	**North - Platinum Dr**	ONE HOUR	Yes	178.00	100.000	N/A
Erb St./Platinum Dr	**West - Erb St.**	ONE HOUR	Yes	783.00	100.000	N/A
Erb St./Platinum Dr	**South - Landfill Gate 2**	ONE HOUR	Yes	17.00	100.000	N/A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	ONE HOUR	Yes	626.00	100.000	N/A
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	ONE HOUR	Yes	912.00	100.000	N/A
Ira Needles Blvd/Erb St.	**West - Erb St.**	ONE HOUR	Yes	988.00	100.000	N/A
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	ONE HOUR	Yes	1582.00	100.000	N/A
Erbsville/Keats Way	**East - Keats Way**	ONE HOUR	Yes	191.00	100.000	N/A
Erbsville/Keats Way	**North - Erbsville Road**	ONE HOUR	Yes	663.00	100.000	N/A
Erbsville/Keats Way	**West - Keats Way**	ONE HOUR	Yes	212.00	100.000	N/A
Erbsville/Keats Way	**South - Erbsville Road**	ONE HOUR	Yes	1034.00	100.000	N/A
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	ONE HOUR	Yes	295.00	100.000	N/A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	ONE HOUR	Yes	218.00	100.000	N/A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	ONE HOUR	Yes	648.00	100.000	N/A
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	ONE HOUR	Yes	338.00	100.000	N/A
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	ONE HOUR	Yes	63.00	100.000	N/A
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	ONE HOUR	Yes	468.00	100.000	N/A
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	ONE HOUR	Yes	749.00	100.000	N/A
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	ONE HOUR	Yes	918.00	100.000	N/A
Bearinger Road/Westmount Road	**East - Bearinger Road**	ONE HOUR	Yes	267.00	100.000	N/A
Bearinger Road/Westmount Road	**North - Westmount Road**	ONE HOUR	Yes	825.00	100.000	N/A
Bearinger Road/Westmount Road	**West - Bearinger Road**	ONE HOUR	Yes	1053.00	100.000	N/A
Bearinger Road/Westmount Road	**South - Westmount Road**	ONE HOUR	Yes	423.00	100.000	N/A
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	ONE HOUR	Yes	311.00	100.000	N/A
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	ONE HOUR	Yes	174.00	100.000	N/A
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	ONE HOUR	Yes	329.00	100.000	N/A
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	ONE HOUR	Yes	225.00	100.000	N/A

Pedestrian Flows

General Flows Data

Roundabout	Arm	Profile Type	Average Pedestrian Flow (Ped/hr)
Ira Needles Blvd/University Avenue	East - University Ave	ONE HOUR	0.00
Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	ONE HOUR	0.00
Ira Needles Blvd/University Avenue	West - Private Access	ONE HOUR	0.00
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	ONE HOUR	7.00
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	ONE HOUR	1.00
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	ONE HOUR	0.00
Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	ONE HOUR	0.00
Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	ONE HOUR	0.00
Erb St./Platinum Dr	East - Erb St. W	ONE HOUR	0.00
Erb St./Platinum Dr	North - Platinum Dr	ONE HOUR	0.00
Erb St./Platinum Dr	West - Erb St.	ONE HOUR	1.00
Erb St./Platinum Dr	South - Landfill Gate 2	ONE HOUR	4.00
Ira Needles Blvd/Erb St.	East - Erb St. W	ONE HOUR	0.00
Ira Needles Blvd/Erb St.	North - Erbsville Rd	ONE HOUR	0.00
Ira Needles Blvd/Erb St.	West - Erb St.	ONE HOUR	1.00
Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	ONE HOUR	4.00
Erbsville/Keats Way	East - Keats Way	ONE HOUR	0.00
Erbsville/Keats Way	North - Erbsville Road	ONE HOUR	0.00
Erbsville/Keats Way	West - Keats Way	ONE HOUR	0.00
Erbsville/Keats Way	South - Erbsville Road	ONE HOUR	7.00
Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	ONE HOUR	17.00
Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	ONE HOUR	17.00
Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	ONE HOUR	0.00
Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	ONE HOUR	12.00
Fischer Hallman Road/Laurelwood Drive	East - Laurelwood Drive	ONE HOUR	0.00
Fischer Hallman Road/Laurelwood Drive	North - Bearinger Road	ONE HOUR	0.00
Fischer Hallman Road/Laurelwood Drive	West - Laurelwood Drive	ONE HOUR	0.00
Fischer Hallman Road/Laurelwood Drive	South - Fischer Hallman Road	ONE HOUR	7.00
Bearinger Road/Westmount Road	East - Bearinger Road	ONE HOUR	0.00
Bearinger Road/Westmount Road	North - Westmount Road	ONE HOUR	0.00
Bearinger Road/Westmount Road	West - Bearinger Road	ONE HOUR	0.00
Bearinger Road/Westmount Road	South - Westmount Road	ONE HOUR	7.00

Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	ONE HOUR	0.00
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	ONE HOUR	0.00
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	ONE HOUR	0.00
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	ONE HOUR	7.00

Direct/Resultant Flows

Direct Flows Data

Time Segment	Roundabout	Arm	Direct Demand Entry Flow (Veh/hr)	DirectDemandEntryFlowInPCE (PCE/hr)	Direct Demand Exit Flow (Veh/hr)	Direct Demand Pedestrian Flow (Ped/hr)
1	**Ira Needles Blvd/University Avenue**	**East - University Ave**	404.28	427.38	N/A	0.00
1	**Ira Needles Blvd/University Avenue**	**North - Ira Needles Blvd**	702.41	718.01	N/A	0.00
1	**Ira Needles Blvd/University Avenue**	**West - Private Access**	71.52	90.52	N/A	0.00
1	**Ira Needles Blvd/University Avenue**	**South - Ira Needles Blvd**	1407.08	1466.70	N/A	5.27
1	**Ira Needles Blvd/Thorndale Dr**	**East - Thorndale Dr**	173.16	175.78	N/A	0.00
1	**Ira Needles Blvd/Thorndale Dr**	**North - Ira Needles Blvd**	814.59	838.69	N/A	0.00
1	**Ira Needles Blvd/Thorndale Dr**	**West - Boardwalk Access**	46.68	53.30	N/A	0.00
1	**Ira Needles Blvd/Thorndale Dr**	**South - Ira Needles Blvd**	1119.49	1155.59	N/A	0.00
1	**Erb St./Platinum Dr**	**East - Erb St. W**	652.72	751.44	N/A	0.00
1	**Erb St./Platinum Dr**	**North - Platinum Dr**	134.01	205.83	N/A	0.00
1	**Erb St./Platinum Dr**	**West - Erb St.**	589.48	615.21	N/A	0.00
1	**Erb St./Platinum Dr**	**South - Landfill Gate 2**	12.80	15.36	N/A	0.00
1	**Ira Needles Blvd/Erb St.**	**East - Erb St. W**	471.29	493.06	N/A	0.00
1	**Ira Needles Blvd/Erb St.**	**North - Erbsville Rd**	686.60	706.18	N/A	0.00
1	**Ira Needles Blvd/Erb St.**	**West - Erb St.**	743.82	760.15	N/A	0.00
1	**Ira Needles Blvd/Erb St.**	**South - Ira Needles Blvd**	1191.01	1232.41	N/A	0.00
1	**Erbsville/Keats Way**	**East - Keats Way**	143.79	146.67	N/A	0.00
1	**Erbsville/Keats Way**	**North - Erbsville Road**	499.14	509.12	N/A	0.00
1	**Erbsville/Keats Way**	**West - Keats Way**	159.60	162.80	N/A	0.00
1	**Erbsville/Keats Way**	**South - Erbsville Road**	778.45	794.02	N/A	5.27
1	**Beaver Creek Rd/Laurelwood Dr**	**East - Laurelwood Dr.**	222.09	234.86	N/A	12.80
1	**Beaver Creek Rd/Laurelwood Dr**	**North - Beaver Creek Rd**	164.12	164.51	N/A	12.80

1	Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	487.85	502.90	N/A	0.00
1	Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	254.46	257.46	N/A	9.03
1	Fischer Hallman Road/Laurelwood Drive	East - Laurelwood Drive	47.43	48.38	N/A	0.00
1	Fischer Hallman Road/Laurelwood Drive	North - Bearinger Road	352.33	359.38	N/A	0.00
1	Fischer Hallman Road/Laurelwood Drive	West - Laurelwood Drive	563.89	575.16	N/A	0.00
1	Fischer Hallman Road/Laurelwood Drive	South - Fischer Hallman Road	691.12	704.94	N/A	5.27
1	Bearinger Road/Westmount Road	East - Bearinger Road	201.01	205.03	N/A	0.00
1	Bearinger Road/Westmount Road	North - Westmount Road	621.10	633.53	N/A	0.00
1	Bearinger Road/Westmount Road	West - Bearinger Road	792.75	808.61	N/A	0.00
1	Bearinger Road/Westmount Road	South - Westmount Road	318.46	324.83	N/A	5.27
1	Conservation Drive/Beaver Creek Road	East - Conservation Drive	234.14	237.90	N/A	0.00
1	Conservation Drive/Beaver Creek Road	North - Beaver Creek Road	131.00	133.62	N/A	0.00
1	Conservation Drive/Beaver Creek Road	West - Conservation Drive	247.69	252.45	N/A	0.00
1	Conservation Drive/Beaver Creek Road	South - Beaver Creek Road	169.39	172.25	N/A	5.27
2	Ira Needles Blvd/University Avenue	East - University Ave	482.75	510.33	N/A	0.00
2	Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	838.75	857.37	N/A	0.00
2	Ira Needles Blvd/University Avenue	West - Private Access	85.40	108.08	N/A	0.00
2	Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	1680.19	1751.38	N/A	6.29
2	Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	206.77	209.89	N/A	0.00
2	Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	972.70	1001.47	N/A	0.00
2	Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	55.74	63.65	N/A	0.00
2	Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	1336.78	1379.89	N/A	0.00
2	Erb St./Platinum Dr	East - Erb St. W	779.42	897.30	N/A	0.00
2	Erb St./Platinum Dr	North - Platinum Dr	160.02	245.78	N/A	0.00
2	Erb St./Platinum Dr	West - Erb St.	703.90	734.62	N/A	0.00
2	Erb St./Platinum Dr	South - Landfill Gate 2	15.28	18.34	N/A	0.00
2	Ira Needles Blvd/Erb St.	East - Erb St. W	562.76	588.76	N/A	0.00
2	Ira Needles Blvd/Erb St.	North - Erbsville Rd	819.87	843.24	N/A	0.00
2	Ira Needles Blvd/Erb St.	West - Erb St.	888.19	907.69	N/A	0.00
2	Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	1422.19	1471.62	N/A	0.00
2	Erbsville/Keats Way	East - Keats Way	171.71	175.14	N/A	0.00
2	Erbsville/Keats Way	North - Erbsville Road	596.02	607.94	N/A	0.00
2	Erbsville/Keats Way	West - Keats Way	190.58	194.40	N/A	0.00
2	Erbsville/Keats Way	South - Erbsville Road	929.54	948.14	N/A	6.29

2	**Beaver Creek Rd/Laurelwood Dr**	**East - Laurelwood Dr.**	265.20	280.45	N/A	15.28
2	**Beaver Creek Rd/Laurelwood Dr**	**North - Beaver Creek Rd**	195.98	196.45	N/A	15.28
2	**Beaver Creek Rd/Laurelwood Dr**	**West - Laurelwood Dr.**	582.54	600.51	N/A	0.00
2	**Beaver Creek Rd/Laurelwood Dr**	**South - Beaver Creek Rd**	303.86	307.43	N/A	10.79
2	**Fischer Hallman Road/Laurelwood Drive**	**East - Laurelwood Drive**	56.64	57.77	N/A	0.00
2	**Fischer Hallman Road/Laurelwood Drive**	**North - Bearinger Road**	420.72	429.14	N/A	0.00
2	**Fischer Hallman Road/Laurelwood Drive**	**West - Laurelwood Drive**	673.34	686.80	N/A	0.00
2	**Fischer Hallman Road/Laurelwood Drive**	**South - Fischer Hallman Road**	825.26	841.77	N/A	6.29
2	**Bearinger Road/Westmount Road**	**East - Bearinger Road**	240.03	244.83	N/A	0.00
2	**Bearinger Road/Westmount Road**	**North - Westmount Road**	741.66	756.49	N/A	0.00
2	**Bearinger Road/Westmount Road**	**West - Bearinger Road**	946.63	965.56	N/A	0.00
2	**Bearinger Road/Westmount Road**	**South - Westmount Road**	380.27	387.87	N/A	6.29
2	**Conservation Drive/Beaver Creek Road**	**East - Conservation Drive**	279.58	284.08	N/A	0.00
2	**Conservation Drive/Beaver Creek Road**	**North - Beaver Creek Road**	156.42	159.55	N/A	0.00
2	**Conservation Drive/Beaver Creek Road**	**West - Conservation Drive**	295.76	301.45	N/A	0.00
2	**Conservation Drive/Beaver Creek Road**	**South - Beaver Creek Road**	202.27	205.69	N/A	6.29
3	**Ira Needles Blvd/University Avenue**	**East - University Ave**	591.25	625.03	N/A	0.00
3	**Ira Needles Blvd/University Avenue**	**North - Ira Needles Blvd**	1027.25	1050.07	N/A	0.00
3	**Ira Needles Blvd/University Avenue**	**West - Private Access**	104.60	132.38	N/A	0.00
3	**Ira Needles Blvd/University Avenue**	**South - Ira Needles Blvd**	2057.81	2145.00	N/A	7.71
3	**Ira Needles Blvd/Thorndale Dr**	**East - Thorndale Dr**	253.23	257.07	N/A	0.00
3	**Ira Needles Blvd/Thorndale Dr**	**North - Ira Needles Blvd**	1191.30	1226.55	N/A	0.00
3	**Ira Needles Blvd/Thorndale Dr**	**West - Boardwalk Access**	68.26	77.95	N/A	0.00
3	**Ira Needles Blvd/Thorndale Dr**	**South - Ira Needles Blvd**	1637.22	1690.01	N/A	0.00
3	**Erb St./Platinum Dr**	**East - Erb St. W**	954.58	1098.96	N/A	0.00
3	**Erb St./Platinum Dr**	**North - Platinum Dr**	195.98	301.02	N/A	0.00
3	**Erb St./Platinum Dr**	**West - Erb St.**	862.10	899.72	N/A	0.00
3	**Erb St./Platinum Dr**	**South - Landfill Gate 2**	18.72	22.46	N/A	0.00
3	**Ira Needles Blvd/Erb St.**	**East - Erb St. W**	689.24	721.08	N/A	0.00
3	**Ira Needles Blvd/Erb St.**	**North - Erbsville Rd**	1004.13	1032.76	N/A	0.00
3	**Ira Needles Blvd/Erb St.**	**West - Erb St.**	1087.81	1111.69	N/A	0.00
3	**Ira Needles Blvd/Erb St.**	**South - Ira Needles Blvd**	1741.81	1802.36	N/A	0.00
3	**Erbsville/Keats Way**	**East - Keats Way**	210.29	214.50	N/A	0.00
3	**Erbsville/Keats Way**	**North - Erbsville Road**	729.98	744.58	N/A	0.00

3	**Erbsville/Keats Way**	**West - Keats Way**	233.42	238.08	N/A	0.00
3	**Erbsville/Keats Way**	**South - Erbsville Road**	1138.46	1161.22	N/A	7.71
3	**Beaver Creek Rd/Laurelwood Dr**	**East - Laurelwood Dr.**	324.80	343.48	N/A	18.72
3	**Beaver Creek Rd/Laurelwood Dr**	**North - Beaver Creek Rd**	240.02	240.60	N/A	18.72
3	**Beaver Creek Rd/Laurelwood Dr**	**West - Laurelwood Dr.**	713.46	735.47	N/A	0.00
3	**Beaver Creek Rd/Laurelwood Dr**	**South - Beaver Creek Rd**	372.14	376.52	N/A	13.21
3	**Fischer Hallman Road/Laurelwood Drive**	**East - Laurelwood Drive**	69.36	70.75	N/A	0.00
3	**Fischer Hallman Road/Laurelwood Drive**	**North - Bearinger Road**	515.28	525.58	N/A	0.00
3	**Fischer Hallman Road/Laurelwood Drive**	**West - Laurelwood Drive**	824.66	841.16	N/A	0.00
3	**Fischer Hallman Road/Laurelwood Drive**	**South - Fischer Hallman Road**	1010.74	1030.95	N/A	7.71
3	**Bearinger Road/Westmount Road**	**East - Bearinger Road**	293.97	299.85	N/A	0.00
3	**Bearinger Road/Westmount Road**	**North - Westmount Road**	908.34	926.51	N/A	0.00
3	**Bearinger Road/Westmount Road**	**West - Bearinger Road**	1159.37	1182.56	N/A	0.00
3	**Bearinger Road/Westmount Road**	**South - Westmount Road**	465.73	475.05	N/A	7.71
3	**Conservation Drive/Beaver Creek Road**	**East - Conservation Drive**	342.42	347.92	N/A	0.00
3	**Conservation Drive/Beaver Creek Road**	**North - Beaver Creek Road**	191.58	195.41	N/A	0.00
3	**Conservation Drive/Beaver Creek Road**	**West - Conservation Drive**	362.24	369.19	N/A	0.00
3	**Conservation Drive/Beaver Creek Road**	**South - Beaver Creek Road**	247.73	251.91	N/A	7.71
4	**Ira Needles Blvd/University Avenue**	**East - University Ave**	591.25	625.03	N/A	0.00
4	**Ira Needles Blvd/University Avenue**	**North - Ira Needles Blvd**	1027.25	1050.07	N/A	0.00
4	**Ira Needles Blvd/University Avenue**	**West - Private Access**	104.60	132.38	N/A	0.00
4	**Ira Needles Blvd/University Avenue**	**South - Ira Needles Blvd**	2057.81	2145.00	N/A	7.71
4	**Ira Needles Blvd/Thorndale Dr**	**East - Thorndale Dr**	253.23	257.07	N/A	0.00
4	**Ira Needles Blvd/Thorndale Dr**	**North - Ira Needles Blvd**	1191.30	1226.55	N/A	0.00
4	**Ira Needles Blvd/Thorndale Dr**	**West - Boardwalk Access**	68.26	77.95	N/A	0.00
4	**Ira Needles Blvd/Thorndale Dr**	**South - Ira Needles Blvd**	1637.22	1690.01	N/A	0.00
4	**Erb St./Platinum Dr**	**East - Erb St. W**	954.58	1098.96	N/A	0.00
4	**Erb St./Platinum Dr**	**North - Platinum Dr**	195.98	301.02	N/A	0.00
4	**Erb St./Platinum Dr**	**West - Erb St.**	862.10	899.72	N/A	0.00
4	**Erb St./Platinum Dr**	**South - Landfill Gate 2**	18.72	22.46	N/A	0.00
4	**Ira Needles Blvd/Erb St.**	**East - Erb St. W**	689.24	721.08	N/A	0.00
4	**Ira Needles Blvd/Erb St.**	**North - Erbsville Rd**	1004.13	1032.76	N/A	0.00
4	**Ira Needles Blvd/Erb St.**	**West - Erb St.**	1087.81	1111.69	N/A	0.00
4	**Ira Needles Blvd/Erb St.**	**South - Ira Needles Blvd**	1741.81	1802.36	N/A	0.00

4	**Erbsville/Keats Way**	**East - Keats Way**	210.29	214.50	N/A	0.00
4	**Erbsville/Keats Way**	**North - Erbsville Road**	729.98	744.58	N/A	0.00
4	**Erbsville/Keats Way**	**West - Keats Way**	233.42	238.08	N/A	0.00
4	**Erbsville/Keats Way**	**South - Erbsville Road**	1138.46	1161.22	N/A	7.71
4	**Beaver Creek Rd/Laurelwood Dr**	**East - Laurelwood Dr.**	324.80	343.48	N/A	18.72
4	**Beaver Creek Rd/Laurelwood Dr**	**North - Beaver Creek Rd**	240.02	240.60	N/A	18.72
4	**Beaver Creek Rd/Laurelwood Dr**	**West - Laurelwood Dr.**	713.46	735.47	N/A	0.00
4	**Beaver Creek Rd/Laurelwood Dr**	**South - Beaver Creek Rd**	372.14	376.52	N/A	13.21
4	**Fischer Hallman Road/Laurelwood Drive**	**East - Laurelwood Drive**	69.36	70.75	N/A	0.00
4	**Fischer Hallman Road/Laurelwood Drive**	**North - Bearinger Road**	515.28	525.58	N/A	0.00
4	**Fischer Hallman Road/Laurelwood Drive**	**West - Laurelwood Drive**	824.66	841.16	N/A	0.00
4	**Fischer Hallman Road/Laurelwood Drive**	**South - Fischer Hallman Road**	1010.74	1030.95	N/A	7.71
4	**Bearinger Road/Westmount Road**	**East - Bearinger Road**	293.97	299.85	N/A	0.00
4	**Bearinger Road/Westmount Road**	**North - Westmount Road**	908.34	926.51	N/A	0.00
4	**Bearinger Road/Westmount Road**	**West - Bearinger Road**	1159.37	1182.56	N/A	0.00
4	**Bearinger Road/Westmount Road**	**South - Westmount Road**	465.73	475.05	N/A	7.71
4	**Conservation Drive/Beaver Creek Road**	**East - Conservation Drive**	342.42	347.92	N/A	0.00
4	**Conservation Drive/Beaver Creek Road**	**North - Beaver Creek Road**	191.58	195.41	N/A	0.00
4	**Conservation Drive/Beaver Creek Road**	**West - Conservation Drive**	362.24	369.19	N/A	0.00
4	**Conservation Drive/Beaver Creek Road**	**South - Beaver Creek Road**	247.73	251.91	N/A	7.71
5	**Ira Needles Blvd/University Avenue**	**East - University Ave**	482.75	510.33	N/A	0.00
5	**Ira Needles Blvd/University Avenue**	**North - Ira Needles Blvd**	838.75	857.37	N/A	0.00
5	**Ira Needles Blvd/University Avenue**	**West - Private Access**	85.40	108.08	N/A	0.00
5	**Ira Needles Blvd/University Avenue**	**South - Ira Needles Blvd**	1680.19	1751.38	N/A	6.29
5	**Ira Needles Blvd/Thorndale Dr**	**East - Thorndale Dr**	206.77	209.89	N/A	0.00
5	**Ira Needles Blvd/Thorndale Dr**	**North - Ira Needles Blvd**	972.70	1001.47	N/A	0.00
5	**Ira Needles Blvd/Thorndale Dr**	**West - Boardwalk Access**	55.74	63.65	N/A	0.00
5	**Ira Needles Blvd/Thorndale Dr**	**South - Ira Needles Blvd**	1336.78	1379.89	N/A	0.00
5	**Erb St./Platinum Dr**	**East - Erb St. W**	779.42	897.30	N/A	0.00
5	**Erb St./Platinum Dr**	**North - Platinum Dr**	160.02	245.78	N/A	0.00
5	**Erb St./Platinum Dr**	**West - Erb St.**	703.90	734.62	N/A	0.00
5	**Erb St./Platinum Dr**	**South - Landfill Gate 2**	15.28	18.34	N/A	0.00
5	**Ira Needles Blvd/Erb St.**	**East - Erb St. W**	562.76	588.76	N/A	0.00
5	**Ira Needles Blvd/Erb St.**	**North - Erbsville Rd**	819.87	843.24	N/A	0.00

5	**Ira Needles Blvd/Erb St.**	**West - Erb St.**	888.19	907.69	N/A	0.00
5	**Ira Needles Blvd/Erb St.**	**South - Ira Needles Blvd**	1422.19	1471.62	N/A	0.00
5	**Erbsville/Keats Way**	**East - Keats Way**	171.71	175.14	N/A	0.00
5	**Erbsville/Keats Way**	**North - Erbsville Road**	596.02	607.94	N/A	0.00
5	**Erbsville/Keats Way**	**West - Keats Way**	190.58	194.40	N/A	0.00
5	**Erbsville/Keats Way**	**South - Erbsville Road**	929.54	948.14	N/A	6.29
5	**Beaver Creek Rd/Laurelwood Dr**	**East - Laurelwood Dr.**	265.20	280.45	N/A	15.28
5	**Beaver Creek Rd/Laurelwood Dr**	**North - Beaver Creek Rd**	195.98	196.45	N/A	15.28
5	**Beaver Creek Rd/Laurelwood Dr**	**West - Laurelwood Dr.**	582.54	600.51	N/A	0.00
5	**Beaver Creek Rd/Laurelwood Dr**	**South - Beaver Creek Rd**	303.86	307.43	N/A	10.79
5	**Fischer Hallman Road/Laurelwood Drive**	**East - Laurelwood Drive**	56.64	57.77	N/A	0.00
5	**Fischer Hallman Road/Laurelwood Drive**	**North - Bearinger Road**	420.72	429.14	N/A	0.00
5	**Fischer Hallman Road/Laurelwood Drive**	**West - Laurelwood Drive**	673.34	686.80	N/A	0.00
5	**Fischer Hallman Road/Laurelwood Drive**	**South - Fischer Hallman Road**	825.26	841.77	N/A	6.29
5	**Bearinger Road/Westmount Road**	**East - Bearinger Road**	240.03	244.83	N/A	0.00
5	**Bearinger Road/Westmount Road**	**North - Westmount Road**	741.66	756.49	N/A	0.00
5	**Bearinger Road/Westmount Road**	**West - Bearinger Road**	946.63	965.56	N/A	0.00
5	**Bearinger Road/Westmount Road**	**South - Westmount Road**	380.27	387.87	N/A	6.29
5	**Conservation Drive/Beaver Creek Road**	**East - Conservation Drive**	279.58	284.08	N/A	0.00
5	**Conservation Drive/Beaver Creek Road**	**North - Beaver Creek Road**	156.42	159.55	N/A	0.00
5	**Conservation Drive/Beaver Creek Road**	**West - Conservation Drive**	295.76	301.45	N/A	0.00
5	**Conservation Drive/Beaver Creek Road**	**South - Beaver Creek Road**	202.27	205.69	N/A	6.29
6	**Ira Needles Blvd/University Avenue**	**East - University Ave**	404.28	427.38	N/A	0.00
6	**Ira Needles Blvd/University Avenue**	**North - Ira Needles Blvd**	702.41	718.01	N/A	0.00
6	**Ira Needles Blvd/University Avenue**	**West - Private Access**	71.52	90.52	N/A	0.00
6	**Ira Needles Blvd/University Avenue**	**South - Ira Needles Blvd**	1407.08	1466.70	N/A	5.27
6	**Ira Needles Blvd/Thorndale Dr**	**East - Thorndale Dr**	173.16	175.78	N/A	0.00
6	**Ira Needles Blvd/Thorndale Dr**	**North - Ira Needles Blvd**	814.59	838.69	N/A	0.00
6	**Ira Needles Blvd/Thorndale Dr**	**West - Boardwalk Access**	46.68	53.30	N/A	0.00
6	**Ira Needles Blvd/Thorndale Dr**	**South - Ira Needles Blvd**	1119.49	1155.59	N/A	0.00
6	**Erb St./Platinum Dr**	**East - Erb St. W**	652.72	751.44	N/A	0.00
6	**Erb St./Platinum Dr**	**North - Platinum Dr**	134.01	205.83	N/A	0.00
6	**Erb St./Platinum Dr**	**West - Erb St.**	589.48	615.21	N/A	0.00
6	**Erb St./Platinum Dr**	**South - Landfill Gate 2**	12.80	15.36	N/A	0.00

6	Ira Needles Blvd/Erb St.	East - Erb St. W	471.29	493.06	N/A	0.00
6	Ira Needles Blvd/Erb St.	North - Erbsville Rd	686.60	706.18	N/A	0.00
6	Ira Needles Blvd/Erb St.	West - Erb St.	743.82	760.15	N/A	0.00
6	Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	1191.01	1232.41	N/A	0.00
6	Erbsville/Keats Way	East - Keats Way	143.79	146.67	N/A	0.00
6	Erbsville/Keats Way	North - Erbsville Road	499.14	509.12	N/A	0.00
6	Erbsville/Keats Way	West - Keats Way	159.60	162.80	N/A	0.00
6	Erbsville/Keats Way	South - Erbsville Road	778.45	794.02	N/A	5.27
6	Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	222.09	234.86	N/A	12.80
6	Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	164.12	164.51	N/A	12.80
6	Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	487.85	502.90	N/A	0.00
6	Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	254.46	257.46	N/A	9.03
6	Fischer Hallman Road/Laurelwood Drive	East - Laurelwood Drive	47.43	48.38	N/A	0.00
6	Fischer Hallman Road/Laurelwood Drive	North - Bearinger Road	352.33	359.38	N/A	0.00
6	Fischer Hallman Road/Laurelwood Drive	West - Laurelwood Drive	563.89	575.16	N/A	0.00
6	Fischer Hallman Road/Laurelwood Drive	South - Fischer Hallman Road	691.12	704.94	N/A	5.27
6	Bearinger Road/Westmount Road	East - Bearinger Road	201.01	205.03	N/A	0.00
6	Bearinger Road/Westmount Road	North - Westmount Road	621.10	633.53	N/A	0.00
6	Bearinger Road/Westmount Road	West - Bearinger Road	792.75	808.61	N/A	0.00
6	Bearinger Road/Westmount Road	South - Westmount Road	318.46	324.83	N/A	5.27
6	Conservation Drive/Beaver Creek Road	East - Conservation Drive	234.14	237.90	N/A	0.00
6	Conservation Drive/Beaver Creek Road	North - Beaver Creek Road	131.00	133.62	N/A	0.00
6	Conservation Drive/Beaver Creek Road	West - Conservation Drive	247.69	252.45	N/A	0.00
6	Conservation Drive/Beaver Creek Road	South - Beaver Creek Road	169.39	172.25	N/A	5.27

Turning Proportions

Turning Counts or Proportions (Veh/hr) - Ira Needles Blvd/ University Avenue (for whole period)

		To			
		1	2	3	4
From	1	0.000	108.000	59.000	370.000
	2	140.000	0.000	37.000	756.000
	3	38.000	33.000	0.000	24.000

	4	628.000	1193.000	48.000	0.000

Turning Proportions (Veh) - Ira Needles Blvd/ University Avenue (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.20	0.11	0.69
	2	0.15	0.00	0.04	0.81
	3	0.40	0.35	0.00	0.25
	4	0.34	0.64	0.03	0.00

Turning Counts or Proportions (Veh/hr) - Ira Needles Blvd/ Thorndale Dr (for whole period)

		To			
		1	2	3	4
From	1	0.000	128.000	10.000	92.000
	2	45.000	0.000	70.000	967.000
	3	15.000	40.000	0.000	7.000
	4	60.000	1420.000	7.000	0.000

Turning Proportions (Veh) - Ira Needles Blvd/ Thorndale Dr (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.56	0.04	0.40
	2	0.04	0.00	0.06	0.89
	3	0.24	0.65	0.00	0.11
	4	0.04	0.95	0.00	0.00

Turning Counts or Proportions (Veh/hr) - Ira Needles Blvd/ Erb St. (for whole period)

		To			
		1	2	3	4
From	1	0.000	119.000	369.000	138.000
	2	181.000	0.000	113.000	618.000
	3	461.000	193.000	0.000	334.000

	4	178.000	829.000	575.000	0.000

Turning Proportions (Veh) - Ira Needles Blvd/ Erb St. (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.19	0.59	0.22
	2	0.20	0.00	0.12	0.68
	3	0.47	0.20	0.00	0.34
	4	0.11	0.52	0.36	0.00

Turning Counts or Proportions (Veh/hr) - Beaver Creek Rd/ Laurelwood Dr (for whole period)

		To			
		1	2	3	4
From	1	0.000	63.000	201.000	31.000
	2	103.000	0.000	29.000	86.000
	3	445.000	49.000	0.000	154.000
	4	179.000	74.000	85.000	0.000

Turning Proportions (Veh) - Beaver Creek Rd/ Laurelwood Dr (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.21	0.68	0.11
	2	0.47	0.00	0.13	0.39
	3	0.69	0.08	0.00	0.24
	4	0.53	0.22	0.25	0.00

Turning Counts or Proportions (Veh/hr) - Erb St./ Platinum Dr (for whole period)

		To			
		1	2	3	4
From	1	0.000	654.000	180.000	33.000
	2	154.000	0.000	24.000	0.000
	3	618.000	160.000	0.000	5.000

	4	17.000	0.000	0.000	0.000

Turning Proportions (Veh) - Erb St./ Platinum Dr (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.75	0.21	0.04
	2	0.87	0.00	0.13	0.00
	3	0.79	0.20	0.00	0.01
	4	1.00	0.00	0.00	0.00

Turning Counts or Proportions (Veh/hr) - Erbsville/ Keats Way (for whole period)

		To			
		1	2	3	4
From	1	0.000	77.000	38.000	76.000
	2	55.000	0.000	29.000	579.000
	3	48.000	98.000	0.000	66.000
	4	63.000	940.000	31.000	0.000

Turning Proportions (Veh) - Erbsville/ Keats Way (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.40	0.20	0.40
	2	0.08	0.00	0.04	0.87
	3	0.23	0.46	0.00	0.31
	4	0.06	0.91	0.03	0.00

Turning Counts or Proportions (Veh/hr) - Fischer Hallman Road/ Laurelwood Drive (for whole period)

		To			
		1	2	3	4
From	1	0.000	13.000	23.000	27.000
	2	43.000	0.000	127.000	298.000
	3	207.000	302.000	0.000	240.000

	4	111.000	688.000	119.000	0.000

Turning Proportions (Veh) - Fischer Hallman Road/ Laurelwood Drive (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.21	0.37	0.43
	2	0.09	0.00	0.27	0.64
	3	0.28	0.40	0.00	0.32
	4	0.12	0.75	0.13	0.00

Turning Counts or Proportions (Veh/hr) - Bearinger Road/ Westmount Road (for whole period)

		To			
		1	2	3	4
From	1	0.000	71.000	135.000	61.000
	2	174.000	0.000	338.000	313.000
	3	331.000	720.000	0.000	2.000
	4	75.000	347.000	1.000	0.000

Turning Proportions (Veh) - Bearinger Road/ Westmount Road (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.27	0.51	0.23
	2	0.21	0.00	0.41	0.38
	3	0.31	0.68	0.00	0.00
	4	0.18	0.82	0.00	0.00

Turning Counts or Proportions (Veh/hr) - Conservation Drive/ Beaver Creek Road (for whole period)

		To			
		1	2	3	4
From	1	0.000	61.000	136.000	114.000
	2	98.000	0.000	21.000	55.000
	3	288.000	13.000	0.000	28.000

	4	158.000	35.000	32.000	0.000

Turning Proportions (Veh) - Conservation Drive/ Beaver Creek Road (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.20	0.44	0.37
	2	0.56	0.00	0.12	0.32
	3	0.88	0.04	0.00	0.09
	4	0.70	0.16	0.14	0.00

Vehicle Mix

Average PCE Per Vehicle - Ira Needles Blvd/ University Avenue (for whole period)

		To			
		1	2	3	4
From	1	1.000	1.080	1.060	1.050
	2	1.040	1.000	1.000	1.020
	3	1.120	1.350	1.000	1.380
	4	1.050	1.030	1.250	1.000

Truck Percentages - Ira Needles Blvd/ University Avenue (for whole period)

		To			
		1	2	3	4
From	1	0.000	8.000	6.000	5.000
	2	4.000	0.000	0.000	2.000
	3	12.000	35.000	0.000	38.000
	4	5.000	3.000	25.000	0.000

Average PCE Per Vehicle - Ira Needles Blvd/ Thorndale Dr (for whole period)

		To			
From		1	2	3	4

	1	1.000	1.020	1.000	1.010
	2	1.020	1.000	1.030	1.030
	3	1.000	1.220	1.000	1.000
	4	1.060	1.030	1.250	1.000

Truck Percentages - Ira Needles Blvd/ Thorndale Dr (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	0.000	2.000	0.000	1.000
	2	2.000	0.000	3.000	3.000
	3	0.000	22.000	0.000	0.000
	4	6.000	3.000	25.000	0.000

Average PCE Per Vehicle - Ira Needles Blvd/ Erb St. (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	1.000	1.030	1.050	1.050
	2	1.010	1.000	1.050	1.030
	3	1.020	1.030	1.000	1.020
	4	1.040	1.030	1.040	1.000

Truck Percentages - Ira Needles Blvd/ Erb St. (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	0.000	3.000	5.000	5.000
	2	1.000	0.000	5.000	3.000
	3	2.000	3.000	0.000	2.000
	4	4.000	3.000	4.000	0.000

Average PCE Per Vehicle - Beaver Creek Rd/ Laurelwood Dr (for whole period)

	To				
From		**1**	**2**	**3**	**4**

	1	1.000	1.030	1.075	1.000
	2	1.000	1.000	1.018	1.000
	3	1.025	1.030	1.000	1.048
	4	1.017	1.000	1.011	1.000

Truck Percentages - Beaver Creek Rd/ Laurelwood Dr (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	0.000	3.000	7.500	0.000
	2	0.000	0.000	1.800	0.000
	3	2.500	3.000	0.000	4.800
	4	1.700	0.000	1.100	0.000

Average PCE Per Vehicle - Erb St./ Platinum Dr (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	1.000	1.170	1.065	1.250
	2	1.600	1.000	1.125	1.000
	3	1.037	1.071	1.000	1.000
	4	1.200	1.000	1.000	1.000

Truck Percentages - Erb St./ Platinum Dr (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	0.000	17.000	6.500	25.000
	2	60.000	0.000	12.500	0.000
	3	3.680	7.140	0.000	0.000
	4	20.000	0.000	0.000	0.000

Average PCE Per Vehicle - Erbsville/ Keats Way (for whole period)

	To				
From		**1**	**2**	**3**	**4**

	1	1.020	1.020	1.020	1.020
	2	1.020	1.020	1.020	1.020
	3	1.020	1.020	1.020	1.020
	4	1.020	1.020	1.020	1.020

Truck Percentages - Erbsville/ Keats Way (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	2.000	2.000	2.000	2.000
	2	2.000	2.000	2.000	2.000
	3	2.000	2.000	2.000	2.000
	4	2.000	2.000	2.000	2.000

Average PCE Per Vehicle - Fischer Hallman Road/ Laurelwood Drive (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	1.020	1.020	1.020	1.020
	2	1.020	1.020	1.020	1.020
	3	1.020	1.020	1.020	1.020
	4	1.020	1.020	1.020	1.020

Truck Percentages - Fischer Hallman Road/ Laurelwood Drive (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	2.000	2.000	2.000	2.000
	2	2.000	2.000	2.000	2.000
	3	2.000	2.000	2.000	2.000
	4	2.000	2.000	2.000	2.000

Average PCE Per Vehicle - Bearinger Road/ Westmount Road (for whole period)

	To				
From		**1**	**2**	**3**	**4**

	1	1.020	1.020	1.020	1.020
	2	1.020	1.020	1.020	1.020
	3	1.020	1.020	1.020	1.020
	4	1.020	1.020	1.020	1.020

Truck Percentages - Bearinger Road/ Westmount Road (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	2.000	2.000	2.000	2.000
	2	2.000	2.000	2.000	2.000
	3	2.000	2.000	2.000	2.000
	4	2.000	2.000	2.000	2.000

Average PCE Per Vehicle - Conservation Drive/ Beaver Creek Road (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	1.020	1.000	1.020	1.020
	2	1.020	1.000	1.020	1.020
	3	1.020	1.000	1.020	1.020
	4	1.020	1.000	1.020	1.020

Truck Percentages - Conservation Drive/ Beaver Creek Road (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	2.000	0.000	2.000	2.000
	2	2.000	0.000	2.000	2.000
	3	2.000	0.000	2.000	2.000
	4	2.000	0.000	2.000	2.000

Results

Results Summary

Roundabout	Arm	Max RFC	Max Delay (s)	Max Queue (Veh)	Max LOS	Total Demand (Veh/hr)	Total Arrivals (Veh)	Total Queueing Delay (Veh-min)	Average Queueing Delay (s)	Rate Of Queueing Delay (Veh-min/min)	Inclusive Queueing Total Delay (Veh-min)	Inclusive Queueing Average Delay (s)	Slope	Intercept (PCE/hr)
Ira Needles Blvd/University Avenue	East - University Ave	0.44	4.75	0.78	A	492.76	739.14	51.39	4.17	0.57	51.40	4.17	0.740	2461.322
Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	0.66	6.82	1.92	A	856.14	1284.20	110.90	5.18	1.23	110.91	5.18	0.678	2138.626
Ira Needles Blvd/University Avenue	West - Private Access	0.32	16.25	0.47	C	87.17	130.76	22.46	10.31	0.25	22.46	10.31	0.647	1916.031
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	1.25	514.63	238.04	F	1715.03	2572.54	10792.07	251.71	119.91	11376.31	265.33	0.680	2144.039
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	0.49	13.54	0.94	B	211.05	316.58	48.68	9.23	0.54	48.69	9.23	0.571	1541.270
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	0.60	4.56	1.50	A	992.87	1489.30	93.09	3.75	1.03	93.10	3.75	0.746	2358.337
Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	0.06	3.20	0.06	A	56.89	85.34	4.13	2.90	0.05	4.13	2.90	0.755	2455.620
Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	0.80	8.80	3.92	A	1364.49	2046.74	202.61	5.94	2.25	202.63	5.94	0.747	2435.697
Erb St./Platinum Dr	East - Erb St. W	0.53	4.27	1.13	A	795.57	1193.36	72.37	3.64	0.80	72.38	3.64	0.723	2436.345
Erb St./Platinum Dr	North - Platinum Dr	0.15	3.20	0.17	A	163.34	245.00	12.55	3.07	0.14	12.55	3.07	0.723	2436.345
Erb St./Platinum Dr	West - Erb St.	0.45	3.46	0.82	A	718.49	1077.74	54.37	3.03	0.60	54.37	3.03	0.723	2436.345
Erb St./Platinum Dr	South - Landfill Gate 2	0.04	7.29	0.04	A	15.60	23.40	2.48	6.35	0.03	2.48	6.35	0.579	1357.445
Ira Needles Blvd/Erb St.	East - Erb St. W	0.59	7.63	1.44	A	574.43	861.64	79.54	5.54	0.88	79.54	5.54	0.781	2703.168
Ira Needles Blvd/Erb St.	North - Erbsville Rd	0.66	6.81	1.87	A	836.87	1255.30	103.34	4.94	1.15	103.35	4.94	0.770	2683.164
Ira Needles Blvd/Erb St.	West - Erb St.	0.73	9.10	2.70	A	906.61	1359.91	137.60	6.07	1.53	137.61	6.07	0.743	2471.717
Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	1.05	104.38	55.61	F	1451.67	2177.51	1391.40	38.34	15.46	1391.45	38.34	0.762	2623.737
Erbsville/Keats Way	East - Keats Way	0.38	10.53	0.61	B	175.26	262.90	35.65	8.14	0.40	35.65	8.14	0.579	1357.445
Erbsville/Keats Way	North - Erbsville Road	0.38	2.99	0.61	A	608.38	912.57	41.41	2.72	0.46	41.41	2.72	0.723	2436.345
Erbsville/Keats Way	West - Keats Way	0.32	7.39	0.48	A	194.53	291.80	30.27	6.22	0.34	30.27	6.22	0.579	1357.445
Erbsville/Keats Way	South - Erbsville Road	0.60	4.78	1.50	A	948.82	1423.22	92.56	3.90	1.03	92.56	3.90	0.723	2436.345
Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	0.32	5.12	0.46	A	270.70	406.05	31.56	4.66	0.35	31.56	4.66	0.579	1357.445
Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	0.23	4.60	0.31	A	200.04	300.06	21.24	4.25	0.24	21.24	4.25	0.579	1357.445
Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	0.68	10.82	2.11	B	594.62	891.93	120.30	8.09	1.34	120.32	8.09	0.579	1357.445
Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	0.53	11.08	1.13	B	310.15	465.23	62.36	8.04	0.69	62.36	8.04	0.579	1357.445

Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	0.13	7.79	0.15	A	57.81	86.71	9.42	6.52	0.10	9.42	6.52	0.579	1357.445
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	0.27	2.57	0.37	A	429.44	644.17	25.86	2.41	0.29	25.86	2.41	0.723	2436.345
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	0.90	36.00	7.72	E	687.30	1030.94	309.04	17.99	3.43	309.10	17.99	0.579	1357.445
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	0.61	5.57	1.55	A	842.37	1263.56	92.09	4.37	1.02	92.10	4.37	0.723	2436.345
Bearinger Road/Westmount Road	**East - Bearinger Road**	0.22	3.55	0.29	A	245.00	367.51	19.10	3.12	0.21	19.10	3.12	0.723	2436.345
Bearinger Road/Westmount Road	**North - Westmount Road**	0.48	3.64	0.92	A	757.03	1135.55	60.08	3.17	0.67	60.09	3.17	0.723	2436.345
Bearinger Road/Westmount Road	**West - Bearinger Road**	0.70	7.35	2.34	A	966.25	1449.38	128.67	5.33	1.43	128.68	5.33	0.723	2436.345
Bearinger Road/Westmount Road	**South - Westmount Road**	0.39	4.90	0.63	A	388.15	582.23	38.69	3.99	0.43	38.69	3.99	0.723	2436.345
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	0.31	4.80	0.45	A	285.38	428.07	31.73	4.45	0.35	31.73	4.45	0.579	1357.445
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	0.20	4.57	0.24	A	159.67	239.50	17.10	4.28	0.19	17.10	4.28	0.579	1357.445
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	0.37	5.82	0.58	A	301.90	452.84	39.12	5.18	0.43	39.12	5.18	0.579	1357.445
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	0.27	5.39	0.37	A	206.46	309.70	25.20	4.88	0.28	25.20	4.88	0.579	1357.445

Main Results

Main results: (8:00 AM-8:15 AM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)
Ira Needles Blvd/University Avenue	**East - University Ave**	404.28	101.07	402.78	599.10	944.99	0.00	1472.75	1364.89	0.275	0.00	0.38
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	702.41	175.60	699.48	990.40	357.37	0.00	1654.51	1167.23	0.425	0.00	0.73
Ira Needles Blvd/University Avenue	**West - Private Access**	71.52	17.88	71.07	107.59	949.26	0.00	704.01	49.28	0.102	0.00	0.11
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	1407.08	351.77	1386.02	862.26	158.08	5.27	1649.26	1649.26	0.853	0.00	5.27
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	173.16	43.29	172.04	90.01	1099.86	0.00	789.18	283.11	0.219	0.00	0.28
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	814.59	203.65	811.87	1190.36	81.54	0.00	2007.05	1972.88	0.406	0.00	0.68

Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	46.68	11.67	46.54	65.25	828.16	0.00	1429.14	737.65	0.033	0.00	0.03
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	1119.49	279.87	1114.82	799.65	75.05	0.00	2070.02	1574.81	0.541	0.00	1.17
Erb St./Platinum Dr	**East - Erb St. W**	652.72	163.18	650.52	592.20	120.11	0.00	1831.91	1781.99	0.356	0.00	0.55
Erb St./Platinum Dr	**North - Platinum Dr**	134.01	33.50	133.57	610.81	159.82	0.00	1353.54	1224.76	0.099	0.00	0.11
Erb St./Platinum Dr	**West - Erb St.**	589.48	147.37	587.78	153.07	140.32	0.00	1966.45	991.17	0.300	0.00	0.43
Erb St./Platinum Dr	**South - Landfill Gate 2**	12.80	3.20	12.72	28.51	699.59	0.00	673.19	0.00	0.019	0.00	0.02
Ira Needles Blvd/Erb St.	**East - Erb St. W**	471.28	117.82	469.45	614.61	1195.48	0.00	1495.16	1198.99	0.315	0.00	0.46
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	686.60	171.65	684.10	854.38	810.55	0.00	1777.34	1265.51	0.386	0.00	0.63
Ira Needles Blvd/Erb St.	**West - Erb St.**	743.82	185.96	740.74	791.82	702.83	0.00	1703.82	1251.84	0.437	0.00	0.77
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	1191.01	297.75	1183.99	817.47	626.10	0.00	1858.80	1552.24	0.641	0.00	1.75
Erbsville/Keats Way	**East - Keats Way**	143.79	35.95	142.83	124.49	801.87	0.00	736.73	234.65	0.195	0.00	0.24
Erbsville/Keats Way	**North - Erbsville Road**	499.14	124.79	497.78	836.19	108.51	0.00	1963.61	1909.71	0.254	0.00	0.34
Erbsville/Keats Way	**West - Keats Way**	159.60	39.90	158.70	73.45	532.84	0.00	857.64	136.95	0.186	0.00	0.23
Erbsville/Keats Way	**South - Erbsville Road**	778.45	194.61	775.77	540.95	150.59	5.27	1935.96	1873.30	0.402	0.00	0.67
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	222.09	55.52	221.05	543.98	155.62	12.80	1070.27	990.27	0.208	0.00	0.26
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	164.12	41.03	163.41	139.23	237.44	12.80	1084.44	726.55	0.151	0.00	0.18
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	487.85	121.96	484.68	235.95	164.90	0.00	1095.30	748.28	0.445	0.00	0.79
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	254.46	63.62	252.90	202.88	446.70	9.03	898.96	447.58	0.283	0.00	0.39
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	47.43	11.86	47.15	269.96	830.59	0.00	722.60	289.71	0.066	0.00	0.07
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	352.33	88.08	351.46	751.06	126.68	0.00	1952.44	1747.99	0.180	0.00	0.22
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	563.89	140.97	558.69	201.85	276.29	0.00	988.37	383.11	0.571	0.00	1.30
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	691.12	172.78	688.58	423.02	411.96	5.27	1775.63	1770.11	0.389	0.00	0.63
Bearinger Road/Westmount Road	**East - Bearinger Road**	201.01	50.25	200.41	435.05	800.94	0.00	1538.10	969.13	0.131	0.00	0.15
Bearinger Road/Westmount Road	**North - Westmount Road**	621.10	155.28	619.23	853.48	147.87	0.00	1939.42	1591.59	0.320	0.00	0.47
Bearinger Road/Westmount Road	**West - Bearinger Road**	792.75	198.19	789.54	355.78	411.32	0.00	1773.24	1265.13	0.447	0.00	0.80
Bearinger Road/Westmount Road	**South - Westmount Road**	318.46	79.61	317.35	282.22	918.64	5.27	1464.75	1047.53	0.217	0.00	0.28
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	234.14	58.53	233.07	407.54	59.93	0.00	1106.32	1025.03	0.212	0.00	0.27
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	131.00	32.75	130.41	81.67	211.33	0.00	1027.24	678.06	0.128	0.00	0.15
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	247.69	61.92	246.43	141.63	200.11	0.00	1030.94	581.71	0.240	0.00	0.31
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	169.39	42.35	168.57	147.63	298.91	5.27	985.51	682.98	0.172	0.00	0.21

Main results: (8:15 AM-8:30 AM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)
Ira Needles Blvd/University Avenue	East - University Ave	482.75	120.69	482.11	697.50	1092.33	0.00	1375.45	1364.89	0.351	0.38	0.54
Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	838.75	209.69	837.37	1148.19	426.25	0.00	1610.64	1167.23	0.521	0.73	1.08
Ira Needles Blvd/University Avenue	West - Private Access	85.40	21.35	85.11	127.28	1136.35	0.00	539.18	49.28	0.158	0.11	0.19
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	1680.19	420.05	1600.58	1032.20	189.26	6.29	1649.26	1649.26	1.019	5.27	25.17
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	206.77	51.69	206.14	107.72	1316.26	0.00	675.60	283.11	0.306	0.28	0.44
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	972.70	243.17	971.64	1424.70	97.70	0.00	1996.26	1972.88	0.487	0.68	0.94
Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	55.74	13.93	55.70	78.10	991.23	0.00	1329.46	737.65	0.042	0.03	0.04
Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	1336.78	334.19	1334.16	957.11	89.82	0.00	2059.47	1574.81	0.649	1.17	1.82
Erb St./Platinum Dr	East - Erb St. W	779.41	194.85	778.63	708.73	143.72	0.00	1817.61	1781.99	0.429	0.55	0.75
Erb St./Platinum Dr	North - Platinum Dr	160.02	40.00	159.91	731.06	191.29	0.00	1338.96	1224.76	0.120	0.11	0.14
Erb St./Platinum Dr	West - Erb St.	703.90	175.97	703.34	183.22	167.99	0.00	1939.92	991.17	0.363	0.43	0.57
Erb St./Platinum Dr	South - Landfill Gate 2	15.28	3.82	15.26	34.13	837.20	0.00	605.32	0.00	0.025	0.02	0.03
Ira Needles Blvd/Erb St.	East - Erb St. W	562.76	140.69	561.70	735.14	1427.99	0.00	1333.69	1198.99	0.422	0.46	0.72
Ira Needles Blvd/Erb St.	North - Erbsville Rd	819.87	204.97	818.53	1020.85	968.83	0.00	1665.92	1265.51	0.492	0.63	0.96
Ira Needles Blvd/Erb St.	West - Erb St.	888.19	222.05	886.41	946.42	840.94	0.00	1610.89	1251.84	0.551	0.77	1.21
Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	1422.19	355.55	1413.92	978.14	749.21	0.00	1775.58	1552.24	0.801	1.75	3.82
Erbsville/Keats Way	East - Keats Way	171.71	42.93	171.27	149.06	959.86	0.00	659.01	234.80	0.261	0.24	0.35
Erbsville/Keats Way	North - Erbsville Road	596.02	149.01	595.63	1001.07	130.06	0.00	1950.36	1909.66	0.306	0.34	0.44
Erbsville/Keats Way	West - Keats Way	190.58	47.65	190.25	87.96	637.73	0.00	800.36	136.95	0.238	0.23	0.31
Erbsville/Keats Way	South - Erbsville Road	929.54	232.39	928.48	647.54	180.43	6.29	1917.31	1872.98	0.485	0.67	0.93
Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	265.20	66.30	264.90	652.04	186.51	15.28	1052.72	989.49	0.252	0.26	0.33
Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	195.98	48.99	195.78	166.87	284.55	15.28	1058.08	726.49	0.185	0.18	0.23
Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	582.54	145.64	581.06	282.76	197.58	0.00	1075.01	748.37	0.542	0.79	1.16
Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	303.85	75.96	303.08	243.16	535.47	10.79	817.07	447.47	0.372	0.39	0.58
Fischer Hallman Road/Laurelwood Drive	East - Laurelwood Drive	56.64	14.16	56.53	323.31	994.44	0.00	641.99	289.83	0.088	0.07	0.10
Fischer Hallman Road/Laurelwood Drive	North - Bearinger Road	420.72	105.18	420.49	899.27	151.70	0.00	1937.07	1747.95	0.217	0.22	0.28
Fischer Hallman Road/Laurelwood Drive	West - Laurelwood Drive	673.34	168.33	669.47	241.58	330.61	0.00	957.82	383.10	0.703	1.30	2.27

Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	825.26	206.32	824.16	506.49	493.59	6.29	1725.28	1769.83	0.478	0.63	0.91
Bearinger Road/Westmount Road	**East - Bearinger Road**	240.03	60.01	239.83	520.69	958.63	0.00	1441.20	969.18	0.167	0.15	0.20
Bearinger Road/Westmount Road	**North - Westmount Road**	741.66	185.41	741.03	1021.51	176.95	0.00	1921.55	1591.57	0.386	0.47	0.63
Bearinger Road/Westmount Road	**West - Bearinger Road**	946.63	236.66	945.00	425.76	492.23	0.00	1721.15	1265.13	0.550	0.80	1.21
Bearinger Road/Westmount Road	**South - Westmount Road**	380.27	95.07	379.82	337.73	1099.50	6.29	1353.59	1047.43	0.281	0.28	0.39
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	279.58	69.90	279.30	488.45	71.83	0.00	1100.51	1025.06	0.254	0.27	0.34
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	156.42	39.11	156.27	97.88	253.25	0.00	1006.62	678.07	0.155	0.15	0.18
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	295.76	73.94	295.38	169.73	239.79	0.00	1009.90	581.70	0.293	0.31	0.41
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	202.27	50.57	202.03	176.91	358.25	6.29	956.03	682.82	0.212	0.21	0.27

Main results: (8:30 AM-8:45 AM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)
Ira Needles Blvd/University Avenue	**East - University Ave**	591.25	147.81	590.31	748.52	1129.68	0.00	1349.78	1364.89	0.438	0.54	0.77
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	1027.25	256.81	1023.94	1206.10	513.89	0.00	1555.51	1167.23	0.660	1.08	1.90
Ira Needles Blvd/University Avenue	**West - Private Access**	104.60	26.15	103.52	147.77	1390.06	0.00	328.99	49.28	0.318	0.19	0.45
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	2057.81	514.45	1647.18	1262.57	231.02	7.71	1649.26	1649.26	1.248	25.17	127.83
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	253.23	63.31	251.32	131.69	1607.42	0.00	522.77	283.11	0.484	0.44	0.91
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	1191.31	297.83	1189.13	1739.62	119.13	0.00	1981.95	1972.88	0.601	0.94	1.49
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	68.26	17.07	68.20	95.53	1212.73	0.00	1194.07	737.65	0.057	0.04	0.06
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	1637.21	409.30	1629.15	1170.96	109.95	0.00	2045.09	1574.81	0.801	1.82	3.84
Erb St./Platinum Dr	**East - Erb St. W**	954.58	238.65	953.08	867.72	175.95	0.00	1798.09	1781.99	0.531	0.75	1.12
Erb St./Platinum Dr	**North - Platinum Dr**	195.98	49.00	195.83	894.89	234.15	0.00	1319.10	1224.76	0.149	0.14	0.17
Erb St./Platinum Dr	**West - Erb St.**	862.10	215.52	861.07	224.28	205.70	0.00	1903.75	991.17	0.453	0.57	0.82
Erb St./Platinum Dr	**South - Landfill Gate 2**	18.72	4.68	18.67	41.78	1025.00	0.00	512.73	0.00	0.037	0.03	0.04
Ira Needles Blvd/Erb St.	**East - Erb St. W**	689.24	172.31	686.59	886.36	1653.80	0.00	1176.89	1198.99	0.586	0.72	1.39
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	1004.13	251.03	1000.64	1193.58	1146.80	0.00	1540.52	1265.51	0.652	0.96	1.83
Ira Needles Blvd/Erb St.	**West - Erb St.**	1087.81	271.95	1082.10	1119.43	1028.01	0.00	1485.00	1251.84	0.733	1.21	2.64
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	1741.81	435.45	1625.28	1195.23	914.87	0.00	1663.59	1552.24	1.047	3.82	32.95
Erbsville/Keats Way	**East - Keats Way**	210.29	52.57	209.28	182.43	1174.60	0.00	553.37	235.00	0.380	0.35	0.60
Erbsville/Keats Way	**North - Erbsville Road**	729.98	182.49	729.31	1224.90	158.98	0.00	1932.60	1909.60	0.378	0.44	0.60
Erbsville/Keats Way	**West - Keats Way**	233.42	58.35	232.76	107.60	780.69	0.00	720.85	136.94	0.324	0.31	0.47
Erbsville/Keats Way	**South - Erbsville Road**	1138.46	284.61	1136.23	792.65	220.80	7.71	1892.10	1872.54	0.602	0.93	1.49

Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	324.80	81.20	324.31	796.69	227.75	18.72	1028.74	988.40	0.316	0.33	0.46
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	240.02	60.01	239.71	203.95	348.11	18.72	1022.60	726.42	0.235	0.23	0.30
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	713.46	178.37	709.83	345.92	241.90	0.00	1045.92	748.48	0.682	1.16	2.07
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	372.14	93.04	370.05	297.34	654.39	13.21	699.65	447.32	0.532	0.58	1.11
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	69.36	17.34	69.16	392.06	1211.45	0.00	535.23	290.00	0.130	0.10	0.15
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	515.28	128.82	514.92	1095.02	185.59	0.00	1916.24	1747.90	0.269	0.28	0.37
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	824.66	206.17	806.30	295.68	404.83	0.00	914.90	383.08	0.901	2.27	6.86
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	1010.74	252.68	1008.27	615.87	595.25	7.71	1662.57	1769.44	0.608	0.91	1.53
Bearinger Road/Westmount Road	**East - Bearinger Road**	293.97	73.49	293.62	636.80	1172.11	0.00	1310.02	969.25	0.224	0.20	0.29
Bearinger Road/Westmount Road	**North - Westmount Road**	908.34	227.09	907.20	1249.09	216.64	0.00	1897.16	1591.54	0.479	0.63	0.91
Bearinger Road/Westmount Road	**West - Bearinger Road**	1159.37	289.84	1154.98	521.23	602.60	0.00	1649.13	1265.13	0.703	1.21	2.31
Bearinger Road/Westmount Road	**South - Westmount Road**	465.73	116.43	464.78	413.46	1344.13	7.71	1203.30	1047.30	0.387	0.39	0.63
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	342.42	85.60	341.96	597.95	87.93	0.00	1092.65	1025.09	0.313	0.34	0.45
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	191.58	47.89	191.34	119.83	310.06	0.00	978.67	678.07	0.196	0.18	0.24
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	362.24	90.56	361.56	207.81	293.60	0.00	980.72	581.69	0.369	0.41	0.58
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	247.73	61.93	247.33	216.60	438.56	7.71	916.18	682.60	0.270	0.27	0.37

Main results: (8:45 AM-9:00 AM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)
Ira Needles Blvd/University Avenue	**East - University Ave**	591.25	147.81	591.23	750.03	1131.24	0.00	1348.69	1364.89	0.438	0.77	0.78
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	1027.25	256.81	1027.16	1207.79	514.67	0.00	1555.01	1167.23	0.661	1.90	1.92
Ira Needles Blvd/University Avenue	**West - Private Access**	104.60	26.15	104.55	148.04	1393.80	0.00	326.02	49.28	0.321	0.45	0.47
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	2057.81	514.45	1649.00	1266.09	232.27	7.71	1649.26	1649.26	1.248	127.83	230.03
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	253.23	63.31	253.14	132.11	1614.87	0.00	518.88	283.11	0.488	0.91	0.94
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	1191.31	297.83	1191.27	1748.05	119.97	0.00	1981.39	1972.88	0.601	1.49	1.50
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	68.26	17.07	68.26	95.78	1215.45	0.00	1192.41	737.65	0.057	0.06	0.06
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	1637.21	409.30	1636.87	1173.61	110.10	0.00	2044.98	1574.81	0.801	3.84	3.92
Erb St./Platinum Dr	**East - Erb St. W**	954.58	238.65	954.56	868.70	176.16	0.00	1797.96	1781.99	0.531	1.12	1.13
Erb St./Platinum Dr	**North - Platinum Dr**	195.98	49.00	195.98	896.21	234.51	0.00	1318.94	1224.76	0.149	0.17	0.17

Erb St./Platinum Dr	**West - Erb St.**	862.10	215.52	862.08	224.60	205.89	0.00	1903.57	991.17	0.453	0.82	0.82
Erb St./Platinum Dr	**South - Landfill Gate 2**	18.72	4.68	18.72	41.84	1026.14	0.00	512.18	0.00	0.037	0.04	0.04
Ira Needles Blvd/Erb St.	**East - Erb St. W**	689.24	172.31	689.02	892.50	1677.85	0.00	1160.18	1198.99	0.594	1.39	1.44
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	1004.13	251.03	1003.97	1208.69	1158.19	0.00	1532.53	1265.51	0.655	1.83	1.87
Ira Needles Blvd/Erb St.	**West - Erb St.**	1087.81	271.95	1087.58	1130.69	1031.47	0.00	1482.68	1251.84	0.734	2.64	2.70
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	1741.81	435.45	1651.19	1199.87	919.17	0.00	1660.68	1552.24	1.049	32.95	55.61
Erbsville/Keats Way	**East - Keats Way**	210.29	52.57	210.27	182.76	1176.95	0.00	552.21	235.00	0.381	0.60	0.61
Erbsville/Keats Way	**North - Erbsville Road**	729.98	182.49	729.97	1227.58	159.63	0.00	1932.19	1909.60	0.378	0.60	0.61
Erbsville/Keats Way	**West - Keats Way**	233.42	58.35	233.40	107.89	781.71	0.00	720.27	136.94	0.324	0.47	0.48
Erbsville/Keats Way	**South - Erbsville Road**	1138.46	284.61	1138.42	793.81	221.30	7.71	1891.80	1872.54	0.602	1.49	1.50
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	324.80	81.20	324.79	800.29	228.96	18.72	1028.09	988.40	0.316	0.46	0.46
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	240.02	60.01	240.02	204.76	348.99	18.72	1022.13	726.42	0.235	0.30	0.31
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	713.46	178.37	713.32	346.80	242.22	0.00	1045.61	748.48	0.682	2.07	2.11
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	372.14	93.04	372.06	298.34	657.19	13.21	696.71	447.32	0.534	1.11	1.13
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	69.36	17.34	69.36	396.51	1219.57	0.00	531.24	290.00	0.131	0.15	0.15
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	515.28	128.82	515.27	1102.87	186.05	0.00	1915.96	1747.90	0.269	0.37	0.37
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	824.66	206.17	821.24	296.16	405.17	0.00	914.36	383.08	0.902	6.86	7.72
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	1010.74	252.68	1010.64	620.97	605.43	7.71	1656.33	1769.44	0.610	1.53	1.55
Bearinger Road/Westmount Road	**East - Bearinger Road**	293.97	73.49	293.97	638.55	1175.79	0.00	1307.76	969.25	0.225	0.29	0.29
Bearinger Road/Westmount Road	**North - Westmount Road**	908.34	227.09	908.33	1252.86	216.90	0.00	1897.00	1591.54	0.479	0.91	0.92
Bearinger Road/Westmount Road	**West - Bearinger Road**	1159.37	289.84	1159.25	521.88	603.35	0.00	1648.63	1265.13	0.703	2.31	2.34
Bearinger Road/Westmount Road	**South - Westmount Road**	465.73	116.43	465.71	413.98	1348.62	7.71	1200.54	1047.30	0.388	0.63	0.63
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	342.42	85.60	342.41	598.94	88.08	0.00	1092.58	1025.09	0.313	0.45	0.45
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	191.58	47.89	191.57	120.01	310.48	0.00	978.46	678.07	0.196	0.24	0.24
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	362.24	90.56	362.22	208.09	293.97	0.00	980.52	581.69	0.369	0.58	0.58
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	247.73	61.93	247.72	216.90	439.29	7.71	915.82	682.60	0.271	0.37	0.37

Main results: (9:00 AM-9:15 AM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)

Ira Needles Blvd/University Avenue	**East - University Ave**	482.75	120.69	483.63	714.74	1124.40	0.00	1354.39	1364.89	0.356	0.78	0.56
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	838.75	209.69	842.04	1179.33	428.69	0.00	1608.96	1167.23	0.521	1.92	1.10
Ira Needles Blvd/University Avenue	**West - Private Access**	85.40	21.35	86.49	128.86	1141.88	0.00	534.24	49.28	0.160	0.47	0.19
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	1680.19	420.05	1648.15	1037.38	190.99	6.29	1649.26	1649.26	1.019	230.03	238.04
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	206.77	51.69	208.71	108.31	1326.68	0.00	670.15	283.11	0.309	0.94	0.45
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	972.70	243.17	974.86	1436.51	98.89	0.00	1995.47	1972.88	0.487	1.50	0.96
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	55.74	13.93	55.80	78.47	995.27	0.00	1327.00	737.65	0.042	0.06	0.04
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	1336.78	334.19	1344.95	961.02	90.05	0.00	2059.31	1574.81	0.649	3.92	1.88
Erb St./Platinum Dr	**East - Erb St. W**	779.41	194.85	780.89	710.27	144.04	0.00	1817.41	1781.99	0.429	1.13	0.76
Erb St./Platinum Dr	**North - Platinum Dr**	160.02	40.00	160.17	733.09	191.85	0.00	1338.70	1224.76	0.120	0.17	0.14
Erb St./Platinum Dr	**West - Erb St.**	703.90	175.97	704.91	183.72	168.30	0.00	1939.63	991.17	0.363	0.82	0.57
Erb St./Platinum Dr	**South - Landfill Gate 2**	15.28	3.82	15.33	34.22	838.99	0.00	604.46	0.00	0.025	0.04	0.03
Ira Needles Blvd/Erb St.	**East - Erb St. W**	562.76	140.69	564.96	763.51	1618.10	0.00	1201.60	1198.99	0.468	1.44	0.89
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	819.87	204.97	823.17	1134.33	1048.73	0.00	1609.91	1265.51	0.509	1.87	1.05
Ira Needles Blvd/Erb St.	**West - Erb St.**	888.19	222.05	894.00	1026.17	845.73	0.00	1607.67	1251.84	0.552	2.70	1.25
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	1422.19	355.55	1626.46	984.58	755.15	0.00	1771.56	1552.24	0.803	55.61	4.54
Erbsville/Keats Way	**East - Keats Way**	171.71	42.93	172.71	149.57	963.38	0.00	657.27	234.80	0.261	0.61	0.36
Erbsville/Keats Way	**North - Erbsville Road**	596.02	149.01	596.68	1005.07	131.02	0.00	1949.78	1909.66	0.306	0.61	0.44
Erbsville/Keats Way	**West - Keats Way**	190.58	47.65	191.23	88.39	639.30	0.00	799.48	136.95	0.238	0.48	0.32
Erbsville/Keats Way	**South - Erbsville Road**	929.54	232.39	931.75	649.34	181.19	6.29	1916.85	1872.98	0.485	1.50	0.95
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	265.20	66.30	265.68	657.30	188.25	15.28	1051.80	989.49	0.252	0.46	0.34
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	195.98	48.99	196.29	168.05	285.88	15.28	1057.37	726.49	0.185	0.31	0.23
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	582.54	145.64	586.16	284.08	198.09	0.00	1074.58	748.37	0.542	2.11	1.20
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	303.85	75.96	305.96	244.66	539.60	10.79	813.04	447.47	0.374	1.13	0.60
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	56.64	14.16	56.84	330.64	1007.57	0.00	635.54	289.83	0.089	0.15	0.10
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	420.72	105.18	421.08	912.00	152.41	0.00	1936.63	1747.95	0.217	0.37	0.28
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	673.34	168.33	694.26	242.31	331.17	0.00	957.08	383.10	0.704	7.72	2.48
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	825.26	206.32	827.72	514.94	510.49	6.29	1714.91	1769.83	0.481	1.55	0.94
Bearinger Road/Westmount Road	**East - Bearinger Road**	240.03	60.01	240.38	523.20	963.90	0.00	1437.97	969.18	0.167	0.29	0.20
Bearinger Road/Westmount Road	**North - Westmount Road**	741.66	185.41	742.79	1026.92	177.36	0.00	1921.30	1591.57	0.386	0.92	0.63
Bearinger Road/Westmount Road	**West - Bearinger Road**	946.63	236.66	951.03	426.76	493.39	0.00	1720.39	1265.13	0.550	2.34	1.24

Bearinger Road/Westmount Road	**South - Westmount Road**	380.27	95.07	381.21	338.53	1105.88	6.29	1349.68	1047.43	0.282	0.63	0.39
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	279.58	69.90	280.03	490.03	72.06	0.00	1100.40	1025.06	0.254	0.45	0.34
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	156.42	39.11	156.65	98.16	253.93	0.00	1006.29	678.07	0.155	0.24	0.19
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	295.76	73.94	296.43	170.19	240.39	0.00	1009.58	581.70	0.293	0.58	0.42
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	202.27	50.57	202.67	177.39	359.43	6.29	955.45	682.82	0.212	0.37	0.27

Main results: (9:15 AM-9:30 AM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)
Ira Needles Blvd/University Avenue	**East - University Ave**	404.28	101.07	404.81	686.19	1115.46	0.00	1361.23	1364.89	0.297	0.56	0.42
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	702.41	175.60	703.82	1154.70	365.58	0.00	1648.58	1167.23	0.426	1.10	0.75
Ira Needles Blvd/University Avenue	**West - Private Access**	71.52	17.88	71.83	114.57	954.83	0.00	699.05	49.28	0.102	0.19	0.11
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	1407.08	351.77	1642.37	867.37	159.30	5.27	1649.26	1649.26	0.853	238.04	179.22
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	173.16	43.29	173.82	90.51	1107.11	0.00	785.39	283.11	0.220	0.45	0.29
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	814.59	203.65	815.67	1198.56	82.37	0.00	2006.50	1972.88	0.406	0.96	0.69
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	46.68	11.67	46.72	65.61	832.43	0.00	1426.53	737.65	0.033	0.04	0.03
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	1119.49	279.87	1122.25	803.78	75.37	0.00	2069.80	1574.81	0.541	1.88	1.19
Erb St./Platinum Dr	**East - Erb St. W**	652.72	163.18	653.52	594.57	120.57	0.00	1831.62	1781.99	0.356	0.76	0.56
Erb St./Platinum Dr	**North - Platinum Dr**	134.01	33.50	134.11	613.54	160.55	0.00	1353.20	1224.76	0.099	0.14	0.11
Erb St./Platinum Dr	**West - Erb St.**	589.48	147.37	590.05	153.76	140.90	0.00	1965.90	991.17	0.300	0.57	0.43
Erb St./Platinum Dr	**South - Landfill Gate 2**	12.80	3.20	12.82	28.64	702.31	0.00	671.84	0.00	0.019	0.03	0.02
Ira Needles Blvd/Erb St.	**East - Erb St. W**	471.28	117.82	472.98	619.76	1212.33	0.00	1483.46	1198.99	0.318	0.89	0.47
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	686.60	171.65	688.25	865.39	819.91	0.00	1770.76	1265.51	0.388	1.05	0.64
Ira Needles Blvd/Erb St.	**West - Erb St.**	743.82	185.96	745.69	800.92	707.23	0.00	1700.85	1251.84	0.437	1.25	0.78
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	1191.01	297.75	1201.89	822.73	630.20	0.00	1856.03	1552.24	0.642	4.54	1.82
Erbsville/Keats Way	**East - Keats Way**	143.79	35.95	144.24	125.15	805.98	0.00	734.71	234.65	0.196	0.36	0.25
Erbsville/Keats Way	**North - Erbsville Road**	499.14	124.79	499.54	840.76	109.46	0.00	1963.02	1909.71	0.254	0.44	0.34
Erbsville/Keats Way	**West - Keats Way**	159.60	39.90	159.94	73.92	535.09	0.00	856.42	136.95	0.186	0.32	0.23
Erbsville/Keats Way	**South - Erbsville Road**	778.45	194.61	779.54	543.44	151.59	5.27	1935.34	1873.30	0.402	0.95	0.68
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	222.09	55.52	222.39	548.92	157.10	12.80	1069.49	990.27	0.208	0.34	0.26
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	164.12	41.03	164.32	140.39	239.10	12.80	1083.55	726.55	0.151	0.23	0.18
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	487.85	121.96	489.41	237.59	165.83	0.00	1094.69	748.28	0.446	1.20	0.81
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	254.46	63.62	255.28	204.50	450.74	9.03	895.37	447.58	0.284	0.60	0.40

Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	47.43	11.86	47.54	273.19	837.76	0.00	719.07	289.71	0.066	0.10	0.07
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	352.33	88.08	352.57	757.83	127.47	0.00	1951.96	1747.99	0.181	0.28	0.22
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	563.89	140.97	568.39	202.77	277.26	0.00	987.73	383.11	0.571	2.48	1.36
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	691.12	172.78	692.29	427.00	418.66	5.27	1771.52	1770.11	0.390	0.94	0.64
Bearinger Road/Westmount Road	**East - Bearinger Road**	201.01	50.25	201.21	437.40	805.58	0.00	1535.25	969.13	0.131	0.20	0.15
Bearinger Road/Westmount Road	**North - Westmount Road**	621.10	155.28	621.74	858.33	148.46	0.00	1939.06	1591.59	0.320	0.63	0.47
Bearinger Road/Westmount Road	**West - Bearinger Road**	792.75	198.19	794.44	357.21	412.98	0.00	1772.18	1265.13	0.447	1.24	0.82
Bearinger Road/Westmount Road	**South - Westmount Road**	318.46	79.61	318.92	283.36	924.06	5.27	1461.42	1047.53	0.218	0.39	0.28
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	234.14	58.53	234.43	410.16	60.32	0.00	1106.13	1025.03	0.212	0.34	0.27
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	131.00	32.75	131.15	82.17	212.57	0.00	1026.63	678.06	0.128	0.19	0.15
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	247.69	61.92	248.08	142.47	201.25	0.00	1030.34	581.71	0.240	0.42	0.32
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	169.39	42.35	169.64	148.50	300.84	5.27	984.56	682.98	0.172	0.27	0.21

Queueing Delay Results

Queueing Delay results: (8:00 AM-8:15 AM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	**East - University Ave**	5.53	0.37	3.360	A	A
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	10.69	0.71	3.759	A	A
Ira Needles Blvd/University Avenue	**West - Private Access**	1.64	0.11	5.684	A	A
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	68.09	4.54	12.805	B	B
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	4.05	0.27	5.822	A	A
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	9.96	0.66	3.006	A	A
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	0.50	0.03	2.603	A	A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	16.95	1.13	3.750	A	A
Erb St./Platinum Dr	**East - Erb St. W**	8.08	0.54	3.042	A	A
Erb St./Platinum Dr	**North - Platinum Dr**	1.61	0.11	2.951	A	A
Erb St./Platinum Dr	**West - Erb St.**	6.28	0.42	2.607	A	A
Erb St./Platinum Dr	**South - Landfill Gate 2**	0.28	0.02	5.450	A	A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	6.71	0.45	3.504	A	A

Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	9.16	0.61	3.286	A	A
Ira Needles Blvd/Erb St.	**West - Erb St.**	11.22	0.75	3.725	A	A
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	25.06	1.67	5.282	A	A
Erbsville/Keats Way	**East - Keats Way**	3.49	0.23	6.051	A	A
Erbsville/Keats Way	**North - Erbsville Road**	5.01	0.33	2.453	A	A
Erbsville/Keats Way	**West - Keats Way**	3.31	0.22	5.144	A	A
Erbsville/Keats Way	**South - Erbsville Road**	9.80	0.65	3.097	A	A
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	3.81	0.25	4.234	A	A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	2.60	0.17	3.906	A	A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	11.44	0.76	5.865	A	A
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	5.69	0.38	5.558	A	A
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	1.02	0.07	5.327	A	A
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	3.25	0.22	2.247	A	A
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	18.37	1.22	8.275	A	A
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	9.27	0.62	3.305	A	A
Bearinger Road/Westmount Road	**East - Bearinger Road**	2.21	0.15	2.689	A	A
Bearinger Road/Westmount Road	**North - Westmount Road**	6.90	0.46	2.723	A	A
Bearinger Road/Westmount Road	**West - Bearinger Road**	11.71	0.78	3.647	A	A
Bearinger Road/Westmount Road	**South - Westmount Road**	4.07	0.27	3.134	A	A
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	3.91	0.26	4.117	A	A
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	2.13	0.14	4.011	A	A
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	4.59	0.31	4.581	A	A
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	3.02	0.20	4.402	A	A

Queueing Delay results: (8:15 AM-8:30 AM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	**East - University Ave**	7.90	0.53	4.027	A	A
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	15.70	1.05	4.647	A	A
Ira Needles Blvd/University Avenue	**West - Private Access**	2.71	0.18	7.923	A	A
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	250.77	16.72	44.293	E	D
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	6.34	0.42	7.659	A	A
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	13.86	0.92	3.510	A	A
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	0.65	0.04	2.825	A	A

Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	26.37	1.76	4.945	A	A
Erb St./Platinum Dr	**East - Erb St. W**	10.98	0.73	3.463	A	A
Erb St./Platinum Dr	**North - Platinum Dr**	2.01	0.13	3.052	A	A
Erb St./Platinum Dr	**West - Erb St.**	8.37	0.56	2.909	A	A
Erb St./Platinum Dr	**South - Landfill Gate 2**	0.38	0.03	6.100	A	A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	10.58	0.71	4.656	A	A
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	14.04	0.94	4.241	A	A
Ira Needles Blvd/Erb St.	**West - Erb St.**	17.66	1.18	4.957	A	A
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	52.52	3.50	9.736	A	A
Erbsville/Keats Way	**East - Keats Way**	5.09	0.34	7.375	A	A
Erbsville/Keats Way	**North - Erbsville Road**	6.49	0.43	2.657	A	A
Erbsville/Keats Way	**West - Keats Way**	4.55	0.30	5.898	A	A
Erbsville/Keats Way	**South - Erbsville Road**	13.71	0.91	3.637	A	A
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	4.93	0.33	4.570	A	A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	3.34	0.22	4.173	A	A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	16.82	1.12	7.266	A	A
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	8.51	0.57	6.994	A	A
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	1.41	0.09	6.149	A	A
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	4.10	0.27	2.373	A	A
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	31.65	2.11	12.317	B	B
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	13.33	0.89	3.990	A	A
Bearinger Road/Westmount Road	**East - Bearinger Road**	2.95	0.20	2.996	A	A
Bearinger Road/Westmount Road	**North - Westmount Road**	9.23	0.62	3.048	A	A
Bearinger Road/Westmount Road	**West - Bearinger Road**	17.62	1.17	4.629	A	A
Bearinger Road/Westmount Road	**South - Westmount Road**	5.73	0.38	3.694	A	A
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	4.99	0.33	4.383	A	A
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	2.70	0.18	4.233	A	A
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	6.04	0.40	5.036	A	A
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	3.93	0.26	4.773	A	A

Queueing Delay results: (8:30 AM-8:45 AM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	**East - University Ave**	11.31	0.75	4.734	A	A

Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	27.23	1.82	6.731	A	A
Ira Needles Blvd/University Avenue	**West - Private Access**	6.42	0.43	15.892	C	B
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	1149.26	76.62	174.232	F	F
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	12.91	0.86	13.170	B	B
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	21.63	1.44	4.528	A	A
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	0.89	0.06	3.196	A	A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	53.12	3.54	8.493	A	A
Erb St./Platinum Dr	**East - Erb St. W**	16.37	1.09	4.252	A	A
Erb St./Platinum Dr	**North - Platinum Dr**	2.57	0.17	3.204	A	A
Erb St./Platinum Dr	**West - Erb St.**	12.08	0.81	3.449	A	A
Erb St./Platinum Dr	**South - Landfill Gate 2**	0.55	0.04	7.286	A	A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	19.87	1.32	7.303	A	A
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	26.22	1.75	6.626	A	A
Ira Needles Blvd/Erb St.	**West - Erb St.**	36.97	2.46	8.811	A	A
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	302.06	20.14	50.778	F	D
Erbsville/Keats Way	**East - Keats Way**	8.65	0.58	10.431	B	B
Erbsville/Keats Way	**North - Erbsville Road**	8.91	0.59	2.990	A	A
Erbsville/Keats Way	**West - Keats Way**	6.89	0.46	7.367	A	A
Erbsville/Keats Way	**South - Erbsville Road**	21.65	1.44	4.748	A	A
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	6.72	0.45	5.107	A	A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	4.49	0.30	4.596	A	A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	29.13	1.94	10.595	B	B
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	15.75	1.05	10.854	B	B
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	2.15	0.14	7.721	A	A
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	5.43	0.36	2.569	A	A
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	83.09	5.54	29.171	D	C
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	22.07	1.47	5.481	A	A
Bearinger Road/Westmount Road	**East - Bearinger Road**	4.25	0.28	3.542	A	A
Bearinger Road/Westmount Road	**North - Westmount Road**	13.38	0.89	3.634	A	A
Bearinger Road/Westmount Road	**West - Bearinger Road**	32.72	2.18	7.220	A	A
Bearinger Road/Westmount Road	**South - Westmount Road**	9.16	0.61	4.869	A	A
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	6.66	0.44	4.792	A	A
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	3.57	0.24	4.571	A	A
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	8.48	0.57	5.808	A	A

Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	5.40	0.36	5.378	A	A

Queueing Delay results: (8:45 AM-9:00 AM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	**East - University Ave**	11.63	0.78	4.752	A	A
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	28.75	1.92	6.817	A	A
Ira Needles Blvd/University Avenue	**West - Private Access**	6.92	0.46	16.248	C	B
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	2683.99	178.93	395.154	F	F
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	13.93	0.93	13.538	B	B
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	22.42	1.49	4.556	A	A
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	0.91	0.06	3.201	A	A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	58.32	3.89	8.800	A	A
Erb St./Platinum Dr	**East - Erb St. W**	16.86	1.12	4.268	A	A
Erb St./Platinum Dr	**North - Platinum Dr**	2.61	0.17	3.205	A	A
Erb St./Platinum Dr	**West - Erb St.**	12.36	0.82	3.455	A	A
Erb St./Platinum Dr	**South - Landfill Gate 2**	0.57	0.04	7.294	A	A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	21.38	1.43	7.634	A	A
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	27.91	1.86	6.806	A	A
Ira Needles Blvd/Erb St.	**West - Erb St.**	40.19	2.68	9.098	A	A
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	666.52	44.43	104.378	F	F
Erbsville/Keats Way	**East - Keats Way**	9.09	0.61	10.526	B	B
Erbsville/Keats Way	**North - Erbsville Road**	9.07	0.60	2.993	A	A
Erbsville/Keats Way	**West - Keats Way**	7.13	0.48	7.393	A	A
Erbsville/Keats Way	**South - Erbsville Road**	22.46	1.50	4.778	A	A
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	6.89	0.46	5.118	A	A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	4.58	0.31	4.602	A	A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	31.41	2.09	10.821	B	B
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	16.83	1.12	11.082	B	B
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	2.23	0.15	7.793	A	A
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	5.50	0.37	2.569	A	A
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	110.32	7.35	36.004	E	D
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	23.14	1.54	5.573	A	A
Bearinger Road/Westmount Road	**East - Bearinger Road**	4.33	0.29	3.550	A	A

Bearinger Road/Westmount Road	**North - Westmount Road**	13.71	0.91	3.640	A	A
Bearinger Road/Westmount Road	**West - Bearinger Road**	34.88	2.33	7.351	A	A
Bearinger Road/Westmount Road	**South - Westmount Road**	9.43	0.63	4.898	A	A
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	6.81	0.45	4.798	A	A
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	3.64	0.24	4.574	A	A
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	8.73	0.58	5.821	A	A
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	5.53	0.37	5.387	A	A

Queueing Delay results: (9:00 AM-9:15 AM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	**East - University Ave**	8.55	0.57	4.139	A	A
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	17.07	1.14	4.715	A	A
Ira Needles Blvd/University Avenue	**West - Private Access**	3.00	0.20	8.059	A	A
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	3510.52	234.03	514.632	F	F
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	7.06	0.47	7.834	A	A
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	14.73	0.98	3.533	A	A
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	0.67	0.04	2.831	A	A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	29.52	1.97	5.097	A	A
Erb St./Platinum Dr	**East - Erb St. W**	11.59	0.77	3.479	A	A
Erb St./Platinum Dr	**North - Platinum Dr**	2.07	0.14	3.056	A	A
Erb St./Platinum Dr	**West - Erb St.**	8.74	0.58	2.919	A	A
Erb St./Platinum Dr	**South - Landfill Gate 2**	0.40	0.03	6.110	A	A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	13.82	0.92	5.675	A	A
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	16.24	1.08	4.594	A	A
Ira Needles Blvd/Erb St.	**West - Erb St.**	19.53	1.30	5.084	A	A
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	316.27	21.08	44.827	E	D
Erbsville/Keats Way	**East - Keats Way**	5.55	0.37	7.446	A	A
Erbsville/Keats Way	**North - Erbsville Road**	6.73	0.45	2.663	A	A
Erbsville/Keats Way	**West - Keats Way**	4.86	0.32	5.926	A	A
Erbsville/Keats Way	**South - Erbsville Road**	14.60	0.97	3.664	A	A
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	5.19	0.35	4.583	A	A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	3.49	0.23	4.183	A	A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	18.91	1.26	7.426	A	A

Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	9.42	0.63	7.130	A	A
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	1.51	0.10	6.224	A	A
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	4.23	0.28	2.377	A	A
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	44.13	2.94	14.681	B	B
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	14.43	0.96	4.070	A	A
Bearinger Road/Westmount Road	**East - Bearinger Road**	3.06	0.20	3.008	A	A
Bearinger Road/Westmount Road	**North - Westmount Road**	9.66	0.64	3.059	A	A
Bearinger Road/Westmount Road	**West - Bearinger Road**	19.23	1.28	4.706	A	A
Bearinger Road/Westmount Road	**South - Westmount Road**	6.04	0.40	3.719	A	A
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	5.24	0.35	4.390	A	A
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	2.82	0.19	4.237	A	A
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	6.41	0.43	5.054	A	A
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	4.14	0.28	4.786	A	A

Queueing Delay results: (9:15 AM-9:30 AM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	**East - University Ave**	6.49	0.43	3.765	A	A
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	11.48	0.77	3.818	A	A
Ira Needles Blvd/University Avenue	**West - Private Access**	1.76	0.12	5.741	A	A
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	3129.43	208.63	457.838	F	F
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	4.39	0.29	5.894	A	A
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	10.50	0.70	3.027	A	A
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	0.51	0.03	2.610	A	A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	18.33	1.22	3.809	A	A
Erb St./Platinum Dr	**East - Erb St. W**	8.49	0.57	3.057	A	A
Erb St./Platinum Dr	**North - Platinum Dr**	1.67	0.11	2.954	A	A
Erb St./Platinum Dr	**West - Erb St.**	6.54	0.44	2.617	A	A
Erb St./Platinum Dr	**South - Landfill Gate 2**	0.30	0.02	5.464	A	A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	7.18	0.48	3.567	A	A
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	9.76	0.65	3.332	A	A
Ira Needles Blvd/Erb St.	**West - Erb St.**	12.03	0.80	3.778	A	A
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	28.97	1.93	5.589	A	A
Erbsville/Keats Way	**East - Keats Way**	3.77	0.25	6.100	A	A

Erbsville/Keats Way	**North - Erbsville Road**	5.20	0.35	2.460	A	A
Erbsville/Keats Way	**West - Keats Way**	3.53	0.24	5.172	A	A
Erbsville/Keats Way	**South - Erbsville Road**	10.34	0.69	3.116	A	A
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	4.02	0.27	4.251	A	A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	2.73	0.18	3.918	A	A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	12.59	0.84	5.962	A	A
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	6.17	0.41	5.632	A	A
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	1.09	0.07	5.361	A	A
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	3.35	0.22	2.252	A	A
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	21.49	1.43	8.675	A	A
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	9.85	0.66	3.338	A	A
Bearinger Road/Westmount Road	**East - Bearinger Road**	2.30	0.15	2.698	A	A
Bearinger Road/Westmount Road	**North - Westmount Road**	7.21	0.48	2.733	A	A
Bearinger Road/Westmount Road	**West - Bearinger Road**	12.52	0.83	3.690	A	A
Bearinger Road/Westmount Road	**South - Westmount Road**	4.26	0.28	3.153	A	A
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	4.12	0.27	4.130	A	A
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	2.24	0.15	4.022	A	A
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	4.87	0.32	4.604	A	A
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	3.19	0.21	4.418	A	A

A1 - Planned 2031 Conditions - D2 - PM Peak Period, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Geometry	Ira Needles Blvd/University Avenue - East - University Ave - Standard Geometry	Effective flare length is over 30m, which is outside the normal range. Treat capacities with increasing caution.
Warning	Geometry	Ira Needles Blvd/University Avenue - North - Ira Needles Blvd - Standard Geometry	Effective flare length is over 30m, which is outside the normal range. Treat capacities with increasing caution.
Warning	Geometry	Ira Needles Blvd/University Avenue -	Effective flare length is over 30m, which is outside the normal range. Treat capacities with increasing caution.

		South - Ira Needles Blvd - Standard Geometry	
Last Run	Last Run	Ira Needles Blvd/University Avenue - North - Ira Needles Blvd - Capacity	Pedestrian Crossing causes blocking on previous arm due to traffic queing to leave the junction in 6 timesegment(s).
Last Run	Last Run	Ira Needles Blvd/University Avenue - South - Ira Needles Blvd - Capacity	Pedestrian Crossing causes blocking on previous arm due to traffic queing to leave the junction in 6 timesegment(s).
Warning	Pedestrian Crossing	Ira Needles Blvd/University Avenue - East - University Ave - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/University Avenue - North - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/University Avenue - West - Private Access - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/University Avenue - South - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - East - Thorndale Dr - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - East - Thorndale Dr - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?

Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - North - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - North - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - West - Boardwalk Access - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - West - Boardwalk Access - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - South - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - South - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Last Run	Last Run	Ira Needles Blvd/Erb St. - South - Ira Needles Blvd - Capacity	Pedestrian Crossing causes blocking on previous arm due to traffic queing to leave the junction in 6 timesegment(s).
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - East - Erb St. W - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - East - Erb St. W - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?

Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - North - Erbsville Rd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - North - Erbsville Rd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - West - Erb St. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - West - Erb St. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - South - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Beaver Creek Rd/Laurelwood Dr - East - Laurelwood Dr. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Beaver Creek Rd/Laurelwood Dr - East - Laurelwood Dr. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Beaver Creek Rd/Laurelwood Dr - North - Beaver Creek Rd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Beaver Creek Rd/Laurelwood Dr - West - Laurelwood Dr. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?

Warning	Pedestrian Crossing	Beaver Creek Rd/Laurelwood Dr - West - Laurelwood Dr. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Beaver Creek Rd/Laurelwood Dr - South - Beaver Creek Rd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - East - Erb St. W - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - East - Erb St. W - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - North - Platinum Dr - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - North - Platinum Dr - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - West - Erb St. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - West - Erb St. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - South - Landfill Gate 2 - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erbsville/Keats Way - East - Keats Way -	Pedestrian crossing uses default settings only. Is this correct?

		Unsignalled Pedestrian Crossing Details	
Warning	Pedestrian Crossing	Erbsville/Keats Way - North - Erbsville Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erbsville/Keats Way - West - Keats Way - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erbsville/Keats Way - South - Erbsville Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Fischer Hallman Road/Laurelwood Drive - East - Laurelwood Drive - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Fischer Hallman Road/Laurelwood Drive - North - Bearinger Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Fischer Hallman Road/Laurelwood Drive - West - Laurelwood Drive - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Fischer Hallman Road/Laurelwood Drive - South - Fischer Hallman Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Bearinger Road/Westmount Road - East - Bearinger Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?

Warning	Pedestrian Crossing	Bearinger Road/Westmount Road - North - Westmount Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Bearinger Road/Westmount Road - West - Bearinger Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Bearinger Road/Westmount Road - South - Westmount Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Conservation Drive/Beaver Creek Road - East - Conservation Drive - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Conservation Drive/Beaver Creek Road - North - Beaver Creek Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Conservation Drive/Beaver Creek Road - West - Conservation Drive - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Conservation Drive/Beaver Creek Road - South - Beaver Creek Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?

Analysis Set Details

Name	Description	Include In Report	Use Specific Demand Set	Demand Set	Locked	Network Flow Scaling Factor (%)	Network Capacity Scaling Factor (%)	Reason For Scaling Factors
Planned 2031 Conditions		Yes		(D1)		100.000	100.000	

Demand Set Details

Name	Scenario Name	Time Period Name	Description	Locked	Run Automatically	Use Relationship	Relationship	Start Time (HH:mm)	Finish Time (HH:mm)	Time Period Length (min)	Time Segment Length (min)	Traffic Profile Type
PM Peak Period, PM	PM Peak Period	PM			Yes			16:00	17:30	90	15	ONE HOUR

Roundabout Network

Roundabout Type(s)

Roundabout	ID	Name	Arm Order	Roundabout Type	Grade Separated	Large Roundabout	Do Geometric Delay
1	1	Ira Needles Blvd/University Avenue	1,2,3,4	Standard			
3	3	Ira Needles Blvd/Thorndale Dr	1,2,3,4	Standard			
5	5	Erb St./Platinum Dr	1,2,3,4	Standard			
6	6	Ira Needles Blvd/Erb St.	1,2,3,4	Standard			
8	8	Erbsville/Keats Way	1,2,3,4	Standard			
12	12	Beaver Creek Rd/Laurelwood Dr	1,2,3,4	Standard			
13	13	Fischer Hallman Road/Laurelwood Drive	1,2,3,4	Standard			
14	14	Bearinger Road/Westmount Road	1,2,3,4	Standard			
18	18	Conservation Drive/Beaver Creek Road	1,2,3,4	Standard			

Roundabout Network Options

Driving Side	Lighting	Road Surface	In London
Right	Normal/unknown	((Mini-roundabouts only))	

Arms

Arms

ID	Name	Description
1	East - University Ave	
2	North - Ira Needles Blvd	
3	West - Private Access	
4	South - Ira Needles Blvd	
1	East - Thorndale Dr	
2	North - Ira Needles Blvd	
3	West - Boardwalk Access	
4	South - Ira Needles Blvd	
1	East - Erb St. W	
2	North - Platinum Dr	
3	West - Erb St.	
4	South - Landfill Gate 2	
1	East - Erb St. W	
2	North - Erbsville Rd	
3	West - Erb St.	
4	South - Ira Needles Blvd	
1	East - Keats Way	
2	North - Erbsville Road	
3	West - Keats Way	
4	South - Erbsville Road	
1	East - Laurelwood Dr.	
2	North - Beaver Creek Rd	
3	West - Laurelwood Dr.	
4	South - Beaver Creek Rd	
1	East - Laurelwood Drive	
2	North - Bearinger Road	
3	West - Laurelwood Drive	
4	South - Fischer Hallman Road	
1	East - Bearinger Road	
2	North - Westmount Road	
3	West - Bearinger Road	
4	South - Westmount Road	
1	East - Conservation Drive	

2	North - Beaver Creek Road	
3	West - Conservation Drive	
4	South - Beaver Creek Road	

Capacity Options

Roundabout	Arm	Minimum Capacity (PCE/hr)	Maximum Capacity (PCE/hr)	Assume Flat Start Profile	Initial Queue (PCE)
Ira Needles Blvd/University Avenue	**East - University Ave**	0.00	99999.00		0.00
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	0.00	99999.00		0.00
Ira Needles Blvd/University Avenue	**West - Private Access**	0.00	99999.00		0.00
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	0.00	99999.00		0.00
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	0.00	99999.00		0.00
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	0.00	99999.00		0.00
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	0.00	99999.00		0.00
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	0.00	99999.00		0.00
Erb St./Platinum Dr	**East - Erb St. W**	0.00	99999.00		0.00
Erb St./Platinum Dr	**North - Platinum Dr**	0.00	99999.00		0.00
Erb St./Platinum Dr	**West - Erb St.**	0.00	99999.00		0.00
Erb St./Platinum Dr	**South - Landfill Gate 2**	0.00	99999.00		0.00
Ira Needles Blvd/Erb St.	**East - Erb St. W**	0.00	99999.00		0.00
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	0.00	99999.00		0.00
Ira Needles Blvd/Erb St.	**West - Erb St.**	0.00	99999.00		0.00
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	0.00	99999.00		0.00
Erbsville/Keats Way	**East - Keats Way**	0.00	99999.00		0.00
Erbsville/Keats Way	**North - Erbsville Road**	0.00	99999.00		0.00
Erbsville/Keats Way	**West - Keats Way**	0.00	99999.00		0.00
Erbsville/Keats Way	**South - Erbsville Road**	0.00	99999.00		0.00
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	0.00	99999.00		0.00
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	0.00	99999.00		0.00
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	0.00	99999.00		0.00
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	0.00	99999.00		0.00
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	0.00	99999.00		0.00
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	0.00	99999.00		0.00
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	0.00	99999.00		0.00

Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	0.00	99999.00		0.00
Bearinger Road/Westmount Road	**East - Bearinger Road**	0.00	99999.00		0.00
Bearinger Road/Westmount Road	**North - Westmount Road**	0.00	99999.00		0.00
Bearinger Road/Westmount Road	**West - Bearinger Road**	0.00	99999.00		0.00
Bearinger Road/Westmount Road	**South - Westmount Road**	0.00	99999.00		0.00
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	0.00	99999.00		0.00
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	0.00	99999.00		0.00
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	0.00	99999.00		0.00
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	0.00	99999.00		0.00

Standard Geometry

Roundabout	Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit Only
Ira Needles Blvd/University Avenue	**East - University Ave**	7.00	7.70	33.22	27.80	55.00	16.36	
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	3.65	7.70	40.78	27.80	55.00	19.60	
Ira Needles Blvd/University Avenue	**West - Private Access**	4.00	7.20	13.78	34.30	55.00	11.79	
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	3.65	7.70	39.60	25.30	55.00	16.84	
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	3.50	6.40	7.65	67.60	55.00	23.37	
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	7.00	8.50	17.60	42.70	44.00	51.42	
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	7.00	8.65	8.60	36.20	50.00	33.36	
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	7.00	8.45	12.74	39.40	50.00	37.81	
Erb St./Platinum Dr	**East - Erb St. W**	7.00	8.00	30.00	20.00	55.00	25.00	
Erb St./Platinum Dr	**North - Platinum Dr**	7.00	8.00	30.00	20.00	55.00	25.00	
Erb St./Platinum Dr	**West - Erb St.**	7.00	8.00	30.00	20.00	55.00	25.00	
Erb St./Platinum Dr	**South - Landfill Gate 2**	3.50	4.50	30.00	20.00	40.00	25.00	
Ira Needles Blvd/Erb St.	**East - Erb St. W**	7.00	8.60	20.00	33.00	56.00	13.00	
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	7.00	9.30	12.00	30.00	56.00	20.00	
Ira Needles Blvd/Erb St.	**West - Erb St.**	6.80	7.80	7.00	23.00	56.00	6.00	
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	7.20	8.60	10.00	29.00	56.00	17.00	
Erbsville/Keats Way	**East - Keats Way**	3.50	4.50	30.00	20.00	40.00	25.00	
Erbsville/Keats Way	**North - Erbsville Road**	7.00	8.00	30.00	20.00	55.00	25.00	
Erbsville/Keats Way	**West - Keats Way**	3.50	4.50	30.00	20.00	40.00	25.00	
Erbsville/Keats Way	**South - Erbsville Road**	7.00	8.00	30.00	20.00	55.00	25.00	

Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	3.50	4.50	30.00	20.00	40.00	25.00	
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	3.50	4.50	30.00	20.00	40.00	25.00	
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	3.50	4.50	30.00	20.00	40.00	25.00	
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	3.50	4.50	30.00	20.00	40.00	25.00	
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	3.50	4.50	30.00	20.00	40.00	25.00	
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	7.00	8.00	30.00	20.00	55.00	25.00	
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	3.50	4.50	30.00	20.00	40.00	25.00	
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	7.00	8.00	30.00	20.00	55.00	25.00	
Bearinger Road/Westmount Road	**East - Bearinger Road**	7.00	8.00	30.00	20.00	55.00	25.00	
Bearinger Road/Westmount Road	**North - Westmount Road**	7.00	8.00	30.00	20.00	55.00	25.00	
Bearinger Road/Westmount Road	**West - Bearinger Road**	7.00	8.00	30.00	20.00	55.00	25.00	
Bearinger Road/Westmount Road	**South - Westmount Road**	7.00	8.00	30.00	20.00	55.00	25.00	
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	3.50	4.50	30.00	20.00	40.00	25.00	
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	3.50	4.50	30.00	20.00	40.00	25.00	
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	3.50	4.50	30.00	20.00	40.00	25.00	
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	3.50	4.50	30.00	20.00	40.00	25.00	

Pedestrian Crossings

Roundabout	Arm	Crossing Type
Ira Needles Blvd/University Avenue	**East - University Ave**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/University Avenue	**West - Private Access**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	Unsignalled Pedestrian Crossing
Erb St./Platinum Dr	**East - Erb St. W**	Unsignalled Pedestrian Crossing
Erb St./Platinum Dr	**North - Platinum Dr**	Unsignalled Pedestrian Crossing
Erb St./Platinum Dr	**West - Erb St.**	Unsignalled Pedestrian Crossing
Erb St./Platinum Dr	**South - Landfill Gate 2**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Erb St.	**East - Erb St. W**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Erb St.	**West - Erb St.**	Unsignalled Pedestrian Crossing

Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	Unsignalled Pedestrian Crossing
Erbsville/Keats Way	**East - Keats Way**	Unsignalled Pedestrian Crossing
Erbsville/Keats Way	**North - Erbsville Road**	Unsignalled Pedestrian Crossing
Erbsville/Keats Way	**West - Keats Way**	Unsignalled Pedestrian Crossing
Erbsville/Keats Way	**South - Erbsville Road**	Unsignalled Pedestrian Crossing
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	Unsignalled Pedestrian Crossing
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	Unsignalled Pedestrian Crossing
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	Unsignalled Pedestrian Crossing
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	Unsignalled Pedestrian Crossing
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	Unsignalled Pedestrian Crossing
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	Unsignalled Pedestrian Crossing
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	Unsignalled Pedestrian Crossing
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	Unsignalled Pedestrian Crossing
Bearinger Road/Westmount Road	**East - Bearinger Road**	Unsignalled Pedestrian Crossing
Bearinger Road/Westmount Road	**North - Westmount Road**	Unsignalled Pedestrian Crossing
Bearinger Road/Westmount Road	**West - Bearinger Road**	Unsignalled Pedestrian Crossing
Bearinger Road/Westmount Road	**South - Westmount Road**	Unsignalled Pedestrian Crossing
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	Unsignalled Pedestrian Crossing
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	Unsignalled Pedestrian Crossing
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	Unsignalled Pedestrian Crossing
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	Unsignalled Pedestrian Crossing

Unsignalled Pedestrian Crossing Crossings

Roundabout	Arm	Space between crossing and intersection entry (PCE)	Vehicles queueing on exit (PCE)	Central Refuge	Crossing Data Type	Crossing length (m)	Crossing time (s)	Crossing length (entry side) (m)	Crossing time (entry side) (s)	Crossing length (exit side) (m)	Crossing time (exit side) (s)
Ira Needles Blvd/University Avenue	**East - University Ave**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/University Avenue	**West - Private Access**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00

Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erb St./Platinum Dr	**East - Erb St. W**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erb St./Platinum Dr	**North - Platinum Dr**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erb St./Platinum Dr	**West - Erb St.**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erb St./Platinum Dr	**South - Landfill Gate 2**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Erb St.	**East - Erb St. W**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Erb St.	**West - Erb St.**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erbsville/Keats Way	**East - Keats Way**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erbsville/Keats Way	**North - Erbsville Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erbsville/Keats Way	**West - Keats Way**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erbsville/Keats Way	**South - Erbsville Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Bearinger Road/Westmount Road	**East - Bearinger Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Bearinger Road/Westmount Road	**North - Westmount Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Bearinger Road/Westmount Road	**West - Bearinger Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Bearinger Road/Westmount Road	**South - Westmount Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00

Arm Slope/ Intercept and Capacity

Slope and Intercept used in model

Roundabout	Arm	Enter Directly	Slope	Intercept (PCE/hr)	Final Slope	Final Intercept (PCE/hr)
Ira Needles Blvd/University Avenue	East - University Ave		((calculated))	((calculated))	0.740	2461.322
Ira Needles Blvd/University Avenue	North - Ira Needles Blvd		((calculated))	((calculated))	0.678	2138.626
Ira Needles Blvd/University Avenue	West - Private Access		((calculated))	((calculated))	0.647	1916.031
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd		((calculated))	((calculated))	0.680	2144.039
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr		((calculated))	((calculated))	0.571	1541.270
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd		((calculated))	((calculated))	0.746	2358.337
Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access		((calculated))	((calculated))	0.755	2455.620
Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd		((calculated))	((calculated))	0.747	2435.697
Erb St./Platinum Dr	East - Erb St. W		((calculated))	((calculated))	0.723	2436.345
Erb St./Platinum Dr	North - Platinum Dr		((calculated))	((calculated))	0.723	2436.345
Erb St./Platinum Dr	West - Erb St.		((calculated))	((calculated))	0.723	2436.345
Erb St./Platinum Dr	South - Landfill Gate 2		((calculated))	((calculated))	0.579	1357.445
Ira Needles Blvd/Erb St.	East - Erb St. W		((calculated))	((calculated))	0.781	2703.168
Ira Needles Blvd/Erb St.	North - Erbsville Rd		((calculated))	((calculated))	0.770	2683.164
Ira Needles Blvd/Erb St.	West - Erb St.		((calculated))	((calculated))	0.743	2471.717
Ira Needles Blvd/Erb St.	South - Ira Needles Blvd		((calculated))	((calculated))	0.762	2623.737
Erbsville/Keats Way	East - Keats Way		((calculated))	((calculated))	0.579	1357.445
Erbsville/Keats Way	North - Erbsville Road		((calculated))	((calculated))	0.723	2436.345
Erbsville/Keats Way	West - Keats Way		((calculated))	((calculated))	0.579	1357.445
Erbsville/Keats Way	South - Erbsville Road		((calculated))	((calculated))	0.723	2436.345
Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.		((calculated))	((calculated))	0.579	1357.445
Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd		((calculated))	((calculated))	0.579	1357.445
Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.		((calculated))	((calculated))	0.579	1357.445
Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd		((calculated))	((calculated))	0.579	1357.445
Fischer Hallman Road/Laurelwood Drive	East - Laurelwood Drive		((calculated))	((calculated))	0.579	1357.445
Fischer Hallman Road/Laurelwood Drive	North - Bearinger Road		((calculated))	((calculated))	0.723	2436.345
Fischer Hallman Road/Laurelwood Drive	West - Laurelwood Drive		((calculated))	((calculated))	0.579	1357.445
Fischer Hallman Road/Laurelwood Drive	South - Fischer Hallman Road		((calculated))	((calculated))	0.723	2436.345
Bearinger Road/Westmount Road	East - Bearinger Road		((calculated))	((calculated))	0.723	2436.345
Bearinger Road/Westmount Road	North - Westmount Road		((calculated))	((calculated))	0.723	2436.345

Bearinger Road/Westmount Road	**West - Bearinger Road**		((calculated))	((calculated))	0.723	2436.345
Bearinger Road/Westmount Road	**South - Westmount Road**		((calculated))	((calculated))	0.723	2436.345
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**		((calculated))	((calculated))	0.579	1357.445
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**		((calculated))	((calculated))	0.579	1357.445
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**		((calculated))	((calculated))	0.579	1357.445
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**		((calculated))	((calculated))	0.579	1357.445

The slope and intercept shown above include any corrections and adjustments.

Arm Capacity Adjustments

Roundabout	Arm	Type	Reason	Direct Capacity Adjustment (PCE/hr)	Percentage Capacity Adjustment (%)
Ira Needles Blvd/University Avenue	**East - University Ave**	Percentage		N/A	90.00
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	Percentage		N/A	90.00
Ira Needles Blvd/University Avenue	**West - Private Access**	Percentage		N/A	90.00
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	Percentage		N/A	90.00
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	Percentage		N/A	90.00
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	Percentage		N/A	90.00
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	Percentage		N/A	90.00
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	Percentage		N/A	90.00
Erb St./Platinum Dr	**East - Erb St. W**	Percentage		N/A	90.00
Erb St./Platinum Dr	**North - Platinum Dr**	Percentage		N/A	90.00
Erb St./Platinum Dr	**West - Erb St.**	Percentage		N/A	90.00
Erb St./Platinum Dr	**South - Landfill Gate 2**	Percentage		N/A	90.00
Ira Needles Blvd/Erb St.	**East - Erb St. W**	Percentage		N/A	90.00
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	Percentage		N/A	90.00
Ira Needles Blvd/Erb St.	**West - Erb St.**	Percentage		N/A	90.00
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	Percentage		N/A	90.00
Erbsville/Keats Way	**East - Keats Way**	Percentage		N/A	85.00
Erbsville/Keats Way	**North - Erbsville Road**	Percentage		N/A	85.00
Erbsville/Keats Way	**West - Keats Way**	Percentage		N/A	85.00
Erbsville/Keats Way	**South - Erbsville Road**	Percentage		N/A	85.00
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	Percentage		N/A	90.00
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	Percentage		N/A	90.00
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	Percentage		N/A	90.00
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	Percentage		N/A	90.00

Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	Percentage		N/A	85.00
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	Percentage		N/A	85.00
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	Percentage		N/A	85.00
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	Percentage		N/A	85.00
Bearinger Road/Westmount Road	**East - Bearinger Road**	Percentage		N/A	85.00
Bearinger Road/Westmount Road	**North - Westmount Road**	Percentage		N/A	85.00
Bearinger Road/Westmount Road	**West - Bearinger Road**	Percentage		N/A	85.00
Bearinger Road/Westmount Road	**South - Westmount Road**	Percentage		N/A	85.00
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	Percentage		N/A	85.00
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	Percentage		N/A	85.00
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	Percentage		N/A	85.00
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	Percentage		N/A	85.00

Traffic Flows

Demand Set Data Options

Default Vehicle Mix	Vehicle Mix Varies Over Time	Vehicle Mix Varies Over Turn	Vehicle Mix Varies Over Entry	Vehicle Mix Source	PCE Factor for a Truck (PCE)	Default Turning Proportions	Estimate from entry/exit counts	Turning Proportions Vary Over Time	Turning Proportions Vary Over Turn	Turning Proportions Vary Over Entry
		Yes	Yes	Truck Percentages	2.00				Yes	Yes

Entry Flows

General Flows Data

Roundabout	Arm	Profile Type	Use Turning Counts	Average Demand Flow (Veh/hr)	Flow Scaling Factor (%)	PHF
Ira Needles Blvd/University Avenue	**East - University Ave**	ONE HOUR	Yes	706.00	100.000	N/A
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	ONE HOUR	Yes	1463.00	100.000	N/A
Ira Needles Blvd/University Avenue	**West - Private Access**	ONE HOUR	Yes	465.00	100.000	N/A
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	ONE HOUR	Yes	1232.00	100.000	N/A
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	ONE HOUR	Yes	251.00	100.000	N/A
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	ONE HOUR	Yes	2062.00	100.000	N/A

Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	ONE HOUR	Yes	218.00	100.000	N/A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	ONE HOUR	Yes	1252.00	100.000	N/A
Erb St./Platinum Dr	**East - Erb St. W**	ONE HOUR	Yes	854.00	100.000	N/A
Erb St./Platinum Dr	**North - Platinum Dr**	ONE HOUR	Yes	947.00	100.000	N/A
Erb St./Platinum Dr	**West - Erb St.**	ONE HOUR	Yes	292.00	100.000	N/A
Erb St./Platinum Dr	**South - Landfill Gate 2**	ONE HOUR	Yes	67.00	100.000	N/A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	ONE HOUR	Yes	963.00	100.000	N/A
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	ONE HOUR	Yes	1415.00	100.000	N/A
Ira Needles Blvd/Erb St.	**West - Erb St.**	ONE HOUR	Yes	1552.00	100.000	N/A
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	ONE HOUR	Yes	1555.00	100.000	N/A
Erbsville/Keats Way	**East - Keats Way**	ONE HOUR	Yes	188.00	100.000	N/A
Erbsville/Keats Way	**North - Erbsville Road**	ONE HOUR	Yes	1159.00	100.000	N/A
Erbsville/Keats Way	**West - Keats Way**	ONE HOUR	Yes	206.00	100.000	N/A
Erbsville/Keats Way	**South - Erbsville Road**	ONE HOUR	Yes	779.00	100.000	N/A
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	ONE HOUR	Yes	691.00	100.000	N/A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	ONE HOUR	Yes	285.00	100.000	N/A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	ONE HOUR	Yes	320.00	100.000	N/A
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	ONE HOUR	Yes	296.00	100.000	N/A
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	ONE HOUR	Yes	304.00	100.000	N/A
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	ONE HOUR	Yes	1081.00	100.000	N/A
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	ONE HOUR	Yes	351.00	100.000	N/A
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	ONE HOUR	Yes	701.00	100.000	N/A
Bearinger Road/Westmount Road	**East - Bearinger Road**	ONE HOUR	Yes	553.00	100.000	N/A
Bearinger Road/Westmount Road	**North - Westmount Road**	ONE HOUR	Yes	1354.00	100.000	N/A
Bearinger Road/Westmount Road	**West - Bearinger Road**	ONE HOUR	Yes	688.00	100.000	N/A
Bearinger Road/Westmount Road	**South - Westmount Road**	ONE HOUR	Yes	441.00	100.000	N/A
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	ONE HOUR	Yes	487.00	100.000	N/A
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	ONE HOUR	Yes	116.00	100.000	N/A
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	ONE HOUR	Yes	227.00	100.000	N/A
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	ONE HOUR	Yes	235.00	100.000	N/A

Pedestrian Flows

General Flows Data

Roundabout	Arm	Profile Type	Average Pedestrian Flow (Ped/hr)
Ira Needles Blvd/University Avenue	East - University Ave	ONE HOUR	13.00
Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	ONE HOUR	5.00
Ira Needles Blvd/University Avenue	West - Private Access	ONE HOUR	7.00
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	ONE HOUR	9.00
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	ONE HOUR	1.00
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	ONE HOUR	1.00
Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	ONE HOUR	0.00
Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	ONE HOUR	0.00
Erb St./Platinum Dr	East - Erb St. W	ONE HOUR	0.00
Erb St./Platinum Dr	North - Platinum Dr	ONE HOUR	0.00
Erb St./Platinum Dr	West - Erb St.	ONE HOUR	3.00
Erb St./Platinum Dr	South - Landfill Gate 2	ONE HOUR	26.00
Ira Needles Blvd/Erb St.	East - Erb St. W	ONE HOUR	0.00
Ira Needles Blvd/Erb St.	North - Erbsville Rd	ONE HOUR	0.00
Ira Needles Blvd/Erb St.	West - Erb St.	ONE HOUR	3.00
Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	ONE HOUR	26.00
Erbsville/Keats Way	East - Keats Way	ONE HOUR	13.00
Erbsville/Keats Way	North - Erbsville Road	ONE HOUR	5.00
Erbsville/Keats Way	West - Keats Way	ONE HOUR	7.00
Erbsville/Keats Way	South - Erbsville Road	ONE HOUR	9.00
Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	ONE HOUR	0.00
Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	ONE HOUR	8.00
Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	ONE HOUR	0.00
Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	ONE HOUR	7.00
Fischer Hallman Road/Laurelwood Drive	East - Laurelwood Drive	ONE HOUR	13.00
Fischer Hallman Road/Laurelwood Drive	North - Bearinger Road	ONE HOUR	5.00
Fischer Hallman Road/Laurelwood Drive	West - Laurelwood Drive	ONE HOUR	7.00
Fischer Hallman Road/Laurelwood Drive	South - Fischer Hallman Road	ONE HOUR	9.00
Bearinger Road/Westmount Road	East - Bearinger Road	ONE HOUR	13.00
Bearinger Road/Westmount Road	North - Westmount Road	ONE HOUR	5.00
Bearinger Road/Westmount Road	West - Bearinger Road	ONE HOUR	7.00
Bearinger Road/Westmount Road	South - Westmount Road	ONE HOUR	9.00

Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	ONE HOUR	13.00
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	ONE HOUR	13.00
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	ONE HOUR	7.00
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	ONE HOUR	9.00

Direct/Resultant Flows

Direct Flows Data

Time Segment	Roundabout	Arm	Direct Demand Entry Flow (Veh/hr)	DirectDemandEntryFlowInPCE (PCE/hr)	Direct Demand Exit Flow (Veh/hr)	Direct Demand Pedestrian Flow (Ped/hr)
1	Ira Needles Blvd/University Avenue	East - University Ave	531.51	567.94	N/A	9.79
1	Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	1101.42	1140.45	N/A	3.76
1	Ira Needles Blvd/University Avenue	West - Private Access	350.08	373.51	N/A	5.27
1	Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	927.51	974.19	N/A	6.78
1	Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	188.97	192.40	N/A	0.00
1	Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	1552.38	1581.13	N/A	0.00
1	Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	164.12	168.67	N/A	0.00
1	Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	942.57	960.05	N/A	0.00
1	Erb St./Platinum Dr	East - Erb St. W	642.94	652.83	N/A	0.00
1	Erb St./Platinum Dr	North - Platinum Dr	712.95	723.72	N/A	0.00
1	Erb St./Platinum Dr	West - Erb St.	219.83	225.82	N/A	0.00
1	Erb St./Platinum Dr	South - Landfill Gate 2	50.44	53.56	N/A	19.57
1	Ira Needles Blvd/Erb St.	East - Erb St. W	725.00	737.26	N/A	0.00
1	Ira Needles Blvd/Erb St.	North - Erbsville Rd	1065.29	1084.98	N/A	0.00
1	Ira Needles Blvd/Erb St.	West - Erb St.	1168.43	1188.96	N/A	0.00
1	Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	1170.69	1184.89	N/A	19.57
1	Erbsville/Keats Way	East - Keats Way	141.54	144.37	N/A	9.79
1	Erbsville/Keats Way	North - Erbsville Road	872.56	890.01	N/A	3.76
1	Erbsville/Keats Way	West - Keats Way	155.09	158.19	N/A	5.27
1	Erbsville/Keats Way	South - Erbsville Road	586.47	598.20	N/A	6.78
1	Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	520.22	524.61	N/A	0.00
1	Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	214.56	215.65	N/A	6.02

1	Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	240.91	243.68	N/A	0.00
1	Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	222.84	222.84	N/A	5.27
1	Fischer Hallman Road/Laurelwood Drive	East - Laurelwood Drive	228.87	233.44	N/A	9.79
1	Fischer Hallman Road/Laurelwood Drive	North - Bearinger Road	813.83	830.11	N/A	3.76
1	Fischer Hallman Road/Laurelwood Drive	West - Laurelwood Drive	264.25	269.54	N/A	5.27
1	Fischer Hallman Road/Laurelwood Drive	South - Fischer Hallman Road	527.75	538.30	N/A	6.78
1	Bearinger Road/Westmount Road	East - Bearinger Road	416.33	424.65	N/A	9.79
1	Bearinger Road/Westmount Road	North - Westmount Road	1019.36	1039.75	N/A	3.76
1	Bearinger Road/Westmount Road	West - Bearinger Road	517.96	528.32	N/A	5.27
1	Bearinger Road/Westmount Road	South - Westmount Road	332.01	338.65	N/A	6.78
1	Conservation Drive/Beaver Creek Road	East - Conservation Drive	366.64	372.59	N/A	9.79
1	Conservation Drive/Beaver Creek Road	North - Beaver Creek Road	87.33	89.08	N/A	9.79
1	Conservation Drive/Beaver Creek Road	West - Conservation Drive	170.90	174.01	N/A	5.27
1	Conservation Drive/Beaver Creek Road	South - Beaver Creek Road	176.92	179.68	N/A	6.78
2	Ira Needles Blvd/University Avenue	East - University Ave	634.68	678.17	N/A	11.69
2	Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	1315.21	1361.81	N/A	4.49
2	Ira Needles Blvd/University Avenue	West - Private Access	418.03	446.01	N/A	6.29
2	Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	1107.54	1163.28	N/A	8.09
2	Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	225.64	229.74	N/A	0.00
2	Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	1853.70	1888.02	N/A	0.00
2	Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	195.98	201.41	N/A	0.00
2	Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	1125.52	1146.40	N/A	0.00
2	Erb St./Platinum Dr	East - Erb St. W	767.73	779.54	N/A	0.00
2	Erb St./Platinum Dr	North - Platinum Dr	851.33	864.19	N/A	0.00
2	Erb St./Platinum Dr	West - Erb St.	262.50	269.65	N/A	0.00
2	Erb St./Platinum Dr	South - Landfill Gate 2	60.23	63.96	N/A	23.37
2	Ira Needles Blvd/Erb St.	East - Erb St. W	865.72	880.36	N/A	0.00
2	Ira Needles Blvd/Erb St.	North - Erbsville Rd	1272.06	1295.57	N/A	0.00
2	Ira Needles Blvd/Erb St.	West - Erb St.	1395.22	1419.74	N/A	0.00
2	Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	1397.91	1414.88	N/A	23.37
2	Erbsville/Keats Way	East - Keats Way	169.01	172.39	N/A	11.69
2	Erbsville/Keats Way	North - Erbsville Road	1041.92	1062.76	N/A	4.49
2	Erbsville/Keats Way	West - Keats Way	185.19	188.89	N/A	6.29
2	Erbsville/Keats Way	South - Erbsville Road	700.31	714.31	N/A	8.09

2	**Beaver Creek Rd/Laurelwood Dr**	**East - Laurelwood Dr.**	621.19	626.44	N/A	0.00
2	**Beaver Creek Rd/Laurelwood Dr**	**North - Beaver Creek Rd**	256.21	257.51	N/A	7.19
2	**Beaver Creek Rd/Laurelwood Dr**	**West - Laurelwood Dr.**	287.67	290.97	N/A	0.00
2	**Beaver Creek Rd/Laurelwood Dr**	**South - Beaver Creek Rd**	266.10	266.10	N/A	6.29
2	**Fischer Hallman Road/Laurelwood Drive**	**East - Laurelwood Drive**	273.29	278.76	N/A	11.69
2	**Fischer Hallman Road/Laurelwood Drive**	**North - Bearinger Road**	971.80	991.23	N/A	4.49
2	**Fischer Hallman Road/Laurelwood Drive**	**West - Laurelwood Drive**	315.54	321.85	N/A	6.29
2	**Fischer Hallman Road/Laurelwood Drive**	**South - Fischer Hallman Road**	630.18	642.79	N/A	8.09
2	**Bearinger Road/Westmount Road**	**East - Bearinger Road**	497.14	507.08	N/A	11.69
2	**Bearinger Road/Westmount Road**	**North - Westmount Road**	1217.22	1241.56	N/A	4.49
2	**Bearinger Road/Westmount Road**	**West - Bearinger Road**	618.50	630.87	N/A	6.29
2	**Bearinger Road/Westmount Road**	**South - Westmount Road**	396.45	404.38	N/A	8.09
2	**Conservation Drive/Beaver Creek Road**	**East - Conservation Drive**	437.80	444.90	N/A	11.69
2	**Conservation Drive/Beaver Creek Road**	**North - Beaver Creek Road**	104.28	106.37	N/A	11.69
2	**Conservation Drive/Beaver Creek Road**	**West - Conservation Drive**	204.07	207.79	N/A	6.29
2	**Conservation Drive/Beaver Creek Road**	**South - Beaver Creek Road**	211.26	214.55	N/A	8.09
3	**Ira Needles Blvd/University Avenue**	**East - University Ave**	777.32	830.59	N/A	14.31
3	**Ira Needles Blvd/University Avenue**	**North - Ira Needles Blvd**	1610.79	1667.87	N/A	5.51
3	**Ira Needles Blvd/University Avenue**	**West - Private Access**	511.97	546.25	N/A	7.71
3	**Ira Needles Blvd/University Avenue**	**South - Ira Needles Blvd**	1356.46	1424.72	N/A	9.91
3	**Ira Needles Blvd/Thorndale Dr**	**East - Thorndale Dr**	276.36	281.38	N/A	0.00
3	**Ira Needles Blvd/Thorndale Dr**	**North - Ira Needles Blvd**	2270.30	2312.34	N/A	0.00
3	**Ira Needles Blvd/Thorndale Dr**	**West - Boardwalk Access**	240.02	246.67	N/A	0.00
3	**Ira Needles Blvd/Thorndale Dr**	**South - Ira Needles Blvd**	1378.48	1404.04	N/A	0.00
3	**Erb St./Platinum Dr**	**East - Erb St. W**	940.27	954.74	N/A	0.00
3	**Erb St./Platinum Dr**	**North - Platinum Dr**	1042.67	1058.41	N/A	0.00
3	**Erb St./Platinum Dr**	**West - Erb St.**	321.50	330.25	N/A	0.00
3	**Erb St./Platinum Dr**	**South - Landfill Gate 2**	73.77	78.33	N/A	28.63
3	**Ira Needles Blvd/Erb St.**	**East - Erb St. W**	1060.28	1078.22	N/A	0.00
3	**Ira Needles Blvd/Erb St.**	**North - Erbsville Rd**	1557.94	1586.75	N/A	0.00
3	**Ira Needles Blvd/Erb St.**	**West - Erb St.**	1708.78	1738.82	N/A	0.00
3	**Ira Needles Blvd/Erb St.**	**South - Ira Needles Blvd**	1712.09	1732.86	N/A	28.63
3	**Erbsville/Keats Way**	**East - Keats Way**	206.99	211.13	N/A	14.31
3	**Erbsville/Keats Way**	**North - Erbsville Road**	1276.08	1301.60	N/A	5.51

3	Erbsville/Keats Way	West - Keats Way	226.81	231.35	N/A	7.71
3	Erbsville/Keats Way	South - Erbsville Road	857.69	874.85	N/A	9.91
3	Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	760.81	767.22	N/A	0.00
3	Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	313.79	315.38	N/A	8.81
3	Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	352.33	356.37	N/A	0.00
3	Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	325.90	325.90	N/A	7.71
3	Fischer Hallman Road/Laurelwood Drive	East - Laurelwood Drive	334.71	341.40	N/A	14.31
3	Fischer Hallman Road/Laurelwood Drive	North - Bearinger Road	1190.20	1214.01	N/A	5.51
3	Fischer Hallman Road/Laurelwood Drive	West - Laurelwood Drive	386.46	394.19	N/A	7.71
3	Fischer Hallman Road/Laurelwood Drive	South - Fischer Hallman Road	771.82	787.25	N/A	9.91
3	Bearinger Road/Westmount Road	East - Bearinger Road	608.86	621.04	N/A	14.31
3	Bearinger Road/Westmount Road	North - Westmount Road	1490.78	1520.60	N/A	5.51
3	Bearinger Road/Westmount Road	West - Bearinger Road	757.50	772.65	N/A	7.71
3	Bearinger Road/Westmount Road	South - Westmount Road	485.55	495.26	N/A	9.91
3	Conservation Drive/Beaver Creek Road	East - Conservation Drive	536.20	544.90	N/A	14.31
3	Conservation Drive/Beaver Creek Road	North - Beaver Creek Road	127.72	130.27	N/A	14.31
3	Conservation Drive/Beaver Creek Road	West - Conservation Drive	249.93	254.49	N/A	7.71
3	Conservation Drive/Beaver Creek Road	South - Beaver Creek Road	258.74	262.77	N/A	9.91
4	Ira Needles Blvd/University Avenue	East - University Ave	777.32	830.59	N/A	14.31
4	Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	1610.79	1667.87	N/A	5.51
4	Ira Needles Blvd/University Avenue	West - Private Access	511.97	546.25	N/A	7.71
4	Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	1356.46	1424.72	N/A	9.91
4	Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	276.36	281.38	N/A	0.00
4	Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	2270.30	2312.34	N/A	0.00
4	Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	240.02	246.67	N/A	0.00
4	Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	1378.48	1404.04	N/A	0.00
4	Erb St./Platinum Dr	East - Erb St. W	940.27	954.74	N/A	0.00
4	Erb St./Platinum Dr	North - Platinum Dr	1042.67	1058.41	N/A	0.00
4	Erb St./Platinum Dr	West - Erb St.	321.50	330.25	N/A	0.00
4	Erb St./Platinum Dr	South - Landfill Gate 2	73.77	78.33	N/A	28.63
4	Ira Needles Blvd/Erb St.	East - Erb St. W	1060.28	1078.22	N/A	0.00
4	Ira Needles Blvd/Erb St.	North - Erbsville Rd	1557.94	1586.75	N/A	0.00
4	Ira Needles Blvd/Erb St.	West - Erb St.	1708.78	1738.82	N/A	0.00
4	Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	1712.09	1732.86	N/A	28.63

4	**Erbsville/Keats Way**	**East - Keats Way**	206.99	211.13	N/A	14.31
4	**Erbsville/Keats Way**	**North - Erbsville Road**	1276.08	1301.60	N/A	5.51
4	**Erbsville/Keats Way**	**West - Keats Way**	226.81	231.35	N/A	7.71
4	**Erbsville/Keats Way**	**South - Erbsville Road**	857.69	874.85	N/A	9.91
4	**Beaver Creek Rd/Laurelwood Dr**	**East - Laurelwood Dr.**	760.81	767.22	N/A	0.00
4	**Beaver Creek Rd/Laurelwood Dr**	**North - Beaver Creek Rd**	313.79	315.38	N/A	8.81
4	**Beaver Creek Rd/Laurelwood Dr**	**West - Laurelwood Dr.**	352.33	356.37	N/A	0.00
4	**Beaver Creek Rd/Laurelwood Dr**	**South - Beaver Creek Rd**	325.90	325.90	N/A	7.71
4	**Fischer Hallman Road/Laurelwood Drive**	**East - Laurelwood Drive**	334.71	341.40	N/A	14.31
4	**Fischer Hallman Road/Laurelwood Drive**	**North - Bearinger Road**	1190.20	1214.01	N/A	5.51
4	**Fischer Hallman Road/Laurelwood Drive**	**West - Laurelwood Drive**	386.46	394.19	N/A	7.71
4	**Fischer Hallman Road/Laurelwood Drive**	**South - Fischer Hallman Road**	771.82	787.25	N/A	9.91
4	**Bearinger Road/Westmount Road**	**East - Bearinger Road**	608.86	621.04	N/A	14.31
4	**Bearinger Road/Westmount Road**	**North - Westmount Road**	1490.78	1520.60	N/A	5.51
4	**Bearinger Road/Westmount Road**	**West - Bearinger Road**	757.50	772.65	N/A	7.71
4	**Bearinger Road/Westmount Road**	**South - Westmount Road**	485.55	495.26	N/A	9.91
4	**Conservation Drive/Beaver Creek Road**	**East - Conservation Drive**	536.20	544.90	N/A	14.31
4	**Conservation Drive/Beaver Creek Road**	**North - Beaver Creek Road**	127.72	130.27	N/A	14.31
4	**Conservation Drive/Beaver Creek Road**	**West - Conservation Drive**	249.93	254.49	N/A	7.71
4	**Conservation Drive/Beaver Creek Road**	**South - Beaver Creek Road**	258.74	262.77	N/A	9.91
5	**Ira Needles Blvd/University Avenue**	**East - University Ave**	634.68	678.17	N/A	11.69
5	**Ira Needles Blvd/University Avenue**	**North - Ira Needles Blvd**	1315.21	1361.81	N/A	4.49
5	**Ira Needles Blvd/University Avenue**	**West - Private Access**	418.03	446.01	N/A	6.29
5	**Ira Needles Blvd/University Avenue**	**South - Ira Needles Blvd**	1107.54	1163.28	N/A	8.09
5	**Ira Needles Blvd/Thorndale Dr**	**East - Thorndale Dr**	225.64	229.74	N/A	0.00
5	**Ira Needles Blvd/Thorndale Dr**	**North - Ira Needles Blvd**	1853.70	1888.02	N/A	0.00
5	**Ira Needles Blvd/Thorndale Dr**	**West - Boardwalk Access**	195.98	201.41	N/A	0.00
5	**Ira Needles Blvd/Thorndale Dr**	**South - Ira Needles Blvd**	1125.52	1146.40	N/A	0.00
5	**Erb St./Platinum Dr**	**East - Erb St. W**	767.73	779.54	N/A	0.00
5	**Erb St./Platinum Dr**	**North - Platinum Dr**	851.33	864.19	N/A	0.00
5	**Erb St./Platinum Dr**	**West - Erb St.**	262.50	269.65	N/A	0.00
5	**Erb St./Platinum Dr**	**South - Landfill Gate 2**	60.23	63.96	N/A	23.37
5	**Ira Needles Blvd/Erb St.**	**East - Erb St. W**	865.72	880.36	N/A	0.00
5	**Ira Needles Blvd/Erb St.**	**North - Erbsville Rd**	1272.06	1295.57	N/A	0.00

5	**Ira Needles Blvd/Erb St.**	**West - Erb St.**	1395.22	1419.74	N/A	0.00
5	**Ira Needles Blvd/Erb St.**	**South - Ira Needles Blvd**	1397.91	1414.88	N/A	23.37
5	**Erbsville/Keats Way**	**East - Keats Way**	169.01	172.39	N/A	11.69
5	**Erbsville/Keats Way**	**North - Erbsville Road**	1041.92	1062.76	N/A	4.49
5	**Erbsville/Keats Way**	**West - Keats Way**	185.19	188.89	N/A	6.29
5	**Erbsville/Keats Way**	**South - Erbsville Road**	700.31	714.31	N/A	8.09
5	**Beaver Creek Rd/Laurelwood Dr**	**East - Laurelwood Dr.**	621.19	626.44	N/A	0.00
5	**Beaver Creek Rd/Laurelwood Dr**	**North - Beaver Creek Rd**	256.21	257.51	N/A	7.19
5	**Beaver Creek Rd/Laurelwood Dr**	**West - Laurelwood Dr.**	287.67	290.97	N/A	0.00
5	**Beaver Creek Rd/Laurelwood Dr**	**South - Beaver Creek Rd**	266.10	266.10	N/A	6.29
5	**Fischer Hallman Road/Laurelwood Drive**	**East - Laurelwood Drive**	273.29	278.76	N/A	11.69
5	**Fischer Hallman Road/Laurelwood Drive**	**North - Bearinger Road**	971.80	991.23	N/A	4.49
5	**Fischer Hallman Road/Laurelwood Drive**	**West - Laurelwood Drive**	315.54	321.85	N/A	6.29
5	**Fischer Hallman Road/Laurelwood Drive**	**South - Fischer Hallman Road**	630.18	642.79	N/A	8.09
5	**Bearinger Road/Westmount Road**	**East - Bearinger Road**	497.14	507.08	N/A	11.69
5	**Bearinger Road/Westmount Road**	**North - Westmount Road**	1217.22	1241.56	N/A	4.49
5	**Bearinger Road/Westmount Road**	**West - Bearinger Road**	618.50	630.87	N/A	6.29
5	**Bearinger Road/Westmount Road**	**South - Westmount Road**	396.45	404.38	N/A	8.09
5	**Conservation Drive/Beaver Creek Road**	**East - Conservation Drive**	437.80	444.90	N/A	11.69
5	**Conservation Drive/Beaver Creek Road**	**North - Beaver Creek Road**	104.28	106.37	N/A	11.69
5	**Conservation Drive/Beaver Creek Road**	**West - Conservation Drive**	204.07	207.79	N/A	6.29
5	**Conservation Drive/Beaver Creek Road**	**South - Beaver Creek Road**	211.26	214.55	N/A	8.09
6	**Ira Needles Blvd/University Avenue**	**East - University Ave**	531.51	567.94	N/A	9.79
6	**Ira Needles Blvd/University Avenue**	**North - Ira Needles Blvd**	1101.42	1140.45	N/A	3.76
6	**Ira Needles Blvd/University Avenue**	**West - Private Access**	350.08	373.51	N/A	5.27
6	**Ira Needles Blvd/University Avenue**	**South - Ira Needles Blvd**	927.51	974.19	N/A	6.78
6	**Ira Needles Blvd/Thorndale Dr**	**East - Thorndale Dr**	188.97	192.40	N/A	0.00
6	**Ira Needles Blvd/Thorndale Dr**	**North - Ira Needles Blvd**	1552.38	1581.13	N/A	0.00
6	**Ira Needles Blvd/Thorndale Dr**	**West - Boardwalk Access**	164.12	168.67	N/A	0.00
6	**Ira Needles Blvd/Thorndale Dr**	**South - Ira Needles Blvd**	942.57	960.05	N/A	0.00
6	**Erb St./Platinum Dr**	**East - Erb St. W**	642.94	652.83	N/A	0.00
6	**Erb St./Platinum Dr**	**North - Platinum Dr**	712.95	723.72	N/A	0.00
6	**Erb St./Platinum Dr**	**West - Erb St.**	219.83	225.82	N/A	0.00
6	**Erb St./Platinum Dr**	**South - Landfill Gate 2**	50.44	53.56	N/A	19.57

6	Ira Needles Blvd/Erb St.	East - Erb St. W	725.00	737.26	N/A	0.00
6	Ira Needles Blvd/Erb St.	North - Erbsville Rd	1065.29	1084.98	N/A	0.00
6	Ira Needles Blvd/Erb St.	West - Erb St.	1168.43	1188.96	N/A	0.00
6	Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	1170.69	1184.89	N/A	19.57
6	Erbsville/Keats Way	East - Keats Way	141.54	144.37	N/A	9.79
6	Erbsville/Keats Way	North - Erbsville Road	872.56	890.01	N/A	3.76
6	Erbsville/Keats Way	West - Keats Way	155.09	158.19	N/A	5.27
6	Erbsville/Keats Way	South - Erbsville Road	586.47	598.20	N/A	6.78
6	Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	520.22	524.61	N/A	0.00
6	Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	214.56	215.65	N/A	6.02
6	Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	240.91	243.68	N/A	0.00
6	Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	222.84	222.84	N/A	5.27
6	Fischer Hallman Road/Laurelwood Drive	East - Laurelwood Drive	228.87	233.44	N/A	9.79
6	Fischer Hallman Road/Laurelwood Drive	North - Bearinger Road	813.83	830.11	N/A	3.76
6	Fischer Hallman Road/Laurelwood Drive	West - Laurelwood Drive	264.25	269.54	N/A	5.27
6	Fischer Hallman Road/Laurelwood Drive	South - Fischer Hallman Road	527.75	538.30	N/A	6.78
6	Bearinger Road/Westmount Road	East - Bearinger Road	416.33	424.65	N/A	9.79
6	Bearinger Road/Westmount Road	North - Westmount Road	1019.36	1039.75	N/A	3.76
6	Bearinger Road/Westmount Road	West - Bearinger Road	517.96	528.32	N/A	5.27
6	Bearinger Road/Westmount Road	South - Westmount Road	332.01	338.65	N/A	6.78
6	Conservation Drive/Beaver Creek Road	East - Conservation Drive	366.64	372.59	N/A	9.79
6	Conservation Drive/Beaver Creek Road	North - Beaver Creek Road	87.33	89.08	N/A	9.79
6	Conservation Drive/Beaver Creek Road	West - Conservation Drive	170.90	174.01	N/A	5.27
6	Conservation Drive/Beaver Creek Road	South - Beaver Creek Road	176.92	179.68	N/A	6.78

Turning Proportions

Turning Counts or Proportions (Veh/hr) - Ira Needles Blvd/ University Avenue (for whole period)

		To			
		1	2	3	4
From	1	0.000	135.000	225.000	346.000
	2	154.000	0.000	120.000	1189.000
	3	180.000	67.000	0.000	218.000

	4	316.000	722.000	194.000	0.000

Turning Proportions (Veh) - Ira Needles Blvd/ University Avenue (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.19	0.32	0.49
	2	0.11	0.00	0.08	0.81
	3	0.39	0.14	0.00	0.47
	4	0.26	0.59	0.16	0.00

Turning Counts or Proportions (Veh/hr) - Ira Needles Blvd/ Thorndale Dr (for whole period)

		To			
		1	2	3	4
From	1	0.000	136.000	23.000	92.000
	2	102.000	0.000	102.000	1858.000
	3	40.000	151.000	0.000	27.000
	4	90.000	1161.000	1.000	0.000

Turning Proportions (Veh) - Ira Needles Blvd/ Thorndale Dr (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.54	0.09	0.37
	2	0.05	0.00	0.05	0.90
	3	0.18	0.69	0.00	0.12
	4	0.07	0.93	0.00	0.00

Turning Counts or Proportions (Veh/hr) - Ira Needles Blvd/ Erb St. (for whole period)

		To			
		1	2	3	4
From	1	0.000	145.000	596.000	222.000
	2	193.000	0.000	214.000	1008.000
	3	430.000	319.000	0.000	803.000

	4	166.000	857.000	532.000	0.000

Turning Proportions (Veh) - Ira Needles Blvd/ Erb St. (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.15	0.62	0.23
	2	0.14	0.00	0.15	0.71
	3	0.28	0.21	0.00	0.52
	4	0.11	0.55	0.34	0.00

Turning Counts or Proportions (Veh/hr) - Beaver Creek Rd/ Laurelwood Dr (for whole period)

		To			
		1	2	3	4
From	1	0.000	108.000	440.000	143.000
	2	63.000	0.000	103.000	119.000
	3	204.000	56.000	0.000	60.000
	4	106.000	98.000	92.000	0.000

Turning Proportions (Veh) - Beaver Creek Rd/ Laurelwood Dr (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.16	0.64	0.21
	2	0.22	0.00	0.36	0.42
	3	0.64	0.18	0.00	0.19
	4	0.36	0.33	0.31	0.00

Turning Counts or Proportions (Veh/hr) - Erb St./ Platinum Dr (for whole period)

		To			
		1	2	3	4
From	1	0.000	244.000	576.000	34.000
	2	715.000	0.000	223.000	9.000
	3	226.000	61.000	0.000	5.000

	4	56.000	6.000	5.000	0.000

Turning Proportions (Veh) - Erb St./ Platinum Dr (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.29	0.67	0.04
	2	0.76	0.00	0.24	0.01
	3	0.77	0.21	0.00	0.02
	4	0.84	0.09	0.07	0.00

Turning Counts or Proportions (Veh/hr) - Erbsville/ Keats Way (for whole period)

		To			
		1	2	3	4
From	1	0.000	56.000	58.000	74.000
	2	67.000	0.000	37.000	1055.000
	3	89.000	62.000	0.000	55.000
	4	113.000	623.000	43.000	0.000

Turning Proportions (Veh) - Erbsville/ Keats Way (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.30	0.31	0.39
	2	0.06	0.00	0.03	0.91
	3	0.43	0.30	0.00	0.27
	4	0.15	0.80	0.06	0.00

Turning Counts or Proportions (Veh/hr) - Fischer Hallman Road/ Laurelwood Drive (for whole period)

		To			
		1	2	3	4
From	1	0.000	56.000	118.000	130.000
	2	51.000	0.000	268.000	762.000
	3	61.000	165.000	0.000	125.000

	4	91.000	405.000	205.000	0.000

Turning Proportions (Veh) - Fischer Hallman Road/ Laurelwood Drive (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.18	0.39	0.43
	2	0.05	0.00	0.25	0.70
	3	0.17	0.47	0.00	0.36
	4	0.13	0.58	0.29	0.00

Turning Counts or Proportions (Veh/hr) - Bearinger Road/ Westmount Road (for whole period)

		To			
		1	2	3	4
From	1	0.000	139.000	329.000	85.000
	2	48.000	0.000	788.000	518.000
	3	205.000	480.000	0.000	3.000
	4	66.000	372.000	3.000	0.000

Turning Proportions (Veh) - Bearinger Road/ Westmount Road (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.25	0.59	0.15
	2	0.04	0.00	0.58	0.38
	3	0.30	0.70	0.00	0.00
	4	0.15	0.84	0.01	0.00

Turning Counts or Proportions (Veh/hr) - Conservation Drive/ Beaver Creek Road (for whole period)

		To			
		1	2	3	4
From	1	0.000	92.000	216.000	179.000
	2	65.000	0.000	14.000	37.000
	3	164.000	20.000	0.000	43.000

	4	135.000	52.000	48.000	0.000

Turning Proportions (Veh) - Conservation Drive/ Beaver Creek Road (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.19	0.44	0.37
	2	0.56	0.00	0.12	0.32
	3	0.72	0.09	0.00	0.19
	4	0.57	0.22	0.20	0.00

Vehicle Mix

Average PCE Per Vehicle - Ira Needles Blvd/ University Avenue (for whole period)

		To			
		1	2	3	4
From	1	1.000	1.070	1.050	1.080
	2	1.020	1.000	1.010	1.040
	3	1.050	1.070	1.000	1.080
	4	1.040	1.020	1.180	1.000

Truck Percentages - Ira Needles Blvd/ University Avenue (for whole period)

		To			
		1	2	3	4
From	1	0.000	7.000	5.000	8.000
	2	2.000	0.000	1.000	4.000
	3	5.000	7.000	0.000	8.000
	4	4.000	2.000	18.000	0.000

Average PCE Per Vehicle - Ira Needles Blvd/ Thorndale Dr (for whole period)

		To			
From		1	2	3	4

	1	1.000	1.020	1.000	1.020
	2	1.000	1.000	1.010	1.020
	3	1.000	1.040	1.000	1.000
	4	1.000	1.020	1.000	1.000

Truck Percentages - Ira Needles Blvd/ Thorndale Dr (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	0.000	2.000	0.000	2.000
	2	0.000	0.000	1.000	2.000
	3	0.000	4.000	0.000	0.000
	4	0.000	2.000	0.000	0.000

Average PCE Per Vehicle - Ira Needles Blvd/ Erb St. (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	1.000	1.010	1.010	1.040
	2	1.020	1.000	1.010	1.020
	3	1.000	1.010	1.000	1.030
	4	1.030	1.010	1.010	1.000

Truck Percentages - Ira Needles Blvd/ Erb St. (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	0.000	1.000	1.000	4.000
	2	2.000	0.000	1.000	2.000
	3	0.000	1.000	0.000	3.000
	4	3.000	1.000	1.000	0.000

Average PCE Per Vehicle - Beaver Creek Rd/ Laurelwood Dr (for whole period)

	To				
From		**1**	**2**	**3**	**4**

	1	1.000	1.000	1.010	1.010
	2	1.000	1.000	1.014	1.000
	3	1.018	1.000	1.000	1.000
	4	1.000	1.000	1.000	1.000

Truck Percentages - Beaver Creek Rd/ Laurelwood Dr (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	0.000	0.000	1.000	1.000
	2	0.000	0.000	1.400	0.000
	3	1.800	0.000	0.000	0.000
	4	0.000	0.000	0.000	0.000

Average PCE Per Vehicle - Erb St./ Platinum Dr (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	1.000	1.000	1.020	1.048
	2	1.020	1.000	1.000	1.000
	3	1.017	1.045	1.000	1.250
	4	1.074	1.000	1.000	1.000

Truck Percentages - Erb St./ Platinum Dr (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	0.000	0.000	2.000	4.760
	2	2.000	0.000	0.000	0.000
	3	1.740	4.540	0.000	25.000
	4	7.400	0.000	0.000	0.000

Average PCE Per Vehicle - Erbsville/ Keats Way (for whole period)

	To				
From		**1**	**2**	**3**	**4**

	1	1.020	1.020	1.020	1.020
	2	1.020	1.020	1.020	1.020
	3	1.020	1.020	1.020	1.020
	4	1.020	1.020	1.020	1.020

Truck Percentages - Erbsville/ Keats Way (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	2.000	2.000	2.000	2.000
	2	2.000	2.000	2.000	2.000
	3	2.000	2.000	2.000	2.000
	4	2.000	2.000	2.000	2.000

Average PCE Per Vehicle - Fischer Hallman Road/ Laurelwood Drive (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	1.020	1.020	1.020	1.020
	2	1.020	1.020	1.020	1.020
	3	1.020	1.020	1.020	1.020
	4	1.020	1.020	1.020	1.020

Truck Percentages - Fischer Hallman Road/ Laurelwood Drive (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	2.000	2.000	2.000	2.000
	2	2.000	2.000	2.000	2.000
	3	2.000	2.000	2.000	2.000
	4	2.000	2.000	2.000	2.000

Average PCE Per Vehicle - Bearinger Road/ Westmount Road (for whole period)

	To				
From		**1**	**2**	**3**	**4**

	1	1.020	1.020	1.020	1.020
	2	1.020	1.020	1.020	1.020
	3	1.020	1.020	1.020	1.020
	4	1.020	1.020	1.020	1.020

Truck Percentages - Bearinger Road/ Westmount Road (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	2.000	2.000	2.000	2.000
	2	2.000	2.000	2.000	2.000
	3	2.000	2.000	2.000	2.000
	4	2.000	2.000	2.000	2.000

Average PCE Per Vehicle - Conservation Drive/ Beaver Creek Road (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	1.020	1.000	1.020	1.020
	2	1.020	1.000	1.020	1.020
	3	1.020	1.000	1.000	1.020
	4	1.020	1.000	1.020	1.020

Truck Percentages - Conservation Drive/ Beaver Creek Road (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	2.000	0.000	2.000	2.000
	2	2.000	0.000	2.000	2.000
	3	2.000	0.000	0.000	2.000
	4	2.000	0.000	2.000	2.000

Results

Results Summary

Roundabout	Arm	Max RFC	Max Delay (s)	Max Queue (Veh)	Max LOS	Total Demand (Veh/hr)	Total Arrivals (Veh)	Total Queueing Delay (Veh-min)	Average Queueing Delay (s)	Rate Of Queueing Delay (Veh-min/min)	Inclusive Queueing Total Delay (Veh-min)	Inclusive Queueing Average Delay (s)	Slope	Intercept (PCE/hr)
Ira Needles Blvd/University Avenue	East - University Ave	0.80	17.87	3.71	C	647.84	971.75	151.48	9.35	1.68	151.49	9.35	0.740	2461.322
Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	1.34	585.40	219.33	F	1342.48	2013.72	9728.75	289.87	108.10	10152.48	302.50	0.678	2138.626
Ira Needles Blvd/University Avenue	West - Private Access	2.40	5560.33	300.97	F	426.69	640.04	12054.36	1130.03	133.94	26989.21	2530.10	0.647	1916.031
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	0.83	12.74	4.65	B	1130.51	1695.76	232.26	8.22	2.58	232.30	8.22	0.680	2144.039
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	0.45	10.59	0.80	B	230.32	345.48	44.75	7.77	0.50	44.75	7.77	0.571	1541.270
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	1.14	234.12	148.20	F	1892.12	2838.18	5321.84	112.51	59.13	5322.10	112.51	0.746	2358.337
Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	0.30	6.38	0.42	A	200.04	300.06	27.51	5.50	0.31	27.51	5.50	0.755	2455.620
Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	0.71	6.36	2.41	A	1148.85	1723.28	136.70	4.76	1.52	136.71	4.76	0.747	2435.697
Erb St./Platinum Dr	East - Erb St. W	0.45	3.09	0.80	A	783.65	1175.47	53.94	2.75	0.60	53.94	2.75	0.723	2436.345
Erb St./Platinum Dr	North - Platinum Dr	0.61	5.34	1.53	A	868.98	1303.48	90.69	4.17	1.01	90.70	4.18	0.723	2436.345
Erb St./Platinum Dr	West - Erb St.	0.20	2.83	0.25	A	267.94	401.92	17.26	2.58	0.19	17.26	2.58	0.723	2436.345
Erb St./Platinum Dr	South - Landfill Gate 2	0.12	6.91	0.14	A	61.48	92.22	9.11	5.93	0.10	9.12	5.93	0.579	1357.445
Ira Needles Blvd/Erb St.	East - Erb St. W	0.89	26.31	7.29	D	883.66	1325.49	264.50	11.97	2.94	264.52	11.97	0.781	2703.168
Ira Needles Blvd/Erb St.	North - Erbsville Rd	1.16	226.79	110.30	F	1298.43	1947.64	3213.92	99.01	35.71	3213.98	99.01	0.770	2683.164
Ira Needles Blvd/Erb St.	West - Erb St.	1.75	2061.31	604.28	F	1424.14	2136.21	25981.64	729.75	288.68	36134.45	1014.91	0.743	2471.717
Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	0.91	20.50	9.22	C	1426.89	2140.33	382.66	10.73	4.25	382.71	10.73	0.762	2623.737
Erbsville/Keats Way	East - Keats Way	0.29	7.21	0.41	A	172.51	258.77	26.33	6.11	0.29	26.33	6.11	0.579	1357.445
Erbsville/Keats Way	North - Erbsville Road	0.67	5.72	2.01	A	1063.52	1595.28	118.35	4.45	1.32	118.37	4.45	0.723	2436.345
Erbsville/Keats Way	West - Keats Way	0.54	18.26	1.13	C	189.03	283.54	56.34	11.92	0.63	56.35	11.92	0.579	1357.445
Erbsville/Keats Way	South - Erbsville Road	0.46	3.62	0.86	A	714.82	1072.24	56.36	3.15	0.63	56.36	3.15	0.723	2436.345
Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	0.72	12.13	2.51	B	634.07	951.11	138.07	8.71	1.53	138.09	8.71	0.579	1357.445
Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	0.38	7.04	0.61	A	261.52	392.28	38.68	5.92	0.43	38.68	5.92	0.579	1357.445

Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	0.35	5.57	0.54	A	293.64	440.45	36.16	4.93	0.40	36.16	4.93	0.579	1357.445
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	0.32	5.10	0.46	A	271.61	407.42	31.26	4.60	0.35	31.26	4.60	0.579	1357.445
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	0.48	10.08	0.93	B	278.96	418.43	54.69	7.84	0.61	54.70	7.84	0.579	1357.445
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	0.78	10.71	3.46	B	991.94	1487.92	166.83	6.73	1.85	166.85	6.73	0.723	2436.345
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	0.68	19.76	2.06	C	322.08	483.13	99.88	12.40	1.11	99.90	12.41	0.579	1357.445
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	0.42	3.41	0.73	A	643.25	964.87	48.48	3.01	0.54	48.49	3.02	0.723	2436.345
Bearinger Road/Westmount Road	**East - Bearinger Road**	0.46	4.96	0.83	A	507.44	761.16	50.44	3.98	0.56	50.45	3.98	0.723	2436.345
Bearinger Road/Westmount Road	**North - Westmount Road**	0.95	36.92	14.41	E	1242.45	1863.68	464.47	14.95	5.16	464.50	14.95	0.723	2436.345
Bearinger Road/Westmount Road	**West - Bearinger Road**	0.49	4.51	0.94	A	631.32	946.98	58.87	3.73	0.65	58.87	3.73	0.723	2436.345
Bearinger Road/Westmount Road	**South - Westmount Road**	0.32	3.46	0.47	A	404.67	607.00	30.88	3.05	0.34	30.88	3.05	0.723	2436.345
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	0.51	6.86	1.01	A	446.88	670.32	65.65	5.88	0.73	65.65	5.88	0.579	1357.445
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	0.15	4.83	0.17	A	106.44	159.67	11.90	4.47	0.13	11.90	4.47	0.579	1357.445
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	0.26	5.04	0.35	A	208.30	312.45	24.05	4.62	0.27	24.05	4.62	0.579	1357.445
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	0.27	5.10	0.37	A	215.64	323.46	25.06	4.65	0.28	25.06	4.65	0.579	1357.445

Main Results

Main results: (4:00 PM-4:15 PM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)
Ira Needles Blvd/University Avenue	**East - University Ave**	531.51	132.88	529.03	477.12	732.65	9.79	1381.20	730.09	0.385	0.00	0.62
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	1101.43	275.36	1088.73	688.57	573.11	3.76	1431.82	1179.57	0.769	0.00	3.17
Ira Needles Blvd/University Avenue	**West - Private Access**	350.08	87.52	325.34	403.14	1258.70	5.27	377.97	240.02	0.926	0.00	6.18

Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	927.52	231.88	922.35	1296.63	287.42	6.78	1636.78	1636.78	0.567	0.00	1.29
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	188.97	47.24	187.84	173.66	984.75	0.00	854.00	301.51	0.221	0.00	0.28
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	1552.38	388.09	1539.71	1085.77	86.81	0.00	2025.79	1990.56	0.766	0.00	3.17
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	164.12	41.03	163.44	94.13	1532.39	0.00	1118.71	802.10	0.147	0.00	0.17
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	942.57	235.64	939.04	1476.47	219.36	0.00	2004.44	1608.73	0.470	0.00	0.88
Erb St./Platinum Dr	**East - Erb St. W**	642.94	160.73	641.21	748.05	54.04	0.00	2123.54	1954.43	0.303	0.00	0.43
Erb St./Platinum Dr	**North - Platinum Dr**	712.95	178.24	710.47	233.50	461.75	0.00	1857.80	1246.01	0.384	0.00	0.62
Erb St./Platinum Dr	**West - Erb St.**	219.83	54.96	219.27	603.52	568.70	0.00	1766.68	1465.39	0.124	0.00	0.14
Erb St./Platinum Dr	**South - Landfill Gate 2**	50.44	12.61	50.16	36.03	751.93	19.57	769.87	0.00	0.066	0.00	0.07
Ira Needles Blvd/Erb St.	**East - Erb St. W**	724.99	181.25	721.31	580.34	1270.98	0.00	1505.00	1078.28	0.482	0.00	0.92
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	1065.28	266.32	1058.39	981.36	1010.93	0.00	1672.85	1295.21	0.637	0.00	1.72
Ira Needles Blvd/Erb St.	**West - Erb St.**	1168.42	292.11	1125.09	1004.71	1064.62	0.00	1228.94	1001.44	0.951	0.00	10.83
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	1170.68	292.67	1163.98	1502.37	687.33	19.57	1858.49	1876.66	0.630	0.00	1.68
Erbsville/Keats Way	**East - Keats Way**	141.54	35.38	140.74	201.55	546.21	9.79	847.90	277.03	0.167	0.00	0.20
Erbsville/Keats Way	**North - Erbsville Road**	872.56	218.14	869.33	555.85	131.09	3.76	1946.49	1830.56	0.448	0.00	0.81
Erbsville/Keats Way	**West - Keats Way**	155.09	38.77	153.86	103.45	896.97	5.27	656.74	149.93	0.236	0.00	0.31
Erbsville/Keats Way	**South - Erbsville Road**	586.47	146.62	584.72	887.80	163.04	6.78	1916.81	1816.87	0.306	0.00	0.44
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	520.22	130.05	516.74	279.46	184.35	0.00	1110.61	818.22	0.468	0.00	0.87
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	214.56	53.64	213.40	196.16	504.92	6.02	949.89	724.98	0.226	0.00	0.29
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	240.91	60.23	239.76	475.11	243.22	0.00	1072.57	794.97	0.225	0.00	0.29
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	222.84	55.71	221.82	241.00	241.98	5.27	1092.26	795.98	0.204	0.00	0.25
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	228.87	57.22	227.37	152.10	581.13	9.79	835.29	231.94	0.274	0.00	0.37
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	813.83	203.46	810.35	469.13	339.37	3.76	1741.03	1212.31	0.467	0.00	0.87
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	264.25	66.06	262.13	443.04	706.68	5.27	757.60	575.09	0.349	0.00	0.53
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	527.75	131.94	526.21	761.80	207.01	6.78	1895.66	1713.70	0.278	0.00	0.38
Bearinger Road/Westmount Road	**East - Bearinger Road**	416.33	104.08	414.91	239.31	641.66	9.79	1584.84	527.60	0.263	0.00	0.35
Bearinger Road/Westmount Road	**North - Westmount Road**	1019.36	254.84	1013.94	743.70	312.87	3.76	1762.13	1586.93	0.578	0.00	1.36
Bearinger Road/Westmount Road	**West - Bearinger Road**	517.96	129.49	516.24	839.19	487.62	5.27	1714.80	1532.18	0.302	0.00	0.43
Bearinger Road/Westmount Road	**South - Westmount Road**	332.01	83.00	331.03	453.93	549.93	6.78	1687.95	1033.66	0.197	0.00	0.24
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	366.64	91.66	364.62	272.76	89.92	9.79	1085.97	987.68	0.338	0.00	0.51
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	87.33	21.83	86.93	122.83	331.70	9.79	958.90	621.79	0.091	0.00	0.10

Conservation Drive/Beaver Creek Road	West - Conservation Drive	170.90	42.72	170.10	208.18	210.46	5.27	1022.23	598.31	0.167	0.00	0.20
Conservation Drive/Beaver Creek Road	South - Beaver Creek Road	176.92	44.23	176.09	193.97	186.59	6.78	1028.53	467.11	0.172	0.00	0.21

Main results: (4:15 PM-4:30 PM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)
Ira Needles Blvd/University Avenue	East - University Ave	634.68	158.67	632.92	503.75	853.74	11.69	1225.64	729.99	0.518	0.62	1.06
Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	1315.21	328.80	1264.24	800.83	685.82	4.49	1332.91	1179.32	0.987	3.17	15.92
Ira Needles Blvd/University Avenue	West - Private Access	418.02	104.51	225.69	479.33	1470.72	6.29	226.75	240.18	1.844	6.18	54.27
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	1107.55	276.89	1104.52	1443.45	252.96	8.09	1636.78	1636.78	0.677	1.29	2.05
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	225.64	56.41	225.08	207.16	1178.51	0.00	753.98	301.51	0.299	0.28	0.42
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	1853.69	463.42	1829.30	1299.56	104.02	0.00	2014.26	1990.56	0.920	3.17	9.26
Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	195.98	48.99	195.59	112.01	1821.31	0.00	924.18	802.10	0.212	0.17	0.27
Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	1125.52	281.38	1123.81	1755.06	261.86	0.00	1975.80	1608.73	0.570	0.88	1.31
Erb St./Platinum Dr	East - Erb St. W	767.73	191.93	767.20	895.25	64.68	0.00	2116.46	1954.43	0.363	0.43	0.57
Erb St./Platinum Dr	North - Platinum Dr	851.33	212.83	850.24	279.39	552.48	0.00	1798.40	1246.01	0.473	0.62	0.89
Erb St./Platinum Dr	West - Erb St.	262.50	65.63	262.34	722.15	680.57	0.00	1694.27	1465.39	0.155	0.14	0.18
Erb St./Platinum Dr	South - Landfill Gate 2	60.23	15.06	60.13	43.12	899.79	23.37	695.92	0.00	0.087	0.07	0.09
Ira Needles Blvd/Erb St.	East - Erb St. W	865.71	216.43	862.69	613.89	1461.71	0.00	1371.83	1078.93	0.631	0.92	1.68
Ira Needles Blvd/Erb St.	North - Erbsville Rd	1272.05	318.01	1261.10	1115.06	1209.35	0.00	1535.83	1295.07	0.828	1.72	4.46
Ira Needles Blvd/Erb St.	West - Erb St.	1395.21	348.80	1058.17	1201.19	1269.26	0.00	1061.18	1001.41	1.315	10.83	95.09
Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	1397.91	349.48	1392.90	1644.74	682.69	23.37	1860.30	1875.62	0.751	1.68	2.93
Erbsville/Keats Way	East - Keats Way	169.01	42.25	168.72	241.34	653.74	11.69	788.91	277.13	0.214	0.20	0.27
Erbsville/Keats Way	North - Erbsville Road	1041.92	260.48	1040.49	665.37	157.09	4.49	1929.14	1830.31	0.540	0.81	1.16
Erbsville/Keats Way	West - Keats Way	185.19	46.30	184.46	123.89	1073.69	6.29	557.71	150.01	0.332	0.31	0.49
Erbsville/Keats Way	South - Erbsville Road	700.31	175.08	699.72	1062.79	195.36	8.09	1890.16	1816.47	0.371	0.44	0.59
Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	621.19	155.30	619.46	334.89	220.89	0.00	1088.48	818.29	0.571	0.87	1.30
Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	256.21	64.05	255.78	235.10	605.25	7.19	897.34	724.79	0.286	0.29	0.40
Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	287.67	71.92	287.31	569.50	291.54	0.00	1042.24	795.03	0.276	0.29	0.38
Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	266.10	66.52	265.80	288.87	289.98	6.29	1066.70	795.78	0.249	0.25	0.33
Fischer Hallman Road/Laurelwood Drive	East - Laurelwood Drive	273.29	68.32	272.63	182.10	695.67	11.69	775.11	232.04	0.353	0.37	0.54
Fischer Hallman Road/Laurelwood Drive	North - Bearinger Road	971.80	242.95	969.68	561.75	406.56	4.49	1656.58	1212.27	0.587	0.87	1.40

Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	315.54	78.89	314.24	530.37	845.87	6.29	678.11	574.97	0.465	0.53	0.85
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	630.18	157.55	629.69	912.03	248.08	8.09	1867.05	1713.42	0.338	0.38	0.51
Bearinger Road/Westmount Road	**East - Bearinger Road**	497.14	124.28	496.55	286.36	767.90	11.69	1482.39	527.64	0.335	0.35	0.50
Bearinger Road/Westmount Road	**North - Westmount Road**	1217.22	304.30	1212.50	890.01	374.43	4.49	1683.64	1586.77	0.723	1.36	2.53
Bearinger Road/Westmount Road	**West - Bearinger Road**	618.50	154.62	617.83	1003.76	583.17	6.29	1648.17	1532.01	0.375	0.43	0.60
Bearinger Road/Westmount Road	**South - Westmount Road**	396.45	99.11	396.14	542.88	658.12	8.09	1619.87	1033.65	0.245	0.24	0.32
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	437.80	109.45	437.11	326.87	107.76	11.69	1075.62	987.10	0.407	0.51	0.68
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	104.28	26.07	104.17	147.23	397.64	11.69	922.84	621.83	0.113	0.10	0.13
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	204.07	51.02	203.84	249.55	252.26	6.29	998.33	598.32	0.204	0.20	0.26
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	211.26	52.82	211.03	232.50	223.61	8.09	1002.48	467.01	0.211	0.21	0.27

Main results: (4:30 PM-4:45 PM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)
Ira Needles Blvd/University Avenue	**East - University Ave**	777.32	194.33	767.78	555.07	1032.01	14.31	985.54	729.84	0.789	1.06	3.44
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	1610.80	402.70	1206.42	966.78	833.03	5.51	1208.43	1178.97	1.333	15.92	117.01
Ira Needles Blvd/University Avenue	**West - Private Access**	511.97	127.99	213.55	555.70	1483.74	7.71	213.60	240.39	2.397	54.27	128.87
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	1356.46	339.12	1346.66	1456.86	240.43	9.91	1636.78	1636.78	0.829	2.05	4.50
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	276.36	69.09	274.88	241.04	1441.25	0.00	618.33	301.51	0.447	0.42	0.79
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	2270.30	567.57	1987.67	1589.09	127.04	0.00	1998.85	1990.56	1.136	9.26	79.92
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	240.02	60.01	239.42	124.61	1990.11	0.00	810.53	802.10	0.296	0.27	0.42
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	1378.47	344.62	1374.19	1921.44	308.10	0.00	1944.48	1608.73	0.709	1.31	2.38
Erb St./Platinum Dr	**East - Erb St. W**	940.28	235.07	939.34	1095.45	79.19	0.00	2106.80	1954.43	0.446	0.57	0.80
Erb St./Platinum Dr	**North - Platinum Dr**	1042.67	260.67	1040.14	342.07	676.45	0.00	1717.25	1246.01	0.607	0.89	1.52
Erb St./Platinum Dr	**West - Erb St.**	321.50	80.37	321.22	883.98	832.61	0.00	1595.83	1465.39	0.201	0.18	0.25
Erb St./Platinum Dr	**South - Landfill Gate 2**	73.77	18.44	73.58	52.78	1101.05	28.63	595.54	0.00	0.124	0.09	0.14
Ira Needles Blvd/Erb St.	**East - Erb St. W**	1060.28	265.07	1041.55	634.81	1710.32	0.00	1198.26	1079.83	0.885	1.68	6.36
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	1557.94	389.49	1346.46	1289.01	1462.87	0.00	1360.75	1294.88	1.145	4.46	57.33
Ira Needles Blvd/Erb St.	**West - Erb St.**	1708.78	427.19	977.27	1426.39	1382.94	0.00	977.35	1001.37	1.748	95.09	277.97
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	1712.08	428.02	1689.84	1704.92	655.29	28.63	1877.22	1874.20	0.912	2.93	8.49
Erbsville/Keats Way	**East - Keats Way**	206.99	51.75	206.44	294.78	799.89	14.31	707.44	277.28	0.293	0.27	0.41
Erbsville/Keats Way	**North - Erbsville Road**	1276.08	319.02	1272.77	814.09	192.23	5.51	1905.16	1829.96	0.670	1.16	1.99

Erbsville/Keats Way	**West - Keats Way**	226.81	56.70	224.38	151.60	1313.40	7.71	425.43	150.11	0.533	0.49	1.10
Erbsville/Keats Way	**South - Erbsville Road**	857.69	214.42	856.61	1299.73	238.05	9.91	1851.99	1815.92	0.463	0.59	0.86
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	760.80	190.20	756.20	409.90	270.41	0.00	1057.15	818.39	0.720	1.30	2.46
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	313.79	78.45	312.96	287.47	739.14	8.81	827.27	724.53	0.379	0.40	0.60
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	352.32	88.08	351.68	695.75	356.35	0.00	999.44	795.13	0.353	0.38	0.54
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	325.90	81.48	325.39	353.11	354.92	7.71	1032.16	795.49	0.316	0.33	0.46
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	334.71	83.68	333.20	222.25	850.43	14.31	693.13	232.19	0.483	0.54	0.91
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	1190.20	297.55	1182.38	686.36	497.28	5.51	1527.77	1212.20	0.779	1.40	3.36
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	386.46	96.61	381.99	647.92	1031.73	7.71	571.10	574.81	0.677	0.85	1.97
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	771.82	192.95	770.94	1111.99	301.74	9.91	1828.26	1713.03	0.422	0.51	0.73
Bearinger Road/Westmount Road	**East - Bearinger Road**	608.86	152.22	607.55	349.44	939.96	14.31	1336.00	527.70	0.456	0.50	0.83
Bearinger Road/Westmount Road	**North - Westmount Road**	1490.78	372.70	1454.01	1089.37	458.14	5.51	1568.37	1586.55	0.951	2.53	11.73
Bearinger Road/Westmount Road	**West - Bearinger Road**	757.50	189.38	756.17	1210.96	701.19	7.71	1563.47	1531.77	0.485	0.60	0.93
Bearinger Road/Westmount Road	**South - Westmount Road**	485.55	121.39	484.99	652.94	804.41	9.91	1527.40	1033.63	0.318	0.32	0.46
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	536.20	134.05	534.89	400.18	131.92	14.31	1061.19	986.28	0.505	0.68	1.01
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	127.72	31.93	127.54	180.20	486.61	14.31	873.05	621.89	0.146	0.13	0.17
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	249.93	62.48	249.56	305.40	308.75	7.71	964.80	598.34	0.259	0.26	0.35
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	258.74	64.69	258.35	284.56	273.76	9.91	964.17	466.88	0.268	0.27	0.36

Main results: (4:45 PM-5:00 PM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)
Ira Needles Blvd/University Avenue	**East - University Ave**	777.32	194.33	776.27	556.85	1038.82	14.31	975.64	729.84	0.797	3.44	3.71
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	1610.80	402.70	1201.54	973.76	841.34	5.51	1201.71	1178.97	1.340	117.01	219.33
Ira Needles Blvd/University Avenue	**West - Private Access**	511.97	127.99	213.42	559.45	1483.42	7.71	213.43	240.39	2.399	128.87	203.51
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	1356.46	339.12	1355.84	1457.00	239.84	9.91	1636.78	1636.78	0.829	4.50	4.65
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	276.36	69.09	276.31	241.91	1445.52	0.00	616.13	301.51	0.449	0.79	0.80
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	2270.30	567.57	1997.20	1594.12	127.70	0.00	1998.41	1990.56	1.136	79.92	148.20
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	240.02	60.01	240.00	125.21	1999.69	0.00	804.07	802.10	0.299	0.42	0.42
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	1378.47	344.62	1378.36	1930.62	309.07	0.00	1943.83	1608.73	0.709	2.38	2.41

Erb St./Platinum Dr	**East - Erb St. W**	940.28	235.07	940.27	1097.68	79.27	0.00	2106.75	1954.43	0.446	0.80	0.80
Erb St./Platinum Dr	**North - Platinum Dr**	1042.67	260.67	1042.62	342.42	677.12	0.00	1716.80	1246.01	0.607	1.52	1.53
Erb St./Platinum Dr	**West - Erb St.**	321.50	80.37	321.50	885.20	834.54	0.00	1594.58	1465.39	0.202	0.25	0.25
Erb St./Platinum Dr	**South - Landfill Gate 2**	73.77	18.44	73.77	52.85	1103.18	28.63	594.48	0.00	0.124	0.14	0.14
Ira Needles Blvd/Erb St.	**East - Erb St. W**	1060.28	265.07	1056.55	636.16	1727.10	0.00	1186.55	1079.83	0.894	6.36	7.29
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	1557.94	389.49	1346.07	1301.44	1482.22	0.00	1347.38	1294.88	1.156	57.33	110.30
Ira Needles Blvd/Erb St.	**West - Erb St.**	1708.78	427.19	974.90	1442.22	1386.07	0.00	974.92	1001.37	1.753	277.97	461.44
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	1712.08	428.02	1709.16	1706.87	654.09	28.63	1878.03	1874.20	0.912	8.49	9.22
Erbsville/Keats Way	**East - Keats Way**	206.99	51.75	206.98	296.12	801.49	14.31	706.54	277.28	0.293	0.41	0.41
Erbsville/Keats Way	**North - Erbsville Road**	1276.08	319.02	1276.01	815.80	192.67	5.51	1904.86	1829.96	0.670	1.99	2.01
Erbsville/Keats Way	**West - Keats Way**	226.81	56.70	226.69	151.93	1316.74	7.71	423.57	150.11	0.535	1.10	1.13
Erbsville/Keats Way	**South - Erbsville Road**	857.69	214.42	857.68	1303.50	239.93	9.91	1850.51	1815.92	0.463	0.86	0.86
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	760.80	190.20	760.58	410.67	270.84	0.00	1056.80	818.39	0.720	2.46	2.51
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	313.79	78.45	313.77	288.43	743.00	8.81	825.26	724.53	0.380	0.60	0.61
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	352.32	88.08	352.31	699.00	357.77	0.00	998.48	795.13	0.353	0.54	0.54
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	325.90	81.48	325.89	354.47	355.61	7.71	1031.80	795.49	0.316	0.46	0.46
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	334.71	83.68	334.66	223.43	853.11	14.31	691.68	232.19	0.484	0.91	0.93
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	1190.20	297.55	1189.80	689.06	498.72	5.51	1525.01	1212.20	0.780	3.36	3.46
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	386.46	96.61	386.11	650.58	1037.94	7.71	567.46	574.81	0.681	1.97	2.06
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	771.82	192.95	771.80	1119.31	304.74	9.91	1826.24	1713.03	0.423	0.73	0.73
Bearinger Road/Westmount Road	**East - Bearinger Road**	608.86	152.22	608.84	350.83	941.33	14.31	1334.78	527.70	0.456	0.83	0.83
Bearinger Road/Westmount Road	**North - Westmount Road**	1490.78	372.70	1480.05	1091.07	459.11	5.51	1561.96	1586.55	0.954	11.73	14.41
Bearinger Road/Westmount Road	**West - Bearinger Road**	757.50	189.38	757.45	1226.88	712.27	7.71	1555.44	1531.77	0.487	0.93	0.94
Bearinger Road/Westmount Road	**South - Westmount Road**	485.55	121.39	485.54	663.11	806.62	9.91	1525.98	1033.63	0.318	0.46	0.47
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	536.20	134.05	536.17	400.76	132.12	14.31	1061.07	986.28	0.505	1.01	1.01
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	127.72	31.93	127.72	180.56	487.73	14.31	872.43	621.89	0.146	0.17	0.17
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	249.93	62.48	249.93	306.07	309.37	7.71	964.42	598.34	0.259	0.35	0.35
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	258.74	64.69	258.74	285.15	274.15	9.91	963.86	466.88	0.268	0.36	0.37

Main results: (5:00 PM-5:15 PM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)
Ira Needles Blvd/University Avenue	**East - University Ave**	634.68	158.67	645.09	501.10	859.23	11.69	1217.99	729.99	0.521	3.71	1.10
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	1315.21	328.80	1315.23	806.60	697.72	4.49	1321.55	1179.32	0.995	219.33	219.32
Ira Needles Blvd/University Avenue	**West - Private Access**	418.02	104.51	196.32	489.45	1523.50	6.29	196.33	240.18	2.129	203.51	258.94
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	1107.55	276.89	1117.60	1477.10	242.73	8.09	1636.78	1636.78	0.677	4.65	2.14
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	225.64	56.41	227.12	216.19	1184.59	0.00	750.84	301.51	0.301	0.80	0.43
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	1853.69	463.42	2000.14	1306.75	104.96	0.00	2013.63	1990.56	0.921	148.20	111.58
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	195.98	48.99	196.39	120.65	1984.46	0.00	814.34	802.10	0.241	0.42	0.32
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	1125.52	281.38	1129.76	1909.83	271.01	0.00	1969.75	1608.73	0.571	2.41	1.35
Erb St./Platinum Dr	**East - Erb St. W**	767.73	191.93	768.66	898.54	64.81	0.00	2116.37	1954.43	0.363	0.80	0.57
Erb St./Platinum Dr	**North - Platinum Dr**	851.33	212.83	853.85	279.92	553.55	0.00	1797.70	1246.01	0.474	1.53	0.91
Erb St./Platinum Dr	**West - Erb St.**	262.50	65.63	262.77	724.01	683.38	0.00	1692.45	1465.39	0.155	0.25	0.18
Erb St./Platinum Dr	**South - Landfill Gate 2**	60.23	15.06	60.41	43.22	902.94	23.37	694.36	0.00	0.087	0.14	0.10
Ira Needles Blvd/Erb St.	**East - Erb St. W**	865.71	216.43	887.91	609.58	1458.76	0.00	1373.90	1078.93	0.630	7.29	1.74
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	1272.05	318.01	1500.33	1105.63	1241.03	0.00	1513.93	1295.07	0.840	110.30	53.23
Ira Needles Blvd/Erb St.	**West - Erb St.**	1395.21	348.80	913.31	1263.25	1478.11	0.00	913.32	1001.41	1.528	461.44	581.92
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	1397.91	349.48	1422.93	1746.02	645.41	23.37	1885.14	1875.62	0.742	9.22	2.96
Erbsville/Keats Way	**East - Keats Way**	169.01	42.25	169.55	243.24	656.12	11.69	787.60	277.13	0.215	0.41	0.28
Erbsville/Keats Way	**North - Erbsville Road**	1041.92	260.48	1045.21	667.91	157.76	4.49	1928.70	1830.31	0.540	2.01	1.19
Erbsville/Keats Way	**West - Keats Way**	185.19	46.30	187.66	124.39	1078.58	6.29	554.91	150.01	0.334	1.13	0.51
Erbsville/Keats Way	**South - Erbsville Road**	700.31	175.08	701.38	1068.27	197.98	8.09	1888.21	1816.47	0.371	0.86	0.59
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	621.19	155.30	625.81	336.08	221.58	0.00	1087.99	818.29	0.571	2.51	1.36
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	256.21	64.05	257.03	236.53	610.86	7.19	894.41	724.79	0.286	0.61	0.40
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	287.67	71.92	288.30	574.25	293.65	0.00	1040.89	795.03	0.276	0.54	0.38
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	266.10	66.52	266.60	290.89	291.06	6.29	1066.13	795.78	0.250	0.46	0.33
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	273.29	68.32	274.78	183.79	699.64	11.69	772.99	232.04	0.354	0.93	0.55
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	971.80	242.95	979.84	565.71	408.71	4.49	1653.16	1212.27	0.588	3.46	1.45
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	315.54	78.89	320.17	534.12	854.42	6.29	673.11	574.97	0.469	2.06	0.90
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	630.18	157.55	631.05	922.22	252.38	8.09	1864.23	1713.42	0.338	0.73	0.51

Bearinger Road/Westmount Road	**East - Bearinger Road**	497.14	124.28	498.44	288.90	770.02	11.69	1480.61	527.64	0.336	0.83	0.51
Bearinger Road/Westmount Road	**North - Westmount Road**	1217.22	304.30	1263.83	892.61	375.85	4.49	1673.67	1586.77	0.727	14.41	2.76
Bearinger Road/Westmount Road	**West - Bearinger Road**	618.50	154.62	619.82	1034.76	604.92	6.29	1632.86	1532.01	0.379	0.94	0.61
Bearinger Road/Westmount Road	**South - Westmount Road**	396.45	99.11	397.01	562.82	661.92	8.09	1617.45	1033.65	0.245	0.47	0.33
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	437.80	109.45	439.08	327.81	108.07	11.69	1075.44	987.10	0.407	1.01	0.69
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	104.28	26.07	104.45	147.79	399.37	11.69	921.90	621.83	0.113	0.17	0.13
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	204.07	51.02	204.43	250.58	253.23	6.29	997.77	598.32	0.205	0.35	0.26
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	211.26	52.82	211.65	233.43	224.23	8.09	1002.03	467.01	0.211	0.37	0.27

Main results: (5:15 PM-5:30 PM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)
Ira Needles Blvd/University Avenue	**East - University Ave**	531.51	132.88	533.46	457.85	718.26	9.79	1401.06	730.09	0.379	1.10	0.62
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	1101.43	275.36	1412.45	673.69	578.03	3.76	1418.89	1179.57	0.776	219.32	141.57
Ira Needles Blvd/University Avenue	**West - Private Access**	350.08	87.52	181.95	432.43	1558.04	5.27	181.95	240.01	1.924	258.94	300.97
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	927.52	231.88	930.78	1494.66	245.33	6.78	1636.78	1636.78	0.567	2.14	1.32
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	188.97	47.24	189.55	196.09	990.34	0.00	851.12	301.51	0.222	0.43	0.29
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	1552.38	388.09	1982.00	1092.28	87.60	0.00	2025.26	1990.56	0.767	111.58	4.18
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	164.12	41.03	164.41	116.17	1953.44	0.00	835.23	802.10	0.197	0.32	0.25
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	942.57	235.64	944.33	1875.77	242.09	0.00	1989.42	1608.73	0.474	1.35	0.91
Erb St./Platinum Dr	**East - Erb St. W**	642.94	160.73	643.48	751.65	54.26	0.00	2123.39	1954.43	0.303	0.57	0.44
Erb St./Platinum Dr	**North - Platinum Dr**	712.95	178.24	714.07	234.34	463.40	0.00	1856.72	1246.01	0.384	0.91	0.63
Erb St./Platinum Dr	**West - Erb St.**	219.83	54.96	220.00	605.93	571.54	0.00	1764.84	1465.39	0.125	0.18	0.14
Erb St./Platinum Dr	**South - Landfill Gate 2**	50.44	12.61	50.54	36.17	755.37	19.57	768.17	0.00	0.066	0.10	0.07
Ira Needles Blvd/Erb St.	**East - Erb St. W**	724.99	181.25	728.20	597.78	1271.84	0.00	1504.40	1078.28	0.482	1.74	0.94
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	1065.28	266.32	1270.93	979.30	1020.74	0.00	1666.08	1295.21	0.639	53.23	1.82
Ira Needles Blvd/Erb St.	**West - Erb St.**	1168.42	292.11	1078.95	1045.08	1246.60	0.00	1078.99	1001.44	1.083	581.92	604.28
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	1170.68	292.67	1175.55	1631.49	694.06	19.57	1853.63	1876.66	0.632	2.96	1.74
Erbsville/Keats Way	**East - Keats Way**	141.54	35.38	141.83	203.03	548.82	9.79	846.48	277.03	0.167	0.28	0.20
Erbsville/Keats Way	**North - Erbsville Road**	872.56	218.14	874.03	558.66	131.99	3.76	1945.91	1830.56	0.448	1.19	0.82
Erbsville/Keats Way	**West - Keats Way**	155.09	38.77	155.87	104.06	901.95	5.27	653.93	149.93	0.237	0.51	0.31
Erbsville/Keats Way	**South - Erbsville Road**	586.47	146.62	587.07	893.04	164.78	6.78	1915.54	1816.87	0.306	0.59	0.44
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	520.22	130.05	522.07	281.26	185.46	0.00	1109.92	818.22	0.469	1.36	0.89

Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	214.56	53.64	215.00	197.70	509.83	6.02	947.33	724.98	0.226	0.40	0.29
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	240.91	60.23	241.28	479.50	245.34	0.00	1071.26	794.97	0.225	0.38	0.29
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	222.84	55.71	223.15	243.05	243.57	5.27	1091.43	795.98	0.204	0.33	0.26
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	228.87	57.22	229.55	153.25	584.56	9.79	833.49	231.94	0.275	0.55	0.38
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	813.83	203.46	816.07	472.37	341.75	3.76	1738.32	1212.31	0.468	1.45	0.89
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	264.25	66.06	265.67	445.90	711.91	5.27	754.59	575.09	0.350	0.90	0.55
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	527.75	131.94	528.25	768.03	209.56	6.78	1894.00	1713.70	0.279	0.51	0.39
Bearinger Road/Westmount Road	**East - Bearinger Road**	416.33	104.08	416.93	240.61	644.46	9.79	1582.62	527.60	0.263	0.51	0.36
Bearinger Road/Westmount Road	**North - Westmount Road**	1019.36	254.84	1024.81	746.99	314.39	3.76	1759.51	1586.93	0.579	2.76	1.39
Bearinger Road/Westmount Road	**West - Bearinger Road**	517.96	129.49	518.67	846.73	492.48	5.27	1711.47	1532.18	0.303	0.61	0.44
Bearinger Road/Westmount Road	**South - Westmount Road**	332.01	83.00	332.33	458.41	552.74	6.78	1686.19	1033.66	0.197	0.33	0.25
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	366.64	91.66	367.36	274.40	90.46	9.79	1085.68	987.68	0.338	0.69	0.51
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	87.33	21.83	87.44	123.68	334.15	9.79	957.61	621.79	0.091	0.13	0.10
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	170.90	42.72	171.12	209.67	211.91	5.27	1021.43	598.31	0.167	0.26	0.20
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	176.92	44.23	177.16	195.33	187.71	6.78	1027.79	467.11	0.172	0.27	0.21

Queueing Delay Results

Queueing Delay results: (4:00 PM-4:15 PM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	**East - University Ave**	9.05	0.60	4.213	A	A
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	43.05	2.87	10.150	B	B
Ira Needles Blvd/University Avenue	**West - Private Access**	65.86	4.39	54.683	F	D
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	18.57	1.24	5.003	A	A
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	4.11	0.27	5.395	A	A
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	43.85	2.92	7.229	A	A
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	2.51	0.17	3.767	A	A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	12.87	0.86	3.368	A	A
Erb St./Platinum Dr	**East - Erb St. W**	6.38	0.43	2.427	A	A
Erb St./Platinum Dr	**North - Platinum Dr**	9.08	0.61	3.131	A	A

Erb St./Platinum Dr	**West - Erb St.**	2.10	0.14	2.326	A	A
Erb St./Platinum Dr	**South - Landfill Gate 2**	1.02	0.07	5.002	A	A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	13.34	0.89	4.573	A	A
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	24.53	1.64	5.797	A	A
Ira Needles Blvd/Erb St.	**West - Erb St.**	118.69	7.91	27.909	D	C
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	23.98	1.60	5.135	A	A
Erbsville/Keats Way	**East - Keats Way**	2.91	0.19	5.086	A	A
Erbsville/Keats Way	**North - Erbsville Road**	11.79	0.79	3.333	A	A
Erbsville/Keats Way	**West - Keats Way**	4.42	0.29	7.141	A	A
Erbsville/Keats Way	**South - Erbsville Road**	6.46	0.43	2.699	A	A
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	12.52	0.83	6.027	A	A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	4.23	0.28	4.888	A	A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	4.21	0.28	4.316	A	A
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	3.73	0.25	4.132	A	A
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	5.43	0.36	5.907	A	A
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	12.68	0.85	3.855	A	A
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	7.61	0.51	7.236	A	A
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	5.66	0.38	2.627	A	A
Bearinger Road/Westmount Road	**East - Bearinger Road**	5.21	0.35	3.072	A	A
Bearinger Road/Westmount Road	**North - Westmount Road**	19.51	1.30	4.778	A	A
Bearinger Road/Westmount Road	**West - Bearinger Road**	6.33	0.42	3.000	A	A
Bearinger Road/Westmount Road	**South - Westmount Road**	3.60	0.24	2.652	A	A
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	7.35	0.49	4.976	A	A
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	1.46	0.10	4.126	A	A
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	2.92	0.19	4.221	A	A
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	3.03	0.20	4.220	A	A

Queueing Delay results: (4:15 PM-4:30 PM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	**East - University Ave**	15.34	1.02	6.055	A	A
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	167.54	11.17	37.611	E	D
Ira Needles Blvd/University Avenue	**West - Private Access**	454.49	30.30	522.125	F	F
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	29.33	1.96	6.724	A	A

Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	6.17	0.41	6.799	A	A
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	114.88	7.66	17.510	C	B
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	3.93	0.26	4.939	A	A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	19.11	1.27	4.217	A	A
Erb St./Platinum Dr	**East - Erb St. W**	8.38	0.56	2.666	A	A
Erb St./Platinum Dr	**North - Platinum Dr**	13.09	0.87	3.794	A	A
Erb St./Platinum Dr	**West - Erb St.**	2.71	0.18	2.513	A	A
Erb St./Platinum Dr	**South - Landfill Gate 2**	1.39	0.09	5.662	A	A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	23.98	1.60	7.028	A	A
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	59.69	3.98	12.628	B	B
Ira Needles Blvd/Erb St.	**West - Erb St.**	797.65	53.18	193.784	F	F
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	41.31	2.75	7.619	A	A
Erbsville/Keats Way	**East - Keats Way**	3.97	0.26	5.802	A	A
Erbsville/Keats Way	**North - Erbsville Road**	17.02	1.13	4.044	A	A
Erbsville/Keats Way	**West - Keats Way**	7.07	0.47	9.625	A	A
Erbsville/Keats Way	**South - Erbsville Road**	8.65	0.58	3.022	A	A
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	18.80	1.25	7.646	A	A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	5.81	0.39	5.607	A	A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	5.57	0.37	4.766	A	A
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	4.87	0.32	4.494	A	A
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	7.84	0.52	7.156	A	A
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	20.29	1.35	5.225	A	A
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	12.26	0.82	9.858	A	A
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	7.50	0.50	2.907	A	A
Bearinger Road/Westmount Road	**East - Bearinger Road**	7.39	0.49	3.650	A	A
Bearinger Road/Westmount Road	**North - Westmount Road**	35.84	2.39	7.565	A	A
Bearinger Road/Westmount Road	**West - Bearinger Road**	8.80	0.59	3.492	A	A
Bearinger Road/Westmount Road	**South - Westmount Road**	4.78	0.32	2.941	A	A
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	9.94	0.66	5.632	A	A
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	1.87	0.12	4.397	A	A
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	3.77	0.25	4.530	A	A
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	3.91	0.26	4.547	A	A

Queueing Delay results: (4:30 PM-4:45 PM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	East - University Ave	45.69	3.05	15.890	C	B
Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	999.02	66.60	207.007	F	F
Ira Needles Blvd/University Avenue	West - Private Access	1373.55	91.57	1569.892	F	F
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	60.71	4.05	12.014	B	B
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	11.32	0.75	10.438	B	B
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	679.69	45.31	88.734	F	F
Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	6.08	0.41	6.297	A	A
Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	33.93	2.26	6.265	A	A
Erb St./Platinum Dr	East - Erb St. W	11.80	0.79	3.080	A	A
Erb St./Platinum Dr	North - Platinum Dr	22.02	1.47	5.296	A	A
Erb St./Platinum Dr	West - Erb St.	3.72	0.25	2.824	A	A
Erb St./Platinum Dr	South - Landfill Gate 2	2.05	0.14	6.896	A	A
Ira Needles Blvd/Erb St.	East - Erb St. W	78.91	5.26	20.901	C	C
Ira Needles Blvd/Erb St.	North - Erbsville Rd	478.06	31.87	92.646	F	F
Ira Needles Blvd/Erb St.	West - Erb St.	2798.03	186.54	695.672	F	F
Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	106.02	7.07	17.436	C	B
Erbsville/Keats Way	East - Keats Way	5.96	0.40	7.178	A	A
Erbsville/Keats Way	North - Erbsville Road	28.62	1.91	5.663	A	A
Erbsville/Keats Way	West - Keats Way	15.22	1.01	17.695	C	B
Erbsville/Keats Way	South - Erbsville Road	12.57	0.84	3.614	A	A
Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	34.16	2.28	11.781	B	B
Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	8.78	0.59	6.988	A	A
Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	7.90	0.53	5.551	A	A
Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	6.72	0.45	5.090	A	A
Fischer Hallman Road/Laurelwood Drive	East - Laurelwood Drive	13.10	0.87	9.961	A	A
Fischer Hallman Road/Laurelwood Drive	North - Bearinger Road	46.12	3.07	10.199	B	B
Fischer Hallman Road/Laurelwood Drive	West - Laurelwood Drive	26.79	1.79	18.611	C	B
Fischer Hallman Road/Laurelwood Drive	South - Fischer Hallman Road	10.68	0.71	3.401	A	A
Bearinger Road/Westmount Road	East - Bearinger Road	12.09	0.81	4.933	A	A
Bearinger Road/Westmount Road	North - Westmount Road	133.53	8.90	25.834	D	C
Bearinger Road/Westmount Road	West - Bearinger Road	13.61	0.91	4.452	A	A
Bearinger Road/Westmount Road	South - Westmount Road	6.83	0.46	3.451	A	A

Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	14.59	0.97	6.824	A	A
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	2.51	0.17	4.827	A	A
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	5.10	0.34	5.031	A	A
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	5.35	0.36	5.098	A	A

Queueing Delay results: (4:45 PM-5:00 PM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	**East - University Ave**	54.14	3.61	17.866	C	B
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	2522.61	168.17	493.000	F	F
Ira Needles Blvd/University Avenue	**West - Private Access**	2492.86	166.19	2826.545	F	F
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	68.87	4.59	12.736	B	B
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	11.99	0.80	10.590	B	B
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	1711.31	114.09	210.573	F	F
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	6.31	0.42	6.381	A	A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	35.96	2.40	6.361	A	A
Erb St./Platinum Dr	**East - Erb St. W**	12.04	0.80	3.085	A	A
Erb St./Platinum Dr	**North - Platinum Dr**	22.96	1.53	5.339	A	A
Erb St./Platinum Dr	**West - Erb St.**	3.78	0.25	2.827	A	A
Erb St./Platinum Dr	**South - Landfill Gate 2**	2.11	0.14	6.912	A	A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	103.78	6.92	26.315	D	C
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	1257.74	83.85	226.792	F	F
Ira Needles Blvd/Erb St.	**West - Erb St.**	5545.59	369.71	1373.154	F	F
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	133.70	8.91	20.499	C	C
Erbsville/Keats Way	**East - Keats Way**	6.16	0.41	7.205	A	A
Erbsville/Keats Way	**North - Erbsville Road**	30.04	2.00	5.722	A	A
Erbsville/Keats Way	**West - Keats Way**	16.73	1.12	18.258	C	B
Erbsville/Keats Way	**South - Erbsville Road**	12.88	0.86	3.625	A	A
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	37.34	2.49	12.128	B	B
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	9.11	0.61	7.037	A	A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	8.12	0.54	5.570	A	A
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	6.88	0.46	5.099	A	A
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	13.83	0.92	10.080	B	B
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	51.27	3.42	10.707	B	B

Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	30.36	2.02	19.762	C	B
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	10.92	0.73	3.413	A	A
Bearinger Road/Westmount Road	**East - Bearinger Road**	12.48	0.83	4.958	A	A
Bearinger Road/Westmount Road	**North - Westmount Road**	198.68	13.25	36.921	E	D
Bearinger Road/Westmount Road	**West - Bearinger Road**	14.09	0.94	4.511	A	A
Bearinger Road/Westmount Road	**South - Westmount Road**	6.97	0.46	3.459	A	A
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	15.16	1.01	6.857	A	A
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	2.56	0.17	4.833	A	A
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	5.22	0.35	5.038	A	A
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	5.47	0.36	5.105	A	A

Queueing Delay results: (5:00 PM-5:15 PM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	**East - University Ave**	17.78	1.19	6.396	A	A
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	3289.87	219.32	585.404	F	F
Ira Needles Blvd/University Avenue	**West - Private Access**	3468.34	231.22	4260.400	F	F
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	34.19	2.28	7.065	A	A
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	6.75	0.45	6.894	A	A
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	1948.35	129.89	234.117	F	F
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	4.90	0.33	5.828	A	A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	20.91	1.39	4.306	A	A
Erb St./Platinum Dr	**East - Erb St. W**	8.72	0.58	2.672	A	A
Erb St./Platinum Dr	**North - Platinum Dr**	13.97	0.93	3.826	A	A
Erb St./Platinum Dr	**West - Erb St.**	2.80	0.19	2.520	A	A
Erb St./Platinum Dr	**South - Landfill Gate 2**	1.47	0.10	5.681	A	A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	29.95	2.00	7.735	A	A
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	1226.51	81.77	194.610	F	F
Ira Needles Blvd/Erb St.	**West - Erb St.**	7825.17	521.68	2061.311	F	F
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	50.43	3.36	8.186	A	A
Erbsville/Keats Way	**East - Keats Way**	4.24	0.28	5.829	A	A
Erbsville/Keats Way	**North - Erbsville Road**	18.34	1.22	4.091	A	A
Erbsville/Keats Way	**West - Keats Way**	8.04	0.54	9.867	A	A
Erbsville/Keats Way	**South - Erbsville Road**	9.05	0.60	3.037	A	A

Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	21.40	1.43	7.866	A	A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	6.24	0.42	5.656	A	A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	5.90	0.39	4.787	A	A
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	5.12	0.34	4.505	A	A
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	8.61	0.57	7.246	A	A
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	22.81	1.52	5.410	A	A
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	14.39	0.96	10.329	B	B
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	7.83	0.52	2.920	A	A
Bearinger Road/Westmount Road	**East - Bearinger Road**	7.80	0.52	3.672	A	A
Bearinger Road/Westmount Road	**North - Westmount Road**	55.17	3.68	9.744	A	A
Bearinger Road/Westmount Road	**West - Bearinger Road**	9.40	0.63	3.560	A	A
Bearinger Road/Westmount Road	**South - Westmount Road**	4.97	0.33	2.950	A	A
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	10.71	0.71	5.670	A	A
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	1.96	0.13	4.404	A	A
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	3.96	0.26	4.541	A	A
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	4.11	0.27	4.558	A	A

Queueing Delay results: (5:15 PM-5:30 PM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	**East - University Ave**	9.48	0.63	4.158	A	A
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	2706.66	180.44	460.419	F	F
Ira Needles Blvd/University Avenue	**West - Private Access**	4199.27	279.95	5560.329	F	F
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	20.59	1.37	5.124	A	A
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	4.42	0.29	5.445	A	A
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	823.75	54.92	102.717	F	F
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	3.77	0.25	5.368	A	A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	13.92	0.93	3.449	A	A
Erb St./Platinum Dr	**East - Erb St. W**	6.63	0.44	2.434	A	A
Erb St./Platinum Dr	**North - Platinum Dr**	9.58	0.64	3.152	A	A
Erb St./Platinum Dr	**West - Erb St.**	2.16	0.14	2.332	A	A
Erb St./Platinum Dr	**South - Landfill Gate 2**	1.08	0.07	5.016	A	A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	14.55	0.97	4.658	A	A
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	167.40	11.16	15.540	C	B

Ira Needles Blvd/Erb St.	**West - Erb St.**	8896.50	593.10	1982.950	F	F
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	27.22	1.81	5.348	A	A
Erbsville/Keats Way	**East - Keats Way**	3.09	0.21	5.110	A	A
Erbsville/Keats Way	**North - Erbsville Road**	12.54	0.84	3.365	A	A
Erbsville/Keats Way	**West - Keats Way**	4.86	0.32	7.241	A	A
Erbsville/Keats Way	**South - Erbsville Road**	6.74	0.45	2.712	A	A
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	13.86	0.92	6.145	A	A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	4.52	0.30	4.920	A	A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	4.46	0.30	4.340	A	A
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	3.94	0.26	4.148	A	A
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	5.88	0.39	5.969	A	A
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	13.67	0.91	3.912	A	A
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	8.48	0.57	7.383	A	A
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	5.90	0.39	2.636	A	A
Bearinger Road/Westmount Road	**East - Bearinger Road**	5.47	0.36	3.089	A	A
Bearinger Road/Westmount Road	**North - Westmount Road**	21.74	1.45	4.935	A	A
Bearinger Road/Westmount Road	**West - Bearinger Road**	6.65	0.44	3.021	A	A
Bearinger Road/Westmount Road	**South - Westmount Road**	3.74	0.25	2.659	A	A
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	7.89	0.53	5.018	A	A
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	1.54	0.10	4.138	A	A
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	3.08	0.21	4.236	A	A
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	3.19	0.21	4.233	A	A

These additional roundabouts were added later to the analysis as new ARCADY files and include planned and recommended-case analysis sets. These sheets are included in both Appendices

File: J:\04 STAFF FOLDERS\Ubaid\Roundabout Analysis Lukezic\Updated Analysis\Future Conditions\New Roundabouts.arc7
Report generation date: 06/06/2018 3:26:42 PM

Summary of roundabout performance

	AM				PM			
	Queue (PCE)	Delay (s)	RFC	LOS	Queue (PCE)	Delay (s)	RFC	LOS
	Planned 2031 Conditions - (Scenario1)							
Columbia Dr Platinum Dr - Columbia St E	1.12	6.64	0.53	A	0.74	5.87	0.43	A
Columbia Dr Platinum Dr - Columbia St W	1.76	8.93	0.64	A	0.41	3.87	0.29	A
Columbia Dr Platinum Dr - Platinum Dr S	0.02	3.49	0.02	A	1.29	7.25	0.57	A
Boardwalk/Erb - Erb St E	1.37	4.58	0.58	A	1.87	5.57	0.65	A
Boardwalk/Erb - Erb St W	0.92	2.86	0.48	A	6.48	11.40	0.87	B
Boardwalk/Erb - The Boardwalk S	0.24	2.60	0.19	A	0.33	3.36	0.25	A
	Planned 2031 With Recommendations - (Scenario1)							

Columbia Dr Platinum Dr - Columbia St E	0.42	2.47	0.29	A	0.30	2.38	0.23	A
Columbia Dr Platinum Dr - Columbia St W	0.50	2.53	0.34	A	0.19	1.80	0.16	A
Columbia Dr Platinum Dr - Platinum Dr S	0.01	1.77	0.01	A	0.43	2.36	0.30	A
Boardwalk/Erb - Erb St E	1.37	4.58	0.58	A	1.87	5.57	0.65	A
Boardwalk/Erb - Erb St W	0.92	2.86	0.48	A	6.48	11.40	0.87	B
Boardwalk/Erb - The Boardwalk S	0.74	8.03	0.43	A	1.77	18.52	0.65	C

Values shown are the maximum values over all time segments. Delay is the maximum value of average delay per arriving vehicle.
(Scenario1) - AM runs from 08:00:00 to 09:30:00
(Scenario1) - PM runs from 16:00:00 to 17:30:00

File summary

File Description

Title	(untitled)
Location	
Site Number	
Date	25/04/2018
Version	
Status	(new file)
Identifier	
Client	
Jobnumber	
Analyst	CORP\ubaidalis
Description	

Analysis Options

RFC Threshold	Vehicle Length (m)	Do Queue Variations
0.85	5.75	

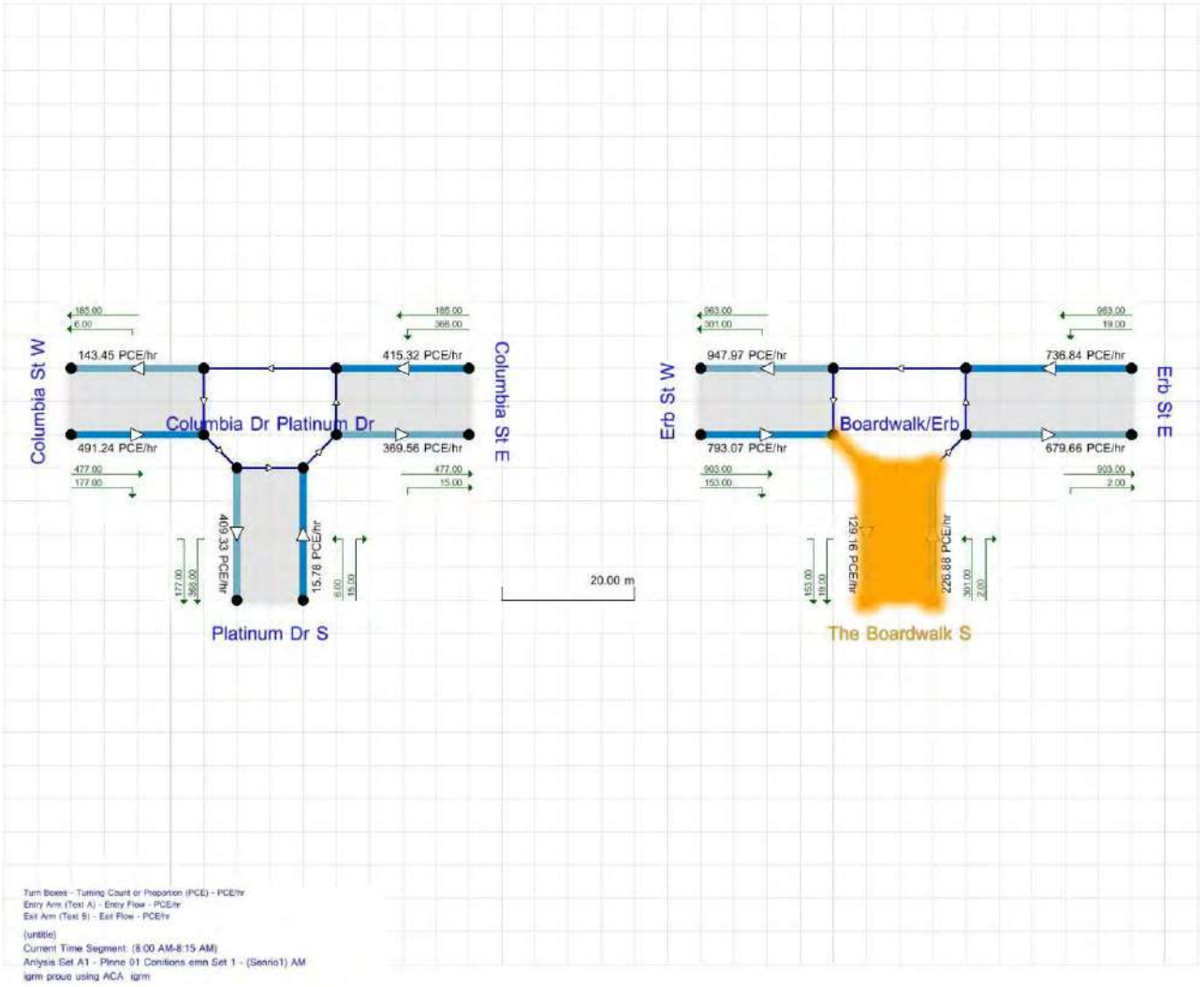
Sorting and Display

Show Arm Names	Arm Grouping	Sorting Direction	Sorting Type	Data Matrix Style	Time Style
Yes	Order	Ascending	Numerical	By Destination	Absolute Time

Units

Distance Units	Speed Units	Traffic Units Input	Traffic Units Results	Flow Units	Average Delay Units	Total Delay Units	Rate Of Delay Units

m	kph	PCE	PCE	perHour	s	-Min	perMin



The intersection diagram reflects the last run of ARCADY.

A1 - Planned 2031 Conditions - D1 - (Scenario1), AM

Data Errors and Warnings

No errors or warnings

Analysis Set Details

Name	Description	Include In Report	Use Specific Demand Set	Demand Set	Locked	Network Flow Scaling Factor (%)	Network Capacity Scaling Factor (%)	Reason For Scaling Factors
Planned 2031 Conditions		Yes		(D1)		100.000	100.000	

Demand Set Details

Name	Scenario Name	Time Period Name	Description	Locked	Run Automatically	Use Relationship	Relationship	Start Time (HH:mm)	Finish Time (HH:mm)	Time Period Length (min)	Time Segment Length (min)	Traffic Profile Type
(Scenario1), AM	(Scenario1)	AM			Yes			08:00	09:30	90	15	ONE HOUR

Roundabout Network

Roundabout Type(s)

Roundabout	ID	Name	Arm Order	Roundabout Type	Grade Separated	Large Roundabout	Do Geometric Delay
1	1	Columbia Dr Platinum Dr	1,2,3	Standard			
2	2	Boardwalk/Erb	1,2,3	Standard			

Roundabout Network Options

Driving Side	Lighting	Road Surface	In London
Right	Normal/unknown	((Mini-roundabouts only))	

Arms

Arms

ID	Name	Description
1	Columbia St E	
2	Columbia St W	
3	Platinum Dr S	
1	Erb St E	
2	Erb St W	
3	The Boardwalk S	

Capacity Options

Roundabout	Arm	Minimum Capacity (PCE/hr)	Maximum Capacity (PCE/hr)	Assume Flat Start Profile	Initial Queue (PCE)
Columbia Dr Platinum Dr	**Columbia St E**	0.00	99999.00		0.00
Columbia Dr Platinum Dr	**Columbia St W**	0.00	99999.00		0.00
Columbia Dr Platinum Dr	**Platinum Dr S**	0.00	99999.00		0.00
Boardwalk/Erb	**Erb St E**	0.00	99999.00		0.00
Boardwalk/Erb	**Erb St W**	0.00	99999.00		0.00
Boardwalk/Erb	**The Boardwalk S**	0.00	99999.00		0.00

Standard Geometry

Roundabout	Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit Only
Columbia Dr Platinum Dr	**Columbia St E**	3.50	4.50	30.00	20.00	40.00	25.00	
Columbia Dr Platinum Dr	**Columbia St W**	3.50	4.50	30.00	20.00	40.00	25.00	
Columbia Dr Platinum Dr	**Platinum Dr S**	3.50	4.50	30.00	20.00	40.00	25.00	
Boardwalk/Erb	**Erb St E**	7.00	8.00	30.00	20.00	55.00	25.00	
Boardwalk/Erb	**Erb St W**	7.00	8.00	30.00	20.00	55.00	25.00	
Boardwalk/Erb	**The Boardwalk S**	7.00	8.00	30.00	20.00	55.00	25.00	

Pedestrian Crossings

Roundabout	Arm	Crossing Type
Columbia Dr Platinum Dr	**Columbia St E**	None
Columbia Dr Platinum Dr	**Columbia St W**	None
Columbia Dr Platinum Dr	**Platinum Dr S**	None
Boardwalk/Erb	**Erb St E**	None

Boardwalk/Erb	**Erb St W**	None
Boardwalk/Erb	**The Boardwalk S**	None

Arm Slope/ Intercept and Capacity

Slope and Intercept used in model

Roundabout	Arm	Enter Directly	Slope	Intercept (PCE/hr)	Final Slope	Final Intercept (PCE/hr)
Columbia Dr Platinum Dr	**Columbia St E**		((calculated))	((calculated))	0.579	1357.445
Columbia Dr Platinum Dr	**Columbia St W**		((calculated))	((calculated))	0.579	1357.445
Columbia Dr Platinum Dr	**Platinum Dr S**		((calculated))	((calculated))	0.579	1357.445
Boardwalk/Erb	**Erb St E**		((calculated))	((calculated))	0.723	2436.345
Boardwalk/Erb	**Erb St W**		((calculated))	((calculated))	0.723	2436.345
Boardwalk/Erb	**The Boardwalk S**		((calculated))	((calculated))	0.723	2436.345

The slope and intercept shown above include any corrections and adjustments.

Arm Capacity Adjustments

Roundabout	Arm	Type	Reason	Direct Capacity Adjustment (PCE/hr)	Percentage Capacity Adjustment (%)
Columbia Dr Platinum Dr	**Columbia St E**	Percentage		N/A	85.00
Columbia Dr Platinum Dr	**Columbia St W**	None	N/A	N/A	N/A
Columbia Dr Platinum Dr	**Platinum Dr S**	None	N/A	N/A	N/A
Boardwalk/Erb	**Erb St E**	Percentage		N/A	85.00
Boardwalk/Erb	**Erb St W**	None	N/A	N/A	N/A
Boardwalk/Erb	**The Boardwalk S**	None	N/A	N/A	N/A

Traffic Flows

Demand Set Data Options

Default Vehicle Mix	Vehicle Mix Varies Over Time	Vehicle Mix Varies Over Turn	Vehicle Mix Varies Over Entry	Vehicle Mix Source	PCE Factor for a Truck (PCE)	Default Turning Proportions	Estimate from entry/exit counts	Turning Proportions Vary Over Time	Turning Proportions Vary Over Turn	Turning Proportions Vary Over Entry
		Yes	Yes	Truck Percentages	2.00				Yes	Yes

Entry Flows

General Flows Data

Roundabout	Arm	Profile Type	Use Turning Counts	Average Demand Flow (PCE/hr)	Flow Scaling Factor (%)	PHF
Columbia Dr Platinum Dr	Columbia St E	ONE HOUR	Yes	553.00	100.000	N/A
Columbia Dr Platinum Dr	Columbia St W	ONE HOUR	Yes	654.00	100.000	N/A
Columbia Dr Platinum Dr	Platinum Dr S	ONE HOUR	Yes	21.00	100.000	N/A
Boardwalk/Erb	Erb St E	ONE HOUR	Yes	982.00	100.000	N/A
Boardwalk/Erb	Erb St W	ONE HOUR	Yes	1056.00	100.000	N/A
Boardwalk/Erb	The Boardwalk S	ONE HOUR	Yes	303.00	100.000	N/A

Direct/Resultant Flows

Direct Flows Data

Time Segment	Roundabout	Arm	Direct Demand Entry Flow (PCE/hr)	DirectDemandEntryFlowInPCE (PCE/hr)	Direct Demand Exit Flow (PCE/hr)	Direct Demand Pedestrian Flow (Ped/hr)
1	Columbia Dr Platinum Dr	Columbia St E	416.33	416.33	N/A	N/A
1	Columbia Dr Platinum Dr	Columbia St W	492.37	492.37	N/A	N/A
1	Columbia Dr Platinum Dr	Platinum Dr S	15.81	15.81	N/A	N/A
1	Boardwalk/Erb	Erb St E	739.30	739.30	N/A	N/A
1	Boardwalk/Erb	Erb St W	795.01	795.01	N/A	N/A
1	Boardwalk/Erb	The Boardwalk S	228.11	228.11	N/A	N/A
2	Columbia Dr Platinum Dr	Columbia St E	497.14	497.14	N/A	N/A
2	Columbia Dr Platinum Dr	Columbia St W	587.93	587.93	N/A	N/A
2	Columbia Dr Platinum Dr	Platinum Dr S	18.88	18.88	N/A	N/A
2	Boardwalk/Erb	Erb St E	882.80	882.80	N/A	N/A
2	Boardwalk/Erb	Erb St W	949.32	949.32	N/A	N/A
2	Boardwalk/Erb	The Boardwalk S	272.39	272.39	N/A	N/A
3	Columbia Dr Platinum Dr	Columbia St E	608.86	608.86	N/A	N/A
3	Columbia Dr Platinum Dr	Columbia St W	720.07	720.07	N/A	N/A
3	Columbia Dr Platinum Dr	Platinum Dr S	23.12	23.12	N/A	N/A
3	Boardwalk/Erb	Erb St E	1081.20	1081.20	N/A	N/A

3	Boardwalk/Erb	Erb St W	1162.68	1162.68	N/A	N/A
3	Boardwalk/Erb	The Boardwalk S	333.61	333.61	N/A	N/A
4	Columbia Dr Platinum Dr	Columbia St E	608.86	608.86	N/A	N/A
4	Columbia Dr Platinum Dr	Columbia St W	720.07	720.07	N/A	N/A
4	Columbia Dr Platinum Dr	Platinum Dr S	23.12	23.12	N/A	N/A
4	Boardwalk/Erb	Erb St E	1081.20	1081.20	N/A	N/A
4	Boardwalk/Erb	Erb St W	1162.68	1162.68	N/A	N/A
4	Boardwalk/Erb	The Boardwalk S	333.61	333.61	N/A	N/A
5	Columbia Dr Platinum Dr	Columbia St E	497.14	497.14	N/A	N/A
5	Columbia Dr Platinum Dr	Columbia St W	587.93	587.93	N/A	N/A
5	Columbia Dr Platinum Dr	Platinum Dr S	18.88	18.88	N/A	N/A
5	Boardwalk/Erb	Erb St E	882.80	882.80	N/A	N/A
5	Boardwalk/Erb	Erb St W	949.32	949.32	N/A	N/A
5	Boardwalk/Erb	The Boardwalk S	272.39	272.39	N/A	N/A
6	Columbia Dr Platinum Dr	Columbia St E	416.33	416.33	N/A	N/A
6	Columbia Dr Platinum Dr	Columbia St W	492.37	492.37	N/A	N/A
6	Columbia Dr Platinum Dr	Platinum Dr S	15.81	15.81	N/A	N/A
6	Boardwalk/Erb	Erb St E	739.30	739.30	N/A	N/A
6	Boardwalk/Erb	Erb St W	795.01	795.01	N/A	N/A
6	Boardwalk/Erb	The Boardwalk S	228.11	228.11	N/A	N/A

Turning Proportions

Turning Counts or Proportions (PCE/hr) - Columbia Dr Platinum Dr (for whole period)

		To		
		1	2	3
From	1	0.000	185.000	368.000
	2	477.000	0.000	177.000
	3	15.000	6.000	0.000

Turning Proportions (PCE) - Columbia Dr Platinum Dr (for whole period)

	To

		1	2	3
From	1	0.00	0.33	0.67
	2	0.73	0.00	0.27
	3	0.71	0.29	0.00

Turning Counts or Proportions (PCE/hr) - Boardwalk/ Erb (for whole period)

		To		
		1	2	3
From	1	0.000	963.000	19.000
	2	903.000	0.000	153.000
	3	2.000	301.000	0.000

Turning Proportions (PCE) - Boardwalk/ Erb (for whole period)

		To		
		1	2	3
From	1	0.00	0.98	0.02
	2	0.86	0.00	0.14
	3	0.01	0.99	0.00

Vehicle Mix

Average PCE Per Vehicle - Columbia Dr Platinum Dr (for whole period)

		To		
		1	2	3
From	1	1.000	1.000	1.000
	2	1.000	1.000	1.000
	3	1.000	1.000	1.000

Truck Percentages - Columbia Dr Platinum Dr (for whole period)

		To		
		1	2	3
From	1	0.000	0.000	0.000

	2	0.000	0.000	0.000
	3	0.000	0.000	0.000

Average PCE Per Vehicle - Boardwalk/ Erb (for whole period)

		To		
		1	2	3
From	1	1.000	1.000	1.000
	2	1.000	1.000	1.000
	3	1.000	1.000	1.000

Truck Percentages - Boardwalk/ Erb (for whole period)

		To		
		1	2	3
From	1	0.000	0.000	0.000
	2	0.000	0.000	0.000
	3	0.000	0.000	0.000

Results

Results Summary

Roundabout	Arm	Max RFC	Max Delay (s)	Max Queue (PCE)	Max LOS	Total Demand (PCE/hr)	Total Arrivals (PCE)	Total Queueing Delay (PCE-min)	Average Queueing Delay (s)	Rate Of Queueing Delay (PCE-min/min)	Inclusive Queueing Total Delay (PCE-min)	Inclusive Queueing Average Delay (s)	Slope	Intercept (PCE/hr)
Columbia Dr Platinum Dr	Columbia St E	0.53	6.64	1.12	A	507.44	761.16	72.52	5.72	0.81	72.53	5.72	0.579	1357.445
Columbia Dr Platinum Dr	Columbia St W	0.64	8.93	1.76	A	600.12	900.18	102.59	6.84	1.14	102.60	6.84	0.579	1357.445
Columbia Dr Platinum Dr	Platinum Dr S	0.02	3.49	0.02	A	19.27	28.90	1.60	3.33	0.02	1.60	3.33	0.579	1357.445
Boardwalk/Erb	Erb St E	0.58	4.58	1.37	A	901.10	1351.65	84.78	3.76	0.94	84.78	3.76	0.723	2436.345
Boardwalk/Erb	Erb St W	0.48	2.86	0.92	A	969.00	1453.51	61.26	2.53	0.68	61.26	2.53	0.723	2436.345
Boardwalk/Erb	The Boardwalk S	0.19	2.60	0.24	A	278.04	417.06	16.33	2.35	0.18	16.33	2.35	0.723	2436.345

Main Results

Main results: (8:00 AM-8:15 AM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	416.33	104.08	414.08	368.35	4.50	0.00	1151.61	1020.26	0.362	0.00	0.56
Columbia Dr Platinum Dr	Columbia St W	492.37	123.09	489.60	143.03	275.56	0.00	1197.96	964.50	0.411	0.00	0.69
Columbia Dr Platinum Dr	Platinum Dr S	15.81	3.95	15.75	408.06	357.09	0.00	1150.77	950.31	0.014	0.00	0.01
Boardwalk/Erb	Erb St E	739.30	184.83	736.83	679.67	226.08	0.00	1931.96	1495.17	0.383	0.00	0.62
Boardwalk/Erb	Erb St W	795.01	198.75	793.07	948.66	14.26	0.00	2426.04	2415.43	0.328	0.00	0.49
Boardwalk/Erb	The Boardwalk S	228.11	57.03	227.58	129.16	678.16	0.00	1946.07	943.12	0.117	0.00	0.13

Main results: (8:15 AM-8:30 AM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	497.14	124.28	496.37	441.38	5.39	0.00	1151.18	1020.26	0.432	0.56	0.75
Columbia Dr Platinum Dr	Columbia St W	587.93	146.98	586.69	171.45	330.32	0.00	1166.27	964.50	0.504	0.69	1.00
Columbia Dr Platinum Dr	Platinum Dr S	18.88	4.72	18.87	489.10	427.90	0.00	1109.79	950.31	0.017	0.01	0.02
Boardwalk/Erb	Erb St E	882.80	220.70	881.83	813.04	270.43	0.00	1904.71	1495.17	0.463	0.62	0.86
Boardwalk/Erb	Erb St W	949.32	237.33	948.70	1135.21	17.06	0.00	2424.01	2415.43	0.392	0.49	0.64
Boardwalk/Erb	The Boardwalk S	272.39	68.10	272.23	154.52	811.25	0.00	1849.85	943.12	0.147	0.13	0.17

Main results: (8:30 AM-8:45 AM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	608.86	152.22	607.44	539.54	6.60	0.00	1150.58	1020.26	0.529	0.75	1.11
Columbia Dr Platinum Dr	Columbia St W	720.07	180.02	717.12	209.81	404.23	0.00	1123.49	964.50	0.641	1.00	1.74
Columbia Dr Platinum Dr	Platinum Dr S	23.12	5.78	23.10	598.31	523.04	0.00	1054.73	950.31	0.022	0.02	0.02
Boardwalk/Erb	Erb St E	1081.20	270.30	1079.20	995.47	331.14	0.00	1867.41	1495.17	0.579	0.86	1.36
Boardwalk/Erb	Erb St W	1162.68	290.67	1161.57	1389.45	20.88	0.00	2421.25	2415.43	0.480	0.64	0.92
Boardwalk/Erb	The Boardwalk S	333.61	83.40	333.34	189.18	993.27	0.00	1718.26	943.12	0.194	0.17	0.24

Main results: (8:45 AM-9:00 AM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	608.86	152.22	608.83	541.63	6.61	0.00	1150.58	1020.26	0.529	1.11	1.12
Columbia Dr Platinum Dr	Columbia St W	720.07	180.02	719.97	210.28	405.15	0.00	1122.96	964.50	0.641	1.74	1.76
Columbia Dr Platinum Dr	Platinum Dr S	23.12	5.78	23.12	600.01	525.12	0.00	1053.53	950.31	0.022	0.02	0.02
Boardwalk/Erb	Erb St E	1081.20	270.30	1081.17	996.41	331.41	0.00	1867.24	1495.17	0.579	1.36	1.37
Boardwalk/Erb	Erb St W	1162.68	290.67	1162.67	1391.66	20.92	0.00	2421.22	2415.43	0.480	0.92	0.92
Boardwalk/Erb	The Boardwalk S	333.61	83.40	333.61	189.37	994.21	0.00	1717.58	943.12	0.194	0.24	0.24

Main results: (9:00 AM-9:15 AM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	497.14	124.28	498.52	444.44	5.40	0.00	1151.17	1020.26	0.432	1.12	0.77
Columbia Dr Platinum Dr	Columbia St W	587.93	146.98	590.86	172.18	331.75	0.00	1165.44	964.50	0.504	1.76	1.03
Columbia Dr Platinum Dr	Platinum Dr S	18.88	4.72	18.90	491.66	430.95	0.00	1108.03	950.31	0.017	0.02	0.02
Boardwalk/Erb	Erb St E	882.80	220.70	884.79	814.52	270.86	0.00	1904.45	1495.17	0.464	1.37	0.87
Boardwalk/Erb	Erb St W	949.32	237.33	950.42	1138.53	17.12	0.00	2423.97	2415.43	0.392	0.92	0.65
Boardwalk/Erb	The Boardwalk S	272.39	68.10	272.66	154.82	812.72	0.00	1848.79	943.12	0.147	0.24	0.17

Main results: (9:15 AM-9:30 AM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	416.33	104.08	417.12	371.37	4.52	0.00	1151.60	1020.26	0.362	0.77	0.57
Columbia Dr Platinum Dr	Columbia St W	492.37	123.09	493.67	144.06	277.57	0.00	1196.80	964.50	0.411	1.03	0.71
Columbia Dr Platinum Dr	Platinum Dr S	15.81	3.95	15.82	411.18	360.06	0.00	1149.06	950.31	0.014	0.02	0.01
Boardwalk/Erb	Erb St E	739.30	184.83	740.29	681.87	226.77	0.00	1931.54	1495.17	0.383	0.87	0.62
Boardwalk/Erb	Erb St W	795.01	198.75	795.64	952.73	14.32	0.00	2425.99	2415.43	0.328	0.65	0.49
Boardwalk/Erb	The Boardwalk S	228.11	57.03	228.27	129.60	680.36	0.00	1944.48	943.12	0.117	0.17	0.13

Queueing Delay Results

Queueing Delay results: (8:00 AM-8:15 AM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	Columbia St E	8.16	0.54	4.866	A	A
Columbia Dr Platinum Dr	Columbia St W	10.02	0.67	5.063	A	A
Columbia Dr Platinum Dr	Platinum Dr S	0.20	0.01	3.171	A	A
Boardwalk/Erb	Erb St E	9.04	0.60	3.005	A	A
Boardwalk/Erb	Erb St W	7.17	0.48	2.201	A	A
Boardwalk/Erb	The Boardwalk S	1.96	0.13	2.095	A	A

Queueing Delay results: (8:15 AM-8:30 AM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	Columbia St E	11.01	0.73	5.490	A	A
Columbia Dr Platinum Dr	Columbia St W	14.58	0.97	6.197	A	A
Columbia Dr Platinum Dr	Platinum Dr S	0.26	0.02	3.299	A	A
Boardwalk/Erb	Erb St E	12.61	0.84	3.516	A	A
Boardwalk/Erb	Erb St W	9.48	0.63	2.438	A	A
Boardwalk/Erb	The Boardwalk S	2.56	0.17	2.281	A	A

Queueing Delay results: (8:30 AM-8:45 AM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	Columbia St E	16.05	1.07	6.610	A	A
Columbia Dr Platinum Dr	Columbia St W	24.72	1.65	8.794	A	A
Columbia Dr Platinum Dr	Platinum Dr S	0.33	0.02	3.488	A	A
Boardwalk/Erb	Erb St E	19.77	1.32	4.555	A	A
Boardwalk/Erb	Erb St W	13.53	0.90	2.855	A	A
Boardwalk/Erb	The Boardwalk S	3.56	0.24	2.599	A	A

Queueing Delay results: (8:45 AM-9:00 AM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	Columbia St E	16.68	1.11	6.644	A	A
Columbia Dr Platinum Dr	Columbia St W	26.30	1.75	8.928	A	A
Columbia Dr Platinum Dr	Platinum Dr S	0.34	0.02	3.492	A	A

Boardwalk/Erb	**Erb St E**	20.46	1.36	4.579	A	A
Boardwalk/Erb	**Erb St W**	13.80	0.92	2.859	A	A
Boardwalk/Erb	**The Boardwalk S**	3.61	0.24	2.600	A	A

Queueing Delay results: (9:00 AM-9:15 AM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	**Columbia St E**	11.86	0.79	5.529	A	A
Columbia Dr Platinum Dr	**Columbia St W**	16.09	1.07	6.298	A	A
Columbia Dr Platinum Dr	**Platinum Dr S**	0.26	0.02	3.304	A	A
Boardwalk/Erb	**Erb St E**	13.37	0.89	3.536	A	A
Boardwalk/Erb	**Erb St W**	9.85	0.66	2.446	A	A
Boardwalk/Erb	**The Boardwalk S**	2.63	0.18	2.284	A	A

Queueing Delay results: (9:15 AM-9:30 AM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	**Columbia St E**	8.76	0.58	4.906	A	A
Columbia Dr Platinum Dr	**Columbia St W**	10.88	0.73	5.129	A	A
Columbia Dr Platinum Dr	**Platinum Dr S**	0.21	0.01	3.178	A	A
Boardwalk/Erb	**Erb St E**	9.52	0.63	3.026	A	A
Boardwalk/Erb	**Erb St W**	7.43	0.50	2.208	A	A
Boardwalk/Erb	**The Boardwalk S**	2.02	0.13	2.099	A	A

A1 - Planned 2031 Conditions - D2 - (Scenario1), PM

Data Errors and Warnings

No errors or warnings

Analysis Set Details

Name	Description	Include In Report	Use Specific Demand Set	Demand Set	Locked	Network Flow Scaling Factor (%)	Network Capacity Scaling Factor (%)	Reason For Scaling Factors
Planned 2031 Conditions		Yes		(D1)		100.000	100.000	

Demand Set Details

Name	Scenario Name	Time Period Name	Description	Locked	Run Automatically	Use Relationship	Relationship	Start Time (HH:mm)	Finish Time (HH:mm)	Time Period Length (min)	Time Segment Length (min)	Traffic Profile Type
(Scenario1), PM	(Scenario1)	PM			Yes			16:00	17:30	90	15	ONE HOUR

Roundabout Network

Roundabout Type(s)

Roundabout	ID	Name	Arm Order	Roundabout Type	Grade Separated	Large Roundabout	Do Geometric Delay
1	1	Columbia Dr Platinum Dr	1,2,3	Standard			
2	2	Boardwalk/Erb	1,2,3	Standard			

Roundabout Network Options

Driving Side	Lighting	Road Surface	In London
Right	Normal/unknown	((Mini-roundabouts only))	

Arms

Arms

ID	Name	Description
1	Columbia St E	
2	Columbia St W	
3	Platinum Dr S	
1	Erb St E	
2	Erb St W	
3	The Boardwalk S	

Capacity Options

Roundabout	Arm	Minimum Capacity (PCE/hr)	Maximum Capacity (PCE/hr)	Assume Flat Start Profile	Initial Queue (PCE)
Columbia Dr Platinum Dr	**Columbia St E**	0.00	99999.00		0.00

Columbia Dr Platinum Dr	**Columbia St W**	0.00	99999.00		0.00
Columbia Dr Platinum Dr	**Platinum Dr S**	0.00	99999.00		0.00
Boardwalk/Erb	**Erb St E**	0.00	99999.00		0.00
Boardwalk/Erb	**Erb St W**	0.00	99999.00		0.00
Boardwalk/Erb	**The Boardwalk S**	0.00	99999.00		0.00

Standard Geometry

Roundabout	Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit Only
Columbia Dr Platinum Dr	**Columbia St E**	3.50	4.50	30.00	20.00	40.00	25.00	
Columbia Dr Platinum Dr	**Columbia St W**	3.50	4.50	30.00	20.00	40.00	25.00	
Columbia Dr Platinum Dr	**Platinum Dr S**	3.50	4.50	30.00	20.00	40.00	25.00	
Boardwalk/Erb	**Erb St E**	7.00	8.00	30.00	20.00	55.00	25.00	
Boardwalk/Erb	**Erb St W**	7.00	8.00	30.00	20.00	55.00	25.00	
Boardwalk/Erb	**The Boardwalk S**	7.00	8.00	30.00	20.00	55.00	25.00	

Pedestrian Crossings

Roundabout	Arm	Crossing Type
Columbia Dr Platinum Dr	**Columbia St E**	None
Columbia Dr Platinum Dr	**Columbia St W**	None
Columbia Dr Platinum Dr	**Platinum Dr S**	None
Boardwalk/Erb	**Erb St E**	None
Boardwalk/Erb	**Erb St W**	None
Boardwalk/Erb	**The Boardwalk S**	None

Arm Slope/ Intercept and Capacity

Slope and Intercept used in model

Roundabout	Arm	Enter Directly	Slope	Intercept (PCE/hr)	Final Slope	Final Intercept (PCE/hr)
Columbia Dr Platinum Dr	**Columbia St E**		((calculated))	((calculated))	0.579	1357.445
Columbia Dr Platinum Dr	**Columbia St W**		((calculated))	((calculated))	0.579	1357.445
Columbia Dr Platinum Dr	**Platinum Dr S**		((calculated))	((calculated))	0.579	1357.445
Boardwalk/Erb	**Erb St E**		((calculated))	((calculated))	0.723	2436.345
Boardwalk/Erb	**Erb St W**		((calculated))	((calculated))	0.723	2436.345

Boardwalk/Erb	**The Boardwalk S**		((calculated))	((calculated))	0.723	2436.345

The slope and intercept shown above include any corrections and adjustments.

Arm Capacity Adjustments

Roundabout	Arm	Type	Reason	Direct Capacity Adjustment (PCE/hr)	Percentage Capacity Adjustment (%)
Columbia Dr Platinum Dr	**Columbia St E**	Percentage		N/A	85.00
Columbia Dr Platinum Dr	**Columbia St W**	None	N/A	N/A	N/A
Columbia Dr Platinum Dr	**Platinum Dr S**	None	N/A	N/A	N/A
Boardwalk/Erb	**Erb St E**	Percentage		N/A	85.00
Boardwalk/Erb	**Erb St W**	None	N/A	N/A	N/A
Boardwalk/Erb	**The Boardwalk S**	None	N/A	N/A	N/A

Traffic Flows

Demand Set Data Options

Default Vehicle Mix	Vehicle Mix Varies Over Time	Vehicle Mix Varies Over Turn	Vehicle Mix Varies Over Entry	Vehicle Mix Source	PCE Factor for a Truck (PCE)	Default Turning Proportions	Estimate from entry/exit counts	Turning Proportions Vary Over Time	Turning Proportions Vary Over Turn	Turning Proportions Vary Over Entry
		Yes	Yes	Truck Percentages	2.00				Yes	Yes

Entry Flows

General Flows Data

Roundabout	Arm	Profile Type	Use Turning Counts	Average Demand Flow (PCE/hr)	Flow Scaling Factor (%)	PHF
Columbia Dr Platinum Dr	**Columbia St E**	ONE HOUR	Yes	414.00	100.000	N/A
Columbia Dr Platinum Dr	**Columbia St W**	ONE HOUR	Yes	351.00	100.000	N/A
Columbia Dr Platinum Dr	**Platinum Dr S**	ONE HOUR	Yes	589.00	100.000	N/A
Boardwalk/Erb	**Erb St E**	ONE HOUR	Yes	1109.00	100.000	N/A
Boardwalk/Erb	**Erb St W**	ONE HOUR	Yes	1923.00	100.000	N/A
Boardwalk/Erb	**The Boardwalk S**	ONE HOUR	Yes	322.00	100.000	N/A

Direct/Resultant Flows

Direct Flows Data

Time Segment	Roundabout	Arm	Direct Demand Entry Flow (PCE/hr)	DirectDemandEntryFlowInPCE (PCE/hr)	Direct Demand Exit Flow (PCE/hr)	Direct Demand Pedestrian Flow (Ped/hr)
1	Columbia Dr Platinum Dr	Columbia St E	311.68	311.68	N/A	N/A
1	Columbia Dr Platinum Dr	Columbia St W	264.25	264.25	N/A	N/A
1	Columbia Dr Platinum Dr	Platinum Dr S	443.43	443.43	N/A	N/A
1	Boardwalk/Erb	Erb St E	834.91	834.91	N/A	N/A
1	Boardwalk/Erb	Erb St W	1447.74	1447.74	N/A	N/A
1	Boardwalk/Erb	The Boardwalk S	242.42	242.42	N/A	N/A
2	Columbia Dr Platinum Dr	Columbia St E	372.18	372.18	N/A	N/A
2	Columbia Dr Platinum Dr	Columbia St W	315.54	315.54	N/A	N/A
2	Columbia Dr Platinum Dr	Platinum Dr S	529.50	529.50	N/A	N/A
2	Boardwalk/Erb	Erb St E	996.97	996.97	N/A	N/A
2	Boardwalk/Erb	Erb St W	1728.74	1728.74	N/A	N/A
2	Boardwalk/Erb	The Boardwalk S	289.47	289.47	N/A	N/A
3	Columbia Dr Platinum Dr	Columbia St E	455.82	455.82	N/A	N/A
3	Columbia Dr Platinum Dr	Columbia St W	386.46	386.46	N/A	N/A
3	Columbia Dr Platinum Dr	Platinum Dr S	648.50	648.50	N/A	N/A
3	Boardwalk/Erb	Erb St E	1221.03	1221.03	N/A	N/A
3	Boardwalk/Erb	Erb St W	2117.26	2117.26	N/A	N/A
3	Boardwalk/Erb	The Boardwalk S	354.53	354.53	N/A	N/A
4	Columbia Dr Platinum Dr	Columbia St E	455.82	455.82	N/A	N/A
4	Columbia Dr Platinum Dr	Columbia St W	386.46	386.46	N/A	N/A
4	Columbia Dr Platinum Dr	Platinum Dr S	648.50	648.50	N/A	N/A
4	Boardwalk/Erb	Erb St E	1221.03	1221.03	N/A	N/A
4	Boardwalk/Erb	Erb St W	2117.26	2117.26	N/A	N/A
4	Boardwalk/Erb	The Boardwalk S	354.53	354.53	N/A	N/A
5	Columbia Dr Platinum Dr	Columbia St E	372.18	372.18	N/A	N/A
5	Columbia Dr Platinum Dr	Columbia St W	315.54	315.54	N/A	N/A
5	Columbia Dr Platinum Dr	Platinum Dr S	529.50	529.50	N/A	N/A
5	Boardwalk/Erb	Erb St E	996.97	996.97	N/A	N/A

5	Boardwalk/Erb	Erb St W	1728.74	1728.74	N/A	N/A
5	Boardwalk/Erb	The Boardwalk S	289.47	289.47	N/A	N/A
6	Columbia Dr Platinum Dr	Columbia St E	311.68	311.68	N/A	N/A
6	Columbia Dr Platinum Dr	Columbia St W	264.25	264.25	N/A	N/A
6	Columbia Dr Platinum Dr	Platinum Dr S	443.43	443.43	N/A	N/A
6	Boardwalk/Erb	Erb St E	834.91	834.91	N/A	N/A
6	Boardwalk/Erb	Erb St W	1447.74	1447.74	N/A	N/A
6	Boardwalk/Erb	The Boardwalk S	242.42	242.42	N/A	N/A

Turning Proportions

Turning Counts or Proportions (PCE/hr) - Columbia Dr Platinum Dr (for whole period)

		To		
		1	2	3
From	1	0.000	349.000	65.000
	2	333.000	0.000	18.000
	3	433.000	156.000	0.000

Turning Proportions (PCE) - Columbia Dr Platinum Dr (for whole period)

		To		
		1	2	3
From	1	0.00	0.84	0.16
	2	0.95	0.00	0.05
	3	0.74	0.26	0.00

Turning Counts or Proportions (PCE/hr) - Boardwalk/ Erb (for whole period)

		To		
		1	2	3
From	1	0.000	1100.000	9.000
	2	1271.000	0.000	652.000
	3	21.000	301.000	0.000

Turning Proportions (PCE) - Boardwalk/ Erb (for whole period)

		To		
		1	2	3
From	1	0.00	0.99	0.01
	2	0.66	0.00	0.34
	3	0.07	0.93	0.00

Vehicle Mix

Average PCE Per Vehicle - Columbia Dr Platinum Dr (for whole period)

		To		
		1	2	3
From	1	1.000	1.000	1.000
	2	1.000	1.000	1.000
	3	1.000	1.000	1.000

Truck Percentages - Columbia Dr Platinum Dr (for whole period)

		To		
		1	2	3
From	1	0.000	0.000	0.000
	2	0.000	0.000	0.000
	3	0.000	0.000	0.000

Average PCE Per Vehicle - Boardwalk/ Erb (for whole period)

		To		
		1	2	3
From	1	1.000	1.000	1.000
	2	1.000	1.000	1.000
	3	1.000	1.000	1.000

Truck Percentages - Boardwalk/ Erb (for whole period)

	To

From		1	2	3
	1	0.000	0.000	0.000
	2	0.000	0.000	0.000
	3	0.000	0.000	0.000

Results

Results Summary

Roundabout	Arm	Max RFC	Max Delay (s)	Max Queue (PCE)	Max LOS	Total Demand (PCE/hr)	Total Arrivals (PCE)	Total Queueing Delay (PCE-min)	Average Queueing Delay (s)	Rate Of Queueing Delay (PCE-min/min)	Inclusive Queueing Total Delay (PCE-min)	Inclusive Queueing Average Delay (s)	Slope	Intercept (PCE/hr)
Columbia Dr Platinum Dr	Columbia St E	0.43	5.87	0.74	A	379.89	569.84	49.36	5.20	0.55	49.36	5.20	0.579	1357.445
Columbia Dr Platinum Dr	Columbia St W	0.29	3.87	0.41	A	322.08	483.13	29.13	3.62	0.32	29.13	3.62	0.579	1357.445
Columbia Dr Platinum Dr	Platinum Dr S	0.57	7.25	1.29	A	540.48	810.72	79.40	5.88	0.88	79.41	5.88	0.579	1357.445
Boardwalk/Erb	Erb St E	0.65	5.57	1.87	A	1017.64	1526.46	110.59	4.35	1.23	110.59	4.35	0.723	2436.345
Boardwalk/Erb	Erb St W	0.87	11.40	6.48	B	1764.58	2646.87	297.68	6.75	3.31	297.71	6.75	0.723	2436.345
Boardwalk/Erb	The Boardwalk S	0.25	3.36	0.33	A	295.47	443.21	21.20	2.87	0.24	21.20	2.87	0.723	2436.345

Main Results

Main results: (4:00 PM-4:15 PM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	311.68	77.92	310.10	574.07	116.84	0.00	1096.35	1067.14	0.284	0.00	0.39
Columbia Dr Platinum Dr	Columbia St W	264.25	66.06	263.26	378.25	48.69	0.00	1329.27	1260.48	0.199	0.00	0.25
Columbia Dr Platinum Dr	Platinum Dr S	443.43	110.86	441.14	62.19	249.76	0.00	1212.89	665.34	0.366	0.00	0.57
Boardwalk/Erb	Erb St E	834.91	208.73	831.89	968.79	226.01	0.00	1932.01	1337.96	0.432	0.00	0.76
Boardwalk/Erb	Erb St W	1447.74	361.93	1441.91	1051.15	6.75	0.00	2431.46	2428.50	0.595	0.00	1.46
Boardwalk/Erb	The Boardwalk S	242.42	60.60	241.78	495.63	953.02	0.00	1747.36	1275.93	0.139	0.00	0.16

Main results: (4:15 PM-4:30 PM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	372.18	93.04	371.68	687.70	140.00	0.00	1084.96	1067.13	0.343	0.39	0.52
Columbia Dr Platinum Dr	Columbia St W	315.54	78.89	315.28	453.33	58.36	0.00	1323.67	1260.48	0.238	0.25	0.31
Columbia Dr Platinum Dr	Platinum Dr S	529.50	132.37	528.59	74.52	299.12	0.00	1184.33	665.34	0.447	0.57	0.80
Boardwalk/Erb	Erb St E	996.97	249.24	995.64	1158.93	270.38	0.00	1904.74	1337.96	0.523	0.76	1.09
Boardwalk/Erb	Erb St W	1728.74	432.18	1724.90	1257.94	8.08	0.00	2430.50	2428.50	0.711	1.46	2.42
Boardwalk/Erb	The Boardwalk S	289.47	72.37	289.24	592.91	1140.06	0.00	1612.14	1275.93	0.180	0.16	0.22

Main results: (4:30 PM-4:45 PM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	455.82	113.96	454.96	841.58	171.25	0.00	1069.58	1067.13	0.426	0.52	0.73
Columbia Dr Platinum Dr	Columbia St W	386.46	96.61	386.05	554.77	71.43	0.00	1316.10	1260.48	0.294	0.31	0.41
Columbia Dr Platinum Dr	Platinum Dr S	648.50	162.13	646.57	91.23	366.25	0.00	1145.47	665.34	0.566	0.80	1.28
Boardwalk/Erb	Erb St E	1221.03	305.26	1217.96	1412.42	331.00	0.00	1867.49	1337.96	0.654	1.09	1.86
Boardwalk/Erb	Erb St W	2117.26	529.32	2102.03	1539.07	9.88	0.00	2429.20	2428.50	0.872	2.42	6.22
Boardwalk/Erb	The Boardwalk S	354.53	88.63	354.09	722.59	1389.33	0.00	1431.93	1275.93	0.248	0.22	0.33

Main results: (4:45 PM-5:00 PM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	455.82	113.96	455.81	843.34	171.75	0.00	1069.34	1067.13	0.426	0.73	0.74
Columbia Dr Platinum Dr	Columbia St W	386.46	96.61	386.45	555.99	71.56	0.00	1316.03	1260.48	0.294	0.41	0.41
Columbia Dr Platinum Dr	Platinum Dr S	648.50	162.13	648.45	91.38	366.64	0.00	1145.25	665.34	0.566	1.28	1.29
Boardwalk/Erb	Erb St E	1221.03	305.26	1220.97	1421.84	331.40	0.00	1867.25	1337.96	0.654	1.86	1.87
Boardwalk/Erb	Erb St W	2117.26	529.32	2116.24	1542.46	9.91	0.00	2429.18	2428.50	0.872	6.22	6.48
Boardwalk/Erb	The Boardwalk S	354.53	88.63	354.52	727.43	1398.72	0.00	1425.14	1275.93	0.249	0.33	0.33

Main results: (5:00 PM-5:15 PM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)

Columbia Dr Platinum Dr	Columbia St E	372.18	93.04	373.03	690.40	140.74	0.00	1084.59	1067.13	0.343	0.74	0.53
Columbia Dr Platinum Dr	Columbia St W	315.54	78.89	315.94	455.20	58.57	0.00	1323.55	1260.48	0.238	0.41	0.31
Columbia Dr Platinum Dr	Platinum Dr S	529.50	132.37	531.40	74.77	299.74	0.00	1183.97	665.34	0.447	1.29	0.82
Boardwalk/Erb	Erb St E	996.97	249.24	1000.02	1172.00	271.00	0.00	1904.36	1337.96	0.524	1.87	1.11
Boardwalk/Erb	Erb St W	1728.74	432.18	1744.61	1262.91	8.12	0.00	2430.48	2428.50	0.711	6.48	2.51
Boardwalk/Erb	The Boardwalk S	289.47	72.37	289.91	599.63	1153.10	0.00	1602.71	1275.93	0.181	0.33	0.22

Main results: (5:15 PM-5:30 PM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	311.68	77.92	312.19	577.63	117.70	0.00	1095.93	1067.14	0.284	0.53	0.40
Columbia Dr Platinum Dr	Columbia St W	264.25	66.06	264.51	380.87	49.01	0.00	1329.08	1260.48	0.199	0.31	0.25
Columbia Dr Platinum Dr	Platinum Dr S	443.43	110.86	444.38	62.58	250.95	0.00	1212.21	665.34	0.366	0.82	0.58
Boardwalk/Erb	Erb St E	834.91	208.73	836.28	975.41	226.83	0.00	1931.50	1337.96	0.432	1.11	0.77
Boardwalk/Erb	Erb St W	1447.74	361.93	1451.84	1056.33	6.79	0.00	2431.44	2428.50	0.595	2.51	1.49
Boardwalk/Erb	The Boardwalk S	242.42	60.60	242.66	499.04	959.59	0.00	1742.61	1275.93	0.139	0.22	0.16

Queueing Delay Results

Queueing Delay results: (4:00 PM-4:15 PM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	Columbia St E	5.75	0.38	4.569	A	A
Columbia Dr Platinum Dr	Columbia St W	3.63	0.24	3.374	A	A
Columbia Dr Platinum Dr	Platinum Dr S	8.32	0.55	4.650	A	A
Boardwalk/Erb	Erb St E	11.06	0.74	3.265	A	A
Boardwalk/Erb	Erb St W	21.12	1.41	3.618	A	A
Boardwalk/Erb	The Boardwalk S	2.37	0.16	2.389	A	A

Queueing Delay results: (4:15 PM-4:30 PM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	Columbia St E	7.61	0.51	5.044	A	A
Columbia Dr Platinum Dr	Columbia St W	4.60	0.31	3.570	A	A

Columbia Dr Platinum Dr	**Platinum Dr S**	11.69	0.78	5.482	A	A
Boardwalk/Erb	**Erb St E**	15.94	1.06	3.954	A	A
Boardwalk/Erb	**Erb St W**	34.75	2.32	5.075	A	A
Boardwalk/Erb	**The Boardwalk S**	3.23	0.22	2.721	A	A

Queueing Delay results: (4:30 PM-4:45 PM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	**Columbia St E**	10.72	0.71	5.848	A	A
Columbia Dr Platinum Dr	**Columbia St W**	6.09	0.41	3.869	A	A
Columbia Dr Platinum Dr	**Platinum Dr S**	18.47	1.23	7.189	A	A
Boardwalk/Erb	**Erb St E**	26.74	1.78	5.515	A	A
Boardwalk/Erb	**Erb St W**	82.78	5.52	10.541	B	B
Boardwalk/Erb	**The Boardwalk S**	4.83	0.32	3.337	A	A

Queueing Delay results: (4:45 PM-5:00 PM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	**Columbia St E**	11.06	0.74	5.867	A	A
Columbia Dr Platinum Dr	**Columbia St W**	6.21	0.41	3.872	A	A
Columbia Dr Platinum Dr	**Platinum Dr S**	19.34	1.29	7.246	A	A
Boardwalk/Erb	**Erb St E**	28.00	1.87	5.568	A	A
Boardwalk/Erb	**Erb St W**	95.67	6.38	11.403	B	B
Boardwalk/Erb	**The Boardwalk S**	4.94	0.33	3.361	A	A

Queueing Delay results: (5:00 PM-5:15 PM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	**Columbia St E**	8.10	0.54	5.064	A	A
Columbia Dr Platinum Dr	**Columbia St W**	4.80	0.32	3.576	A	A
Columbia Dr Platinum Dr	**Platinum Dr S**	12.66	0.84	5.532	A	A
Boardwalk/Erb	**Erb St E**	17.12	1.14	3.995	A	A
Boardwalk/Erb	**Erb St W**	40.37	2.69	5.365	A	A
Boardwalk/Erb	**The Boardwalk S**	3.37	0.22	2.742	A	A

Queueing Delay results: (5:15 PM-5:30 PM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	Columbia St E	6.12	0.41	4.597	A	A
Columbia Dr Platinum Dr	Columbia St W	3.79	0.25	3.381	A	A
Columbia Dr Platinum Dr	Platinum Dr S	8.93	0.60	4.693	A	A
Boardwalk/Erb	Erb St E	11.73	0.78	3.290	A	A
Boardwalk/Erb	Erb St W	22.99	1.53	3.692	A	A
Boardwalk/Erb	The Boardwalk S	2.46	0.16	2.401	A	A

A2 - Planned 2031 With Recommendations - D1 - (Scenario1), AM

Data Errors and Warnings

No errors or warnings

Analysis Set Details

Name	Description	Include In Report	Use Specific Demand Set	Demand Set	Locked	Network Flow Scaling Factor (%)	Network Capacity Scaling Factor (%)	Reason For Scaling Factors
Planned 2031 With Recommendations		Yes		(D1)		100.000	100.000	

Demand Set Details

Name	Scenario Name	Time Period Name	Description	Locked	Run Automatically	Use Relationship	Relationship	Start Time (HH:mm)	Finish Time (HH:mm)	Time Period Length (min)	Time Segment Length (min)	Traffic Profile Type
(Scenario1), AM	(Scenario1)	AM			Yes			08:00	09:30	90	15	ONE HOUR

Roundabout Network

Roundabout Type(s)

Roundabout	ID	Name	Arm Order	Roundabout Type	Grade Separated	Large Roundabout	Do Geometric Delay
1	1	Columbia Dr Platinum Dr	1,2,3	Standard			
2	2	Boardwalk/Erb	1,2,3	Standard			

Roundabout Network Options

Driving Side	Lighting	Road Surface	In London
Right	Normal/unknown	((Mini-roundabouts only))	

Arms

Arms

ID	Name	Description
1	Columbia St E	
2	Columbia St W	
3	Platinum Dr S	
1	Erb St E	
2	Erb St W	
3	The Boardwalk S	

Capacity Options

Roundabout	Arm	Minimum Capacity (PCE/hr)	Maximum Capacity (PCE/hr)	Assume Flat Start Profile	Initial Queue (PCE)
Columbia Dr Platinum Dr	**Columbia St E**	0.00	99999.00		0.00
Columbia Dr Platinum Dr	**Columbia St W**	0.00	99999.00		0.00
Columbia Dr Platinum Dr	**Platinum Dr S**	0.00	99999.00		0.00
Boardwalk/Erb	**Erb St E**	0.00	99999.00		0.00
Boardwalk/Erb	**Erb St W**	0.00	99999.00		0.00
Boardwalk/Erb	**The Boardwalk S**	0.00	99999.00		0.00

Standard Geometry

Roundabout	Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit Only
Columbia Dr Platinum Dr	**Columbia St E**	7.00	8.00	30.00	20.00	55.00	25.00	
Columbia Dr Platinum Dr	**Columbia St W**	7.00	8.00	30.00	20.00	55.00	25.00	

Columbia Dr Platinum Dr	**Platinum Dr S**	7.00	8.00	30.00	20.00	55.00	25.00	
Boardwalk/Erb	**Erb St E**	7.00	8.00	30.00	20.00	55.00	25.00	
Boardwalk/Erb	**Erb St W**	7.00	8.00	30.00	20.00	55.00	25.00	
Boardwalk/Erb	**The Boardwalk S**	3.50	4.50	30.00	20.00	40.00	25.00	

Pedestrian Crossings

Roundabout	Arm	Crossing Type
Columbia Dr Platinum Dr	**Columbia St E**	None
Columbia Dr Platinum Dr	**Columbia St W**	None
Columbia Dr Platinum Dr	**Platinum Dr S**	None
Boardwalk/Erb	**Erb St E**	None
Boardwalk/Erb	**Erb St W**	None
Boardwalk/Erb	**The Boardwalk S**	None

Arm Slope/ Intercept and Capacity

Slope and Intercept used in model

Roundabout	Arm	Enter Directly	Slope	Intercept (PCE/hr)	Final Slope	Final Intercept (PCE/hr)
Columbia Dr Platinum Dr	**Columbia St E**		((calculated))	((calculated))	0.723	2436.345
Columbia Dr Platinum Dr	**Columbia St W**		((calculated))	((calculated))	0.723	2436.345
Columbia Dr Platinum Dr	**Platinum Dr S**		((calculated))	((calculated))	0.723	2436.345
Boardwalk/Erb	**Erb St E**		((calculated))	((calculated))	0.723	2436.345
Boardwalk/Erb	**Erb St W**		((calculated))	((calculated))	0.723	2436.345
Boardwalk/Erb	**The Boardwalk S**		((calculated))	((calculated))	0.579	1357.445

The slope and intercept shown above include any corrections and adjustments.

Arm Capacity Adjustments

Roundabout	Arm	Type	Reason	Direct Capacity Adjustment (PCE/hr)	Percentage Capacity Adjustment (%)
Columbia Dr Platinum Dr	**Columbia St E**	Percentage		N/A	85.00
Columbia Dr Platinum Dr	**Columbia St W**	None	N/A	N/A	N/A
Columbia Dr Platinum Dr	**Platinum Dr S**	None	N/A	N/A	N/A
Boardwalk/Erb	**Erb St E**	Percentage		N/A	85.00
Boardwalk/Erb	**Erb St W**	None	N/A	N/A	N/A
Boardwalk/Erb	**The Boardwalk S**	None	N/A	N/A	N/A

Traffic Flows

Demand Set Data Options

Default Vehicle Mix	Vehicle Mix Varies Over Time	Vehicle Mix Varies Over Turn	Vehicle Mix Varies Over Entry	Vehicle Mix Source	PCE Factor for a Truck (PCE)	Default Turning Proportions	Estimate from entry/exit counts	Turning Proportions Vary Over Time	Turning Proportions Vary Over Turn	Turning Proportions Vary Over Entry
		Yes	Yes	Truck Percentages	2.00				Yes	Yes

Entry Flows

General Flows Data

Roundabout	Arm	Profile Type	Use Turning Counts	Average Demand Flow (PCE/hr)	Flow Scaling Factor (%)	PHF
Columbia Dr Platinum Dr	Columbia St E	ONE HOUR	Yes	553.00	100.000	N/A
Columbia Dr Platinum Dr	Columbia St W	ONE HOUR	Yes	654.00	100.000	N/A
Columbia Dr Platinum Dr	Platinum Dr S	ONE HOUR	Yes	21.00	100.000	N/A
Boardwalk/Erb	Erb St E	ONE HOUR	Yes	982.00	100.000	N/A
Boardwalk/Erb	Erb St W	ONE HOUR	Yes	1056.00	100.000	N/A
Boardwalk/Erb	The Boardwalk S	ONE HOUR	Yes	303.00	100.000	N/A

Direct/Resultant Flows

Direct Flows Data

Time Segment	Roundabout	Arm	Direct Demand Entry Flow (PCE/hr)	DirectDemandEntryFlowInPCE (PCE/hr)	Direct Demand Exit Flow (PCE/hr)	Direct Demand Pedestrian Flow (Ped/hr)
1	Columbia Dr Platinum Dr	Columbia St E	416.33	416.33	N/A	N/A
1	Columbia Dr Platinum Dr	Columbia St W	492.37	492.37	N/A	N/A
1	Columbia Dr Platinum Dr	Platinum Dr S	15.81	15.81	N/A	N/A
1	Boardwalk/Erb	Erb St E	739.30	739.30	N/A	N/A
1	Boardwalk/Erb	Erb St W	795.01	795.01	N/A	N/A
1	Boardwalk/Erb	The Boardwalk S	228.11	228.11	N/A	N/A
2	Columbia Dr Platinum Dr	Columbia St E	497.14	497.14	N/A	N/A

2	Columbia Dr Platinum Dr	Columbia St W	587.93	587.93	N/A	N/A
2	Columbia Dr Platinum Dr	Platinum Dr S	18.88	18.88	N/A	N/A
2	Boardwalk/Erb	Erb St E	882.80	882.80	N/A	N/A
2	Boardwalk/Erb	Erb St W	949.32	949.32	N/A	N/A
2	Boardwalk/Erb	The Boardwalk S	272.39	272.39	N/A	N/A
3	Columbia Dr Platinum Dr	Columbia St E	608.86	608.86	N/A	N/A
3	Columbia Dr Platinum Dr	Columbia St W	720.07	720.07	N/A	N/A
3	Columbia Dr Platinum Dr	Platinum Dr S	23.12	23.12	N/A	N/A
3	Boardwalk/Erb	Erb St E	1081.20	1081.20	N/A	N/A
3	Boardwalk/Erb	Erb St W	1162.68	1162.68	N/A	N/A
3	Boardwalk/Erb	The Boardwalk S	333.61	333.61	N/A	N/A
4	Columbia Dr Platinum Dr	Columbia St E	608.86	608.86	N/A	N/A
4	Columbia Dr Platinum Dr	Columbia St W	720.07	720.07	N/A	N/A
4	Columbia Dr Platinum Dr	Platinum Dr S	23.12	23.12	N/A	N/A
4	Boardwalk/Erb	Erb St E	1081.20	1081.20	N/A	N/A
4	Boardwalk/Erb	Erb St W	1162.68	1162.68	N/A	N/A
4	Boardwalk/Erb	The Boardwalk S	333.61	333.61	N/A	N/A
5	Columbia Dr Platinum Dr	Columbia St E	497.14	497.14	N/A	N/A
5	Columbia Dr Platinum Dr	Columbia St W	587.93	587.93	N/A	N/A
5	Columbia Dr Platinum Dr	Platinum Dr S	18.88	18.88	N/A	N/A
5	Boardwalk/Erb	Erb St E	882.80	882.80	N/A	N/A
5	Boardwalk/Erb	Erb St W	949.32	949.32	N/A	N/A
5	Boardwalk/Erb	The Boardwalk S	272.39	272.39	N/A	N/A
6	Columbia Dr Platinum Dr	Columbia St E	416.33	416.33	N/A	N/A
6	Columbia Dr Platinum Dr	Columbia St W	492.37	492.37	N/A	N/A
6	Columbia Dr Platinum Dr	Platinum Dr S	15.81	15.81	N/A	N/A
6	Boardwalk/Erb	Erb St E	739.30	739.30	N/A	N/A
6	Boardwalk/Erb	Erb St W	795.01	795.01	N/A	N/A
6	Boardwalk/Erb	The Boardwalk S	228.11	228.11	N/A	N/A

Turning Proportions

Turning Counts or Proportions (PCE/hr) - Columbia Dr Platinum Dr (for whole period)

		To		
		1	2	3
From	1	0.000	185.000	368.000
	2	477.000	0.000	177.000
	3	15.000	6.000	0.000

Turning Proportions (PCE) - Columbia Dr Platinum Dr (for whole period)

		To		
		1	2	3
From	1	0.00	0.33	0.67
	2	0.73	0.00	0.27
	3	0.71	0.29	0.00

Turning Counts or Proportions (PCE/hr) - Boardwalk/ Erb (for whole period)

		To		
		1	2	3
From	1	0.000	963.000	19.000
	2	903.000	0.000	153.000
	3	2.000	301.000	0.000

Turning Proportions (PCE) - Boardwalk/ Erb (for whole period)

		To		
		1	2	3
From	1	0.00	0.98	0.02
	2	0.86	0.00	0.14
	3	0.01	0.99	0.00

Vehicle Mix

Average PCE Per Vehicle - Columbia Dr Platinum Dr (for whole period)

		To		
From		1	2	3

	1	1.000	1.000	1.000
	2	1.000	1.000	1.000
	3	1.000	1.000	1.000

Truck Percentages - Columbia Dr Platinum Dr (for whole period)

		To		
		1	2	3
From	1	0.000	0.000	0.000
	2	0.000	0.000	0.000
	3	0.000	0.000	0.000

Average PCE Per Vehicle - Boardwalk/ Erb (for whole period)

		To		
		1	2	3
From	1	1.000	1.000	1.000
	2	1.000	1.000	1.000
	3	1.000	1.000	1.000

Truck Percentages - Boardwalk/ Erb (for whole period)

		To		
		1	2	3
From	1	0.000	0.000	0.000
	2	0.000	0.000	0.000
	3	0.000	0.000	0.000

Results

Results Summary

Roundabout	Arm	Max RFC	Max Delay (s)	Max Queue (PCE)	Max LOS	Total Demand (PCE/hr)	Total Arrivals (PCE)	Total Queueing Delay (PCE-min)	Average Queueing Delay (s)	Rate Of Queueing Delay	Inclusive Queueing Total Delay (PCE-min)	Inclusive Queueing Average Delay (s)	Slope	Intercept (PCE/hr)

										(PCE-min/min)				
Columbia Dr Platinum Dr	Columbia St E	0.29	2.47	0.42	A	507.44	761.16	29.46	2.32	0.33	29.46	2.32	0.723	2436.345
Columbia Dr Platinum Dr	Columbia St W	0.34	2.53	0.50	A	600.12	900.18	34.44	2.30	0.38	34.45	2.30	0.723	2436.345
Columbia Dr Platinum Dr	Platinum Dr S	0.01	1.77	0.01	A	19.27	28.90	0.83	1.72	0.01	0.83	1.72	0.723	2436.345
Boardwalk/Erb	Erb St E	0.58	4.58	1.37	A	901.10	1351.65	84.76	3.76	0.94	84.77	3.76	0.723	2436.345
Boardwalk/Erb	Erb St W	0.48	2.86	0.92	A	969.00	1453.51	61.26	2.53	0.68	61.26	2.53	0.723	2436.345
Boardwalk/Erb	The Boardwalk S	0.43	8.03	0.74	A	278.04	417.06	44.22	6.36	0.49	44.22	6.36	0.579	1357.445

Main Results

Main results: (8:00 AM-8:15 AM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	416.33	104.08	415.32	369.56	4.51	0.00	2068.12	1789.01	0.201	0.00	0.25
Columbia Dr Platinum Dr	Columbia St W	492.37	123.09	491.24	143.45	276.38	0.00	2236.54	1575.66	0.220	0.00	0.28
Columbia Dr Platinum Dr	Platinum Dr S	15.81	3.95	15.78	409.33	358.29	0.00	2177.32	1605.52	0.007	0.00	0.01
Boardwalk/Erb	Erb St E	739.30	184.83	736.84	679.66	225.39	0.00	1932.39	1969.96	0.383	0.00	0.62
Boardwalk/Erb	Erb St W	795.01	198.75	793.07	947.97	14.26	0.00	2426.04	2408.79	0.328	0.00	0.49
Boardwalk/Erb	The Boardwalk S	228.11	57.03	226.88	129.16	678.16	0.00	964.95	165.32	0.236	0.00	0.31

Main results: (8:15 AM-8:30 AM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	497.14	124.28	496.88	442.05	5.39	0.00	2067.58	1789.01	0.240	0.25	0.32
Columbia Dr Platinum Dr	Columbia St W	587.93	146.98	587.60	171.62	330.65	0.00	2197.30	1575.66	0.268	0.28	0.36
Columbia Dr Platinum Dr	Platinum Dr S	18.88	4.72	18.87	489.68	428.57	0.00	2126.51	1605.52	0.009	0.01	0.01
Boardwalk/Erb	Erb St E	882.80	220.70	881.83	813.04	270.07	0.00	1904.93	1969.96	0.463	0.62	0.86
Boardwalk/Erb	Erb St W	949.32	237.33	948.70	1134.84	17.06	0.00	2424.01	2408.79	0.392	0.49	0.64
Boardwalk/Erb	The Boardwalk S	272.39	68.10	271.87	154.52	811.25	0.00	887.93	165.32	0.307	0.31	0.44

Main results: (8:30 AM-8:45 AM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	608.86	152.22	608.46	541.29	6.60	0.00	2066.84	1789.01	0.295	0.32	0.42
Columbia Dr Platinum Dr	Columbia St W	720.07	180.02	719.51	210.16	404.91	0.00	2143.62	1575.66	0.336	0.36	0.50
Columbia Dr Platinum Dr	Platinum Dr S	23.12	5.78	23.11	599.64	524.78	0.00	2056.96	1605.52	0.011	0.01	0.01
Boardwalk/Erb	Erb St E	1081.20	270.30	1079.20	995.47	330.24	0.00	1867.96	1969.96	0.579	0.86	1.36
Boardwalk/Erb	Erb St W	1162.68	290.67	1161.57	1388.56	20.88	0.00	2421.25	2408.79	0.480	0.64	0.92
Boardwalk/Erb	The Boardwalk S	333.61	83.40	332.44	189.18	993.27	0.00	782.58	165.32	0.426	0.44	0.73

Main results: (8:45 AM-9:00 AM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	608.86	152.22	608.86	541.70	6.61	0.00	2066.83	1789.01	0.295	0.42	0.42
Columbia Dr Platinum Dr	Columbia St W	720.07	180.02	720.06	210.29	405.17	0.00	2143.42	1575.66	0.336	0.50	0.50
Columbia Dr Platinum Dr	Platinum Dr S	23.12	5.78	23.12	600.05	525.18	0.00	2056.66	1605.52	0.011	0.01	0.01
Boardwalk/Erb	Erb St E	1081.20	270.30	1081.17	996.41	331.38	0.00	1867.26	1969.96	0.579	1.36	1.37
Boardwalk/Erb	Erb St W	1162.68	290.67	1162.67	1391.63	20.92	0.00	2421.22	2408.79	0.480	0.92	0.92
Boardwalk/Erb	The Boardwalk S	333.61	83.40	333.58	189.37	994.21	0.00	782.04	165.32	0.427	0.73	0.74

Main results: (9:00 AM-9:15 AM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	497.14	124.28	497.53	442.71	5.40	0.00	2067.58	1789.01	0.240	0.42	0.32
Columbia Dr Platinum Dr	Columbia St W	587.93	146.98	588.49	171.84	331.09	0.00	2196.98	1575.66	0.268	0.50	0.37
Columbia Dr Platinum Dr	Platinum Dr S	18.88	4.72	18.89	490.36	429.22	0.00	2126.04	1605.52	0.009	0.01	0.01
Boardwalk/Erb	Erb St E	882.80	220.70	884.78	814.52	271.75	0.00	1903.90	1969.96	0.464	1.37	0.87
Boardwalk/Erb	Erb St W	949.32	237.33	950.42	1139.41	17.12	0.00	2423.97	2408.79	0.392	0.92	0.65
Boardwalk/Erb	The Boardwalk S	272.39	68.10	273.55	154.82	812.72	0.00	887.08	165.32	0.307	0.74	0.45

Main results: (9:15 AM-9:30 AM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)

Columbia Dr Platinum Dr	**Columbia St E**	416.33	104.08	416.59	370.65	4.52	0.00	2068.12	1789.01	0.201	0.32	0.25
Columbia Dr Platinum Dr	**Columbia St W**	492.37	123.09	492.70	143.88	277.22	0.00	2235.93	1575.66	0.220	0.37	0.28
Columbia Dr Platinum Dr	**Platinum Dr S**	15.81	3.95	15.82	410.57	359.35	0.00	2176.55	1605.52	0.007	0.01	0.01
Boardwalk/Erb	**Erb St E**	739.30	184.83	740.29	681.87	227.14	0.00	1931.31	1969.96	0.383	0.87	0.62
Boardwalk/Erb	**Erb St W**	795.01	198.75	795.64	953.11	14.32	0.00	2425.99	2408.79	0.328	0.65	0.49
Boardwalk/Erb	**The Boardwalk S**	228.11	57.03	228.65	129.60	680.36	0.00	963.68	165.32	0.237	0.45	0.31

Queueing Delay Results

Queueing Delay results: (8:00 AM-8:15 AM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	**Columbia St E**	3.72	0.25	2.177	A	A
Columbia Dr Platinum Dr	**Columbia St W**	4.16	0.28	2.062	A	A
Columbia Dr Platinum Dr	**Platinum Dr S**	0.11	0.01	1.664	A	A
Boardwalk/Erb	**Erb St E**	9.04	0.60	3.004	A	A
Boardwalk/Erb	**Erb St W**	7.17	0.48	2.201	A	A
Boardwalk/Erb	**The Boardwalk S**	4.48	0.30	4.870	A	A

Queueing Delay results: (8:15 AM-8:30 AM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	**Columbia St E**	4.68	0.31	2.291	A	A
Columbia Dr Platinum Dr	**Columbia St W**	5.40	0.36	2.236	A	A
Columbia Dr Platinum Dr	**Platinum Dr S**	0.13	0.01	1.707	A	A
Boardwalk/Erb	**Erb St E**	12.61	0.84	3.515	A	A
Boardwalk/Erb	**Erb St W**	9.48	0.63	2.438	A	A
Boardwalk/Erb	**The Boardwalk S**	6.42	0.43	5.838	A	A

Queueing Delay results: (8:30 AM-8:45 AM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	**Columbia St E**	6.16	0.41	2.468	A	A
Columbia Dr Platinum Dr	**Columbia St W**	7.45	0.50	2.526	A	A
Columbia Dr Platinum Dr	**Platinum Dr S**	0.17	0.01	1.769	A	A

Boardwalk/Erb	**Erb St E**	19.76	1.32	4.552	A	A
Boardwalk/Erb	**Erb St W**	13.53	0.90	2.855	A	A
Boardwalk/Erb	**The Boardwalk S**	10.58	0.71	7.977	A	A

Queueing Delay results: (8:45 AM-9:00 AM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	**Columbia St E**	6.25	0.42	2.468	A	A
Columbia Dr Platinum Dr	**Columbia St W**	7.57	0.50	2.528	A	A
Columbia Dr Platinum Dr	**Platinum Dr S**	0.17	0.01	1.769	A	A
Boardwalk/Erb	**Erb St E**	20.45	1.36	4.579	A	A
Boardwalk/Erb	**Erb St W**	13.80	0.92	2.859	A	A
Boardwalk/Erb	**The Boardwalk S**	11.04	0.74	8.026	A	A

Queueing Delay results: (9:00 AM-9:15 AM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	**Columbia St E**	4.82	0.32	2.293	A	A
Columbia Dr Platinum Dr	**Columbia St W**	5.57	0.37	2.238	A	A
Columbia Dr Platinum Dr	**Platinum Dr S**	0.14	0.01	1.710	A	A
Boardwalk/Erb	**Erb St E**	13.38	0.89	3.541	A	A
Boardwalk/Erb	**Erb St W**	9.85	0.66	2.446	A	A
Boardwalk/Erb	**The Boardwalk S**	6.91	0.46	5.878	A	A

Queueing Delay results: (9:15 AM-9:30 AM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	**Columbia St E**	3.83	0.26	2.181	A	A
Columbia Dr Platinum Dr	**Columbia St W**	4.29	0.29	2.065	A	A
Columbia Dr Platinum Dr	**Platinum Dr S**	0.11	0.01	1.667	A	A
Boardwalk/Erb	**Erb St E**	9.52	0.63	3.026	A	A
Boardwalk/Erb	**Erb St W**	7.43	0.50	2.210	A	A
Boardwalk/Erb	**The Boardwalk S**	4.79	0.32	4.900	A	A

A2 - Planned 2031 With Recommendations - D2 - (Scenario1), PM

Data Errors and Warnings

No errors or warnings

Analysis Set Details

Name	Description	Include In Report	Use Specific Demand Set	Demand Set	Locked	Network Flow Scaling Factor (%)	Network Capacity Scaling Factor (%)	Reason For Scaling Factors
Planned 2031 With Recommendations		Yes		(D1)		100.000	100.000	

Demand Set Details

Name	Scenario Name	Time Period Name	Description	Locked	Run Automatically	Use Relationship	Relationship	Start Time (HH:mm)	Finish Time (HH:mm)	Time Period Length (min)	Time Segment Length (min)	Traffic Profile Type
(Scenario1), PM	(Scenario1)	PM			Yes			16:00	17:30	90	15	ONE HOUR

Roundabout Network

Roundabout Type(s)

Roundabout	ID	Name	Arm Order	Roundabout Type	Grade Separated	Large Roundabout	Do Geometric Delay
1	1	Columbia Dr Platinum Dr	1,2,3	Standard			
2	2	Boardwalk/Erb	1,2,3	Standard			

Roundabout Network Options

Driving Side	Lighting	Road Surface	In London
Right	Normal/unknown	((Mini-roundabouts only))	

Arms

Arms

ID	Name	Description
1	Columbia St E	
2	Columbia St W	
3	Platinum Dr S	
1	Erb St E	
2	Erb St W	
3	The Boardwalk S	

Capacity Options

Roundabout	Arm	Minimum Capacity (PCE/hr)	Maximum Capacity (PCE/hr)	Assume Flat Start Profile	Initial Queue (PCE)
Columbia Dr Platinum Dr	**Columbia St E**	0.00	99999.00		0.00
Columbia Dr Platinum Dr	**Columbia St W**	0.00	99999.00		0.00
Columbia Dr Platinum Dr	**Platinum Dr S**	0.00	99999.00		0.00
Boardwalk/Erb	**Erb St E**	0.00	99999.00		0.00
Boardwalk/Erb	**Erb St W**	0.00	99999.00		0.00
Boardwalk/Erb	**The Boardwalk S**	0.00	99999.00		0.00

Standard Geometry

Roundabout	Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit Only
Columbia Dr Platinum Dr	**Columbia St E**	7.00	8.00	30.00	20.00	55.00	25.00	
Columbia Dr Platinum Dr	**Columbia St W**	7.00	8.00	30.00	20.00	55.00	25.00	
Columbia Dr Platinum Dr	**Platinum Dr S**	7.00	8.00	30.00	20.00	55.00	25.00	
Boardwalk/Erb	**Erb St E**	7.00	8.00	30.00	20.00	55.00	25.00	
Boardwalk/Erb	**Erb St W**	7.00	8.00	30.00	20.00	55.00	25.00	
Boardwalk/Erb	**The Boardwalk S**	3.50	4.50	30.00	20.00	40.00	25.00	

Pedestrian Crossings

Roundabout	Arm	Crossing Type
Columbia Dr Platinum Dr	**Columbia St E**	None
Columbia Dr Platinum Dr	**Columbia St W**	None
Columbia Dr Platinum Dr	**Platinum Dr S**	None
Boardwalk/Erb	**Erb St E**	None

Boardwalk/Erb	**Erb St W**	None
Boardwalk/Erb	**The Boardwalk S**	None

Arm Slope/ Intercept and Capacity

Slope and Intercept used in model

Roundabout	Arm	Enter Directly	Slope	Intercept (PCE/hr)	Final Slope	Final Intercept (PCE/hr)
Columbia Dr Platinum Dr	**Columbia St E**		((calculated))	((calculated))	0.723	2436.345
Columbia Dr Platinum Dr	**Columbia St W**		((calculated))	((calculated))	0.723	2436.345
Columbia Dr Platinum Dr	**Platinum Dr S**		((calculated))	((calculated))	0.723	2436.345
Boardwalk/Erb	**Erb St E**		((calculated))	((calculated))	0.723	2436.345
Boardwalk/Erb	**Erb St W**		((calculated))	((calculated))	0.723	2436.345
Boardwalk/Erb	**The Boardwalk S**		((calculated))	((calculated))	0.579	1357.445

The slope and intercept shown above include any corrections and adjustments.

Arm Capacity Adjustments

Roundabout	Arm	Type	Reason	Direct Capacity Adjustment (PCE/hr)	Percentage Capacity Adjustment (%)
Columbia Dr Platinum Dr	**Columbia St E**	Percentage		N/A	85.00
Columbia Dr Platinum Dr	**Columbia St W**	None	N/A	N/A	N/A
Columbia Dr Platinum Dr	**Platinum Dr S**	None	N/A	N/A	N/A
Boardwalk/Erb	**Erb St E**	Percentage		N/A	85.00
Boardwalk/Erb	**Erb St W**	None	N/A	N/A	N/A
Boardwalk/Erb	**The Boardwalk S**	None	N/A	N/A	N/A

Traffic Flows

Demand Set Data Options

Default Vehicle Mix	Vehicle Mix Varies Over Time	Vehicle Mix Varies Over Turn	Vehicle Mix Varies Over Entry	Vehicle Mix Source	PCE Factor for a Truck (PCE)	Default Turning Proportions	Estimate from entry/exit counts	Turning Proportions Vary Over Time	Turning Proportions Vary Over Turn	Turning Proportions Vary Over Entry
		Yes	Yes	Truck Percentages	2.00				Yes	Yes

Entry Flows

General Flows Data

Roundabout	Arm	Profile Type	Use Turning Counts	Average Demand Flow (PCE/hr)	Flow Scaling Factor (%)	PHF
Columbia Dr Platinum Dr	Columbia St E	ONE HOUR	Yes	414.00	100.000	N/A
Columbia Dr Platinum Dr	Columbia St W	ONE HOUR	Yes	351.00	100.000	N/A
Columbia Dr Platinum Dr	Platinum Dr S	ONE HOUR	Yes	589.00	100.000	N/A
Boardwalk/Erb	Erb St E	ONE HOUR	Yes	1109.00	100.000	N/A
Boardwalk/Erb	Erb St W	ONE HOUR	Yes	1923.00	100.000	N/A
Boardwalk/Erb	The Boardwalk S	ONE HOUR	Yes	322.00	100.000	N/A

Direct/Resultant Flows

Direct Flows Data

Time Segment	Roundabout	Arm	Direct Demand Entry Flow (PCE/hr)	DirectDemandEntryFlowInPCE (PCE/hr)	Direct Demand Exit Flow (PCE/hr)	Direct Demand Pedestrian Flow (Ped/hr)
1	Columbia Dr Platinum Dr	Columbia St E	311.68	311.68	N/A	N/A
1	Columbia Dr Platinum Dr	Columbia St W	264.25	264.25	N/A	N/A
1	Columbia Dr Platinum Dr	Platinum Dr S	443.43	443.43	N/A	N/A
1	Boardwalk/Erb	Erb St E	834.91	834.91	N/A	N/A
1	Boardwalk/Erb	Erb St W	1447.74	1447.74	N/A	N/A
1	Boardwalk/Erb	The Boardwalk S	242.42	242.42	N/A	N/A
2	Columbia Dr Platinum Dr	Columbia St E	372.18	372.18	N/A	N/A
2	Columbia Dr Platinum Dr	Columbia St W	315.54	315.54	N/A	N/A
2	Columbia Dr Platinum Dr	Platinum Dr S	529.50	529.50	N/A	N/A
2	Boardwalk/Erb	Erb St E	996.97	996.97	N/A	N/A
2	Boardwalk/Erb	Erb St W	1728.74	1728.74	N/A	N/A
2	Boardwalk/Erb	The Boardwalk S	289.47	289.47	N/A	N/A
3	Columbia Dr Platinum Dr	Columbia St E	455.82	455.82	N/A	N/A
3	Columbia Dr Platinum Dr	Columbia St W	386.46	386.46	N/A	N/A
3	Columbia Dr Platinum Dr	Platinum Dr S	648.50	648.50	N/A	N/A
3	Boardwalk/Erb	Erb St E	1221.03	1221.03	N/A	N/A

3	Boardwalk/Erb	Erb St W	2117.26	2117.26	N/A	N/A
3	Boardwalk/Erb	The Boardwalk S	354.53	354.53	N/A	N/A
4	Columbia Dr Platinum Dr	Columbia St E	455.82	455.82	N/A	N/A
4	Columbia Dr Platinum Dr	Columbia St W	386.46	386.46	N/A	N/A
4	Columbia Dr Platinum Dr	Platinum Dr S	648.50	648.50	N/A	N/A
4	Boardwalk/Erb	Erb St E	1221.03	1221.03	N/A	N/A
4	Boardwalk/Erb	Erb St W	2117.26	2117.26	N/A	N/A
4	Boardwalk/Erb	The Boardwalk S	354.53	354.53	N/A	N/A
5	Columbia Dr Platinum Dr	Columbia St E	372.18	372.18	N/A	N/A
5	Columbia Dr Platinum Dr	Columbia St W	315.54	315.54	N/A	N/A
5	Columbia Dr Platinum Dr	Platinum Dr S	529.50	529.50	N/A	N/A
5	Boardwalk/Erb	Erb St E	996.97	996.97	N/A	N/A
5	Boardwalk/Erb	Erb St W	1728.74	1728.74	N/A	N/A
5	Boardwalk/Erb	The Boardwalk S	289.47	289.47	N/A	N/A
6	Columbia Dr Platinum Dr	Columbia St E	311.68	311.68	N/A	N/A
6	Columbia Dr Platinum Dr	Columbia St W	264.25	264.25	N/A	N/A
6	Columbia Dr Platinum Dr	Platinum Dr S	443.43	443.43	N/A	N/A
6	Boardwalk/Erb	Erb St E	834.91	834.91	N/A	N/A
6	Boardwalk/Erb	Erb St W	1447.74	1447.74	N/A	N/A
6	Boardwalk/Erb	The Boardwalk S	242.42	242.42	N/A	N/A

Turning Proportions

Turning Counts or Proportions (PCE/hr) - Columbia Dr Platinum Dr (for whole period)

		To		
		1	2	3
From	1	0.000	349.000	65.000
	2	333.000	0.000	18.000
	3	433.000	156.000	0.000

Turning Proportions (PCE) - Columbia Dr Platinum Dr (for whole period)

	To

		1	2	3
From	1	0.00	0.84	0.16
	2	0.95	0.00	0.05
	3	0.74	0.26	0.00

Turning Counts or Proportions (PCE/hr) - Boardwalk/ Erb (for whole period)

		To		
		1	2	3
From	1	0.000	1100.000	9.000
	2	1271.000	0.000	652.000
	3	21.000	301.000	0.000

Turning Proportions (PCE) - Boardwalk/ Erb (for whole period)

		To		
		1	2	3
From	1	0.00	0.99	0.01
	2	0.66	0.00	0.34
	3	0.07	0.93	0.00

Vehicle Mix

Average PCE Per Vehicle - Columbia Dr Platinum Dr (for whole period)

		To		
		1	2	3
From	1	1.000	1.000	1.000
	2	1.000	1.000	1.000
	3	1.000	1.000	1.000

Truck Percentages - Columbia Dr Platinum Dr (for whole period)

		To		
		1	2	3
From	1	0.000	0.000	0.000

	2	0.000	0.000	0.000
	3	0.000	0.000	0.000

Average PCE Per Vehicle - Boardwalk/ Erb (for whole period)

		To		
		1	2	3
From	1	1.000	1.000	1.000
	2	1.000	1.000	1.000
	3	1.000	1.000	1.000

Truck Percentages - Boardwalk/ Erb (for whole period)

		To		
		1	2	3
From	1	0.000	0.000	0.000
	2	0.000	0.000	0.000
	3	0.000	0.000	0.000

Results

Results Summary

Roundabout	Arm	Max RFC	Max Delay (s)	Max Queue (PCE)	Max LOS	Total Demand (PCE/hr)	Total Arrivals (PCE)	Total Queueing Delay (PCE-min)	Average Queueing Delay (s)	Rate Of Queueing Delay (PCE-min/min)	Inclusive Queueing Total Delay (PCE-min)	Inclusive Queueing Average Delay (s)	Slope	Intercept (PCE/hr)
Columbia Dr Platinum Dr	Columbia St E	0.23	2.38	0.30	A	379.89	569.84	21.44	2.26	0.24	21.44	2.26	0.723	2436.345
Columbia Dr Platinum Dr	Columbia St W	0.16	1.80	0.19	A	322.08	483.13	14.03	1.74	0.16	14.03	1.74	0.723	2436.345
Columbia Dr Platinum Dr	Platinum Dr S	0.30	2.36	0.43	A	540.48	810.72	29.39	2.18	0.33	29.39	2.18	0.723	2436.345
Boardwalk/Erb	Erb St E	0.65	5.57	1.87	A	1017.64	1526.46	110.50	4.34	1.23	110.51	4.34	0.723	2436.345
Boardwalk/Erb	Erb St W	0.87	11.40	6.48	B	1764.58	2646.87	297.68	6.75	3.31	297.71	6.75	0.723	2436.345
Boardwalk/Erb	The Boardwalk S	0.65	18.52	1.77	C	295.47	443.21	84.03	11.38	0.93	84.04	11.38	0.579	1357.445

Main Results

Main results: (4:00 PM-4:15 PM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	311.68	77.92	310.94	575.50	117.19	0.00	1998.88	1921.97	0.156	0.00	0.18
Columbia Dr Platinum Dr	Columbia St W	264.25	66.06	263.76	379.31	48.82	0.00	2401.05	2218.19	0.110	0.00	0.12
Columbia Dr Platinum Dr	Platinum Dr S	443.43	110.86	442.45	62.35	250.23	0.00	2255.44	914.94	0.197	0.00	0.24
Boardwalk/Erb	Erb St E	834.91	208.73	831.89	968.72	225.02	0.00	1932.62	1824.12	0.432	0.00	0.76
Boardwalk/Erb	Erb St W	1447.74	361.93	1441.91	1050.16	6.75	0.00	2431.46	2425.64	0.595	0.00	1.46
Boardwalk/Erb	The Boardwalk S	242.42	60.60	240.71	495.63	953.02	0.00	805.87	429.57	0.301	0.00	0.43

Main results: (4:15 PM-4:30 PM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	372.18	93.04	371.99	688.31	140.17	0.00	1984.76	1921.97	0.188	0.18	0.23
Columbia Dr Platinum Dr	Columbia St W	315.54	78.89	315.43	453.76	58.40	0.00	2394.12	2218.19	0.132	0.12	0.15
Columbia Dr Platinum Dr	Platinum Dr S	529.50	132.37	529.23	74.58	299.25	0.00	2220.00	914.94	0.239	0.24	0.31
Boardwalk/Erb	Erb St E	996.97	249.24	995.64	1158.87	269.58	0.00	1905.24	1824.14	0.523	0.76	1.09
Boardwalk/Erb	Erb St W	1728.74	432.18	1724.90	1257.14	8.08	0.00	2430.50	2425.64	0.711	1.46	2.42
Boardwalk/Erb	The Boardwalk S	289.47	72.37	288.38	592.91	1140.06	0.00	697.62	429.57	0.415	0.43	0.70

Main results: (4:30 PM-4:45 PM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	455.82	113.96	455.54	842.89	171.64	0.00	1965.42	1921.97	0.232	0.23	0.30
Columbia Dr Platinum Dr	Columbia St W	386.46	96.61	386.29	555.66	71.52	0.00	2384.64	2218.19	0.162	0.15	0.19
Columbia Dr Platinum Dr	Platinum Dr S	648.50	162.13	648.05	91.33	366.48	0.00	2171.40	914.94	0.299	0.31	0.42
Boardwalk/Erb	Erb St E	1221.03	305.26	1217.98	1412.19	327.69	0.00	1869.53	1824.14	0.653	1.09	1.85
Boardwalk/Erb	Erb St W	2117.26	529.32	2102.03	1535.78	9.88	0.00	2429.20	2425.64	0.872	2.42	6.22
Boardwalk/Erb	The Boardwalk S	354.53	88.63	350.55	722.59	1389.33	0.00	553.36	429.57	0.641	0.70	1.69

Main results: (4:45 PM-5:00 PM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	455.82	113.96	455.82	843.38	171.76	0.00	1965.35	1921.97	0.232	0.30	0.30
Columbia Dr Platinum Dr	Columbia St W	386.46	96.61	386.46	556.01	71.57	0.00	2384.61	2218.19	0.162	0.19	0.19
Columbia Dr Platinum Dr	Platinum Dr S	648.50	162.13	648.50	91.38	366.64	0.00	2171.28	914.94	0.299	0.42	0.43
Boardwalk/Erb	Erb St E	1221.03	305.26	1220.95	1421.82	331.11	0.00	1867.42	1824.14	0.654	1.85	1.87
Boardwalk/Erb	Erb St W	2117.26	529.32	2116.24	1542.15	9.91	0.00	2429.18	2425.64	0.872	6.22	6.48
Boardwalk/Erb	The Boardwalk S	354.53	88.63	354.21	727.43	1398.72	0.00	547.92	429.57	0.647	1.69	1.77

Main results: (5:00 PM-5:15 PM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	372.18	93.04	372.46	689.10	140.36	0.00	1984.64	1921.97	0.188	0.30	0.23
Columbia Dr Platinum Dr	Columbia St W	315.54	78.89	315.71	454.34	58.48	0.00	2394.07	2218.19	0.132	0.19	0.15
Columbia Dr Platinum Dr	Platinum Dr S	529.50	132.37	529.94	74.67	299.52	0.00	2219.81	914.94	0.239	0.43	0.31
Boardwalk/Erb	Erb St E	996.97	249.24	1000.01	1172.25	274.47	0.00	1902.23	1824.14	0.524	1.87	1.11
Boardwalk/Erb	Erb St W	1728.74	432.18	1744.61	1266.36	8.12	0.00	2430.48	2425.64	0.711	6.48	2.51
Boardwalk/Erb	The Boardwalk S	289.47	72.37	293.62	599.63	1153.10	0.00	690.08	429.57	0.419	1.77	0.73

Main results: (5:15 PM-5:30 PM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	311.68	77.92	311.87	576.99	117.52	0.00	1998.68	1921.97	0.156	0.23	0.19
Columbia Dr Platinum Dr	Columbia St W	264.25	66.06	264.36	380.42	48.96	0.00	2400.95	2218.19	0.110	0.15	0.12
Columbia Dr Platinum Dr	Platinum Dr S	443.43	110.86	443.71	62.52	250.81	0.00	2255.02	914.94	0.197	0.31	0.25
Boardwalk/Erb	Erb St E	834.91	208.73	836.29	975.47	227.72	0.00	1930.96	1824.12	0.432	1.11	0.77
Boardwalk/Erb	Erb St W	1447.74	361.93	1451.84	1057.23	6.79	0.00	2431.44	2425.64	0.595	2.51	1.49
Boardwalk/Erb	The Boardwalk S	242.42	60.60	243.61	499.04	959.59	0.00	802.08	429.57	0.302	0.73	0.44

Queueing Delay Results

Queueing Delay results: (4:00 PM-4:15 PM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	Columbia St E	2.73	0.18	2.131	A	A
Columbia Dr Platinum Dr	Columbia St W	1.83	0.12	1.683	A	A
Columbia Dr Platinum Dr	Platinum Dr S	3.61	0.24	1.984	A	A
Boardwalk/Erb	Erb St E	11.05	0.74	3.263	A	A
Boardwalk/Erb	Erb St W	21.12	1.41	3.618	A	A
Boardwalk/Erb	The Boardwalk S	6.16	0.41	6.350	A	A

Queueing Delay results: (4:15 PM-4:30 PM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	Columbia St E	3.42	0.23	2.232	A	A
Columbia Dr Platinum Dr	Columbia St W	2.25	0.15	1.731	A	A
Columbia Dr Platinum Dr	Platinum Dr S	4.64	0.31	2.129	A	A
Boardwalk/Erb	Erb St E	15.93	1.06	3.952	A	A
Boardwalk/Erb	Erb St W	34.75	2.32	5.075	A	A
Boardwalk/Erb	The Boardwalk S	10.07	0.67	8.773	A	A

Queueing Delay results: (4:30 PM-4:45 PM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	Columbia St E	4.46	0.30	2.384	A	A
Columbia Dr Platinum Dr	Columbia St W	2.87	0.19	1.800	A	A
Columbia Dr Platinum Dr	Platinum Dr S	6.29	0.42	2.363	A	A
Boardwalk/Erb	Erb St E	26.66	1.78	5.498	A	A
Boardwalk/Erb	Erb St W	82.78	5.52	10.541	B	B
Boardwalk/Erb	The Boardwalk S	23.19	1.55	17.419	C	B

Queueing Delay results: (4:45 PM-5:00 PM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	Columbia St E	4.52	0.30	2.384	A	A
Columbia Dr Platinum Dr	Columbia St W	2.90	0.19	1.800	A	A
Columbia Dr Platinum Dr	Platinum Dr S	6.37	0.42	2.363	A	A

Boardwalk/Erb	**Erb St E**	27.95	1.86	5.566	A	A
Boardwalk/Erb	**Erb St W**	95.67	6.38	11.403	B	B
Boardwalk/Erb	**The Boardwalk S**	26.16	1.74	18.519	C	B

Queueing Delay results: (5:00 PM-5:15 PM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	**Columbia St E**	3.51	0.23	2.234	A	A
Columbia Dr Platinum Dr	**Columbia St W**	2.30	0.15	1.734	A	A
Columbia Dr Platinum Dr	**Platinum Dr S**	4.77	0.32	2.132	A	A
Boardwalk/Erb	**Erb St E**	17.17	1.14	4.004	A	A
Boardwalk/Erb	**Erb St W**	40.37	2.69	5.365	A	A
Boardwalk/Erb	**The Boardwalk S**	11.67	0.78	9.173	A	A

Queueing Delay results: (5:15 PM-5:30 PM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	**Columbia St E**	2.81	0.19	2.134	A	A
Columbia Dr Platinum Dr	**Columbia St W**	1.87	0.12	1.686	A	A
Columbia Dr Platinum Dr	**Platinum Dr S**	3.72	0.25	1.989	A	A
Boardwalk/Erb	**Erb St E**	11.74	0.78	3.292	A	A
Boardwalk/Erb	**Erb St W**	22.99	1.53	3.692	A	A
Boardwalk/Erb	**The Boardwalk S**	6.77	0.45	6.459	A	A

APPENDIX

D-3 2031 CONDITIONS - WITH RECOMMENDED IMPROVEMENTS

ARCADY 7

Version: 7.1.1.245 [9th June 2011]
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File: J:\04 STAFF FOLDERS\Ubaid\Roundabout Analysis Lukezic\Updated Analysis\Future Conditions\Re-assigned Traffic\Future - Reassigned2.arc7
Report generation date: 06/06/2018 3:16:23 PM

Summary of roundabout performance

There are warnings associated with one or more model runs - see the 'Data Errors and Warnings' tables for each Analysis or Demand Set.

	AM				PM			
	Queue (Veh)	Delay (s)	RFC	LOS	Queue (Veh)	Delay (s)	RFC	LOS
	Planned 2031 Conditions with Recommendations - AM Peak Period							
Ira Needles Blvd/University Avenue - East - University Ave	1.03	6.33	0.51	A	2.16	10.54	0.69	B
Ira Needles Blvd/University Avenue - North - Ira Needles Blvd	1.71	7.12	0.63	A	20.32	64.31	0.99	F
Ira Needles Blvd/University Avenue - West - Private Access	0.25	5.68	0.20	A	6.69	58.50	0.91	F

Ira Needles Blvd/University Avenue - South - Ira Needles Blvd	4.36	12.87	0.82	B	1.65	6.70	0.63	A
Ira Needles Blvd/Thorndale Dr - East - Thorndale Dr	0.68	9.78	0.41	A	0.60	7.92	0.38	A
Ira Needles Blvd/Thorndale Dr - North - Ira Needles Blvd	1.18	4.16	0.54	A	4.89	11.26	0.84	B
Ira Needles Blvd/Thorndale Dr - West - Boardwalk Access	0.10	2.89	0.09	A	0.73	5.72	0.42	A
Ira Needles Blvd/Thorndale Dr - South - Ira Needles Blvd	2.36	6.06	0.70	A	1.47	4.61	0.60	A
Erb St./Platinum Dr - East - Erb St. W	1.13	4.27	0.53	A	0.80	3.09	0.45	A
Erb St./Platinum Dr - North - Platinum Dr	0.17	3.20	0.15	A	1.53	5.34	0.61	A
Erb St./Platinum Dr - West - Erb St.	0.82	3.46	0.45	A	0.25	2.83	0.20	A
Erb St./Platinum Dr - South - Landfill Gate 2	0.04	7.29	0.04	A	0.14	6.91	0.12	A
Ira Needles Blvd/Erb St. - East - Erb St. W	1.06	5.57	0.52	A	3.31	12.05	0.77	B
Ira Needles Blvd/Erb St. - North - Erbsville Rd	1.35	4.88	0.58	A	7.88	20.86	0.90	C
Ira Needles Blvd/Erb St. - West - Erb St.	1.63	6.43	0.62	A	10.94	42.17	0.94	E
Ira Needles Blvd/Erb St. - South - Ira Needles Blvd	5.34	14.14	0.85	B	5.37	14.58	0.85	B
Erbsville/Keats Way - East - Keats Way	0.61	10.53	0.38	B	0.41	7.21	0.29	A
Erbsville/Keats Way - North - Erbsville Road	0.61	2.99	0.38	A	2.01	5.72	0.67	A
Erbsville/Keats Way - West - Keats Way	0.48	7.39	0.32	A	1.13	18.26	0.54	C
Erbsville/Keats Way - South - Erbsville Road	1.50	4.78	0.60	A	0.86	3.62	0.46	A
Beaver Creek Rd/Laurelwood Dr - East - Laurelwood Dr.	0.46	5.12	0.32	A	2.51	12.13	0.72	B
Beaver Creek Rd/Laurelwood Dr - North - Beaver Creek Rd	0.31	4.60	0.23	A	0.61	7.04	0.38	A
Beaver Creek Rd/Laurelwood Dr - West - Laurelwood Dr.	2.11	10.82	0.68	B	0.54	5.57	0.35	A
Beaver Creek Rd/Laurelwood Dr - South - Beaver Creek Rd	1.13	11.08	0.53	B	0.46	5.10	0.32	A
Fischer Hallman Road/Laurelwood Drive - East - Laurelwood Drive	0.15	7.79	0.13	A	0.93	10.08	0.48	B
Fischer Hallman Road/Laurelwood Drive - North - Bearinger Road	0.37	2.57	0.27	A	3.46	10.71	0.78	B
Fischer Hallman Road/Laurelwood Drive - West - Laurelwood Drive	7.72	36.00	0.90	E	2.06	19.76	0.68	C
Fischer Hallman Road/Laurelwood Drive - South - Fischer Hallman Road	1.55	5.57	0.61	A	0.73	3.41	0.42	A
Bearinger Road/Westmount Road - East - Bearinger Road	0.29	3.55	0.22	A	0.83	4.96	0.46	A
Bearinger Road/Westmount Road - North - Westmount Road	0.92	3.64	0.48	A	14.41	36.92	0.95	E
Bearinger Road/Westmount Road - West - Bearinger Road	2.34	7.35	0.70	A	0.94	4.51	0.49	A
Bearinger Road/Westmount Road - South - Westmount Road	0.63	4.90	0.39	A	0.47	3.46	0.32	A
Conservation Drive/Beaver Creek Road - East - Conservation Drive	0.45	4.80	0.31	A	1.01	6.86	0.51	A
Conservation Drive/Beaver Creek Road - North - Beaver Creek Road	0.24	4.57	0.20	A	0.17	4.83	0.15	A
Conservation Drive/Beaver Creek Road - West - Conservation Drive	0.58	5.82	0.37	A	0.35	5.04	0.26	A
Conservation Drive/Beaver Creek Road - South - Beaver Creek Road	0.37	5.39	0.27	A	0.37	5.10	0.27	A

Values shown are the maximum values over all time segments. Delay is the maximum value of average delay per arriving vehicle.

AM Peak Period - AM runs from 08:00:00 to 09:30:00
PM Peak Period - PM runs from 16:00:00 to 17:30:00

File summary

File Description

Title	Roundabout Analysis Waterloo LRT
Location	Waterloo
Site Number	
Date	13/02/2017
Version	
Status	(new file)
Identifier	
Client	
Jobnumber	
Analyst	Ubaid Ali
Description	

Analysis Options

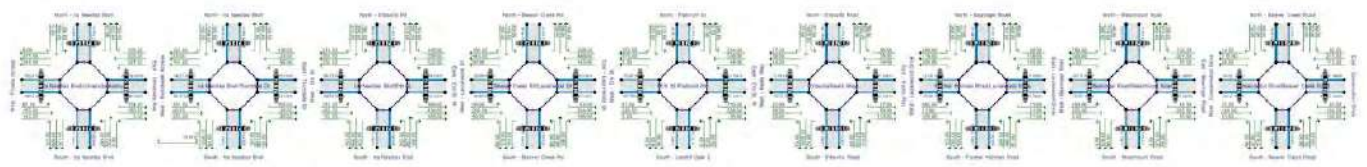
RFC Threshold	Vehicle Length (m)	Do Queue Variations
0.85	5.75	

Sorting and Display

Show Arm Names	Arm Grouping	Sorting Direction	Sorting Type	Data Matrix Style	Time Style
Yes	Order	Ascending	Numerical	By Destination	Absolute Time

Units

Distance Units	Speed Units	Traffic Units Input	Traffic Units Results	Flow Units	Average Delay Units	Total Delay Units	Rate Of Delay Units
m	kph	Veh	Veh	perHour	s	-Min	perMin



Turn Boxes - Turning Count or Proportion (Veh) - Veh/hr
Entry Arm (Text A) - Entry Flow - Veh/hr
Exit Arm (Text B) - Exit Flow - Veh/hr

ounout Anlysis terloc T
Current Time Segment: (4:00 PM-4:15 PM)
Anlysis Set A1 - Pinne 01 Conitions with eommentions emn Set - PM Pe Perio PM
iqrm proue using ACA iqrm

The intersection diagram reflects the last run of ARCADY.

A1 - Planned 2031 Conditions with Recommendations - D1 - AM Peak Period, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Geometry	Ira Needles Blvd/University Avenue - East - University Ave - Standard Geometry	Effective flare length is over 30m, which is outside the normal range. Treat capacities with increasing caution.
Warning	Geometry	Ira Needles Blvd/University Avenue - North - Ira Needles Blvd - Standard Geometry	Effective flare length is over 30m, which is outside the normal range. Treat capacities with increasing caution.
Warning	Geometry	Ira Needles Blvd/University Avenue - South - Ira Needles Blvd - Standard Geometry	Effective flare length is over 30m, which is outside the normal range. Treat capacities with increasing caution.
Last Run	Last Run	Ira Needles Blvd/University Avenue - South - Ira Needles Blvd - Capacity	Pedestrian Crossing causes blocking on previous arm due to traffic queing to leave the junction in 6 timesegment(s).
Warning	Pedestrian Crossing	Ira Needles Blvd/University Avenue - East - University Ave - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/University Avenue - East - University Ave - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/University Avenue - North - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/University Avenue -	Pedestrian crossing uses default flow of 0. Is this correct?

		North - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	
Warning	Pedestrian Crossing	Ira Needles Blvd/University Avenue - West - Private Access - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/University Avenue - West - Private Access - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/University Avenue - South - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - East - Thorndale Dr - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - East - Thorndale Dr - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - North - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - North - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - West - Boardwalk Access -	Pedestrian crossing uses default settings only. Is this correct?

		Unsignalled Pedestrian Crossing Details	
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - West - Boardwalk Access - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - South - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - South - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - East - Erb St. W - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - East - Erb St. W - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - North - Erbsville Rd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - North - Erbsville Rd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - West - Erb St. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - West - Erb St. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?

Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - South - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - South - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Beaver Creek Rd/Laurelwood Dr - East - Laurelwood Dr. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Beaver Creek Rd/Laurelwood Dr - North - Beaver Creek Rd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Beaver Creek Rd/Laurelwood Dr - West - Laurelwood Dr. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Beaver Creek Rd/Laurelwood Dr - West - Laurelwood Dr. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Beaver Creek Rd/Laurelwood Dr - South - Beaver Creek Rd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - East - Erb St. W - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - East - Erb St. W - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?

Warning	Pedestrian Crossing	Erb St./Platinum Dr - North - Platinum Dr - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - North - Platinum Dr - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - West - Erb St. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - West - Erb St. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - South - Landfill Gate 2 - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - South - Landfill Gate 2 - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Erbsville/Keats Way - East - Keats Way - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erbsville/Keats Way - East - Keats Way - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Erbsville/Keats Way - North - Erbsville Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erbsville/Keats Way - North - Erbsville Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?

Warning	Pedestrian Crossing	Erbsville/Keats Way - West - Keats Way - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erbsville/Keats Way - West - Keats Way - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Erbsville/Keats Way - South - Erbsville Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Fischer Hallman Road/Laurelwood Drive - East - Laurelwood Drive - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Fischer Hallman Road/Laurelwood Drive - East - Laurelwood Drive - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Fischer Hallman Road/Laurelwood Drive - North - Bearinger Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Fischer Hallman Road/Laurelwood Drive - North - Bearinger Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Fischer Hallman Road/Laurelwood Drive - West - Laurelwood Drive - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Fischer Hallman Road/Laurelwood Drive - West - Laurelwood Drive -	Pedestrian crossing uses default flow of 0. Is this correct?

		Unsignalled Pedestrian Crossing Details	
Warning	Pedestrian Crossing	Fischer Hallman Road/Laurelwood Drive - South - Fischer Hallman Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Bearinger Road/Westmount Road - East - Bearinger Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Bearinger Road/Westmount Road - East - Bearinger Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Bearinger Road/Westmount Road - North - Westmount Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Bearinger Road/Westmount Road - North - Westmount Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Bearinger Road/Westmount Road - West - Bearinger Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Bearinger Road/Westmount Road - West - Bearinger Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Bearinger Road/Westmount Road - South - Westmount Road	Pedestrian crossing uses default settings only. Is this correct?

		- Unsignalled Pedestrian Crossing Details	
Warning	Pedestrian Crossing	Conservation Drive/Beaver Creek Road - East - Conservation Drive - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Conservation Drive/Beaver Creek Road - East - Conservation Drive - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Conservation Drive/Beaver Creek Road - North - Beaver Creek Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Conservation Drive/Beaver Creek Road - North - Beaver Creek Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Conservation Drive/Beaver Creek Road - West - Conservation Drive - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Conservation Drive/Beaver Creek Road - West - Conservation Drive - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Conservation Drive/Beaver Creek Road - South - Beaver Creek	Pedestrian crossing uses default settings only. Is this correct?

		Road - Unsignalled Pedestrian Crossing Details	

Analysis Set Details

Name	Description	Include In Report	Use Specific Demand Set	Demand Set	Locked	Network Flow Scaling Factor (%)	Network Capacity Scaling Factor (%)	Reason For Scaling Factors
Planned 2031 Conditions with Recommendations		Yes		(D1)		100.000	100.000	

Demand Set Details

Name	Scenario Name	Time Period Name	Description	Locked	Run Automatically	Use Relationship	Relationship	Start Time (HH:mm)	Finish Time (HH:mm)	Time Period Length (min)	Time Segment Length (min)	Traffic Profile Type
AM Peak Period, AM	AM Peak Period	AM			Yes			08:00	09:30	90	15	ONE HOUR

Roundabout Network

Roundabout Type(s)

Roundabout	ID	Name	Arm Order	Roundabout Type	Grade Separated	Large Roundabout	Do Geometric Delay
1	1	Ira Needles Blvd/University Avenue	1,2,3,4	Standard			
3	3	Ira Needles Blvd/Thorndale Dr	1,2,3,4	Standard			
5	5	Erb St./Platinum Dr	1,2,3,4	Standard			
6	6	Ira Needles Blvd/Erb St.	1,2,3,4	Standard			
8	8	Erbsville/Keats Way	1,2,3,4	Standard			
12	12	Beaver Creek Rd/Laurelwood Dr	1,2,3,4	Standard			
13	13	Fischer Hallman Road/Laurelwood Drive	1,2,3,4	Standard			
14	14	Bearinger Road/Westmount Road	1,2,3,4	Standard			
18	18	Conservation Drive/Beaver Creek Road	1,2,3,4	Standard			

Roundabout Network Options

Driving Side	Lighting	Road Surface	In London
Right	Normal/unknown	((Mini-roundabouts only))	

Arms

Arms

ID	Name	Description
1	East - University Ave	
2	North - Ira Needles Blvd	
3	West - Private Access	
4	South - Ira Needles Blvd	
1	East - Thorndale Dr	
2	North - Ira Needles Blvd	
3	West - Boardwalk Access	
4	South - Ira Needles Blvd	
1	East - Erb St. W	
2	North - Platinum Dr	
3	West - Erb St.	
4	South - Landfill Gate 2	
1	East - Erb St. W	
2	North - Erbsville Rd	
3	West - Erb St.	
4	South - Ira Needles Blvd	
1	East - Keats Way	
2	North - Erbsville Road	
3	West - Keats Way	
4	South - Erbsville Road	
1	East - Laurelwood Dr.	
2	North - Beaver Creek Rd	
3	West - Laurelwood Dr.	
4	South - Beaver Creek Rd	
1	East - Laurelwood Drive	
2	North - Bearinger Road	
3	West - Laurelwood Drive	
4	South - Fischer Hallman Road	
1	East - Bearinger Road	

2	North - Westmount Road	
3	West - Bearinger Road	
4	South - Westmount Road	
1	East - Conservation Drive	
2	North - Beaver Creek Road	
3	West - Conservation Drive	
4	South - Beaver Creek Road	

Capacity Options

Roundabout	Arm	Minimum Capacity (PCE/hr)	Maximum Capacity (PCE/hr)	Assume Flat Start Profile	Initial Queue (PCE)
Ira Needles Blvd/University Avenue	**East - University Ave**	0.00	99999.00		0.00
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	0.00	99999.00		0.00
Ira Needles Blvd/University Avenue	**West - Private Access**	0.00	99999.00		0.00
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	0.00	99999.00		0.00
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	0.00	99999.00		0.00
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	0.00	99999.00		0.00
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	0.00	99999.00		0.00
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	0.00	99999.00		0.00
Erb St./Platinum Dr	**East - Erb St. W**	0.00	99999.00		0.00
Erb St./Platinum Dr	**North - Platinum Dr**	0.00	99999.00		0.00
Erb St./Platinum Dr	**West - Erb St.**	0.00	99999.00		0.00
Erb St./Platinum Dr	**South - Landfill Gate 2**	0.00	99999.00		0.00
Ira Needles Blvd/Erb St.	**East - Erb St. W**	0.00	99999.00		0.00
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	0.00	99999.00		0.00
Ira Needles Blvd/Erb St.	**West - Erb St.**	0.00	99999.00		0.00
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	0.00	99999.00		0.00
Erbsville/Keats Way	**East - Keats Way**	0.00	99999.00		0.00
Erbsville/Keats Way	**North - Erbsville Road**	0.00	99999.00		0.00
Erbsville/Keats Way	**West - Keats Way**	0.00	99999.00		0.00
Erbsville/Keats Way	**South - Erbsville Road**	0.00	99999.00		0.00
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	0.00	99999.00		0.00
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	0.00	99999.00		0.00
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	0.00	99999.00		0.00

Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	0.00	99999.00		0.00
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	0.00	99999.00		0.00
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	0.00	99999.00		0.00
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	0.00	99999.00		0.00
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	0.00	99999.00		0.00
Bearinger Road/Westmount Road	**East - Bearinger Road**	0.00	99999.00		0.00
Bearinger Road/Westmount Road	**North - Westmount Road**	0.00	99999.00		0.00
Bearinger Road/Westmount Road	**West - Bearinger Road**	0.00	99999.00		0.00
Bearinger Road/Westmount Road	**South - Westmount Road**	0.00	99999.00		0.00
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	0.00	99999.00		0.00
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	0.00	99999.00		0.00
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	0.00	99999.00		0.00
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	0.00	99999.00		0.00

Standard Geometry

Roundabout	Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit Only
Ira Needles Blvd/University Avenue	**East - University Ave**	7.00	7.70	33.22	27.80	55.00	16.36	
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	3.65	7.70	40.78	27.80	55.00	19.60	
Ira Needles Blvd/University Avenue	**West - Private Access**	10.50	11.00	30.00	20.00	70.00	11.79	
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	3.65	7.70	39.60	25.30	55.00	16.84	
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	3.50	6.40	7.65	67.60	55.00	23.37	
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	7.00	8.50	17.60	42.70	44.00	51.42	
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	7.00	8.65	8.60	36.20	50.00	33.36	
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	7.00	8.45	12.74	39.40	50.00	37.81	
Erb St./Platinum Dr	**East - Erb St. W**	7.00	8.00	30.00	20.00	55.00	25.00	
Erb St./Platinum Dr	**North - Platinum Dr**	7.00	8.00	30.00	20.00	55.00	25.00	
Erb St./Platinum Dr	**West - Erb St.**	7.00	8.00	30.00	20.00	55.00	25.00	
Erb St./Platinum Dr	**South - Landfill Gate 2**	3.50	4.50	30.00	20.00	40.00	25.00	
Ira Needles Blvd/Erb St.	**East - Erb St. W**	7.00	8.60	20.00	33.00	56.00	13.00	
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	7.00	9.30	12.00	30.00	56.00	20.00	
Ira Needles Blvd/Erb St.	**West - Erb St.**	6.80	7.80	7.00	23.00	56.00	6.00	
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	7.20	8.60	10.00	29.00	56.00	17.00	

Erbsville/Keats Way	**East - Keats Way**	3.50	4.50	30.00	20.00	40.00	25.00	
Erbsville/Keats Way	**North - Erbsville Road**	7.00	8.00	30.00	20.00	55.00	25.00	
Erbsville/Keats Way	**West - Keats Way**	3.50	4.50	30.00	20.00	40.00	25.00	
Erbsville/Keats Way	**South - Erbsville Road**	7.00	8.00	30.00	20.00	55.00	25.00	
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	3.50	4.50	30.00	20.00	40.00	25.00	
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	3.50	4.50	30.00	20.00	40.00	25.00	
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	3.50	4.50	30.00	20.00	40.00	25.00	
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	3.50	4.50	30.00	20.00	40.00	25.00	
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	3.50	4.50	30.00	20.00	40.00	25.00	
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	7.00	8.00	30.00	20.00	55.00	25.00	
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	3.50	4.50	30.00	20.00	40.00	25.00	
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	7.00	8.00	30.00	20.00	55.00	25.00	
Bearinger Road/Westmount Road	**East - Bearinger Road**	7.00	8.00	30.00	20.00	55.00	25.00	
Bearinger Road/Westmount Road	**North - Westmount Road**	7.00	8.00	30.00	20.00	55.00	25.00	
Bearinger Road/Westmount Road	**West - Bearinger Road**	7.00	8.00	30.00	20.00	55.00	25.00	
Bearinger Road/Westmount Road	**South - Westmount Road**	7.00	8.00	30.00	20.00	55.00	25.00	
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	3.50	4.50	30.00	20.00	40.00	25.00	
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	3.50	4.50	30.00	20.00	40.00	25.00	
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	3.50	4.50	30.00	20.00	40.00	25.00	
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	3.50	4.50	30.00	20.00	40.00	25.00	

Pedestrian Crossings

Roundabout	Arm	Crossing Type
Ira Needles Blvd/University Avenue	**East - University Ave**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/University Avenue	**West - Private Access**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	Unsignalled Pedestrian Crossing
Erb St./Platinum Dr	**East - Erb St. W**	Unsignalled Pedestrian Crossing
Erb St./Platinum Dr	**North - Platinum Dr**	Unsignalled Pedestrian Crossing
Erb St./Platinum Dr	**West - Erb St.**	Unsignalled Pedestrian Crossing

Erb St./Platinum Dr	**South - Landfill Gate 2**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Erb St.	**East - Erb St. W**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Erb St.	**West - Erb St.**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	Unsignalled Pedestrian Crossing
Erbsville/Keats Way	**East - Keats Way**	Unsignalled Pedestrian Crossing
Erbsville/Keats Way	**North - Erbsville Road**	Unsignalled Pedestrian Crossing
Erbsville/Keats Way	**West - Keats Way**	Unsignalled Pedestrian Crossing
Erbsville/Keats Way	**South - Erbsville Road**	Unsignalled Pedestrian Crossing
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	Unsignalled Pedestrian Crossing
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	Unsignalled Pedestrian Crossing
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	Unsignalled Pedestrian Crossing
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	Unsignalled Pedestrian Crossing
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	Unsignalled Pedestrian Crossing
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	Unsignalled Pedestrian Crossing
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	Unsignalled Pedestrian Crossing
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	Unsignalled Pedestrian Crossing
Bearinger Road/Westmount Road	**East - Bearinger Road**	Unsignalled Pedestrian Crossing
Bearinger Road/Westmount Road	**North - Westmount Road**	Unsignalled Pedestrian Crossing
Bearinger Road/Westmount Road	**West - Bearinger Road**	Unsignalled Pedestrian Crossing
Bearinger Road/Westmount Road	**South - Westmount Road**	Unsignalled Pedestrian Crossing
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	Unsignalled Pedestrian Crossing
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	Unsignalled Pedestrian Crossing
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	Unsignalled Pedestrian Crossing
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	Unsignalled Pedestrian Crossing

Unsignalled Pedestrian Crossing Crossings

Roundabout	Arm	Space between crossing and intersection entry (PCE)	Vehicles queueing on exit (PCE)	Central Refuge	Crossing Data Type	Crossing length (m)	Crossing time (s)	Crossing length (entry side) (m)	Crossing time (entry side) (s)	Crossing length (exit side) (m)	Crossing time (exit side) (s)
Ira Needles Blvd/University Avenue	**East - University Ave**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00

Ira Needles Blvd/University Avenue	**West - Private Access**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erb St./Platinum Dr	**East - Erb St. W**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erb St./Platinum Dr	**North - Platinum Dr**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erb St./Platinum Dr	**West - Erb St.**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erb St./Platinum Dr	**South - Landfill Gate 2**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Erb St.	**East - Erb St. W**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Erb St.	**West - Erb St.**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erbsville/Keats Way	**East - Keats Way**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erbsville/Keats Way	**North - Erbsville Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erbsville/Keats Way	**West - Keats Way**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erbsville/Keats Way	**South - Erbsville Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Bearinger Road/Westmount Road	**East - Bearinger Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Bearinger Road/Westmount Road	**North - Westmount Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Bearinger Road/Westmount Road	**West - Bearinger Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Bearinger Road/Westmount Road	**South - Westmount Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00

Conservation Drive/Beaver Creek Road	North - Beaver Creek Road	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Conservation Drive/Beaver Creek Road	West - Conservation Drive	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Conservation Drive/Beaver Creek Road	South - Beaver Creek Road	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00

Arm Slope/ Intercept and Capacity

Slope and Intercept used in model

Roundabout	Arm	Enter Directly	Slope	Intercept (PCE/hr)	Final Slope	Final Intercept (PCE/hr)
Ira Needles Blvd/University Avenue	East - University Ave		((calculated))	((calculated))	0.740	2461.322
Ira Needles Blvd/University Avenue	North - Ira Needles Blvd		((calculated))	((calculated))	0.678	2138.626
Ira Needles Blvd/University Avenue	West - Private Access		((calculated))	((calculated))	0.809	3535.452
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd		((calculated))	((calculated))	0.680	2144.039
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr		((calculated))	((calculated))	0.571	1541.270
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd		((calculated))	((calculated))	0.746	2358.337
Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access		((calculated))	((calculated))	0.755	2455.620
Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd		((calculated))	((calculated))	0.747	2435.697
Erb St./Platinum Dr	East - Erb St. W		((calculated))	((calculated))	0.723	2436.345
Erb St./Platinum Dr	North - Platinum Dr		((calculated))	((calculated))	0.723	2436.345
Erb St./Platinum Dr	West - Erb St.		((calculated))	((calculated))	0.723	2436.345
Erb St./Platinum Dr	South - Landfill Gate 2		((calculated))	((calculated))	0.579	1357.445
Ira Needles Blvd/Erb St.	East - Erb St. W		((calculated))	((calculated))	0.781	2703.168
Ira Needles Blvd/Erb St.	North - Erbsville Rd		((calculated))	((calculated))	0.770	2683.164
Ira Needles Blvd/Erb St.	West - Erb St.		((calculated))	((calculated))	0.743	2471.717
Ira Needles Blvd/Erb St.	South - Ira Needles Blvd		((calculated))	((calculated))	0.762	2623.737
Erbsville/Keats Way	East - Keats Way		((calculated))	((calculated))	0.579	1357.445
Erbsville/Keats Way	North - Erbsville Road		((calculated))	((calculated))	0.723	2436.345
Erbsville/Keats Way	West - Keats Way		((calculated))	((calculated))	0.579	1357.445
Erbsville/Keats Way	South - Erbsville Road		((calculated))	((calculated))	0.723	2436.345
Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.		((calculated))	((calculated))	0.579	1357.445
Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd		((calculated))	((calculated))	0.579	1357.445
Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.		((calculated))	((calculated))	0.579	1357.445
Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd		((calculated))	((calculated))	0.579	1357.445
Fischer Hallman Road/Laurelwood Drive	East - Laurelwood Drive		((calculated))	((calculated))	0.579	1357.445
Fischer Hallman Road/Laurelwood Drive	North - Bearinger Road		((calculated))	((calculated))	0.723	2436.345

Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**		((calculated))	((calculated))	0.579	1357.445
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**		((calculated))	((calculated))	0.723	2436.345
Bearinger Road/Westmount Road	**East - Bearinger Road**		((calculated))	((calculated))	0.723	2436.345
Bearinger Road/Westmount Road	**North - Westmount Road**		((calculated))	((calculated))	0.723	2436.345
Bearinger Road/Westmount Road	**West - Bearinger Road**		((calculated))	((calculated))	0.723	2436.345
Bearinger Road/Westmount Road	**South - Westmount Road**		((calculated))	((calculated))	0.723	2436.345
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**		((calculated))	((calculated))	0.579	1357.445
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**		((calculated))	((calculated))	0.579	1357.445
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**		((calculated))	((calculated))	0.579	1357.445
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**		((calculated))	((calculated))	0.579	1357.445

The slope and intercept shown above include any corrections and adjustments.

Arm Capacity Adjustments

Roundabout	Arm	Type	Reason	Direct Capacity Adjustment (PCE/hr)	Percentage Capacity Adjustment (%)
Ira Needles Blvd/University Avenue	**East - University Ave**	Percentage		N/A	85.00
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	Percentage		N/A	85.00
Ira Needles Blvd/University Avenue	**West - Private Access**	Percentage		N/A	85.00
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	Percentage		N/A	85.00
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	Percentage		N/A	90.00
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	Percentage		N/A	90.00
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	Percentage		N/A	90.00
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	Percentage		N/A	90.00
Erb St./Platinum Dr	**East - Erb St. W**	Percentage		N/A	90.00
Erb St./Platinum Dr	**North - Platinum Dr**	Percentage		N/A	90.00
Erb St./Platinum Dr	**West - Erb St.**	Percentage		N/A	90.00
Erb St./Platinum Dr	**South - Landfill Gate 2**	Percentage		N/A	90.00
Ira Needles Blvd/Erb St.	**East - Erb St. W**	Percentage		N/A	90.00
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	Percentage		N/A	90.00
Ira Needles Blvd/Erb St.	**West - Erb St.**	Percentage		N/A	90.00
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	Percentage		N/A	90.00
Erbsville/Keats Way	**East - Keats Way**	Percentage		N/A	85.00
Erbsville/Keats Way	**North - Erbsville Road**	Percentage		N/A	85.00
Erbsville/Keats Way	**West - Keats Way**	Percentage		N/A	85.00
Erbsville/Keats Way	**South - Erbsville Road**	Percentage		N/A	85.00

Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	Percentage		N/A	90.00
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	Percentage		N/A	90.00
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	Percentage		N/A	90.00
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	Percentage		N/A	90.00
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	Percentage		N/A	85.00
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	Percentage		N/A	85.00
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	Percentage		N/A	85.00
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	Percentage		N/A	85.00
Bearinger Road/Westmount Road	**East - Bearinger Road**	Percentage		N/A	85.00
Bearinger Road/Westmount Road	**North - Westmount Road**	Percentage		N/A	85.00
Bearinger Road/Westmount Road	**West - Bearinger Road**	Percentage		N/A	85.00
Bearinger Road/Westmount Road	**South - Westmount Road**	Percentage		N/A	85.00
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	Percentage		N/A	85.00
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	Percentage		N/A	85.00
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	Percentage		N/A	85.00
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	Percentage		N/A	85.00

Traffic Flows

Demand Set Data Options

Default Vehicle Mix	Vehicle Mix Varies Over Time	Vehicle Mix Varies Over Turn	Vehicle Mix Varies Over Entry	Vehicle Mix Source	PCE Factor for a Truck (PCE)	Default Turning Proportions	Estimate from entry/exit counts	Turning Proportions Vary Over Time	Turning Proportions Vary Over Turn	Turning Proportions Vary Over Entry
		Yes	Yes	Truck Percentages	2.00				Yes	Yes

Entry Flows

General Flows Data

Roundabout	Arm	Profile Type	Use Turning Counts	Average Demand Flow (Veh/hr)	Flow Scaling Factor (%)	PHF
Ira Needles Blvd/University Avenue	**East - University Ave**	ONE HOUR	Yes	537.00	100.000	N/A
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	ONE HOUR	Yes	796.00	100.000	N/A

Ira Needles Blvd/University Avenue	**West - Private Access**	ONE HOUR	Yes	145.00	100.000	N/A
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	ONE HOUR	Yes	1141.00	100.000	N/A
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	ONE HOUR	Yes	230.00	100.000	N/A
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	ONE HOUR	Yes	932.00	100.000	N/A
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	ONE HOUR	Yes	112.00	100.000	N/A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	ONE HOUR	Yes	1287.00	100.000	N/A
Erb St./Platinum Dr	**East - Erb St. W**	ONE HOUR	Yes	867.00	100.000	N/A
Erb St./Platinum Dr	**North - Platinum Dr**	ONE HOUR	Yes	178.00	100.000	N/A
Erb St./Platinum Dr	**West - Erb St.**	ONE HOUR	Yes	783.00	100.000	N/A
Erb St./Platinum Dr	**South - Landfill Gate 2**	ONE HOUR	Yes	17.00	100.000	N/A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	ONE HOUR	Yes	626.00	100.000	N/A
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	ONE HOUR	Yes	912.00	100.000	N/A
Ira Needles Blvd/Erb St.	**West - Erb St.**	ONE HOUR	Yes	838.00	100.000	N/A
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	ONE HOUR	Yes	1282.00	100.000	N/A
Erbsville/Keats Way	**East - Keats Way**	ONE HOUR	Yes	191.00	100.000	N/A
Erbsville/Keats Way	**North - Erbsville Road**	ONE HOUR	Yes	663.00	100.000	N/A
Erbsville/Keats Way	**West - Keats Way**	ONE HOUR	Yes	212.00	100.000	N/A
Erbsville/Keats Way	**South - Erbsville Road**	ONE HOUR	Yes	1034.00	100.000	N/A
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	ONE HOUR	Yes	295.00	100.000	N/A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	ONE HOUR	Yes	218.00	100.000	N/A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	ONE HOUR	Yes	648.00	100.000	N/A
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	ONE HOUR	Yes	338.00	100.000	N/A
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	ONE HOUR	Yes	63.00	100.000	N/A
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	ONE HOUR	Yes	468.00	100.000	N/A
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	ONE HOUR	Yes	749.00	100.000	N/A
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	ONE HOUR	Yes	918.00	100.000	N/A
Bearinger Road/Westmount Road	**East - Bearinger Road**	ONE HOUR	Yes	267.00	100.000	N/A
Bearinger Road/Westmount Road	**North - Westmount Road**	ONE HOUR	Yes	825.00	100.000	N/A
Bearinger Road/Westmount Road	**West - Bearinger Road**	ONE HOUR	Yes	1053.00	100.000	N/A
Bearinger Road/Westmount Road	**South - Westmount Road**	ONE HOUR	Yes	423.00	100.000	N/A
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	ONE HOUR	Yes	311.00	100.000	N/A
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	ONE HOUR	Yes	174.00	100.000	N/A
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	ONE HOUR	Yes	329.00	100.000	N/A
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	ONE HOUR	Yes	225.00	100.000	N/A

Pedestrian Flows

General Flows Data

Roundabout	Arm	Profile Type	Average Pedestrian Flow (Ped/hr)
Ira Needles Blvd/University Avenue	East - University Ave	ONE HOUR	0.00
Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	ONE HOUR	0.00
Ira Needles Blvd/University Avenue	West - Private Access	ONE HOUR	0.00
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	ONE HOUR	7.00
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	ONE HOUR	1.00
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	ONE HOUR	0.00
Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	ONE HOUR	0.00
Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	ONE HOUR	0.00
Erb St./Platinum Dr	East - Erb St. W	ONE HOUR	0.00
Erb St./Platinum Dr	North - Platinum Dr	ONE HOUR	0.00
Erb St./Platinum Dr	West - Erb St.	ONE HOUR	1.00
Erb St./Platinum Dr	South - Landfill Gate 2	ONE HOUR	4.00
Ira Needles Blvd/Erb St.	East - Erb St. W	ONE HOUR	0.00
Ira Needles Blvd/Erb St.	North - Erbsville Rd	ONE HOUR	0.00
Ira Needles Blvd/Erb St.	West - Erb St.	ONE HOUR	1.00
Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	ONE HOUR	4.00
Erbsville/Keats Way	East - Keats Way	ONE HOUR	0.00
Erbsville/Keats Way	North - Erbsville Road	ONE HOUR	0.00
Erbsville/Keats Way	West - Keats Way	ONE HOUR	0.00
Erbsville/Keats Way	South - Erbsville Road	ONE HOUR	7.00
Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	ONE HOUR	17.00
Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	ONE HOUR	17.00
Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	ONE HOUR	0.00
Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	ONE HOUR	12.00
Fischer Hallman Road/Laurelwood Drive	East - Laurelwood Drive	ONE HOUR	0.00
Fischer Hallman Road/Laurelwood Drive	North - Bearinger Road	ONE HOUR	0.00
Fischer Hallman Road/Laurelwood Drive	West - Laurelwood Drive	ONE HOUR	0.00
Fischer Hallman Road/Laurelwood Drive	South - Fischer Hallman Road	ONE HOUR	7.00
Bearinger Road/Westmount Road	East - Bearinger Road	ONE HOUR	0.00

Bearinger Road/Westmount Road	**North - Westmount Road**	ONE HOUR	0.00
Bearinger Road/Westmount Road	**West - Bearinger Road**	ONE HOUR	0.00
Bearinger Road/Westmount Road	**South - Westmount Road**	ONE HOUR	7.00
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	ONE HOUR	0.00
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	ONE HOUR	0.00
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	ONE HOUR	0.00
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	ONE HOUR	7.00

Direct/Resultant Flows

Direct Flows Data

Time Segment	Roundabout	Arm	Direct Demand Entry Flow (Veh/hr)	DirectDemandEntryFlowInPCE (PCE/hr)	Direct Demand Exit Flow (Veh/hr)	Direct Demand Pedestrian Flow (Ped/hr)
1	**Ira Needles Blvd/University Avenue**	**East - University Ave**	404.28	427.38	N/A	0.00
1	**Ira Needles Blvd/University Avenue**	**North - Ira Needles Blvd**	599.27	613.36	N/A	0.00
1	**Ira Needles Blvd/University Avenue**	**West - Private Access**	109.16	142.46	N/A	0.00
1	**Ira Needles Blvd/University Avenue**	**South - Ira Needles Blvd**	859.00	909.29	N/A	5.27
1	**Ira Needles Blvd/Thorndale Dr**	**East - Thorndale Dr**	173.16	175.78	N/A	0.00
1	**Ira Needles Blvd/Thorndale Dr**	**North - Ira Needles Blvd**	701.66	722.37	N/A	0.00
1	**Ira Needles Blvd/Thorndale Dr**	**West - Boardwalk Access**	84.32	90.94	N/A	0.00
1	**Ira Needles Blvd/Thorndale Dr**	**South - Ira Needles Blvd**	968.92	1017.07	N/A	0.00
1	**Erb St./Platinum Dr**	**East - Erb St. W**	652.72	751.44	N/A	0.00
1	**Erb St./Platinum Dr**	**North - Platinum Dr**	134.01	205.83	N/A	0.00
1	**Erb St./Platinum Dr**	**West - Erb St.**	589.48	615.21	N/A	0.00
1	**Erb St./Platinum Dr**	**South - Landfill Gate 2**	12.80	15.36	N/A	0.00
1	**Ira Needles Blvd/Erb St.**	**East - Erb St. W**	471.29	493.06	N/A	0.00
1	**Ira Needles Blvd/Erb St.**	**North - Erbsville Rd**	686.60	706.18	N/A	0.00
1	**Ira Needles Blvd/Erb St.**	**West - Erb St.**	630.89	644.96	N/A	0.00
1	**Ira Needles Blvd/Erb St.**	**South - Ira Needles Blvd**	965.16	997.52	N/A	0.00
1	**Erbsville/Keats Way**	**East - Keats Way**	143.79	146.67	N/A	0.00
1	**Erbsville/Keats Way**	**North - Erbsville Road**	499.14	509.12	N/A	0.00
1	**Erbsville/Keats Way**	**West - Keats Way**	159.60	162.80	N/A	0.00

1	Erbsville/Keats Way	South - Erbsville Road	778.45	794.02	N/A	5.27
1	Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	222.09	234.86	N/A	12.80
1	Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	164.12	164.51	N/A	12.80
1	Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	487.85	502.90	N/A	0.00
1	Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	254.46	257.46	N/A	9.03
1	Fischer Hallman Road/Laurelwood Drive	East - Laurelwood Drive	47.43	48.38	N/A	0.00
1	Fischer Hallman Road/Laurelwood Drive	North - Bearinger Road	352.33	359.38	N/A	0.00
1	Fischer Hallman Road/Laurelwood Drive	West - Laurelwood Drive	563.89	575.16	N/A	0.00
1	Fischer Hallman Road/Laurelwood Drive	South - Fischer Hallman Road	691.12	704.94	N/A	5.27
1	Bearinger Road/Westmount Road	East - Bearinger Road	201.01	205.03	N/A	0.00
1	Bearinger Road/Westmount Road	North - Westmount Road	621.10	633.53	N/A	0.00
1	Bearinger Road/Westmount Road	West - Bearinger Road	792.75	808.61	N/A	0.00
1	Bearinger Road/Westmount Road	South - Westmount Road	318.46	324.83	N/A	5.27
1	Conservation Drive/Beaver Creek Road	East - Conservation Drive	234.14	237.90	N/A	0.00
1	Conservation Drive/Beaver Creek Road	North - Beaver Creek Road	131.00	133.62	N/A	0.00
1	Conservation Drive/Beaver Creek Road	West - Conservation Drive	247.69	252.45	N/A	0.00
1	Conservation Drive/Beaver Creek Road	South - Beaver Creek Road	169.39	172.25	N/A	5.27
2	Ira Needles Blvd/University Avenue	East - University Ave	482.75	510.33	N/A	0.00
2	Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	715.59	732.42	N/A	0.00
2	Ira Needles Blvd/University Avenue	West - Private Access	130.35	170.11	N/A	0.00
2	Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	1025.74	1085.78	N/A	6.29
2	Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	206.77	209.89	N/A	0.00
2	Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	837.85	862.58	N/A	0.00
2	Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	100.69	108.60	N/A	0.00
2	Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	1156.99	1214.48	N/A	0.00
2	Erb St./Platinum Dr	East - Erb St. W	779.42	897.30	N/A	0.00
2	Erb St./Platinum Dr	North - Platinum Dr	160.02	245.78	N/A	0.00
2	Erb St./Platinum Dr	West - Erb St.	703.90	734.62	N/A	0.00
2	Erb St./Platinum Dr	South - Landfill Gate 2	15.28	18.34	N/A	0.00
2	Ira Needles Blvd/Erb St.	East - Erb St. W	562.76	588.76	N/A	0.00
2	Ira Needles Blvd/Erb St.	North - Erbsville Rd	819.87	843.24	N/A	0.00
2	Ira Needles Blvd/Erb St.	West - Erb St.	753.34	770.15	N/A	0.00
2	Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	1152.49	1191.14	N/A	0.00
2	Erbsville/Keats Way	East - Keats Way	171.71	175.14	N/A	0.00

2	**Erbsville/Keats Way**	**North - Erbsville Road**	596.02	607.94	N/A	0.00
2	**Erbsville/Keats Way**	**West - Keats Way**	190.58	194.40	N/A	0.00
2	**Erbsville/Keats Way**	**South - Erbsville Road**	929.54	948.14	N/A	6.29
2	**Beaver Creek Rd/Laurelwood Dr**	**East - Laurelwood Dr.**	265.20	280.45	N/A	15.28
2	**Beaver Creek Rd/Laurelwood Dr**	**North - Beaver Creek Rd**	195.98	196.45	N/A	15.28
2	**Beaver Creek Rd/Laurelwood Dr**	**West - Laurelwood Dr.**	582.54	600.51	N/A	0.00
2	**Beaver Creek Rd/Laurelwood Dr**	**South - Beaver Creek Rd**	303.86	307.43	N/A	10.79
2	**Fischer Hallman Road/Laurelwood Drive**	**East - Laurelwood Drive**	56.64	57.77	N/A	0.00
2	**Fischer Hallman Road/Laurelwood Drive**	**North - Bearinger Road**	420.72	429.14	N/A	0.00
2	**Fischer Hallman Road/Laurelwood Drive**	**West - Laurelwood Drive**	673.34	686.80	N/A	0.00
2	**Fischer Hallman Road/Laurelwood Drive**	**South - Fischer Hallman Road**	825.26	841.77	N/A	6.29
2	**Bearinger Road/Westmount Road**	**East - Bearinger Road**	240.03	244.83	N/A	0.00
2	**Bearinger Road/Westmount Road**	**North - Westmount Road**	741.66	756.49	N/A	0.00
2	**Bearinger Road/Westmount Road**	**West - Bearinger Road**	946.63	965.56	N/A	0.00
2	**Bearinger Road/Westmount Road**	**South - Westmount Road**	380.27	387.87	N/A	6.29
2	**Conservation Drive/Beaver Creek Road**	**East - Conservation Drive**	279.58	284.08	N/A	0.00
2	**Conservation Drive/Beaver Creek Road**	**North - Beaver Creek Road**	156.42	159.55	N/A	0.00
2	**Conservation Drive/Beaver Creek Road**	**West - Conservation Drive**	295.76	301.45	N/A	0.00
2	**Conservation Drive/Beaver Creek Road**	**South - Beaver Creek Road**	202.27	205.69	N/A	6.29
3	**Ira Needles Blvd/University Avenue**	**East - University Ave**	591.25	625.03	N/A	0.00
3	**Ira Needles Blvd/University Avenue**	**North - Ira Needles Blvd**	876.41	897.02	N/A	0.00
3	**Ira Needles Blvd/University Avenue**	**West - Private Access**	159.65	208.35	N/A	0.00
3	**Ira Needles Blvd/University Avenue**	**South - Ira Needles Blvd**	1256.26	1329.80	N/A	7.71
3	**Ira Needles Blvd/Thorndale Dr**	**East - Thorndale Dr**	253.23	257.07	N/A	0.00
3	**Ira Needles Blvd/Thorndale Dr**	**North - Ira Needles Blvd**	1026.15	1056.44	N/A	0.00
3	**Ira Needles Blvd/Thorndale Dr**	**West - Boardwalk Access**	123.31	133.00	N/A	0.00
3	**Ira Needles Blvd/Thorndale Dr**	**South - Ira Needles Blvd**	1417.01	1487.42	N/A	0.00
3	**Erb St./Platinum Dr**	**East - Erb St. W**	954.58	1098.96	N/A	0.00
3	**Erb St./Platinum Dr**	**North - Platinum Dr**	195.98	301.02	N/A	0.00
3	**Erb St./Platinum Dr**	**West - Erb St.**	862.10	899.72	N/A	0.00
3	**Erb St./Platinum Dr**	**South - Landfill Gate 2**	18.72	22.46	N/A	0.00
3	**Ira Needles Blvd/Erb St.**	**East - Erb St. W**	689.24	721.08	N/A	0.00
3	**Ira Needles Blvd/Erb St.**	**North - Erbsville Rd**	1004.13	1032.76	N/A	0.00
3	**Ira Needles Blvd/Erb St.**	**West - Erb St.**	922.66	943.23	N/A	0.00

3	**Ira Needles Blvd/Erb St.**	**South - Ira Needles Blvd**	1411.51	1458.84	N/A	0.00
3	**Erbsville/Keats Way**	**East - Keats Way**	210.29	214.50	N/A	0.00
3	**Erbsville/Keats Way**	**North - Erbsville Road**	729.98	744.58	N/A	0.00
3	**Erbsville/Keats Way**	**West - Keats Way**	233.42	238.08	N/A	0.00
3	**Erbsville/Keats Way**	**South - Erbsville Road**	1138.46	1161.22	N/A	7.71
3	**Beaver Creek Rd/Laurelwood Dr**	**East - Laurelwood Dr.**	324.80	343.48	N/A	18.72
3	**Beaver Creek Rd/Laurelwood Dr**	**North - Beaver Creek Rd**	240.02	240.60	N/A	18.72
3	**Beaver Creek Rd/Laurelwood Dr**	**West - Laurelwood Dr.**	713.46	735.47	N/A	0.00
3	**Beaver Creek Rd/Laurelwood Dr**	**South - Beaver Creek Rd**	372.14	376.52	N/A	13.21
3	**Fischer Hallman Road/Laurelwood Drive**	**East - Laurelwood Drive**	69.36	70.75	N/A	0.00
3	**Fischer Hallman Road/Laurelwood Drive**	**North - Bearinger Road**	515.28	525.58	N/A	0.00
3	**Fischer Hallman Road/Laurelwood Drive**	**West - Laurelwood Drive**	824.66	841.16	N/A	0.00
3	**Fischer Hallman Road/Laurelwood Drive**	**South - Fischer Hallman Road**	1010.74	1030.95	N/A	7.71
3	**Bearinger Road/Westmount Road**	**East - Bearinger Road**	293.97	299.85	N/A	0.00
3	**Bearinger Road/Westmount Road**	**North - Westmount Road**	908.34	926.51	N/A	0.00
3	**Bearinger Road/Westmount Road**	**West - Bearinger Road**	1159.37	1182.56	N/A	0.00
3	**Bearinger Road/Westmount Road**	**South - Westmount Road**	465.73	475.05	N/A	7.71
3	**Conservation Drive/Beaver Creek Road**	**East - Conservation Drive**	342.42	347.92	N/A	0.00
3	**Conservation Drive/Beaver Creek Road**	**North - Beaver Creek Road**	191.58	195.41	N/A	0.00
3	**Conservation Drive/Beaver Creek Road**	**West - Conservation Drive**	362.24	369.19	N/A	0.00
3	**Conservation Drive/Beaver Creek Road**	**South - Beaver Creek Road**	247.73	251.91	N/A	7.71
4	**Ira Needles Blvd/University Avenue**	**East - University Ave**	591.25	625.03	N/A	0.00
4	**Ira Needles Blvd/University Avenue**	**North - Ira Needles Blvd**	876.41	897.02	N/A	0.00
4	**Ira Needles Blvd/University Avenue**	**West - Private Access**	159.65	208.35	N/A	0.00
4	**Ira Needles Blvd/University Avenue**	**South - Ira Needles Blvd**	1256.26	1329.80	N/A	7.71
4	**Ira Needles Blvd/Thorndale Dr**	**East - Thorndale Dr**	253.23	257.07	N/A	0.00
4	**Ira Needles Blvd/Thorndale Dr**	**North - Ira Needles Blvd**	1026.15	1056.44	N/A	0.00
4	**Ira Needles Blvd/Thorndale Dr**	**West - Boardwalk Access**	123.31	133.00	N/A	0.00
4	**Ira Needles Blvd/Thorndale Dr**	**South - Ira Needles Blvd**	1417.01	1487.42	N/A	0.00
4	**Erb St./Platinum Dr**	**East - Erb St. W**	954.58	1098.96	N/A	0.00
4	**Erb St./Platinum Dr**	**North - Platinum Dr**	195.98	301.02	N/A	0.00
4	**Erb St./Platinum Dr**	**West - Erb St.**	862.10	899.72	N/A	0.00
4	**Erb St./Platinum Dr**	**South - Landfill Gate 2**	18.72	22.46	N/A	0.00
4	**Ira Needles Blvd/Erb St.**	**East - Erb St. W**	689.24	721.08	N/A	0.00

4	**Ira Needles Blvd/Erb St.**	**North - Erbsville Rd**	1004.13	1032.76	N/A	0.00
4	**Ira Needles Blvd/Erb St.**	**West - Erb St.**	922.66	943.23	N/A	0.00
4	**Ira Needles Blvd/Erb St.**	**South - Ira Needles Blvd**	1411.51	1458.84	N/A	0.00
4	**Erbsville/Keats Way**	**East - Keats Way**	210.29	214.50	N/A	0.00
4	**Erbsville/Keats Way**	**North - Erbsville Road**	729.98	744.58	N/A	0.00
4	**Erbsville/Keats Way**	**West - Keats Way**	233.42	238.08	N/A	0.00
4	**Erbsville/Keats Way**	**South - Erbsville Road**	1138.46	1161.22	N/A	7.71
4	**Beaver Creek Rd/Laurelwood Dr**	**East - Laurelwood Dr.**	324.80	343.48	N/A	18.72
4	**Beaver Creek Rd/Laurelwood Dr**	**North - Beaver Creek Rd**	240.02	240.60	N/A	18.72
4	**Beaver Creek Rd/Laurelwood Dr**	**West - Laurelwood Dr.**	713.46	735.47	N/A	0.00
4	**Beaver Creek Rd/Laurelwood Dr**	**South - Beaver Creek Rd**	372.14	376.52	N/A	13.21
4	**Fischer Hallman Road/Laurelwood Drive**	**East - Laurelwood Drive**	69.36	70.75	N/A	0.00
4	**Fischer Hallman Road/Laurelwood Drive**	**North - Bearinger Road**	515.28	525.58	N/A	0.00
4	**Fischer Hallman Road/Laurelwood Drive**	**West - Laurelwood Drive**	824.66	841.16	N/A	0.00
4	**Fischer Hallman Road/Laurelwood Drive**	**South - Fischer Hallman Road**	1010.74	1030.95	N/A	7.71
4	**Bearinger Road/Westmount Road**	**East - Bearinger Road**	293.97	299.85	N/A	0.00
4	**Bearinger Road/Westmount Road**	**North - Westmount Road**	908.34	926.51	N/A	0.00
4	**Bearinger Road/Westmount Road**	**West - Bearinger Road**	1159.37	1182.56	N/A	0.00
4	**Bearinger Road/Westmount Road**	**South - Westmount Road**	465.73	475.05	N/A	7.71
4	**Conservation Drive/Beaver Creek Road**	**East - Conservation Drive**	342.42	347.92	N/A	0.00
4	**Conservation Drive/Beaver Creek Road**	**North - Beaver Creek Road**	191.58	195.41	N/A	0.00
4	**Conservation Drive/Beaver Creek Road**	**West - Conservation Drive**	362.24	369.19	N/A	0.00
4	**Conservation Drive/Beaver Creek Road**	**South - Beaver Creek Road**	247.73	251.91	N/A	7.71
5	**Ira Needles Blvd/University Avenue**	**East - University Ave**	482.75	510.33	N/A	0.00
5	**Ira Needles Blvd/University Avenue**	**North - Ira Needles Blvd**	715.59	732.42	N/A	0.00
5	**Ira Needles Blvd/University Avenue**	**West - Private Access**	130.35	170.11	N/A	0.00
5	**Ira Needles Blvd/University Avenue**	**South - Ira Needles Blvd**	1025.74	1085.78	N/A	6.29
5	**Ira Needles Blvd/Thorndale Dr**	**East - Thorndale Dr**	206.77	209.89	N/A	0.00
5	**Ira Needles Blvd/Thorndale Dr**	**North - Ira Needles Blvd**	837.85	862.58	N/A	0.00
5	**Ira Needles Blvd/Thorndale Dr**	**West - Boardwalk Access**	100.69	108.60	N/A	0.00
5	**Ira Needles Blvd/Thorndale Dr**	**South - Ira Needles Blvd**	1156.99	1214.48	N/A	0.00
5	**Erb St./Platinum Dr**	**East - Erb St. W**	779.42	897.30	N/A	0.00
5	**Erb St./Platinum Dr**	**North - Platinum Dr**	160.02	245.78	N/A	0.00
5	**Erb St./Platinum Dr**	**West - Erb St.**	703.90	734.62	N/A	0.00

5	**Erb St./Platinum Dr**	**South - Landfill Gate 2**	15.28	18.34	N/A	0.00
5	**Ira Needles Blvd/Erb St.**	**East - Erb St. W**	562.76	588.76	N/A	0.00
5	**Ira Needles Blvd/Erb St.**	**North - Erbsville Rd**	819.87	843.24	N/A	0.00
5	**Ira Needles Blvd/Erb St.**	**West - Erb St.**	753.34	770.15	N/A	0.00
5	**Ira Needles Blvd/Erb St.**	**South - Ira Needles Blvd**	1152.49	1191.14	N/A	0.00
5	**Erbsville/Keats Way**	**East - Keats Way**	171.71	175.14	N/A	0.00
5	**Erbsville/Keats Way**	**North - Erbsville Road**	596.02	607.94	N/A	0.00
5	**Erbsville/Keats Way**	**West - Keats Way**	190.58	194.40	N/A	0.00
5	**Erbsville/Keats Way**	**South - Erbsville Road**	929.54	948.14	N/A	6.29
5	**Beaver Creek Rd/Laurelwood Dr**	**East - Laurelwood Dr.**	265.20	280.45	N/A	15.28
5	**Beaver Creek Rd/Laurelwood Dr**	**North - Beaver Creek Rd**	195.98	196.45	N/A	15.28
5	**Beaver Creek Rd/Laurelwood Dr**	**West - Laurelwood Dr.**	582.54	600.51	N/A	0.00
5	**Beaver Creek Rd/Laurelwood Dr**	**South - Beaver Creek Rd**	303.86	307.43	N/A	10.79
5	**Fischer Hallman Road/Laurelwood Drive**	**East - Laurelwood Drive**	56.64	57.77	N/A	0.00
5	**Fischer Hallman Road/Laurelwood Drive**	**North - Bearinger Road**	420.72	429.14	N/A	0.00
5	**Fischer Hallman Road/Laurelwood Drive**	**West - Laurelwood Drive**	673.34	686.80	N/A	0.00
5	**Fischer Hallman Road/Laurelwood Drive**	**South - Fischer Hallman Road**	825.26	841.77	N/A	6.29
5	**Bearinger Road/Westmount Road**	**East - Bearinger Road**	240.03	244.83	N/A	0.00
5	**Bearinger Road/Westmount Road**	**North - Westmount Road**	741.66	756.49	N/A	0.00
5	**Bearinger Road/Westmount Road**	**West - Bearinger Road**	946.63	965.56	N/A	0.00
5	**Bearinger Road/Westmount Road**	**South - Westmount Road**	380.27	387.87	N/A	6.29
5	**Conservation Drive/Beaver Creek Road**	**East - Conservation Drive**	279.58	284.08	N/A	0.00
5	**Conservation Drive/Beaver Creek Road**	**North - Beaver Creek Road**	156.42	159.55	N/A	0.00
5	**Conservation Drive/Beaver Creek Road**	**West - Conservation Drive**	295.76	301.45	N/A	0.00
5	**Conservation Drive/Beaver Creek Road**	**South - Beaver Creek Road**	202.27	205.69	N/A	6.29
6	**Ira Needles Blvd/University Avenue**	**East - University Ave**	404.28	427.38	N/A	0.00
6	**Ira Needles Blvd/University Avenue**	**North - Ira Needles Blvd**	599.27	613.36	N/A	0.00
6	**Ira Needles Blvd/University Avenue**	**West - Private Access**	109.16	142.46	N/A	0.00
6	**Ira Needles Blvd/University Avenue**	**South - Ira Needles Blvd**	859.00	909.29	N/A	5.27
6	**Ira Needles Blvd/Thorndale Dr**	**East - Thorndale Dr**	173.16	175.78	N/A	0.00
6	**Ira Needles Blvd/Thorndale Dr**	**North - Ira Needles Blvd**	701.66	722.37	N/A	0.00
6	**Ira Needles Blvd/Thorndale Dr**	**West - Boardwalk Access**	84.32	90.94	N/A	0.00
6	**Ira Needles Blvd/Thorndale Dr**	**South - Ira Needles Blvd**	968.92	1017.07	N/A	0.00
6	**Erb St./Platinum Dr**	**East - Erb St. W**	652.72	751.44	N/A	0.00

6	Erb St./Platinum Dr	North - Platinum Dr	134.01	205.83	N/A	0.00
6	Erb St./Platinum Dr	West - Erb St.	589.48	615.21	N/A	0.00
6	Erb St./Platinum Dr	South - Landfill Gate 2	12.80	15.36	N/A	0.00
6	Ira Needles Blvd/Erb St.	East - Erb St. W	471.29	493.06	N/A	0.00
6	Ira Needles Blvd/Erb St.	North - Erbsville Rd	686.60	706.18	N/A	0.00
6	Ira Needles Blvd/Erb St.	West - Erb St.	630.89	644.96	N/A	0.00
6	Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	965.16	997.52	N/A	0.00
6	Erbsville/Keats Way	East - Keats Way	143.79	146.67	N/A	0.00
6	Erbsville/Keats Way	North - Erbsville Road	499.14	509.12	N/A	0.00
6	Erbsville/Keats Way	West - Keats Way	159.60	162.80	N/A	0.00
6	Erbsville/Keats Way	South - Erbsville Road	778.45	794.02	N/A	5.27
6	Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	222.09	234.86	N/A	12.80
6	Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	164.12	164.51	N/A	12.80
6	Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	487.85	502.90	N/A	0.00
6	Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	254.46	257.46	N/A	9.03
6	Fischer Hallman Road/Laurelwood Drive	East - Laurelwood Drive	47.43	48.38	N/A	0.00
6	Fischer Hallman Road/Laurelwood Drive	North - Bearinger Road	352.33	359.38	N/A	0.00
6	Fischer Hallman Road/Laurelwood Drive	West - Laurelwood Drive	563.89	575.16	N/A	0.00
6	Fischer Hallman Road/Laurelwood Drive	South - Fischer Hallman Road	691.12	704.94	N/A	5.27
6	Bearinger Road/Westmount Road	East - Bearinger Road	201.01	205.03	N/A	0.00
6	Bearinger Road/Westmount Road	North - Westmount Road	621.10	633.53	N/A	0.00
6	Bearinger Road/Westmount Road	West - Bearinger Road	792.75	808.61	N/A	0.00
6	Bearinger Road/Westmount Road	South - Westmount Road	318.46	324.83	N/A	5.27
6	Conservation Drive/Beaver Creek Road	East - Conservation Drive	234.14	237.90	N/A	0.00
6	Conservation Drive/Beaver Creek Road	North - Beaver Creek Road	131.00	133.62	N/A	0.00
6	Conservation Drive/Beaver Creek Road	West - Conservation Drive	247.69	252.45	N/A	0.00
6	Conservation Drive/Beaver Creek Road	South - Beaver Creek Road	169.39	172.25	N/A	5.27

Turning Proportions

Turning Counts or Proportions (Veh/hr) - Ira Needles Blvd/ University Avenue (for whole period)

		To			
From		1	2	3	4

	1	0.000	108.000	59.000	370.000
	2	140.000	0.000	0.000	656.000
	3	38.000	33.000	0.000	74.000
	4	0.000	993.000	148.000	0.000

Turning Proportions (Veh) - Ira Needles Blvd/ University Avenue (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.20	0.11	0.69
	2	0.18	0.00	0.00	0.82
	3	0.26	0.23	0.00	0.51
	4	0.00	0.87	0.13	0.00

Turning Counts or Proportions (Veh/hr) - Ira Needles Blvd/ Thorndale Dr (for whole period)

		To			
		1	2	3	4
From	1	0.000	128.000	10.000	92.000
	2	45.000	0.000	70.000	817.000
	3	15.000	40.000	0.000	57.000
	4	60.000	1120.000	107.000	0.000

Turning Proportions (Veh) - Ira Needles Blvd/ Thorndale Dr (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.56	0.04	0.40
	2	0.05	0.00	0.08	0.88
	3	0.13	0.36	0.00	0.51
	4	0.05	0.87	0.08	0.00

Turning Counts or Proportions (Veh/hr) - Ira Needles Blvd/ Erb St. (for whole period)

		To			
From		1	2	3	4

	1	0.000	119.000	369.000	138.000
	2	181.000	0.000	113.000	618.000
	3	461.000	193.000	0.000	184.000
	4	178.000	829.000	275.000	0.000

Turning Proportions (Veh) - Ira Needles Blvd/ Erb St. (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.19	0.59	0.22
	2	0.20	0.00	0.12	0.68
	3	0.55	0.23	0.00	0.22
	4	0.14	0.65	0.21	0.00

Turning Counts or Proportions (Veh/hr) - Beaver Creek Rd/ Laurelwood Dr (for whole period)

		To			
		1	2	3	4
From	1	0.000	63.000	201.000	31.000
	2	103.000	0.000	29.000	86.000
	3	445.000	49.000	0.000	154.000
	4	179.000	74.000	85.000	0.000

Turning Proportions (Veh) - Beaver Creek Rd/ Laurelwood Dr (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.21	0.68	0.11
	2	0.47	0.00	0.13	0.39
	3	0.69	0.08	0.00	0.24
	4	0.53	0.22	0.25	0.00

Turning Counts or Proportions (Veh/hr) - Erb St./ Platinum Dr (for whole period)

	To				
From		1	2	3	4

	1	0.000	654.000	180.000	33.000
	2	154.000	0.000	24.000	0.000
	3	618.000	160.000	0.000	5.000
	4	17.000	0.000	0.000	0.000

Turning Proportions (Veh) - Erb St./ Platinum Dr (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.75	0.21	0.04
	2	0.87	0.00	0.13	0.00
	3	0.79	0.20	0.00	0.01
	4	1.00	0.00	0.00	0.00

Turning Counts or Proportions (Veh/hr) - Erbsville/ Keats Way (for whole period)

		To			
		1	2	3	4
From	1	0.000	77.000	38.000	76.000
	2	55.000	0.000	29.000	579.000
	3	48.000	98.000	0.000	66.000
	4	63.000	940.000	31.000	0.000

Turning Proportions (Veh) - Erbsville/ Keats Way (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.40	0.20	0.40
	2	0.08	0.00	0.04	0.87
	3	0.23	0.46	0.00	0.31
	4	0.06	0.91	0.03	0.00

Turning Counts or Proportions (Veh/hr) - Fischer Hallman Road/ Laurelwood Drive (for whole period)

	To				
From		1	2	3	4

	1	0.000	13.000	23.000	27.000
	2	43.000	0.000	127.000	298.000
	3	207.000	302.000	0.000	240.000
	4	111.000	688.000	119.000	0.000

Turning Proportions (Veh) - Fischer Hallman Road/ Laurelwood Drive (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.21	0.37	0.43
	2	0.09	0.00	0.27	0.64
	3	0.28	0.40	0.00	0.32
	4	0.12	0.75	0.13	0.00

Turning Counts or Proportions (Veh/hr) - Bearinger Road/ Westmount Road (for whole period)

		To			
		1	2	3	4
From	1	0.000	71.000	135.000	61.000
	2	174.000	0.000	338.000	313.000
	3	331.000	720.000	0.000	2.000
	4	75.000	347.000	1.000	0.000

Turning Proportions (Veh) - Bearinger Road/ Westmount Road (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.27	0.51	0.23
	2	0.21	0.00	0.41	0.38
	3	0.31	0.68	0.00	0.00
	4	0.18	0.82	0.00	0.00

Turning Counts or Proportions (Veh/hr) - Conservation Drive/ Beaver Creek Road (for whole period)

	To			
From	1	2	3	4

	1	0.000	61.000	136.000	114.000
	2	98.000	0.000	21.000	55.000
	3	288.000	13.000	0.000	28.000
	4	158.000	35.000	32.000	0.000

Turning Proportions (Veh) - Conservation Drive/ Beaver Creek Road (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.20	0.44	0.37
	2	0.56	0.00	0.12	0.32
	3	0.88	0.04	0.00	0.09
	4	0.70	0.16	0.14	0.00

Vehicle Mix

Average PCE Per Vehicle - Ira Needles Blvd/ University Avenue (for whole period)

		To			
		1	2	3	4
From	1	1.000	1.080	1.060	1.050
	2	1.040	1.000	1.000	1.020
	3	1.120	1.350	1.000	1.380
	4	1.050	1.030	1.250	1.000

Truck Percentages - Ira Needles Blvd/ University Avenue (for whole period)

		To			
		1	2	3	4
From	1	0.000	8.000	6.000	5.000
	2	4.000	0.000	0.000	2.000
	3	12.000	35.000	0.000	38.000
	4	5.000	3.000	25.000	0.000

Average PCE Per Vehicle - Ira Needles Blvd/ Thorndale Dr (for whole period)

		To			
		1	2	3	4
From	1	1.000	1.020	1.000	1.010
	2	1.020	1.000	1.030	1.030
	3	1.000	1.220	1.000	1.000
	4	1.060	1.030	1.250	1.000

Truck Percentages - Ira Needles Blvd/ Thorndale Dr (for whole period)

		To			
		1	2	3	4
From	1	0.000	2.000	0.000	1.000
	2	2.000	0.000	3.000	3.000
	3	0.000	22.000	0.000	0.000
	4	6.000	3.000	25.000	0.000

Average PCE Per Vehicle - Ira Needles Blvd/ Erb St. (for whole period)

		To			
		1	2	3	4
From	1	1.000	1.030	1.050	1.050
	2	1.010	1.000	1.050	1.030
	3	1.020	1.030	1.000	1.020
	4	1.040	1.030	1.040	1.000

Truck Percentages - Ira Needles Blvd/ Erb St. (for whole period)

		To			
		1	2	3	4
From	1	0.000	3.000	5.000	5.000
	2	1.000	0.000	5.000	3.000
	3	2.000	3.000	0.000	2.000
	4	4.000	3.000	4.000	0.000

Average PCE Per Vehicle - Beaver Creek Rd/ Laurelwood Dr (for whole period)

		To			
		1	2	3	4
From	1	1.000	1.030	1.075	1.000
	2	1.000	1.000	1.018	1.000
	3	1.025	1.030	1.000	1.048
	4	1.017	1.000	1.011	1.000

Truck Percentages - Beaver Creek Rd/ Laurelwood Dr (for whole period)

		To			
		1	2	3	4
From	1	0.000	3.000	7.500	0.000
	2	0.000	0.000	1.800	0.000
	3	2.500	3.000	0.000	4.800
	4	1.700	0.000	1.100	0.000

Average PCE Per Vehicle - Erb St./ Platinum Dr (for whole period)

		To			
		1	2	3	4
From	1	1.000	1.170	1.065	1.250
	2	1.600	1.000	1.125	1.000
	3	1.037	1.071	1.000	1.000
	4	1.200	1.000	1.000	1.000

Truck Percentages - Erb St./ Platinum Dr (for whole period)

		To			
		1	2	3	4
From	1	0.000	17.000	6.500	25.000
	2	60.000	0.000	12.500	0.000
	3	3.680	7.140	0.000	0.000
	4	20.000	0.000	0.000	0.000

Average PCE Per Vehicle - Erbsville/ Keats Way (for whole period)

		To			
		1	2	3	4
From	1	1.020	1.020	1.020	1.020
	2	1.020	1.020	1.020	1.020
	3	1.020	1.020	1.020	1.020
	4	1.020	1.020	1.020	1.020

Truck Percentages - Erbsville/ Keats Way (for whole period)

		To			
		1	2	3	4
From	1	2.000	2.000	2.000	2.000
	2	2.000	2.000	2.000	2.000
	3	2.000	2.000	2.000	2.000
	4	2.000	2.000	2.000	2.000

Average PCE Per Vehicle - Fischer Hallman Road/ Laurelwood Drive (for whole period)

		To			
		1	2	3	4
From	1	1.020	1.020	1.020	1.020
	2	1.020	1.020	1.020	1.020
	3	1.020	1.020	1.020	1.020
	4	1.020	1.020	1.020	1.020

Truck Percentages - Fischer Hallman Road/ Laurelwood Drive (for whole period)

		To			
		1	2	3	4
From	1	2.000	2.000	2.000	2.000
	2	2.000	2.000	2.000	2.000
	3	2.000	2.000	2.000	2.000
	4	2.000	2.000	2.000	2.000

Average PCE Per Vehicle - Bearinger Road/ Westmount Road (for whole period)

		To			
		1	2	3	4
From	1	1.020	1.020	1.020	1.020
	2	1.020	1.020	1.020	1.020
	3	1.020	1.020	1.020	1.020
	4	1.020	1.020	1.020	1.020

Truck Percentages - Bearinger Road/ Westmount Road (for whole period)

		To			
		1	2	3	4
From	1	2.000	2.000	2.000	2.000
	2	2.000	2.000	2.000	2.000
	3	2.000	2.000	2.000	2.000
	4	2.000	2.000	2.000	2.000

Average PCE Per Vehicle - Conservation Drive/ Beaver Creek Road (for whole period)

		To			
		1	2	3	4
From	1	1.020	1.000	1.020	1.020
	2	1.020	1.000	1.020	1.020
	3	1.020	1.000	1.020	1.020
	4	1.020	1.000	1.020	1.020

Truck Percentages - Conservation Drive/ Beaver Creek Road (for whole period)

		To			
		1	2	3	4
From	1	2.000	0.000	2.000	2.000
	2	2.000	0.000	2.000	2.000
	3	2.000	0.000	2.000	2.000
	4	2.000	0.000	2.000	2.000

Results

Results Summary

Roundabout	Arm	Max RFC	Max Delay (s)	Max Queue (Veh)	Max LOS	Total Demand (Veh/hr)	Total Arrivals (Veh)	Total Queueing Delay (Veh-min)	Average Queueing Delay (s)	Rate Of Queueing Delay (Veh-min/min)	Inclusive Queueing Total Delay (Veh-min)	Inclusive Queueing Average Delay (s)	Slope	Intercept (PCE/hr)
Ira Needles Blvd/University Avenue	East - University Ave	0.51	6.33	1.03	A	492.76	739.14	59.65	4.84	0.66	59.66	4.84	0.740	2461.322
Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	0.63	7.12	1.71	A	730.42	1095.63	98.80	5.41	1.10	98.81	5.41	0.678	2138.626
Ira Needles Blvd/University Avenue	West - Private Access	0.20	5.68	0.25	A	133.05	199.58	13.62	4.09	0.15	13.62	4.09	0.809	3535.452
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	0.82	12.87	4.36	B	1047.00	1570.50	221.02	8.44	2.46	221.05	8.45	0.680	2144.039
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	0.41	9.78	0.68	A	211.05	316.58	38.71	7.34	0.43	38.71	7.34	0.571	1541.270
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	0.54	4.16	1.18	A	855.22	1282.83	74.89	3.50	0.83	74.89	3.50	0.746	2358.337
Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	0.09	2.89	0.10	A	102.77	154.16	6.79	2.64	0.08	6.79	2.64	0.755	2455.620
Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	0.70	6.06	2.36	A	1180.97	1771.46	135.93	4.60	1.51	135.95	4.60	0.747	2435.697
Erb St./Platinum Dr	East - Erb St. W	0.53	4.27	1.13	A	795.57	1193.36	72.37	3.64	0.80	72.38	3.64	0.723	2436.345
Erb St./Platinum Dr	North - Platinum Dr	0.15	3.20	0.17	A	163.34	245.00	12.55	3.07	0.14	12.55	3.07	0.723	2436.345
Erb St./Platinum Dr	West - Erb St.	0.45	3.46	0.82	A	718.49	1077.74	54.37	3.03	0.60	54.37	3.03	0.723	2436.345
Erb St./Platinum Dr	South - Landfill Gate 2	0.04	7.29	0.04	A	15.60	23.40	2.48	6.35	0.03	2.48	6.35	0.579	1357.445
Ira Needles Blvd/Erb St.	East - Erb St. W	0.52	5.57	1.06	A	574.43	861.64	60.68	4.23	0.67	60.68	4.23	0.781	2703.168
Ira Needles Blvd/Erb St.	North - Erbsville Rd	0.58	4.88	1.35	A	836.87	1255.30	80.10	3.83	0.89	80.11	3.83	0.770	2683.164
Ira Needles Blvd/Erb St.	West - Erb St.	0.62	6.43	1.63	A	768.97	1153.45	91.73	4.77	1.02	91.74	4.77	0.743	2471.717
Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	0.85	14.14	5.34	B	1176.39	1764.58	235.02	7.99	2.61	235.04	7.99	0.762	2623.737
Erbsville/Keats Way	East - Keats Way	0.38	10.53	0.61	B	175.26	262.90	35.65	8.14	0.40	35.65	8.14	0.579	1357.445
Erbsville/Keats Way	North - Erbsville Road	0.38	2.99	0.61	A	608.38	912.57	41.41	2.72	0.46	41.41	2.72	0.723	2436.345
Erbsville/Keats Way	West - Keats Way	0.32	7.39	0.48	A	194.53	291.80	30.27	6.22	0.34	30.27	6.22	0.579	1357.445
Erbsville/Keats Way	South - Erbsville Road	0.60	4.78	1.50	A	948.82	1423.22	92.56	3.90	1.03	92.56	3.90	0.723	2436.345
Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	0.32	5.12	0.46	A	270.70	406.05	31.56	4.66	0.35	31.56	4.66	0.579	1357.445
Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	0.23	4.60	0.31	A	200.04	300.06	21.24	4.25	0.24	21.24	4.25	0.579	1357.445

Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	0.68	10.82	2.11	B	594.62	891.93	120.30	8.09	1.34	120.32	8.09	0.579	1357.445
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	0.53	11.08	1.13	B	310.15	465.23	62.36	8.04	0.69	62.36	8.04	0.579	1357.445
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	0.13	7.79	0.15	A	57.81	86.71	9.42	6.52	0.10	9.42	6.52	0.579	1357.445
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	0.27	2.57	0.37	A	429.44	644.17	25.86	2.41	0.29	25.86	2.41	0.723	2436.345
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	0.90	36.00	7.72	E	687.30	1030.94	309.04	17.99	3.43	309.10	17.99	0.579	1357.445
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	0.61	5.57	1.55	A	842.37	1263.56	92.09	4.37	1.02	92.10	4.37	0.723	2436.345
Bearinger Road/Westmount Road	**East - Bearinger Road**	0.22	3.55	0.29	A	245.00	367.51	19.10	3.12	0.21	19.10	3.12	0.723	2436.345
Bearinger Road/Westmount Road	**North - Westmount Road**	0.48	3.64	0.92	A	757.03	1135.55	60.08	3.17	0.67	60.09	3.17	0.723	2436.345
Bearinger Road/Westmount Road	**West - Bearinger Road**	0.70	7.35	2.34	A	966.25	1449.38	128.67	5.33	1.43	128.68	5.33	0.723	2436.345
Bearinger Road/Westmount Road	**South - Westmount Road**	0.39	4.90	0.63	A	388.15	582.23	38.69	3.99	0.43	38.69	3.99	0.723	2436.345
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	0.31	4.80	0.45	A	285.38	428.07	31.73	4.45	0.35	31.73	4.45	0.579	1357.445
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	0.20	4.57	0.24	A	159.67	239.50	17.10	4.28	0.19	17.10	4.28	0.579	1357.445
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	0.37	5.82	0.58	A	301.90	452.84	39.12	5.18	0.43	39.12	5.18	0.579	1357.445
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	0.27	5.39	0.37	A	206.46	309.70	25.20	4.88	0.28	25.20	4.88	0.579	1357.445

Main Results

Main results: (8:00 AM-8:15 AM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)
Ira Needles Blvd/University Avenue	**East - University Ave**	404.28	101.07	402.70	133.46	878.75	0.00	1421.65	982.99	0.284	0.00	0.40
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	599.27	149.82	596.65	848.97	432.48	0.00	1507.74	1171.35	0.397	0.00	0.65
Ira Needles Blvd/University Avenue	**West - Private Access**	109.16	27.29	108.84	155.02	874.12	0.00	1436.48	167.56	0.076	0.00	0.08
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	859.00	214.75	853.98	824.72	158.23	5.27	1533.84	1533.84	0.560	0.00	1.26

Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	173.16	43.29	172.15	90.04	950.35	0.00	858.83	307.26	0.202	0.00	0.25
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	701.66	175.41	699.41	965.89	156.60	0.00	1946.00	1855.67	0.361	0.00	0.56
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	84.32	21.08	84.10	140.27	715.75	0.00	1586.00	858.51	0.053	0.00	0.06
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	968.92	242.23	965.31	724.77	75.07	0.00	2035.62	1716.64	0.476	0.00	0.90
Erb St./Platinum Dr	**East - Erb St. W**	652.72	163.18	650.52	592.20	120.11	0.00	1831.91	1781.99	0.356	0.00	0.55
Erb St./Platinum Dr	**North - Platinum Dr**	134.01	33.50	133.57	610.81	159.82	0.00	1353.54	1224.76	0.099	0.00	0.11
Erb St./Platinum Dr	**West - Erb St.**	589.48	147.37	587.78	153.07	140.32	0.00	1966.45	991.17	0.300	0.00	0.43
Erb St./Platinum Dr	**South - Landfill Gate 2**	12.80	3.20	12.72	28.51	699.59	0.00	673.19	0.00	0.019	0.00	0.02
Ira Needles Blvd/Erb St.	**East - Erb St. W**	471.28	117.82	469.69	615.02	972.23	0.00	1651.17	1254.39	0.285	0.00	0.40
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	686.60	171.65	684.41	855.40	586.52	0.00	1934.33	1406.18	0.355	0.00	0.55
Ira Needles Blvd/Erb St.	**West - Erb St.**	630.89	157.72	628.55	567.78	703.15	0.00	1703.02	1160.42	0.370	0.00	0.58
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	965.16	241.29	960.89	705.33	626.37	0.00	1860.83	1483.14	0.519	0.00	1.07
Erbsville/Keats Way	**East - Keats Way**	143.79	35.95	142.83	124.49	801.87	0.00	736.73	234.65	0.195	0.00	0.24
Erbsville/Keats Way	**North - Erbsville Road**	499.14	124.79	497.78	836.19	108.51	0.00	1963.61	1909.71	0.254	0.00	0.34
Erbsville/Keats Way	**West - Keats Way**	159.60	39.90	158.70	73.45	532.84	0.00	857.64	136.95	0.186	0.00	0.23
Erbsville/Keats Way	**South - Erbsville Road**	778.45	194.61	775.77	540.95	150.59	5.27	1935.96	1873.30	0.402	0.00	0.67
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	222.09	55.52	221.05	543.98	155.62	12.80	1070.27	990.27	0.208	0.00	0.26
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	164.12	41.03	163.41	139.23	237.44	12.80	1084.44	726.55	0.151	0.00	0.18
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	487.85	121.96	484.68	235.95	164.90	0.00	1095.30	748.28	0.445	0.00	0.79
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	254.46	63.62	252.90	202.88	446.70	9.03	898.96	447.58	0.283	0.00	0.39
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	47.43	11.86	47.15	269.96	830.59	0.00	722.60	289.71	0.066	0.00	0.07
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	352.33	88.08	351.46	751.06	126.68	0.00	1952.44	1747.99	0.180	0.00	0.22
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	563.89	140.97	558.69	201.85	276.29	0.00	988.37	383.11	0.571	0.00	1.30
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	691.12	172.78	688.58	423.02	411.96	5.27	1775.63	1770.11	0.389	0.00	0.63
Bearinger Road/Westmount Road	**East - Bearinger Road**	201.01	50.25	200.41	435.05	800.94	0.00	1538.10	969.13	0.131	0.00	0.15
Bearinger Road/Westmount Road	**North - Westmount Road**	621.10	155.28	619.23	853.48	147.87	0.00	1939.42	1591.59	0.320	0.00	0.47
Bearinger Road/Westmount Road	**West - Bearinger Road**	792.75	198.19	789.54	355.78	411.32	0.00	1773.24	1265.13	0.447	0.00	0.80
Bearinger Road/Westmount Road	**South - Westmount Road**	318.46	79.61	317.35	282.22	918.64	5.27	1464.75	1047.53	0.217	0.00	0.28
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	234.14	58.53	233.07	407.54	59.93	0.00	1106.32	1025.03	0.212	0.00	0.27
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	131.00	32.75	130.41	81.67	211.33	0.00	1027.24	678.06	0.128	0.00	0.15
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	247.69	61.92	246.43	141.63	200.11	0.00	1030.94	581.71	0.240	0.00	0.31

Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	169.39	42.35	168.57	147.63	298.91	5.27	985.51	682.98	0.172	0.00	0.21

Main results: (8:15 AM-8:30 AM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)
Ira Needles Blvd/University Avenue	**East - University Ave**	482.75	120.69	482.02	159.76	1052.49	0.00	1311.45	982.99	0.368	0.40	0.58
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	715.59	178.90	714.37	1016.76	517.76	0.00	1454.82	1171.35	0.492	0.65	0.96
Ira Needles Blvd/University Avenue	**West - Private Access**	130.35	32.59	130.18	185.64	1046.50	0.00	1171.20	167.56	0.111	0.08	0.12
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	1025.73	256.43	1022.86	987.28	189.39	6.29	1533.84	1533.84	0.669	1.26	1.97
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	206.77	51.69	206.28	107.75	1137.40	0.00	758.91	307.26	0.272	0.25	0.37
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	837.85	209.46	837.02	1156.15	187.53	0.00	1923.17	1855.67	0.436	0.56	0.77
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	100.69	25.17	100.62	167.89	856.67	0.00	1494.83	858.51	0.067	0.06	0.07
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	1156.99	289.25	1155.32	867.46	89.83	0.00	2025.25	1716.64	0.571	0.90	1.32
Erb St./Platinum Dr	**East - Erb St. W**	779.41	194.85	778.63	708.73	143.72	0.00	1817.61	1781.99	0.429	0.55	0.75
Erb St./Platinum Dr	**North - Platinum Dr**	160.02	40.00	159.91	731.06	191.29	0.00	1338.96	1224.76	0.120	0.11	0.14
Erb St./Platinum Dr	**West - Erb St.**	703.90	175.97	703.34	183.22	167.99	0.00	1939.92	991.17	0.363	0.43	0.57
Erb St./Platinum Dr	**South - Landfill Gate 2**	15.28	3.82	15.26	34.13	837.20	0.00	605.32	0.00	0.025	0.02	0.03
Ira Needles Blvd/Erb St.	**East - Erb St. W**	562.76	140.69	562.01	735.93	1163.15	0.00	1518.77	1254.39	0.371	0.40	0.58
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	819.87	204.97	818.91	1023.40	701.75	0.00	1853.07	1406.18	0.442	0.55	0.79
Ira Needles Blvd/Erb St.	**West - Erb St.**	753.35	188.34	752.20	679.33	841.34	0.00	1610.07	1160.42	0.468	0.58	0.87
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	1152.50	288.12	1149.52	843.97	749.56	0.00	1777.45	1483.14	0.648	1.07	1.81
Erbsville/Keats Way	**East - Keats Way**	171.71	42.93	171.27	149.06	959.86	0.00	659.01	234.80	0.261	0.24	0.35
Erbsville/Keats Way	**North - Erbsville Road**	596.02	149.01	595.63	1001.07	130.06	0.00	1950.36	1909.66	0.306	0.34	0.44
Erbsville/Keats Way	**West - Keats Way**	190.58	47.65	190.25	87.96	637.73	0.00	800.36	136.95	0.238	0.23	0.31
Erbsville/Keats Way	**South - Erbsville Road**	929.54	232.39	928.48	647.54	180.43	6.29	1917.31	1872.98	0.485	0.67	0.93
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	265.20	66.30	264.90	652.04	186.51	15.28	1052.72	989.49	0.252	0.26	0.33
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	195.98	48.99	195.78	166.87	284.55	15.28	1058.08	726.49	0.185	0.18	0.23
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	582.54	145.64	581.06	282.76	197.58	0.00	1075.01	748.37	0.542	0.79	1.16
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	303.85	75.96	303.08	243.16	535.47	10.79	817.07	447.47	0.372	0.39	0.58
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	56.64	14.16	56.53	323.31	994.44	0.00	641.99	289.83	0.088	0.07	0.10
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	420.72	105.18	420.49	899.27	151.70	0.00	1937.07	1747.95	0.217	0.22	0.28

Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	673.34	168.33	669.47	241.58	330.61	0.00	957.82	383.10	0.703	1.30	2.27
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	825.26	206.32	824.16	506.49	493.59	6.29	1725.28	1769.83	0.478	0.63	0.91
Bearinger Road/Westmount Road	**East - Bearinger Road**	240.03	60.01	239.83	520.69	958.63	0.00	1441.20	969.18	0.167	0.15	0.20
Bearinger Road/Westmount Road	**North - Westmount Road**	741.66	185.41	741.03	1021.51	176.95	0.00	1921.55	1591.57	0.386	0.47	0.63
Bearinger Road/Westmount Road	**West - Bearinger Road**	946.63	236.66	945.00	425.76	492.23	0.00	1721.15	1265.13	0.550	0.80	1.21
Bearinger Road/Westmount Road	**South - Westmount Road**	380.27	95.07	379.82	337.73	1099.50	6.29	1353.59	1047.43	0.281	0.28	0.39
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	279.58	69.90	279.30	488.45	71.83	0.00	1100.51	1025.06	0.254	0.27	0.34
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	156.42	39.11	156.27	97.88	253.25	0.00	1006.62	678.07	0.155	0.15	0.18
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	295.76	73.94	295.38	169.73	239.79	0.00	1009.90	581.70	0.293	0.31	0.41
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	202.27	50.57	202.03	176.91	358.25	6.29	956.03	682.82	0.212	0.21	0.27

Main results: (8:30 AM-8:45 AM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)
Ira Needles Blvd/University Avenue	**East - University Ave**	591.25	147.81	589.50	195.34	1283.51	0.00	1164.90	982.99	0.508	0.58	1.02
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	876.41	219.10	873.47	1240.28	632.73	0.00	1383.53	1171.35	0.633	0.96	1.69
Ira Needles Blvd/University Avenue	**West - Private Access**	159.65	39.91	159.16	226.55	1279.65	0.00	799.78	167.56	0.200	0.12	0.25
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	1256.26	314.07	1247.28	1207.25	231.56	7.71	1533.84	1533.84	0.819	1.97	4.22
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	253.23	63.31	252.03	131.84	1391.08	0.00	623.40	307.26	0.406	0.37	0.67
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	1026.15	256.54	1024.52	1413.87	229.24	0.00	1892.36	1855.67	0.542	0.77	1.17
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	123.31	30.83	123.21	205.38	1048.39	0.00	1370.79	858.51	0.090	0.07	0.10
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	1417.01	354.25	1412.95	1061.63	109.97	0.00	2011.10	1716.64	0.705	1.32	2.33
Erb St./Platinum Dr	**East - Erb St. W**	954.58	238.65	953.08	867.72	175.95	0.00	1798.09	1781.99	0.531	0.75	1.12
Erb St./Platinum Dr	**North - Platinum Dr**	195.98	49.00	195.83	894.89	234.15	0.00	1319.10	1224.76	0.149	0.14	0.17
Erb St./Platinum Dr	**West - Erb St.**	862.10	215.52	861.07	224.28	205.70	0.00	1903.75	991.17	0.453	0.57	0.82
Erb St./Platinum Dr	**South - Landfill Gate 2**	18.72	4.68	18.67	41.78	1025.00	0.00	512.73	0.00	0.037	0.03	0.04
Ira Needles Blvd/Erb St.	**East - Erb St. W**	689.24	172.31	687.41	898.93	1416.01	0.00	1343.41	1254.39	0.513	0.58	1.04
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	1004.13	251.03	1001.92	1246.73	856.70	0.00	1743.81	1406.18	0.576	0.79	1.34
Ira Needles Blvd/Erb St.	**West - Erb St.**	922.66	230.66	919.68	829.31	1029.32	0.00	1483.62	1160.42	0.622	0.87	1.62
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	1411.51	352.88	1398.36	1032.41	916.59	0.00	1664.40	1483.14	0.848	1.81	5.10
Erbsville/Keats Way	**East - Keats Way**	210.29	52.57	209.28	182.43	1174.60	0.00	553.37	235.00	0.380	0.35	0.60
Erbsville/Keats Way	**North - Erbsville Road**	729.98	182.49	729.31	1224.90	158.98	0.00	1932.60	1909.60	0.378	0.44	0.60

Erbsville/Keats Way	**West - Keats Way**	233.42	58.35	232.76	107.60	780.69	0.00	720.85	136.94	0.324	0.31	0.47
Erbsville/Keats Way	**South - Erbsville Road**	1138.46	284.61	1136.23	792.65	220.80	7.71	1892.10	1872.54	0.602	0.93	1.49
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	324.80	81.20	324.31	796.69	227.75	18.72	1028.74	988.40	0.316	0.33	0.46
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	240.02	60.01	239.71	203.95	348.11	18.72	1022.60	726.42	0.235	0.23	0.30
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	713.46	178.37	709.83	345.92	241.90	0.00	1045.92	748.48	0.682	1.16	2.07
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	372.14	93.04	370.05	297.34	654.39	13.21	699.65	447.32	0.532	0.58	1.11
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	69.36	17.34	69.16	392.06	1211.45	0.00	535.23	290.00	0.130	0.10	0.15
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	515.28	128.82	514.92	1095.02	185.59	0.00	1916.24	1747.90	0.269	0.28	0.37
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	824.66	206.17	806.30	295.68	404.83	0.00	914.90	383.08	0.901	2.27	6.86
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	1010.74	252.68	1008.27	615.87	595.25	7.71	1662.57	1769.44	0.608	0.91	1.53
Bearinger Road/Westmount Road	**East - Bearinger Road**	293.97	73.49	293.62	636.80	1172.11	0.00	1310.02	969.25	0.224	0.20	0.29
Bearinger Road/Westmount Road	**North - Westmount Road**	908.34	227.09	907.20	1249.09	216.64	0.00	1897.16	1591.54	0.479	0.63	0.91
Bearinger Road/Westmount Road	**West - Bearinger Road**	1159.37	289.84	1154.98	521.23	602.60	0.00	1649.13	1265.13	0.703	1.21	2.31
Bearinger Road/Westmount Road	**South - Westmount Road**	465.73	116.43	464.78	413.46	1344.13	7.71	1203.30	1047.30	0.387	0.39	0.63
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	342.42	85.60	341.96	597.95	87.93	0.00	1092.65	1025.09	0.313	0.34	0.45
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	191.58	47.89	191.34	119.83	310.06	0.00	978.67	678.07	0.196	0.18	0.24
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	362.24	90.56	361.56	207.81	293.60	0.00	980.72	581.69	0.369	0.41	0.58
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	247.73	61.93	247.33	216.60	438.56	7.71	916.18	682.60	0.270	0.27	0.37

Main results: (8:45 AM-9:00 AM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)
Ira Needles Blvd/University Avenue	**East - University Ave**	591.25	147.81	591.19	195.96	1292.03	0.00	1159.51	982.99	0.510	1.02	1.03
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	876.41	219.10	876.33	1248.05	635.17	0.00	1381.96	1171.35	0.634	1.69	1.71
Ira Needles Blvd/University Avenue	**West - Private Access**	159.65	39.91	159.64	227.83	1283.67	0.00	793.49	167.56	0.201	0.25	0.25
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	1256.26	314.07	1255.69	1211.01	232.29	7.71	1533.84	1533.84	0.819	4.22	4.36
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	253.23	63.31	253.20	132.12	1394.89	0.00	621.37	307.26	0.408	0.67	0.68
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	1026.15	256.54	1026.12	1418.00	230.09	0.00	1891.75	1855.67	0.542	1.17	1.18
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	123.31	30.83	123.31	205.88	1050.34	0.00	1369.54	858.51	0.090	0.10	0.10
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	1417.01	354.25	1416.91	1063.54	110.10	0.00	2011.01	1716.64	0.705	2.33	2.36

Erb St./Platinum Dr	**East - Erb St. W**	954.58	238.65	954.56	868.70	176.16	0.00	1797.96	1781.99	0.531	1.12	1.13
Erb St./Platinum Dr	**North - Platinum Dr**	195.98	49.00	195.98	896.21	234.51	0.00	1318.94	1224.76	0.149	0.17	0.17
Erb St./Platinum Dr	**West - Erb St.**	862.10	215.52	862.08	224.60	205.89	0.00	1903.57	991.17	0.453	0.82	0.82
Erb St./Platinum Dr	**South - Landfill Gate 2**	18.72	4.68	18.72	41.84	1026.14	0.00	512.18	0.00	0.037	0.04	0.04
Ira Needles Blvd/Erb St.	**East - Erb St. W**	689.24	172.31	689.17	902.65	1427.16	0.00	1335.68	1254.39	0.516	1.04	1.06
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	1004.13	251.03	1004.08	1255.60	860.74	0.00	1740.97	1406.18	0.577	1.34	1.35
Ira Needles Blvd/Erb St.	**West - Erb St.**	922.66	230.66	922.59	833.22	1031.60	0.00	1482.08	1160.42	0.623	1.62	1.63
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	1411.51	352.88	1410.53	1034.89	919.29	0.00	1662.58	1483.14	0.849	5.10	5.34
Erbsville/Keats Way	**East - Keats Way**	210.29	52.57	210.27	182.76	1176.95	0.00	552.21	235.00	0.381	0.60	0.61
Erbsville/Keats Way	**North - Erbsville Road**	729.98	182.49	729.97	1227.58	159.63	0.00	1932.19	1909.60	0.378	0.60	0.61
Erbsville/Keats Way	**West - Keats Way**	233.42	58.35	233.40	107.89	781.71	0.00	720.27	136.94	0.324	0.47	0.48
Erbsville/Keats Way	**South - Erbsville Road**	1138.46	284.61	1138.42	793.81	221.30	7.71	1891.80	1872.54	0.602	1.49	1.50
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	324.80	81.20	324.79	800.29	228.96	18.72	1028.09	988.40	0.316	0.46	0.46
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	240.02	60.01	240.02	204.76	348.99	18.72	1022.13	726.42	0.235	0.30	0.31
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	713.46	178.37	713.32	346.80	242.22	0.00	1045.61	748.48	0.682	2.07	2.11
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	372.14	93.04	372.06	298.34	657.19	13.21	696.71	447.32	0.534	1.11	1.13
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	69.36	17.34	69.36	396.51	1219.57	0.00	531.24	290.00	0.131	0.15	0.15
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	515.28	128.82	515.27	1102.87	186.05	0.00	1915.96	1747.90	0.269	0.37	0.37
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	824.66	206.17	821.24	296.16	405.17	0.00	914.36	383.08	0.902	6.86	7.72
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	1010.74	252.68	1010.64	620.97	605.43	7.71	1656.33	1769.44	0.610	1.53	1.55
Bearinger Road/Westmount Road	**East - Bearinger Road**	293.97	73.49	293.97	638.55	1175.79	0.00	1307.76	969.25	0.225	0.29	0.29
Bearinger Road/Westmount Road	**North - Westmount Road**	908.34	227.09	908.33	1252.86	216.90	0.00	1897.00	1591.54	0.479	0.91	0.92
Bearinger Road/Westmount Road	**West - Bearinger Road**	1159.37	289.84	1159.25	521.88	603.35	0.00	1648.63	1265.13	0.703	2.31	2.34
Bearinger Road/Westmount Road	**South - Westmount Road**	465.73	116.43	465.71	413.98	1348.62	7.71	1200.54	1047.30	0.388	0.63	0.63
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	342.42	85.60	342.41	598.94	88.08	0.00	1092.58	1025.09	0.313	0.45	0.45
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	191.58	47.89	191.57	120.01	310.48	0.00	978.46	678.07	0.196	0.24	0.24
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	362.24	90.56	362.22	208.09	293.97	0.00	980.52	581.69	0.369	0.58	0.58
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	247.73	61.93	247.72	216.90	439.29	7.71	915.82	682.60	0.271	0.37	0.37

Main results: (9:00 AM-9:15 AM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)
Ira Needles Blvd/University Avenue	**East - University Ave**	482.75	120.69	484.51	160.66	1064.69	0.00	1303.74	982.99	0.370	1.03	0.59
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	715.59	178.90	718.52	1027.90	521.31	0.00	1452.55	1171.35	0.493	1.71	0.98
Ira Needles Blvd/University Avenue	**West - Private Access**	130.35	32.59	130.85	187.47	1052.35	0.00	1162.02	167.56	0.112	0.25	0.13
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	1025.73	256.43	1034.91	992.76	190.44	6.29	1533.84	1533.84	0.669	4.36	2.07
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	206.77	51.69	207.97	108.16	1142.91	0.00	755.98	307.26	0.274	0.68	0.38
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	837.85	209.46	839.45	1162.12	188.76	0.00	1922.29	1855.67	0.436	1.18	0.78
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	100.69	25.17	100.79	168.62	859.60	0.00	1492.94	858.51	0.067	0.10	0.07
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	1156.99	289.25	1161.03	870.36	90.03	0.00	2025.11	1716.64	0.571	2.36	1.35
Erb St./Platinum Dr	**East - Erb St. W**	779.41	194.85	780.89	710.27	144.04	0.00	1817.41	1781.99	0.429	1.13	0.76
Erb St./Platinum Dr	**North - Platinum Dr**	160.02	40.00	160.17	733.09	191.85	0.00	1338.70	1224.76	0.120	0.17	0.14
Erb St./Platinum Dr	**West - Erb St.**	703.90	175.97	704.91	183.72	168.30	0.00	1939.63	991.17	0.363	0.82	0.57
Erb St./Platinum Dr	**South - Landfill Gate 2**	15.28	3.82	15.33	34.22	838.99	0.00	604.46	0.00	0.025	0.04	0.03
Ira Needles Blvd/Erb St.	**East - Erb St. W**	562.76	140.69	564.59	741.16	1178.58	0.00	1508.07	1254.39	0.373	1.06	0.60
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	819.87	204.97	822.07	1035.72	707.46	0.00	1849.07	1406.18	0.443	1.35	0.80
Ira Needles Blvd/Erb St.	**West - Erb St.**	753.35	188.34	756.32	684.85	844.68	0.00	1607.82	1160.42	0.469	1.63	0.89
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	1152.50	288.12	1166.33	847.59	753.40	0.00	1774.85	1483.14	0.649	5.34	1.89
Erbsville/Keats Way	**East - Keats Way**	171.71	42.93	172.71	149.57	963.38	0.00	657.27	234.80	0.261	0.61	0.36
Erbsville/Keats Way	**North - Erbsville Road**	596.02	149.01	596.68	1005.07	131.02	0.00	1949.78	1909.66	0.306	0.61	0.44
Erbsville/Keats Way	**West - Keats Way**	190.58	47.65	191.23	88.39	639.30	0.00	799.48	136.95	0.238	0.48	0.32
Erbsville/Keats Way	**South - Erbsville Road**	929.54	232.39	931.75	649.34	181.19	6.29	1916.85	1872.98	0.485	1.50	0.95
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	265.20	66.30	265.68	657.30	188.25	15.28	1051.80	989.49	0.252	0.46	0.34
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	195.98	48.99	196.29	168.05	285.88	15.28	1057.37	726.49	0.185	0.31	0.23
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	582.54	145.64	586.16	284.08	198.09	0.00	1074.58	748.37	0.542	2.11	1.20
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	303.85	75.96	305.96	244.66	539.60	10.79	813.04	447.47	0.374	1.13	0.60
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	56.64	14.16	56.84	330.64	1007.57	0.00	635.54	289.83	0.089	0.15	0.10
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	420.72	105.18	421.08	912.00	152.41	0.00	1936.63	1747.95	0.217	0.37	0.28
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	673.34	168.33	694.26	242.31	331.17	0.00	957.08	383.10	0.704	7.72	2.48
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	825.26	206.32	827.72	514.94	510.49	6.29	1714.91	1769.83	0.481	1.55	0.94

Bearinger Road/Westmount Road	**East - Bearinger Road**	240.03	60.01	240.38	523.20	963.90	0.00	1437.97	969.18	0.167	0.29	0.20
Bearinger Road/Westmount Road	**North - Westmount Road**	741.66	185.41	742.79	1026.92	177.36	0.00	1921.30	1591.57	0.386	0.92	0.63
Bearinger Road/Westmount Road	**West - Bearinger Road**	946.63	236.66	951.03	426.76	493.39	0.00	1720.39	1265.13	0.550	2.34	1.24
Bearinger Road/Westmount Road	**South - Westmount Road**	380.27	95.07	381.21	338.53	1105.88	6.29	1349.68	1047.43	0.282	0.63	0.39
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	279.58	69.90	280.03	490.03	72.06	0.00	1100.40	1025.06	0.254	0.45	0.34
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	156.42	39.11	156.65	98.16	253.93	0.00	1006.29	678.07	0.155	0.24	0.19
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	295.76	73.94	296.43	170.19	240.39	0.00	1009.58	581.70	0.293	0.58	0.42
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	202.27	50.57	202.67	177.39	359.43	6.29	955.45	682.82	0.212	0.37	0.27

Main results: (9:15 AM-9:30 AM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)
Ira Needles Blvd/University Avenue	**East - University Ave**	404.28	101.07	405.05	134.28	886.99	0.00	1416.44	982.99	0.285	0.59	0.40
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	599.27	149.82	600.53	856.63	435.41	0.00	1505.89	1171.35	0.398	0.98	0.67
Ira Needles Blvd/University Avenue	**West - Private Access**	109.16	27.29	109.34	156.33	879.61	0.00	1428.47	167.56	0.076	0.13	0.08
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	859.00	214.75	862.10	829.79	159.16	5.27	1533.84	1533.84	0.560	2.07	1.29
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	173.16	43.29	173.66	90.47	955.54	0.00	856.06	307.26	0.202	0.38	0.26
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	701.66	175.41	702.50	971.48	157.71	0.00	1945.20	1855.67	0.361	0.78	0.57
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	84.32	21.08	84.38	141.01	719.20	0.00	1583.77	858.51	0.053	0.07	0.06
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	968.92	242.23	970.65	728.23	75.36	0.00	2035.42	1716.64	0.476	1.35	0.91
Erb St./Platinum Dr	**East - Erb St. W**	652.72	163.18	653.52	594.57	120.57	0.00	1831.62	1781.99	0.356	0.76	0.56
Erb St./Platinum Dr	**North - Platinum Dr**	134.01	33.50	134.11	613.54	160.55	0.00	1353.20	1224.76	0.099	0.14	0.11
Erb St./Platinum Dr	**West - Erb St.**	589.48	147.37	590.05	153.76	140.90	0.00	1965.90	991.17	0.300	0.57	0.43
Erb St./Platinum Dr	**South - Landfill Gate 2**	12.80	3.20	12.82	28.64	702.31	0.00	671.84	0.00	0.019	0.03	0.02
Ira Needles Blvd/Erb St.	**East - Erb St. W**	471.28	117.82	472.07	618.63	979.46	0.00	1646.16	1254.39	0.286	0.60	0.40
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	686.60	171.65	687.59	861.48	590.05	0.00	1931.84	1406.18	0.355	0.80	0.55
Ira Needles Blvd/Erb St.	**West - Erb St.**	630.89	157.72	632.08	571.18	706.47	0.00	1700.79	1160.42	0.371	0.89	0.59
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	965.16	241.29	968.34	708.79	629.76	0.00	1858.54	1483.14	0.519	1.89	1.09
Erbsville/Keats Way	**East - Keats Way**	143.79	35.95	144.24	125.15	805.98	0.00	734.71	234.65	0.196	0.36	0.25
Erbsville/Keats Way	**North - Erbsville Road**	499.14	124.79	499.54	840.76	109.46	0.00	1963.02	1909.71	0.254	0.44	0.34
Erbsville/Keats Way	**West - Keats Way**	159.60	39.90	159.94	73.92	535.09	0.00	856.42	136.95	0.186	0.32	0.23
Erbsville/Keats Way	**South - Erbsville Road**	778.45	194.61	779.54	543.44	151.59	5.27	1935.34	1873.30	0.402	0.95	0.68
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	222.09	55.52	222.39	548.92	157.10	12.80	1069.49	990.27	0.208	0.34	0.26

Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	164.12	41.03	164.32	140.39	239.10	12.80	1083.55	726.55	0.151	0.23	0.18
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	487.85	121.96	489.41	237.59	165.83	0.00	1094.69	748.28	0.446	1.20	0.81
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	254.46	63.62	255.28	204.50	450.74	9.03	895.37	447.58	0.284	0.60	0.40
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	47.43	11.86	47.54	273.19	837.76	0.00	719.07	289.71	0.066	0.10	0.07
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	352.33	88.08	352.57	757.83	127.47	0.00	1951.96	1747.99	0.181	0.28	0.22
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	563.89	140.97	568.39	202.77	277.26	0.00	987.73	383.11	0.571	2.48	1.36
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	691.12	172.78	692.29	427.00	418.66	5.27	1771.52	1770.11	0.390	0.94	0.64
Bearinger Road/Westmount Road	**East - Bearinger Road**	201.01	50.25	201.21	437.40	805.58	0.00	1535.25	969.13	0.131	0.20	0.15
Bearinger Road/Westmount Road	**North - Westmount Road**	621.10	155.28	621.74	858.33	148.46	0.00	1939.06	1591.59	0.320	0.63	0.47
Bearinger Road/Westmount Road	**West - Bearinger Road**	792.75	198.19	794.44	357.21	412.98	0.00	1772.18	1265.13	0.447	1.24	0.82
Bearinger Road/Westmount Road	**South - Westmount Road**	318.46	79.61	318.92	283.36	924.06	5.27	1461.42	1047.53	0.218	0.39	0.28
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	234.14	58.53	234.43	410.16	60.32	0.00	1106.13	1025.03	0.212	0.34	0.27
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	131.00	32.75	131.15	82.17	212.57	0.00	1026.63	678.06	0.128	0.19	0.15
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	247.69	61.92	248.08	142.47	201.25	0.00	1030.34	581.71	0.240	0.42	0.32
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	169.39	42.35	169.64	148.50	300.84	5.27	984.56	682.98	0.172	0.27	0.21

Queueing Delay Results

Queueing Delay results: (8:00 AM-8:15 AM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	**East - University Ave**	5.79	0.39	3.529	A	A
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	9.55	0.64	3.940	A	A
Ira Needles Blvd/University Avenue	**West - Private Access**	1.21	0.08	2.711	A	A
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	18.05	1.20	5.256	A	A
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	3.65	0.24	5.235	A	A
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	8.24	0.55	2.883	A	A
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	0.83	0.06	2.396	A	A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	13.17	0.88	3.352	A	A
Erb St./Platinum Dr	**East - Erb St. W**	8.08	0.54	3.042	A	A
Erb St./Platinum Dr	**North - Platinum Dr**	1.61	0.11	2.951	A	A

Erb St./Platinum Dr	**West - Erb St.**	6.28	0.42	2.607	A	A
Erb St./Platinum Dr	**South - Landfill Gate 2**	0.28	0.02	5.450	A	A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	5.84	0.39	3.043	A	A
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	8.04	0.54	2.875	A	A
Ira Needles Blvd/Erb St.	**West - Erb St.**	8.57	0.57	3.343	A	A
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	15.50	1.03	3.982	A	A
Erbsville/Keats Way	**East - Keats Way**	3.49	0.23	6.051	A	A
Erbsville/Keats Way	**North - Erbsville Road**	5.01	0.33	2.453	A	A
Erbsville/Keats Way	**West - Keats Way**	3.31	0.22	5.144	A	A
Erbsville/Keats Way	**South - Erbsville Road**	9.80	0.65	3.097	A	A
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	3.81	0.25	4.234	A	A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	2.60	0.17	3.906	A	A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	11.44	0.76	5.865	A	A
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	5.69	0.38	5.558	A	A
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	1.02	0.07	5.327	A	A
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	3.25	0.22	2.247	A	A
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	18.37	1.22	8.275	A	A
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	9.27	0.62	3.305	A	A
Bearinger Road/Westmount Road	**East - Bearinger Road**	2.21	0.15	2.689	A	A
Bearinger Road/Westmount Road	**North - Westmount Road**	6.90	0.46	2.723	A	A
Bearinger Road/Westmount Road	**West - Bearinger Road**	11.71	0.78	3.647	A	A
Bearinger Road/Westmount Road	**South - Westmount Road**	4.07	0.27	3.134	A	A
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	3.91	0.26	4.117	A	A
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	2.13	0.14	4.011	A	A
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	4.59	0.31	4.581	A	A
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	3.02	0.20	4.402	A	A

Queueing Delay results: (8:15 AM-8:30 AM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	**East - University Ave**	8.49	0.57	4.337	A	A
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	13.99	0.93	4.854	A	A
Ira Needles Blvd/University Avenue	**West - Private Access**	1.84	0.12	3.457	A	A
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	28.28	1.89	7.003	A	A

Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	5.42	0.36	6.509	A	A
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	11.30	0.75	3.313	A	A
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	1.07	0.07	2.581	A	A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	19.26	1.28	4.131	A	A
Erb St./Platinum Dr	**East - Erb St. W**	10.98	0.73	3.463	A	A
Erb St./Platinum Dr	**North - Platinum Dr**	2.01	0.13	3.052	A	A
Erb St./Platinum Dr	**West - Erb St.**	8.37	0.56	2.909	A	A
Erb St./Platinum Dr	**South - Landfill Gate 2**	0.38	0.03	6.100	A	A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	8.60	0.57	3.757	A	A
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	11.59	0.77	3.478	A	A
Ira Needles Blvd/Erb St.	**West - Erb St.**	12.77	0.85	4.191	A	A
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	26.09	1.74	5.705	A	A
Erbsville/Keats Way	**East - Keats Way**	5.09	0.34	7.375	A	A
Erbsville/Keats Way	**North - Erbsville Road**	6.49	0.43	2.657	A	A
Erbsville/Keats Way	**West - Keats Way**	4.55	0.30	5.898	A	A
Erbsville/Keats Way	**South - Erbsville Road**	13.71	0.91	3.637	A	A
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	4.93	0.33	4.570	A	A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	3.34	0.22	4.173	A	A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	16.82	1.12	7.266	A	A
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	8.51	0.57	6.994	A	A
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	1.41	0.09	6.149	A	A
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	4.10	0.27	2.373	A	A
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	31.65	2.11	12.317	B	B
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	13.33	0.89	3.990	A	A
Bearinger Road/Westmount Road	**East - Bearinger Road**	2.95	0.20	2.996	A	A
Bearinger Road/Westmount Road	**North - Westmount Road**	9.23	0.62	3.048	A	A
Bearinger Road/Westmount Road	**West - Bearinger Road**	17.62	1.17	4.629	A	A
Bearinger Road/Westmount Road	**South - Westmount Road**	5.73	0.38	3.694	A	A
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	4.99	0.33	4.383	A	A
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	2.70	0.18	4.233	A	A
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	6.04	0.40	5.036	A	A
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	3.93	0.26	4.773	A	A

Queueing Delay results: (8:30 AM-8:45 AM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	East - University Ave	14.71	0.98	6.238	A	A
Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	24.24	1.62	7.017	A	A
Ira Needles Blvd/University Avenue	West - Private Access	3.62	0.24	5.616	A	A
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	57.13	3.81	12.190	B	B
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	9.66	0.64	9.662	A	A
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	17.13	1.14	4.141	A	A
Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	1.46	0.10	2.885	A	A
Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	33.36	2.22	5.978	A	A
Erb St./Platinum Dr	East - Erb St. W	16.37	1.09	4.252	A	A
Erb St./Platinum Dr	North - Platinum Dr	2.57	0.17	3.204	A	A
Erb St./Platinum Dr	West - Erb St.	12.08	0.81	3.449	A	A
Erb St./Platinum Dr	South - Landfill Gate 2	0.55	0.04	7.286	A	A
Ira Needles Blvd/Erb St.	East - Erb St. W	15.10	1.01	5.472	A	A
Ira Needles Blvd/Erb St.	North - Erbsville Rd	19.46	1.30	4.838	A	A
Ira Needles Blvd/Erb St.	West - Erb St.	23.19	1.55	6.351	A	A
Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	67.45	4.50	12.938	B	B
Erbsville/Keats Way	East - Keats Way	8.65	0.58	10.431	B	B
Erbsville/Keats Way	North - Erbsville Road	8.91	0.59	2.990	A	A
Erbsville/Keats Way	West - Keats Way	6.89	0.46	7.367	A	A
Erbsville/Keats Way	South - Erbsville Road	21.65	1.44	4.748	A	A
Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	6.72	0.45	5.107	A	A
Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	4.49	0.30	4.596	A	A
Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	29.13	1.94	10.595	B	B
Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	15.75	1.05	10.854	B	B
Fischer Hallman Road/Laurelwood Drive	East - Laurelwood Drive	2.15	0.14	7.721	A	A
Fischer Hallman Road/Laurelwood Drive	North - Bearinger Road	5.43	0.36	2.569	A	A
Fischer Hallman Road/Laurelwood Drive	West - Laurelwood Drive	83.09	5.54	29.171	D	C
Fischer Hallman Road/Laurelwood Drive	South - Fischer Hallman Road	22.07	1.47	5.481	A	A
Bearinger Road/Westmount Road	East - Bearinger Road	4.25	0.28	3.542	A	A
Bearinger Road/Westmount Road	North - Westmount Road	13.38	0.89	3.634	A	A
Bearinger Road/Westmount Road	West - Bearinger Road	32.72	2.18	7.220	A	A
Bearinger Road/Westmount Road	South - Westmount Road	9.16	0.61	4.869	A	A

Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	6.66	0.44	4.792	A	A
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	3.57	0.24	4.571	A	A
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	8.48	0.57	5.808	A	A
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	5.40	0.36	5.378	A	A

Queueing Delay results: (8:45 AM-9:00 AM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	**East - University Ave**	15.39	1.03	6.334	A	A
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	25.59	1.71	7.117	A	A
Ira Needles Blvd/University Avenue	**West - Private Access**	3.74	0.25	5.679	A	A
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	64.56	4.30	12.871	B	B
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	10.17	0.68	9.776	A	A
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	17.65	1.18	4.158	A	A
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	1.48	0.10	2.888	A	A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	35.24	2.35	6.057	A	A
Erb St./Platinum Dr	**East - Erb St. W**	16.86	1.12	4.268	A	A
Erb St./Platinum Dr	**North - Platinum Dr**	2.61	0.17	3.205	A	A
Erb St./Platinum Dr	**West - Erb St.**	12.36	0.82	3.455	A	A
Erb St./Platinum Dr	**South - Landfill Gate 2**	0.57	0.04	7.294	A	A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	15.78	1.05	5.568	A	A
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	20.23	1.35	4.885	A	A
Ira Needles Blvd/Erb St.	**West - Erb St.**	24.39	1.63	6.431	A	A
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	78.72	5.25	14.144	B	B
Erbsville/Keats Way	**East - Keats Way**	9.09	0.61	10.526	B	B
Erbsville/Keats Way	**North - Erbsville Road**	9.07	0.60	2.993	A	A
Erbsville/Keats Way	**West - Keats Way**	7.13	0.48	7.393	A	A
Erbsville/Keats Way	**South - Erbsville Road**	22.46	1.50	4.778	A	A
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	6.89	0.46	5.118	A	A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	4.58	0.31	4.602	A	A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	31.41	2.09	10.821	B	B
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	16.83	1.12	11.082	B	B
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	2.23	0.15	7.793	A	A
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	5.50	0.37	2.569	A	A

Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	110.32	7.35	36.004	E	D
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	23.14	1.54	5.573	A	A
Bearinger Road/Westmount Road	**East - Bearinger Road**	4.33	0.29	3.550	A	A
Bearinger Road/Westmount Road	**North - Westmount Road**	13.71	0.91	3.640	A	A
Bearinger Road/Westmount Road	**West - Bearinger Road**	34.88	2.33	7.351	A	A
Bearinger Road/Westmount Road	**South - Westmount Road**	9.43	0.63	4.898	A	A
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	6.81	0.45	4.798	A	A
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	3.64	0.24	4.574	A	A
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	8.73	0.58	5.821	A	A
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	5.53	0.37	5.387	A	A

Queueing Delay results: (9:00 AM-9:15 AM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	**East - University Ave**	9.13	0.61	4.405	A	A
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	15.21	1.01	4.925	A	A
Ira Needles Blvd/University Avenue	**West - Private Access**	1.94	0.13	3.491	A	A
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	32.94	2.20	7.342	A	A
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	5.89	0.39	6.585	A	A
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	11.92	0.79	3.331	A	A
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	1.10	0.07	2.585	A	A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	20.88	1.39	4.186	A	A
Erb St./Platinum Dr	**East - Erb St. W**	11.59	0.77	3.479	A	A
Erb St./Platinum Dr	**North - Platinum Dr**	2.07	0.14	3.056	A	A
Erb St./Platinum Dr	**West - Erb St.**	8.74	0.58	2.919	A	A
Erb St./Platinum Dr	**South - Landfill Gate 2**	0.40	0.03	6.110	A	A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	9.21	0.61	3.825	A	A
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	12.33	0.82	3.514	A	A
Ira Needles Blvd/Erb St.	**West - Erb St.**	13.74	0.92	4.243	A	A
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	30.42	2.03	6.045	A	A
Erbsville/Keats Way	**East - Keats Way**	5.55	0.37	7.446	A	A
Erbsville/Keats Way	**North - Erbsville Road**	6.73	0.45	2.663	A	A
Erbsville/Keats Way	**West - Keats Way**	4.86	0.32	5.926	A	A
Erbsville/Keats Way	**South - Erbsville Road**	14.60	0.97	3.664	A	A

Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	5.19	0.35	4.583	A	A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	3.49	0.23	4.183	A	A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	18.91	1.26	7.426	A	A
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	9.42	0.63	7.130	A	A
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	1.51	0.10	6.224	A	A
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	4.23	0.28	2.377	A	A
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	44.13	2.94	14.681	B	B
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	14.43	0.96	4.070	A	A
Bearinger Road/Westmount Road	**East - Bearinger Road**	3.06	0.20	3.008	A	A
Bearinger Road/Westmount Road	**North - Westmount Road**	9.66	0.64	3.059	A	A
Bearinger Road/Westmount Road	**West - Bearinger Road**	19.23	1.28	4.706	A	A
Bearinger Road/Westmount Road	**South - Westmount Road**	6.04	0.40	3.719	A	A
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	5.24	0.35	4.390	A	A
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	2.82	0.19	4.237	A	A
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	6.41	0.43	5.054	A	A
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	4.14	0.28	4.786	A	A

Queueing Delay results: (9:15 AM-9:30 AM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	**East - University Ave**	6.14	0.41	3.561	A	A
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	10.22	0.68	3.981	A	A
Ira Needles Blvd/University Avenue	**West - Private Access**	1.26	0.08	2.728	A	A
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	20.06	1.34	5.385	A	A
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	3.92	0.26	5.280	A	A
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	8.65	0.58	2.898	A	A
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	0.85	0.06	2.400	A	A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	14.03	0.94	3.388	A	A
Erb St./Platinum Dr	**East - Erb St. W**	8.49	0.57	3.057	A	A
Erb St./Platinum Dr	**North - Platinum Dr**	1.67	0.11	2.954	A	A
Erb St./Platinum Dr	**West - Erb St.**	6.54	0.44	2.617	A	A
Erb St./Platinum Dr	**South - Landfill Gate 2**	0.30	0.02	5.464	A	A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	6.15	0.41	3.067	A	A
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	8.46	0.56	2.894	A	A

Ira Needles Blvd/Erb St.	**West - Erb St.**	9.08	0.61	3.371	A	A
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	16.85	1.12	4.058	A	A
Erbsville/Keats Way	**East - Keats Way**	3.77	0.25	6.100	A	A
Erbsville/Keats Way	**North - Erbsville Road**	5.20	0.35	2.460	A	A
Erbsville/Keats Way	**West - Keats Way**	3.53	0.24	5.172	A	A
Erbsville/Keats Way	**South - Erbsville Road**	10.34	0.69	3.116	A	A
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	4.02	0.27	4.251	A	A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	2.73	0.18	3.918	A	A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	12.59	0.84	5.962	A	A
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	6.17	0.41	5.632	A	A
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	1.09	0.07	5.361	A	A
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	3.35	0.22	2.252	A	A
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	21.49	1.43	8.675	A	A
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	9.85	0.66	3.338	A	A
Bearinger Road/Westmount Road	**East - Bearinger Road**	2.30	0.15	2.698	A	A
Bearinger Road/Westmount Road	**North - Westmount Road**	7.21	0.48	2.733	A	A
Bearinger Road/Westmount Road	**West - Bearinger Road**	12.52	0.83	3.690	A	A
Bearinger Road/Westmount Road	**South - Westmount Road**	4.26	0.28	3.153	A	A
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	4.12	0.27	4.130	A	A
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	2.24	0.15	4.022	A	A
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	4.87	0.32	4.604	A	A
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	3.19	0.21	4.418	A	A

A1 - Planned 2031 Conditions with Recommendations - D2 - PM Peak Period, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Geometry	Ira Needles Blvd/University Avenue - East - University Ave - Standard Geometry	Effective flare length is over 30m, which is outside the normal range. Treat capacities with increasing caution.

Warning	Geometry	Ira Needles Blvd/University Avenue - North - Ira Needles Blvd - Standard Geometry	Effective flare length is over 30m, which is outside the normal range. Treat capacities with increasing caution.
Warning	Geometry	Ira Needles Blvd/University Avenue - South - Ira Needles Blvd - Standard Geometry	Effective flare length is over 30m, which is outside the normal range. Treat capacities with increasing caution.
Last Run	Last Run	Ira Needles Blvd/University Avenue - South - Ira Needles Blvd - Capacity	Pedestrian Crossing causes blocking on previous arm due to traffic queing to leave the junction in 6 timesegment(s).
Warning	Pedestrian Crossing	Ira Needles Blvd/University Avenue - East - University Ave - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/University Avenue - North - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/University Avenue - West - Private Access - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/University Avenue - South - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - East - Thorndale Dr - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - East - Thorndale Dr -	Pedestrian crossing uses default flow of 0. Is this correct?

		Unsignalled Pedestrian Crossing Details	
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - North - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - North - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - West - Boardwalk Access - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - West - Boardwalk Access - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - South - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Thorndale Dr - South - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - East - Erb St. W - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - East - Erb St. W - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?

Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - North - Erbsville Rd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - North - Erbsville Rd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - West - Erb St. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - West - Erb St. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Ira Needles Blvd/Erb St. - South - Ira Needles Blvd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Beaver Creek Rd/Laurelwood Dr - East - Laurelwood Dr. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Beaver Creek Rd/Laurelwood Dr - East - Laurelwood Dr. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Beaver Creek Rd/Laurelwood Dr - North - Beaver Creek Rd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Beaver Creek Rd/Laurelwood Dr - West - Laurelwood Dr. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?

Warning	Pedestrian Crossing	Beaver Creek Rd/Laurelwood Dr - West - Laurelwood Dr. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Beaver Creek Rd/Laurelwood Dr - South - Beaver Creek Rd - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - East - Erb St. W - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - East - Erb St. W - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - North - Platinum Dr - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - North - Platinum Dr - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - West - Erb St. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - West - Erb St. - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Erb St./Platinum Dr - South - Landfill Gate 2 - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erbsville/Keats Way - East - Keats Way -	Pedestrian crossing uses default settings only. Is this correct?

		Unsignalled Pedestrian Crossing Details	
Warning	Pedestrian Crossing	Erbsville/Keats Way - North - Erbsville Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erbsville/Keats Way - West - Keats Way - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Erbsville/Keats Way - South - Erbsville Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Fischer Hallman Road/Laurelwood Drive - East - Laurelwood Drive - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Fischer Hallman Road/Laurelwood Drive - North - Bearinger Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Fischer Hallman Road/Laurelwood Drive - West - Laurelwood Drive - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Fischer Hallman Road/Laurelwood Drive - South - Fischer Hallman Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Bearinger Road/Westmount Road - East - Bearinger Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?

Warning	Pedestrian Crossing	Bearinger Road/Westmount Road - North - Westmount Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Bearinger Road/Westmount Road - West - Bearinger Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Bearinger Road/Westmount Road - South - Westmount Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Conservation Drive/Beaver Creek Road - East - Conservation Drive - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Conservation Drive/Beaver Creek Road - North - Beaver Creek Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Conservation Drive/Beaver Creek Road - West - Conservation Drive - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Conservation Drive/Beaver Creek Road - South - Beaver Creek Road - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?

Analysis Set Details

Name	Description	Include In Report	Use Specific Demand Set	Demand Set	Locked	Network Flow Scaling Factor (%)	Network Capacity Scaling Factor (%)	Reason For Scaling Factors
Planned 2031 Conditions with Recommendations		Yes		(D1)		100.000	100.000	

Demand Set Details

Name	Scenario Name	Time Period Name	Description	Locked	Run Automatically	Use Relationship	Relationship	Start Time (HH:mm)	Finish Time (HH:mm)	Time Period Length (min)	Time Segment Length (min)	Traffic Profile Type
PM Peak Period, PM	PM Peak Period	PM			Yes			16:00	17:30	90	15	ONE HOUR

Roundabout Network

Roundabout Type(s)

Roundabout	ID	Name	Arm Order	Roundabout Type	Grade Separated	Large Roundabout	Do Geometric Delay
1	1	Ira Needles Blvd/University Avenue	1,2,3,4	Standard			
3	3	Ira Needles Blvd/Thorndale Dr	1,2,3,4	Standard			
5	5	Erb St./Platinum Dr	1,2,3,4	Standard			
6	6	Ira Needles Blvd/Erb St.	1,2,3,4	Standard			
8	8	Erbsville/Keats Way	1,2,3,4	Standard			
12	12	Beaver Creek Rd/Laurelwood Dr	1,2,3,4	Standard			
13	13	Fischer Hallman Road/Laurelwood Drive	1,2,3,4	Standard			
14	14	Bearinger Road/Westmount Road	1,2,3,4	Standard			
18	18	Conservation Drive/Beaver Creek Road	1,2,3,4	Standard			

Roundabout Network Options

Driving Side	Lighting	Road Surface	In London
Right	Normal/unknown	((Mini-roundabouts only))	

Arms

Arms

ID	Name	Description
1	East - University Ave	
2	North - Ira Needles Blvd	
3	West - Private Access	
4	South - Ira Needles Blvd	
1	East - Thorndale Dr	
2	North - Ira Needles Blvd	
3	West - Boardwalk Access	
4	South - Ira Needles Blvd	
1	East - Erb St. W	
2	North - Platinum Dr	
3	West - Erb St.	
4	South - Landfill Gate 2	
1	East - Erb St. W	
2	North - Erbsville Rd	
3	West - Erb St.	
4	South - Ira Needles Blvd	
1	East - Keats Way	
2	North - Erbsville Road	
3	West - Keats Way	
4	South - Erbsville Road	
1	East - Laurelwood Dr.	
2	North - Beaver Creek Rd	
3	West - Laurelwood Dr.	
4	South - Beaver Creek Rd	
1	East - Laurelwood Drive	
2	North - Bearinger Road	
3	West - Laurelwood Drive	
4	South - Fischer Hallman Road	
1	East - Bearinger Road	
2	North - Westmount Road	
3	West - Bearinger Road	
4	South - Westmount Road	
1	East - Conservation Drive	

2	North - Beaver Creek Road	
3	West - Conservation Drive	
4	South - Beaver Creek Road	

Capacity Options

Roundabout	Arm	Minimum Capacity (PCE/hr)	Maximum Capacity (PCE/hr)	Assume Flat Start Profile	Initial Queue (PCE)
Ira Needles Blvd/University Avenue	**East - University Ave**	0.00	99999.00		0.00
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	0.00	99999.00		0.00
Ira Needles Blvd/University Avenue	**West - Private Access**	0.00	99999.00		0.00
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	0.00	99999.00		0.00
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	0.00	99999.00		0.00
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	0.00	99999.00		0.00
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	0.00	99999.00		0.00
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	0.00	99999.00		0.00
Erb St./Platinum Dr	**East - Erb St. W**	0.00	99999.00		0.00
Erb St./Platinum Dr	**North - Platinum Dr**	0.00	99999.00		0.00
Erb St./Platinum Dr	**West - Erb St.**	0.00	99999.00		0.00
Erb St./Platinum Dr	**South - Landfill Gate 2**	0.00	99999.00		0.00
Ira Needles Blvd/Erb St.	**East - Erb St. W**	0.00	99999.00		0.00
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	0.00	99999.00		0.00
Ira Needles Blvd/Erb St.	**West - Erb St.**	0.00	99999.00		0.00
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	0.00	99999.00		0.00
Erbsville/Keats Way	**East - Keats Way**	0.00	99999.00		0.00
Erbsville/Keats Way	**North - Erbsville Road**	0.00	99999.00		0.00
Erbsville/Keats Way	**West - Keats Way**	0.00	99999.00		0.00
Erbsville/Keats Way	**South - Erbsville Road**	0.00	99999.00		0.00
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	0.00	99999.00		0.00
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	0.00	99999.00		0.00
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	0.00	99999.00		0.00
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	0.00	99999.00		0.00
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	0.00	99999.00		0.00
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	0.00	99999.00		0.00
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	0.00	99999.00		0.00

Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	0.00	99999.00		0.00
Bearinger Road/Westmount Road	**East - Bearinger Road**	0.00	99999.00		0.00
Bearinger Road/Westmount Road	**North - Westmount Road**	0.00	99999.00		0.00
Bearinger Road/Westmount Road	**West - Bearinger Road**	0.00	99999.00		0.00
Bearinger Road/Westmount Road	**South - Westmount Road**	0.00	99999.00		0.00
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	0.00	99999.00		0.00
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	0.00	99999.00		0.00
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	0.00	99999.00		0.00
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	0.00	99999.00		0.00

Standard Geometry

Roundabout	Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit Only
Ira Needles Blvd/University Avenue	**East - University Ave**	7.00	7.70	33.22	27.80	55.00	16.36	
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	3.65	7.70	40.78	27.80	55.00	19.60	
Ira Needles Blvd/University Avenue	**West - Private Access**	10.50	11.00	30.00	20.00	70.00	11.79	
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	3.65	7.70	39.60	25.30	55.00	16.84	
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	3.50	6.40	7.65	67.60	55.00	23.37	
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	7.00	8.50	17.60	42.70	44.00	51.42	
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	7.00	8.65	8.60	36.20	50.00	33.36	
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	7.00	8.45	12.74	39.40	50.00	37.81	
Erb St./Platinum Dr	**East - Erb St. W**	7.00	8.00	30.00	20.00	55.00	25.00	
Erb St./Platinum Dr	**North - Platinum Dr**	7.00	8.00	30.00	20.00	55.00	25.00	
Erb St./Platinum Dr	**West - Erb St.**	7.00	8.00	30.00	20.00	55.00	25.00	
Erb St./Platinum Dr	**South - Landfill Gate 2**	3.50	4.50	30.00	20.00	40.00	25.00	
Ira Needles Blvd/Erb St.	**East - Erb St. W**	7.00	8.60	20.00	33.00	56.00	13.00	
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	7.00	9.30	12.00	30.00	56.00	20.00	
Ira Needles Blvd/Erb St.	**West - Erb St.**	6.80	7.80	7.00	23.00	56.00	6.00	
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	7.20	8.60	10.00	29.00	56.00	17.00	
Erbsville/Keats Way	**East - Keats Way**	3.50	4.50	30.00	20.00	40.00	25.00	
Erbsville/Keats Way	**North - Erbsville Road**	7.00	8.00	30.00	20.00	55.00	25.00	
Erbsville/Keats Way	**West - Keats Way**	3.50	4.50	30.00	20.00	40.00	25.00	
Erbsville/Keats Way	**South - Erbsville Road**	7.00	8.00	30.00	20.00	55.00	25.00	

Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	3.50	4.50	30.00	20.00	40.00	25.00	
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	3.50	4.50	30.00	20.00	40.00	25.00	
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	3.50	4.50	30.00	20.00	40.00	25.00	
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	3.50	4.50	30.00	20.00	40.00	25.00	
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	3.50	4.50	30.00	20.00	40.00	25.00	
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	7.00	8.00	30.00	20.00	55.00	25.00	
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	3.50	4.50	30.00	20.00	40.00	25.00	
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	7.00	8.00	30.00	20.00	55.00	25.00	
Bearinger Road/Westmount Road	**East - Bearinger Road**	7.00	8.00	30.00	20.00	55.00	25.00	
Bearinger Road/Westmount Road	**North - Westmount Road**	7.00	8.00	30.00	20.00	55.00	25.00	
Bearinger Road/Westmount Road	**West - Bearinger Road**	7.00	8.00	30.00	20.00	55.00	25.00	
Bearinger Road/Westmount Road	**South - Westmount Road**	7.00	8.00	30.00	20.00	55.00	25.00	
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	3.50	4.50	30.00	20.00	40.00	25.00	
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	3.50	4.50	30.00	20.00	40.00	25.00	
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	3.50	4.50	30.00	20.00	40.00	25.00	
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	3.50	4.50	30.00	20.00	40.00	25.00	

Pedestrian Crossings

Roundabout	Arm	Crossing Type
Ira Needles Blvd/University Avenue	**East - University Ave**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/University Avenue	**West - Private Access**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	Unsignalled Pedestrian Crossing
Erb St./Platinum Dr	**East - Erb St. W**	Unsignalled Pedestrian Crossing
Erb St./Platinum Dr	**North - Platinum Dr**	Unsignalled Pedestrian Crossing
Erb St./Platinum Dr	**West - Erb St.**	Unsignalled Pedestrian Crossing
Erb St./Platinum Dr	**South - Landfill Gate 2**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Erb St.	**East - Erb St. W**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	Unsignalled Pedestrian Crossing
Ira Needles Blvd/Erb St.	**West - Erb St.**	Unsignalled Pedestrian Crossing

Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	Unsignalled Pedestrian Crossing
Erbsville/Keats Way	**East - Keats Way**	Unsignalled Pedestrian Crossing
Erbsville/Keats Way	**North - Erbsville Road**	Unsignalled Pedestrian Crossing
Erbsville/Keats Way	**West - Keats Way**	Unsignalled Pedestrian Crossing
Erbsville/Keats Way	**South - Erbsville Road**	Unsignalled Pedestrian Crossing
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	Unsignalled Pedestrian Crossing
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	Unsignalled Pedestrian Crossing
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	Unsignalled Pedestrian Crossing
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	Unsignalled Pedestrian Crossing
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	Unsignalled Pedestrian Crossing
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	Unsignalled Pedestrian Crossing
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	Unsignalled Pedestrian Crossing
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	Unsignalled Pedestrian Crossing
Bearinger Road/Westmount Road	**East - Bearinger Road**	Unsignalled Pedestrian Crossing
Bearinger Road/Westmount Road	**North - Westmount Road**	Unsignalled Pedestrian Crossing
Bearinger Road/Westmount Road	**West - Bearinger Road**	Unsignalled Pedestrian Crossing
Bearinger Road/Westmount Road	**South - Westmount Road**	Unsignalled Pedestrian Crossing
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	Unsignalled Pedestrian Crossing
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	Unsignalled Pedestrian Crossing
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	Unsignalled Pedestrian Crossing
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	Unsignalled Pedestrian Crossing

Unsignalled Pedestrian Crossing Crossings

Roundabout	Arm	Space between crossing and intersection entry (PCE)	Vehicles queueing on exit (PCE)	Central Refuge	Crossing Data Type	Crossing length (m)	Crossing time (s)	Crossing length (entry side) (m)	Crossing time (entry side) (s)	Crossing length (exit side) (m)	Crossing time (exit side) (s)
Ira Needles Blvd/University Avenue	**East - University Ave**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/University Avenue	**West - Private Access**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00

Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erb St./Platinum Dr	**East - Erb St. W**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erb St./Platinum Dr	**North - Platinum Dr**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erb St./Platinum Dr	**West - Erb St.**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erb St./Platinum Dr	**South - Landfill Gate 2**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Erb St.	**East - Erb St. W**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Erb St.	**West - Erb St.**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erbsville/Keats Way	**East - Keats Way**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erbsville/Keats Way	**North - Erbsville Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erbsville/Keats Way	**West - Keats Way**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Erbsville/Keats Way	**South - Erbsville Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Bearinger Road/Westmount Road	**East - Bearinger Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Bearinger Road/Westmount Road	**North - Westmount Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Bearinger Road/Westmount Road	**West - Bearinger Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Bearinger Road/Westmount Road	**South - Westmount Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	0.00	0.00		Distance	0.00	0.00	0.00	0.00	0.00	0.00

Arm Slope/ Intercept and Capacity

Slope and Intercept used in model

Roundabout	Arm	Enter Directly	Slope	Intercept (PCE/hr)	Final Slope	Final Intercept (PCE/hr)
Ira Needles Blvd/University Avenue	East - University Ave		((calculated))	((calculated))	0.740	2461.322
Ira Needles Blvd/University Avenue	North - Ira Needles Blvd		((calculated))	((calculated))	0.678	2138.626
Ira Needles Blvd/University Avenue	West - Private Access		((calculated))	((calculated))	0.809	3535.452
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd		((calculated))	((calculated))	0.680	2144.039
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr		((calculated))	((calculated))	0.571	1541.270
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd		((calculated))	((calculated))	0.746	2358.337
Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access		((calculated))	((calculated))	0.755	2455.620
Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd		((calculated))	((calculated))	0.747	2435.697
Erb St./Platinum Dr	East - Erb St. W		((calculated))	((calculated))	0.723	2436.345
Erb St./Platinum Dr	North - Platinum Dr		((calculated))	((calculated))	0.723	2436.345
Erb St./Platinum Dr	West - Erb St.		((calculated))	((calculated))	0.723	2436.345
Erb St./Platinum Dr	South - Landfill Gate 2		((calculated))	((calculated))	0.579	1357.445
Ira Needles Blvd/Erb St.	East - Erb St. W		((calculated))	((calculated))	0.781	2703.168
Ira Needles Blvd/Erb St.	North - Erbsville Rd		((calculated))	((calculated))	0.770	2683.164
Ira Needles Blvd/Erb St.	West - Erb St.		((calculated))	((calculated))	0.743	2471.717
Ira Needles Blvd/Erb St.	South - Ira Needles Blvd		((calculated))	((calculated))	0.762	2623.737
Erbsville/Keats Way	East - Keats Way		((calculated))	((calculated))	0.579	1357.445
Erbsville/Keats Way	North - Erbsville Road		((calculated))	((calculated))	0.723	2436.345
Erbsville/Keats Way	West - Keats Way		((calculated))	((calculated))	0.579	1357.445
Erbsville/Keats Way	South - Erbsville Road		((calculated))	((calculated))	0.723	2436.345
Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.		((calculated))	((calculated))	0.579	1357.445
Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd		((calculated))	((calculated))	0.579	1357.445
Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.		((calculated))	((calculated))	0.579	1357.445
Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd		((calculated))	((calculated))	0.579	1357.445
Fischer Hallman Road/Laurelwood Drive	East - Laurelwood Drive		((calculated))	((calculated))	0.579	1357.445
Fischer Hallman Road/Laurelwood Drive	North - Bearinger Road		((calculated))	((calculated))	0.723	2436.345
Fischer Hallman Road/Laurelwood Drive	West - Laurelwood Drive		((calculated))	((calculated))	0.579	1357.445
Fischer Hallman Road/Laurelwood Drive	South - Fischer Hallman Road		((calculated))	((calculated))	0.723	2436.345
Bearinger Road/Westmount Road	East - Bearinger Road		((calculated))	((calculated))	0.723	2436.345
Bearinger Road/Westmount Road	North - Westmount Road		((calculated))	((calculated))	0.723	2436.345

Bearinger Road/Westmount Road	**West - Bearinger Road**		((calculated))	((calculated))	0.723	2436.345
Bearinger Road/Westmount Road	**South - Westmount Road**		((calculated))	((calculated))	0.723	2436.345
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**		((calculated))	((calculated))	0.579	1357.445
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**		((calculated))	((calculated))	0.579	1357.445
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**		((calculated))	((calculated))	0.579	1357.445
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**		((calculated))	((calculated))	0.579	1357.445

The slope and intercept shown above include any corrections and adjustments.

Arm Capacity Adjustments

Roundabout	Arm	Type	Reason	Direct Capacity Adjustment (PCE/hr)	Percentage Capacity Adjustment (%)
Ira Needles Blvd/University Avenue	**East - University Ave**	Percentage		N/A	85.00
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	Percentage		N/A	85.00
Ira Needles Blvd/University Avenue	**West - Private Access**	Percentage		N/A	85.00
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	Percentage		N/A	85.00
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	Percentage		N/A	90.00
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	Percentage		N/A	90.00
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	Percentage		N/A	90.00
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	Percentage		N/A	90.00
Erb St./Platinum Dr	**East - Erb St. W**	Percentage		N/A	90.00
Erb St./Platinum Dr	**North - Platinum Dr**	Percentage		N/A	90.00
Erb St./Platinum Dr	**West - Erb St.**	Percentage		N/A	90.00
Erb St./Platinum Dr	**South - Landfill Gate 2**	Percentage		N/A	90.00
Ira Needles Blvd/Erb St.	**East - Erb St. W**	Percentage		N/A	90.00
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	Percentage		N/A	90.00
Ira Needles Blvd/Erb St.	**West - Erb St.**	Percentage		N/A	90.00
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	Percentage		N/A	90.00
Erbsville/Keats Way	**East - Keats Way**	Percentage		N/A	85.00
Erbsville/Keats Way	**North - Erbsville Road**	Percentage		N/A	85.00
Erbsville/Keats Way	**West - Keats Way**	Percentage		N/A	85.00
Erbsville/Keats Way	**South - Erbsville Road**	Percentage		N/A	85.00
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	Percentage		N/A	90.00
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	Percentage		N/A	90.00
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	Percentage		N/A	90.00
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	Percentage		N/A	90.00

Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	Percentage		N/A	85.00
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	Percentage		N/A	85.00
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	Percentage		N/A	85.00
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	Percentage		N/A	85.00
Bearinger Road/Westmount Road	**East - Bearinger Road**	Percentage		N/A	85.00
Bearinger Road/Westmount Road	**North - Westmount Road**	Percentage		N/A	85.00
Bearinger Road/Westmount Road	**West - Bearinger Road**	Percentage		N/A	85.00
Bearinger Road/Westmount Road	**South - Westmount Road**	Percentage		N/A	85.00
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	Percentage		N/A	85.00
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	Percentage		N/A	85.00
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	Percentage		N/A	85.00
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	Percentage		N/A	85.00

Traffic Flows

Demand Set Data Options

Default Vehicle Mix	Vehicle Mix Varies Over Time	Vehicle Mix Varies Over Turn	Vehicle Mix Varies Over Entry	Vehicle Mix Source	PCE Factor for a Truck (PCE)	Default Turning Proportions	Estimate from entry/exit counts	Turning Proportions Vary Over Time	Turning Proportions Vary Over Turn	Turning Proportions Vary Over Entry
		Yes	Yes	Truck Percentages	2.00				Yes	Yes

Entry Flows

General Flows Data

Roundabout	Arm	Profile Type	Use Turning Counts	Average Demand Flow (Veh/hr)	Flow Scaling Factor (%)	PHF
Ira Needles Blvd/University Avenue	**East - University Ave**	ONE HOUR	Yes	681.00	100.000	N/A
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	ONE HOUR	Yes	1053.00	100.000	N/A
Ira Needles Blvd/University Avenue	**West - Private Access**	ONE HOUR	Yes	390.00	100.000	N/A
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	ONE HOUR	Yes	816.00	100.000	N/A
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	ONE HOUR	Yes	251.00	100.000	N/A
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	ONE HOUR	Yes	1462.00	100.000	N/A

Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	ONE HOUR	Yes	418.00	100.000	N/A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	ONE HOUR	Yes	1052.00	100.000	N/A
Erb St./Platinum Dr	**East - Erb St. W**	ONE HOUR	Yes	854.00	100.000	N/A
Erb St./Platinum Dr	**North - Platinum Dr**	ONE HOUR	Yes	947.00	100.000	N/A
Erb St./Platinum Dr	**West - Erb St.**	ONE HOUR	Yes	292.00	100.000	N/A
Erb St./Platinum Dr	**South - Landfill Gate 2**	ONE HOUR	Yes	67.00	100.000	N/A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	ONE HOUR	Yes	923.00	100.000	N/A
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	ONE HOUR	Yes	1307.00	100.000	N/A
Ira Needles Blvd/Erb St.	**West - Erb St.**	ONE HOUR	Yes	902.00	100.000	N/A
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	ONE HOUR	Yes	1255.00	100.000	N/A
Erbsville/Keats Way	**East - Keats Way**	ONE HOUR	Yes	188.00	100.000	N/A
Erbsville/Keats Way	**North - Erbsville Road**	ONE HOUR	Yes	1159.00	100.000	N/A
Erbsville/Keats Way	**West - Keats Way**	ONE HOUR	Yes	206.00	100.000	N/A
Erbsville/Keats Way	**South - Erbsville Road**	ONE HOUR	Yes	779.00	100.000	N/A
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	ONE HOUR	Yes	691.00	100.000	N/A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	ONE HOUR	Yes	285.00	100.000	N/A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	ONE HOUR	Yes	320.00	100.000	N/A
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	ONE HOUR	Yes	296.00	100.000	N/A
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	ONE HOUR	Yes	304.00	100.000	N/A
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	ONE HOUR	Yes	1081.00	100.000	N/A
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	ONE HOUR	Yes	351.00	100.000	N/A
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	ONE HOUR	Yes	701.00	100.000	N/A
Bearinger Road/Westmount Road	**East - Bearinger Road**	ONE HOUR	Yes	553.00	100.000	N/A
Bearinger Road/Westmount Road	**North - Westmount Road**	ONE HOUR	Yes	1354.00	100.000	N/A
Bearinger Road/Westmount Road	**West - Bearinger Road**	ONE HOUR	Yes	688.00	100.000	N/A
Bearinger Road/Westmount Road	**South - Westmount Road**	ONE HOUR	Yes	441.00	100.000	N/A
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	ONE HOUR	Yes	487.00	100.000	N/A
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	ONE HOUR	Yes	116.00	100.000	N/A
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	ONE HOUR	Yes	227.00	100.000	N/A
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	ONE HOUR	Yes	235.00	100.000	N/A

Pedestrian Flows

General Flows Data

Roundabout	Arm	Profile Type	Average Pedestrian Flow (Ped/hr)
Ira Needles Blvd/University Avenue	East - University Ave	ONE HOUR	13.00
Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	ONE HOUR	5.00
Ira Needles Blvd/University Avenue	West - Private Access	ONE HOUR	7.00
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	ONE HOUR	9.00
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	ONE HOUR	1.00
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	ONE HOUR	1.00
Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	ONE HOUR	0.00
Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	ONE HOUR	0.00
Erb St./Platinum Dr	East - Erb St. W	ONE HOUR	0.00
Erb St./Platinum Dr	North - Platinum Dr	ONE HOUR	0.00
Erb St./Platinum Dr	West - Erb St.	ONE HOUR	3.00
Erb St./Platinum Dr	South - Landfill Gate 2	ONE HOUR	26.00
Ira Needles Blvd/Erb St.	East - Erb St. W	ONE HOUR	0.00
Ira Needles Blvd/Erb St.	North - Erbsville Rd	ONE HOUR	0.00
Ira Needles Blvd/Erb St.	West - Erb St.	ONE HOUR	3.00
Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	ONE HOUR	26.00
Erbsville/Keats Way	East - Keats Way	ONE HOUR	13.00
Erbsville/Keats Way	North - Erbsville Road	ONE HOUR	5.00
Erbsville/Keats Way	West - Keats Way	ONE HOUR	7.00
Erbsville/Keats Way	South - Erbsville Road	ONE HOUR	9.00
Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	ONE HOUR	0.00
Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	ONE HOUR	8.00
Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	ONE HOUR	0.00
Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	ONE HOUR	7.00
Fischer Hallman Road/Laurelwood Drive	East - Laurelwood Drive	ONE HOUR	13.00
Fischer Hallman Road/Laurelwood Drive	North - Bearinger Road	ONE HOUR	5.00
Fischer Hallman Road/Laurelwood Drive	West - Laurelwood Drive	ONE HOUR	7.00
Fischer Hallman Road/Laurelwood Drive	South - Fischer Hallman Road	ONE HOUR	9.00
Bearinger Road/Westmount Road	East - Bearinger Road	ONE HOUR	13.00
Bearinger Road/Westmount Road	North - Westmount Road	ONE HOUR	5.00
Bearinger Road/Westmount Road	West - Bearinger Road	ONE HOUR	7.00
Bearinger Road/Westmount Road	South - Westmount Road	ONE HOUR	9.00

Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	ONE HOUR	13.00
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	ONE HOUR	13.00
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	ONE HOUR	7.00
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	ONE HOUR	9.00

Direct/Resultant Flows

Direct Flows Data

Time Segment	Roundabout	Arm	Direct Demand Entry Flow (Veh/hr)	DirectDemandEntryFlowInPCE (PCE/hr)	Direct Demand Exit Flow (Veh/hr)	Direct Demand Pedestrian Flow (Ped/hr)
1	Ira Needles Blvd/University Avenue	East - University Ave	512.69	547.61	N/A	9.79
1	Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	792.75	822.14	N/A	3.76
1	Ira Needles Blvd/University Avenue	West - Private Access	293.61	312.53	N/A	5.27
1	Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	614.33	662.03	N/A	6.78
1	Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	188.97	192.40	N/A	0.00
1	Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	1100.67	1120.38	N/A	0.00
1	Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	314.69	319.24	N/A	0.00
1	Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	792.00	804.96	N/A	0.00
1	Erb St./Platinum Dr	East - Erb St. W	642.94	652.83	N/A	0.00
1	Erb St./Platinum Dr	North - Platinum Dr	712.95	723.72	N/A	0.00
1	Erb St./Platinum Dr	West - Erb St.	219.83	225.82	N/A	0.00
1	Erb St./Platinum Dr	South - Landfill Gate 2	50.44	53.56	N/A	19.57
1	Ira Needles Blvd/Erb St.	East - Erb St. W	694.88	706.85	N/A	0.00
1	Ira Needles Blvd/Erb St.	North - Erbsville Rd	983.98	1002.05	N/A	0.00
1	Ira Needles Blvd/Erb St.	West - Erb St.	679.07	684.93	N/A	0.00
1	Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	944.83	956.78	N/A	19.57
1	Erbsville/Keats Way	East - Keats Way	141.54	144.37	N/A	9.79
1	Erbsville/Keats Way	North - Erbsville Road	872.56	890.01	N/A	3.76
1	Erbsville/Keats Way	West - Keats Way	155.09	158.19	N/A	5.27
1	Erbsville/Keats Way	South - Erbsville Road	586.47	598.20	N/A	6.78
1	Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	520.22	524.61	N/A	0.00
1	Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	214.56	215.65	N/A	6.02

1	Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	240.91	243.68	N/A	0.00
1	Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	222.84	222.84	N/A	5.27
1	Fischer Hallman Road/Laurelwood Drive	East - Laurelwood Drive	228.87	233.44	N/A	9.79
1	Fischer Hallman Road/Laurelwood Drive	North - Bearinger Road	813.83	830.11	N/A	3.76
1	Fischer Hallman Road/Laurelwood Drive	West - Laurelwood Drive	264.25	269.54	N/A	5.27
1	Fischer Hallman Road/Laurelwood Drive	South - Fischer Hallman Road	527.75	538.30	N/A	6.78
1	Bearinger Road/Westmount Road	East - Bearinger Road	416.33	424.65	N/A	9.79
1	Bearinger Road/Westmount Road	North - Westmount Road	1019.36	1039.75	N/A	3.76
1	Bearinger Road/Westmount Road	West - Bearinger Road	517.96	528.32	N/A	5.27
1	Bearinger Road/Westmount Road	South - Westmount Road	332.01	338.65	N/A	6.78
1	Conservation Drive/Beaver Creek Road	East - Conservation Drive	366.64	372.59	N/A	9.79
1	Conservation Drive/Beaver Creek Road	North - Beaver Creek Road	87.33	89.08	N/A	9.79
1	Conservation Drive/Beaver Creek Road	West - Conservation Drive	170.90	174.01	N/A	5.27
1	Conservation Drive/Beaver Creek Road	South - Beaver Creek Road	176.92	179.68	N/A	6.78
2	Ira Needles Blvd/University Avenue	East - University Ave	612.21	653.90	N/A	11.69
2	Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	946.63	981.72	N/A	4.49
2	Ira Needles Blvd/University Avenue	West - Private Access	350.60	373.19	N/A	6.29
2	Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	733.57	790.53	N/A	8.09
2	Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	225.64	229.74	N/A	0.00
2	Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	1314.31	1337.84	N/A	0.00
2	Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	375.77	381.20	N/A	0.00
2	Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	945.73	961.21	N/A	0.00
2	Erb St./Platinum Dr	East - Erb St. W	767.73	779.54	N/A	0.00
2	Erb St./Platinum Dr	North - Platinum Dr	851.33	864.19	N/A	0.00
2	Erb St./Platinum Dr	West - Erb St.	262.50	269.65	N/A	0.00
2	Erb St./Platinum Dr	South - Landfill Gate 2	60.23	63.96	N/A	23.37
2	Ira Needles Blvd/Erb St.	East - Erb St. W	829.76	844.04	N/A	0.00
2	Ira Needles Blvd/Erb St.	North - Erbsville Rd	1174.97	1196.54	N/A	0.00
2	Ira Needles Blvd/Erb St.	West - Erb St.	810.88	817.87	N/A	0.00
2	Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	1128.22	1142.49	N/A	23.37
2	Erbsville/Keats Way	East - Keats Way	169.01	172.39	N/A	11.69
2	Erbsville/Keats Way	North - Erbsville Road	1041.92	1062.76	N/A	4.49
2	Erbsville/Keats Way	West - Keats Way	185.19	188.89	N/A	6.29
2	Erbsville/Keats Way	South - Erbsville Road	700.31	714.31	N/A	8.09

2	**Beaver Creek Rd/Laurelwood Dr**	**East - Laurelwood Dr.**	621.19	626.44	N/A	0.00
2	**Beaver Creek Rd/Laurelwood Dr**	**North - Beaver Creek Rd**	256.21	257.51	N/A	7.19
2	**Beaver Creek Rd/Laurelwood Dr**	**West - Laurelwood Dr.**	287.67	290.97	N/A	0.00
2	**Beaver Creek Rd/Laurelwood Dr**	**South - Beaver Creek Rd**	266.10	266.10	N/A	6.29
2	**Fischer Hallman Road/Laurelwood Drive**	**East - Laurelwood Drive**	273.29	278.76	N/A	11.69
2	**Fischer Hallman Road/Laurelwood Drive**	**North - Bearinger Road**	971.80	991.23	N/A	4.49
2	**Fischer Hallman Road/Laurelwood Drive**	**West - Laurelwood Drive**	315.54	321.85	N/A	6.29
2	**Fischer Hallman Road/Laurelwood Drive**	**South - Fischer Hallman Road**	630.18	642.79	N/A	8.09
2	**Bearinger Road/Westmount Road**	**East - Bearinger Road**	497.14	507.08	N/A	11.69
2	**Bearinger Road/Westmount Road**	**North - Westmount Road**	1217.22	1241.56	N/A	4.49
2	**Bearinger Road/Westmount Road**	**West - Bearinger Road**	618.50	630.87	N/A	6.29
2	**Bearinger Road/Westmount Road**	**South - Westmount Road**	396.45	404.38	N/A	8.09
2	**Conservation Drive/Beaver Creek Road**	**East - Conservation Drive**	437.80	444.90	N/A	11.69
2	**Conservation Drive/Beaver Creek Road**	**North - Beaver Creek Road**	104.28	106.37	N/A	11.69
2	**Conservation Drive/Beaver Creek Road**	**West - Conservation Drive**	204.07	207.79	N/A	6.29
2	**Conservation Drive/Beaver Creek Road**	**South - Beaver Creek Road**	211.26	214.55	N/A	8.09
3	**Ira Needles Blvd/University Avenue**	**East - University Ave**	749.79	800.86	N/A	14.31
3	**Ira Needles Blvd/University Avenue**	**North - Ira Needles Blvd**	1159.37	1202.36	N/A	5.51
3	**Ira Needles Blvd/University Avenue**	**West - Private Access**	429.40	457.07	N/A	7.71
3	**Ira Needles Blvd/University Avenue**	**South - Ira Needles Blvd**	898.43	968.19	N/A	9.91
3	**Ira Needles Blvd/Thorndale Dr**	**East - Thorndale Dr**	276.36	281.38	N/A	0.00
3	**Ira Needles Blvd/Thorndale Dr**	**North - Ira Needles Blvd**	1609.69	1638.52	N/A	0.00
3	**Ira Needles Blvd/Thorndale Dr**	**West - Boardwalk Access**	460.23	466.88	N/A	0.00
3	**Ira Needles Blvd/Thorndale Dr**	**South - Ira Needles Blvd**	1158.27	1177.23	N/A	0.00
3	**Erb St./Platinum Dr**	**East - Erb St. W**	940.27	954.74	N/A	0.00
3	**Erb St./Platinum Dr**	**North - Platinum Dr**	1042.67	1058.41	N/A	0.00
3	**Erb St./Platinum Dr**	**West - Erb St.**	321.50	330.25	N/A	0.00
3	**Erb St./Platinum Dr**	**South - Landfill Gate 2**	73.77	78.33	N/A	28.63
3	**Ira Needles Blvd/Erb St.**	**East - Erb St. W**	1016.24	1033.74	N/A	0.00
3	**Ira Needles Blvd/Erb St.**	**North - Erbsville Rd**	1439.03	1465.46	N/A	0.00
3	**Ira Needles Blvd/Erb St.**	**West - Erb St.**	993.12	1001.69	N/A	0.00
3	**Ira Needles Blvd/Erb St.**	**South - Ira Needles Blvd**	1381.78	1399.25	N/A	28.63
3	**Erbsville/Keats Way**	**East - Keats Way**	206.99	211.13	N/A	14.31
3	**Erbsville/Keats Way**	**North - Erbsville Road**	1276.08	1301.60	N/A	5.51

3	Erbsville/Keats Way	West - Keats Way	226.81	231.35	N/A	7.71
3	Erbsville/Keats Way	South - Erbsville Road	857.69	874.85	N/A	9.91
3	Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	760.81	767.22	N/A	0.00
3	Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	313.79	315.38	N/A	8.81
3	Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	352.33	356.37	N/A	0.00
3	Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	325.90	325.90	N/A	7.71
3	Fischer Hallman Road/Laurelwood Drive	East - Laurelwood Drive	334.71	341.40	N/A	14.31
3	Fischer Hallman Road/Laurelwood Drive	North - Bearinger Road	1190.20	1214.01	N/A	5.51
3	Fischer Hallman Road/Laurelwood Drive	West - Laurelwood Drive	386.46	394.19	N/A	7.71
3	Fischer Hallman Road/Laurelwood Drive	South - Fischer Hallman Road	771.82	787.25	N/A	9.91
3	Bearinger Road/Westmount Road	East - Bearinger Road	608.86	621.04	N/A	14.31
3	Bearinger Road/Westmount Road	North - Westmount Road	1490.78	1520.60	N/A	5.51
3	Bearinger Road/Westmount Road	West - Bearinger Road	757.50	772.65	N/A	7.71
3	Bearinger Road/Westmount Road	South - Westmount Road	485.55	495.26	N/A	9.91
3	Conservation Drive/Beaver Creek Road	East - Conservation Drive	536.20	544.90	N/A	14.31
3	Conservation Drive/Beaver Creek Road	North - Beaver Creek Road	127.72	130.27	N/A	14.31
3	Conservation Drive/Beaver Creek Road	West - Conservation Drive	249.93	254.49	N/A	7.71
3	Conservation Drive/Beaver Creek Road	South - Beaver Creek Road	258.74	262.77	N/A	9.91
4	Ira Needles Blvd/University Avenue	East - University Ave	749.79	800.86	N/A	14.31
4	Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	1159.37	1202.36	N/A	5.51
4	Ira Needles Blvd/University Avenue	West - Private Access	429.40	457.07	N/A	7.71
4	Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	898.43	968.19	N/A	9.91
4	Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	276.36	281.38	N/A	0.00
4	Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	1609.69	1638.52	N/A	0.00
4	Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	460.23	466.88	N/A	0.00
4	Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	1158.27	1177.23	N/A	0.00
4	Erb St./Platinum Dr	East - Erb St. W	940.27	954.74	N/A	0.00
4	Erb St./Platinum Dr	North - Platinum Dr	1042.67	1058.41	N/A	0.00
4	Erb St./Platinum Dr	West - Erb St.	321.50	330.25	N/A	0.00
4	Erb St./Platinum Dr	South - Landfill Gate 2	73.77	78.33	N/A	28.63
4	Ira Needles Blvd/Erb St.	East - Erb St. W	1016.24	1033.74	N/A	0.00
4	Ira Needles Blvd/Erb St.	North - Erbsville Rd	1439.03	1465.46	N/A	0.00
4	Ira Needles Blvd/Erb St.	West - Erb St.	993.12	1001.69	N/A	0.00
4	Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	1381.78	1399.25	N/A	28.63

4	**Erbsville/Keats Way**	**East - Keats Way**	206.99	211.13	N/A	14.31
4	**Erbsville/Keats Way**	**North - Erbsville Road**	1276.08	1301.60	N/A	5.51
4	**Erbsville/Keats Way**	**West - Keats Way**	226.81	231.35	N/A	7.71
4	**Erbsville/Keats Way**	**South - Erbsville Road**	857.69	874.85	N/A	9.91
4	**Beaver Creek Rd/Laurelwood Dr**	**East - Laurelwood Dr.**	760.81	767.22	N/A	0.00
4	**Beaver Creek Rd/Laurelwood Dr**	**North - Beaver Creek Rd**	313.79	315.38	N/A	8.81
4	**Beaver Creek Rd/Laurelwood Dr**	**West - Laurelwood Dr.**	352.33	356.37	N/A	0.00
4	**Beaver Creek Rd/Laurelwood Dr**	**South - Beaver Creek Rd**	325.90	325.90	N/A	7.71
4	**Fischer Hallman Road/Laurelwood Drive**	**East - Laurelwood Drive**	334.71	341.40	N/A	14.31
4	**Fischer Hallman Road/Laurelwood Drive**	**North - Bearinger Road**	1190.20	1214.01	N/A	5.51
4	**Fischer Hallman Road/Laurelwood Drive**	**West - Laurelwood Drive**	386.46	394.19	N/A	7.71
4	**Fischer Hallman Road/Laurelwood Drive**	**South - Fischer Hallman Road**	771.82	787.25	N/A	9.91
4	**Bearinger Road/Westmount Road**	**East - Bearinger Road**	608.86	621.04	N/A	14.31
4	**Bearinger Road/Westmount Road**	**North - Westmount Road**	1490.78	1520.60	N/A	5.51
4	**Bearinger Road/Westmount Road**	**West - Bearinger Road**	757.50	772.65	N/A	7.71
4	**Bearinger Road/Westmount Road**	**South - Westmount Road**	485.55	495.26	N/A	9.91
4	**Conservation Drive/Beaver Creek Road**	**East - Conservation Drive**	536.20	544.90	N/A	14.31
4	**Conservation Drive/Beaver Creek Road**	**North - Beaver Creek Road**	127.72	130.27	N/A	14.31
4	**Conservation Drive/Beaver Creek Road**	**West - Conservation Drive**	249.93	254.49	N/A	7.71
4	**Conservation Drive/Beaver Creek Road**	**South - Beaver Creek Road**	258.74	262.77	N/A	9.91
5	**Ira Needles Blvd/University Avenue**	**East - University Ave**	612.21	653.90	N/A	11.69
5	**Ira Needles Blvd/University Avenue**	**North - Ira Needles Blvd**	946.63	981.72	N/A	4.49
5	**Ira Needles Blvd/University Avenue**	**West - Private Access**	350.60	373.19	N/A	6.29
5	**Ira Needles Blvd/University Avenue**	**South - Ira Needles Blvd**	733.57	790.53	N/A	8.09
5	**Ira Needles Blvd/Thorndale Dr**	**East - Thorndale Dr**	225.64	229.74	N/A	0.00
5	**Ira Needles Blvd/Thorndale Dr**	**North - Ira Needles Blvd**	1314.31	1337.84	N/A	0.00
5	**Ira Needles Blvd/Thorndale Dr**	**West - Boardwalk Access**	375.77	381.20	N/A	0.00
5	**Ira Needles Blvd/Thorndale Dr**	**South - Ira Needles Blvd**	945.73	961.21	N/A	0.00
5	**Erb St./Platinum Dr**	**East - Erb St. W**	767.73	779.54	N/A	0.00
5	**Erb St./Platinum Dr**	**North - Platinum Dr**	851.33	864.19	N/A	0.00
5	**Erb St./Platinum Dr**	**West - Erb St.**	262.50	269.65	N/A	0.00
5	**Erb St./Platinum Dr**	**South - Landfill Gate 2**	60.23	63.96	N/A	23.37
5	**Ira Needles Blvd/Erb St.**	**East - Erb St. W**	829.76	844.04	N/A	0.00
5	**Ira Needles Blvd/Erb St.**	**North - Erbsville Rd**	1174.97	1196.54	N/A	0.00

5	**Ira Needles Blvd/Erb St.**	**West - Erb St.**	810.88	817.87	N/A	0.00
5	**Ira Needles Blvd/Erb St.**	**South - Ira Needles Blvd**	1128.22	1142.49	N/A	23.37
5	**Erbsville/Keats Way**	**East - Keats Way**	169.01	172.39	N/A	11.69
5	**Erbsville/Keats Way**	**North - Erbsville Road**	1041.92	1062.76	N/A	4.49
5	**Erbsville/Keats Way**	**West - Keats Way**	185.19	188.89	N/A	6.29
5	**Erbsville/Keats Way**	**South - Erbsville Road**	700.31	714.31	N/A	8.09
5	**Beaver Creek Rd/Laurelwood Dr**	**East - Laurelwood Dr.**	621.19	626.44	N/A	0.00
5	**Beaver Creek Rd/Laurelwood Dr**	**North - Beaver Creek Rd**	256.21	257.51	N/A	7.19
5	**Beaver Creek Rd/Laurelwood Dr**	**West - Laurelwood Dr.**	287.67	290.97	N/A	0.00
5	**Beaver Creek Rd/Laurelwood Dr**	**South - Beaver Creek Rd**	266.10	266.10	N/A	6.29
5	**Fischer Hallman Road/Laurelwood Drive**	**East - Laurelwood Drive**	273.29	278.76	N/A	11.69
5	**Fischer Hallman Road/Laurelwood Drive**	**North - Bearinger Road**	971.80	991.23	N/A	4.49
5	**Fischer Hallman Road/Laurelwood Drive**	**West - Laurelwood Drive**	315.54	321.85	N/A	6.29
5	**Fischer Hallman Road/Laurelwood Drive**	**South - Fischer Hallman Road**	630.18	642.79	N/A	8.09
5	**Bearinger Road/Westmount Road**	**East - Bearinger Road**	497.14	507.08	N/A	11.69
5	**Bearinger Road/Westmount Road**	**North - Westmount Road**	1217.22	1241.56	N/A	4.49
5	**Bearinger Road/Westmount Road**	**West - Bearinger Road**	618.50	630.87	N/A	6.29
5	**Bearinger Road/Westmount Road**	**South - Westmount Road**	396.45	404.38	N/A	8.09
5	**Conservation Drive/Beaver Creek Road**	**East - Conservation Drive**	437.80	444.90	N/A	11.69
5	**Conservation Drive/Beaver Creek Road**	**North - Beaver Creek Road**	104.28	106.37	N/A	11.69
5	**Conservation Drive/Beaver Creek Road**	**West - Conservation Drive**	204.07	207.79	N/A	6.29
5	**Conservation Drive/Beaver Creek Road**	**South - Beaver Creek Road**	211.26	214.55	N/A	8.09
6	**Ira Needles Blvd/University Avenue**	**East - University Ave**	512.69	547.61	N/A	9.79
6	**Ira Needles Blvd/University Avenue**	**North - Ira Needles Blvd**	792.75	822.14	N/A	3.76
6	**Ira Needles Blvd/University Avenue**	**West - Private Access**	293.61	312.53	N/A	5.27
6	**Ira Needles Blvd/University Avenue**	**South - Ira Needles Blvd**	614.33	662.03	N/A	6.78
6	**Ira Needles Blvd/Thorndale Dr**	**East - Thorndale Dr**	188.97	192.40	N/A	0.00
6	**Ira Needles Blvd/Thorndale Dr**	**North - Ira Needles Blvd**	1100.67	1120.38	N/A	0.00
6	**Ira Needles Blvd/Thorndale Dr**	**West - Boardwalk Access**	314.69	319.24	N/A	0.00
6	**Ira Needles Blvd/Thorndale Dr**	**South - Ira Needles Blvd**	792.00	804.96	N/A	0.00
6	**Erb St./Platinum Dr**	**East - Erb St. W**	642.94	652.83	N/A	0.00
6	**Erb St./Platinum Dr**	**North - Platinum Dr**	712.95	723.72	N/A	0.00
6	**Erb St./Platinum Dr**	**West - Erb St.**	219.83	225.82	N/A	0.00
6	**Erb St./Platinum Dr**	**South - Landfill Gate 2**	50.44	53.56	N/A	19.57

6	Ira Needles Blvd/Erb St.	East - Erb St. W	694.88	706.85	N/A	0.00
6	Ira Needles Blvd/Erb St.	North - Erbsville Rd	983.98	1002.05	N/A	0.00
6	Ira Needles Blvd/Erb St.	West - Erb St.	679.07	684.93	N/A	0.00
6	Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	944.83	956.78	N/A	19.57
6	Erbsville/Keats Way	East - Keats Way	141.54	144.37	N/A	9.79
6	Erbsville/Keats Way	North - Erbsville Road	872.56	890.01	N/A	3.76
6	Erbsville/Keats Way	West - Keats Way	155.09	158.19	N/A	5.27
6	Erbsville/Keats Way	South - Erbsville Road	586.47	598.20	N/A	6.78
6	Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	520.22	524.61	N/A	0.00
6	Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	214.56	215.65	N/A	6.02
6	Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	240.91	243.68	N/A	0.00
6	Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	222.84	222.84	N/A	5.27
6	Fischer Hallman Road/Laurelwood Drive	East - Laurelwood Drive	228.87	233.44	N/A	9.79
6	Fischer Hallman Road/Laurelwood Drive	North - Bearinger Road	813.83	830.11	N/A	3.76
6	Fischer Hallman Road/Laurelwood Drive	West - Laurelwood Drive	264.25	269.54	N/A	5.27
6	Fischer Hallman Road/Laurelwood Drive	South - Fischer Hallman Road	527.75	538.30	N/A	6.78
6	Bearinger Road/Westmount Road	East - Bearinger Road	416.33	424.65	N/A	9.79
6	Bearinger Road/Westmount Road	North - Westmount Road	1019.36	1039.75	N/A	3.76
6	Bearinger Road/Westmount Road	West - Bearinger Road	517.96	528.32	N/A	5.27
6	Bearinger Road/Westmount Road	South - Westmount Road	332.01	338.65	N/A	6.78
6	Conservation Drive/Beaver Creek Road	East - Conservation Drive	366.64	372.59	N/A	9.79
6	Conservation Drive/Beaver Creek Road	North - Beaver Creek Road	87.33	89.08	N/A	9.79
6	Conservation Drive/Beaver Creek Road	West - Conservation Drive	170.90	174.01	N/A	5.27
6	Conservation Drive/Beaver Creek Road	South - Beaver Creek Road	176.92	179.68	N/A	6.78

Turning Proportions

Turning Counts or Proportions (Veh/hr) - Ira Needles Blvd/ University Avenue (for whole period)

		To			
		1	2	3	4
From	1	0.000	135.000	225.000	321.000
	2	154.000	0.000	0.000	899.000
	3	180.000	67.000	0.000	143.000

	4	0.000	522.000	294.000	0.000

Turning Proportions (Veh) - Ira Needles Blvd/ University Avenue (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.20	0.33	0.47
	2	0.15	0.00	0.00	0.85
	3	0.46	0.17	0.00	0.37
	4	0.00	0.64	0.36	0.00

Turning Counts or Proportions (Veh/hr) - Ira Needles Blvd/ Thorndale Dr (for whole period)

		To			
		1	2	3	4
From	1	0.000	136.000	23.000	92.000
	2	102.000	0.000	102.000	1258.000
	3	40.000	151.000	0.000	227.000
	4	90.000	861.000	101.000	0.000

Turning Proportions (Veh) - Ira Needles Blvd/ Thorndale Dr (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.54	0.09	0.37
	2	0.07	0.00	0.07	0.86
	3	0.10	0.36	0.00	0.54
	4	0.09	0.82	0.10	0.00

Turning Counts or Proportions (Veh/hr) - Ira Needles Blvd/ Erb St. (for whole period)

		To			
		1	2	3	4
From	1	0.000	145.000	556.000	222.000
	2	193.000	0.000	214.000	900.000
	3	430.000	319.000	0.000	153.000

	4	166.000	857.000	232.000	0.000

Turning Proportions (Veh) - Ira Needles Blvd/ Erb St. (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.16	0.60	0.24
	2	0.15	0.00	0.16	0.69
	3	0.48	0.35	0.00	0.17
	4	0.13	0.68	0.18	0.00

Turning Counts or Proportions (Veh/hr) - Beaver Creek Rd/ Laurelwood Dr (for whole period)

		To			
		1	2	3	4
From	1	0.000	108.000	440.000	143.000
	2	63.000	0.000	103.000	119.000
	3	204.000	56.000	0.000	60.000
	4	106.000	98.000	92.000	0.000

Turning Proportions (Veh) - Beaver Creek Rd/ Laurelwood Dr (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.16	0.64	0.21
	2	0.22	0.00	0.36	0.42
	3	0.64	0.18	0.00	0.19
	4	0.36	0.33	0.31	0.00

Turning Counts or Proportions (Veh/hr) - Erb St./ Platinum Dr (for whole period)

		To			
		1	2	3	4
From	1	0.000	244.000	576.000	34.000
	2	715.000	0.000	223.000	9.000
	3	226.000	61.000	0.000	5.000

	4	56.000	6.000	5.000	0.000

Turning Proportions (Veh) - Erb St./ Platinum Dr (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.29	0.67	0.04
	2	0.76	0.00	0.24	0.01
	3	0.77	0.21	0.00	0.02
	4	0.84	0.09	0.07	0.00

Turning Counts or Proportions (Veh/hr) - Erbsville/ Keats Way (for whole period)

		To			
		1	2	3	4
From	1	0.000	56.000	58.000	74.000
	2	67.000	0.000	37.000	1055.000
	3	89.000	62.000	0.000	55.000
	4	113.000	623.000	43.000	0.000

Turning Proportions (Veh) - Erbsville/ Keats Way (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.30	0.31	0.39
	2	0.06	0.00	0.03	0.91
	3	0.43	0.30	0.00	0.27
	4	0.15	0.80	0.06	0.00

Turning Counts or Proportions (Veh/hr) - Fischer Hallman Road/ Laurelwood Drive (for whole period)

		To			
		1	2	3	4
From	1	0.000	56.000	118.000	130.000
	2	51.000	0.000	268.000	762.000
	3	61.000	165.000	0.000	125.000

	4	91.000	405.000	205.000	0.000

Turning Proportions (Veh) - Fischer Hallman Road/ Laurelwood Drive (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.18	0.39	0.43
	2	0.05	0.00	0.25	0.70
	3	0.17	0.47	0.00	0.36
	4	0.13	0.58	0.29	0.00

Turning Counts or Proportions (Veh/hr) - Bearinger Road/ Westmount Road (for whole period)

		To			
		1	2	3	4
From	1	0.000	139.000	329.000	85.000
	2	48.000	0.000	788.000	518.000
	3	205.000	480.000	0.000	3.000
	4	66.000	372.000	3.000	0.000

Turning Proportions (Veh) - Bearinger Road/ Westmount Road (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.25	0.59	0.15
	2	0.04	0.00	0.58	0.38
	3	0.30	0.70	0.00	0.00
	4	0.15	0.84	0.01	0.00

Turning Counts or Proportions (Veh/hr) - Conservation Drive/ Beaver Creek Road (for whole period)

		To			
		1	2	3	4
From	1	0.000	92.000	216.000	179.000
	2	65.000	0.000	14.000	37.000
	3	164.000	20.000	0.000	43.000

	4	135.000	52.000	48.000	0.000

Turning Proportions (Veh) - Conservation Drive/ Beaver Creek Road (for whole period)

		To			
		1	2	3	4
From	1	0.00	0.19	0.44	0.37
	2	0.56	0.00	0.12	0.32
	3	0.72	0.09	0.00	0.19
	4	0.57	0.22	0.20	0.00

Vehicle Mix

Average PCE Per Vehicle - Ira Needles Blvd/ University Avenue (for whole period)

		To			
		1	2	3	4
From	1	1.000	1.070	1.050	1.080
	2	1.020	1.000	1.010	1.040
	3	1.050	1.070	1.000	1.080
	4	1.040	1.020	1.180	1.000

Truck Percentages - Ira Needles Blvd/ University Avenue (for whole period)

		To			
		1	2	3	4
From	1	0.000	7.000	5.000	8.000
	2	2.000	0.000	1.000	4.000
	3	5.000	7.000	0.000	8.000
	4	4.000	2.000	18.000	0.000

Average PCE Per Vehicle - Ira Needles Blvd/ Thorndale Dr (for whole period)

		To			
From		1	2	3	4

	1	1.000	1.020	1.000	1.020
	2	1.000	1.000	1.010	1.020
	3	1.000	1.040	1.000	1.000
	4	1.000	1.020	1.000	1.000

Truck Percentages - Ira Needles Blvd/ Thorndale Dr (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	0.000	2.000	0.000	2.000
	2	0.000	0.000	1.000	2.000
	3	0.000	4.000	0.000	0.000
	4	0.000	2.000	0.000	0.000

Average PCE Per Vehicle - Ira Needles Blvd/ Erb St. (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	1.000	1.010	1.010	1.040
	2	1.020	1.000	1.010	1.020
	3	1.000	1.010	1.000	1.030
	4	1.030	1.010	1.010	1.000

Truck Percentages - Ira Needles Blvd/ Erb St. (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	0.000	1.000	1.000	4.000
	2	2.000	0.000	1.000	2.000
	3	0.000	1.000	0.000	3.000
	4	3.000	1.000	1.000	0.000

Average PCE Per Vehicle - Beaver Creek Rd/ Laurelwood Dr (for whole period)

	To				
From		**1**	**2**	**3**	**4**

	1	1.000	1.000	1.010	1.010
	2	1.000	1.000	1.014	1.000
	3	1.018	1.000	1.000	1.000
	4	1.000	1.000	1.000	1.000

Truck Percentages - Beaver Creek Rd/ Laurelwood Dr (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	0.000	0.000	1.000	1.000
	2	0.000	0.000	1.400	0.000
	3	1.800	0.000	0.000	0.000
	4	0.000	0.000	0.000	0.000

Average PCE Per Vehicle - Erb St./ Platinum Dr (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	1.000	1.000	1.020	1.048
	2	1.020	1.000	1.000	1.000
	3	1.017	1.045	1.000	1.250
	4	1.074	1.000	1.000	1.000

Truck Percentages - Erb St./ Platinum Dr (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	0.000	0.000	2.000	4.760
	2	2.000	0.000	0.000	0.000
	3	1.740	4.540	0.000	25.000
	4	7.400	0.000	0.000	0.000

Average PCE Per Vehicle - Erbsville/ Keats Way (for whole period)

	To				
From		**1**	**2**	**3**	**4**

	1	1.020	1.020	1.020	1.020
	2	1.020	1.020	1.020	1.020
	3	1.020	1.020	1.020	1.020
	4	1.020	1.020	1.020	1.020

Truck Percentages - Erbsville/ Keats Way (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	2.000	2.000	2.000	2.000
	2	2.000	2.000	2.000	2.000
	3	2.000	2.000	2.000	2.000
	4	2.000	2.000	2.000	2.000

Average PCE Per Vehicle - Fischer Hallman Road/ Laurelwood Drive (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	1.020	1.020	1.020	1.020
	2	1.020	1.020	1.020	1.020
	3	1.020	1.020	1.020	1.020
	4	1.020	1.020	1.020	1.020

Truck Percentages - Fischer Hallman Road/ Laurelwood Drive (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	2.000	2.000	2.000	2.000
	2	2.000	2.000	2.000	2.000
	3	2.000	2.000	2.000	2.000
	4	2.000	2.000	2.000	2.000

Average PCE Per Vehicle - Bearinger Road/ Westmount Road (for whole period)

	To				
From		**1**	**2**	**3**	**4**

	1	1.020	1.020	1.020	1.020
	2	1.020	1.020	1.020	1.020
	3	1.020	1.020	1.020	1.020
	4	1.020	1.020	1.020	1.020

Truck Percentages - Bearinger Road/ Westmount Road (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	2.000	2.000	2.000	2.000
	2	2.000	2.000	2.000	2.000
	3	2.000	2.000	2.000	2.000
	4	2.000	2.000	2.000	2.000

Average PCE Per Vehicle - Conservation Drive/ Beaver Creek Road (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	1.020	1.000	1.020	1.020
	2	1.020	1.000	1.020	1.020
	3	1.020	1.000	1.000	1.020
	4	1.020	1.000	1.020	1.020

Truck Percentages - Conservation Drive/ Beaver Creek Road (for whole period)

		To			
		1	**2**	**3**	**4**
From	**1**	2.000	0.000	2.000	2.000
	2	2.000	0.000	2.000	2.000
	3	2.000	0.000	0.000	2.000
	4	2.000	0.000	2.000	2.000

Results

Results Summary

Roundabout	Arm	Max RFC	Max Delay (s)	Max Queue (Veh)	Max LOS	Total Demand (Veh/hr)	Total Arrivals (Veh)	Total Queueing Delay (Veh-min)	Average Queueing Delay (s)	Rate Of Queueing Delay (Veh-min/min)	Inclusive Queueing Total Delay (Veh-min)	Inclusive Queueing Average Delay (s)	Slope	Intercept (PCE/hr)
Ira Needles Blvd/University Avenue	East - University Ave	0.69	10.54	2.16	B	624.90	937.34	105.88	6.78	1.18	105.89	6.78	0.740	2461.322
Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	0.99	64.31	20.32	F	966.25	1449.37	582.76	24.12	6.48	582.81	24.13	0.678	2138.626
Ira Needles Blvd/University Avenue	West - Private Access	0.91	58.50	6.69	F	357.87	536.80	164.55	18.39	1.83	164.56	18.39	0.809	3535.452
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	0.63	6.70	1.65	A	748.77	1123.16	98.70	5.27	1.10	98.71	5.27	0.680	2144.039
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	0.38	7.92	0.60	A	230.32	345.48	36.26	6.30	0.40	36.26	6.30	0.571	1541.270
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	0.84	11.26	4.89	B	1341.55	2012.33	236.26	7.04	2.63	236.29	7.05	0.746	2358.337
Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	0.42	5.72	0.73	A	383.56	575.35	42.12	4.39	0.47	42.13	4.39	0.755	2455.620
Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	0.60	4.61	1.47	A	965.33	1448.00	90.35	3.74	1.00	90.35	3.74	0.747	2435.697
Erb St./Platinum Dr	East - Erb St. W	0.45	3.09	0.80	A	783.65	1175.47	53.94	2.75	0.60	53.94	2.75	0.723	2436.345
Erb St./Platinum Dr	North - Platinum Dr	0.61	5.34	1.53	A	868.98	1303.48	90.69	4.17	1.01	90.70	4.18	0.723	2436.345
Erb St./Platinum Dr	West - Erb St.	0.20	2.83	0.25	A	267.94	401.92	17.26	2.58	0.19	17.26	2.58	0.723	2436.345
Erb St./Platinum Dr	South - Landfill Gate 2	0.12	6.91	0.14	A	61.48	92.22	9.11	5.93	0.10	9.12	5.93	0.579	1357.445
Ira Needles Blvd/Erb St.	East - Erb St. W	0.77	12.05	3.31	B	846.96	1270.44	150.91	7.13	1.68	150.92	7.13	0.781	2703.168
Ira Needles Blvd/Erb St.	North - Erbsville Rd	0.90	20.86	7.88	C	1199.33	1798.99	302.98	10.11	3.37	303.00	10.11	0.770	2683.164
Ira Needles Blvd/Erb St.	West - Erb St.	0.94	42.17	10.94	E	827.69	1241.53	334.54	16.17	3.72	334.56	16.17	0.743	2471.717
Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	0.85	14.58	5.37	B	1151.60	1727.41	232.59	8.08	2.58	232.61	8.08	0.762	2623.737
Erbsville/Keats Way	East - Keats Way	0.29	7.21	0.41	A	172.51	258.77	26.33	6.11	0.29	26.33	6.11	0.579	1357.445
Erbsville/Keats Way	North - Erbsville Road	0.67	5.72	2.01	A	1063.52	1595.28	118.35	4.45	1.32	118.37	4.45	0.723	2436.345
Erbsville/Keats Way	West - Keats Way	0.54	18.26	1.13	C	189.03	283.54	56.34	11.92	0.63	56.35	11.92	0.579	1357.445
Erbsville/Keats Way	South - Erbsville Road	0.46	3.62	0.86	A	714.82	1072.24	56.36	3.15	0.63	56.36	3.15	0.723	2436.345
Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	0.72	12.13	2.51	B	634.07	951.11	138.07	8.71	1.53	138.09	8.71	0.579	1357.445
Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	0.38	7.04	0.61	A	261.52	392.28	38.68	5.92	0.43	38.68	5.92	0.579	1357.445
Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	0.35	5.57	0.54	A	293.64	440.45	36.16	4.93	0.40	36.16	4.93	0.579	1357.445
Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	0.32	5.10	0.46	A	271.61	407.42	31.26	4.60	0.35	31.26	4.60	0.579	1357.445

Fischer Hallman Road/Laurelwood Drive	East - Laurelwood Drive	0.48	10.08	0.93	B	278.96	418.43	54.69	7.84	0.61	54.70	7.84	0.579	1357.445
Fischer Hallman Road/Laurelwood Drive	North - Bearinger Road	0.78	10.71	3.46	B	991.94	1487.92	166.83	6.73	1.85	166.85	6.73	0.723	2436.345
Fischer Hallman Road/Laurelwood Drive	West - Laurelwood Drive	0.68	19.76	2.06	C	322.08	483.13	99.88	12.40	1.11	99.90	12.41	0.579	1357.445
Fischer Hallman Road/Laurelwood Drive	South - Fischer Hallman Road	0.42	3.41	0.73	A	643.25	964.87	48.48	3.01	0.54	48.49	3.02	0.723	2436.345
Bearinger Road/Westmount Road	East - Bearinger Road	0.46	4.96	0.83	A	507.44	761.16	50.44	3.98	0.56	50.45	3.98	0.723	2436.345
Bearinger Road/Westmount Road	North - Westmount Road	0.95	36.92	14.41	E	1242.45	1863.68	464.47	14.95	5.16	464.50	14.95	0.723	2436.345
Bearinger Road/Westmount Road	West - Bearinger Road	0.49	4.51	0.94	A	631.32	946.98	58.87	3.73	0.65	58.87	3.73	0.723	2436.345
Bearinger Road/Westmount Road	South - Westmount Road	0.32	3.46	0.47	A	404.67	607.00	30.88	3.05	0.34	30.88	3.05	0.723	2436.345
Conservation Drive/Beaver Creek Road	East - Conservation Drive	0.51	6.86	1.01	A	446.88	670.32	65.65	5.88	0.73	65.65	5.88	0.579	1357.445
Conservation Drive/Beaver Creek Road	North - Beaver Creek Road	0.15	4.83	0.17	A	106.44	159.67	11.90	4.47	0.13	11.90	4.47	0.579	1357.445
Conservation Drive/Beaver Creek Road	West - Conservation Drive	0.26	5.04	0.35	A	208.30	312.45	24.05	4.62	0.27	24.05	4.62	0.579	1357.445
Conservation Drive/Beaver Creek Road	South - Beaver Creek Road	0.27	5.10	0.37	A	215.64	323.46	25.06	4.65	0.28	25.06	4.65	0.579	1357.445

Main Results

Main results: (4:00 PM-4:15 PM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)
Ira Needles Blvd/University Avenue	East - University Ave	512.69	128.17	510.46	250.15	661.85	9.79	1424.49	614.04	0.360	0.00	0.56
Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	792.75	198.19	787.25	542.69	629.62	3.76	1359.85	1116.65	0.583	0.00	1.37
Ira Needles Blvd/University Avenue	West - Private Access	293.61	73.40	292.54	389.01	1027.87	5.27	1385.66	544.24	0.212	0.00	0.27
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	614.33	153.58	611.59	1020.00	300.41	6.78	1506.65	1391.85	0.408	0.00	0.68
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	188.97	47.24	187.95	173.99	835.15	0.00	931.82	349.77	0.203	0.00	0.25
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	1100.67	275.17	1095.70	861.20	161.90	0.00	1977.48	1864.61	0.557	0.00	1.24

Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	314.69	78.67	313.58	169.46	1088.15	0.00	1436.65	908.52	0.219	0.00	0.28
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	792.00	198.00	789.41	1181.99	219.73	0.00	2008.49	1787.52	0.394	0.00	0.65
Erb St./Platinum Dr	**East - Erb St. W**	642.94	160.73	641.21	748.05	54.04	0.00	2123.54	1954.43	0.303	0.00	0.43
Erb St./Platinum Dr	**North - Platinum Dr**	712.95	178.24	710.47	233.50	461.75	0.00	1857.80	1246.01	0.384	0.00	0.62
Erb St./Platinum Dr	**West - Erb St.**	219.83	54.96	219.27	603.52	568.70	0.00	1766.68	1465.39	0.124	0.00	0.14
Erb St./Platinum Dr	**South - Landfill Gate 2**	50.44	12.61	50.16	36.03	751.93	19.57	769.87	0.00	0.066	0.00	0.07
Ira Needles Blvd/Erb St.	**East - Erb St. W**	694.88	173.72	692.01	591.13	1055.18	0.00	1655.18	1167.74	0.420	0.00	0.72
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	983.98	246.00	979.47	990.00	757.19	0.00	1847.47	1483.57	0.533	0.00	1.13
Ira Needles Blvd/Erb St.	**West - Erb St.**	679.07	169.77	675.60	751.12	985.53	0.00	1455.32	990.81	0.467	0.00	0.87
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	944.83	236.21	940.67	955.50	705.64	19.57	1845.17	1617.01	0.512	0.00	1.04
Erbsville/Keats Way	**East - Keats Way**	141.54	35.38	140.74	201.55	546.21	9.79	847.90	277.03	0.167	0.00	0.20
Erbsville/Keats Way	**North - Erbsville Road**	872.56	218.14	869.33	555.85	131.09	3.76	1946.49	1830.56	0.448	0.00	0.81
Erbsville/Keats Way	**West - Keats Way**	155.09	38.77	153.86	103.45	896.97	5.27	656.74	149.93	0.236	0.00	0.31
Erbsville/Keats Way	**South - Erbsville Road**	586.47	146.62	584.72	887.80	163.04	6.78	1916.81	1816.87	0.306	0.00	0.44
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	520.22	130.05	516.74	279.46	184.35	0.00	1110.61	818.22	0.468	0.00	0.87
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	214.56	53.64	213.40	196.16	504.92	6.02	949.89	724.98	0.226	0.00	0.29
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	240.91	60.23	239.76	475.11	243.22	0.00	1072.57	794.97	0.225	0.00	0.29
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	222.84	55.71	221.82	241.00	241.98	5.27	1092.26	795.98	0.204	0.00	0.25
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	228.87	57.22	227.37	152.10	581.13	9.79	835.29	231.94	0.274	0.00	0.37
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	813.83	203.46	810.35	469.13	339.37	3.76	1741.03	1212.31	0.467	0.00	0.87
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	264.25	66.06	262.13	443.04	706.68	5.27	757.60	575.09	0.349	0.00	0.53
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	527.75	131.94	526.21	761.80	207.01	6.78	1895.66	1713.70	0.278	0.00	0.38
Bearinger Road/Westmount Road	**East - Bearinger Road**	416.33	104.08	414.91	239.31	641.66	9.79	1584.84	527.60	0.263	0.00	0.35
Bearinger Road/Westmount Road	**North - Westmount Road**	1019.36	254.84	1013.94	743.70	312.87	3.76	1762.13	1586.93	0.578	0.00	1.36
Bearinger Road/Westmount Road	**West - Bearinger Road**	517.96	129.49	516.24	839.19	487.62	5.27	1714.80	1532.18	0.302	0.00	0.43
Bearinger Road/Westmount Road	**South - Westmount Road**	332.01	83.00	331.03	453.93	549.93	6.78	1687.95	1033.66	0.197	0.00	0.24
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	366.64	91.66	364.62	272.76	89.92	9.79	1085.97	987.68	0.338	0.00	0.51
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	87.33	21.83	86.93	122.83	331.70	9.79	958.90	621.79	0.091	0.00	0.10
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	170.90	42.72	170.10	208.18	210.46	5.27	1022.23	598.31	0.167	0.00	0.20
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	176.92	44.23	176.09	193.97	186.59	6.78	1028.53	467.11	0.172	0.00	0.21

Main results: (4:15 PM-4:30 PM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)
Ira Needles Blvd/University Avenue	East - University Ave	612.20	153.05	610.85	298.94	792.44	11.69	1287.65	614.69	0.475	0.56	0.90
Ira Needles Blvd/University Avenue	North - Ira Needles Blvd	946.62	236.66	941.29	649.65	753.64	4.49	1281.69	1116.25	0.739	1.37	2.71
Ira Needles Blvd/University Avenue	West - Private Access	350.60	87.65	349.43	465.71	1229.23	6.29	970.92	544.25	0.361	0.27	0.56
Ira Needles Blvd/University Avenue	South - Ira Needles Blvd	733.57	183.39	732.40	1219.70	358.97	8.09	1479.40	1390.93	0.496	0.68	0.97
Ira Needles Blvd/Thorndale Dr	East - Thorndale Dr	225.64	56.41	225.21	208.21	999.42	0.00	847.13	349.77	0.266	0.25	0.36
Ira Needles Blvd/Thorndale Dr	North - Ira Needles Blvd	1314.30	328.58	1311.23	1030.76	193.88	0.00	1956.21	1864.61	0.672	1.24	2.01
Ira Needles Blvd/Thorndale Dr	West - Boardwalk Access	375.77	93.94	375.26	202.82	1302.30	0.00	1290.64	908.52	0.291	0.28	0.41
Ira Needles Blvd/Thorndale Dr	South - Ira Needles Blvd	945.73	236.43	944.68	1414.61	262.95	0.00	1979.32	1787.52	0.478	0.65	0.91
Erb St./Platinum Dr	East - Erb St. W	767.73	191.93	767.20	895.25	64.68	0.00	2116.46	1954.43	0.363	0.43	0.57
Erb St./Platinum Dr	North - Platinum Dr	851.33	212.83	850.24	279.39	552.48	0.00	1798.40	1246.01	0.473	0.62	0.89
Erb St./Platinum Dr	West - Erb St.	262.50	65.63	262.34	722.15	680.57	0.00	1694.27	1465.39	0.155	0.14	0.18
Erb St./Platinum Dr	South - Landfill Gate 2	60.23	15.06	60.13	43.12	899.79	23.37	695.92	0.00	0.087	0.07	0.09
Ira Needles Blvd/Erb St.	East - Erb St. W	829.75	207.44	827.82	706.86	1262.07	0.00	1510.78	1168.21	0.549	0.72	1.20
Ira Needles Blvd/Erb St.	North - Erbsville Rd	1174.97	293.74	1171.40	1184.10	905.79	0.00	1744.66	1483.40	0.673	1.13	2.02
Ira Needles Blvd/Erb St.	West - Erb St.	810.88	202.72	807.70	898.48	1178.71	0.00	1288.69	990.83	0.629	0.87	1.66
Ira Needles Blvd/Erb St.	South - Ira Needles Blvd	1128.21	282.05	1125.25	1142.74	843.67	23.37	1750.61	1616.23	0.644	1.04	1.78
Erbsville/Keats Way	East - Keats Way	169.01	42.25	168.72	241.34	653.74	11.69	788.91	277.13	0.214	0.20	0.27
Erbsville/Keats Way	North - Erbsville Road	1041.92	260.48	1040.49	665.37	157.09	4.49	1929.14	1830.31	0.540	0.81	1.16
Erbsville/Keats Way	West - Keats Way	185.19	46.30	184.46	123.89	1073.69	6.29	557.71	150.01	0.332	0.31	0.49
Erbsville/Keats Way	South - Erbsville Road	700.31	175.08	699.72	1062.79	195.36	8.09	1890.16	1816.47	0.371	0.44	0.59
Beaver Creek Rd/Laurelwood Dr	East - Laurelwood Dr.	621.19	155.30	619.46	334.89	220.89	0.00	1088.48	818.29	0.571	0.87	1.30
Beaver Creek Rd/Laurelwood Dr	North - Beaver Creek Rd	256.21	64.05	255.78	235.10	605.25	7.19	897.34	724.79	0.286	0.29	0.40
Beaver Creek Rd/Laurelwood Dr	West - Laurelwood Dr.	287.67	71.92	287.31	569.50	291.54	0.00	1042.24	795.03	0.276	0.29	0.38
Beaver Creek Rd/Laurelwood Dr	South - Beaver Creek Rd	266.10	66.52	265.80	288.87	289.98	6.29	1066.70	795.78	0.249	0.25	0.33
Fischer Hallman Road/Laurelwood Drive	East - Laurelwood Drive	273.29	68.32	272.63	182.10	695.67	11.69	775.11	232.04	0.353	0.37	0.54
Fischer Hallman Road/Laurelwood Drive	North - Bearinger Road	971.80	242.95	969.68	561.75	406.56	4.49	1656.58	1212.27	0.587	0.87	1.40
Fischer Hallman Road/Laurelwood Drive	West - Laurelwood Drive	315.54	78.89	314.24	530.37	845.87	6.29	678.11	574.97	0.465	0.53	0.85

Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	630.18	157.55	629.69	912.03	248.08	8.09	1867.05	1713.42	0.338	0.38	0.51
Bearinger Road/Westmount Road	**East - Bearinger Road**	497.14	124.28	496.55	286.36	767.90	11.69	1482.39	527.64	0.335	0.35	0.50
Bearinger Road/Westmount Road	**North - Westmount Road**	1217.22	304.30	1212.50	890.01	374.43	4.49	1683.64	1586.77	0.723	1.36	2.53
Bearinger Road/Westmount Road	**West - Bearinger Road**	618.50	154.62	617.83	1003.76	583.17	6.29	1648.17	1532.01	0.375	0.43	0.60
Bearinger Road/Westmount Road	**South - Westmount Road**	396.45	99.11	396.14	542.88	658.12	8.09	1619.87	1033.65	0.245	0.24	0.32
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	437.80	109.45	437.11	326.87	107.76	11.69	1075.62	987.10	0.407	0.51	0.68
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	104.28	26.07	104.17	147.23	397.64	11.69	922.84	621.83	0.113	0.10	0.13
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	204.07	51.02	203.84	249.55	252.26	6.29	998.33	598.32	0.204	0.20	0.26
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	211.26	52.82	211.03	232.50	223.61	8.09	1002.48	467.01	0.211	0.21	0.27

Main results: (4:30 PM-4:45 PM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)
Ira Needles Blvd/University Avenue	**East - University Ave**	749.79	187.45	744.97	354.27	967.20	14.31	1094.40	615.57	0.685	0.90	2.10
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	1159.37	289.84	1110.87	792.13	920.05	5.51	1176.40	1115.71	0.986	2.71	14.83
Ira Needles Blvd/University Avenue	**West - Private Access**	429.40	107.35	415.58	568.89	1462.04	7.71	516.54	544.29	0.831	0.56	4.01
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	898.43	224.61	895.80	1451.95	425.67	9.91	1438.77	1389.66	0.624	0.97	1.63
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	276.36	69.09	275.40	254.37	1222.96	0.00	731.88	349.77	0.378	0.36	0.60
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	1609.69	402.42	1598.80	1261.19	237.17	0.00	1927.42	1864.61	0.835	2.01	4.73
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	460.23	115.06	458.99	247.77	1588.20	0.00	1095.70	908.52	0.420	0.41	0.72
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	1158.27	289.57	1156.05	1725.92	321.28	0.00	1939.94	1787.52	0.597	0.91	1.46
Erb St./Platinum Dr	**East - Erb St. W**	940.28	235.07	939.34	1095.45	79.19	0.00	2106.80	1954.43	0.446	0.57	0.80
Erb St./Platinum Dr	**North - Platinum Dr**	1042.67	260.67	1040.14	342.07	676.45	0.00	1717.25	1246.01	0.607	0.89	1.52
Erb St./Platinum Dr	**West - Erb St.**	321.50	80.37	321.22	883.98	832.61	0.00	1595.83	1465.39	0.201	0.18	0.25
Erb St./Platinum Dr	**South - Landfill Gate 2**	73.77	18.44	73.58	52.78	1101.05	28.63	595.54	0.00	0.124	0.09	0.14
Ira Needles Blvd/Erb St.	**East - Erb St. W**	1016.24	254.06	1008.51	850.74	1529.33	0.00	1324.24	1168.85	0.767	1.20	3.13
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	1439.04	359.76	1418.48	1434.69	1103.15	0.00	1608.12	1483.16	0.895	2.02	7.16
Ira Needles Blvd/Erb St.	**West - Erb St.**	993.12	248.28	965.35	1092.84	1428.79	0.00	1070.93	990.85	0.927	1.66	8.60
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	1381.77	345.44	1368.99	1383.08	1011.07	28.63	1635.99	1615.15	0.845	1.78	4.98
Erbsville/Keats Way	**East - Keats Way**	206.99	51.75	206.44	294.78	799.89	14.31	707.44	277.28	0.293	0.27	0.41
Erbsville/Keats Way	**North - Erbsville Road**	1276.08	319.02	1272.77	814.09	192.23	5.51	1905.16	1829.96	0.670	1.16	1.99
Erbsville/Keats Way	**West - Keats Way**	226.81	56.70	224.38	151.60	1313.40	7.71	425.43	150.11	0.533	0.49	1.10
Erbsville/Keats Way	**South - Erbsville Road**	857.69	214.42	856.61	1299.73	238.05	9.91	1851.99	1815.92	0.463	0.59	0.86

Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	760.80	190.20	756.20	409.90	270.41	0.00	1057.15	818.39	0.720	1.30	2.46
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	313.79	78.45	312.96	287.47	739.14	8.81	827.27	724.53	0.379	0.40	0.60
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	352.32	88.08	351.68	695.75	356.35	0.00	999.44	795.13	0.353	0.38	0.54
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	325.90	81.48	325.39	353.11	354.92	7.71	1032.16	795.49	0.316	0.33	0.46
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	334.71	83.68	333.20	222.25	850.43	14.31	693.13	232.19	0.483	0.54	0.91
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	1190.20	297.55	1182.38	686.36	497.28	5.51	1527.77	1212.20	0.779	1.40	3.36
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	386.46	96.61	381.99	647.92	1031.73	7.71	571.10	574.81	0.677	0.85	1.97
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	771.82	192.95	770.94	1111.99	301.74	9.91	1828.26	1713.03	0.422	0.51	0.73
Bearinger Road/Westmount Road	**East - Bearinger Road**	608.86	152.22	607.55	349.44	939.96	14.31	1336.00	527.70	0.456	0.50	0.83
Bearinger Road/Westmount Road	**North - Westmount Road**	1490.78	372.70	1454.01	1089.37	458.14	5.51	1568.37	1586.55	0.951	2.53	11.73
Bearinger Road/Westmount Road	**West - Bearinger Road**	757.50	189.38	756.17	1210.96	701.19	7.71	1563.47	1531.77	0.485	0.60	0.93
Bearinger Road/Westmount Road	**South - Westmount Road**	485.55	121.39	484.99	652.94	804.41	9.91	1527.40	1033.63	0.318	0.32	0.46
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	536.20	134.05	534.89	400.18	131.92	14.31	1061.19	986.28	0.505	0.68	1.01
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	127.72	31.93	127.54	180.20	486.61	14.31	873.05	621.89	0.146	0.13	0.17
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	249.93	62.48	249.56	305.40	308.75	7.71	964.80	598.34	0.259	0.26	0.35
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	258.74	64.69	258.35	284.56	273.76	9.91	964.17	466.88	0.268	0.27	0.36

Main results: (4:45 PM-5:00 PM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)
Ira Needles Blvd/University Avenue	**East - University Ave**	749.79	187.45	749.57	359.59	970.27	14.31	1090.49	615.57	0.688	2.10	2.16
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	1159.37	289.84	1137.41	795.19	924.65	5.51	1173.56	1115.71	0.988	14.83	20.32
Ira Needles Blvd/University Avenue	**West - Private Access**	429.40	107.35	418.68	571.32	1490.74	7.71	469.94	544.29	0.914	4.01	6.69
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	898.43	224.61	898.34	1477.91	431.51	9.91	1435.32	1389.66	0.626	1.63	1.65
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	276.36	69.09	276.33	255.39	1225.38	0.00	730.63	349.77	0.378	0.60	0.60
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	1609.69	402.42	1609.05	1263.91	237.81	0.00	1926.99	1864.61	0.835	4.73	4.89
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	460.23	115.06	460.19	248.78	1598.07	0.00	1088.97	908.52	0.423	0.72	0.73
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	1158.27	289.57	1158.23	1735.73	322.54	0.00	1939.09	1787.52	0.597	1.46	1.47
Erb St./Platinum Dr	**East - Erb St. W**	940.28	235.07	940.27	1097.68	79.27	0.00	2106.75	1954.43	0.446	0.80	0.80
Erb St./Platinum Dr	**North - Platinum Dr**	1042.67	260.67	1042.62	342.42	677.12	0.00	1716.80	1246.01	0.607	1.52	1.53

Erb St./Platinum Dr	**West - Erb St.**	321.50	80.37	321.50	885.20	834.54	0.00	1594.58	1465.39	0.202	0.25	0.25
Erb St./Platinum Dr	**South - Landfill Gate 2**	73.77	18.44	73.77	52.85	1103.18	28.63	594.48	0.00	0.124	0.14	0.14
Ira Needles Blvd/Erb St.	**East - Erb St. W**	1016.24	254.06	1015.55	863.61	1545.56	0.00	1312.91	1168.85	0.774	3.13	3.31
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	1439.04	359.76	1436.14	1449.95	1111.17	0.00	1602.58	1483.16	0.898	7.16	7.88
Ira Needles Blvd/Erb St.	**West - Erb St.**	993.12	248.28	983.75	1102.04	1445.25	0.00	1056.32	990.85	0.940	8.60	10.94
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	1381.77	345.44	1380.21	1400.05	1028.96	28.63	1623.90	1615.15	0.851	4.98	5.37
Erbsville/Keats Way	**East - Keats Way**	206.99	51.75	206.98	296.12	801.49	14.31	706.54	277.28	0.293	0.41	0.41
Erbsville/Keats Way	**North - Erbsville Road**	1276.08	319.02	1276.01	815.80	192.67	5.51	1904.86	1829.96	0.670	1.99	2.01
Erbsville/Keats Way	**West - Keats Way**	226.81	56.70	226.69	151.93	1316.74	7.71	423.57	150.11	0.535	1.10	1.13
Erbsville/Keats Way	**South - Erbsville Road**	857.69	214.42	857.68	1303.50	239.93	9.91	1850.51	1815.92	0.463	0.86	0.86
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	760.80	190.20	760.58	410.67	270.84	0.00	1056.80	818.39	0.720	2.46	2.51
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	313.79	78.45	313.77	288.43	743.00	8.81	825.26	724.53	0.380	0.60	0.61
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	352.32	88.08	352.31	699.00	357.77	0.00	998.48	795.13	0.353	0.54	0.54
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	325.90	81.48	325.89	354.47	355.61	7.71	1031.80	795.49	0.316	0.46	0.46
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	334.71	83.68	334.66	223.43	853.11	14.31	691.68	232.19	0.484	0.91	0.93
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	1190.20	297.55	1189.80	689.06	498.72	5.51	1525.01	1212.20	0.780	3.36	3.46
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	386.46	96.61	386.11	650.58	1037.94	7.71	567.46	574.81	0.681	1.97	2.06
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	771.82	192.95	771.80	1119.31	304.74	9.91	1826.24	1713.03	0.423	0.73	0.73
Bearinger Road/Westmount Road	**East - Bearinger Road**	608.86	152.22	608.84	350.83	941.33	14.31	1334.78	527.70	0.456	0.83	0.83
Bearinger Road/Westmount Road	**North - Westmount Road**	1490.78	372.70	1480.05	1091.07	459.11	5.51	1561.96	1586.55	0.954	11.73	14.41
Bearinger Road/Westmount Road	**West - Bearinger Road**	757.50	189.38	757.45	1226.88	712.27	7.71	1555.44	1531.77	0.487	0.93	0.94
Bearinger Road/Westmount Road	**South - Westmount Road**	485.55	121.39	485.54	663.11	806.62	9.91	1525.98	1033.63	0.318	0.46	0.47
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	536.20	134.05	536.17	400.76	132.12	14.31	1061.07	986.28	0.505	1.01	1.01
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	127.72	31.93	127.72	180.56	487.73	14.31	872.43	621.89	0.146	0.17	0.17
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	249.93	62.48	249.93	306.07	309.37	7.71	964.42	598.34	0.259	0.35	0.35
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	258.74	64.69	258.74	285.15	274.15	9.91	963.86	466.88	0.268	0.36	0.37

Main results: (5:00 PM-5:15 PM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)

Ira Needles Blvd/University Avenue	**East - University Ave**	612.20	153.05	617.11	321.33	800.43	11.69	1278.09	614.69	0.479	2.16	0.93
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	946.62	236.66	1015.86	657.54	760.00	4.49	1277.77	1116.25	0.741	20.32	3.01
Ira Needles Blvd/University Avenue	**West - Private Access**	350.60	87.65	374.31	469.11	1306.75	6.29	817.76	544.25	0.429	6.69	0.76
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	733.57	183.39	736.12	1295.43	385.63	8.09	1463.79	1390.93	0.501	1.65	1.02
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	225.64	56.41	226.59	209.65	1003.03	0.00	845.27	349.77	0.267	0.60	0.37
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	1314.30	328.58	1325.52	1034.79	194.82	0.00	1955.58	1864.61	0.672	4.89	2.09
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	375.77	93.94	377.01	204.25	1316.10	0.00	1281.23	908.52	0.293	0.73	0.42
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	945.73	236.43	947.93	1428.36	264.75	0.00	1978.11	1787.52	0.478	1.47	0.92
Erb St./Platinum Dr	**East - Erb St. W**	767.73	191.93	768.66	898.54	64.81	0.00	2116.37	1954.43	0.363	0.80	0.57
Erb St./Platinum Dr	**North - Platinum Dr**	851.33	212.83	853.85	279.92	553.55	0.00	1797.70	1246.01	0.474	1.53	0.91
Erb St./Platinum Dr	**West - Erb St.**	262.50	65.63	262.77	724.01	683.38	0.00	1692.45	1465.39	0.155	0.25	0.18
Erb St./Platinum Dr	**South - Landfill Gate 2**	60.23	15.06	60.41	43.22	902.94	23.37	694.36	0.00	0.087	0.14	0.10
Ira Needles Blvd/Erb St.	**East - Erb St. W**	829.75	207.44	837.89	731.90	1290.62	0.00	1490.85	1168.21	0.557	3.31	1.27
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	1174.97	293.74	1197.95	1211.14	917.37	0.00	1736.65	1483.40	0.677	7.88	2.14
Ira Needles Blvd/Erb St.	**West - Erb St.**	810.88	202.72	847.35	911.99	1203.33	0.00	1266.34	990.83	0.640	10.94	1.83
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	1128.21	282.05	1141.99	1170.17	880.52	23.37	1725.67	1616.23	0.654	5.37	1.92
Erbsville/Keats Way	**East - Keats Way**	169.01	42.25	169.55	243.24	656.12	11.69	787.60	277.13	0.215	0.41	0.28
Erbsville/Keats Way	**North - Erbsville Road**	1041.92	260.48	1045.21	667.91	157.76	4.49	1928.70	1830.31	0.540	2.01	1.19
Erbsville/Keats Way	**West - Keats Way**	185.19	46.30	187.66	124.39	1078.58	6.29	554.91	150.01	0.334	1.13	0.51
Erbsville/Keats Way	**South - Erbsville Road**	700.31	175.08	701.38	1068.27	197.98	8.09	1888.21	1816.47	0.371	0.86	0.59
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	621.19	155.30	625.81	336.08	221.58	0.00	1087.99	818.29	0.571	2.51	1.36
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	256.21	64.05	257.03	236.53	610.86	7.19	894.41	724.79	0.286	0.61	0.40
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	287.67	71.92	288.30	574.25	293.65	0.00	1040.89	795.03	0.276	0.54	0.38
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	266.10	66.52	266.60	290.89	291.06	6.29	1066.13	795.78	0.250	0.46	0.33
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	273.29	68.32	274.78	183.79	699.64	11.69	772.99	232.04	0.354	0.93	0.55
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	971.80	242.95	979.84	565.71	408.71	4.49	1653.16	1212.27	0.588	3.46	1.45
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	315.54	78.89	320.17	534.12	854.42	6.29	673.11	574.97	0.469	2.06	0.90
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	630.18	157.55	631.05	922.22	252.38	8.09	1864.23	1713.42	0.338	0.73	0.51
Bearinger Road/Westmount Road	**East - Bearinger Road**	497.14	124.28	498.44	288.90	770.02	11.69	1480.61	527.64	0.336	0.83	0.51
Bearinger Road/Westmount Road	**North - Westmount Road**	1217.22	304.30	1263.83	892.61	375.85	4.49	1673.67	1586.77	0.727	14.41	2.76
Bearinger Road/Westmount Road	**West - Bearinger Road**	618.50	154.62	619.82	1034.76	604.92	6.29	1632.86	1532.01	0.379	0.94	0.61

Bearinger Road/Westmount Road	**South - Westmount Road**	396.45	99.11	397.01	562.82	661.92	8.09	1617.45	1033.65	0.245	0.47	0.33
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	437.80	109.45	439.08	327.81	108.07	11.69	1075.44	987.10	0.407	1.01	0.69
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	104.28	26.07	104.45	147.79	399.37	11.69	921.90	621.83	0.113	0.17	0.13
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	204.07	51.02	204.43	250.58	253.23	6.29	997.77	598.32	0.205	0.35	0.26
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	211.26	52.82	211.65	233.43	224.23	8.09	1002.03	467.01	0.211	0.37	0.27

Main results: (5:15 PM-5:30 PM)

Roundabout	Arm	Demand (Veh/hr)	Arrivals (Veh)	Entry Flow (Veh/hr)	Exit Flow (Veh/hr)	Circulating Flow (Veh/hr)	Pedestrian Demand (Ped/hr)	Capacity (Veh/hr)	Saturation Capacity (Veh/hr)	RFC	Start Queue (Veh)	End Queue (Veh)
Ira Needles Blvd/University Avenue	**East - University Ave**	512.69	128.17	514.13	253.27	666.39	9.79	1419.84	614.04	0.361	0.93	0.57
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	792.75	198.19	799.09	546.51	634.01	3.76	1357.10	1116.65	0.584	3.01	1.43
Ira Needles Blvd/University Avenue	**West - Private Access**	293.61	73.40	295.55	391.67	1041.44	5.27	1358.76	544.23	0.216	0.76	0.28
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	614.33	153.58	615.61	1032.94	304.05	6.78	1506.65	1391.86	0.408	1.02	0.69
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	188.97	47.24	189.41	175.03	839.10	0.00	929.78	349.77	0.203	0.37	0.26
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	1100.67	275.17	1103.94	865.59	162.92	0.00	1976.80	1864.61	0.557	2.09	1.27
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	314.69	78.67	315.23	170.52	1096.36	0.00	1431.06	908.52	0.220	0.42	0.28
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	792.00	198.00	793.07	1190.53	221.06	0.00	2007.60	1787.52	0.395	0.92	0.66
Erb St./Platinum Dr	**East - Erb St. W**	642.94	160.73	643.48	751.65	54.26	0.00	2123.39	1954.43	0.303	0.57	0.44
Erb St./Platinum Dr	**North - Platinum Dr**	712.95	178.24	714.07	234.34	463.40	0.00	1856.72	1246.01	0.384	0.91	0.63
Erb St./Platinum Dr	**West - Erb St.**	219.83	54.96	220.00	605.93	571.54	0.00	1764.84	1465.39	0.125	0.18	0.14
Erb St./Platinum Dr	**South - Landfill Gate 2**	50.44	12.61	50.54	36.17	755.37	19.57	768.17	0.00	0.066	0.10	0.07
Ira Needles Blvd/Erb St.	**East - Erb St. W**	694.88	173.72	697.03	596.82	1064.32	0.00	1648.80	1167.74	0.421	1.27	0.73
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	983.98	246.00	987.91	998.53	762.83	0.00	1843.56	1483.57	0.534	2.14	1.16
Ira Needles Blvd/Erb St.	**West - Erb St.**	679.07	169.77	682.81	756.93	993.81	0.00	1448.22	990.81	0.469	1.83	0.89
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	944.83	236.21	948.26	963.74	712.87	19.57	1840.27	1617.01	0.513	1.92	1.06
Erbsville/Keats Way	**East - Keats Way**	141.54	35.38	141.83	203.03	548.82	9.79	846.48	277.03	0.167	0.28	0.20
Erbsville/Keats Way	**North - Erbsville Road**	872.56	218.14	874.03	558.66	131.99	3.76	1945.91	1830.56	0.448	1.19	0.82
Erbsville/Keats Way	**West - Keats Way**	155.09	38.77	155.87	104.06	901.95	5.27	653.93	149.93	0.237	0.51	0.31
Erbsville/Keats Way	**South - Erbsville Road**	586.47	146.62	587.07	893.04	164.78	6.78	1915.54	1816.87	0.306	0.59	0.44
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	520.22	130.05	522.07	281.26	185.46	0.00	1109.92	818.22	0.469	1.36	0.89
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	214.56	53.64	215.00	197.70	509.83	6.02	947.33	724.98	0.226	0.40	0.29
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	240.91	60.23	241.28	479.50	245.34	0.00	1071.26	794.97	0.225	0.38	0.29
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	222.84	55.71	223.15	243.05	243.57	5.27	1091.43	795.98	0.204	0.33	0.26

Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	228.87	57.22	229.55	153.25	584.56	9.79	833.49	231.94	0.275	0.55	0.38
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	813.83	203.46	816.07	472.37	341.75	3.76	1738.32	1212.31	0.468	1.45	0.89
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	264.25	66.06	265.67	445.90	711.91	5.27	754.59	575.09	0.350	0.90	0.55
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	527.75	131.94	528.25	768.03	209.56	6.78	1894.00	1713.70	0.279	0.51	0.39
Bearinger Road/Westmount Road	**East - Bearinger Road**	416.33	104.08	416.93	240.61	644.46	9.79	1582.62	527.60	0.263	0.51	0.36
Bearinger Road/Westmount Road	**North - Westmount Road**	1019.36	254.84	1024.81	746.99	314.39	3.76	1759.51	1586.93	0.579	2.76	1.39
Bearinger Road/Westmount Road	**West - Bearinger Road**	517.96	129.49	518.67	846.73	492.48	5.27	1711.47	1532.18	0.303	0.61	0.44
Bearinger Road/Westmount Road	**South - Westmount Road**	332.01	83.00	332.33	458.41	552.74	6.78	1686.19	1033.66	0.197	0.33	0.25
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	366.64	91.66	367.36	274.40	90.46	9.79	1085.68	987.68	0.338	0.69	0.51
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	87.33	21.83	87.44	123.68	334.15	9.79	957.61	621.79	0.091	0.13	0.10
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	170.90	42.72	171.12	209.67	211.91	5.27	1021.43	598.31	0.167	0.26	0.20
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	176.92	44.23	177.16	195.33	187.71	6.78	1027.79	467.11	0.172	0.27	0.21

Queueing Delay Results

Queueing Delay results: (4:00 PM-4:15 PM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	**East - University Ave**	8.16	0.54	3.929	A	A
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	19.62	1.31	6.230	A	A
Ira Needles Blvd/University Avenue	**West - Private Access**	3.93	0.26	3.290	A	A
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	9.96	0.66	4.010	A	A
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	3.69	0.25	4.834	A	A
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	17.99	1.20	4.060	A	A
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	4.11	0.27	3.202	A	A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	9.50	0.63	2.947	A	A
Erb St./Platinum Dr	**East - Erb St. W**	6.38	0.43	2.427	A	A
Erb St./Platinum Dr	**North - Platinum Dr**	9.08	0.61	3.131	A	A
Erb St./Platinum Dr	**West - Erb St.**	2.10	0.14	2.326	A	A
Erb St./Platinum Dr	**South - Landfill Gate 2**	1.02	0.07	5.002	A	A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	10.48	0.70	3.727	A	A

Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	16.35	1.09	4.126	A	A
Ira Needles Blvd/Erb St.	**West - Erb St.**	12.56	0.84	4.597	A	A
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	15.10	1.01	3.962	A	A
Erbsville/Keats Way	**East - Keats Way**	2.91	0.19	5.086	A	A
Erbsville/Keats Way	**North - Erbsville Road**	11.79	0.79	3.333	A	A
Erbsville/Keats Way	**West - Keats Way**	4.42	0.29	7.141	A	A
Erbsville/Keats Way	**South - Erbsville Road**	6.46	0.43	2.699	A	A
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	12.52	0.83	6.027	A	A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	4.23	0.28	4.888	A	A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	4.21	0.28	4.316	A	A
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	3.73	0.25	4.132	A	A
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	5.43	0.36	5.907	A	A
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	12.68	0.85	3.855	A	A
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	7.61	0.51	7.236	A	A
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	5.66	0.38	2.627	A	A
Bearinger Road/Westmount Road	**East - Bearinger Road**	5.21	0.35	3.072	A	A
Bearinger Road/Westmount Road	**North - Westmount Road**	19.51	1.30	4.778	A	A
Bearinger Road/Westmount Road	**West - Bearinger Road**	6.33	0.42	3.000	A	A
Bearinger Road/Westmount Road	**South - Westmount Road**	3.60	0.24	2.652	A	A
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	7.35	0.49	4.976	A	A
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	1.46	0.10	4.126	A	A
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	2.92	0.19	4.221	A	A
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	3.03	0.20	4.220	A	A

Queueing Delay results: (4:15 PM-4:30 PM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	**East - University Ave**	13.05	0.87	5.308	A	A
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	37.69	2.51	10.414	B	B
Ira Needles Blvd/University Avenue	**West - Private Access**	8.14	0.54	5.782	A	A
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	14.22	0.95	4.811	A	A
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	5.28	0.35	5.785	A	A
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	28.95	1.93	5.555	A	A
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	6.01	0.40	3.931	A	A

Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	13.35	0.89	3.476	A	A
Erb St./Platinum Dr	**East - Erb St. W**	8.38	0.56	2.666	A	A
Erb St./Platinum Dr	**North - Platinum Dr**	13.09	0.87	3.794	A	A
Erb St./Platinum Dr	**West - Erb St.**	2.71	0.18	2.513	A	A
Erb St./Platinum Dr	**South - Landfill Gate 2**	1.39	0.09	5.662	A	A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	17.46	1.16	5.256	A	A
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	28.92	1.93	6.241	A	A
Ira Needles Blvd/Erb St.	**West - Erb St.**	23.70	1.58	7.436	A	A
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	25.64	1.71	5.729	A	A
Erbsville/Keats Way	**East - Keats Way**	3.97	0.26	5.802	A	A
Erbsville/Keats Way	**North - Erbsville Road**	17.02	1.13	4.044	A	A
Erbsville/Keats Way	**West - Keats Way**	7.07	0.47	9.625	A	A
Erbsville/Keats Way	**South - Erbsville Road**	8.65	0.58	3.022	A	A
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	18.80	1.25	7.646	A	A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	5.81	0.39	5.607	A	A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	5.57	0.37	4.766	A	A
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	4.87	0.32	4.494	A	A
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	7.84	0.52	7.156	A	A
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	20.29	1.35	5.225	A	A
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	12.26	0.82	9.858	A	A
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	7.50	0.50	2.907	A	A
Bearinger Road/Westmount Road	**East - Bearinger Road**	7.39	0.49	3.650	A	A
Bearinger Road/Westmount Road	**North - Westmount Road**	35.84	2.39	7.565	A	A
Bearinger Road/Westmount Road	**West - Bearinger Road**	8.80	0.59	3.492	A	A
Bearinger Road/Westmount Road	**South - Westmount Road**	4.78	0.32	2.941	A	A
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	9.94	0.66	5.632	A	A
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	1.87	0.12	4.397	A	A
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	3.77	0.25	4.530	A	A
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	3.91	0.26	4.547	A	A

Queueing Delay results: (4:30 PM-4:45 PM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	**East - University Ave**	29.36	1.96	10.164	B	B

Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	155.46	10.36	39.604	E	D
Ira Needles Blvd/University Avenue	**West - Private Access**	48.75	3.25	32.237	D	C
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	23.44	1.56	6.599	A	A
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	8.67	0.58	7.870	A	A
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	64.00	4.27	10.617	B	B
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	10.43	0.70	5.644	A	A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	21.27	1.42	4.579	A	A
Erb St./Platinum Dr	**East - Erb St. W**	11.80	0.79	3.080	A	A
Erb St./Platinum Dr	**North - Platinum Dr**	22.02	1.47	5.296	A	A
Erb St./Platinum Dr	**West - Erb St.**	3.72	0.25	2.824	A	A
Erb St./Platinum Dr	**South - Landfill Gate 2**	2.05	0.14	6.896	A	A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	42.90	2.86	11.139	B	B
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	89.75	5.98	17.388	C	B
Ira Needles Blvd/Erb St.	**West - Erb St.**	99.36	6.62	28.788	D	C
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	65.94	4.40	12.907	B	B
Erbsville/Keats Way	**East - Keats Way**	5.96	0.40	7.178	A	A
Erbsville/Keats Way	**North - Erbsville Road**	28.62	1.91	5.663	A	A
Erbsville/Keats Way	**West - Keats Way**	15.22	1.01	17.695	C	B
Erbsville/Keats Way	**South - Erbsville Road**	12.57	0.84	3.614	A	A
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	34.16	2.28	11.781	B	B
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	8.78	0.59	6.988	A	A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	7.90	0.53	5.551	A	A
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	6.72	0.45	5.090	A	A
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	13.10	0.87	9.961	A	A
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	46.12	3.07	10.199	B	B
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	26.79	1.79	18.611	C	B
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	10.68	0.71	3.401	A	A
Bearinger Road/Westmount Road	**East - Bearinger Road**	12.09	0.81	4.933	A	A
Bearinger Road/Westmount Road	**North - Westmount Road**	133.53	8.90	25.834	D	C
Bearinger Road/Westmount Road	**West - Bearinger Road**	13.61	0.91	4.452	A	A
Bearinger Road/Westmount Road	**South - Westmount Road**	6.83	0.46	3.451	A	A
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	14.59	0.97	6.824	A	A
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	2.51	0.17	4.827	A	A
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	5.10	0.34	5.031	A	A

Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	5.35	0.36	5.098	A	A

Queueing Delay results: (4:45 PM-5:00 PM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	**East - University Ave**	32.03	2.14	10.543	B	B
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	266.67	17.78	64.312	F	E
Ira Needles Blvd/University Avenue	**West - Private Access**	84.66	5.64	58.501	F	E
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	24.69	1.65	6.701	A	A
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	9.03	0.60	7.924	A	A
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	72.43	4.83	11.262	B	B
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	10.85	0.72	5.725	A	A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	22.05	1.47	4.610	A	A
Erb St./Platinum Dr	**East - Erb St. W**	12.04	0.80	3.085	A	A
Erb St./Platinum Dr	**North - Platinum Dr**	22.96	1.53	5.339	A	A
Erb St./Platinum Dr	**West - Erb St.**	3.78	0.25	2.827	A	A
Erb St./Platinum Dr	**South - Landfill Gate 2**	2.11	0.14	6.912	A	A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	48.67	3.24	12.051	B	B
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	113.88	7.59	20.862	C	C
Ira Needles Blvd/Erb St.	**West - Erb St.**	149.27	9.95	42.169	E	D
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	78.34	5.22	14.580	B	B
Erbsville/Keats Way	**East - Keats Way**	6.16	0.41	7.205	A	A
Erbsville/Keats Way	**North - Erbsville Road**	30.04	2.00	5.722	A	A
Erbsville/Keats Way	**West - Keats Way**	16.73	1.12	18.258	C	B
Erbsville/Keats Way	**South - Erbsville Road**	12.88	0.86	3.625	A	A
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	37.34	2.49	12.128	B	B
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	9.11	0.61	7.037	A	A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	8.12	0.54	5.570	A	A
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	6.88	0.46	5.099	A	A
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	13.83	0.92	10.080	B	B
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	51.27	3.42	10.707	B	B
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	30.36	2.02	19.762	C	B
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	10.92	0.73	3.413	A	A
Bearinger Road/Westmount Road	**East - Bearinger Road**	12.48	0.83	4.958	A	A

Bearinger Road/Westmount Road	**North - Westmount Road**	198.68	13.25	36.921	E	D
Bearinger Road/Westmount Road	**West - Bearinger Road**	14.09	0.94	4.511	A	A
Bearinger Road/Westmount Road	**South - Westmount Road**	6.97	0.46	3.459	A	A
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	15.16	1.01	6.857	A	A
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	2.56	0.17	4.833	A	A
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	5.22	0.35	5.038	A	A
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	5.47	0.36	5.105	A	A

Queueing Delay results: (5:00 PM-5:15 PM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	**East - University Ave**	14.54	0.97	5.485	A	A
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	80.81	5.39	16.747	C	B
Ira Needles Blvd/University Avenue	**West - Private Access**	14.81	0.99	8.547	A	A
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	15.73	1.05	4.964	A	A
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	5.67	0.38	5.827	A	A
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	33.25	2.22	5.811	A	A
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	6.41	0.43	3.988	A	A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	14.18	0.95	3.501	A	A
Erb St./Platinum Dr	**East - Erb St. W**	8.72	0.58	2.672	A	A
Erb St./Platinum Dr	**North - Platinum Dr**	13.97	0.93	3.826	A	A
Erb St./Platinum Dr	**West - Erb St.**	2.80	0.19	2.520	A	A
Erb St./Platinum Dr	**South - Landfill Gate 2**	1.47	0.10	5.681	A	A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	20.11	1.34	5.579	A	A
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	36.17	2.41	6.958	A	A
Ira Needles Blvd/Erb St.	**West - Erb St.**	35.83	2.39	9.324	A	A
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	31.10	2.07	6.309	A	A
Erbsville/Keats Way	**East - Keats Way**	4.24	0.28	5.829	A	A
Erbsville/Keats Way	**North - Erbsville Road**	18.34	1.22	4.091	A	A
Erbsville/Keats Way	**West - Keats Way**	8.04	0.54	9.867	A	A
Erbsville/Keats Way	**South - Erbsville Road**	9.05	0.60	3.037	A	A
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	21.40	1.43	7.866	A	A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	6.24	0.42	5.656	A	A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	5.90	0.39	4.787	A	A

Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	5.12	0.34	4.505	A	A
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	8.61	0.57	7.246	A	A
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	22.81	1.52	5.410	A	A
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	14.39	0.96	10.329	B	B
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	7.83	0.52	2.920	A	A
Bearinger Road/Westmount Road	**East - Bearinger Road**	7.80	0.52	3.672	A	A
Bearinger Road/Westmount Road	**North - Westmount Road**	55.17	3.68	9.746	A	A
Bearinger Road/Westmount Road	**West - Bearinger Road**	9.40	0.63	3.560	A	A
Bearinger Road/Westmount Road	**South - Westmount Road**	4.97	0.33	2.950	A	A
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	10.71	0.71	5.670	A	A
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	1.96	0.13	4.404	A	A
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	3.96	0.26	4.541	A	A
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	4.11	0.27	4.558	A	A

Queueing Delay results: (5:15 PM-5:30 PM)

Roundabout	Arm	Queueing Total Delay (Veh-min)	Queueing Rate Of Delay (Veh-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Ira Needles Blvd/University Avenue	**East - University Ave**	8.74	0.58	3.980	A	A
Ira Needles Blvd/University Avenue	**North - Ira Needles Blvd**	22.52	1.50	6.520	A	A
Ira Needles Blvd/University Avenue	**West - Private Access**	4.25	0.28	3.391	A	A
Ira Needles Blvd/University Avenue	**South - Ira Needles Blvd**	10.65	0.71	4.047	A	A
Ira Needles Blvd/Thorndale Dr	**East - Thorndale Dr**	3.93	0.26	4.866	A	A
Ira Needles Blvd/Thorndale Dr	**North - Ira Needles Blvd**	19.63	1.31	4.141	A	A
Ira Needles Blvd/Thorndale Dr	**West - Boardwalk Access**	4.32	0.29	3.227	A	A
Ira Needles Blvd/Thorndale Dr	**South - Ira Needles Blvd**	10.00	0.67	2.966	A	A
Erb St./Platinum Dr	**East - Erb St. W**	6.63	0.44	2.434	A	A
Erb St./Platinum Dr	**North - Platinum Dr**	9.58	0.64	3.152	A	A
Erb St./Platinum Dr	**West - Erb St.**	2.16	0.14	2.332	A	A
Erb St./Platinum Dr	**South - Landfill Gate 2**	1.08	0.07	5.016	A	A
Ira Needles Blvd/Erb St.	**East - Erb St. W**	11.29	0.75	3.792	A	A
Ira Needles Blvd/Erb St.	**North - Erbsville Rd**	17.90	1.19	4.227	A	A
Ira Needles Blvd/Erb St.	**West - Erb St.**	13.83	0.92	4.725	A	A
Ira Needles Blvd/Erb St.	**South - Ira Needles Blvd**	16.46	1.10	4.050	A	A
Erbsville/Keats Way	**East - Keats Way**	3.09	0.21	5.110	A	A

Erbsville/Keats Way	**North - Erbsville Road**	12.54	0.84	3.365	A	A
Erbsville/Keats Way	**West - Keats Way**	4.86	0.32	7.241	A	A
Erbsville/Keats Way	**South - Erbsville Road**	6.74	0.45	2.712	A	A
Beaver Creek Rd/Laurelwood Dr	**East - Laurelwood Dr.**	13.86	0.92	6.145	A	A
Beaver Creek Rd/Laurelwood Dr	**North - Beaver Creek Rd**	4.52	0.30	4.920	A	A
Beaver Creek Rd/Laurelwood Dr	**West - Laurelwood Dr.**	4.46	0.30	4.340	A	A
Beaver Creek Rd/Laurelwood Dr	**South - Beaver Creek Rd**	3.94	0.26	4.148	A	A
Fischer Hallman Road/Laurelwood Drive	**East - Laurelwood Drive**	5.88	0.39	5.969	A	A
Fischer Hallman Road/Laurelwood Drive	**North - Bearinger Road**	13.67	0.91	3.912	A	A
Fischer Hallman Road/Laurelwood Drive	**West - Laurelwood Drive**	8.48	0.57	7.383	A	A
Fischer Hallman Road/Laurelwood Drive	**South - Fischer Hallman Road**	5.90	0.39	2.636	A	A
Bearinger Road/Westmount Road	**East - Bearinger Road**	5.47	0.36	3.089	A	A
Bearinger Road/Westmount Road	**North - Westmount Road**	21.74	1.45	4.935	A	A
Bearinger Road/Westmount Road	**West - Bearinger Road**	6.65	0.44	3.021	A	A
Bearinger Road/Westmount Road	**South - Westmount Road**	3.74	0.25	2.659	A	A
Conservation Drive/Beaver Creek Road	**East - Conservation Drive**	7.89	0.53	5.018	A	A
Conservation Drive/Beaver Creek Road	**North - Beaver Creek Road**	1.54	0.10	4.138	A	A
Conservation Drive/Beaver Creek Road	**West - Conservation Drive**	3.08	0.21	4.236	A	A
Conservation Drive/Beaver Creek Road	**South - Beaver Creek Road**	3.19	0.21	4.233	A	A

These additional roundabouts were added later to the analysis as new ARCADY files and include planned and recommended-case analysis sets. These sheets are included in both Appendices

File: J:\04 STAFF FOLDERS\Ubaid\Roundabout Analysis Lukezic\Updated Analysis\Future Conditions\New Roundabouts.arc7
Report generation date: 06/06/2018 3:26:42 PM

Summary of roundabout performance

	AM				PM			
	Queue (PCE)	Delay (s)	RFC	LOS	Queue (PCE)	Delay (s)	RFC	LOS
	Planned 2031 Conditions - (Scenario1)							
Columbia Dr Platinum Dr - Columbia St E	1.12	6.64	0.53	A	0.74	5.87	0.43	A
Columbia Dr Platinum Dr - Columbia St W	1.76	8.93	0.64	A	0.41	3.87	0.29	A
Columbia Dr Platinum Dr - Platinum Dr S	0.02	3.49	0.02	A	1.29	7.25	0.57	A
Boardwalk/Erb - Erb St E	1.37	4.58	0.58	A	1.87	5.57	0.65	A
Boardwalk/Erb - Erb St W	0.92	2.86	0.48	A	6.48	11.40	0.87	B
Boardwalk/Erb - The Boardwalk S	0.24	2.60	0.19	A	0.33	3.36	0.25	A
	Planned 2031 With Recommendations - (Scenario1)							

Columbia Dr Platinum Dr - Columbia St E	0.42	2.47	0.29	A	0.30	2.38	0.23	A
Columbia Dr Platinum Dr - Columbia St W	0.50	2.53	0.34	A	0.19	1.80	0.16	A
Columbia Dr Platinum Dr - Platinum Dr S	0.01	1.77	0.01	A	0.43	2.36	0.30	A
Boardwalk/Erb - Erb St E	1.37	4.58	0.58	A	1.87	5.57	0.65	A
Boardwalk/Erb - Erb St W	0.92	2.86	0.48	A	6.48	11.40	0.87	B
Boardwalk/Erb - The Boardwalk S	0.74	8.03	0.43	A	1.77	18.52	0.65	C

Values shown are the maximum values over all time segments. Delay is the maximum value of average delay per arriving vehicle.
(Scenario1) - AM runs from 08:00:00 to 09:30:00
(Scenario1) - PM runs from 16:00:00 to 17:30:00

File summary

File Description

Title	(untitled)
Location	
Site Number	
Date	25/04/2018
Version	
Status	(new file)
Identifier	
Client	
Jobnumber	
Analyst	CORP\ubaidalis
Description	

Analysis Options

RFC Threshold	Vehicle Length (m)	Do Queue Variations
0.85	5.75	

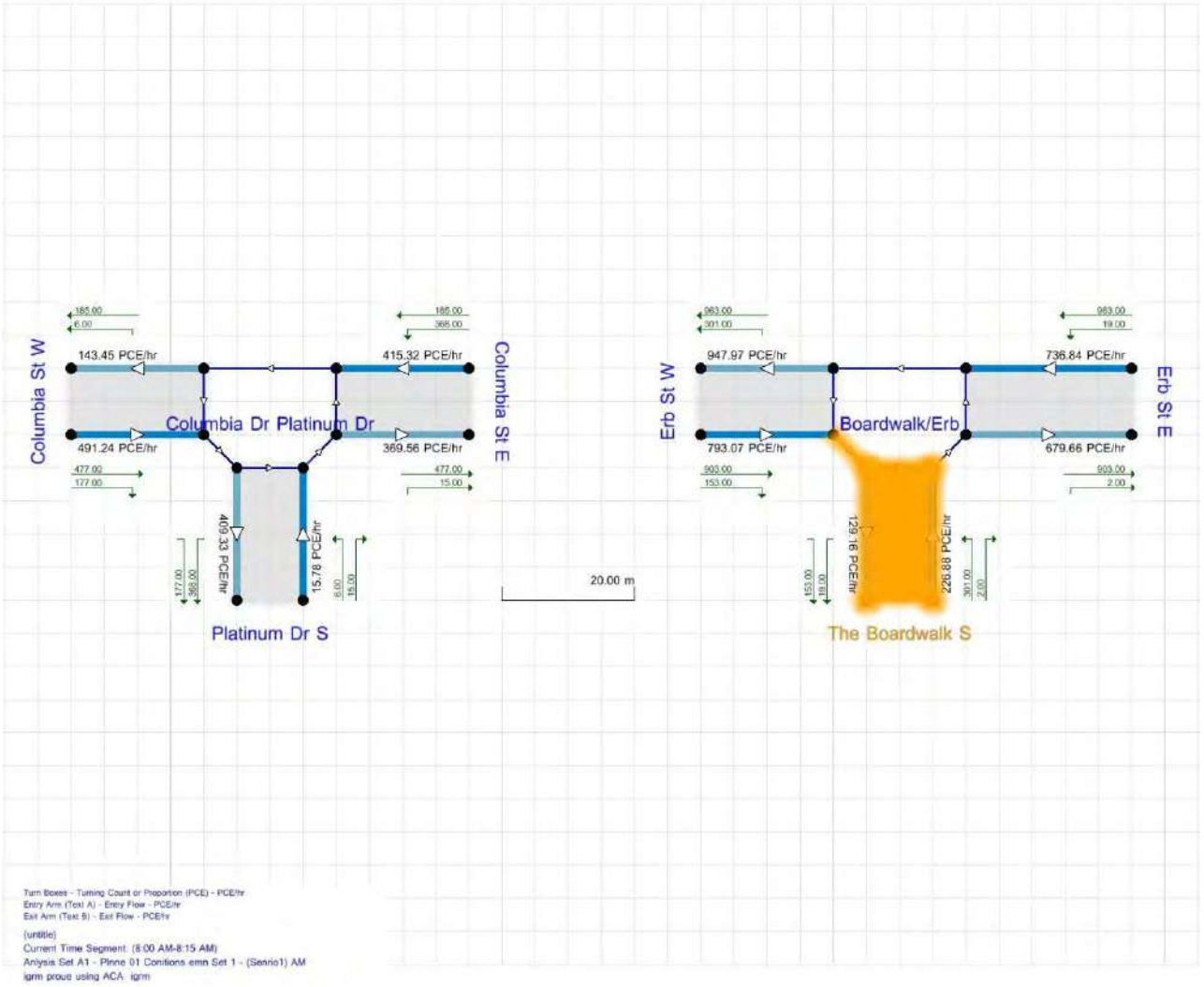
Sorting and Display

Show Arm Names	Arm Grouping	Sorting Direction	Sorting Type	Data Matrix Style	Time Style
Yes	Order	Ascending	Numerical	By Destination	Absolute Time

Units

Distance Units	Speed Units	Traffic Units Input	Traffic Units Results	Flow Units	Average Delay Units	Total Delay Units	Rate Of Delay Units

m	kph	PCE	PCE	perHour	s	-Min	perMin



The intersection diagram reflects the last run of ARCADY.

A1 - Planned 2031 Conditions - D1 - (Scenario1), AM

Data Errors and Warnings

No errors or warnings

Analysis Set Details

Name	Description	Include In Report	Use Specific Demand Set	Demand Set	Locked	Network Flow Scaling Factor (%)	Network Capacity Scaling Factor (%)	Reason For Scaling Factors
Planned 2031 Conditions		Yes		(D1)		100.000	100.000	

Demand Set Details

Name	Scenario Name	Time Period Name	Description	Locked	Run Automatically	Use Relationship	Relationship	Start Time (HH:mm)	Finish Time (HH:mm)	Time Period Length (min)	Time Segment Length (min)	Traffic Profile Type
(Scenario1), AM	(Scenario1)	AM			Yes			08:00	09:30	90	15	ONE HOUR

Roundabout Network

Roundabout Type(s)

Roundabout	ID	Name	Arm Order	Roundabout Type	Grade Separated	Large Roundabout	Do Geometric Delay
1	1	Columbia Dr Platinum Dr	1,2,3	Standard			
2	2	Boardwalk/Erb	1,2,3	Standard			

Roundabout Network Options

Driving Side	Lighting	Road Surface	In London
Right	Normal/unknown	((Mini-roundabouts only))	

Arms

Arms

ID	Name	Description
1	Columbia St E	
2	Columbia St W	
3	Platinum Dr S	
1	Erb St E	
2	Erb St W	
3	The Boardwalk S	

Capacity Options

Roundabout	Arm	Minimum Capacity (PCE/hr)	Maximum Capacity (PCE/hr)	Assume Flat Start Profile	Initial Queue (PCE)
Columbia Dr Platinum Dr	**Columbia St E**	0.00	99999.00		0.00
Columbia Dr Platinum Dr	**Columbia St W**	0.00	99999.00		0.00
Columbia Dr Platinum Dr	**Platinum Dr S**	0.00	99999.00		0.00
Boardwalk/Erb	**Erb St E**	0.00	99999.00		0.00
Boardwalk/Erb	**Erb St W**	0.00	99999.00		0.00
Boardwalk/Erb	**The Boardwalk S**	0.00	99999.00		0.00

Standard Geometry

Roundabout	Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit Only
Columbia Dr Platinum Dr	**Columbia St E**	3.50	4.50	30.00	20.00	40.00	25.00	
Columbia Dr Platinum Dr	**Columbia St W**	3.50	4.50	30.00	20.00	40.00	25.00	
Columbia Dr Platinum Dr	**Platinum Dr S**	3.50	4.50	30.00	20.00	40.00	25.00	
Boardwalk/Erb	**Erb St E**	7.00	8.00	30.00	20.00	55.00	25.00	
Boardwalk/Erb	**Erb St W**	7.00	8.00	30.00	20.00	55.00	25.00	
Boardwalk/Erb	**The Boardwalk S**	7.00	8.00	30.00	20.00	55.00	25.00	

Pedestrian Crossings

Roundabout	Arm	Crossing Type
Columbia Dr Platinum Dr	**Columbia St E**	None
Columbia Dr Platinum Dr	**Columbia St W**	None
Columbia Dr Platinum Dr	**Platinum Dr S**	None
Boardwalk/Erb	**Erb St E**	None

Boardwalk/Erb	**Erb St W**	None
Boardwalk/Erb	**The Boardwalk S**	None

Arm Slope/ Intercept and Capacity

Slope and Intercept used in model

Roundabout	Arm	Enter Directly	Slope	Intercept (PCE/hr)	Final Slope	Final Intercept (PCE/hr)
Columbia Dr Platinum Dr	**Columbia St E**		((calculated))	((calculated))	0.579	1357.445
Columbia Dr Platinum Dr	**Columbia St W**		((calculated))	((calculated))	0.579	1357.445
Columbia Dr Platinum Dr	**Platinum Dr S**		((calculated))	((calculated))	0.579	1357.445
Boardwalk/Erb	**Erb St E**		((calculated))	((calculated))	0.723	2436.345
Boardwalk/Erb	**Erb St W**		((calculated))	((calculated))	0.723	2436.345
Boardwalk/Erb	**The Boardwalk S**		((calculated))	((calculated))	0.723	2436.345

The slope and intercept shown above include any corrections and adjustments.

Arm Capacity Adjustments

Roundabout	Arm	Type	Reason	Direct Capacity Adjustment (PCE/hr)	Percentage Capacity Adjustment (%)
Columbia Dr Platinum Dr	**Columbia St E**	Percentage		N/A	85.00
Columbia Dr Platinum Dr	**Columbia St W**	None	N/A	N/A	N/A
Columbia Dr Platinum Dr	**Platinum Dr S**	None	N/A	N/A	N/A
Boardwalk/Erb	**Erb St E**	Percentage		N/A	85.00
Boardwalk/Erb	**Erb St W**	None	N/A	N/A	N/A
Boardwalk/Erb	**The Boardwalk S**	None	N/A	N/A	N/A

Traffic Flows

Demand Set Data Options

Default Vehicle Mix	Vehicle Mix Varies Over Time	Vehicle Mix Varies Over Turn	Vehicle Mix Varies Over Entry	Vehicle Mix Source	PCE Factor for a Truck (PCE)	Default Turning Proportions	Estimate from entry/exit counts	Turning Proportions Vary Over Time	Turning Proportions Vary Over Turn	Turning Proportions Vary Over Entry
		Yes	Yes	Truck Percentages	2.00				Yes	Yes

Entry Flows

General Flows Data

Roundabout	Arm	Profile Type	Use Turning Counts	Average Demand Flow (PCE/hr)	Flow Scaling Factor (%)	PHF
Columbia Dr Platinum Dr	Columbia St E	ONE HOUR	Yes	553.00	100.000	N/A
Columbia Dr Platinum Dr	Columbia St W	ONE HOUR	Yes	654.00	100.000	N/A
Columbia Dr Platinum Dr	Platinum Dr S	ONE HOUR	Yes	21.00	100.000	N/A
Boardwalk/Erb	Erb St E	ONE HOUR	Yes	982.00	100.000	N/A
Boardwalk/Erb	Erb St W	ONE HOUR	Yes	1056.00	100.000	N/A
Boardwalk/Erb	The Boardwalk S	ONE HOUR	Yes	303.00	100.000	N/A

Direct/Resultant Flows

Direct Flows Data

Time Segment	Roundabout	Arm	Direct Demand Entry Flow (PCE/hr)	DirectDemandEntryFlowInPCE (PCE/hr)	Direct Demand Exit Flow (PCE/hr)	Direct Demand Pedestrian Flow (Ped/hr)
1	Columbia Dr Platinum Dr	Columbia St E	416.33	416.33	N/A	N/A
1	Columbia Dr Platinum Dr	Columbia St W	492.37	492.37	N/A	N/A
1	Columbia Dr Platinum Dr	Platinum Dr S	15.81	15.81	N/A	N/A
1	Boardwalk/Erb	Erb St E	739.30	739.30	N/A	N/A
1	Boardwalk/Erb	Erb St W	795.01	795.01	N/A	N/A
1	Boardwalk/Erb	The Boardwalk S	228.11	228.11	N/A	N/A
2	Columbia Dr Platinum Dr	Columbia St E	497.14	497.14	N/A	N/A
2	Columbia Dr Platinum Dr	Columbia St W	587.93	587.93	N/A	N/A
2	Columbia Dr Platinum Dr	Platinum Dr S	18.88	18.88	N/A	N/A
2	Boardwalk/Erb	Erb St E	882.80	882.80	N/A	N/A
2	Boardwalk/Erb	Erb St W	949.32	949.32	N/A	N/A
2	Boardwalk/Erb	The Boardwalk S	272.39	272.39	N/A	N/A
3	Columbia Dr Platinum Dr	Columbia St E	608.86	608.86	N/A	N/A
3	Columbia Dr Platinum Dr	Columbia St W	720.07	720.07	N/A	N/A
3	Columbia Dr Platinum Dr	Platinum Dr S	23.12	23.12	N/A	N/A
3	Boardwalk/Erb	Erb St E	1081.20	1081.20	N/A	N/A

3	Boardwalk/Erb	Erb St W	1162.68	1162.68	N/A	N/A
3	Boardwalk/Erb	The Boardwalk S	333.61	333.61	N/A	N/A
4	Columbia Dr Platinum Dr	Columbia St E	608.86	608.86	N/A	N/A
4	Columbia Dr Platinum Dr	Columbia St W	720.07	720.07	N/A	N/A
4	Columbia Dr Platinum Dr	Platinum Dr S	23.12	23.12	N/A	N/A
4	Boardwalk/Erb	Erb St E	1081.20	1081.20	N/A	N/A
4	Boardwalk/Erb	Erb St W	1162.68	1162.68	N/A	N/A
4	Boardwalk/Erb	The Boardwalk S	333.61	333.61	N/A	N/A
5	Columbia Dr Platinum Dr	Columbia St E	497.14	497.14	N/A	N/A
5	Columbia Dr Platinum Dr	Columbia St W	587.93	587.93	N/A	N/A
5	Columbia Dr Platinum Dr	Platinum Dr S	18.88	18.88	N/A	N/A
5	Boardwalk/Erb	Erb St E	882.80	882.80	N/A	N/A
5	Boardwalk/Erb	Erb St W	949.32	949.32	N/A	N/A
5	Boardwalk/Erb	The Boardwalk S	272.39	272.39	N/A	N/A
6	Columbia Dr Platinum Dr	Columbia St E	416.33	416.33	N/A	N/A
6	Columbia Dr Platinum Dr	Columbia St W	492.37	492.37	N/A	N/A
6	Columbia Dr Platinum Dr	Platinum Dr S	15.81	15.81	N/A	N/A
6	Boardwalk/Erb	Erb St E	739.30	739.30	N/A	N/A
6	Boardwalk/Erb	Erb St W	795.01	795.01	N/A	N/A
6	Boardwalk/Erb	The Boardwalk S	228.11	228.11	N/A	N/A

Turning Proportions

Turning Counts or Proportions (PCE/hr) - Columbia Dr Platinum Dr (for whole period)

		To		
		1	2	3
From	1	0.000	185.000	368.000
	2	477.000	0.000	177.000
	3	15.000	6.000	0.000

Turning Proportions (PCE) - Columbia Dr Platinum Dr (for whole period)

	To

		1	2	3
From	1	0.00	0.33	0.67
	2	0.73	0.00	0.27
	3	0.71	0.29	0.00

Turning Counts or Proportions (PCE/hr) - Boardwalk/ Erb (for whole period)

		To		
		1	2	3
From	1	0.000	963.000	19.000
	2	903.000	0.000	153.000
	3	2.000	301.000	0.000

Turning Proportions (PCE) - Boardwalk/ Erb (for whole period)

		To		
		1	2	3
From	1	0.00	0.98	0.02
	2	0.86	0.00	0.14
	3	0.01	0.99	0.00

Vehicle Mix

Average PCE Per Vehicle - Columbia Dr Platinum Dr (for whole period)

		To		
		1	2	3
From	1	1.000	1.000	1.000
	2	1.000	1.000	1.000
	3	1.000	1.000	1.000

Truck Percentages - Columbia Dr Platinum Dr (for whole period)

		To		
		1	2	3
From	1	0.000	0.000	0.000

	2	0.000	0.000	0.000
	3	0.000	0.000	0.000

Average PCE Per Vehicle - Boardwalk/ Erb (for whole period)

		To		
		1	2	3
From	1	1.000	1.000	1.000
	2	1.000	1.000	1.000
	3	1.000	1.000	1.000

Truck Percentages - Boardwalk/ Erb (for whole period)

		To		
		1	2	3
From	1	0.000	0.000	0.000
	2	0.000	0.000	0.000
	3	0.000	0.000	0.000

Results

Results Summary

Roundabout	Arm	Max RFC	Max Delay (s)	Max Queue (PCE)	Max LOS	Total Demand (PCE/hr)	Total Arrivals (PCE)	Total Queueing Delay (PCE-min)	Average Queueing Delay (s)	Rate Of Queueing Delay (PCE-min/min)	Inclusive Queueing Total Delay (PCE-min)	Inclusive Queueing Average Delay (s)	Slope	Intercept (PCE/hr)
Columbia Dr Platinum Dr	Columbia St E	0.53	6.64	1.12	A	507.44	761.16	72.52	5.72	0.81	72.53	5.72	0.579	1357.445
Columbia Dr Platinum Dr	Columbia St W	0.64	8.93	1.76	A	600.12	900.18	102.59	6.84	1.14	102.60	6.84	0.579	1357.445
Columbia Dr Platinum Dr	Platinum Dr S	0.02	3.49	0.02	A	19.27	28.90	1.60	3.33	0.02	1.60	3.33	0.579	1357.445
Boardwalk/Erb	Erb St E	0.58	4.58	1.37	A	901.10	1351.65	84.78	3.76	0.94	84.78	3.76	0.723	2436.345
Boardwalk/Erb	Erb St W	0.48	2.86	0.92	A	969.00	1453.51	61.26	2.53	0.68	61.26	2.53	0.723	2436.345
Boardwalk/Erb	The Boardwalk S	0.19	2.60	0.24	A	278.04	417.06	16.33	2.35	0.18	16.33	2.35	0.723	2436.345

Main Results

Main results: (8:00 AM-8:15 AM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	416.33	104.08	414.08	368.35	4.50	0.00	1151.61	1020.26	0.362	0.00	0.56
Columbia Dr Platinum Dr	Columbia St W	492.37	123.09	489.60	143.03	275.56	0.00	1197.96	964.50	0.411	0.00	0.69
Columbia Dr Platinum Dr	Platinum Dr S	15.81	3.95	15.75	408.06	357.09	0.00	1150.77	950.31	0.014	0.00	0.01
Boardwalk/Erb	Erb St E	739.30	184.83	736.83	679.67	226.08	0.00	1931.96	1495.17	0.383	0.00	0.62
Boardwalk/Erb	Erb St W	795.01	198.75	793.07	948.66	14.26	0.00	2426.04	2415.43	0.328	0.00	0.49
Boardwalk/Erb	The Boardwalk S	228.11	57.03	227.58	129.16	678.16	0.00	1946.07	943.12	0.117	0.00	0.13

Main results: (8:15 AM-8:30 AM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	497.14	124.28	496.37	441.38	5.39	0.00	1151.18	1020.26	0.432	0.56	0.75
Columbia Dr Platinum Dr	Columbia St W	587.93	146.98	586.69	171.45	330.32	0.00	1166.27	964.50	0.504	0.69	1.00
Columbia Dr Platinum Dr	Platinum Dr S	18.88	4.72	18.87	489.10	427.90	0.00	1109.79	950.31	0.017	0.01	0.02
Boardwalk/Erb	Erb St E	882.80	220.70	881.83	813.04	270.43	0.00	1904.71	1495.17	0.463	0.62	0.86
Boardwalk/Erb	Erb St W	949.32	237.33	948.70	1135.21	17.06	0.00	2424.01	2415.43	0.392	0.49	0.64
Boardwalk/Erb	The Boardwalk S	272.39	68.10	272.23	154.52	811.25	0.00	1849.85	943.12	0.147	0.13	0.17

Main results: (8:30 AM-8:45 AM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	608.86	152.22	607.44	539.54	6.60	0.00	1150.58	1020.26	0.529	0.75	1.11
Columbia Dr Platinum Dr	Columbia St W	720.07	180.02	717.12	209.81	404.23	0.00	1123.49	964.50	0.641	1.00	1.74
Columbia Dr Platinum Dr	Platinum Dr S	23.12	5.78	23.10	598.31	523.04	0.00	1054.73	950.31	0.022	0.02	0.02
Boardwalk/Erb	Erb St E	1081.20	270.30	1079.20	995.47	331.14	0.00	1867.41	1495.17	0.579	0.86	1.36
Boardwalk/Erb	Erb St W	1162.68	290.67	1161.57	1389.45	20.88	0.00	2421.25	2415.43	0.480	0.64	0.92
Boardwalk/Erb	The Boardwalk S	333.61	83.40	333.34	189.18	993.27	0.00	1718.26	943.12	0.194	0.17	0.24

Main results: (8:45 AM-9:00 AM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	608.86	152.22	608.83	541.63	6.61	0.00	1150.58	1020.26	0.529	1.11	1.12
Columbia Dr Platinum Dr	Columbia St W	720.07	180.02	719.97	210.28	405.15	0.00	1122.96	964.50	0.641	1.74	1.76
Columbia Dr Platinum Dr	Platinum Dr S	23.12	5.78	23.12	600.01	525.12	0.00	1053.53	950.31	0.022	0.02	0.02
Boardwalk/Erb	Erb St E	1081.20	270.30	1081.17	996.41	331.41	0.00	1867.24	1495.17	0.579	1.36	1.37
Boardwalk/Erb	Erb St W	1162.68	290.67	1162.67	1391.66	20.92	0.00	2421.22	2415.43	0.480	0.92	0.92
Boardwalk/Erb	The Boardwalk S	333.61	83.40	333.61	189.37	994.21	0.00	1717.58	943.12	0.194	0.24	0.24

Main results: (9:00 AM-9:15 AM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	497.14	124.28	498.52	444.44	5.40	0.00	1151.17	1020.26	0.432	1.12	0.77
Columbia Dr Platinum Dr	Columbia St W	587.93	146.98	590.86	172.18	331.75	0.00	1165.44	964.50	0.504	1.76	1.03
Columbia Dr Platinum Dr	Platinum Dr S	18.88	4.72	18.90	491.66	430.95	0.00	1108.03	950.31	0.017	0.02	0.02
Boardwalk/Erb	Erb St E	882.80	220.70	884.79	814.52	270.86	0.00	1904.45	1495.17	0.464	1.37	0.87
Boardwalk/Erb	Erb St W	949.32	237.33	950.42	1138.53	17.12	0.00	2423.97	2415.43	0.392	0.92	0.65
Boardwalk/Erb	The Boardwalk S	272.39	68.10	272.66	154.82	812.72	0.00	1848.79	943.12	0.147	0.24	0.17

Main results: (9:15 AM-9:30 AM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	416.33	104.08	417.12	371.37	4.52	0.00	1151.60	1020.26	0.362	0.77	0.57
Columbia Dr Platinum Dr	Columbia St W	492.37	123.09	493.67	144.06	277.57	0.00	1196.80	964.50	0.411	1.03	0.71
Columbia Dr Platinum Dr	Platinum Dr S	15.81	3.95	15.82	411.18	360.06	0.00	1149.06	950.31	0.014	0.02	0.01
Boardwalk/Erb	Erb St E	739.30	184.83	740.29	681.87	226.77	0.00	1931.54	1495.17	0.383	0.87	0.62
Boardwalk/Erb	Erb St W	795.01	198.75	795.64	952.73	14.32	0.00	2425.99	2415.43	0.328	0.65	0.49
Boardwalk/Erb	The Boardwalk S	228.11	57.03	228.27	129.60	680.36	0.00	1944.48	943.12	0.117	0.17	0.13

Queueing Delay Results

Queueing Delay results: (8:00 AM-8:15 AM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	Columbia St E	8.16	0.54	4.866	A	A
Columbia Dr Platinum Dr	Columbia St W	10.02	0.67	5.063	A	A
Columbia Dr Platinum Dr	Platinum Dr S	0.20	0.01	3.171	A	A
Boardwalk/Erb	Erb St E	9.04	0.60	3.005	A	A
Boardwalk/Erb	Erb St W	7.17	0.48	2.201	A	A
Boardwalk/Erb	The Boardwalk S	1.96	0.13	2.095	A	A

Queueing Delay results: (8:15 AM-8:30 AM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	Columbia St E	11.01	0.73	5.490	A	A
Columbia Dr Platinum Dr	Columbia St W	14.58	0.97	6.197	A	A
Columbia Dr Platinum Dr	Platinum Dr S	0.26	0.02	3.299	A	A
Boardwalk/Erb	Erb St E	12.61	0.84	3.516	A	A
Boardwalk/Erb	Erb St W	9.48	0.63	2.438	A	A
Boardwalk/Erb	The Boardwalk S	2.56	0.17	2.281	A	A

Queueing Delay results: (8:30 AM-8:45 AM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	Columbia St E	16.05	1.07	6.610	A	A
Columbia Dr Platinum Dr	Columbia St W	24.72	1.65	8.794	A	A
Columbia Dr Platinum Dr	Platinum Dr S	0.33	0.02	3.488	A	A
Boardwalk/Erb	Erb St E	19.77	1.32	4.555	A	A
Boardwalk/Erb	Erb St W	13.53	0.90	2.855	A	A
Boardwalk/Erb	The Boardwalk S	3.56	0.24	2.599	A	A

Queueing Delay results: (8:45 AM-9:00 AM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	Columbia St E	16.68	1.11	6.644	A	A
Columbia Dr Platinum Dr	Columbia St W	26.30	1.75	8.928	A	A
Columbia Dr Platinum Dr	Platinum Dr S	0.34	0.02	3.492	A	A

Boardwalk/Erb	**Erb St E**	20.46	1.36	4.579	A	A
Boardwalk/Erb	**Erb St W**	13.80	0.92	2.859	A	A
Boardwalk/Erb	**The Boardwalk S**	3.61	0.24	2.600	A	A

Queueing Delay results: (9:00 AM-9:15 AM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	**Columbia St E**	11.86	0.79	5.529	A	A
Columbia Dr Platinum Dr	**Columbia St W**	16.09	1.07	6.298	A	A
Columbia Dr Platinum Dr	**Platinum Dr S**	0.26	0.02	3.304	A	A
Boardwalk/Erb	**Erb St E**	13.37	0.89	3.536	A	A
Boardwalk/Erb	**Erb St W**	9.85	0.66	2.446	A	A
Boardwalk/Erb	**The Boardwalk S**	2.63	0.18	2.284	A	A

Queueing Delay results: (9:15 AM-9:30 AM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	**Columbia St E**	8.76	0.58	4.906	A	A
Columbia Dr Platinum Dr	**Columbia St W**	10.88	0.73	5.129	A	A
Columbia Dr Platinum Dr	**Platinum Dr S**	0.21	0.01	3.178	A	A
Boardwalk/Erb	**Erb St E**	9.52	0.63	3.026	A	A
Boardwalk/Erb	**Erb St W**	7.43	0.50	2.208	A	A
Boardwalk/Erb	**The Boardwalk S**	2.02	0.13	2.099	A	A

A1 - Planned 2031 Conditions - D2 - (Scenario1), PM

Data Errors and Warnings

No errors or warnings

Analysis Set Details

Name	Description	Include In Report	Use Specific Demand Set	Demand Set	Locked	Network Flow Scaling Factor (%)	Network Capacity Scaling Factor (%)	Reason For Scaling Factors
Planned 2031 Conditions		Yes		(D1)		100.000	100.000	

Demand Set Details

Name	Scenario Name	Time Period Name	Description	Locked	Run Automatically	Use Relationship	Relationship	Start Time (HH:mm)	Finish Time (HH:mm)	Time Period Length (min)	Time Segment Length (min)	Traffic Profile Type
(Scenario1), PM	(Scenario1)	PM			Yes			16:00	17:30	90	15	ONE HOUR

Roundabout Network

Roundabout Type(s)

Roundabout	ID	Name	Arm Order	Roundabout Type	Grade Separated	Large Roundabout	Do Geometric Delay
1	1	Columbia Dr Platinum Dr	1,2,3	Standard			
2	2	Boardwalk/Erb	1,2,3	Standard			

Roundabout Network Options

Driving Side	Lighting	Road Surface	In London
Right	Normal/unknown	((Mini-roundabouts only))	

Arms

Arms

ID	Name	Description
1	Columbia St E	
2	Columbia St W	
3	Platinum Dr S	
1	Erb St E	
2	Erb St W	
3	The Boardwalk S	

Capacity Options

Roundabout	Arm	Minimum Capacity (PCE/hr)	Maximum Capacity (PCE/hr)	Assume Flat Start Profile	Initial Queue (PCE)
Columbia Dr Platinum Dr	**Columbia St E**	0.00	99999.00		0.00

Columbia Dr Platinum Dr	**Columbia St W**	0.00	99999.00		0.00
Columbia Dr Platinum Dr	**Platinum Dr S**	0.00	99999.00		0.00
Boardwalk/Erb	**Erb St E**	0.00	99999.00		0.00
Boardwalk/Erb	**Erb St W**	0.00	99999.00		0.00
Boardwalk/Erb	**The Boardwalk S**	0.00	99999.00		0.00

Standard Geometry

Roundabout	Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit Only
Columbia Dr Platinum Dr	**Columbia St E**	3.50	4.50	30.00	20.00	40.00	25.00	
Columbia Dr Platinum Dr	**Columbia St W**	3.50	4.50	30.00	20.00	40.00	25.00	
Columbia Dr Platinum Dr	**Platinum Dr S**	3.50	4.50	30.00	20.00	40.00	25.00	
Boardwalk/Erb	**Erb St E**	7.00	8.00	30.00	20.00	55.00	25.00	
Boardwalk/Erb	**Erb St W**	7.00	8.00	30.00	20.00	55.00	25.00	
Boardwalk/Erb	**The Boardwalk S**	7.00	8.00	30.00	20.00	55.00	25.00	

Pedestrian Crossings

Roundabout	Arm	Crossing Type
Columbia Dr Platinum Dr	**Columbia St E**	None
Columbia Dr Platinum Dr	**Columbia St W**	None
Columbia Dr Platinum Dr	**Platinum Dr S**	None
Boardwalk/Erb	**Erb St E**	None
Boardwalk/Erb	**Erb St W**	None
Boardwalk/Erb	**The Boardwalk S**	None

Arm Slope/ Intercept and Capacity

Slope and Intercept used in model

Roundabout	Arm	Enter Directly	Slope	Intercept (PCE/hr)	Final Slope	Final Intercept (PCE/hr)
Columbia Dr Platinum Dr	**Columbia St E**		((calculated))	((calculated))	0.579	1357.445
Columbia Dr Platinum Dr	**Columbia St W**		((calculated))	((calculated))	0.579	1357.445
Columbia Dr Platinum Dr	**Platinum Dr S**		((calculated))	((calculated))	0.579	1357.445
Boardwalk/Erb	**Erb St E**		((calculated))	((calculated))	0.723	2436.345
Boardwalk/Erb	**Erb St W**		((calculated))	((calculated))	0.723	2436.345

Boardwalk/Erb	**The Boardwalk S**		((calculated))	((calculated))	0.723	2436.345

The slope and intercept shown above include any corrections and adjustments.

Arm Capacity Adjustments

Roundabout	Arm	Type	Reason	Direct Capacity Adjustment (PCE/hr)	Percentage Capacity Adjustment (%)
Columbia Dr Platinum Dr	**Columbia St E**	Percentage		N/A	85.00
Columbia Dr Platinum Dr	**Columbia St W**	None	N/A	N/A	N/A
Columbia Dr Platinum Dr	**Platinum Dr S**	None	N/A	N/A	N/A
Boardwalk/Erb	**Erb St E**	Percentage		N/A	85.00
Boardwalk/Erb	**Erb St W**	None	N/A	N/A	N/A
Boardwalk/Erb	**The Boardwalk S**	None	N/A	N/A	N/A

Traffic Flows

Demand Set Data Options

Default Vehicle Mix	Vehicle Mix Varies Over Time	Vehicle Mix Varies Over Turn	Vehicle Mix Varies Over Entry	Vehicle Mix Source	PCE Factor for a Truck (PCE)	Default Turning Proportions	Estimate from entry/exit counts	Turning Proportions Vary Over Time	Turning Proportions Vary Over Turn	Turning Proportions Vary Over Entry
		Yes	Yes	Truck Percentages	2.00				Yes	Yes

Entry Flows

General Flows Data

Roundabout	Arm	Profile Type	Use Turning Counts	Average Demand Flow (PCE/hr)	Flow Scaling Factor (%)	PHF
Columbia Dr Platinum Dr	**Columbia St E**	ONE HOUR	Yes	414.00	100.000	N/A
Columbia Dr Platinum Dr	**Columbia St W**	ONE HOUR	Yes	351.00	100.000	N/A
Columbia Dr Platinum Dr	**Platinum Dr S**	ONE HOUR	Yes	589.00	100.000	N/A
Boardwalk/Erb	**Erb St E**	ONE HOUR	Yes	1109.00	100.000	N/A
Boardwalk/Erb	**Erb St W**	ONE HOUR	Yes	1923.00	100.000	N/A
Boardwalk/Erb	**The Boardwalk S**	ONE HOUR	Yes	322.00	100.000	N/A

Direct/Resultant Flows

Direct Flows Data

Time Segment	Roundabout	Arm	Direct Demand Entry Flow (PCE/hr)	DirectDemandEntryFlowInPCE (PCE/hr)	Direct Demand Exit Flow (PCE/hr)	Direct Demand Pedestrian Flow (Ped/hr)
1	Columbia Dr Platinum Dr	Columbia St E	311.68	311.68	N/A	N/A
1	Columbia Dr Platinum Dr	Columbia St W	264.25	264.25	N/A	N/A
1	Columbia Dr Platinum Dr	Platinum Dr S	443.43	443.43	N/A	N/A
1	Boardwalk/Erb	Erb St E	834.91	834.91	N/A	N/A
1	Boardwalk/Erb	Erb St W	1447.74	1447.74	N/A	N/A
1	Boardwalk/Erb	The Boardwalk S	242.42	242.42	N/A	N/A
2	Columbia Dr Platinum Dr	Columbia St E	372.18	372.18	N/A	N/A
2	Columbia Dr Platinum Dr	Columbia St W	315.54	315.54	N/A	N/A
2	Columbia Dr Platinum Dr	Platinum Dr S	529.50	529.50	N/A	N/A
2	Boardwalk/Erb	Erb St E	996.97	996.97	N/A	N/A
2	Boardwalk/Erb	Erb St W	1728.74	1728.74	N/A	N/A
2	Boardwalk/Erb	The Boardwalk S	289.47	289.47	N/A	N/A
3	Columbia Dr Platinum Dr	Columbia St E	455.82	455.82	N/A	N/A
3	Columbia Dr Platinum Dr	Columbia St W	386.46	386.46	N/A	N/A
3	Columbia Dr Platinum Dr	Platinum Dr S	648.50	648.50	N/A	N/A
3	Boardwalk/Erb	Erb St E	1221.03	1221.03	N/A	N/A
3	Boardwalk/Erb	Erb St W	2117.26	2117.26	N/A	N/A
3	Boardwalk/Erb	The Boardwalk S	354.53	354.53	N/A	N/A
4	Columbia Dr Platinum Dr	Columbia St E	455.82	455.82	N/A	N/A
4	Columbia Dr Platinum Dr	Columbia St W	386.46	386.46	N/A	N/A
4	Columbia Dr Platinum Dr	Platinum Dr S	648.50	648.50	N/A	N/A
4	Boardwalk/Erb	Erb St E	1221.03	1221.03	N/A	N/A
4	Boardwalk/Erb	Erb St W	2117.26	2117.26	N/A	N/A
4	Boardwalk/Erb	The Boardwalk S	354.53	354.53	N/A	N/A
5	Columbia Dr Platinum Dr	Columbia St E	372.18	372.18	N/A	N/A
5	Columbia Dr Platinum Dr	Columbia St W	315.54	315.54	N/A	N/A
5	Columbia Dr Platinum Dr	Platinum Dr S	529.50	529.50	N/A	N/A
5	Boardwalk/Erb	Erb St E	996.97	996.97	N/A	N/A

5	Boardwalk/Erb	Erb St W	1728.74	1728.74	N/A	N/A
5	Boardwalk/Erb	The Boardwalk S	289.47	289.47	N/A	N/A
6	Columbia Dr Platinum Dr	Columbia St E	311.68	311.68	N/A	N/A
6	Columbia Dr Platinum Dr	Columbia St W	264.25	264.25	N/A	N/A
6	Columbia Dr Platinum Dr	Platinum Dr S	443.43	443.43	N/A	N/A
6	Boardwalk/Erb	Erb St E	834.91	834.91	N/A	N/A
6	Boardwalk/Erb	Erb St W	1447.74	1447.74	N/A	N/A
6	Boardwalk/Erb	The Boardwalk S	242.42	242.42	N/A	N/A

Turning Proportions

Turning Counts or Proportions (PCE/hr) - Columbia Dr Platinum Dr (for whole period)

		To		
		1	2	3
From	1	0.000	349.000	65.000
	2	333.000	0.000	18.000
	3	433.000	156.000	0.000

Turning Proportions (PCE) - Columbia Dr Platinum Dr (for whole period)

		To		
		1	2	3
From	1	0.00	0.84	0.16
	2	0.95	0.00	0.05
	3	0.74	0.26	0.00

Turning Counts or Proportions (PCE/hr) - Boardwalk/ Erb (for whole period)

		To		
		1	2	3
From	1	0.000	1100.000	9.000
	2	1271.000	0.000	652.000
	3	21.000	301.000	0.000

Turning Proportions (PCE) - Boardwalk/ Erb (for whole period)

		To		
		1	2	3
From	1	0.00	0.99	0.01
	2	0.66	0.00	0.34
	3	0.07	0.93	0.00

Vehicle Mix

Average PCE Per Vehicle - Columbia Dr Platinum Dr (for whole period)

		To		
		1	2	3
From	1	1.000	1.000	1.000
	2	1.000	1.000	1.000
	3	1.000	1.000	1.000

Truck Percentages - Columbia Dr Platinum Dr (for whole period)

		To		
		1	2	3
From	1	0.000	0.000	0.000
	2	0.000	0.000	0.000
	3	0.000	0.000	0.000

Average PCE Per Vehicle - Boardwalk/ Erb (for whole period)

		To		
		1	2	3
From	1	1.000	1.000	1.000
	2	1.000	1.000	1.000
	3	1.000	1.000	1.000

Truck Percentages - Boardwalk/ Erb (for whole period)

	To

From		1	2	3
	1	0.000	0.000	0.000
	2	0.000	0.000	0.000
	3	0.000	0.000	0.000

Results

Results Summary

Roundabout	Arm	Max RFC	Max Delay (s)	Max Queue (PCE)	Max LOS	Total Demand (PCE/hr)	Total Arrivals (PCE)	Total Queueing Delay (PCE-min)	Average Queueing Delay (s)	Rate Of Queueing Delay (PCE-min/min)	Inclusive Queueing Total Delay (PCE-min)	Inclusive Queueing Average Delay (s)	Slope	Intercept (PCE/hr)
Columbia Dr Platinum Dr	Columbia St E	0.43	5.87	0.74	A	379.89	569.84	49.36	5.20	0.55	49.36	5.20	0.579	1357.445
Columbia Dr Platinum Dr	Columbia St W	0.29	3.87	0.41	A	322.08	483.13	29.13	3.62	0.32	29.13	3.62	0.579	1357.445
Columbia Dr Platinum Dr	Platinum Dr S	0.57	7.25	1.29	A	540.48	810.72	79.40	5.88	0.88	79.41	5.88	0.579	1357.445
Boardwalk/Erb	Erb St E	0.65	5.57	1.87	A	1017.64	1526.46	110.59	4.35	1.23	110.59	4.35	0.723	2436.345
Boardwalk/Erb	Erb St W	0.87	11.40	6.48	B	1764.58	2646.87	297.68	6.75	3.31	297.71	6.75	0.723	2436.345
Boardwalk/Erb	The Boardwalk S	0.25	3.36	0.33	A	295.47	443.21	21.20	2.87	0.24	21.20	2.87	0.723	2436.345

Main Results

Main results: (4:00 PM-4:15 PM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	311.68	77.92	310.10	574.07	116.84	0.00	1096.35	1067.14	0.284	0.00	0.39
Columbia Dr Platinum Dr	Columbia St W	264.25	66.06	263.26	378.25	48.69	0.00	1329.27	1260.48	0.199	0.00	0.25
Columbia Dr Platinum Dr	Platinum Dr S	443.43	110.86	441.14	62.19	249.76	0.00	1212.89	665.34	0.366	0.00	0.57
Boardwalk/Erb	Erb St E	834.91	208.73	831.89	968.79	226.01	0.00	1932.01	1337.96	0.432	0.00	0.76
Boardwalk/Erb	Erb St W	1447.74	361.93	1441.91	1051.15	6.75	0.00	2431.46	2428.50	0.595	0.00	1.46
Boardwalk/Erb	The Boardwalk S	242.42	60.60	241.78	495.63	953.02	0.00	1747.36	1275.93	0.139	0.00	0.16

Main results: (4:15 PM-4:30 PM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	372.18	93.04	371.68	687.70	140.00	0.00	1084.96	1067.13	0.343	0.39	0.52
Columbia Dr Platinum Dr	Columbia St W	315.54	78.89	315.28	453.33	58.36	0.00	1323.67	1260.48	0.238	0.25	0.31
Columbia Dr Platinum Dr	Platinum Dr S	529.50	132.37	528.59	74.52	299.12	0.00	1184.33	665.34	0.447	0.57	0.80
Boardwalk/Erb	Erb St E	996.97	249.24	995.64	1158.93	270.38	0.00	1904.74	1337.96	0.523	0.76	1.09
Boardwalk/Erb	Erb St W	1728.74	432.18	1724.90	1257.94	8.08	0.00	2430.50	2428.50	0.711	1.46	2.42
Boardwalk/Erb	The Boardwalk S	289.47	72.37	289.24	592.91	1140.06	0.00	1612.14	1275.93	0.180	0.16	0.22

Main results: (4:30 PM-4:45 PM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	455.82	113.96	454.96	841.58	171.25	0.00	1069.58	1067.13	0.426	0.52	0.73
Columbia Dr Platinum Dr	Columbia St W	386.46	96.61	386.05	554.77	71.43	0.00	1316.10	1260.48	0.294	0.31	0.41
Columbia Dr Platinum Dr	Platinum Dr S	648.50	162.13	646.57	91.23	366.25	0.00	1145.47	665.34	0.566	0.80	1.28
Boardwalk/Erb	Erb St E	1221.03	305.26	1217.96	1412.42	331.00	0.00	1867.49	1337.96	0.654	1.09	1.86
Boardwalk/Erb	Erb St W	2117.26	529.32	2102.03	1539.07	9.88	0.00	2429.20	2428.50	0.872	2.42	6.22
Boardwalk/Erb	The Boardwalk S	354.53	88.63	354.09	722.59	1389.33	0.00	1431.93	1275.93	0.248	0.22	0.33

Main results: (4:45 PM-5:00 PM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	455.82	113.96	455.81	843.34	171.75	0.00	1069.34	1067.13	0.426	0.73	0.74
Columbia Dr Platinum Dr	Columbia St W	386.46	96.61	386.45	555.99	71.56	0.00	1316.03	1260.48	0.294	0.41	0.41
Columbia Dr Platinum Dr	Platinum Dr S	648.50	162.13	648.45	91.38	366.64	0.00	1145.25	665.34	0.566	1.28	1.29
Boardwalk/Erb	Erb St E	1221.03	305.26	1220.97	1421.84	331.40	0.00	1867.25	1337.96	0.654	1.86	1.87
Boardwalk/Erb	Erb St W	2117.26	529.32	2116.24	1542.46	9.91	0.00	2429.18	2428.50	0.872	6.22	6.48
Boardwalk/Erb	The Boardwalk S	354.53	88.63	354.52	727.43	1398.72	0.00	1425.14	1275.93	0.249	0.33	0.33

Main results: (5:00 PM-5:15 PM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)

Columbia Dr Platinum Dr	Columbia St E	372.18	93.04	373.03	690.40	140.74	0.00	1084.59	1067.13	0.343	0.74	0.53
Columbia Dr Platinum Dr	Columbia St W	315.54	78.89	315.94	455.20	58.57	0.00	1323.55	1260.48	0.238	0.41	0.31
Columbia Dr Platinum Dr	Platinum Dr S	529.50	132.37	531.40	74.77	299.74	0.00	1183.97	665.34	0.447	1.29	0.82
Boardwalk/Erb	Erb St E	996.97	249.24	1000.02	1172.00	271.00	0.00	1904.36	1337.96	0.524	1.87	1.11
Boardwalk/Erb	Erb St W	1728.74	432.18	1744.61	1262.91	8.12	0.00	2430.48	2428.50	0.711	6.48	2.51
Boardwalk/Erb	The Boardwalk S	289.47	72.37	289.91	599.63	1153.10	0.00	1602.71	1275.93	0.181	0.33	0.22

Main results: (5:15 PM-5:30 PM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	311.68	77.92	312.19	577.63	117.70	0.00	1095.93	1067.14	0.284	0.53	0.40
Columbia Dr Platinum Dr	Columbia St W	264.25	66.06	264.51	380.87	49.01	0.00	1329.08	1260.48	0.199	0.31	0.25
Columbia Dr Platinum Dr	Platinum Dr S	443.43	110.86	444.38	62.58	250.95	0.00	1212.21	665.34	0.366	0.82	0.58
Boardwalk/Erb	Erb St E	834.91	208.73	836.28	975.41	226.83	0.00	1931.50	1337.96	0.432	1.11	0.77
Boardwalk/Erb	Erb St W	1447.74	361.93	1451.84	1056.33	6.79	0.00	2431.44	2428.50	0.595	2.51	1.49
Boardwalk/Erb	The Boardwalk S	242.42	60.60	242.66	499.04	959.59	0.00	1742.61	1275.93	0.139	0.22	0.16

Queueing Delay Results

Queueing Delay results: (4:00 PM-4:15 PM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	Columbia St E	5.75	0.38	4.569	A	A
Columbia Dr Platinum Dr	Columbia St W	3.63	0.24	3.374	A	A
Columbia Dr Platinum Dr	Platinum Dr S	8.32	0.55	4.650	A	A
Boardwalk/Erb	Erb St E	11.06	0.74	3.265	A	A
Boardwalk/Erb	Erb St W	21.12	1.41	3.618	A	A
Boardwalk/Erb	The Boardwalk S	2.37	0.16	2.389	A	A

Queueing Delay results: (4:15 PM-4:30 PM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	Columbia St E	7.61	0.51	5.044	A	A
Columbia Dr Platinum Dr	Columbia St W	4.60	0.31	3.570	A	A

Columbia Dr Platinum Dr	**Platinum Dr S**	11.69	0.78	5.482	A	A
Boardwalk/Erb	**Erb St E**	15.94	1.06	3.954	A	A
Boardwalk/Erb	**Erb St W**	34.75	2.32	5.075	A	A
Boardwalk/Erb	**The Boardwalk S**	3.23	0.22	2.721	A	A

Queueing Delay results: (4:30 PM-4:45 PM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	**Columbia St E**	10.72	0.71	5.848	A	A
Columbia Dr Platinum Dr	**Columbia St W**	6.09	0.41	3.869	A	A
Columbia Dr Platinum Dr	**Platinum Dr S**	18.47	1.23	7.189	A	A
Boardwalk/Erb	**Erb St E**	26.74	1.78	5.515	A	A
Boardwalk/Erb	**Erb St W**	82.78	5.52	10.541	B	B
Boardwalk/Erb	**The Boardwalk S**	4.83	0.32	3.337	A	A

Queueing Delay results: (4:45 PM-5:00 PM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	**Columbia St E**	11.06	0.74	5.867	A	A
Columbia Dr Platinum Dr	**Columbia St W**	6.21	0.41	3.872	A	A
Columbia Dr Platinum Dr	**Platinum Dr S**	19.34	1.29	7.246	A	A
Boardwalk/Erb	**Erb St E**	28.00	1.87	5.568	A	A
Boardwalk/Erb	**Erb St W**	95.67	6.38	11.403	B	B
Boardwalk/Erb	**The Boardwalk S**	4.94	0.33	3.361	A	A

Queueing Delay results: (5:00 PM-5:15 PM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	**Columbia St E**	8.10	0.54	5.064	A	A
Columbia Dr Platinum Dr	**Columbia St W**	4.80	0.32	3.576	A	A
Columbia Dr Platinum Dr	**Platinum Dr S**	12.66	0.84	5.532	A	A
Boardwalk/Erb	**Erb St E**	17.12	1.14	3.995	A	A
Boardwalk/Erb	**Erb St W**	40.37	2.69	5.365	A	A
Boardwalk/Erb	**The Boardwalk S**	3.37	0.22	2.742	A	A

Queueing Delay results: (5:15 PM-5:30 PM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	Columbia St E	6.12	0.41	4.597	A	A
Columbia Dr Platinum Dr	Columbia St W	3.79	0.25	3.381	A	A
Columbia Dr Platinum Dr	Platinum Dr S	8.93	0.60	4.693	A	A
Boardwalk/Erb	Erb St E	11.73	0.78	3.290	A	A
Boardwalk/Erb	Erb St W	22.99	1.53	3.692	A	A
Boardwalk/Erb	The Boardwalk S	2.46	0.16	2.401	A	A

A2 - Planned 2031 With Recommendations - D1 - (Scenario1), AM

Data Errors and Warnings

No errors or warnings

Analysis Set Details

Name	Description	Include In Report	Use Specific Demand Set	Demand Set	Locked	Network Flow Scaling Factor (%)	Network Capacity Scaling Factor (%)	Reason For Scaling Factors
Planned 2031 With Recommendations		Yes		(D1)		100.000	100.000	

Demand Set Details

Name	Scenario Name	Time Period Name	Description	Locked	Run Automatically	Use Relationship	Relationship	Start Time (HH:mm)	Finish Time (HH:mm)	Time Period Length (min)	Time Segment Length (min)	Traffic Profile Type
(Scenario1), AM	(Scenario1)	AM			Yes			08:00	09:30	90	15	ONE HOUR

Roundabout Network

Roundabout Type(s)

Roundabout	ID	Name	Arm Order	Roundabout Type	Grade Separated	Large Roundabout	Do Geometric Delay
1	1	Columbia Dr Platinum Dr	1,2,3	Standard			
2	2	Boardwalk/Erb	1,2,3	Standard			

Roundabout Network Options

Driving Side	Lighting	Road Surface	In London
Right	Normal/unknown	((Mini-roundabouts only))	

Arms

Arms

ID	Name	Description
1	Columbia St E	
2	Columbia St W	
3	Platinum Dr S	
1	Erb St E	
2	Erb St W	
3	The Boardwalk S	

Capacity Options

Roundabout	Arm	Minimum Capacity (PCE/hr)	Maximum Capacity (PCE/hr)	Assume Flat Start Profile	Initial Queue (PCE)
Columbia Dr Platinum Dr	**Columbia St E**	0.00	99999.00		0.00
Columbia Dr Platinum Dr	**Columbia St W**	0.00	99999.00		0.00
Columbia Dr Platinum Dr	**Platinum Dr S**	0.00	99999.00		0.00
Boardwalk/Erb	**Erb St E**	0.00	99999.00		0.00
Boardwalk/Erb	**Erb St W**	0.00	99999.00		0.00
Boardwalk/Erb	**The Boardwalk S**	0.00	99999.00		0.00

Standard Geometry

Roundabout	Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit Only
Columbia Dr Platinum Dr	**Columbia St E**	7.00	8.00	30.00	20.00	55.00	25.00	
Columbia Dr Platinum Dr	**Columbia St W**	7.00	8.00	30.00	20.00	55.00	25.00	

Columbia Dr Platinum Dr	**Platinum Dr S**	7.00	8.00	30.00	20.00	55.00	25.00	
Boardwalk/Erb	**Erb St E**	7.00	8.00	30.00	20.00	55.00	25.00	
Boardwalk/Erb	**Erb St W**	7.00	8.00	30.00	20.00	55.00	25.00	
Boardwalk/Erb	**The Boardwalk S**	3.50	4.50	30.00	20.00	40.00	25.00	

Pedestrian Crossings

Roundabout	Arm	Crossing Type
Columbia Dr Platinum Dr	**Columbia St E**	None
Columbia Dr Platinum Dr	**Columbia St W**	None
Columbia Dr Platinum Dr	**Platinum Dr S**	None
Boardwalk/Erb	**Erb St E**	None
Boardwalk/Erb	**Erb St W**	None
Boardwalk/Erb	**The Boardwalk S**	None

Arm Slope/ Intercept and Capacity

Slope and Intercept used in model

Roundabout	Arm	Enter Directly	Slope	Intercept (PCE/hr)	Final Slope	Final Intercept (PCE/hr)
Columbia Dr Platinum Dr	**Columbia St E**		((calculated))	((calculated))	0.723	2436.345
Columbia Dr Platinum Dr	**Columbia St W**		((calculated))	((calculated))	0.723	2436.345
Columbia Dr Platinum Dr	**Platinum Dr S**		((calculated))	((calculated))	0.723	2436.345
Boardwalk/Erb	**Erb St E**		((calculated))	((calculated))	0.723	2436.345
Boardwalk/Erb	**Erb St W**		((calculated))	((calculated))	0.723	2436.345
Boardwalk/Erb	**The Boardwalk S**		((calculated))	((calculated))	0.579	1357.445

The slope and intercept shown above include any corrections and adjustments.

Arm Capacity Adjustments

Roundabout	Arm	Type	Reason	Direct Capacity Adjustment (PCE/hr)	Percentage Capacity Adjustment (%)
Columbia Dr Platinum Dr	**Columbia St E**	Percentage		N/A	85.00
Columbia Dr Platinum Dr	**Columbia St W**	None	N/A	N/A	N/A
Columbia Dr Platinum Dr	**Platinum Dr S**	None	N/A	N/A	N/A
Boardwalk/Erb	**Erb St E**	Percentage		N/A	85.00
Boardwalk/Erb	**Erb St W**	None	N/A	N/A	N/A
Boardwalk/Erb	**The Boardwalk S**	None	N/A	N/A	N/A

Traffic Flows

Demand Set Data Options

Default Vehicle Mix	Vehicle Mix Varies Over Time	Vehicle Mix Varies Over Turn	Vehicle Mix Varies Over Entry	Vehicle Mix Source	PCE Factor for a Truck (PCE)	Default Turning Proportions	Estimate from entry/exit counts	Turning Proportions Vary Over Time	Turning Proportions Vary Over Turn	Turning Proportions Vary Over Entry
		Yes	Yes	Truck Percentages	2.00				Yes	Yes

Entry Flows

General Flows Data

Roundabout	Arm	Profile Type	Use Turning Counts	Average Demand Flow (PCE/hr)	Flow Scaling Factor (%)	PHF
Columbia Dr Platinum Dr	Columbia St E	ONE HOUR	Yes	553.00	100.000	N/A
Columbia Dr Platinum Dr	Columbia St W	ONE HOUR	Yes	654.00	100.000	N/A
Columbia Dr Platinum Dr	Platinum Dr S	ONE HOUR	Yes	21.00	100.000	N/A
Boardwalk/Erb	Erb St E	ONE HOUR	Yes	982.00	100.000	N/A
Boardwalk/Erb	Erb St W	ONE HOUR	Yes	1056.00	100.000	N/A
Boardwalk/Erb	The Boardwalk S	ONE HOUR	Yes	303.00	100.000	N/A

Direct/Resultant Flows

Direct Flows Data

Time Segment	Roundabout	Arm	Direct Demand Entry Flow (PCE/hr)	DirectDemandEntryFlowInPCE (PCE/hr)	Direct Demand Exit Flow (PCE/hr)	Direct Demand Pedestrian Flow (Ped/hr)
1	Columbia Dr Platinum Dr	Columbia St E	416.33	416.33	N/A	N/A
1	Columbia Dr Platinum Dr	Columbia St W	492.37	492.37	N/A	N/A
1	Columbia Dr Platinum Dr	Platinum Dr S	15.81	15.81	N/A	N/A
1	Boardwalk/Erb	Erb St E	739.30	739.30	N/A	N/A
1	Boardwalk/Erb	Erb St W	795.01	795.01	N/A	N/A
1	Boardwalk/Erb	The Boardwalk S	228.11	228.11	N/A	N/A
2	Columbia Dr Platinum Dr	Columbia St E	497.14	497.14	N/A	N/A

2	Columbia Dr Platinum Dr	Columbia St W	587.93	587.93	N/A	N/A
2	Columbia Dr Platinum Dr	Platinum Dr S	18.88	18.88	N/A	N/A
2	Boardwalk/Erb	Erb St E	882.80	882.80	N/A	N/A
2	Boardwalk/Erb	Erb St W	949.32	949.32	N/A	N/A
2	Boardwalk/Erb	The Boardwalk S	272.39	272.39	N/A	N/A
3	Columbia Dr Platinum Dr	Columbia St E	608.86	608.86	N/A	N/A
3	Columbia Dr Platinum Dr	Columbia St W	720.07	720.07	N/A	N/A
3	Columbia Dr Platinum Dr	Platinum Dr S	23.12	23.12	N/A	N/A
3	Boardwalk/Erb	Erb St E	1081.20	1081.20	N/A	N/A
3	Boardwalk/Erb	Erb St W	1162.68	1162.68	N/A	N/A
3	Boardwalk/Erb	The Boardwalk S	333.61	333.61	N/A	N/A
4	Columbia Dr Platinum Dr	Columbia St E	608.86	608.86	N/A	N/A
4	Columbia Dr Platinum Dr	Columbia St W	720.07	720.07	N/A	N/A
4	Columbia Dr Platinum Dr	Platinum Dr S	23.12	23.12	N/A	N/A
4	Boardwalk/Erb	Erb St E	1081.20	1081.20	N/A	N/A
4	Boardwalk/Erb	Erb St W	1162.68	1162.68	N/A	N/A
4	Boardwalk/Erb	The Boardwalk S	333.61	333.61	N/A	N/A
5	Columbia Dr Platinum Dr	Columbia St E	497.14	497.14	N/A	N/A
5	Columbia Dr Platinum Dr	Columbia St W	587.93	587.93	N/A	N/A
5	Columbia Dr Platinum Dr	Platinum Dr S	18.88	18.88	N/A	N/A
5	Boardwalk/Erb	Erb St E	882.80	882.80	N/A	N/A
5	Boardwalk/Erb	Erb St W	949.32	949.32	N/A	N/A
5	Boardwalk/Erb	The Boardwalk S	272.39	272.39	N/A	N/A
6	Columbia Dr Platinum Dr	Columbia St E	416.33	416.33	N/A	N/A
6	Columbia Dr Platinum Dr	Columbia St W	492.37	492.37	N/A	N/A
6	Columbia Dr Platinum Dr	Platinum Dr S	15.81	15.81	N/A	N/A
6	Boardwalk/Erb	Erb St E	739.30	739.30	N/A	N/A
6	Boardwalk/Erb	Erb St W	795.01	795.01	N/A	N/A
6	Boardwalk/Erb	The Boardwalk S	228.11	228.11	N/A	N/A

Turning Proportions

Turning Counts or Proportions (PCE/hr) - Columbia Dr Platinum Dr (for whole period)

		To		
		1	2	3
From	1	0.000	185.000	368.000
	2	477.000	0.000	177.000
	3	15.000	6.000	0.000

Turning Proportions (PCE) - Columbia Dr Platinum Dr (for whole period)

		To		
		1	2	3
From	1	0.00	0.33	0.67
	2	0.73	0.00	0.27
	3	0.71	0.29	0.00

Turning Counts or Proportions (PCE/hr) - Boardwalk/ Erb (for whole period)

		To		
		1	2	3
From	1	0.000	963.000	19.000
	2	903.000	0.000	153.000
	3	2.000	301.000	0.000

Turning Proportions (PCE) - Boardwalk/ Erb (for whole period)

		To		
		1	2	3
From	1	0.00	0.98	0.02
	2	0.86	0.00	0.14
	3	0.01	0.99	0.00

Vehicle Mix

Average PCE Per Vehicle - Columbia Dr Platinum Dr (for whole period)

		To		
From		1	2	3

	1	1.000	1.000	1.000
	2	1.000	1.000	1.000
	3	1.000	1.000	1.000

Truck Percentages - Columbia Dr Platinum Dr (for whole period)

		To		
		1	2	3
From	1	0.000	0.000	0.000
	2	0.000	0.000	0.000
	3	0.000	0.000	0.000

Average PCE Per Vehicle - Boardwalk/ Erb (for whole period)

		To		
		1	2	3
From	1	1.000	1.000	1.000
	2	1.000	1.000	1.000
	3	1.000	1.000	1.000

Truck Percentages - Boardwalk/ Erb (for whole period)

		To		
		1	2	3
From	1	0.000	0.000	0.000
	2	0.000	0.000	0.000
	3	0.000	0.000	0.000

Results

Results Summary

Roundabout	Arm	Max RFC	Max Delay (s)	Max Queue (PCE)	Max LOS	Total Demand (PCE/hr)	Total Arrivals (PCE)	Total Queueing Delay (PCE-min)	Average Queueing Delay (s)	Rate Of Queueing Delay	Inclusive Queueing Total Delay (PCE-min)	Inclusive Queueing Average Delay (s)	Slope	Intercept (PCE/hr)

										(PCE-min/min)				
Columbia Dr Platinum Dr	Columbia St E	0.29	2.47	0.42	A	507.44	761.16	29.46	2.32	0.33	29.46	2.32	0.723	2436.345
Columbia Dr Platinum Dr	Columbia St W	0.34	2.53	0.50	A	600.12	900.18	34.44	2.30	0.38	34.45	2.30	0.723	2436.345
Columbia Dr Platinum Dr	Platinum Dr S	0.01	1.77	0.01	A	19.27	28.90	0.83	1.72	0.01	0.83	1.72	0.723	2436.345
Boardwalk/Erb	Erb St E	0.58	4.58	1.37	A	901.10	1351.65	84.76	3.76	0.94	84.77	3.76	0.723	2436.345
Boardwalk/Erb	Erb St W	0.48	2.86	0.92	A	969.00	1453.51	61.26	2.53	0.68	61.26	2.53	0.723	2436.345
Boardwalk/Erb	The Boardwalk S	0.43	8.03	0.74	A	278.04	417.06	44.22	6.36	0.49	44.22	6.36	0.579	1357.445

Main Results

Main results: (8:00 AM-8:15 AM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	416.33	104.08	415.32	369.56	4.51	0.00	2068.12	1789.01	0.201	0.00	0.25
Columbia Dr Platinum Dr	Columbia St W	492.37	123.09	491.24	143.45	276.38	0.00	2236.54	1575.66	0.220	0.00	0.28
Columbia Dr Platinum Dr	Platinum Dr S	15.81	3.95	15.78	409.33	358.29	0.00	2177.32	1605.52	0.007	0.00	0.01
Boardwalk/Erb	Erb St E	739.30	184.83	736.84	679.66	225.39	0.00	1932.39	1969.96	0.383	0.00	0.62
Boardwalk/Erb	Erb St W	795.01	198.75	793.07	947.97	14.26	0.00	2426.04	2408.79	0.328	0.00	0.49
Boardwalk/Erb	The Boardwalk S	228.11	57.03	226.88	129.16	678.16	0.00	964.95	165.32	0.236	0.00	0.31

Main results: (8:15 AM-8:30 AM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	497.14	124.28	496.88	442.05	5.39	0.00	2067.58	1789.01	0.240	0.25	0.32
Columbia Dr Platinum Dr	Columbia St W	587.93	146.98	587.60	171.62	330.65	0.00	2197.30	1575.66	0.268	0.28	0.36
Columbia Dr Platinum Dr	Platinum Dr S	18.88	4.72	18.87	489.68	428.57	0.00	2126.51	1605.52	0.009	0.01	0.01
Boardwalk/Erb	Erb St E	882.80	220.70	881.83	813.04	270.07	0.00	1904.93	1969.96	0.463	0.62	0.86
Boardwalk/Erb	Erb St W	949.32	237.33	948.70	1134.84	17.06	0.00	2424.01	2408.79	0.392	0.49	0.64
Boardwalk/Erb	The Boardwalk S	272.39	68.10	271.87	154.52	811.25	0.00	887.93	165.32	0.307	0.31	0.44

Main results: (8:30 AM-8:45 AM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	608.86	152.22	608.46	541.29	6.60	0.00	2066.84	1789.01	0.295	0.32	0.42
Columbia Dr Platinum Dr	Columbia St W	720.07	180.02	719.51	210.16	404.91	0.00	2143.62	1575.66	0.336	0.36	0.50
Columbia Dr Platinum Dr	Platinum Dr S	23.12	5.78	23.11	599.64	524.78	0.00	2056.96	1605.52	0.011	0.01	0.01
Boardwalk/Erb	Erb St E	1081.20	270.30	1079.20	995.47	330.24	0.00	1867.96	1969.96	0.579	0.86	1.36
Boardwalk/Erb	Erb St W	1162.68	290.67	1161.57	1388.56	20.88	0.00	2421.25	2408.79	0.480	0.64	0.92
Boardwalk/Erb	The Boardwalk S	333.61	83.40	332.44	189.18	993.27	0.00	782.58	165.32	0.426	0.44	0.73

Main results: (8:45 AM-9:00 AM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	608.86	152.22	608.86	541.70	6.61	0.00	2066.83	1789.01	0.295	0.42	0.42
Columbia Dr Platinum Dr	Columbia St W	720.07	180.02	720.06	210.29	405.17	0.00	2143.42	1575.66	0.336	0.50	0.50
Columbia Dr Platinum Dr	Platinum Dr S	23.12	5.78	23.12	600.05	525.18	0.00	2056.66	1605.52	0.011	0.01	0.01
Boardwalk/Erb	Erb St E	1081.20	270.30	1081.17	996.41	331.38	0.00	1867.26	1969.96	0.579	1.36	1.37
Boardwalk/Erb	Erb St W	1162.68	290.67	1162.67	1391.63	20.92	0.00	2421.22	2408.79	0.480	0.92	0.92
Boardwalk/Erb	The Boardwalk S	333.61	83.40	333.58	189.37	994.21	0.00	782.04	165.32	0.427	0.73	0.74

Main results: (9:00 AM-9:15 AM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	497.14	124.28	497.53	442.71	5.40	0.00	2067.58	1789.01	0.240	0.42	0.32
Columbia Dr Platinum Dr	Columbia St W	587.93	146.98	588.49	171.84	331.09	0.00	2196.98	1575.66	0.268	0.50	0.37
Columbia Dr Platinum Dr	Platinum Dr S	18.88	4.72	18.89	490.36	429.22	0.00	2126.04	1605.52	0.009	0.01	0.01
Boardwalk/Erb	Erb St E	882.80	220.70	884.78	814.52	271.75	0.00	1903.90	1969.96	0.464	1.37	0.87
Boardwalk/Erb	Erb St W	949.32	237.33	950.42	1139.41	17.12	0.00	2423.97	2408.79	0.392	0.92	0.65
Boardwalk/Erb	The Boardwalk S	272.39	68.10	273.55	154.82	812.72	0.00	887.08	165.32	0.307	0.74	0.45

Main results: (9:15 AM-9:30 AM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)

Columbia Dr Platinum Dr	**Columbia St E**	416.33	104.08	416.59	370.65	4.52	0.00	2068.12	1789.01	0.201	0.32	0.25
Columbia Dr Platinum Dr	**Columbia St W**	492.37	123.09	492.70	143.88	277.22	0.00	2235.93	1575.66	0.220	0.37	0.28
Columbia Dr Platinum Dr	**Platinum Dr S**	15.81	3.95	15.82	410.57	359.35	0.00	2176.55	1605.52	0.007	0.01	0.01
Boardwalk/Erb	**Erb St E**	739.30	184.83	740.29	681.87	227.14	0.00	1931.31	1969.96	0.383	0.87	0.62
Boardwalk/Erb	**Erb St W**	795.01	198.75	795.64	953.11	14.32	0.00	2425.99	2408.79	0.328	0.65	0.49
Boardwalk/Erb	**The Boardwalk S**	228.11	57.03	228.65	129.60	680.36	0.00	963.68	165.32	0.237	0.45	0.31

Queueing Delay Results

Queueing Delay results: (8:00 AM-8:15 AM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	**Columbia St E**	3.72	0.25	2.177	A	A
Columbia Dr Platinum Dr	**Columbia St W**	4.16	0.28	2.062	A	A
Columbia Dr Platinum Dr	**Platinum Dr S**	0.11	0.01	1.664	A	A
Boardwalk/Erb	**Erb St E**	9.04	0.60	3.004	A	A
Boardwalk/Erb	**Erb St W**	7.17	0.48	2.201	A	A
Boardwalk/Erb	**The Boardwalk S**	4.48	0.30	4.870	A	A

Queueing Delay results: (8:15 AM-8:30 AM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	**Columbia St E**	4.68	0.31	2.291	A	A
Columbia Dr Platinum Dr	**Columbia St W**	5.40	0.36	2.236	A	A
Columbia Dr Platinum Dr	**Platinum Dr S**	0.13	0.01	1.707	A	A
Boardwalk/Erb	**Erb St E**	12.61	0.84	3.515	A	A
Boardwalk/Erb	**Erb St W**	9.48	0.63	2.438	A	A
Boardwalk/Erb	**The Boardwalk S**	6.42	0.43	5.838	A	A

Queueing Delay results: (8:30 AM-8:45 AM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	**Columbia St E**	6.16	0.41	2.468	A	A
Columbia Dr Platinum Dr	**Columbia St W**	7.45	0.50	2.526	A	A
Columbia Dr Platinum Dr	**Platinum Dr S**	0.17	0.01	1.769	A	A

Boardwalk/Erb	**Erb St E**	19.76	1.32	4.552	A	A
Boardwalk/Erb	**Erb St W**	13.53	0.90	2.855	A	A
Boardwalk/Erb	**The Boardwalk S**	10.58	0.71	7.977	A	A

Queueing Delay results: (8:45 AM-9:00 AM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	**Columbia St E**	6.25	0.42	2.468	A	A
Columbia Dr Platinum Dr	**Columbia St W**	7.57	0.50	2.528	A	A
Columbia Dr Platinum Dr	**Platinum Dr S**	0.17	0.01	1.769	A	A
Boardwalk/Erb	**Erb St E**	20.45	1.36	4.579	A	A
Boardwalk/Erb	**Erb St W**	13.80	0.92	2.859	A	A
Boardwalk/Erb	**The Boardwalk S**	11.04	0.74	8.026	A	A

Queueing Delay results: (9:00 AM-9:15 AM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	**Columbia St E**	4.82	0.32	2.293	A	A
Columbia Dr Platinum Dr	**Columbia St W**	5.57	0.37	2.238	A	A
Columbia Dr Platinum Dr	**Platinum Dr S**	0.14	0.01	1.710	A	A
Boardwalk/Erb	**Erb St E**	13.38	0.89	3.541	A	A
Boardwalk/Erb	**Erb St W**	9.85	0.66	2.446	A	A
Boardwalk/Erb	**The Boardwalk S**	6.91	0.46	5.878	A	A

Queueing Delay results: (9:15 AM-9:30 AM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	**Columbia St E**	3.83	0.26	2.181	A	A
Columbia Dr Platinum Dr	**Columbia St W**	4.29	0.29	2.065	A	A
Columbia Dr Platinum Dr	**Platinum Dr S**	0.11	0.01	1.667	A	A
Boardwalk/Erb	**Erb St E**	9.52	0.63	3.026	A	A
Boardwalk/Erb	**Erb St W**	7.43	0.50	2.210	A	A
Boardwalk/Erb	**The Boardwalk S**	4.79	0.32	4.900	A	A

A2 - Planned 2031 With Recommendations - D2 - (Scenario1), PM

Data Errors and Warnings

No errors or warnings

Analysis Set Details

Name	Description	Include In Report	Use Specific Demand Set	Demand Set	Locked	Network Flow Scaling Factor (%)	Network Capacity Scaling Factor (%)	Reason For Scaling Factors
Planned 2031 With Recommendations		Yes		(D1)		100.000	100.000	

Demand Set Details

Name	Scenario Name	Time Period Name	Description	Locked	Run Automatically	Use Relationship	Relationship	Start Time (HH:mm)	Finish Time (HH:mm)	Time Period Length (min)	Time Segment Length (min)	Traffic Profile Type
(Scenario1), PM	(Scenario1)	PM			Yes			16:00	17:30	90	15	ONE HOUR

Roundabout Network

Roundabout Type(s)

Roundabout	ID	Name	Arm Order	Roundabout Type	Grade Separated	Large Roundabout	Do Geometric Delay
1	1	Columbia Dr Platinum Dr	1,2,3	Standard			
2	2	Boardwalk/Erb	1,2,3	Standard			

Roundabout Network Options

Driving Side	Lighting	Road Surface	In London
Right	Normal/unknown	((Mini-roundabouts only))	

Arms

Arms

ID	Name	Description
1	Columbia St E	
2	Columbia St W	
3	Platinum Dr S	
1	Erb St E	
2	Erb St W	
3	The Boardwalk S	

Capacity Options

Roundabout	Arm	Minimum Capacity (PCE/hr)	Maximum Capacity (PCE/hr)	Assume Flat Start Profile	Initial Queue (PCE)
Columbia Dr Platinum Dr	**Columbia St E**	0.00	99999.00		0.00
Columbia Dr Platinum Dr	**Columbia St W**	0.00	99999.00		0.00
Columbia Dr Platinum Dr	**Platinum Dr S**	0.00	99999.00		0.00
Boardwalk/Erb	**Erb St E**	0.00	99999.00		0.00
Boardwalk/Erb	**Erb St W**	0.00	99999.00		0.00
Boardwalk/Erb	**The Boardwalk S**	0.00	99999.00		0.00

Standard Geometry

Roundabout	Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit Only
Columbia Dr Platinum Dr	**Columbia St E**	7.00	8.00	30.00	20.00	55.00	25.00	
Columbia Dr Platinum Dr	**Columbia St W**	7.00	8.00	30.00	20.00	55.00	25.00	
Columbia Dr Platinum Dr	**Platinum Dr S**	7.00	8.00	30.00	20.00	55.00	25.00	
Boardwalk/Erb	**Erb St E**	7.00	8.00	30.00	20.00	55.00	25.00	
Boardwalk/Erb	**Erb St W**	7.00	8.00	30.00	20.00	55.00	25.00	
Boardwalk/Erb	**The Boardwalk S**	3.50	4.50	30.00	20.00	40.00	25.00	

Pedestrian Crossings

Roundabout	Arm	Crossing Type
Columbia Dr Platinum Dr	**Columbia St E**	None
Columbia Dr Platinum Dr	**Columbia St W**	None
Columbia Dr Platinum Dr	**Platinum Dr S**	None
Boardwalk/Erb	**Erb St E**	None

Boardwalk/Erb	**Erb St W**	None
Boardwalk/Erb	**The Boardwalk S**	None

Arm Slope/ Intercept and Capacity

Slope and Intercept used in model

Roundabout	Arm	Enter Directly	Slope	Intercept (PCE/hr)	Final Slope	Final Intercept (PCE/hr)
Columbia Dr Platinum Dr	**Columbia St E**		((calculated))	((calculated))	0.723	2436.345
Columbia Dr Platinum Dr	**Columbia St W**		((calculated))	((calculated))	0.723	2436.345
Columbia Dr Platinum Dr	**Platinum Dr S**		((calculated))	((calculated))	0.723	2436.345
Boardwalk/Erb	**Erb St E**		((calculated))	((calculated))	0.723	2436.345
Boardwalk/Erb	**Erb St W**		((calculated))	((calculated))	0.723	2436.345
Boardwalk/Erb	**The Boardwalk S**		((calculated))	((calculated))	0.579	1357.445

The slope and intercept shown above include any corrections and adjustments.

Arm Capacity Adjustments

Roundabout	Arm	Type	Reason	Direct Capacity Adjustment (PCE/hr)	Percentage Capacity Adjustment (%)
Columbia Dr Platinum Dr	**Columbia St E**	Percentage		N/A	85.00
Columbia Dr Platinum Dr	**Columbia St W**	None	N/A	N/A	N/A
Columbia Dr Platinum Dr	**Platinum Dr S**	None	N/A	N/A	N/A
Boardwalk/Erb	**Erb St E**	Percentage		N/A	85.00
Boardwalk/Erb	**Erb St W**	None	N/A	N/A	N/A
Boardwalk/Erb	**The Boardwalk S**	None	N/A	N/A	N/A

Traffic Flows

Demand Set Data Options

Default Vehicle Mix	Vehicle Mix Varies Over Time	Vehicle Mix Varies Over Turn	Vehicle Mix Varies Over Entry	Vehicle Mix Source	PCE Factor for a Truck (PCE)	Default Turning Proportions	Estimate from entry/exit counts	Turning Proportions Vary Over Time	Turning Proportions Vary Over Turn	Turning Proportions Vary Over Entry
		Yes	Yes	Truck Percentages	2.00				Yes	Yes

Entry Flows

General Flows Data

Roundabout	Arm	Profile Type	Use Turning Counts	Average Demand Flow (PCE/hr)	Flow Scaling Factor (%)	PHF
Columbia Dr Platinum Dr	Columbia St E	ONE HOUR	Yes	414.00	100.000	N/A
Columbia Dr Platinum Dr	Columbia St W	ONE HOUR	Yes	351.00	100.000	N/A
Columbia Dr Platinum Dr	Platinum Dr S	ONE HOUR	Yes	589.00	100.000	N/A
Boardwalk/Erb	Erb St E	ONE HOUR	Yes	1109.00	100.000	N/A
Boardwalk/Erb	Erb St W	ONE HOUR	Yes	1923.00	100.000	N/A
Boardwalk/Erb	The Boardwalk S	ONE HOUR	Yes	322.00	100.000	N/A

Direct/Resultant Flows

Direct Flows Data

Time Segment	Roundabout	Arm	Direct Demand Entry Flow (PCE/hr)	DirectDemandEntryFlowInPCE (PCE/hr)	Direct Demand Exit Flow (PCE/hr)	Direct Demand Pedestrian Flow (Ped/hr)
1	Columbia Dr Platinum Dr	Columbia St E	311.68	311.68	N/A	N/A
1	Columbia Dr Platinum Dr	Columbia St W	264.25	264.25	N/A	N/A
1	Columbia Dr Platinum Dr	Platinum Dr S	443.43	443.43	N/A	N/A
1	Boardwalk/Erb	Erb St E	834.91	834.91	N/A	N/A
1	Boardwalk/Erb	Erb St W	1447.74	1447.74	N/A	N/A
1	Boardwalk/Erb	The Boardwalk S	242.42	242.42	N/A	N/A
2	Columbia Dr Platinum Dr	Columbia St E	372.18	372.18	N/A	N/A
2	Columbia Dr Platinum Dr	Columbia St W	315.54	315.54	N/A	N/A
2	Columbia Dr Platinum Dr	Platinum Dr S	529.50	529.50	N/A	N/A
2	Boardwalk/Erb	Erb St E	996.97	996.97	N/A	N/A
2	Boardwalk/Erb	Erb St W	1728.74	1728.74	N/A	N/A
2	Boardwalk/Erb	The Boardwalk S	289.47	289.47	N/A	N/A
3	Columbia Dr Platinum Dr	Columbia St E	455.82	455.82	N/A	N/A
3	Columbia Dr Platinum Dr	Columbia St W	386.46	386.46	N/A	N/A
3	Columbia Dr Platinum Dr	Platinum Dr S	648.50	648.50	N/A	N/A
3	Boardwalk/Erb	Erb St E	1221.03	1221.03	N/A	N/A

3	Boardwalk/Erb	Erb St W	2117.26	2117.26	N/A	N/A
3	Boardwalk/Erb	The Boardwalk S	354.53	354.53	N/A	N/A
4	Columbia Dr Platinum Dr	Columbia St E	455.82	455.82	N/A	N/A
4	Columbia Dr Platinum Dr	Columbia St W	386.46	386.46	N/A	N/A
4	Columbia Dr Platinum Dr	Platinum Dr S	648.50	648.50	N/A	N/A
4	Boardwalk/Erb	Erb St E	1221.03	1221.03	N/A	N/A
4	Boardwalk/Erb	Erb St W	2117.26	2117.26	N/A	N/A
4	Boardwalk/Erb	The Boardwalk S	354.53	354.53	N/A	N/A
5	Columbia Dr Platinum Dr	Columbia St E	372.18	372.18	N/A	N/A
5	Columbia Dr Platinum Dr	Columbia St W	315.54	315.54	N/A	N/A
5	Columbia Dr Platinum Dr	Platinum Dr S	529.50	529.50	N/A	N/A
5	Boardwalk/Erb	Erb St E	996.97	996.97	N/A	N/A
5	Boardwalk/Erb	Erb St W	1728.74	1728.74	N/A	N/A
5	Boardwalk/Erb	The Boardwalk S	289.47	289.47	N/A	N/A
6	Columbia Dr Platinum Dr	Columbia St E	311.68	311.68	N/A	N/A
6	Columbia Dr Platinum Dr	Columbia St W	264.25	264.25	N/A	N/A
6	Columbia Dr Platinum Dr	Platinum Dr S	443.43	443.43	N/A	N/A
6	Boardwalk/Erb	Erb St E	834.91	834.91	N/A	N/A
6	Boardwalk/Erb	Erb St W	1447.74	1447.74	N/A	N/A
6	Boardwalk/Erb	The Boardwalk S	242.42	242.42	N/A	N/A

Turning Proportions

Turning Counts or Proportions (PCE/hr) - Columbia Dr Platinum Dr (for whole period)

		To		
		1	2	3
From	1	0.000	349.000	65.000
	2	333.000	0.000	18.000
	3	433.000	156.000	0.000

Turning Proportions (PCE) - Columbia Dr Platinum Dr (for whole period)

	To

		1	2	3
From	1	0.00	0.84	0.16
	2	0.95	0.00	0.05
	3	0.74	0.26	0.00

Turning Counts or Proportions (PCE/hr) - Boardwalk/ Erb (for whole period)

		To		
		1	2	3
From	1	0.000	1100.000	9.000
	2	1271.000	0.000	652.000
	3	21.000	301.000	0.000

Turning Proportions (PCE) - Boardwalk/ Erb (for whole period)

		To		
		1	2	3
From	1	0.00	0.99	0.01
	2	0.66	0.00	0.34
	3	0.07	0.93	0.00

Vehicle Mix

Average PCE Per Vehicle - Columbia Dr Platinum Dr (for whole period)

		To		
		1	2	3
From	1	1.000	1.000	1.000
	2	1.000	1.000	1.000
	3	1.000	1.000	1.000

Truck Percentages - Columbia Dr Platinum Dr (for whole period)

		To		
		1	2	3
From	1	0.000	0.000	0.000

	2	0.000	0.000	0.000
	3	0.000	0.000	0.000

Average PCE Per Vehicle - Boardwalk/ Erb (for whole period)

		To		
		1	2	3
From	1	1.000	1.000	1.000
	2	1.000	1.000	1.000
	3	1.000	1.000	1.000

Truck Percentages - Boardwalk/ Erb (for whole period)

		To		
		1	2	3
From	1	0.000	0.000	0.000
	2	0.000	0.000	0.000
	3	0.000	0.000	0.000

Results

Results Summary

Roundabout	Arm	Max RFC	Max Delay (s)	Max Queue (PCE)	Max LOS	Total Demand (PCE/hr)	Total Arrivals (PCE)	Total Queueing Delay (PCE-min)	Average Queueing Delay (s)	Rate Of Queueing Delay (PCE-min/min)	Inclusive Queueing Total Delay (PCE-min)	Inclusive Queueing Average Delay (s)	Slope	Intercept (PCE/hr)
Columbia Dr Platinum Dr	Columbia St E	0.23	2.38	0.30	A	379.89	569.84	21.44	2.26	0.24	21.44	2.26	0.723	2436.345
Columbia Dr Platinum Dr	Columbia St W	0.16	1.80	0.19	A	322.08	483.13	14.03	1.74	0.16	14.03	1.74	0.723	2436.345
Columbia Dr Platinum Dr	Platinum Dr S	0.30	2.36	0.43	A	540.48	810.72	29.39	2.18	0.33	29.39	2.18	0.723	2436.345
Boardwalk/Erb	Erb St E	0.65	5.57	1.87	A	1017.64	1526.46	110.50	4.34	1.23	110.51	4.34	0.723	2436.345
Boardwalk/Erb	Erb St W	0.87	11.40	6.48	B	1764.58	2646.87	297.68	6.75	3.31	297.71	6.75	0.723	2436.345
Boardwalk/Erb	The Boardwalk S	0.65	18.52	1.77	C	295.47	443.21	84.03	11.38	0.93	84.04	11.38	0.579	1357.445

Main Results

Main results: (4:00 PM-4:15 PM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	311.68	77.92	310.94	575.50	117.19	0.00	1998.88	1921.97	0.156	0.00	0.18
Columbia Dr Platinum Dr	Columbia St W	264.25	66.06	263.76	379.31	48.82	0.00	2401.05	2218.19	0.110	0.00	0.12
Columbia Dr Platinum Dr	Platinum Dr S	443.43	110.86	442.45	62.35	250.23	0.00	2255.44	914.94	0.197	0.00	0.24
Boardwalk/Erb	Erb St E	834.91	208.73	831.89	968.72	225.02	0.00	1932.62	1824.12	0.432	0.00	0.76
Boardwalk/Erb	Erb St W	1447.74	361.93	1441.91	1050.16	6.75	0.00	2431.46	2425.64	0.595	0.00	1.46
Boardwalk/Erb	The Boardwalk S	242.42	60.60	240.71	495.63	953.02	0.00	805.87	429.57	0.301	0.00	0.43

Main results: (4:15 PM-4:30 PM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	372.18	93.04	371.99	688.31	140.17	0.00	1984.76	1921.97	0.188	0.18	0.23
Columbia Dr Platinum Dr	Columbia St W	315.54	78.89	315.43	453.76	58.40	0.00	2394.12	2218.19	0.132	0.12	0.15
Columbia Dr Platinum Dr	Platinum Dr S	529.50	132.37	529.23	74.58	299.25	0.00	2220.00	914.94	0.239	0.24	0.31
Boardwalk/Erb	Erb St E	996.97	249.24	995.64	1158.87	269.58	0.00	1905.24	1824.14	0.523	0.76	1.09
Boardwalk/Erb	Erb St W	1728.74	432.18	1724.90	1257.14	8.08	0.00	2430.50	2425.64	0.711	1.46	2.42
Boardwalk/Erb	The Boardwalk S	289.47	72.37	288.38	592.91	1140.06	0.00	697.62	429.57	0.415	0.43	0.70

Main results: (4:30 PM-4:45 PM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	455.82	113.96	455.54	842.89	171.64	0.00	1965.42	1921.97	0.232	0.23	0.30
Columbia Dr Platinum Dr	Columbia St W	386.46	96.61	386.29	555.66	71.52	0.00	2384.64	2218.19	0.162	0.15	0.19
Columbia Dr Platinum Dr	Platinum Dr S	648.50	162.13	648.05	91.33	366.48	0.00	2171.40	914.94	0.299	0.31	0.42
Boardwalk/Erb	Erb St E	1221.03	305.26	1217.98	1412.19	327.69	0.00	1869.53	1824.14	0.653	1.09	1.85
Boardwalk/Erb	Erb St W	2117.26	529.32	2102.03	1535.78	9.88	0.00	2429.20	2425.64	0.872	2.42	6.22
Boardwalk/Erb	The Boardwalk S	354.53	88.63	350.55	722.59	1389.33	0.00	553.36	429.57	0.641	0.70	1.69

Main results: (4:45 PM-5:00 PM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	455.82	113.96	455.82	843.38	171.76	0.00	1965.35	1921.97	0.232	0.30	0.30
Columbia Dr Platinum Dr	Columbia St W	386.46	96.61	386.46	556.01	71.57	0.00	2384.61	2218.19	0.162	0.19	0.19
Columbia Dr Platinum Dr	Platinum Dr S	648.50	162.13	648.50	91.38	366.64	0.00	2171.28	914.94	0.299	0.42	0.43
Boardwalk/Erb	Erb St E	1221.03	305.26	1220.95	1421.82	331.11	0.00	1867.42	1824.14	0.654	1.85	1.87
Boardwalk/Erb	Erb St W	2117.26	529.32	2116.24	1542.15	9.91	0.00	2429.18	2425.64	0.872	6.22	6.48
Boardwalk/Erb	The Boardwalk S	354.53	88.63	354.21	727.43	1398.72	0.00	547.92	429.57	0.647	1.69	1.77

Main results: (5:00 PM-5:15 PM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	372.18	93.04	372.46	689.10	140.36	0.00	1984.64	1921.97	0.188	0.30	0.23
Columbia Dr Platinum Dr	Columbia St W	315.54	78.89	315.71	454.34	58.48	0.00	2394.07	2218.19	0.132	0.19	0.15
Columbia Dr Platinum Dr	Platinum Dr S	529.50	132.37	529.94	74.67	299.52	0.00	2219.81	914.94	0.239	0.43	0.31
Boardwalk/Erb	Erb St E	996.97	249.24	1000.01	1172.25	274.47	0.00	1902.23	1824.14	0.524	1.87	1.11
Boardwalk/Erb	Erb St W	1728.74	432.18	1744.61	1266.36	8.12	0.00	2430.48	2425.64	0.711	6.48	2.51
Boardwalk/Erb	The Boardwalk S	289.47	72.37	293.62	599.63	1153.10	0.00	690.08	429.57	0.419	1.77	0.73

Main results: (5:15 PM-5:30 PM)

Roundabout	Arm	Demand (PCE/hr)	Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	RFC	Start Queue (PCE)	End Queue (PCE)
Columbia Dr Platinum Dr	Columbia St E	311.68	77.92	311.87	576.99	117.52	0.00	1998.68	1921.97	0.156	0.23	0.19
Columbia Dr Platinum Dr	Columbia St W	264.25	66.06	264.36	380.42	48.96	0.00	2400.95	2218.19	0.110	0.15	0.12
Columbia Dr Platinum Dr	Platinum Dr S	443.43	110.86	443.71	62.52	250.81	0.00	2255.02	914.94	0.197	0.31	0.25
Boardwalk/Erb	Erb St E	834.91	208.73	836.29	975.47	227.72	0.00	1930.96	1824.12	0.432	1.11	0.77
Boardwalk/Erb	Erb St W	1447.74	361.93	1451.84	1057.23	6.79	0.00	2431.44	2425.64	0.595	2.51	1.49
Boardwalk/Erb	The Boardwalk S	242.42	60.60	243.61	499.04	959.59	0.00	802.08	429.57	0.302	0.73	0.44

Queueing Delay Results

Queueing Delay results: (4:00 PM-4:15 PM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	Columbia St E	2.73	0.18	2.131	A	A
Columbia Dr Platinum Dr	Columbia St W	1.83	0.12	1.683	A	A
Columbia Dr Platinum Dr	Platinum Dr S	3.61	0.24	1.984	A	A
Boardwalk/Erb	Erb St E	11.05	0.74	3.263	A	A
Boardwalk/Erb	Erb St W	21.12	1.41	3.618	A	A
Boardwalk/Erb	The Boardwalk S	6.16	0.41	6.350	A	A

Queueing Delay results: (4:15 PM-4:30 PM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	Columbia St E	3.42	0.23	2.232	A	A
Columbia Dr Platinum Dr	Columbia St W	2.25	0.15	1.731	A	A
Columbia Dr Platinum Dr	Platinum Dr S	4.64	0.31	2.129	A	A
Boardwalk/Erb	Erb St E	15.93	1.06	3.952	A	A
Boardwalk/Erb	Erb St W	34.75	2.32	5.075	A	A
Boardwalk/Erb	The Boardwalk S	10.07	0.67	8.773	A	A

Queueing Delay results: (4:30 PM-4:45 PM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	Columbia St E	4.46	0.30	2.384	A	A
Columbia Dr Platinum Dr	Columbia St W	2.87	0.19	1.800	A	A
Columbia Dr Platinum Dr	Platinum Dr S	6.29	0.42	2.363	A	A
Boardwalk/Erb	Erb St E	26.66	1.78	5.498	A	A
Boardwalk/Erb	Erb St W	82.78	5.52	10.541	B	B
Boardwalk/Erb	The Boardwalk S	23.19	1.55	17.419	C	B

Queueing Delay results: (4:45 PM-5:00 PM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	Columbia St E	4.52	0.30	2.384	A	A
Columbia Dr Platinum Dr	Columbia St W	2.90	0.19	1.800	A	A
Columbia Dr Platinum Dr	Platinum Dr S	6.37	0.42	2.363	A	A

Boardwalk/Erb	**Erb St E**	27.95	1.86	5.566	A	A
Boardwalk/Erb	**Erb St W**	95.67	6.38	11.403	B	B
Boardwalk/Erb	**The Boardwalk S**	26.16	1.74	18.519	C	B

Queueing Delay results: (5:00 PM-5:15 PM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	**Columbia St E**	3.51	0.23	2.234	A	A
Columbia Dr Platinum Dr	**Columbia St W**	2.30	0.15	1.734	A	A
Columbia Dr Platinum Dr	**Platinum Dr S**	4.77	0.32	2.132	A	A
Boardwalk/Erb	**Erb St E**	17.17	1.14	4.004	A	A
Boardwalk/Erb	**Erb St W**	40.37	2.69	5.365	A	A
Boardwalk/Erb	**The Boardwalk S**	11.67	0.78	9.173	A	A

Queueing Delay results: (5:15 PM-5:30 PM)

Roundabout	Arm	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
Columbia Dr Platinum Dr	**Columbia St E**	2.81	0.19	2.134	A	A
Columbia Dr Platinum Dr	**Columbia St W**	1.87	0.12	1.686	A	A
Columbia Dr Platinum Dr	**Platinum Dr S**	3.72	0.25	1.989	A	A
Boardwalk/Erb	**Erb St E**	11.74	0.78	3.292	A	A
Boardwalk/Erb	**Erb St W**	22.99	1.53	3.692	A	A
Boardwalk/Erb	**The Boardwalk S**	6.77	0.45	6.459	A	A

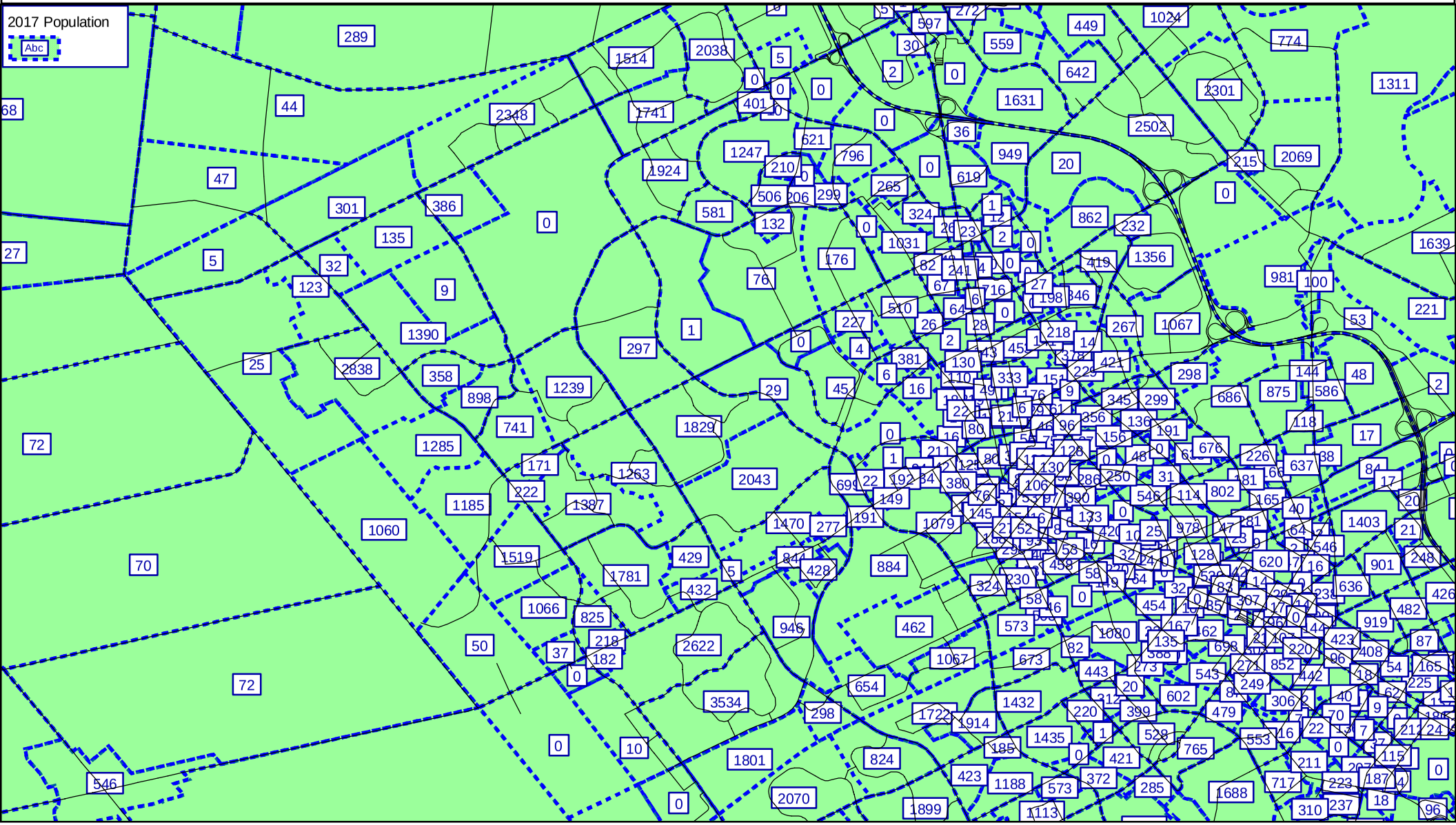
APPENDIX

E VISUM MODEL INFORMATION

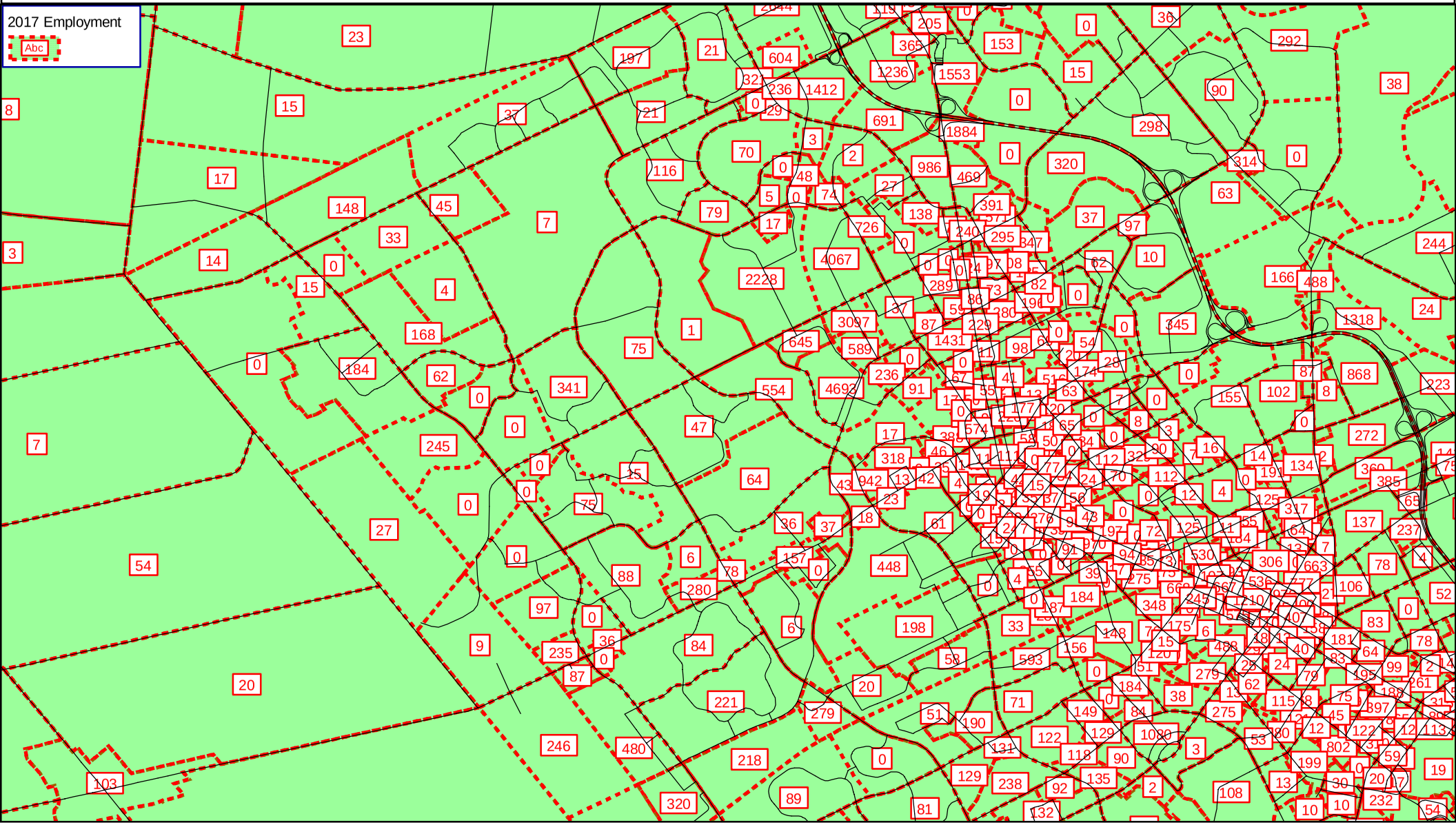
APPENDIX

E-1 2017 AND 2031 POPULATION AND EMPLOYMENT

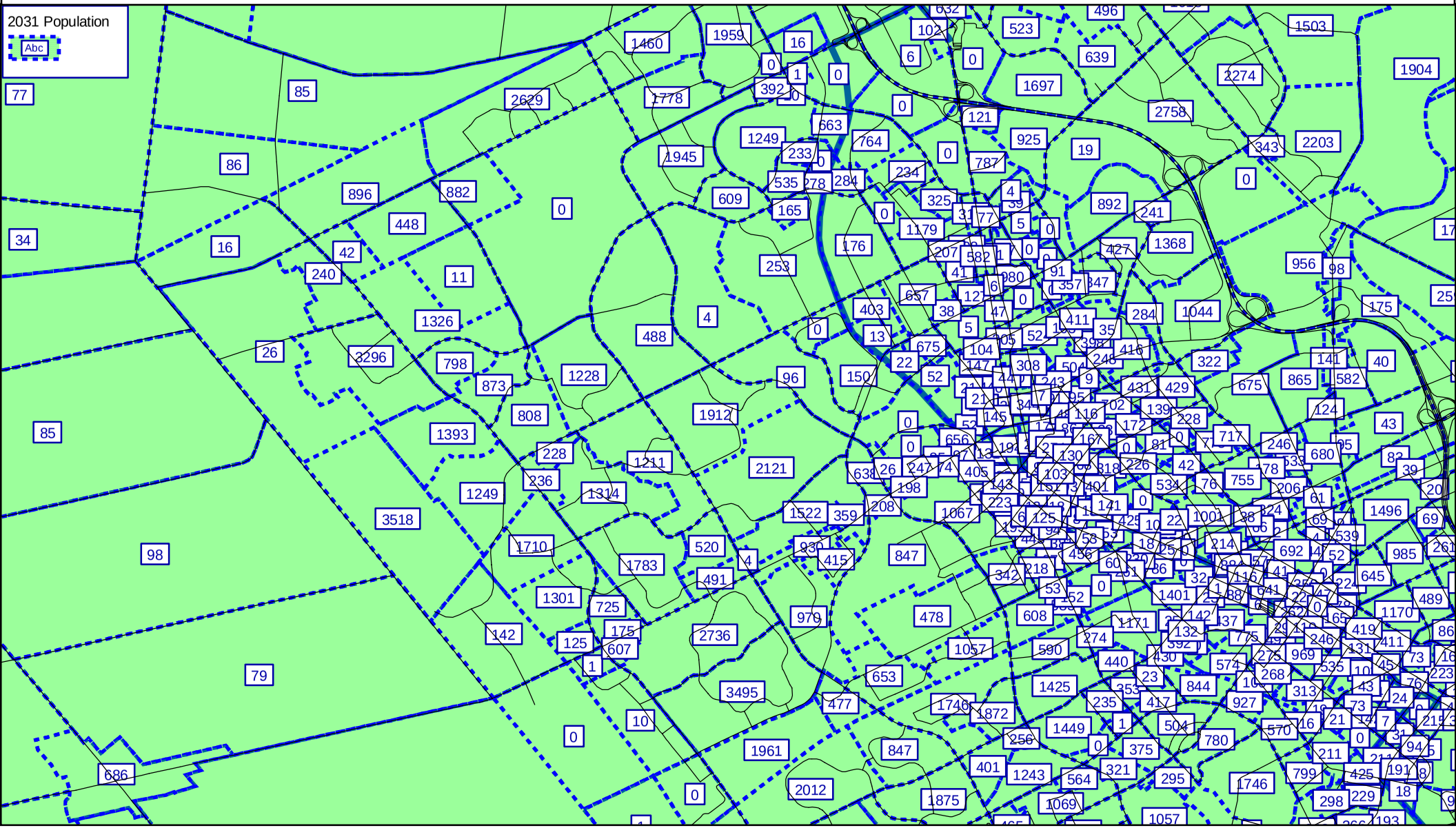
2017 Population



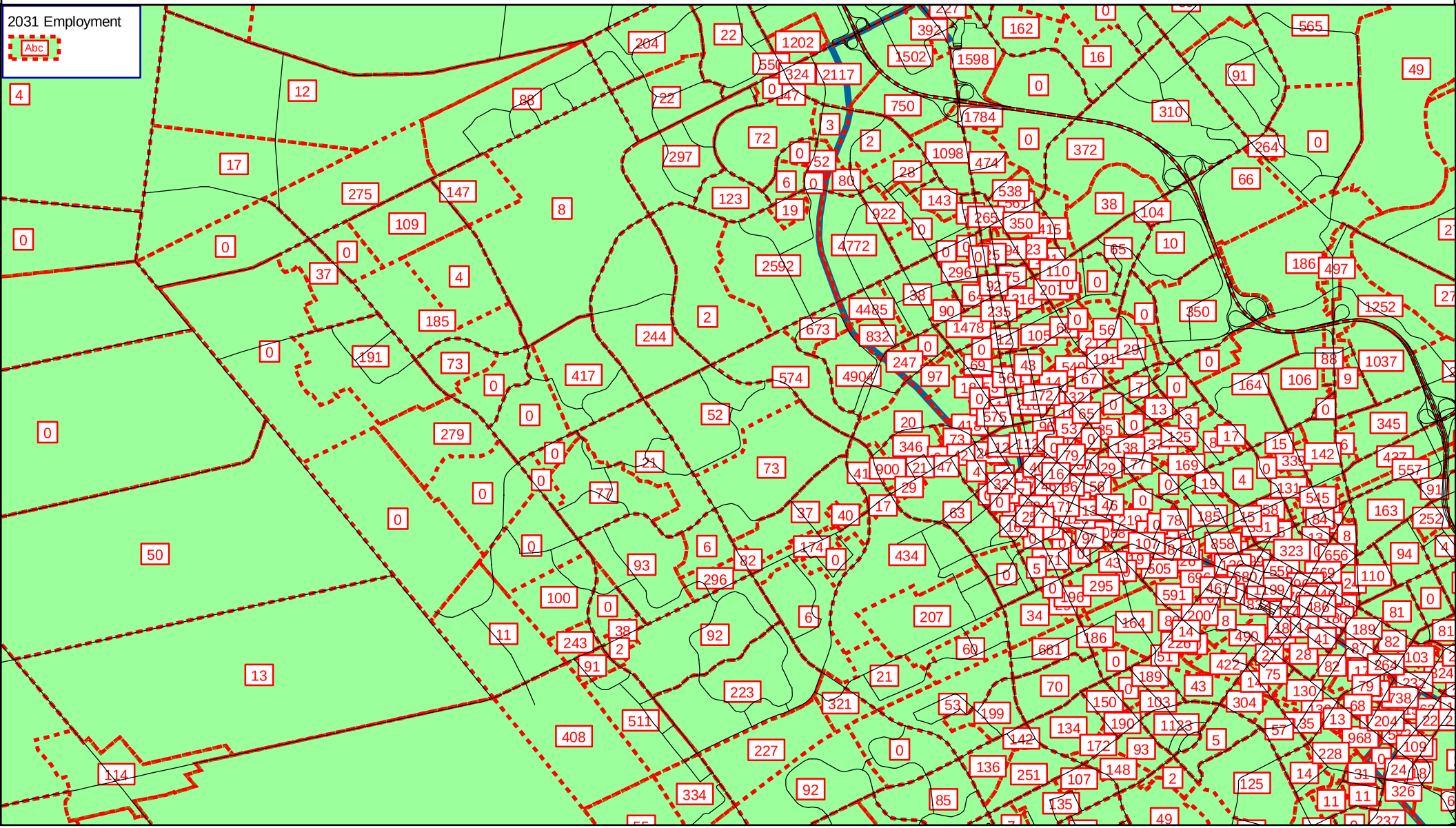
2017 Employment



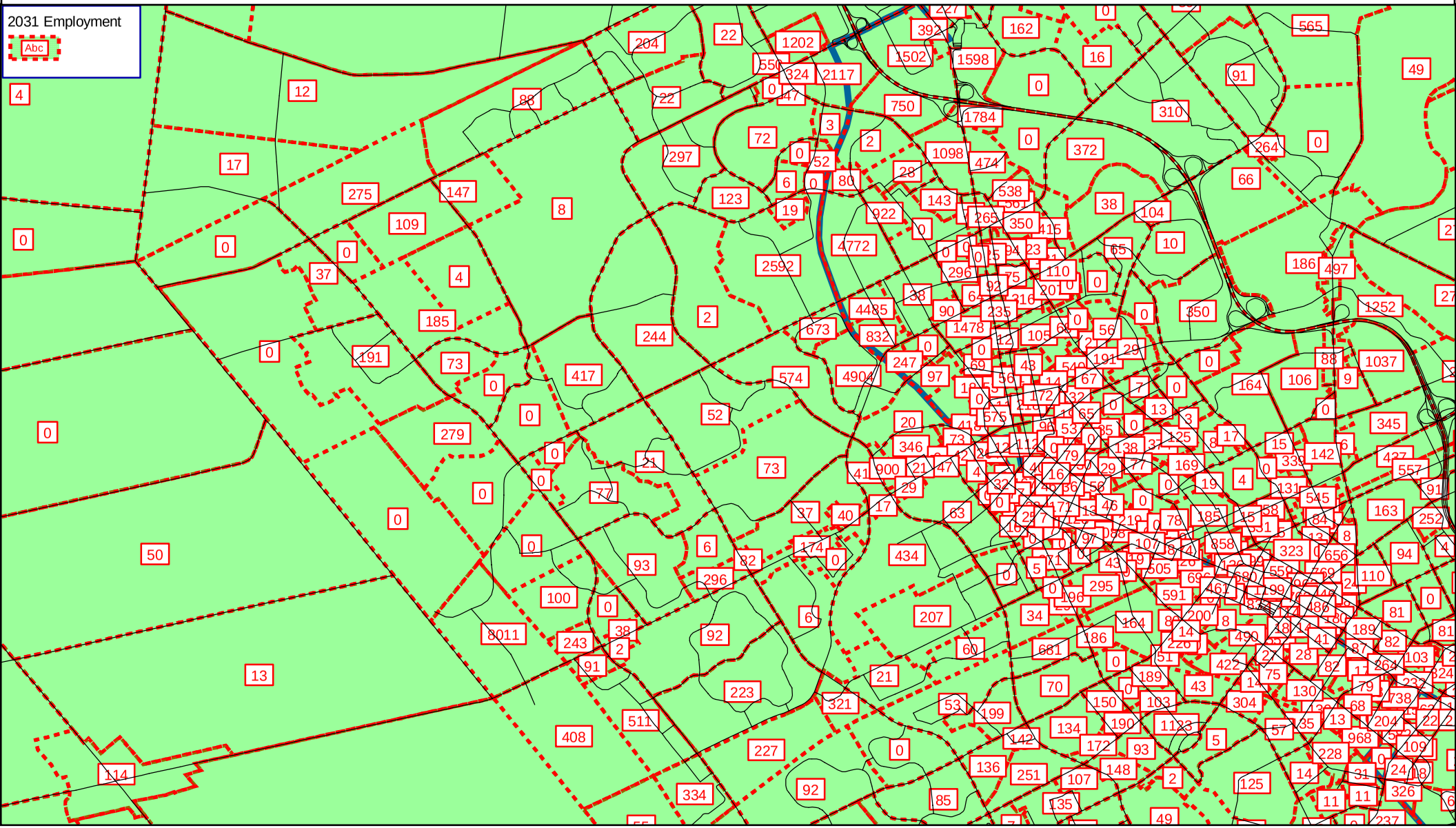
2031 Population



2031 Base Case (Without Development) Employment

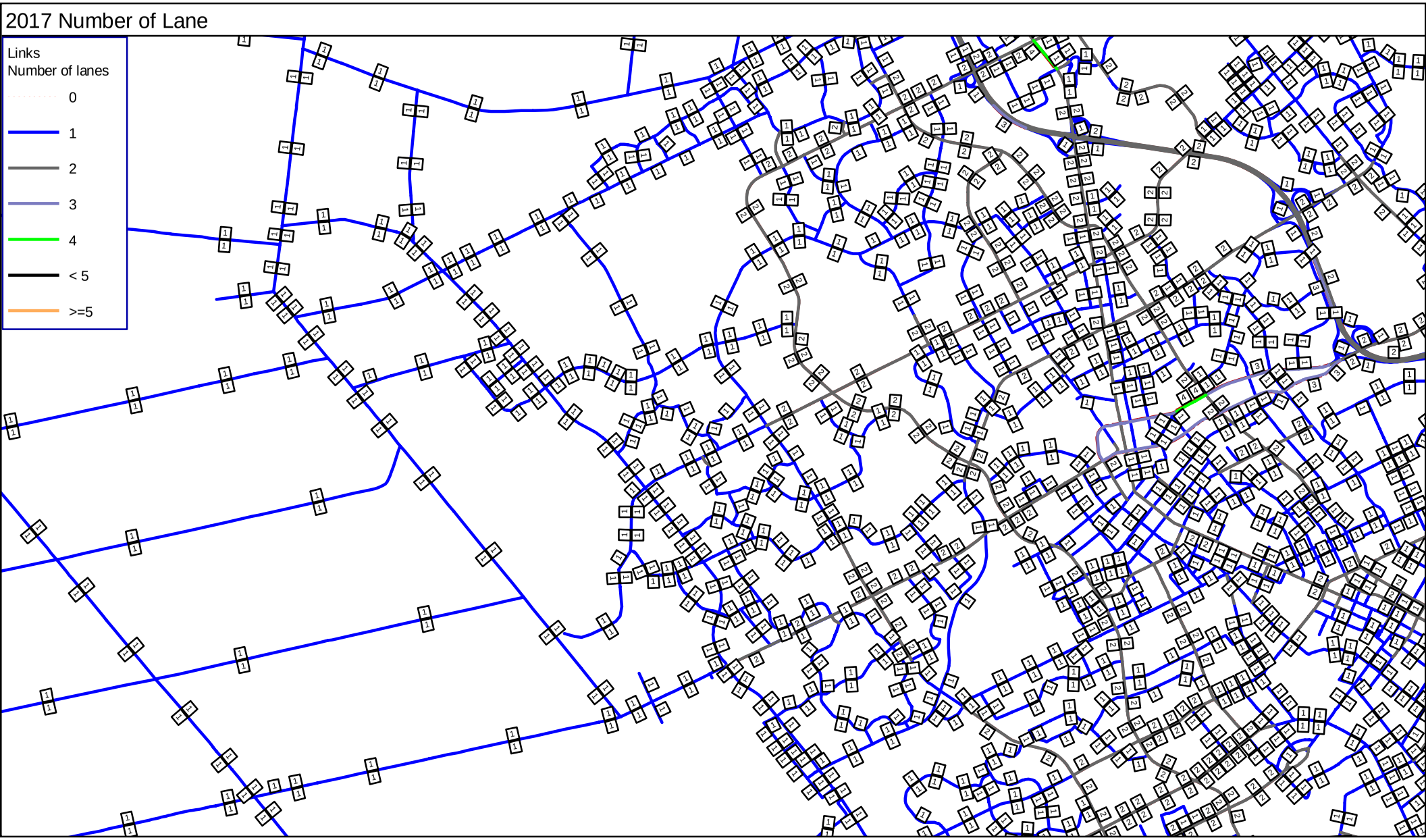


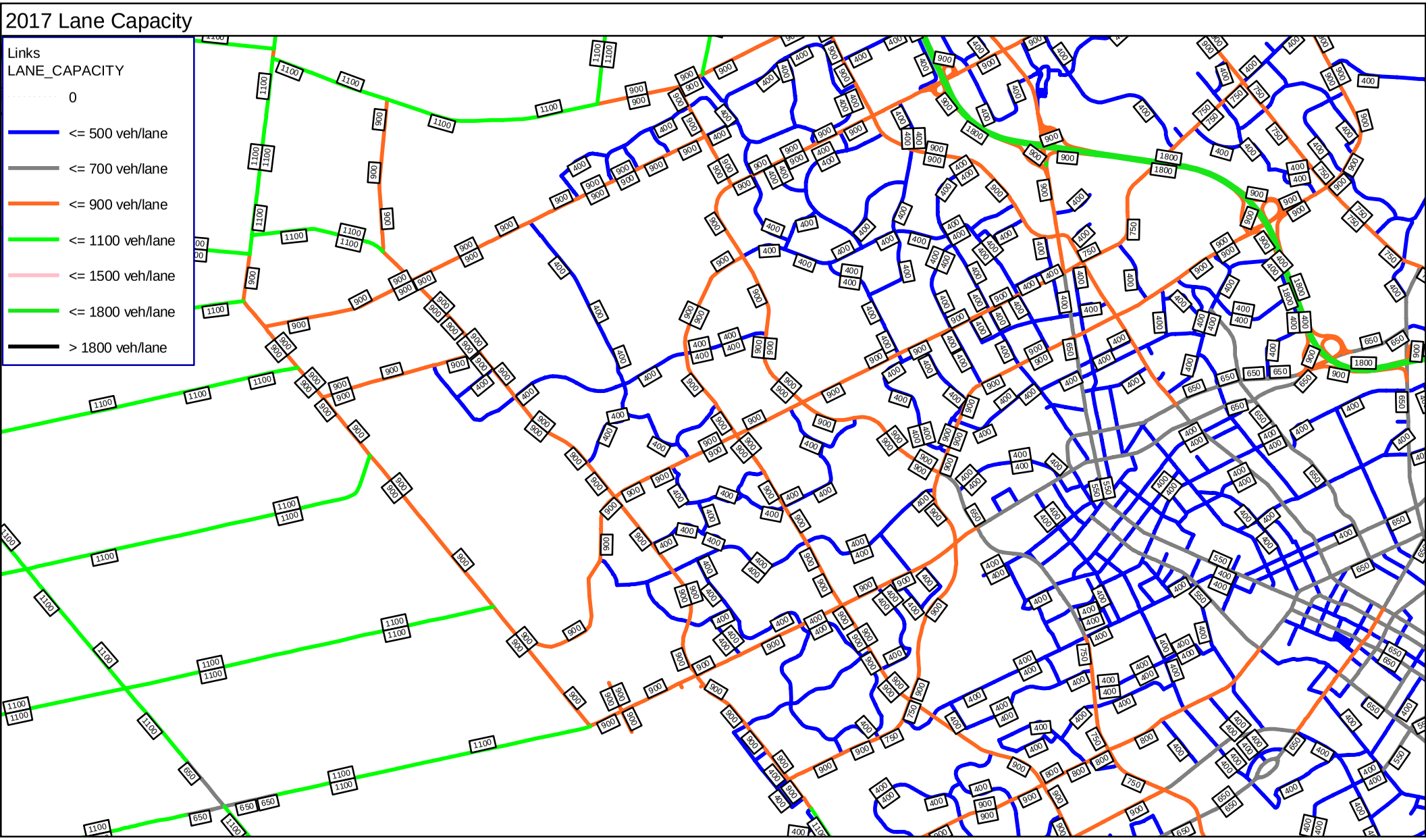
2031 Proposed (With Development) Employment

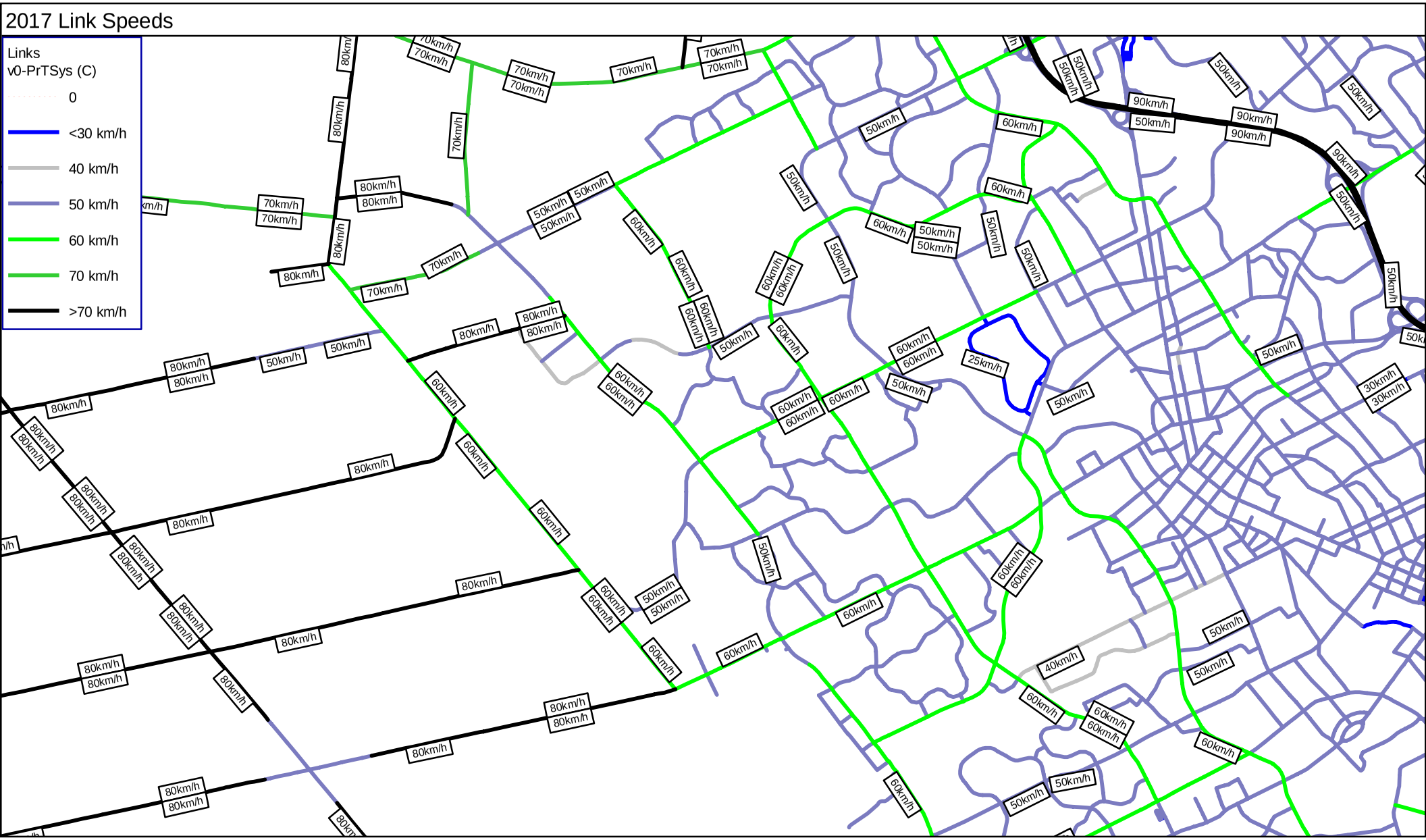


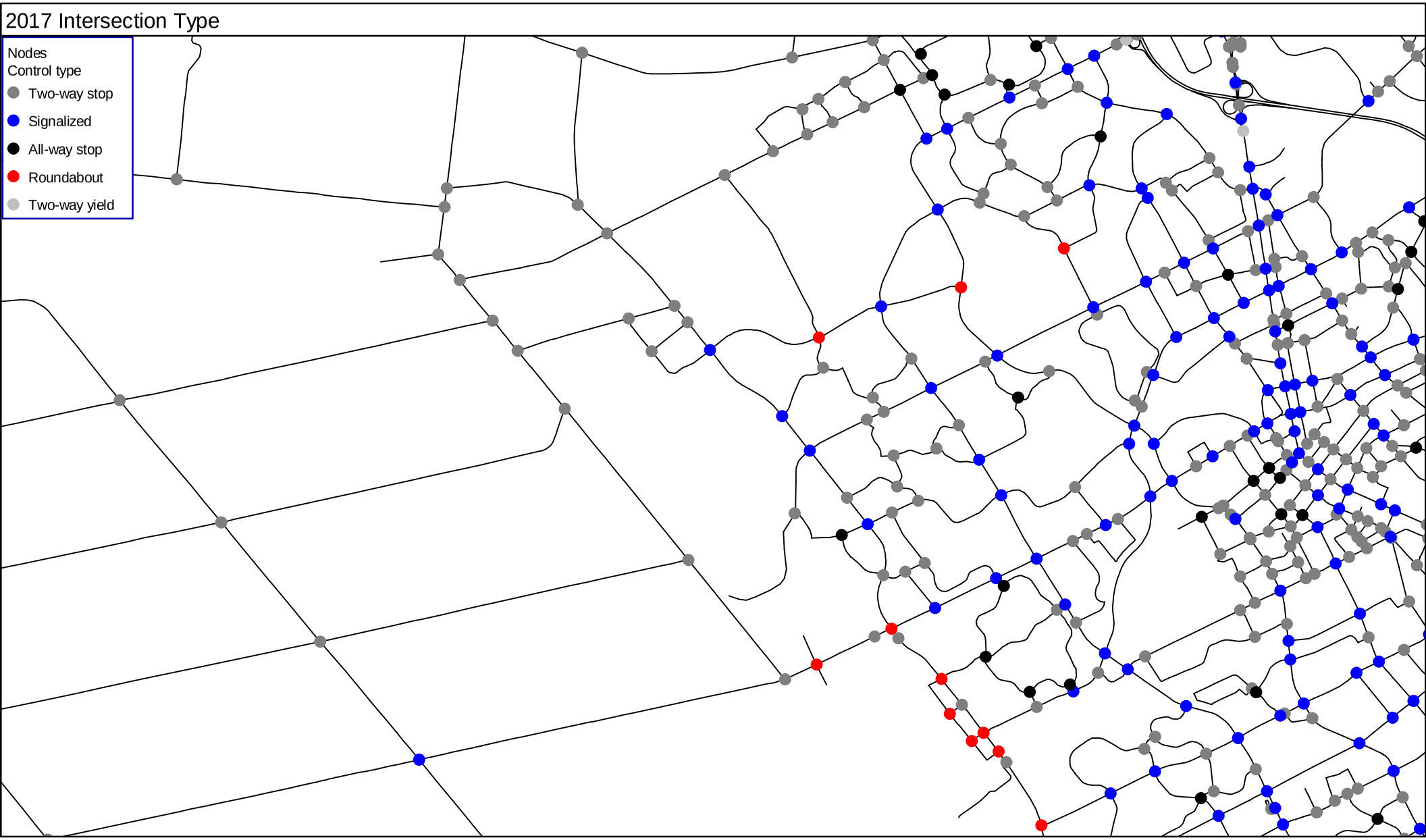
APPENDIX

E-2 2017 STUDY AREA NETWORK

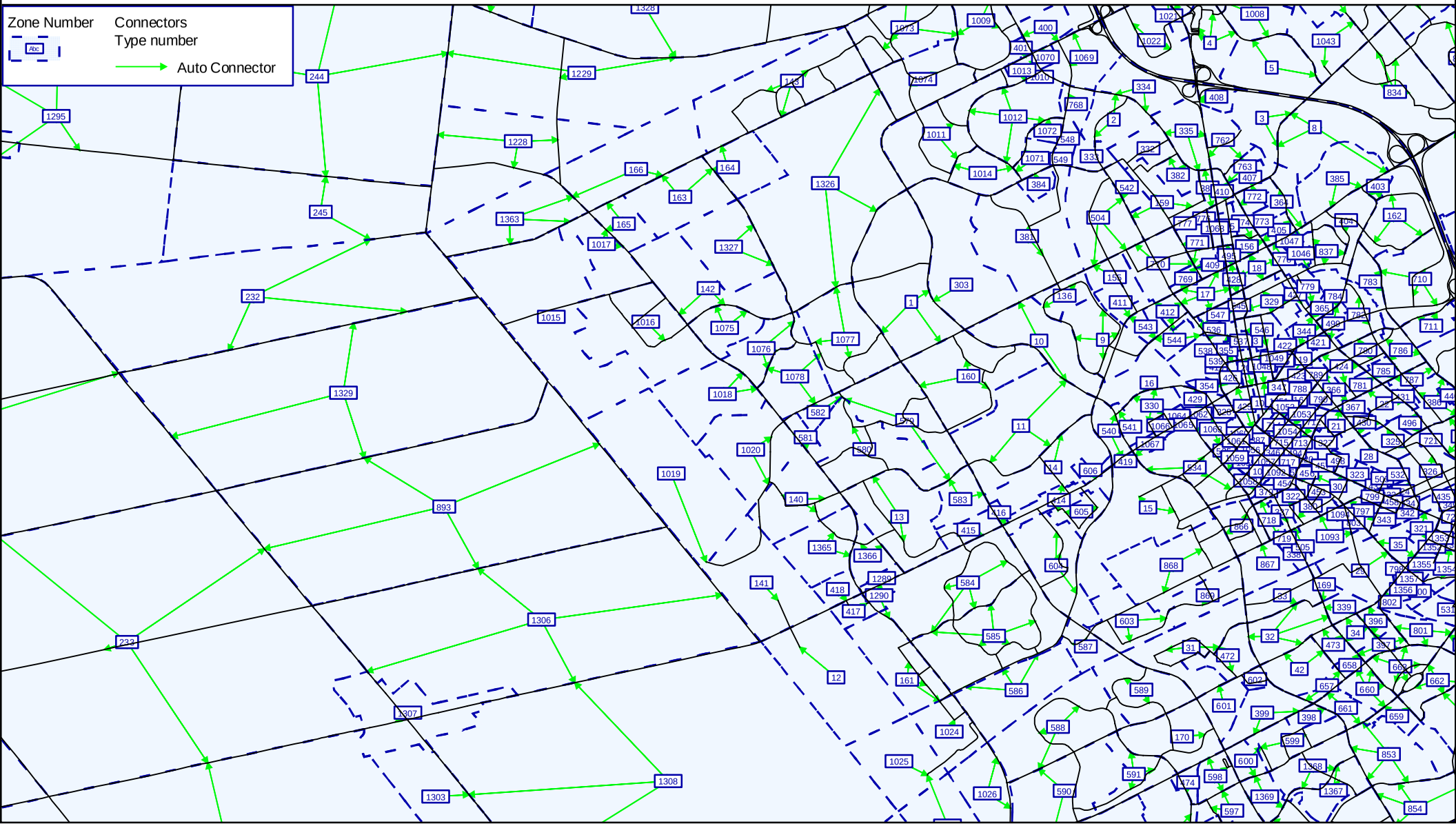

2017 Number of Lane
Links
Number of lanes
0
1
2
3
4
< 5
>=5


2017 Lane Capacity
Links
LANE_CAPACITY
0
<= 500 veh/lane
<= 700 veh/lane
<= 900 veh/lane
<= 1100 veh/lane
<= 1500 veh/lane
<= 1800 veh/lane
> 1800 veh/lane


2017 Link Speeds
Links
v0-PrTSys (C)
0
<30 km/h
40 km/h
50 km/h
60 km/h
70 km/h
>70 km/h


2017 Intersection Type
Nodes
Control type
Two-way stop
Signalized
All-way stop
Roundabout
Two-way yield

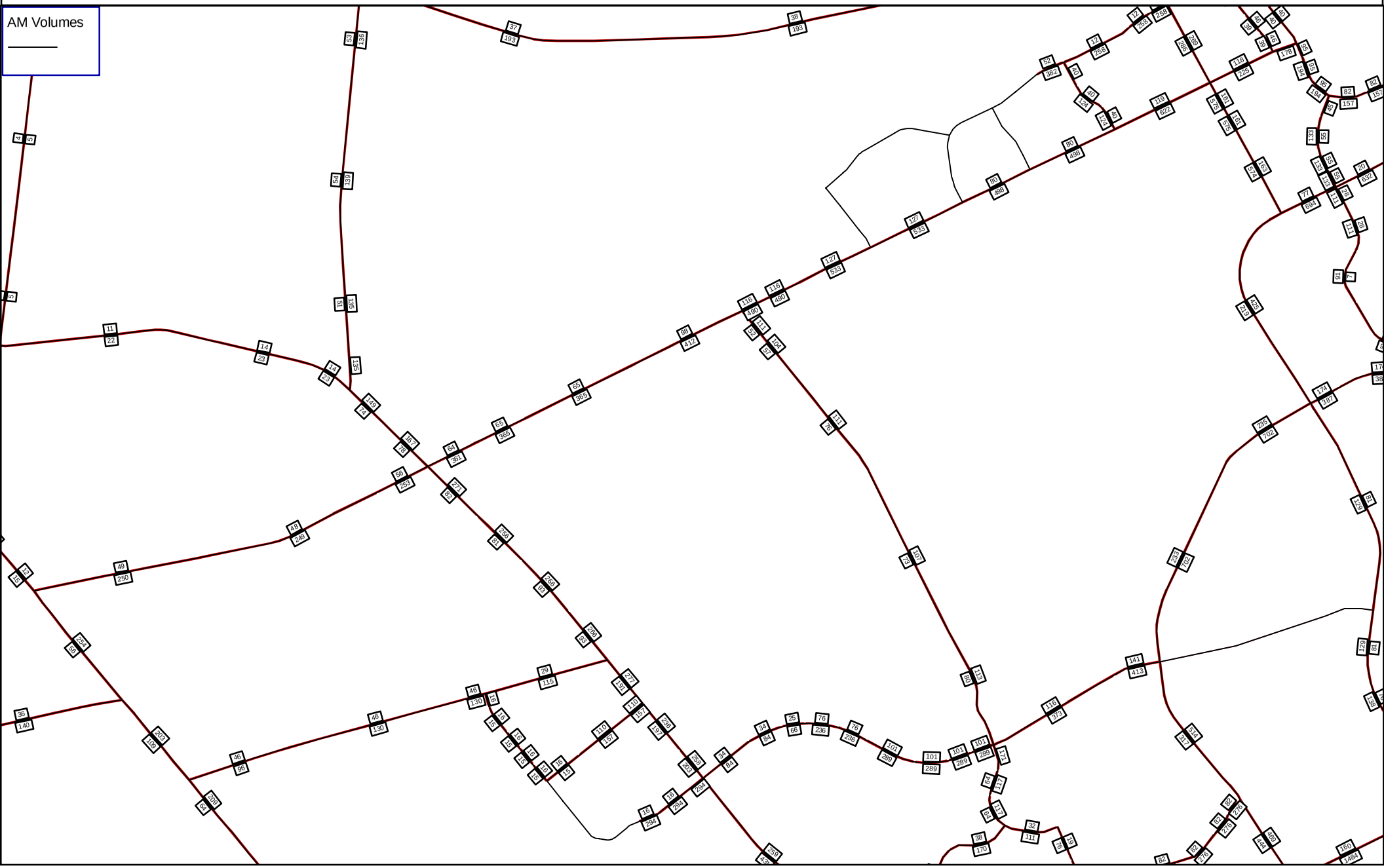
2017 Centroid Connectors



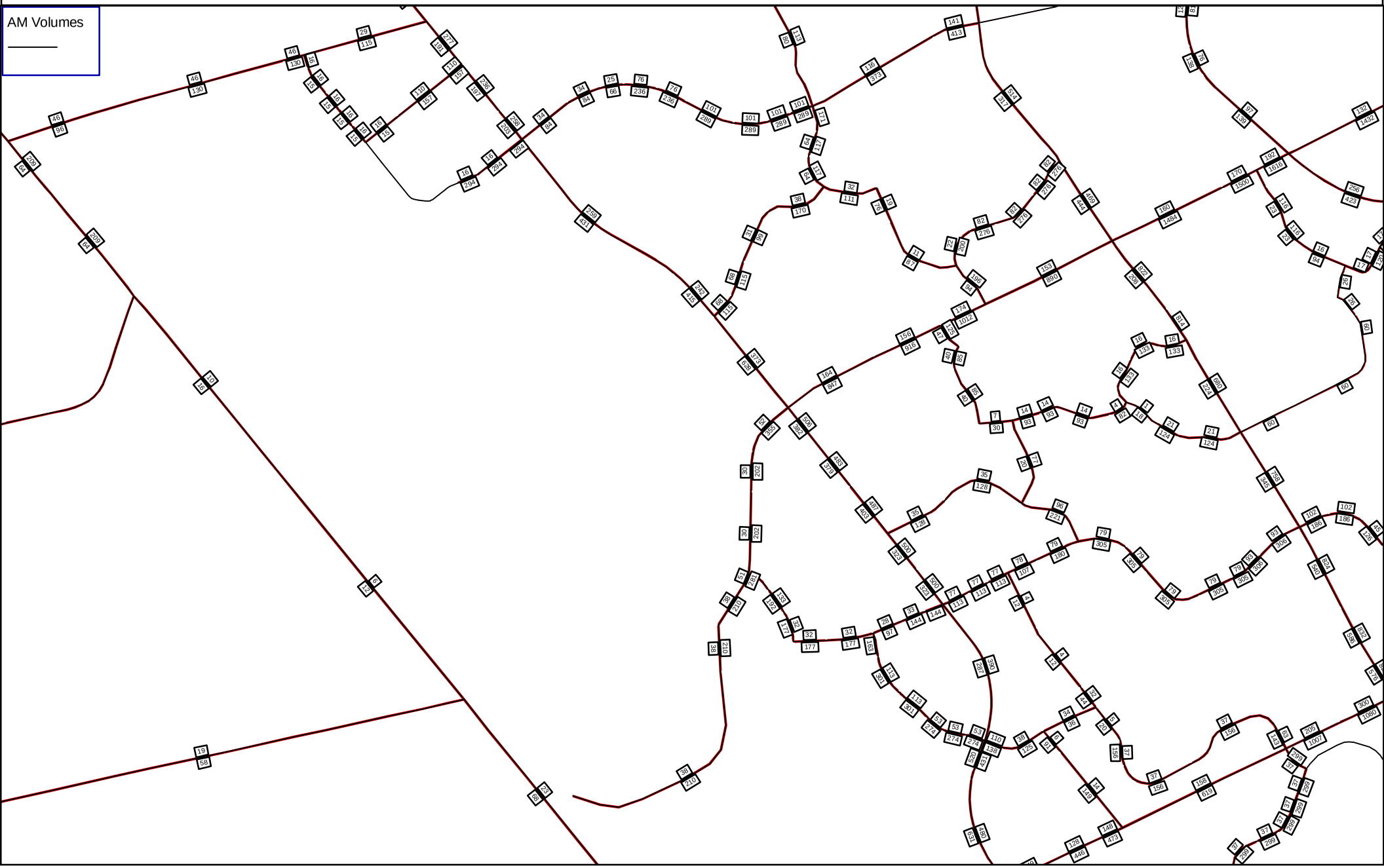
APPENDIX

E-3 2017 MODEL RESULTS

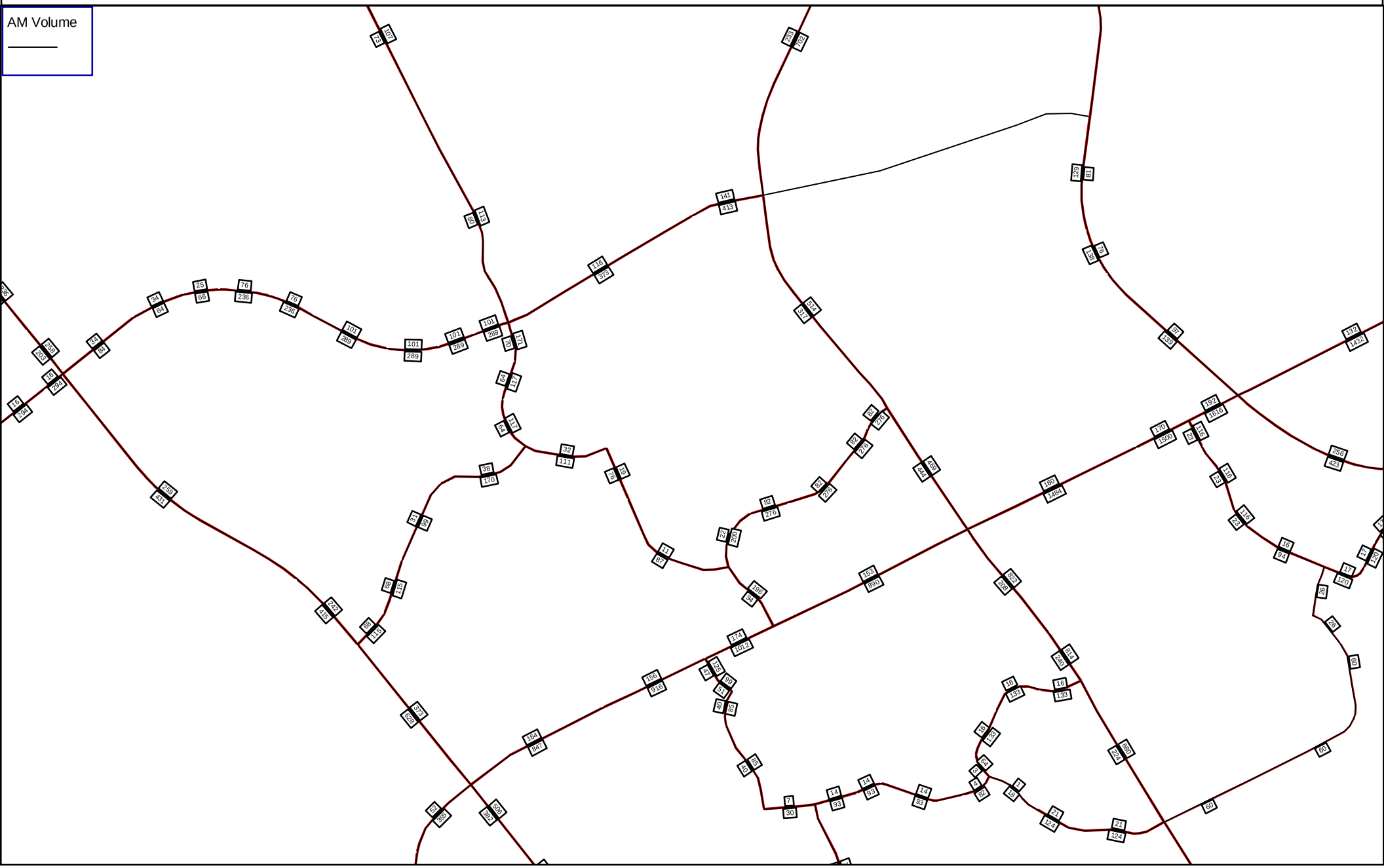
2017 AM Volume



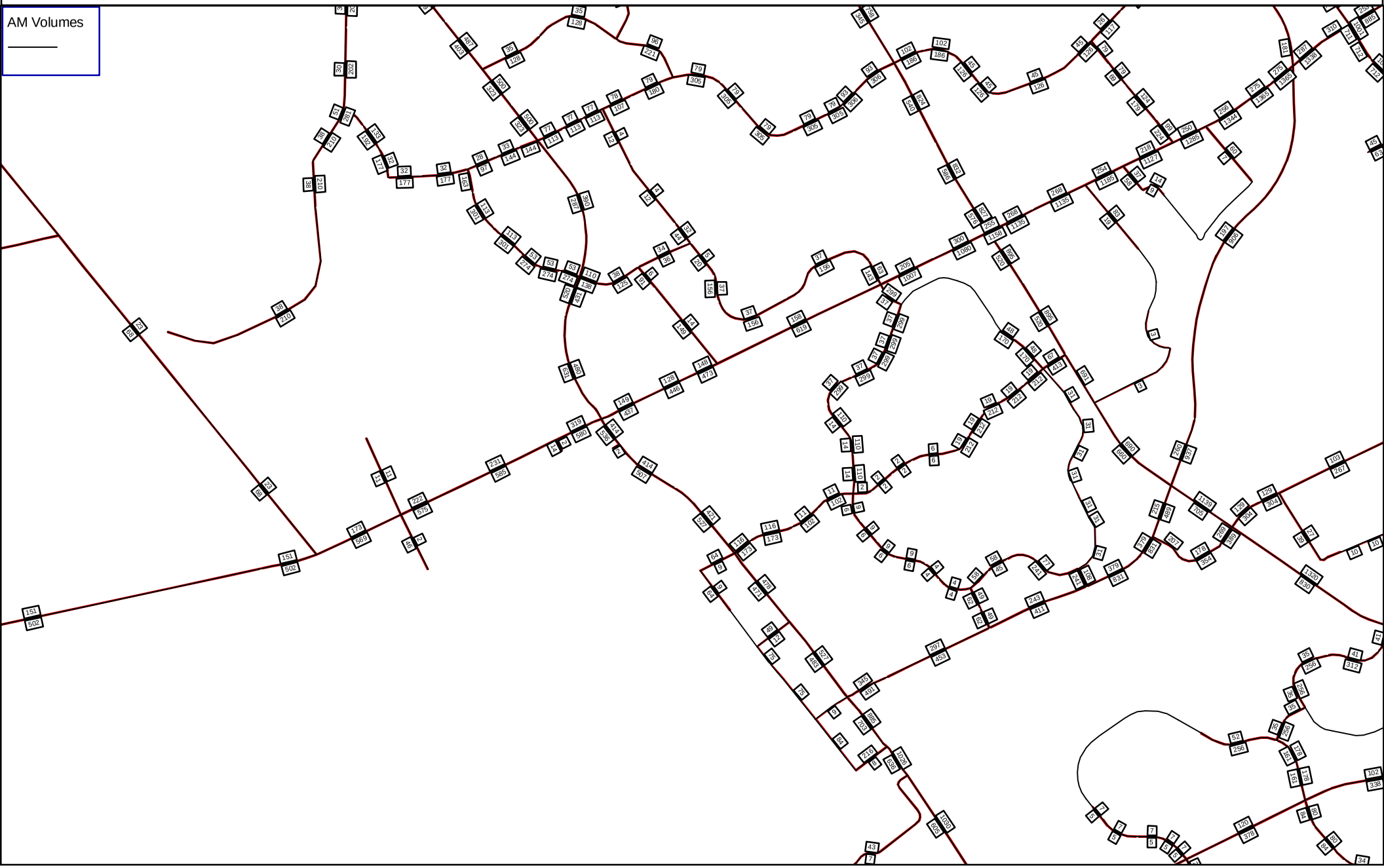
2017 AM Volume



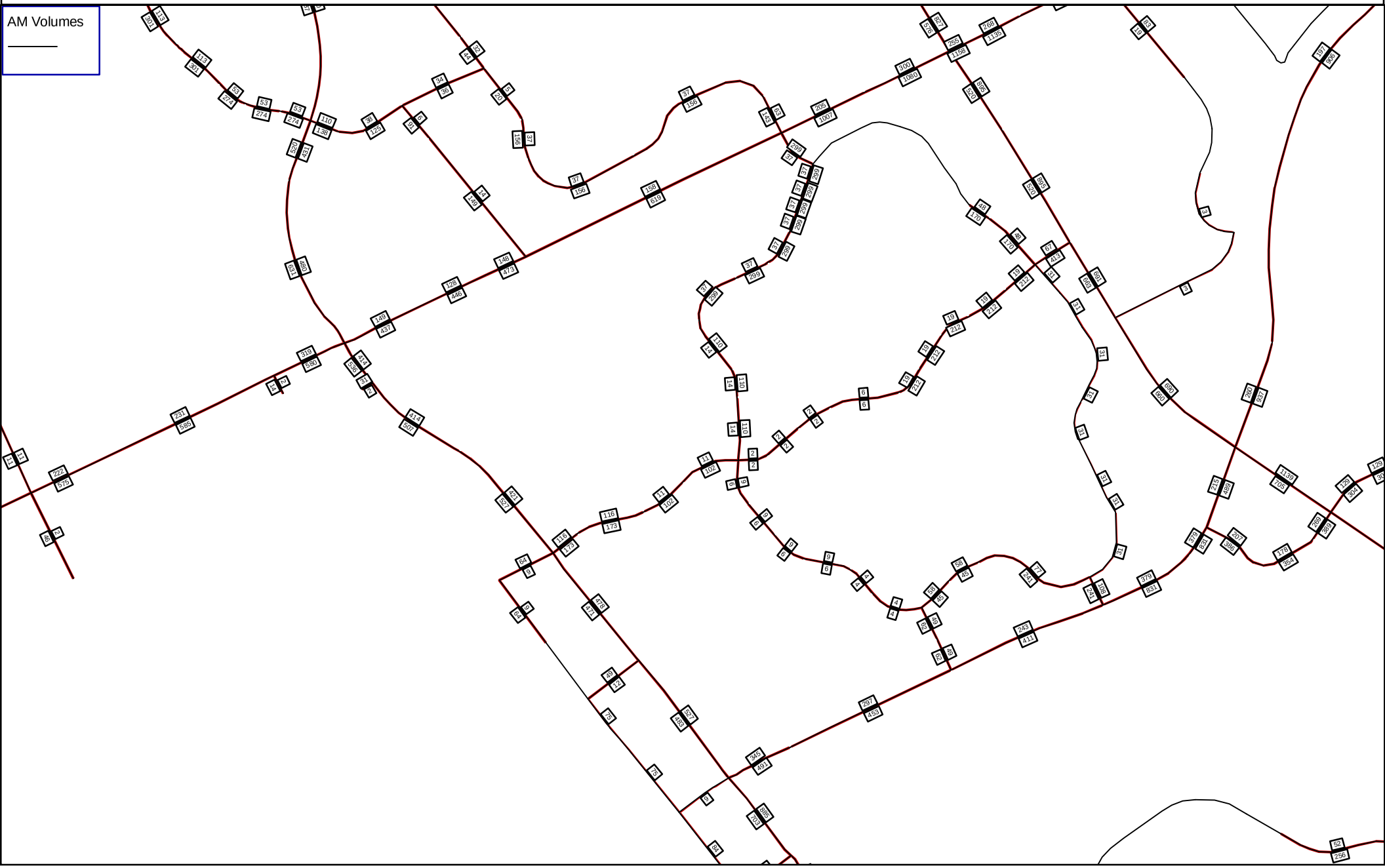
2017 AM Volume



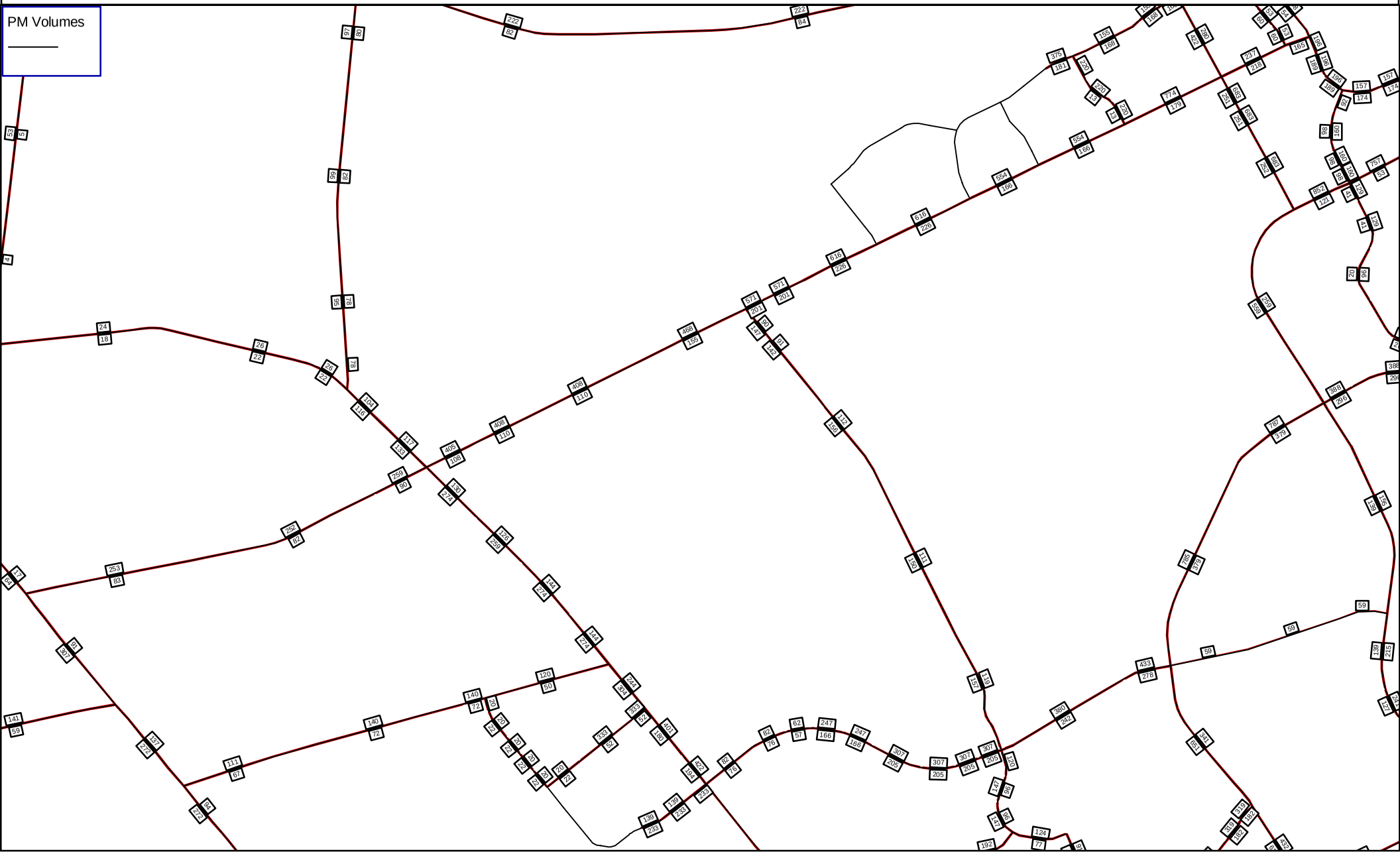
2017 AM Volume



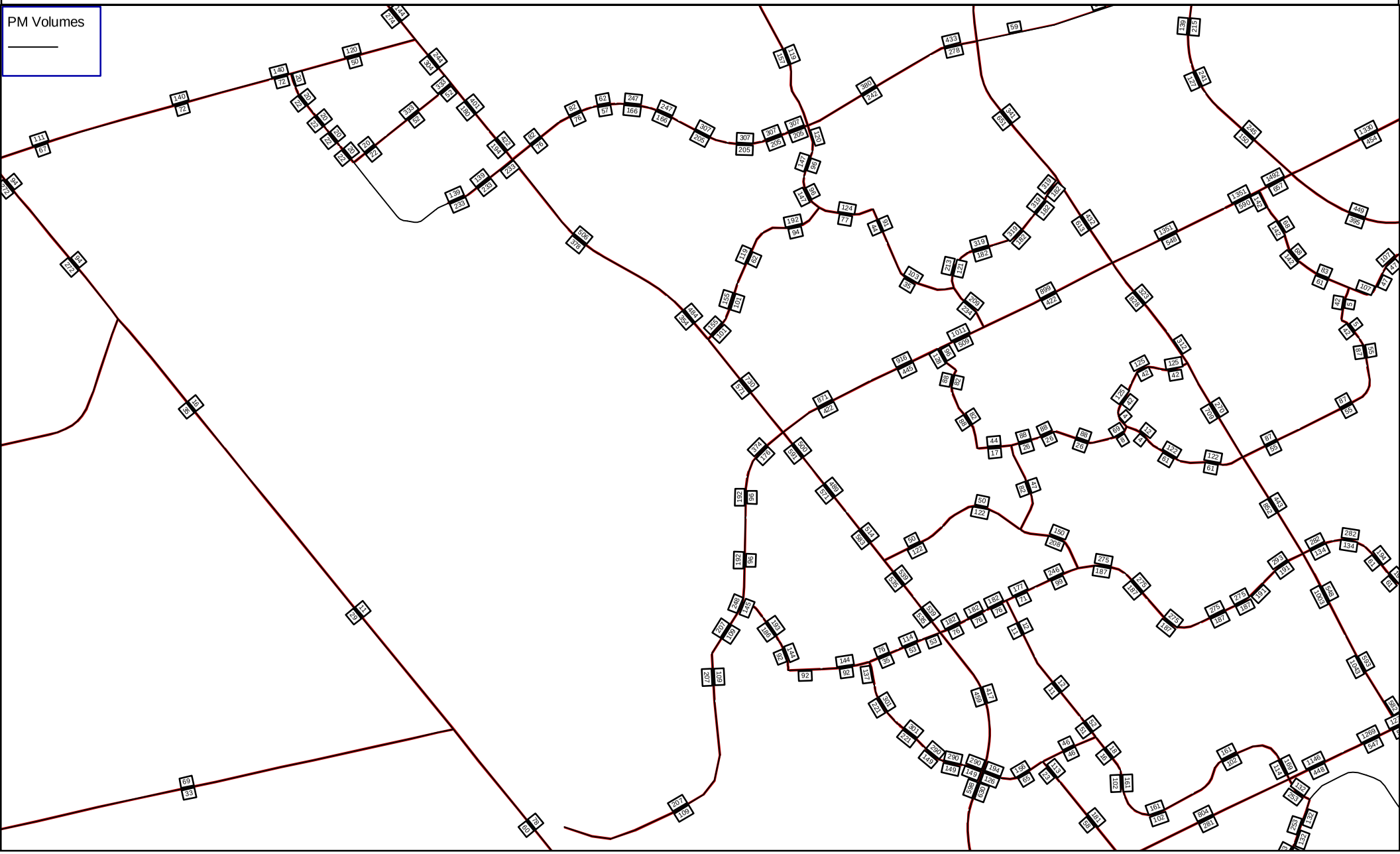
2017 AM Volume



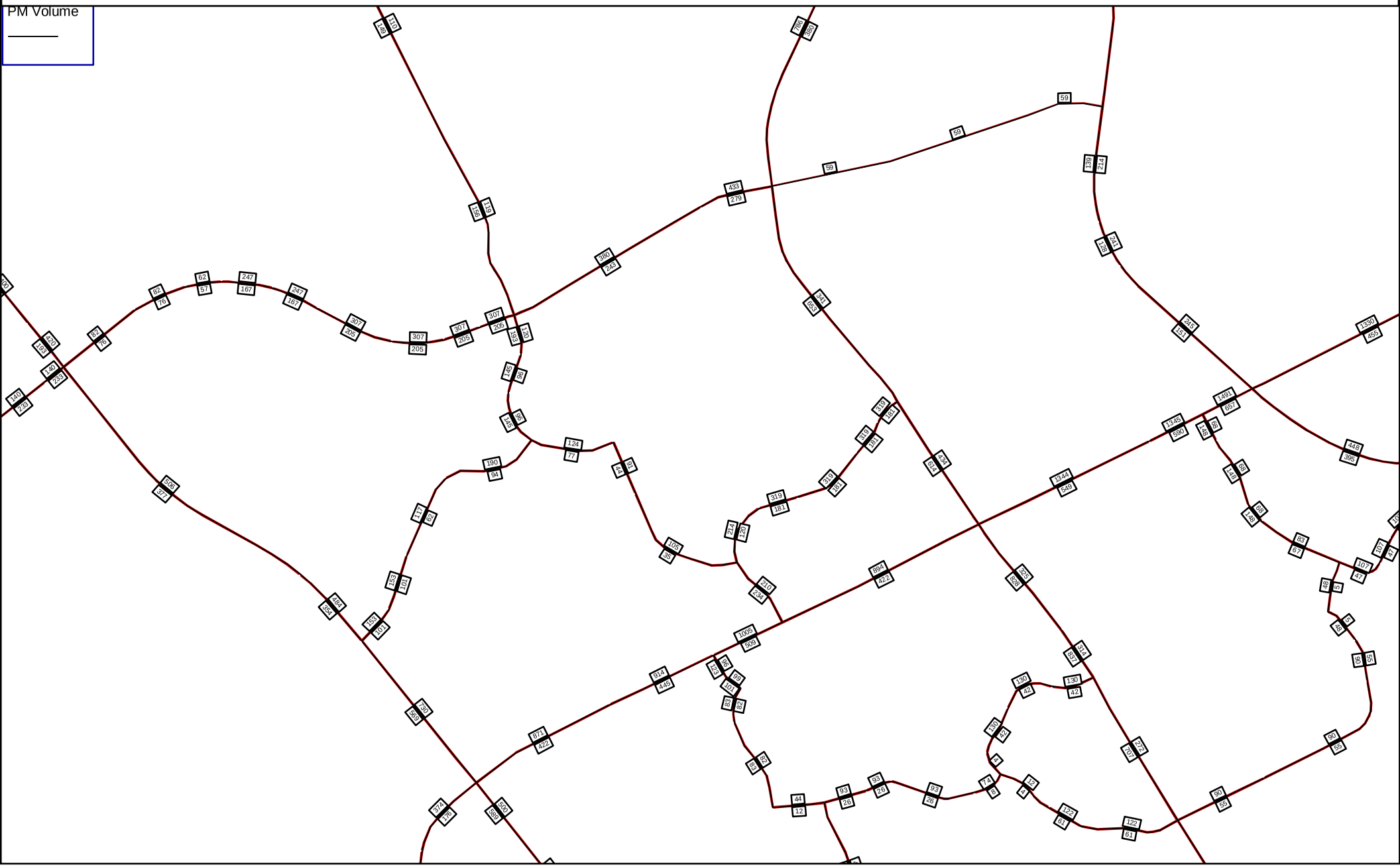
2017 PM Volume



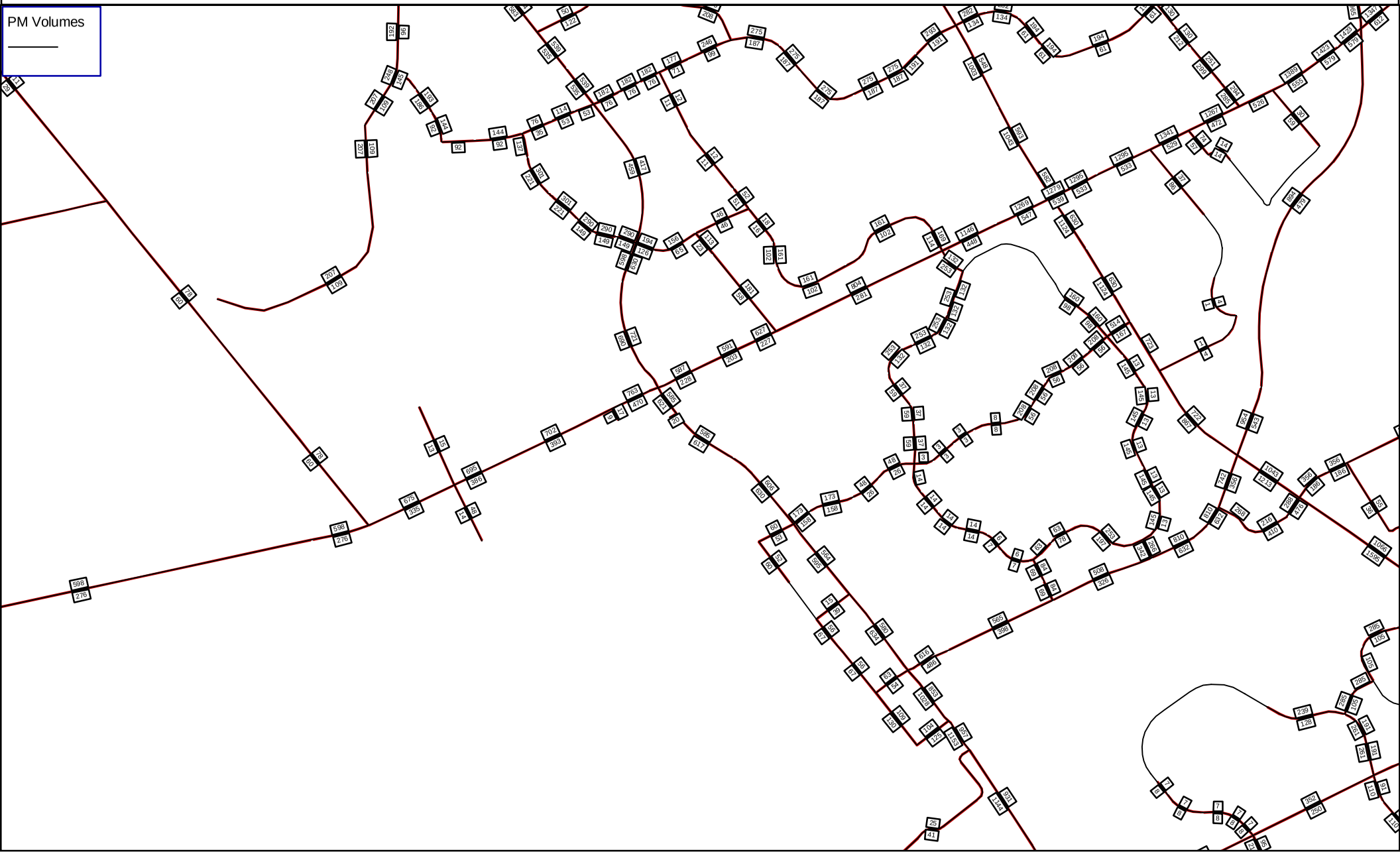
2017 PM Volume



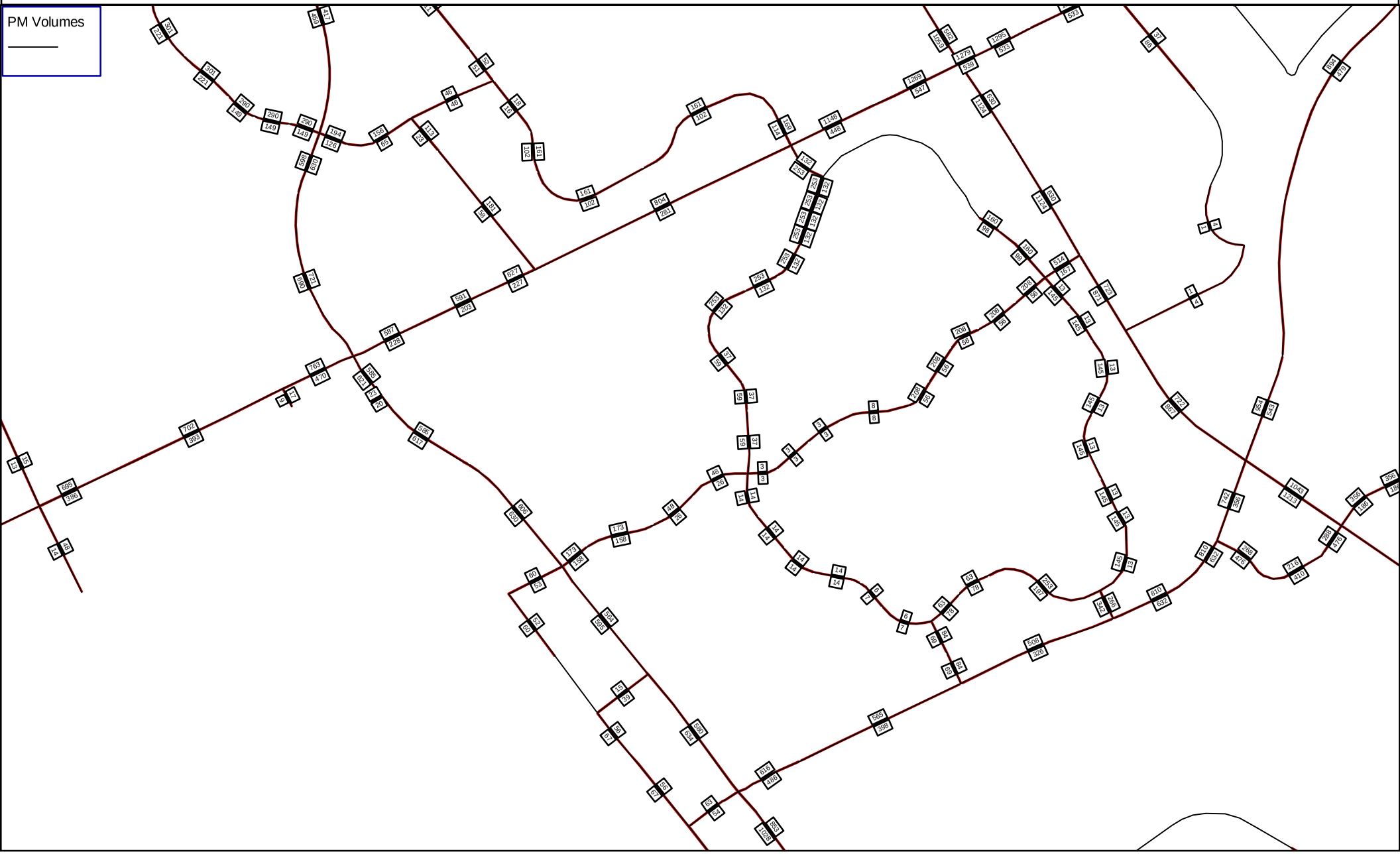
2017 PM Volume



2017 PM Volume



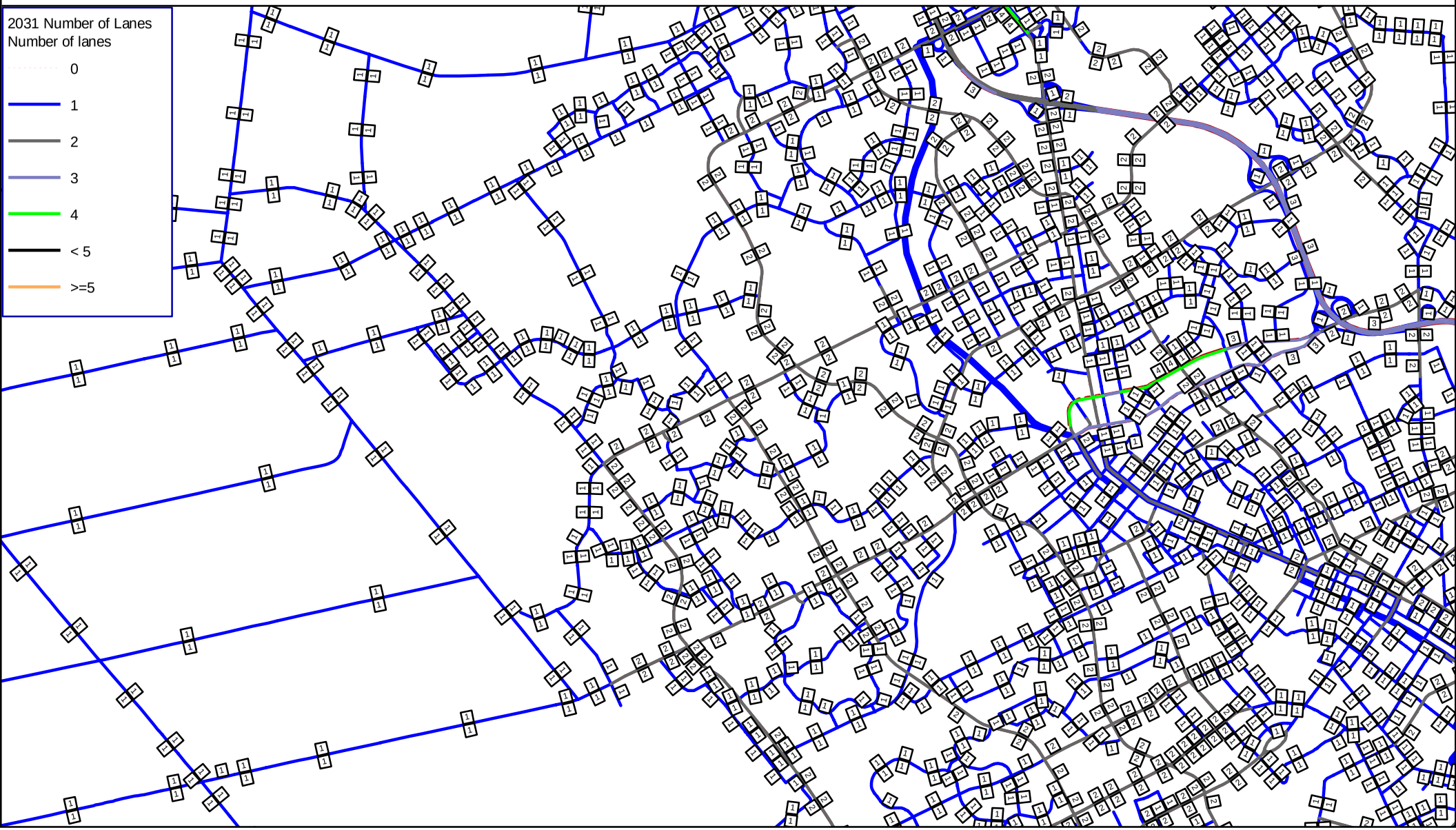
2017 PM Volume



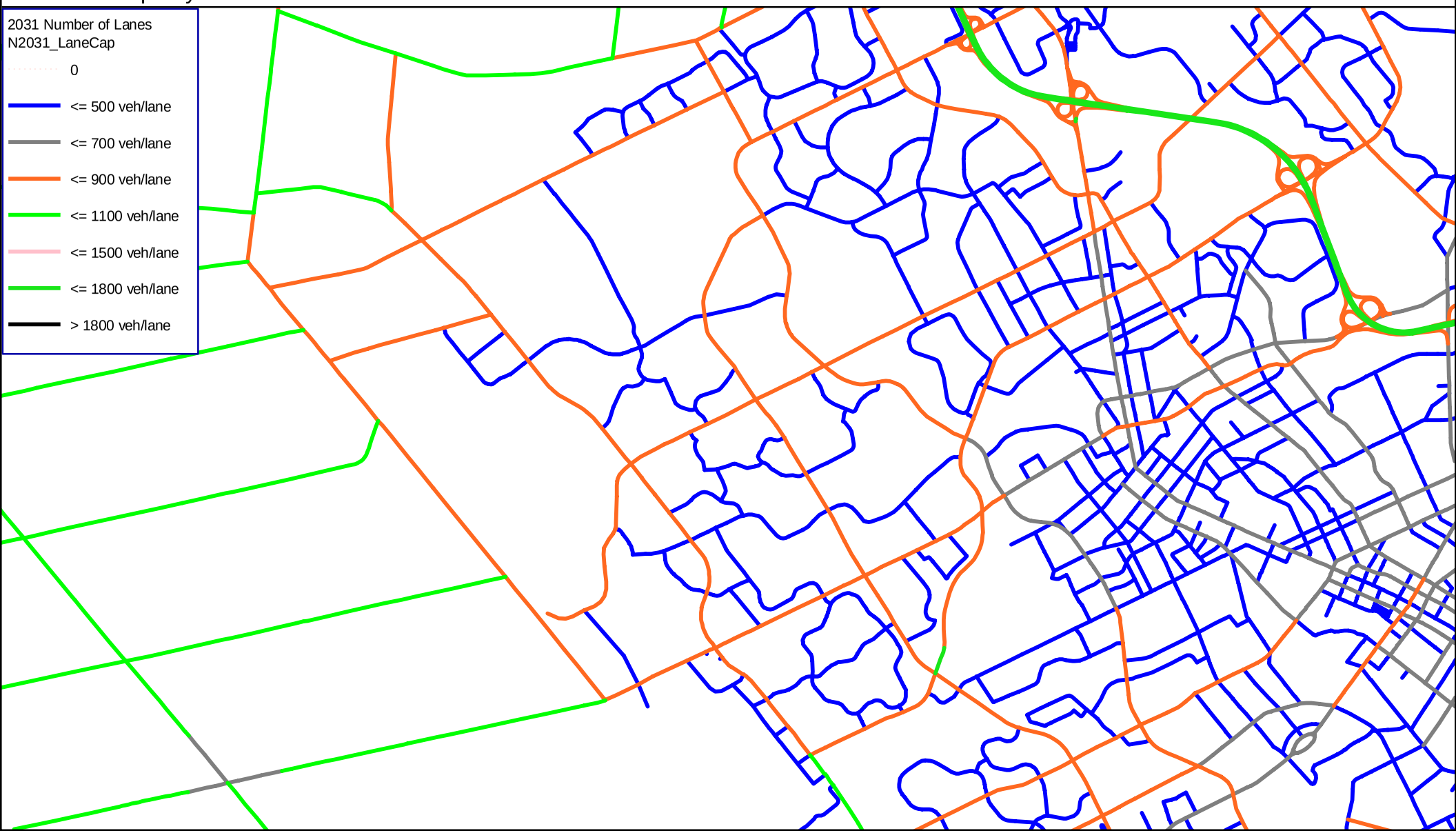
APPENDIX

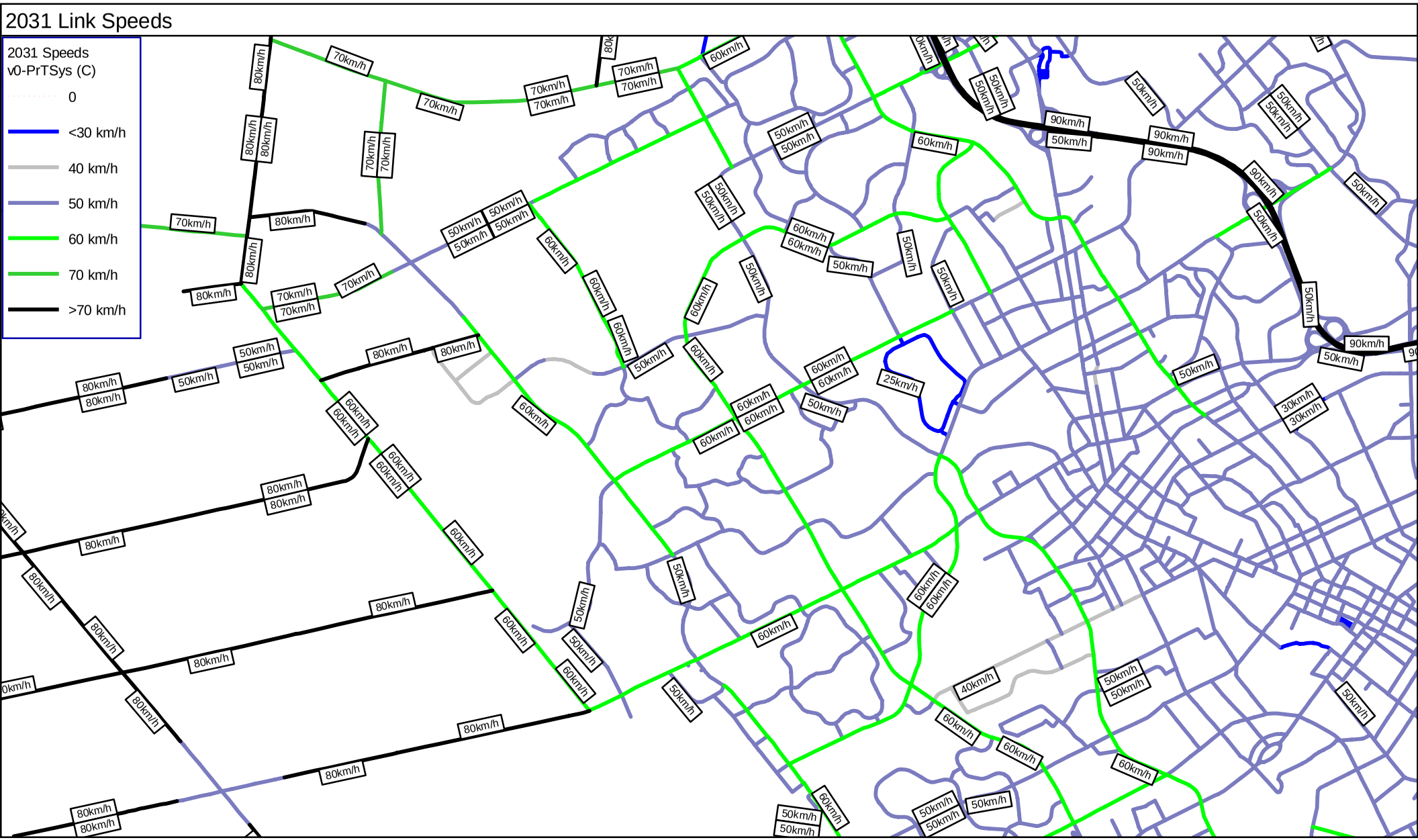
E-4 *2031 STUDY AREA NETWORK*

2031 Number of Lane

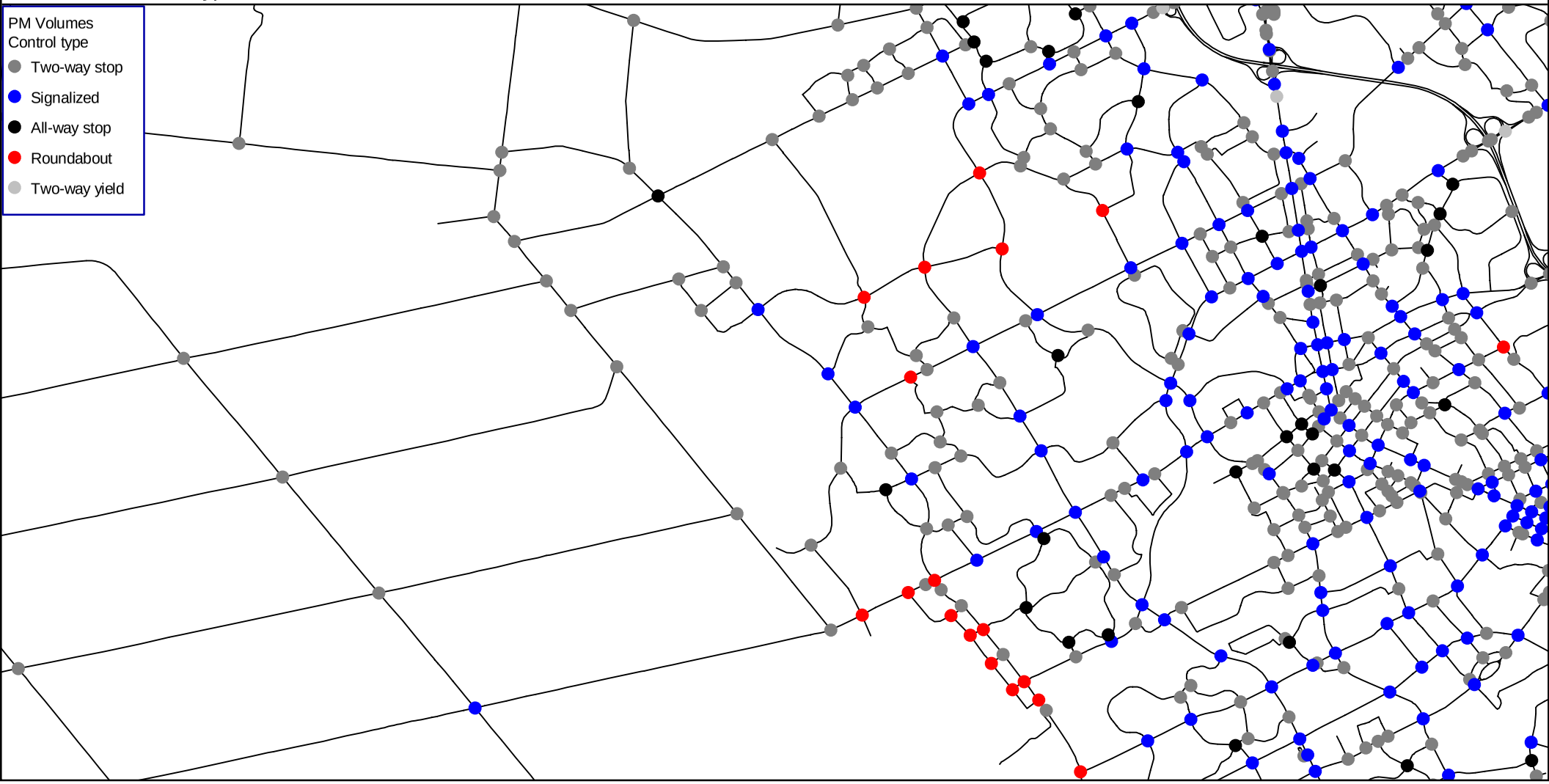


2031 Lane Capacity

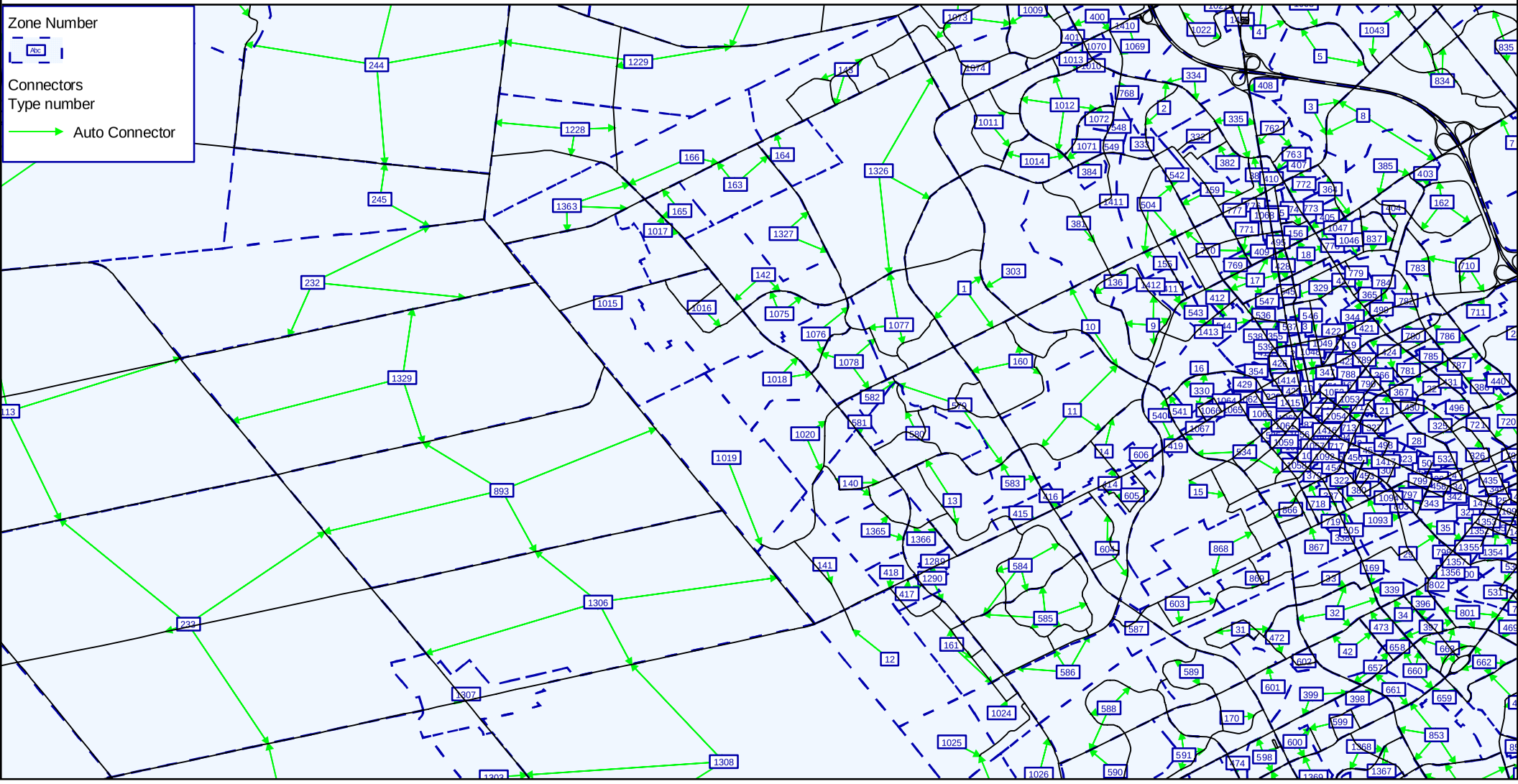



2031 Link Speeds
2031 Speeds
v0-PrTSys (C)
0
<30 km/h
40 km/h
50 km/h
60 km/h
70 km/h
>70 km/h

2031 Intersection Type



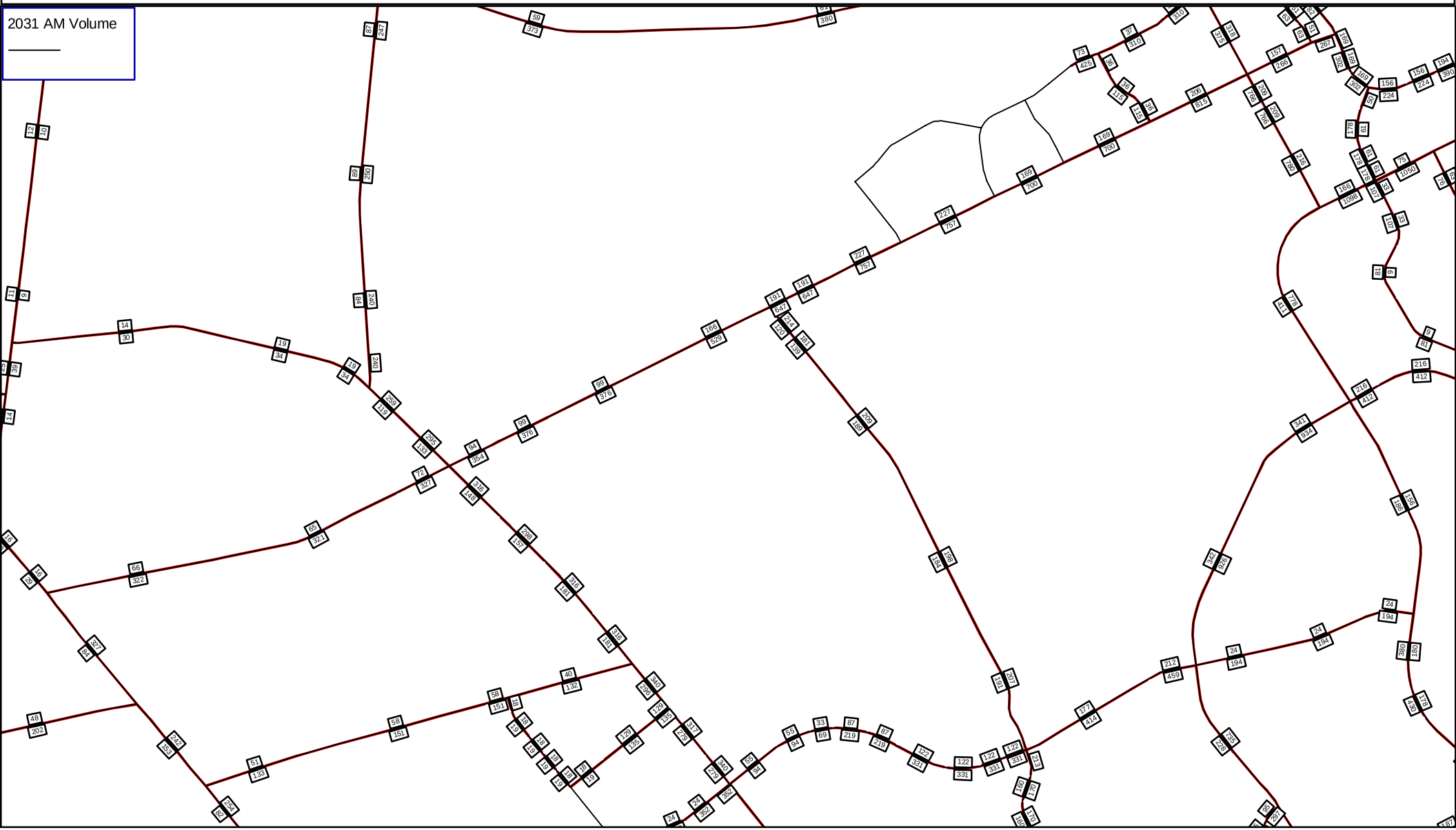
2031 Centroid Connectors



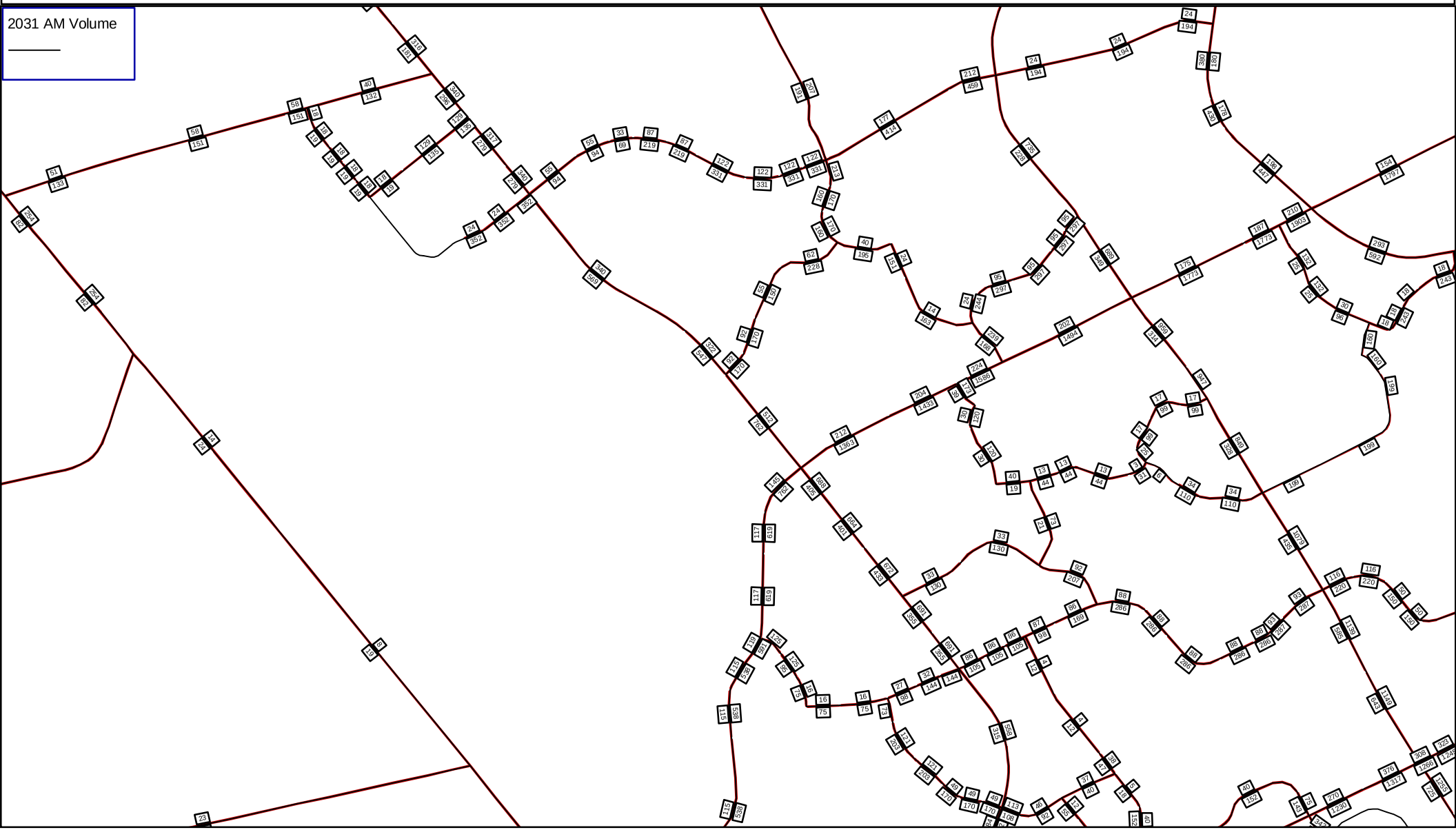
APPENDIX

E-5 2031 MODEL RESULTS – BASE CASE (WITHOUT ADDITIONAL EMPLOYMENT)

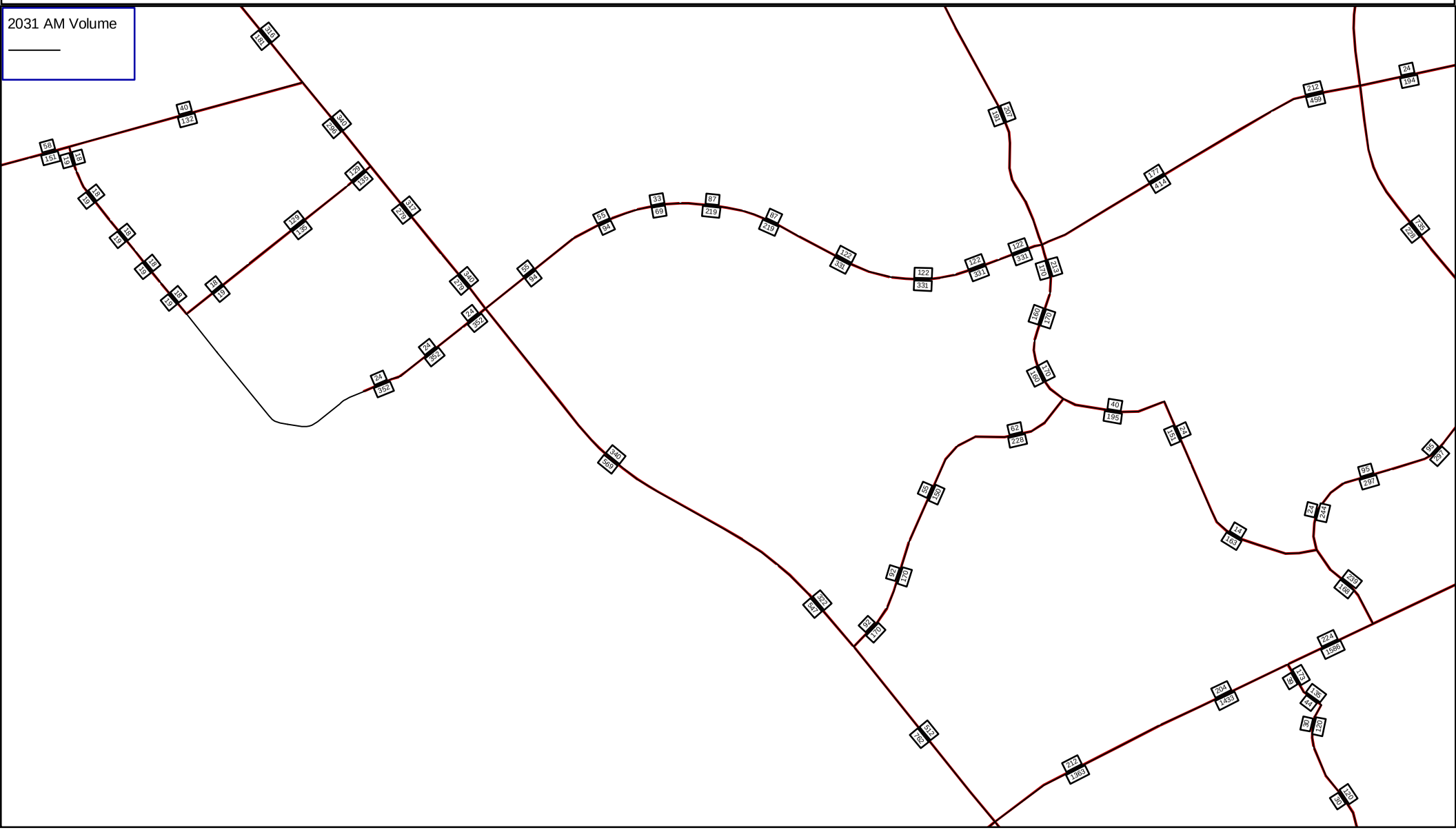
2031 AM Volume (Original Employment)



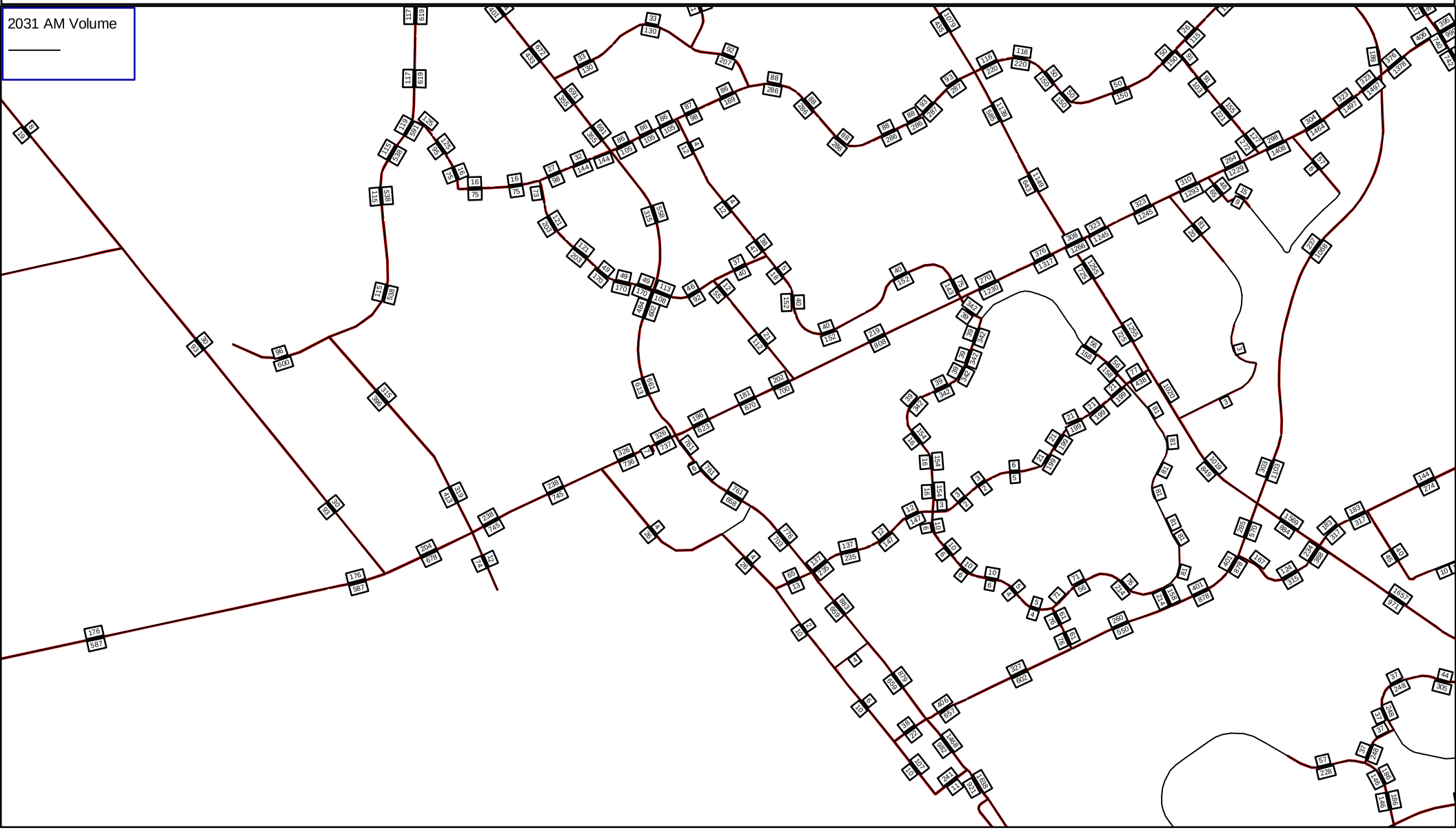
2031 AM Volume (Original Employment)



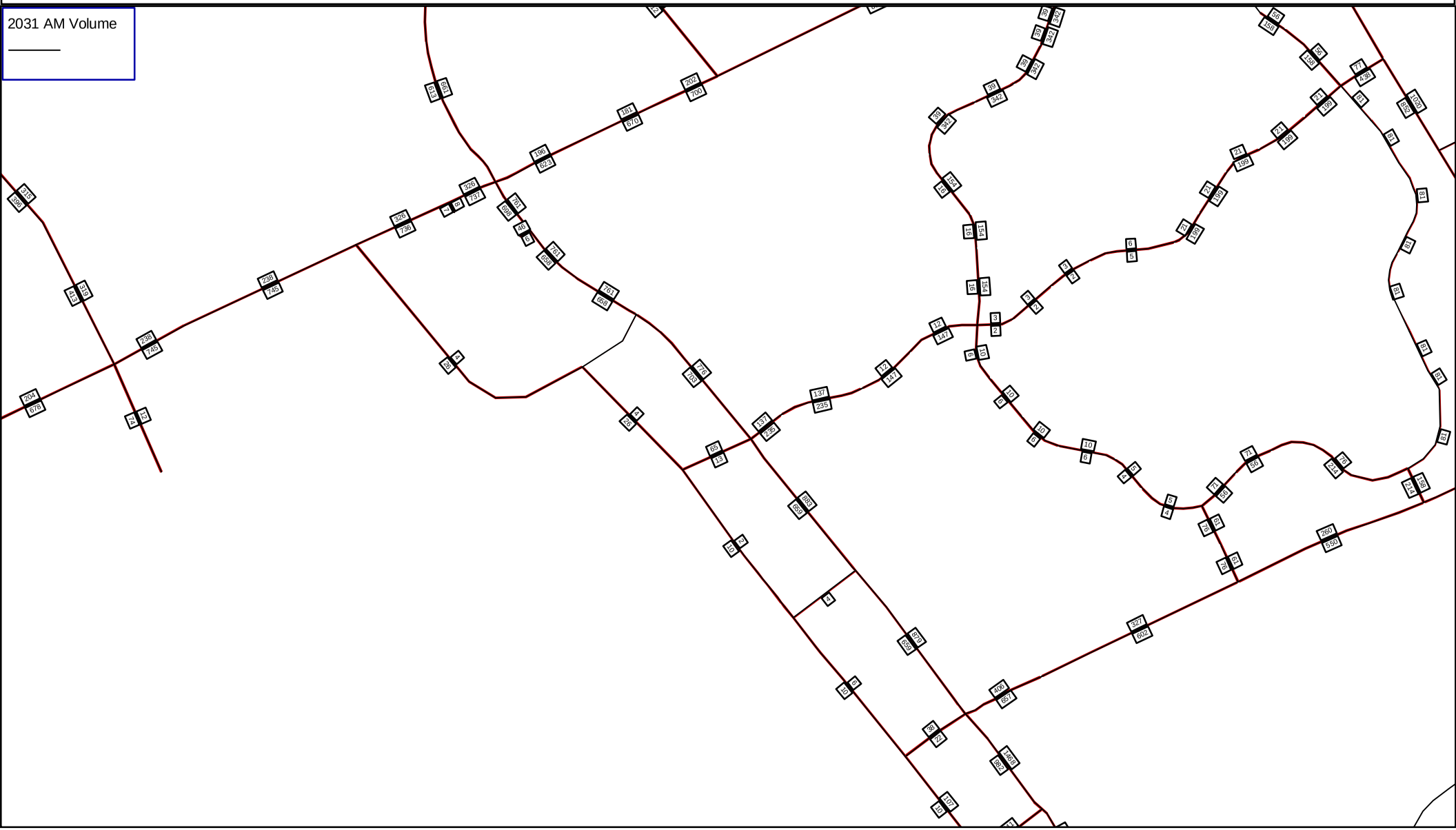
2031 AM Volume (Original Employment)



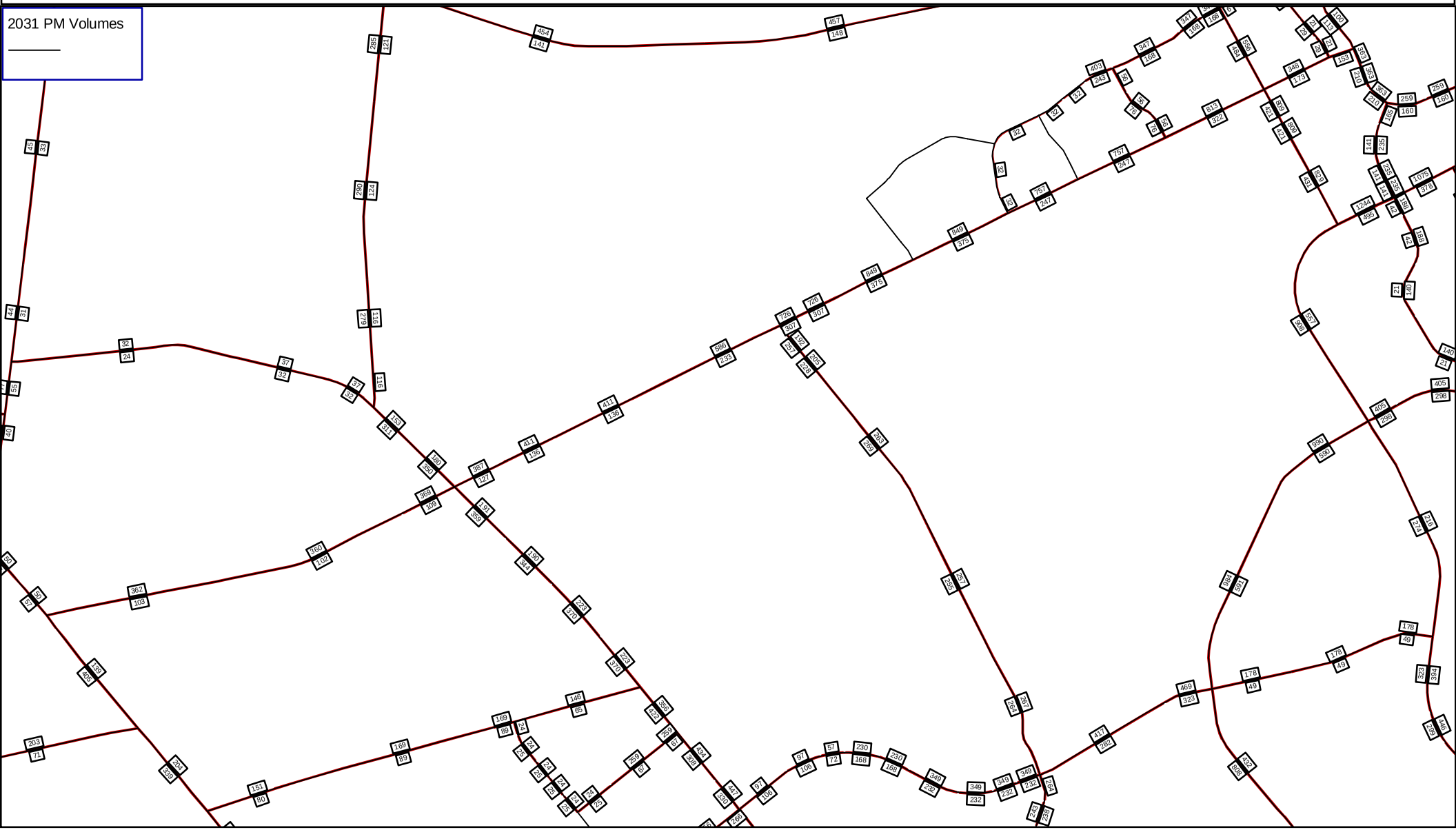
2031 AM Volume (Original Employment)



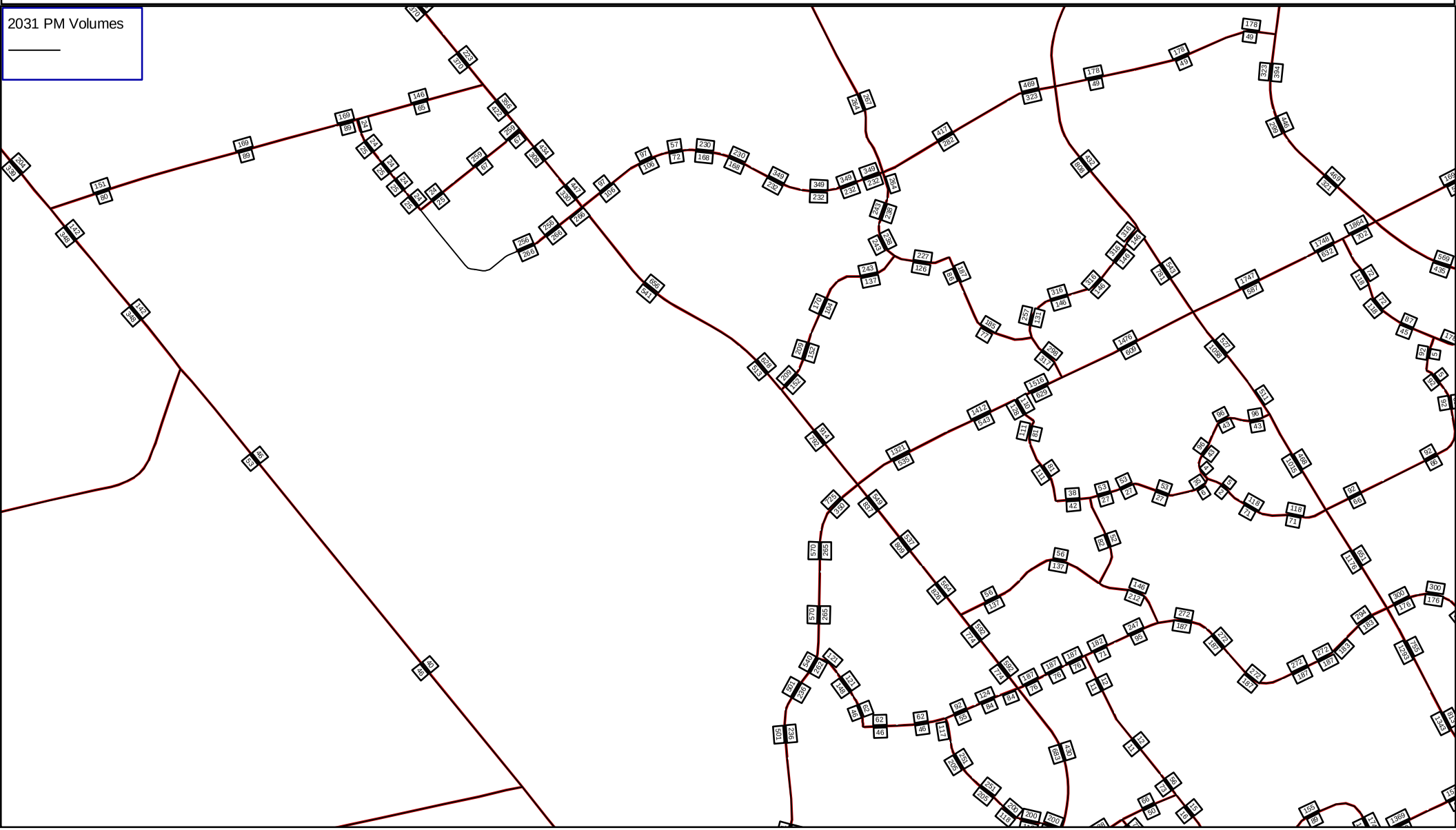
2031 AM Volume (Original Employment)



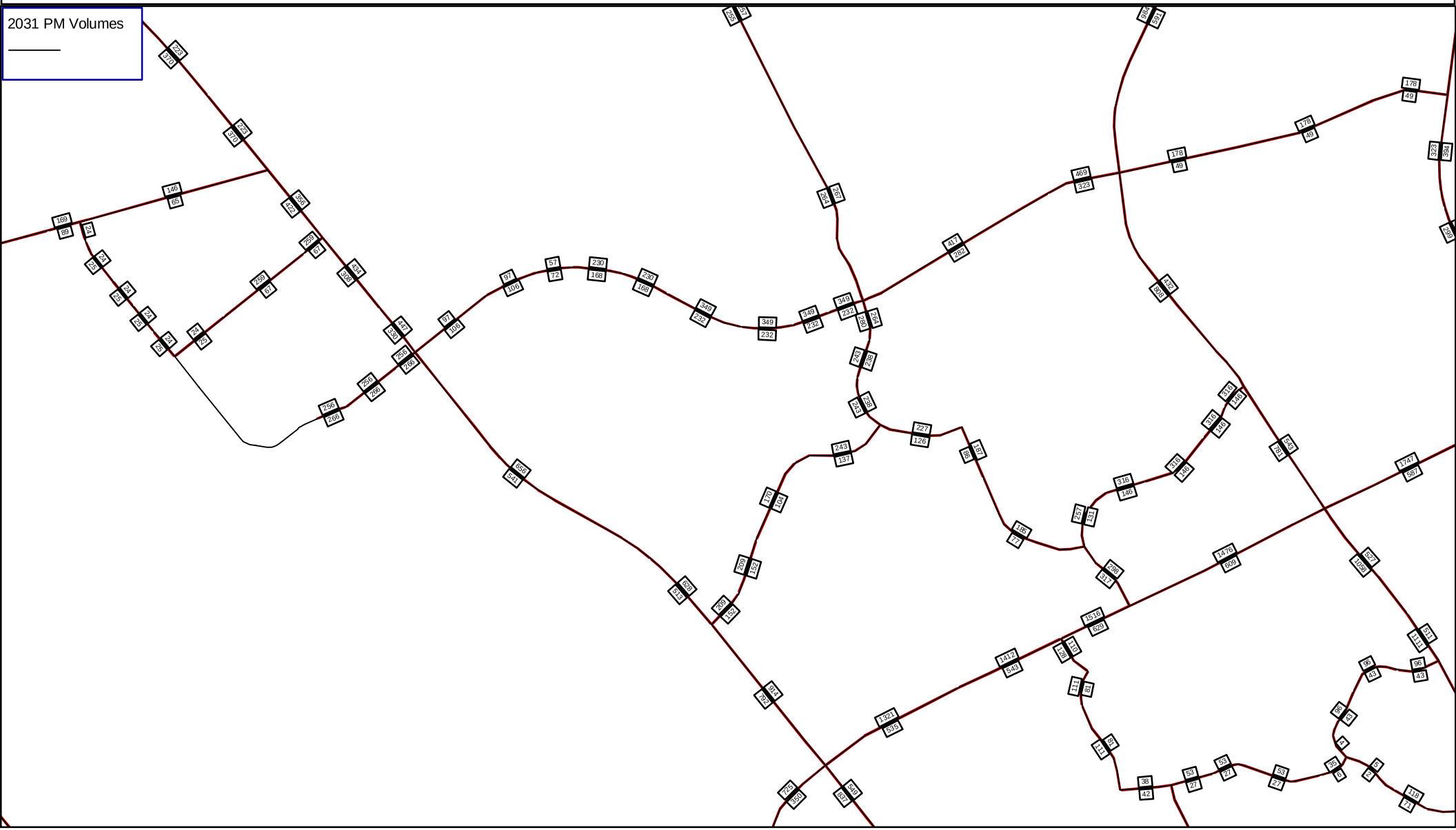
2031 PM Volume (Original Employment)



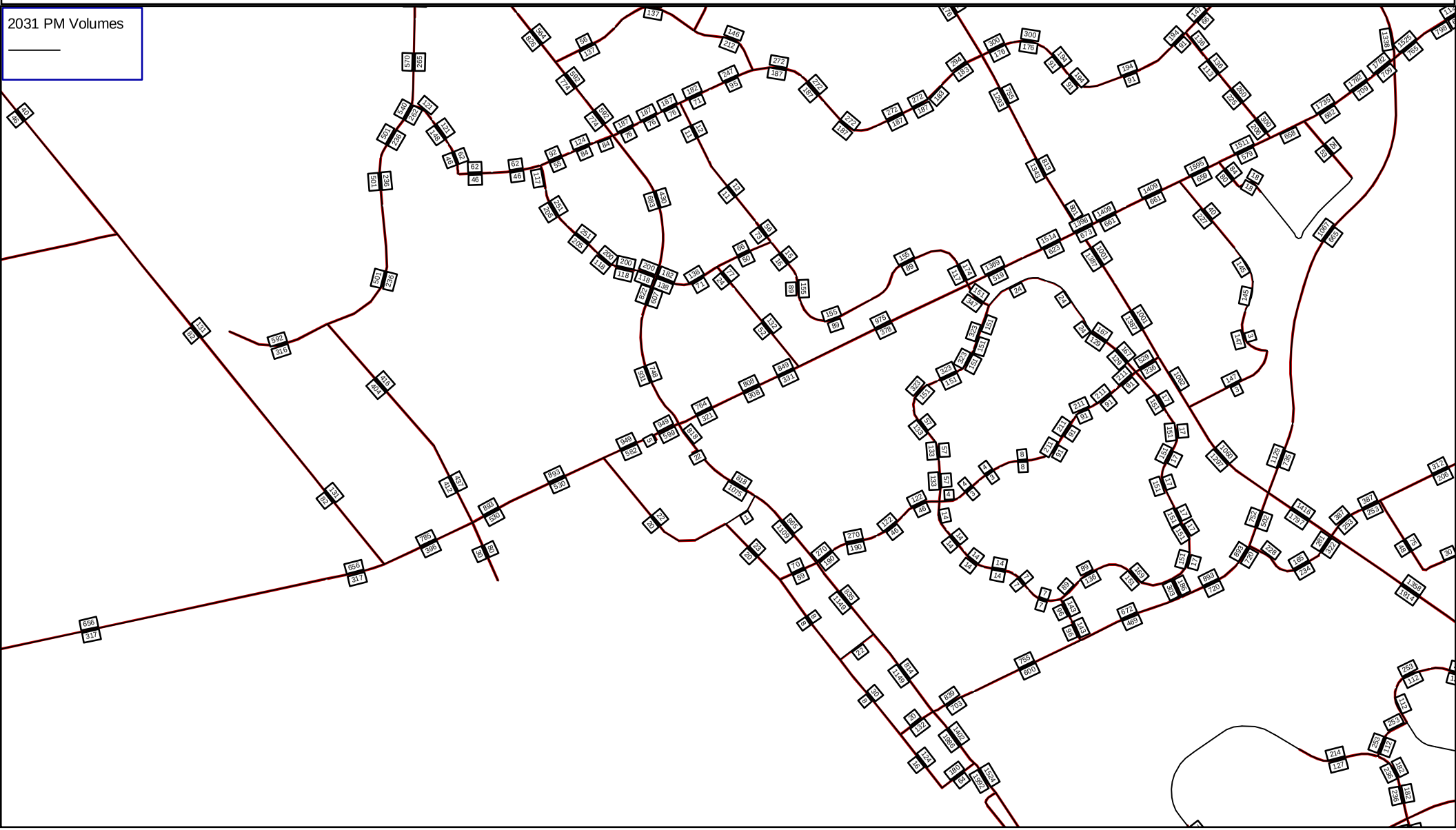
2031 PM Volume (Original Employment)



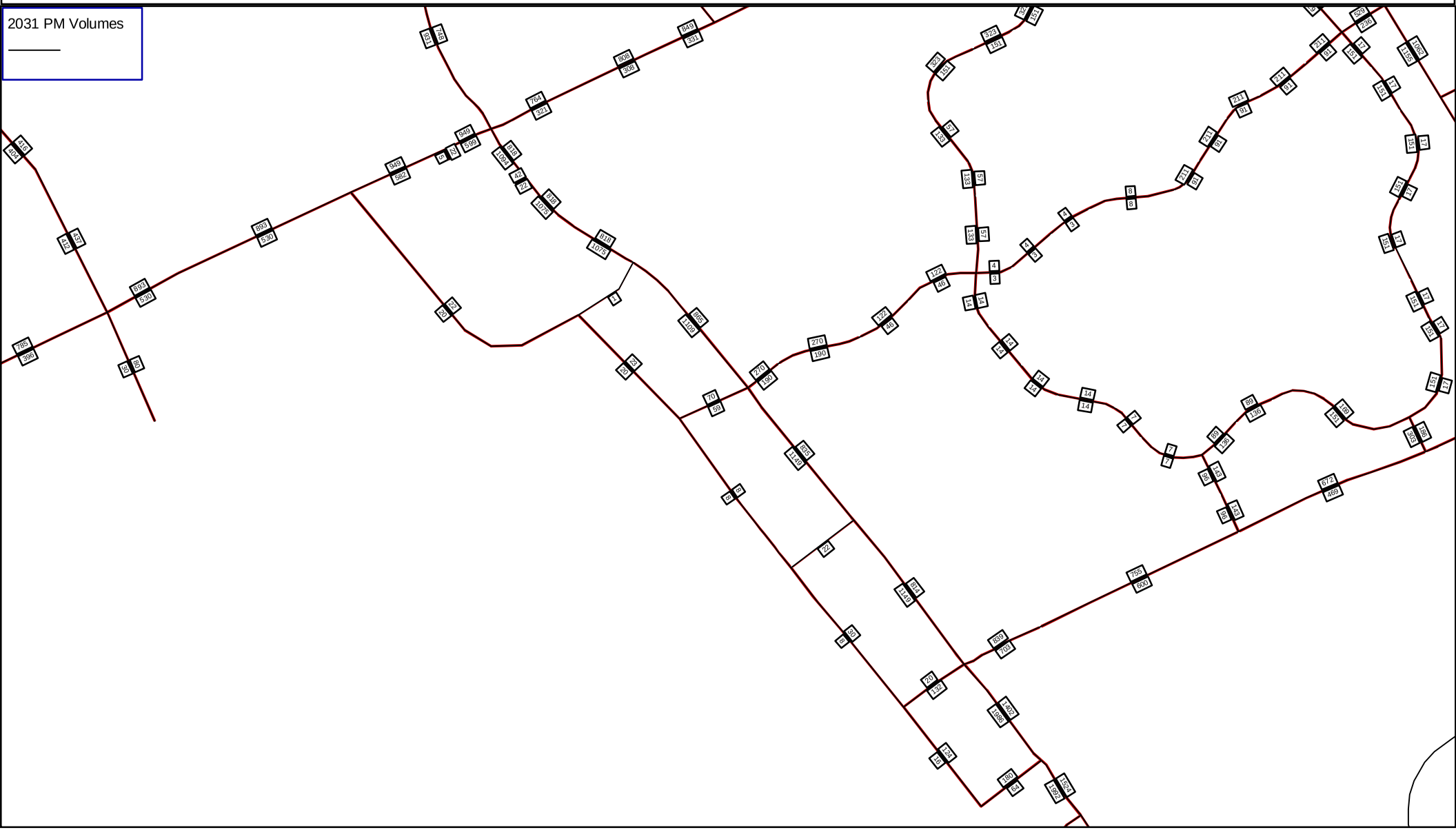
2031 PM Volume (Original Employment)



2031 PM Volume (Original Employment)



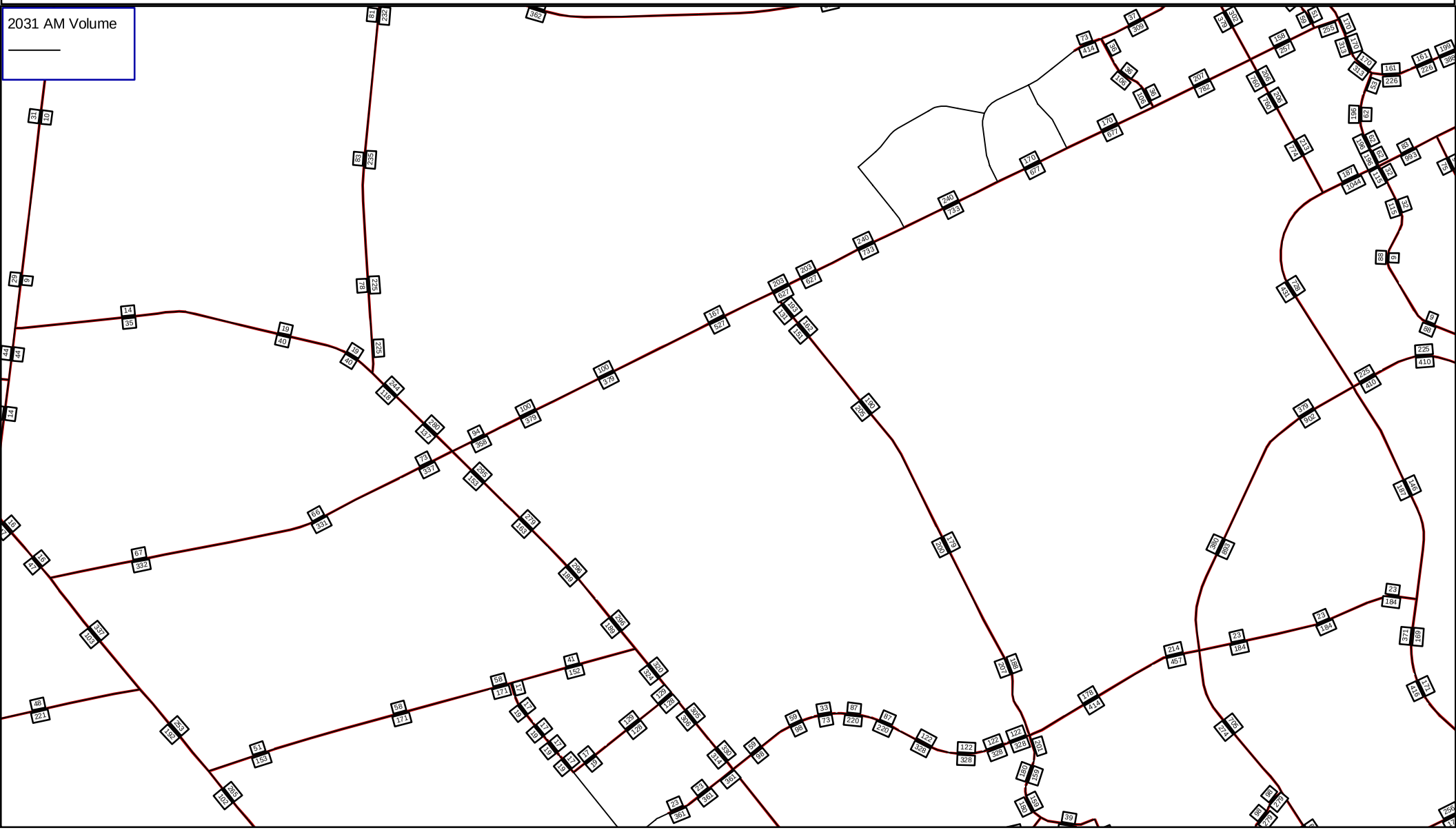
2031 PM Volume (Original Employment)



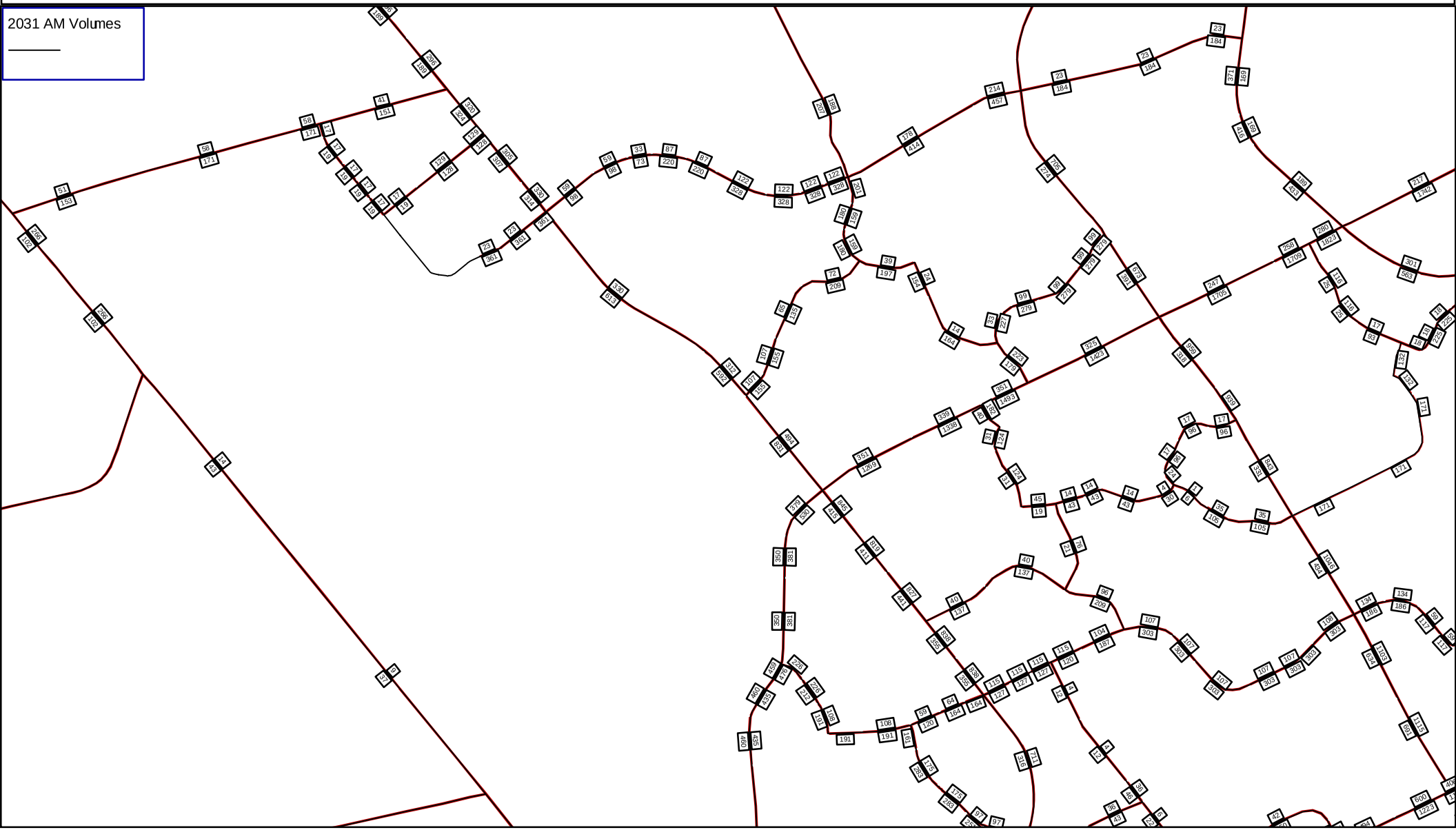
APPENDIX

E-6 2031 MODEL RESULTS – WITH ADDITIONAL EMPLOYMENT

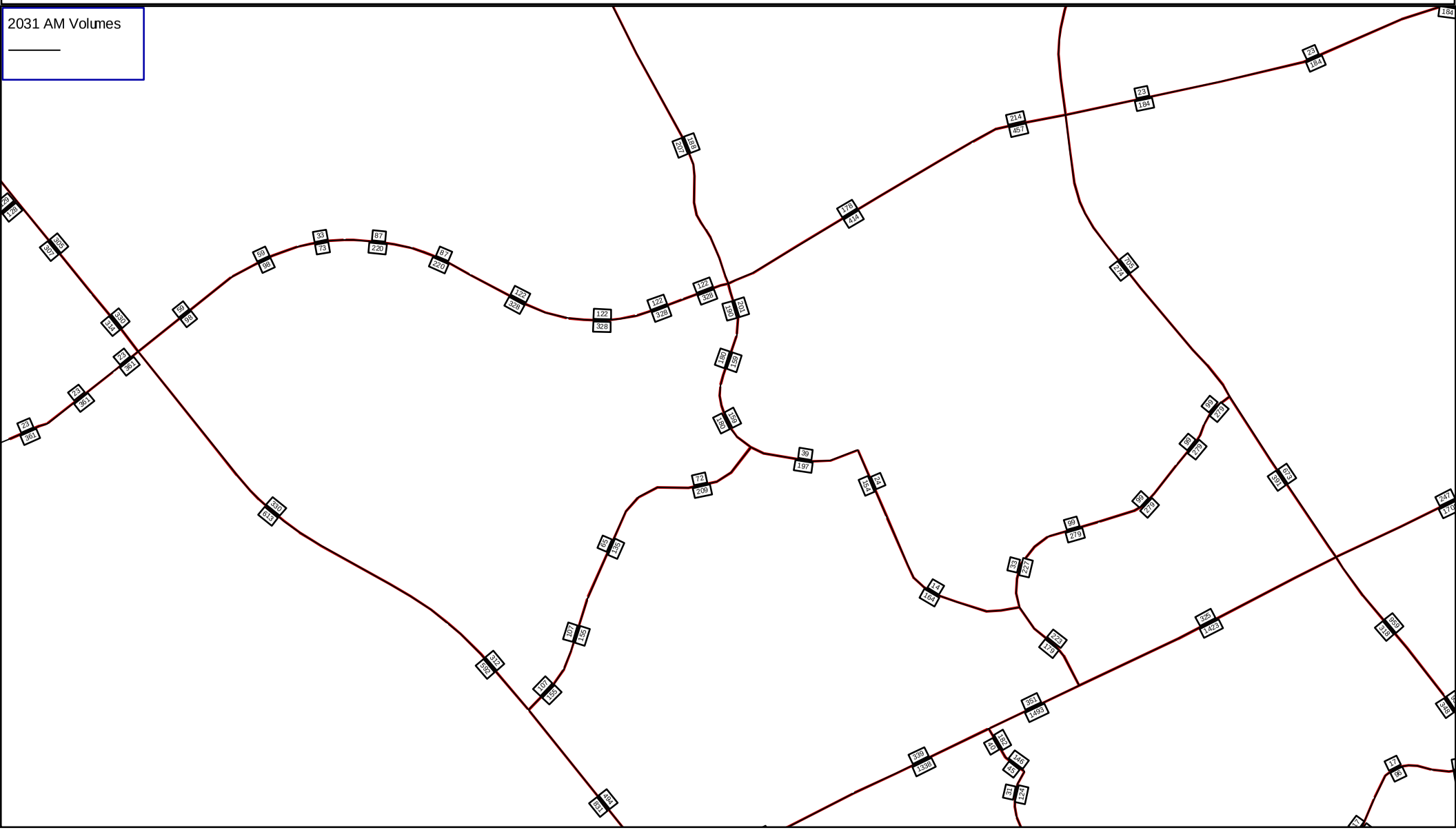
2031 AM Volume (Proposed Employment)



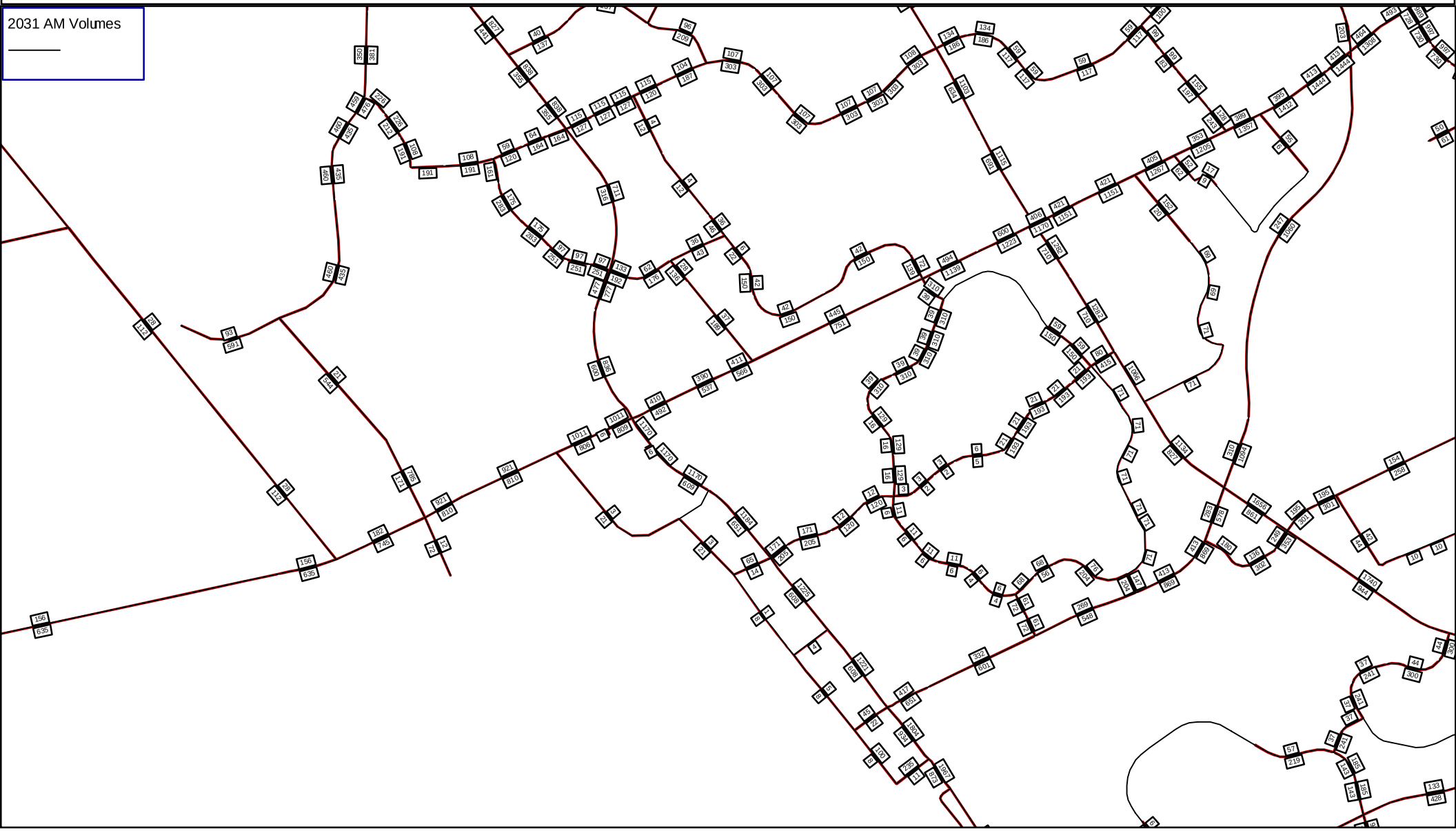
2031 AM Volume (Proposed Employment)



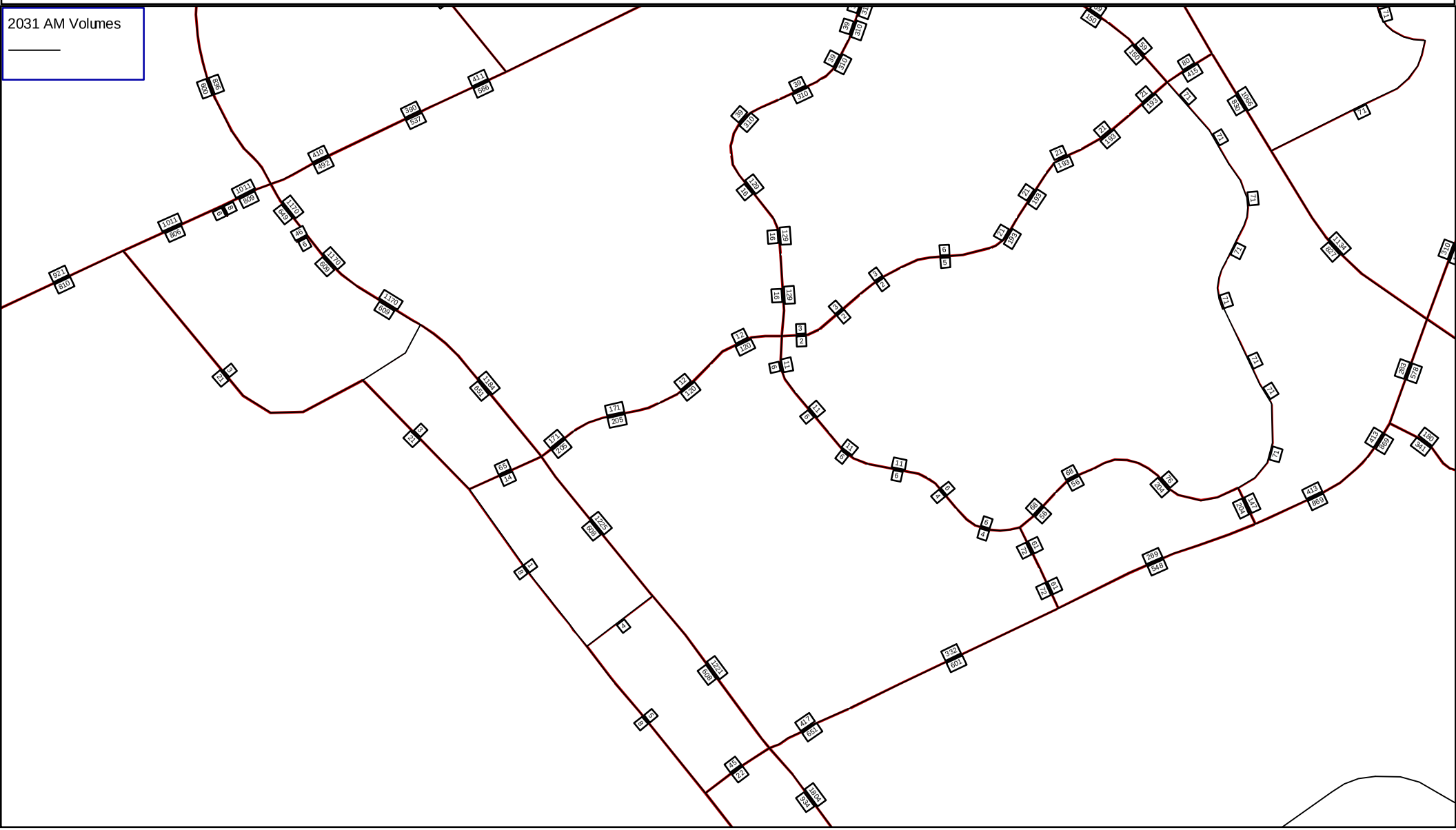
2031 AM Volume (Proposed Employment)



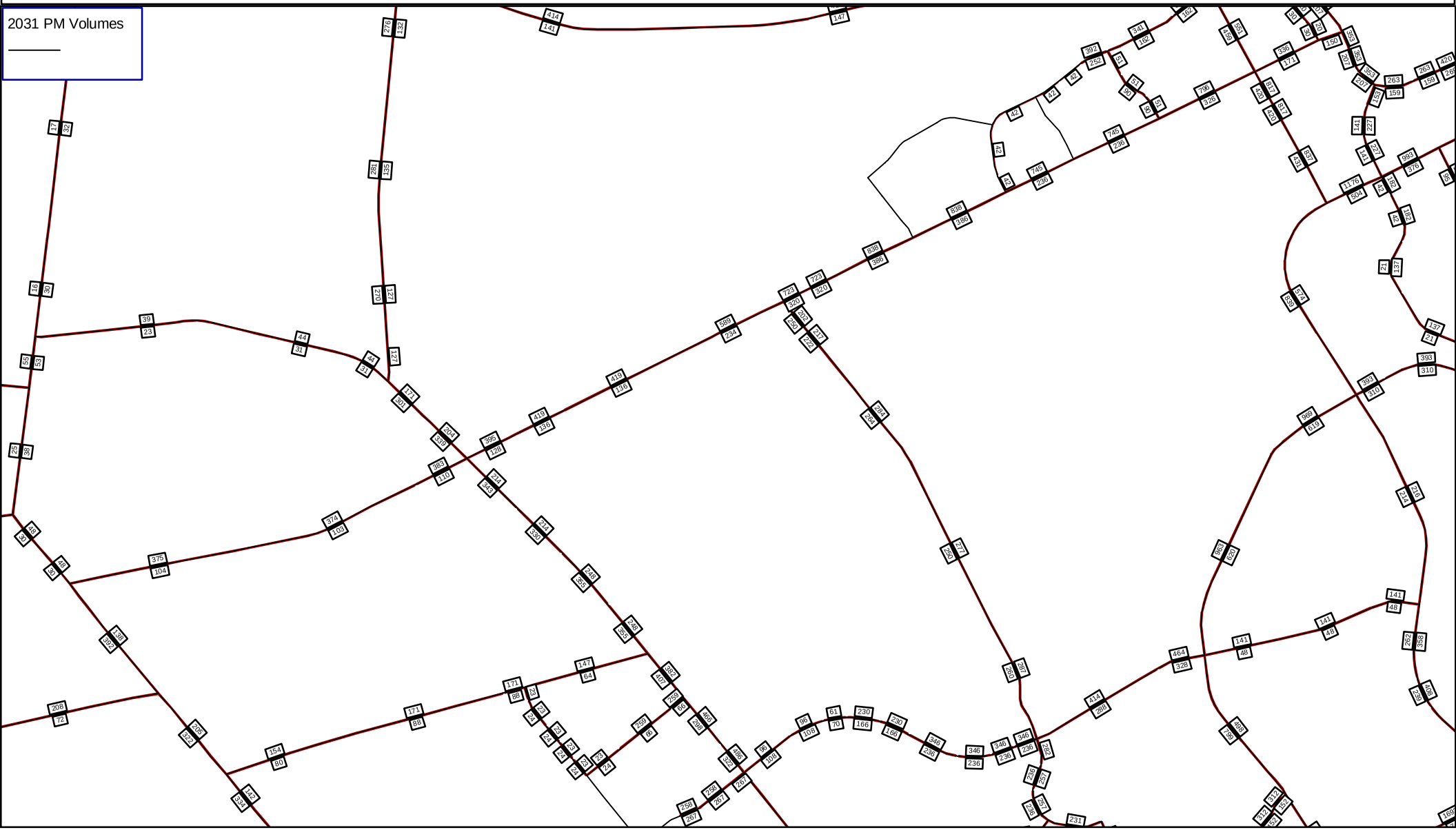
2031 AM Volume (Proposed Employment)



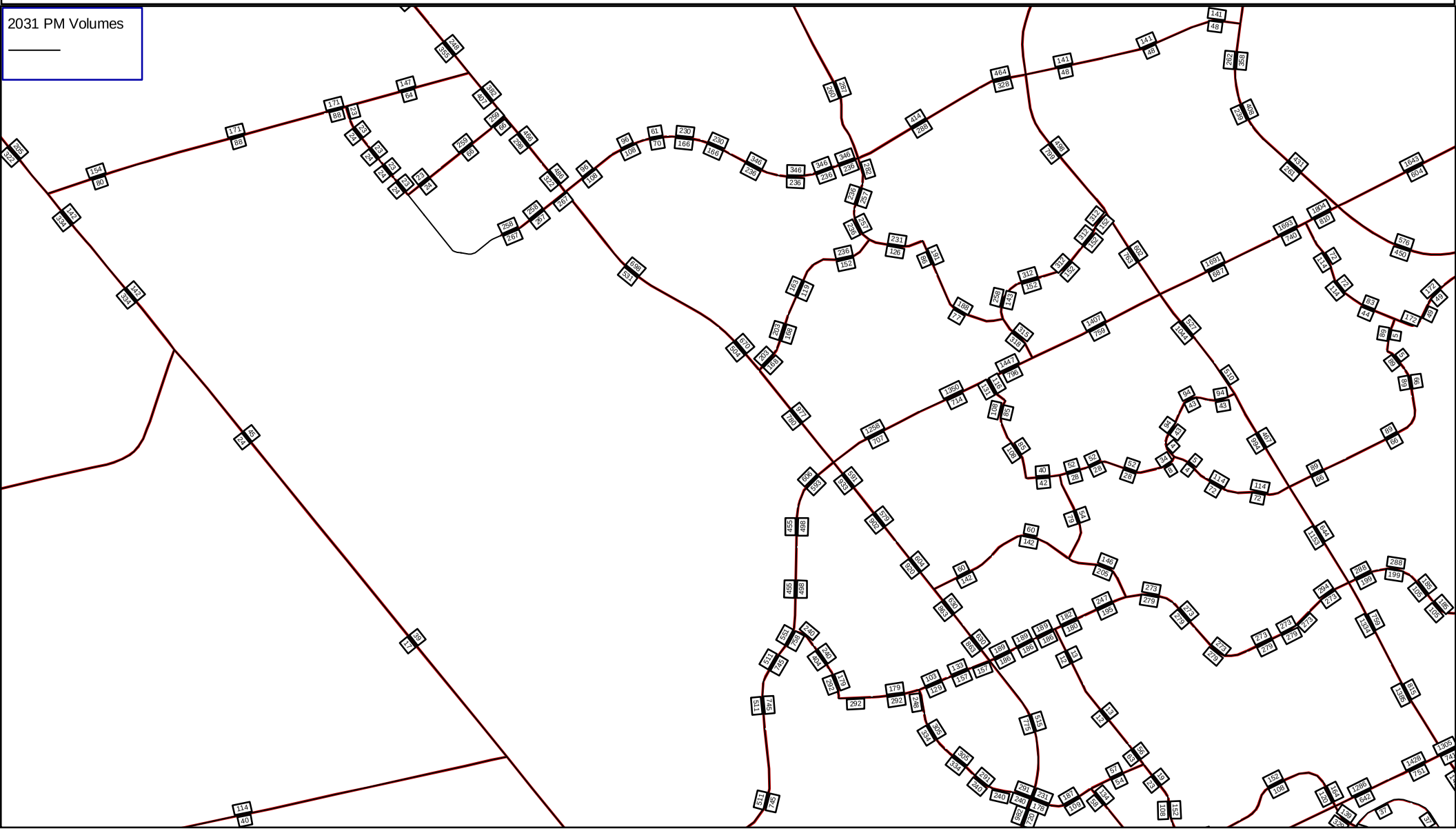
2031 AM Volume (Proposed Employment)



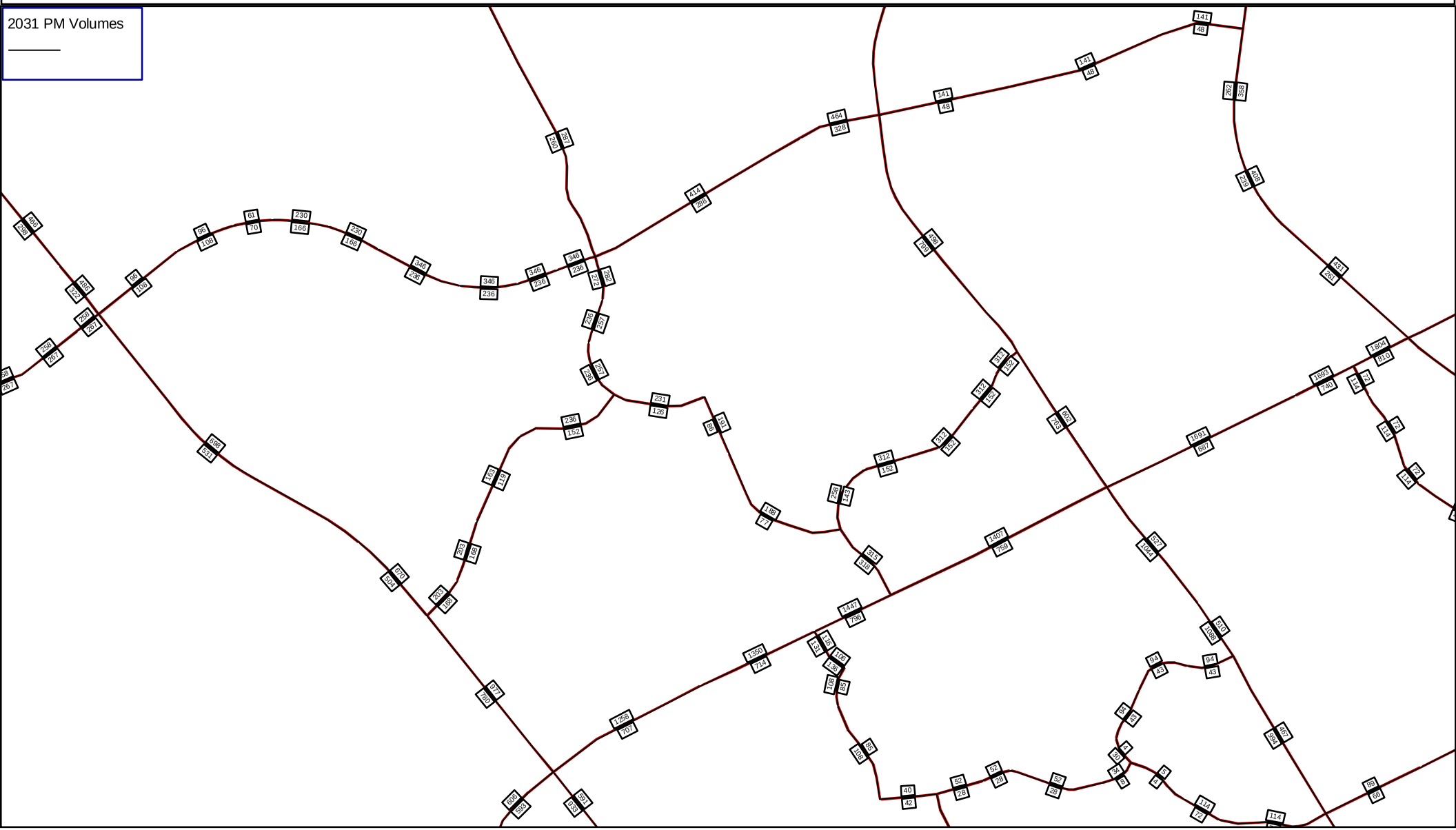
2031 PM Volume (Proposed Employment)



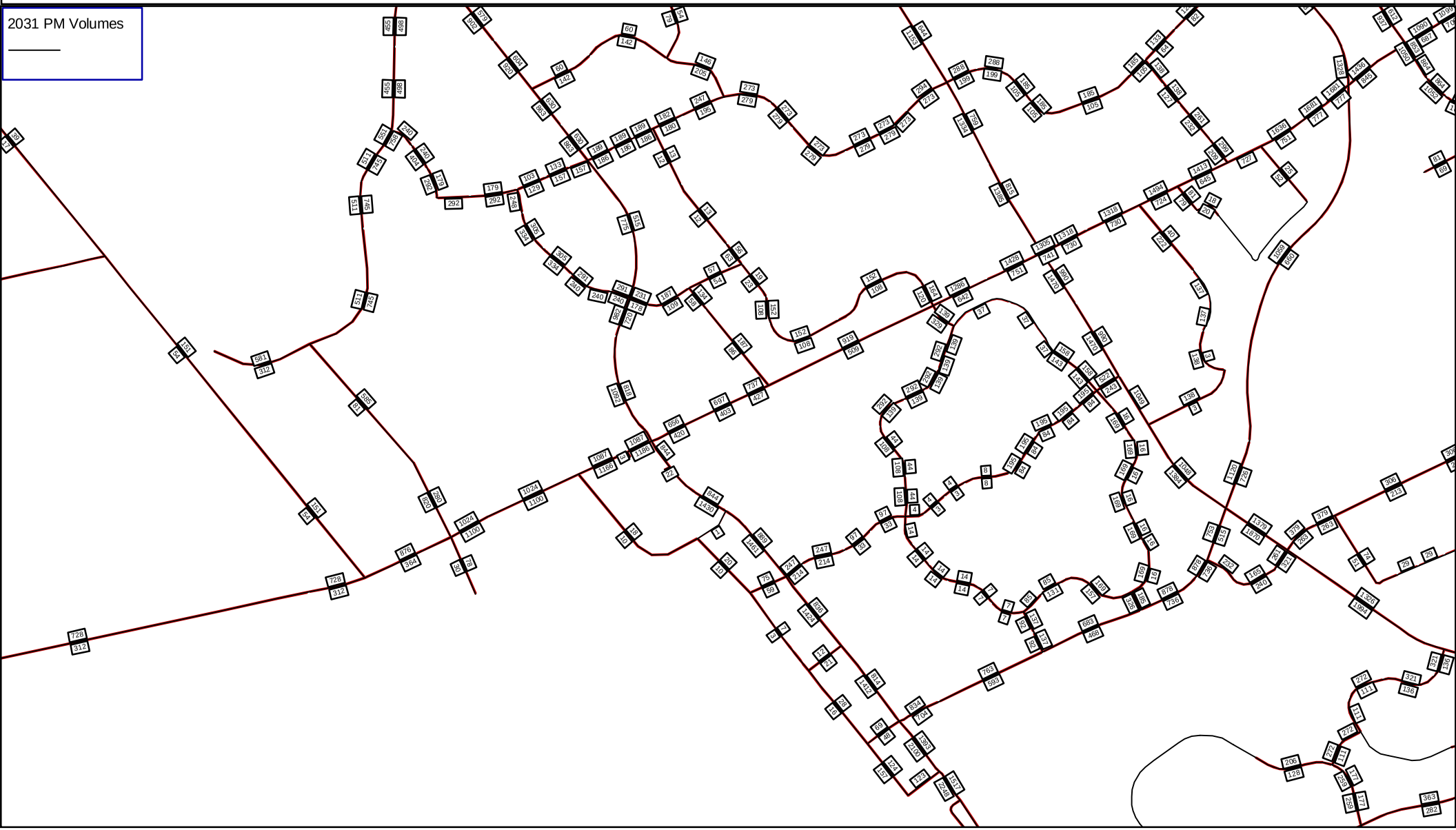
2031 PM Volume (Proposed Employment)



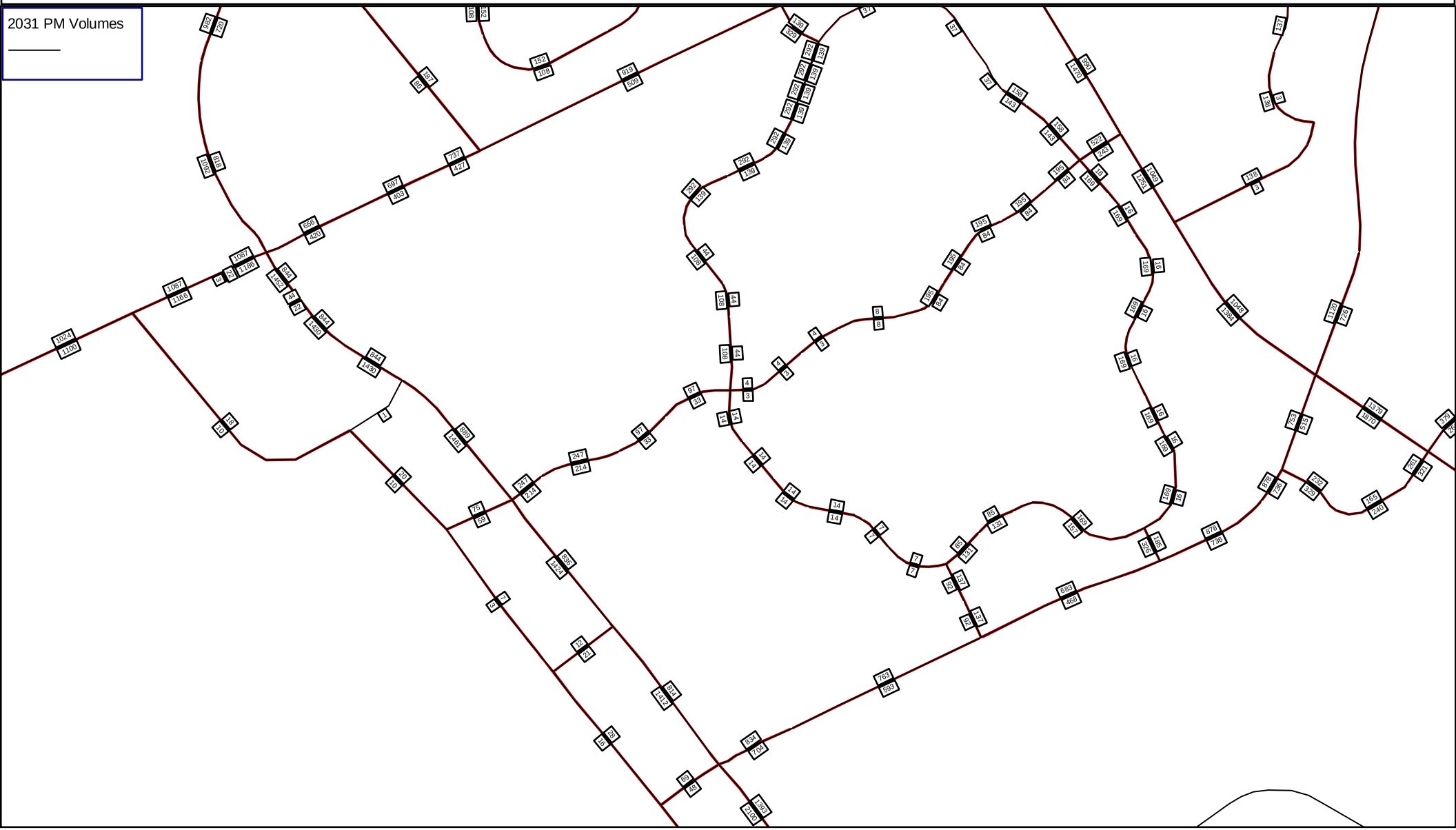
2031 PM Volume (Proposed Employment)



2031 PM Volume (Proposed Employment)



2031 PM Volume (Proposed Employment)



APPENDIX

F

ESTIMATED 2031 DIRECTIONAL LINK VOLUMES

Integrated Multi-Modal Transportation Study, Waterloo West Side
Forecasted 2031 AM Peak Hour Traffic Volumes (Scenario with 8,000 Employees in City Employment Zone 141)

Roadway	Direction	Location	Existing Traffic Volume (From TMC)	2017 Traffic Forecast (from VISUM)	2031 Traffic Forecast (from VISUM)	Growth (2017-2031 from VISUM)	2031 Traffic Forecast Existing Traffic Volume from TMC plus growth from VISUM)	Number of Lanes	Lane Capacity (from VISUM, except 650 coded instead of 400 based on counts)	Link Capacity	Link V/C
Conservation Drive	Eastbound	East of Wilmot Ln	51	250	332	82	133	1	900	900	0.15
Conservation Drive	Westbound	East of Wilmot Ln	21	49	67	18	39	1	900	900	0.04
Wilmot Ln	Northbound	North of Conservation Dr	22	12	16	4	26	1	900	900	0.03
Wilmot Ln	Southbound	North of Conservation Dr	19	15	47	32	51	1	900	900	0.06
Wilmot Ln	Northbound	South of Conservation Dr	68	254	337	83	151	1	900	900	0.17
Wilmot Ln	Southbound	South of Conservation Dr	35	56	103	47	82	1	900	900	0.09
Conservation Drive	Eastbound	East of Erbsville Road	236	361	358	-3	250	1	900	900	0.28
Conservation Drive	Westbound	East of Erbsville Road	100	64	94	30	130	1	900	900	0.14
Conservation Drive	Eastbound	West of Erbsville Road	55	253	339	86	141	1	900	900	0.16
Conservation Drive	Westbound	West of Erbsville Road	16	56	73	17	33	1	900	900	0.04
Erbsville Road	Northbound	North of Conservation Drive	157	167	280	113	270	1	900	900	0.30
Erbsville Road	Southbound	North of Conservation Drive	180	78	137	59	239	1	900	900	0.27
Erbsville Road	Northbound	South of Conservation Drive	271	271	295	24	295	1	900	900	0.33
Erbsville Road	Southbound	South of Conservation Drive	197	82	153	71	268	1	900	900	0.30
Conservation Drive	Eastbound	East of Beaver Creek Rd	298	490	627	137	435	1	900	900	0.48
Conservation Drive	Westbound	East of Beaver Creek Rd	154	116	203	87	241	1	900	900	0.27
Conservation Drive	Eastbound	West of Beaver Creek Rd	207	412	527	115	322	1	900	900	0.36
Conservation Drive	Westbound	West of Beaver Creek Rd	105	98	167	69	174	1	900	900	0.19
Beaver Creek Rd	Northbound	South of Conservation Drive	110	111	193	82	192	1	650	650	0.30
Beaver Creek Rd	Southbound	South of Conservation Drive	68	52	131	79	147	1	650	650	0.23
Conservation Drive	Eastbound	East of Westmount Rd	55	225	257	32	87	1	900	900	0.10
Conservation Drive	Westbound	East of Westmount Rd	73	118	158	40	113	1	900	900	0.13
Conservation Drive	Eastbound	West of Westmount Rd	387	622	782	160	547	1	900	900	0.61
Conservation Drive	Westbound	West of Westmount Rd	117	119	207	88	205	1	900	900	0.23
Westmount Rd	Northbound	North of Conservation Drive	288	269	302	33	321	1	900	900	0.36
Westmount Rd	Southbound	North of Conservation Drive	219	286	379	93	312	1	900	900	0.35
Westmount Rd	Northbound	South of Conservation Drive	253	161	206	45	298	1	900	900	0.33
Westmount Rd	Southbound	South of Conservation Drive	472	575	760	185	657	1	900	900	0.73
Laurelwood Drive	Eastbound	East of Erbsville Road	432	84	98	14	446	1	650	650	0.69
Laurelwood Drive	Westbound	East of Erbsville Road	246	34	59	25	271	1	650	650	0.42
Laurelwood Drive	Eastbound	West of Erbsville Road	483	294	361	67	550	1	650	650	0.85
Laurelwood Drive	Westbound	West of Erbsville Road	361	16	23	7	368	1	650	650	0.57
Erbsville Road	Northbound	North of Laurelwood Drive	353	258	330	72	425	1	900	900	0.47
Erbsville Road	Southbound	North of Laurelwood Drive	376	203	314	111	487	1	900	900	0.54
Erbsville Road	Northbound	South of Laurelwood Drive	634	259	330	71	705	1	900	900	0.78
Erbsville Road	Southbound	South of Laurelwood Drive	593	431	613	182	775	1	900	900	0.86
Laurelwood Drive	Eastbound	East of Beaver Creek Rd	662	373	414	41	703	1	650	650	1.08
Laurelwood Drive	Westbound	East of Beaver Creek Rd	233	116	178	62	295	1	650	650	0.45
Laurelwood Drive	Eastbound	West of Beaver Creek Rd	580	289	328	39	619	1	650	650	0.95
Laurelwood Drive	Westbound	West of Beaver Creek Rd	285	101	122	21	306	1	650	650	0.47
Beaver Creek Rd	Northbound	North of Laurelwood Drive	110	113	188	75	185	1	650	650	0.28
Beaver Creek Rd	Southbound	North of Laurelwood Drive	91	80	207	127	218	1	650	650	0.34
Beaver Creek Rd	Northbound	South of Laurelwood Drive	299	171	201	30	329	1	650	650	0.51
Beaver Creek Rd	Southbound	South of Laurelwood Drive	146	64	190	126	272	1	650	650	0.42
Laurelwood Drive	Eastbound	East of Bearinger Rd	191	10	184	174	365	1	650	650	0.56
Laurelwood Drive	Westbound	East of Bearinger Rd	49	10	23	13	62	1	650	650	0.10
Laurelwood Drive	Eastbound	West of Bearinger Rd	631	413	457	44	675	1	650	650	1.04
Laurelwood Drive	Westbound	West of Bearinger Rd	197	141	214	73	270	1	650	650	0.42
Bearinger Rd	Northbound	North of Laurelwood Drive	827	702	893	191	1018	2	900	1800	0.57
Bearinger Rd	Southbound	North of Laurelwood Drive	318	233	380	147	465	2	900	1800	0.26
Fisher-Hallman Road	Northbound	South of Laurelwood Drive	713	514	705	191	904	2	900	1800	0.50
Fisher-Hallman Road	Southbound	South of Laurelwood Drive	496	317	274	-43	500	2	900	1800	0.28
Bearinger Road	Eastbound	East of Westmount Rd	550	387	410	23	573	1	650	650	0.88
Bearinger Road	Westbound	East of Westmount Rd	217	174	225	51	268	1	650	650	0.41
Bearinger Road	Eastbound	West of Westmount Rd	850	702	902	200	1050	2	900	1800	0.58
Bearinger Road	Westbound	West of Westmount Rd	327	235	379	144	471	2	900	1800	0.26
Westmount Rd	Northbound	North of Bearinger Road	841	425	728	303	1144	2	900	1800	0.64
Westmount Rd	Southbound	North of Bearinger Road	618	219	431	212	830	2	900	1800	0.46
Westmount Rd	Northbound	South of Bearinger Road	349	81	146	65	414	2	900	1800	0.23
Westmount Rd	Southbound	South of Bearinger Road	316	129	187	58	374	2	900	1800	0.21
Northfield Drive	Eastbound	East of Westmount Rd	915	694	1044	350	1265	2	900	1800	0.70
Northfield Drive	Westbound	East of Westmount Rd	378	77	187	110	488	2	900	1800	0.27
Westmount Rd	Eastbound	West of Westmount Rd	835	425	728	303	1138	2	900	1800	0.63

Thorndale Drive	Eastbound	East of Ira Needles Blvd	88	173	205	32	120	1	650	650	0.18
Fisher-Hallman Road	Southbound	South of Erb Street	668	520	710	190	858	2	900	1800	0.48
Fisher-Hallman Road	Northbound	South of Erb Street	915	895	1282	387	1302	2	900	1800	0.72
Fisher-Hallman Road	Southbound	North of Erb Street	730	576	691	115	845	2	900	1800	0.47
Fisher-Hallman Road	Northbound	North of Erb Street	1008	827	1115	288	1296	2	900	1800	0.72
Erb Street	Westbound	West of Fisher-Hallman Road	450	300	600	300	750	2	900	1800	0.42
Erb Street	Eastbound	West of Fisher-Hallman Road	1051	1080	1223	143	1194	2	900	1800	0.66
Erb Street	Westbound	East of Fisher-Hallman Road	402	255	406	151	553	2	900	1800	0.31
Erb Street	Eastbound	East of Fisher-Hallman Road	972	1158	1170	12	984	2	900	1800	0.55
Ira Needles Blvd	Southbound	South of Erb Street	965	536	649	113	1078	2	900	1800	0.60
Ira Needles Blvd	Northbound	South of Erb Street	828	414	1170	756	1584	2	900	1800	0.88
Ira Needles Blvd	Southbound	North of Erb Street	909	631	600	-31	920	2	900	1800	0.51
Ira Needles Blvd	Northbound	North of Erb Street	784	480	836	356	1140	2	900	1800	0.63
Erb Street	Westbound	West of Ira Needles Blvd	364	319	1011	692	1056	2	900	1800	0.59
Erb Street	Eastbound	West of Ira Needles Blvd	768	580	809	229	997	2	900	1800	0.55
Erb Street	Westbound	East of Ira Needles Blvd	366	149	410	261	627	2	900	1800	0.35
Erb Street	Eastbound	East of Ira Needles Blvd	758	437	492	55	813	2	900	1800	0.45
The Boardwalk	Southbound	South of Erb Street	0	0	21	21	21	2	400	800	0.03
The Boardwalk	Northbound	South of Erb Street	0	0	3	3	3	2	400	800	0.00
Erb Street	Westbound	West of The Boardwalk	192	222	921	699	891	2	900	1800	0.50
Erb Street	Eastbound	West of The Boardwalk	581	575	810	235	816	2	900	1800	0.45
Erb Street	Westbound	East of The Boardwalk	364	319	1011	692	1056	2	900	1800	0.59
Erb Street	Eastbound	East of The Boardwalk	768	580	809	229	997	2	900	1800	0.55
Platinum Drive	Southbound	South of Erb Street	8	46	72	26	34	1	650	650	0.05
Platinum Drive	Northbound	South of Erb Street	6	2	12	10	16	1	650	650	0.02
Platinum Drive	Southbound	North of Erb Street	13	11	171	160	173	2	650	1300	0.13
Platinum Drive	Northbound	North of Erb Street	20	11	785	774	794	2	650	1300	0.61
Erb Street	Westbound	West of Platinum Drive	189	173	182	9	198	1	900	900	0.22
Erb Street	Eastbound	West of Platinum Drive	587	569	745	176	763	1	900	900	0.85
Erb Street	Westbound	East of Platinum Drive	192	222	921	699	891	2	900	1800	0.50
Erb Street	Eastbound	East of Platinum Drive	581	575	810	235	816	2	900	1800	0.45
Erb Street	Southbound	North of Erb Street	36	68	112	44	80	1	900	900	0.09
Wilmot Ln	Northbound	North of Erb Street	13	23	28	5	18	1	900	900	0.02
Erb Street	Westbound	West of Wilmot Ln	197	151	156	5	202	1	1100	1100	0.18
Erb Street	Eastbound	West of Wilmot Ln	674	502	635	133	807	1	1100	1100	0.73
Erb Street	Westbound	East of Wilmot Ln	202	173	182	9	211	1	900	900	0.23
Erb Street	Eastbound	East of Wilmot Ln	702	569	745	176	878	1	900	900	0.98
Erbsville Road	Southbound	South of Keats Way	688	287	316	29	717	2	900	1800	0.40
Erbsville Road	Northbound	South of Keats Way	709	390	711	321	1030	2	900	1800	0.57
Erbsville Road	Southbound	North of Keats Way	635	323	355	32	667	2	900	1800	0.37
Erbsville Road	Northbound	North of Keats Way	782	500	838	338	1120	2	900	1800	0.62
Keats Way	Westbound	West of Erbsville Road	67	33	64	31	98	1	650	650	0.15
Keats Way	Eastbound	West of Erbsville Road	192	144	164	20	212	1	650	650	0.33
Keats Way	Westbound	East of Erbsville Road	153	77	115	38	191	1	650	650	0.29
Keats Way	Eastbound	East of Erbsville Road	152	113	127	14	166	1	650	650	0.26
Fisher-Hallman Road	Southbound	South of Columbia Street	492	208	318	110	602	2	900	1800	0.33
Fisher-Hallman Road	Northbound	South of Columbia Street	1006	822	959	137	1143	2	900	1800	0.64
Fisher-Hallman Road	Southbound	North of Columbia Street	611	444	391	-53	620	2	900	1800	0.34
Fisher-Hallman Road	Northbound	North of Columbia Street	683	469	673	204	887	2	900	1800	0.49
Columbia Street	Westbound	West of Fisher-Hallman Road	383	153	325	172	555	2	900	1800	0.31
Columbia Street	Eastbound	West of Fisher-Hallman Road	998	890	1423	533	1531	2	900	1800	0.85
Columbia Street	Westbound	East of Fisher-Hallman Road	355	160	247	87	442	2	900	1800	0.25
Columbia Street	Eastbound	East of Fisher-Hallman Road	1412	1484	1705	221	1633	2	900	1800	0.91
Erbsville Road	Southbound	South of Columbia Street	648	382	415	33	681	2	900	1800	0.38
Erbsville Road	Northbound	South of Columbia Street	746	506	845	339	1085	2	900	1800	0.60
Erbsville Road	Southbound	North of Columbia Street	722	628	831	203	975	1	900	900	1.08
Erbsville Road	Northbound	North of Columbia Street	618	373	494	121	739	1	900	900	0.82
Columbia Street	Westbound	West of Erbsville Road	148	52	379	327	475	1	900	900	0.53
Columbia Street	Eastbound	West of Erbsville Road	416	355	530	175	591	1	900	900	0.66
Columbia Street	Westbound	East of Erbsville Road	335	164	351	187	522	2	900	1800	0.29
Columbia Street	Eastbound	East of Erbsville Road	855	847	1269	422	1277	2	900	1800	0.71
Platinum Drive	Southbound	South of Columbia Street	0	0	544	544	544	1	400	400	1.36
Platinum Drive	Northbound	South of Columbia Street	0	0	21	21	21	1	400	400	0.05
Columbia Street	Westbound	West of Platinum Drive	134	38	93	55	189	1	900	900	0.21
Columbia Street	Eastbound	West of Platinum Drive	271	210	591	381	652	1	900	900	0.72
Columbia Street	Westbound	East of Platinum Drive	134	38	460	422	556	1	900	900	0.62
Columbia Street	Eastbound	East of Platinum Drive	271	210	435	225	496	1	900	900	0.55
Westmount Rd	Southbound	North of Northfield Drive	585	574	774	200	785	1	900	900	0.87
Westmount Rd	Northbound	North of Northfield Drive	241	163	213	50	291	1	900	900	0.32
Westmount Rd	Westbound	West of Westmount Rd	642	219	431	212	854	2	900	1800	0.47

Thorndale Drive	Westbound	East of Ira Needles Blvd	175	116	171	55	230	1	650	650	0.35
Thorndale Drive	Eastbound	West of Ira Needles Blvd	58	9	14	5	63	1	650	650	0.10
Thorndale Drive	Westbound	West of Ira Needles Blvd	82	64	65	1	83	1	650	650	0.13
Ira Needles Blvd	Northbound	North of Thorndale Dr	830	421	1184	763	1593	2	900	1800	0.89
Ira Needles Blvd	Southbound	North of Thorndale Dr	958	527	651	124	1082	2	900	1800	0.60
Ira Needles Blvd	Northbound	South of Thorndale Dr	735	478	1225	747	1482	2	900	1800	0.82
Ira Needles Blvd	Southbound	South of Thorndale Dr	926	471	608	137	1063	2	900	1800	0.59
University Avenue	Eastbound	East of Ira Needles Blvd	607	491	651	160	767	2	900	1800	0.43
University Avenue	Westbound	East of Ira Needles Blvd	461	345	417	72	533	2	900	1800	0.30
University Avenue	Eastbound	West of Ira Needles Blvd	81	9	22	13	94	2	650	1300	0.07
University Avenue	Westbound	West of Ira Needles Blvd	99	30	45	15	114	2	650	1300	0.09
Ira Needles Blvd	Northbound	North of University Avenue	632	527	1221	694	1326	2	900	1800	0.74
Ira Needles Blvd	Southbound	North of University Avenue	765	483	608	125	890	2	900	1800	0.49
Ira Needles Blvd	Northbound	South of University Avenue	961	885	1804	919	1880	2	1100	2200	0.85
Ira Needles Blvd	Southbound	South of University Avenue	930	703	934	231	1161	2	1100	2200	0.53
University Avenue	Eastbound	East of Fisher-Hallman Road	890	937	1094	157	1047	1	1100	1100	0.95
University Avenue	Westbound	East of Fisher-Hallman Road	222	260	310	50	272	1	1100	1100	0.25
University Avenue	Eastbound	West of Fisher-Hallman Road	929	489	578	89	1018	1	1500	1500	0.68
University Avenue	Westbound	West of Fisher-Hallman Road	339	215	283	68	407	1	1500	1500	0.27
Fisher-Hallman Road	Northbound	North of University Avenue	812	690	1134	444	1256	2	900	1800	0.70
Fisher-Hallman Road	Southbound	North of University Avenue	782	660	827	167	949	2	900	1800	0.53
Fisher-Hallman Road	Northbound	South of University Avenue	1148	1139	1656	517	1665	2	900	1800	0.93
Fisher-Hallman Road	Southbound	South of University Avenue	1040	705	861	156	1196	2	900	1800	0.66

Notes:

Traffic growth forecast from model over-written to be more consistent with existing traffic

No volumes in model, estimated by WSP

Applied variables to obtain the same 2031 forecasted volumes as the ajdacent intersections

No 2017 TMC or Vissum volumes as road section does not exist. 2031 Vissum forecasted volumes used in analysis

Derived based on adjacent 2017 TMC data assuming volume diffenrential from 2017 vissum model

V/C = 0.85 to 0.99

V/C > 1.0

Integrated Multi-Modal Transportation Study, Waterloo West Side
Forecasted 2031 PM Peak Hour Traffic Volumes (Scenario with 8,000 Employees in City Employment Zone 141)

Roadway	Direction	Location	Existing Traffic Volume (From TMC)	2017 Traffic Forecast (from VISUM)	2031 Traffic Forecast (from VISUM)	Growth (2017-2031 from VISUM)	2031 Traffic Forecast Existing Traffic Volume from TMC plus growth from VISUM)	Number of Lanes	Lane Capacity (from VISUM, except 650 coded instead of 400 based on counts)	Link Capacity	Link V/C
Conservation Drive	Eastbound	East of Wilmot Ln	19	83	104	21	40	1	900	900	0.04
Conservation Drive	Westbound	East of Wilmot Ln	64	253	375	122	186	1	900	900	0.21
Wilmot Ln	Northbound	North of Conservation Dr	13	17	48	31	44	1	900	900	0.05
Wilmot Ln	Southbound	North of Conservation Dr	18	64	30	-34	20	1	900	900	0.02
Wilmot Ln	Northbound	South of Conservation Dr	29	91	138	47	76	1	900	900	0.08
Wilmot Ln	Southbound	South of Conservation Dr	79	307	392	85	164	1	900	900	0.18
Conservation Drive	Eastbound	East of Erbsville Road	178	108	128	20	198	1	900	900	0.22
Conservation Drive	Westbound	East of Erbsville Road	237	405	395	-10	240	1	900	900	0.27
Conservation Drive	Eastbound	West of Erbsville Road	24	90	110	20	44	1	900	900	0.05
Conservation Drive	Westbound	West of Erbsville Road	56	259	383	124	180	1	900	900	0.20
Erbsville Road	Northbound	North of Conservation Drive	183	117	204	87	270	1	900	900	0.30
Erbsville Road	Southbound	North of Conservation Drive	170	133	339	206	376	1	900	900	0.42
Erbsville Road	Northbound	South of Conservation Drive	274	130	214	84	358	1	900	900	0.40
Erbsville Road	Southbound	South of Conservation Drive	288	274	343	69	357	1	900	900	0.40
Conservation Drive	Eastbound	East of Beaver Creek Rd	174	201	320	119	293	1	900	900	0.33
Conservation Drive	Westbound	East of Beaver Creek Rd	237	571	723	152	389	1	900	900	0.43
Conservation Drive	Eastbound	West of Beaver Creek Rd	131	155	234	79	210	1	900	900	0.23
Conservation Drive	Westbound	West of Beaver Creek Rd	146	468	589	121	267	1	900	900	0.30
Beaver Creek Rd	Northbound	South of Conservation Drive	73	90	202	112	185	1	650	650	0.28
Beaver Creek Rd	Southbound	South of Conservation Drive	121	147	250	103	224	1	650	650	0.34
Conservation Drive	Eastbound	East of Westmount Rd	47	218	171	-47	50	1	900	900	0.06
Conservation Drive	Westbound	East of Westmount Rd	40	237	336	99	139	1	900	900	0.15
Conservation Drive	Eastbound	West of Westmount Rd	168	179	326	147	315	1	900	900	0.35
Conservation Drive	Westbound	West of Westmount Rd	446	774	796	22	468	1	900	900	0.52
Westmount Rd	Northbound	North of Conservation Drive	268	280	551	271	539	1	900	900	0.60
Westmount Rd	Southbound	North of Conservation Drive	335	422	459	37	372	1	900	900	0.41
Westmount Rd	Northbound	South of Conservation Drive	527	683	817	134	661	1	900	900	0.73
Westmount Rd	Southbound	South of Conservation Drive	309	251	420	169	478	1	900	900	0.53
Laurelwood Drive	Eastbound	East of Erbsville Road	248	76	108	32	280	1	650	650	0.43
Laurelwood Drive	Westbound	East of Erbsville Road	389	82	96	14	403	1	650	650	0.62
Laurelwood Drive	Eastbound	West of Erbsville Road	241	233	267	34	275	1	650	650	0.42
Laurelwood Drive	Westbound	West of Erbsville Road	330	139	258	119	449	1	650	650	0.69
Erbsville Road	Northbound	North of Laurelwood Drive	371	422	486	64	435	1	900	900	0.48
Erbsville Road	Southbound	North of Laurelwood Drive	373	194	322	128	501	1	900	900	0.56
Erbsville Road	Northbound	South of Laurelwood Drive	520	506	698	192	712	1	900	900	0.79
Erbsville Road	Southbound	South of Laurelwood Drive	574	378	531	153	727	1	900	900	0.81
Laurelwood Drive	Eastbound	East of Beaver Creek Rd	328	242	288	46	374	1	650	650	0.58
Laurelwood Drive	Westbound	East of Beaver Creek Rd	614	380	414	34	648	1	650	650	1.00
Laurelwood Drive	Eastbound	West of Beaver Creek Rd	288	205	236	31	319	1	650	650	0.49
Laurelwood Drive	Westbound	West of Beaver Creek Rd	559	307	346	39	598	1	650	650	0.92
Beaver Creek Rd	Northbound	North of Laurelwood Drive	95	119	287	168	263	1	650	650	0.40
Beaver Creek Rd	Southbound	North of Laurelwood Drive	181	157	260	103	284	1	650	650	0.44
Beaver Creek Rd	Northbound	South of Laurelwood Drive	133	120	282	162	295	1	650	650	0.45
Beaver Creek Rd	Southbound	South of Laurelwood Drive	234	147	236	89	323	1	650	650	0.50
Laurelwood Drive	Eastbound	East of Bearinger Rd	166	10	48	38	204	1	650	650	0.31
Laurelwood Drive	Westbound	East of Bearinger Rd	223	59	141	82	305	1	650	650	0.47
Laurelwood Drive	Eastbound	West of Bearinger Rd	288	278	328	50	338	1	650	650	0.52
Laurelwood Drive	Westbound	West of Bearinger Rd	542	433	464	31	573	1	650	650	0.88
Bearinger Rd	Northbound	North of Laurelwood Drive	389	379	620	241	630	2	900	1800	0.35
Bearinger Rd	Southbound	North of Laurelwood Drive	909	785	963	178	1087	2	900	1800	0.60
Fisher-Hallman Road	Northbound	South of Laurelwood Drive	526	341	498	157	683	2	900	1800	0.38
Fisher-Hallman Road	Southbound	South of Laurelwood Drive	849	651	799	148	997	2	900	1800	0.55
Bearinger Road	Eastbound	East of Westmount Rd	306	296	310	14	320	1	650	650	0.49
Bearinger Road	Westbound	East of Westmount Rd	538	388	393	5	543	1	650	650	0.84
Bearinger Road	Eastbound	West of Westmount Rd	445	379	619	240	685	2	900	1800	0.38
Bearinger Road	Westbound	West of Westmount Rd	934	787	969	182	1116	2	900	1800	0.62
Westmount Rd	Northbound	North of Bearinger Road	680	259	574	315	995	2	900	1800	0.55
Westmount Rd	Southbound	North of Bearinger Road	1078	559	839	280	1358	2	900	1800	0.75
Westmount Rd	Northbound	South of Bearinger Road	378	155	216	61	439	2	900	1800	0.24
Westmount Rd	Southbound	South of Bearinger Road	519	139	214	75	594	2	900	1800	0.33
Northfield Drive	Eastbound	East of Westmount Rd	493	121	504	383	876	2	900	1800	0.49
Northfield Drive	Westbound	East of Westmount Rd	1187	852	1176	324	1511	2	900	1800	0.84
Westmount Rd	Eastbound	West of Westmount Rd	695	259	574	315	1010	2	900	1800	0.56

Westmount Rd	Westbound	West of Westmount Rd	1188	559	839	280	1468	2	900	1800	0.82
Westmount Rd	Northbound	North of Northfield Drive	548	683	837	154	702	1	900	900	0.78
Westmount Rd	Southbound	North of Northfield Drive	347	252	431	179	526	1	900	900	0.58
Columbia Street	Eastbound	East of Platinum Drive	143	109	745	636	779	1	900	900	0.87
Columbia Street	Westbound	East of Platinum Drive	119	207	511	304	423	1	900	900	0.47
Columbia Street	Eastbound	West of Platinum Drive	143	109	312	203	346	1	900	900	0.38
Columbia Street	Westbound	West of Platinum Drive	119	207	581	374	493	1	900	900	0.55
Platinum Drive	Nortbound	South of Columbia Street	0	0	585	585	585	1	400	400	1.46
Platinum Drive	Southbound	South of Columbia Street	0	0	81	81	81	1	400	400	0.20
Columbia Street	Eastbound	East of Erbsville Road	499	422	707	285	784	2	900	1800	0.44
Columbia Street	Westbound	East of Erbsville Road	888	871	1258	387	1275	2	900	1800	0.71
Columbia Street	Eastbound	West of Erbsville Road	210	176	593	417	627	1	900	900	0.70
Columbia Street	Westbound	West of Erbsville Road	286	374	606	232	518	1	900	900	0.58
Erbsville Road	Northbound	North of Columbia Street	716	730	977	247	963	1	900	900	1.07
Erbsville Road	Southbound	North of Columbia Street	663	571	780	209	872	1	900	900	0.97
Erbsville Road	Northbound	South of Columbia Street	630	500	591	91	721	2	900	1800	0.40
Erbsville Road	Southbound	South of Columbia Street	890	591	933	342	1232	2	900	1800	0.68
Columbia Street	Eastbound	East of Fisher-Hallman Road	519	548	687	139	658	2	900	1800	0.37
Columbia Street	Westbound	East of Fisher-Hallman Road	1264	1351	1691	340	1604	2	900	1800	0.89
Columbia Street	Eastbound	West of Fisher-Hallman Road	442	422	759	337	779	2	900	1800	0.43
Columbia Street	Westbound	West of Fisher-Hallman Road	1033	899	1407	508	1541	2	900	1800	0.86
Fisher-Hallman Road	Northbound	North of Columbia Street	642	432	602	170	812	2	900	1800	0.45
Fisher-Hallman Road	Southbound	North of Columbia Street	935	613	763	150	1085	2	900	1800	0.60
Fisher-Hallman Road	Northbound	South of Columbia Street	552	323	527	204	756	2	900	1800	0.42
Fisher-Hallman Road	Southbound	South of Columbia Street	999	828	1044	216	1215	2	900	1800	0.68
Keats Way	Eastbound	East of Erbsville Road	159	76	186	110	269	1	650	650	0.41
Keats Way	Westbound	East of Erbsville Road	181	182	189	7	188	1	650	650	0.29
Keats Way	Eastbound	West of Erbsville Road	103	53	157	104	207	1	650	650	0.32
Keats Way	Westbound	West of Erbsville Road	119	114	133	19	138	1	650	650	0.21
Erbsville Road	Northbound	North of Keats Way	651	539	630	91	742	2	900	1800	0.41
Erbsville Road	Southbound	North of Keats Way	831	535	863	328	1159	2	900	1800	0.64
Erbsville Road	Northbound	South of Keats Way	681	417	515	98	779	2	900	1800	0.43
Erbsville Road	Southbound	South of Keats Way	867	459	775	316	1183	2	900	1800	0.66
Erb Street	Eastbound	East of Wilmot Ln	344	335	364	29	373	1	900	900	0.41
Erb Street	Westbound	East of Wilmot Ln	621	675	876	201	822	1	900	900	0.91
Erb Street	Eastbound	West of Wilmot Ln	326	276	312	36	362	1	1100	1100	0.33
Erb Street	Westbound	West of Wilmot Ln	574	598	728	130	704	1	1100	1100	0.64
Wilmot Ln	Northbound	North of Erb Street	59	78	151	73	132	1	900	900	0.15
Wilmot Ln	Southbound	North of Erb Street	27	60	54	-6	30	1	900	900	0.03
Erb Street	Eastbound	East of Platinum Drive	306	386	1100	714	1020	2	900	1800	0.57
Erb Street	Westbound	East of Platinum Drive	543	695	1024	329	872	2	900	1800	0.48
Erb Street	Eastbound	West of Platinum Drive	255	335	364	29	284	1	900	900	0.32
Erb Street	Westbound	West of Platinum Drive	585	675	876	201	786	1	900	900	0.87
Platinum Drive	Northbound	North of Erb Street	39	15	280	265	304	2	650	1300	0.23
Platinum Drive	Southbound	North of Erb Street	127	13	820	807	934	2	650	1300	0.72
Platinum Drive	Northbound	South of Erb Street	32	48	78	30	62	1	650	650	0.10
Platinum Drive	Southbound	South of Erb Street	27	14	30	16	43	1	650	650	0.07
Erb Street	Eastbound	East of The Boardwalk	834	470	1186	716	1550	2	900	1800	0.86
Erb Street	Westbound	East of The Boardwalk	1016	763	1087	324	1340	2	900	1800	0.74
Erb Street	Eastbound	West of The Boardwalk	306	386	1100	714	1020	2	900	1800	0.57
Erb Street	Westbound	West of The Boardwalk	543	695	1024	329	872	2	900	1800	0.48
The Boardwalk	Northbound	South of Erb Street	0	0	18	18	18	2	400	800	0.02
The Boardwalk	Southbound	South of Erb Street	0	0	10	10	10	2	400	800	0.01
Erb Street	Eastbound	East of Ira Needles Blvd	598	228	420	192	790	2	900	1800	0.44
Erb Street	Westbound	East of Ira Needles Blvd	856	587	656	69	925	2	900	1800	0.51
Erb Street	Eastbound	West of Ira Needles Blvd	834	470	1186	716	1550	2	900	1800	0.86
Erb Street	Westbound	West of Ira Needles Blvd	1016	763	1087	324	1340	2	900	1800	0.74
Ira Needles Blvd	Northbound	North of Erb Street	1179	721	818	97	1276	2	900	1800	0.71
Ira Needles Blvd	Southbound	North of Erb Street	1011	690	1092	402	1413	2	900	1800	0.79
Ira Needles Blvd	Northbound	South of Erb Street	1300	585	844	259	1559	2	900	1800	0.87
Ira Needles Blvd	Southbound	South of Erb Street	1208	621	1452	831	2039	2	900	1800	1.13
Erb Street	Eastbound	East of Fisher-Hallman Road	540	539	741	202	742	2	900	1800	0.41
Erb Street	Westbound	East of Fisher-Hallman Road	951	1279	1305	26	977	2	900	1800	0.54
Erb Street	Eastbound	West of Fisher-Hallman Road	560	547	751	204	764	2	900	1800	0.42
Erb Street	Westbound	West of Fisher-Hallman Road	1103	1269	1428	159	1262	2	900	1800	0.70
Fisher-Hallman Road	Northbound	North of Erb Street	743	582	815	233	976	2	900	1800	0.54
Fisher-Hallman Road	Southbound	North of Erb Street	1064	1059	1385	326	1390	2	900	1800	0.77
Fisher-Hallman Road	Northbound	South of Erb Street	744	630	990	360	1104	2	900	1800	0.61
Fisher-Hallman Road	Southbound	South of Erb Street	933	1124	1470	346	1279	2	900	1800	0.71
Thorndale Drive	Eastbound	East of Ira Needles Blvd	176	158	214	56	232	1	650	650	0.36

Thorndale Drive	Westbound	East of Ira Needles Blvd	177	173	247	74	251	1	650	650	0.39
Thorndale Drive	Eastbound	West of Ira Needles Blvd	213	53	59	6	219	1	650	650	0.34
Thorndale Drive	Westbound	West of Ira Needles Blvd	111	60	75	15	126	1	650	650	0.19
Ira Needles Blvd	Northbound	North of Thorndale Dr	1158	606	889	283	1441	2	900	1800	0.80
Ira Needles Blvd	Southbound	North of Thorndale Dr	1224	630	1461	831	2055	2	900	1800	1.14
Ira Needles Blvd	Northbound	South of Thorndale Dr	985	564	836	272	1257	2	900	1800	0.70
Ira Needles Blvd	Southbound	South of Thorndale Dr	1154	595	1424	829	1983	2	900	1800	1.10
University Avenue	Eastbound	East of Ira Needles Blvd	401	486	704	218	619	2	900	1800	0.34
University Avenue	Westbound	East of Ira Needles Blvd	466	616	834	218	684	2	900	1800	0.38
University Avenue	Eastbound	West of Ira Needles Blvd	434	54	48	-6	440	2	650	1300	0.34
University Avenue	Westbound	West of Ira Needles Blvd	488	63	69	6	494	2	650	1300	0.38
Ira Needles Blvd	Northbound	North of University Avenue	668	580	814	234	902	2	900	1800	0.50
Ira Needles Blvd	Southbound	North of University Avenue	650	634	1412	778	1428	2	900	1800	0.79
Ira Needles Blvd	Northbound	South of University Avenue	713	853	1393	540	1253	2	1100	2200	0.57
Ira Needles Blvd	Southbound	South of University Avenue	706	1028	2100	1072	1778	2	1100	2200	0.81
University Avenue	Eastbound	East of Fisher-Hallman Road	377	543	726	183	560	1	1100	1100	0.51
University Avenue	Westbound	East of Fisher-Hallman Road	898	954	1120	166	1064	1	1100	1100	0.97
University Avenue	Eastbound	West of Fisher-Hallman Road	545	356	515	159	704	1	1500	1500	0.47
University Avenue	Westbound	West of Fisher-Hallman Road	902	742	753	11	913	1	1500	1500	0.61
Fisher-Hallman Road	Northbound	North of University Avenue	879	722	1048	326	1205	2	900	1800	0.67
Fisher-Hallman Road	Southbound	North of University Avenue	913	867	1384	517	1430	2	900	1800	0.79
Fisher-Hallman Road	Northbound	South of University Avenue	1165	1043	1379	336	1501	2	900	1800	0.83
Fisher-Hallman Road	Southbound	South of University Avenue	1363	1213	1870	657	2020	2	900	1800	1.12

Notes:

Traffic growth forecast from model over-written to be more consistent with existing traffic

No volumes in model, estimated by WSP

Applied variables to obtain the same 2031 forecasted volumes as the ajdacent intersections

No 2017 TMC or Vissum volumes as road section does not exist. 2031 Vissum forecasted volumes used in analysis

Derived based on adjacent 2017 TMC data assuming volume diffenrential from 2017 vissum model

V/C = 0.85 to 0.99

V/C > 1.0

APPENDIX

G TMC FORECAST FROM THE NCHRP 255 ITERATIVE METHOD

Ira Needles Blvd at University Ave - AM Peak Hour

Destinations

Origins	North	East	South	West	Total	Target	Factor
North	0	137	599	29	**765**	*890*	1.163
East	96	0	315	50	**461**	*533*	1.156
South	513	428	0	20	**961**	*1880*	1.956
West	23	42	16	0	**81**	*94*	1.160
Total	**632**	**607**	**930**	**99**	**2268**		
Target	*1326*	*767*	*1161*	*144*		*3398*	
	2.098	1.264	1.248	1.455			

0	159	697	34	**890**	*890*	1.000		0	117	749	37	**904**	*890*	0.985	2%
111	0	364	58	**533**	*533*	1.000		129	0	392	64	**584**	*533*	0.912	10%
1004	837	0	39	**1880**	*1880*	1.000		1166	614	0	43	**1823**	*1880*	1.031	3%
27	49	19	0	**94**	*94*	1.000		31	36	20	0	**87**	*94*	1.084	8%
1141	**1045**	**1080**	**131**	**3397**				**1326**	**767**	**1161**	**144**	**3398**			
1326	*767*	*1161*	*144*					*1326*	*767*	*1161*	*144*				
1.162	0.734	1.075	1.102					1.000	1.000	1.000	1.000				
14%	36%	7%	9%												

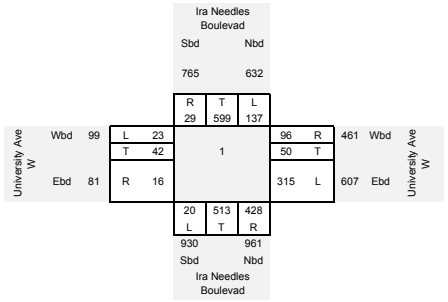
0	115	738	37	**890**	*890*	1.000		0	112	767	38	**917**	*890*	0.970	3%
118	0	357	58	**533**	*533*	1.000		115	0	371	60	**547**	*533*	0.975	3%
1202	633	0	44	**1880**	*1880*	1.000		1178	617	0	46	**1841**	*1880*	1.021	2%
34	39	22	0	**94**	*94*	1.000		33	38	22	0	**93**	*94*	1.009	1%
1353	**787**	**1117**	**139**	**3397**				**1326**	**767**	**1161**	**144**	**3398**			
1326	*767*	*1161*	*144*					*1326*	*767*	*1161*	*144*				
0.980	0.974	1.039	1.035					1.000	1.000	1.000	1.000				
2%	3%	4%	3%												

0	109	744	37	**890**	*890*	1.000		0	107	765	37	**910**	*890*	0.978	2%
112	0	362	59	**533**	*533*	1.000		110	0	372	59	**542**	*533*	0.983	2%
1203	630	0	47	**1880**	*1880*	1.000		1183	622	0	48	**1852**	*1880*	1.015	1%
33	38	23	0	**94**	*94*	1.000		33	38	23	0	**94**	*94*	1.004	0%
1348	**777**	**1129**	**142**	**3397**				**1326**	**767**	**1161**	**144**	**3398**			
1326	*767*	*1161*	*144*					*1326*	*767*	*1161*	*144*				
0.983	0.987	1.028	1.012					1.000	1.000	1.000	1.000				
2%	1%	3%	1%												

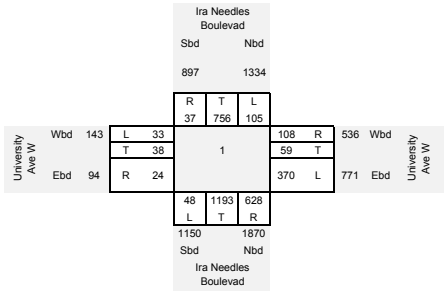
0	105	749	36	**890**	*890*	1.000		0	104	764	37	**904**	*890*	0.984	2%
109	0	366	58	**533**	*533*	1.000		107	0	373	59	**540**	*533*	0.988	1%
1201	631	0	48	**1880**	*1880*	1.000		1186	625	0	49	**1860**	*1880*	1.011	1%
33	38	23	0	**94**	*94*	1.000		32	37	24	0	**94**	*94*	1.003	0%
1342	**774**	**1138**	**143**	**3397**				**1326**	**767**	**1161**	**144**	**3398**			
1326	*767*	*1161*	*144*					*1326*	*767*	*1161*	*144*				
0.988	0.991	1.020	1.008					1.000	1.000	1.000	1.000				
1%	1%	2%	1%												

	North	East	South	West	Total	Target		
North	0	105	756	37	**897**	*890*	0.992	1%
East	108	0	370	59	**536**	*533*	0.994	1%
South	1193	628	0	48	**1870**	*1880*	1.005	1%
West	33	38	24	0	**94**	*94*	1.001	0%
Total	**1334**	**771**	**1150**	**143**	**3398**			
Target	*1326*	*767*	*1161*	*144*				
	0.994	0.995	1.010	1.004				
	1%	0%	1%	0%				

Existing AM



Forecasted 2031 AM



Fischer-Halman Rd at University Dr W - AM Peak Hour

Destinations

Origins	North	East	South	West	Total	Target	Factor
North	0	19	700	63	**782**	*949*	1.214
East	9	0	95	118	**222**	*272*	1.225
South	653	337	0	158	**1148**	*1665*	1.450
West	150	534	245	0	**929**	*1018*	1.096
Total	**812**	**890**	**1040**	**339**	**3081**		
Target	*1256*	*1047*	*1196*	*407*		*3905*	
	1.547	1.176	1.150	1.201			

0	23	849	76	**949**	*949*	1.000		0	22	823	69	**914**	*949*	1.038	4%
11	0	116	145	**272**	*272*	1.000		12	0	113	131	**256**	*272*	1.063	6%
947	489	0	229	**1665**	*1665*	1.000		1060	466	0	207	**1733**	*1665*	0.961	4%
164	585	268	0	**1018**	*1018*	1.000		184	558	260	0	**1003**	*1018*	1.015	2%
1122	**1097**	**1234**	**450**	**3904**				**1256**	**1047**	**1196**	**407**	**3906**			
1256	*1047*	*1196*	*407*					*1256*	*1047*	*1196*	*407*				
1.119	0.954	0.969	0.904					1.000	1.000	1.000	1.000				
11%	5%	3%	11%												

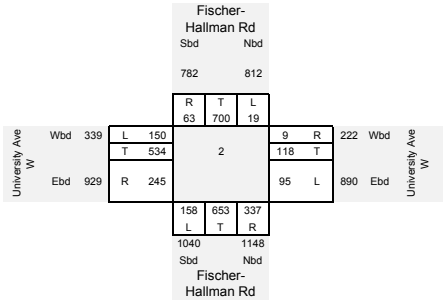
0	23	854	72	**949**	*949*	1.000		0	23	825	71	**919**	*949*	1.032	3%
13	0	120	139	**272**	*272*	1.000		14	0	116	138	**267**	*272*	1.017	2%
1018	448	0	199	**1665**	*1665*	1.000		1050	452	0	198	**1699**	*1665*	0.980	2%
187	567	264	0	**1018**	*1018*	1.000		193	572	255	0	**1020**	*1018*	0.998	0%
1218	**1038**	**1238**	**410**	**3904**				**1256**	**1047**	**1196**	**407**	**3906**			
1256	*1047*	*1196*	*407*					*1256*	*1047*	*1196*	*407*				
1.031	1.009	0.966	0.993					1.000	1.000	1.000	1.000				
3%	1%	4%	1%												

0	24	852	74	**949**	*949*	1.000		0	24	832	73	**930**	*949*	1.021	2%
14	0	118	140	**272**	*272*	1.000		14	0	115	140	**269**	*272*	1.010	1%
1029	443	0	194	**1665**	*1665*	1.000		1046	447	0	193	**1687**	*1665*	0.987	1%
192	571	255	0	**1018**	*1018*	1.000		196	576	249	0	**1021**	*1018*	0.997	0%
1235	**1038**	**1224**	**408**	**3904**				**1256**	**1047**	**1196**	**407**	**3906**			
1256	*1047*	*1196*	*407*					*1256*	*1047*	*1196*	*407*				
1.017	1.009	0.977	0.998					1.000	1.000	1.000	1.000				
2%	1%	2%	0%												

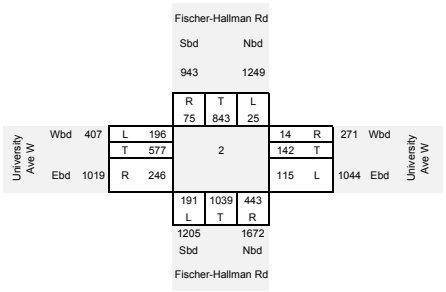
0	25	850	75	**949**	*949*	1.000		0	25	837	75	**937**	*949*	1.013	1%
14	0	116	142	**272**	*272*	1.000		14	0	115	141	**270**	*272*	1.006	1%
1033	441	0	191	**1665**	*1665*	1.000		1044	444	0	191	**1679**	*1665*	0.992	1%
195	575	248	0	**1018**	*1018*	1.000		197	578	244	0	**1020**	*1018*	0.998	0%
1242	**1040**	**1214**	**407**	**3904**				**1256**	**1047**	**1196**	**407**	**3906**			
1256	*1047*	*1196*	*407*					*1256*	*1047*	*1196*	*407*				
1.011	1.006	0.985	0.999					1.000	1.000	1.000	1.000				
1%	1%	1%	0%												

	North	East	South	West	Total	Target		
North	0	25	843	75	**943**	*949*	1.007	1%
East	14	0	115	142	**271**	*272*	1.003	0%
South	1039	443	0	191	**1672**	*1665*	0.996	0%
West	196	577	246	0	**1019**	*1018*	0.999	0%
Total	**1249**	**1044**	**1205**	**407**	**3905**			
Target	*1256*	*1047*	*1196*	*407*				
	1.005	1.003	0.993	0.999				
	1%	0%	1%	0%				

Existing AM



Forecasted 2031 AM



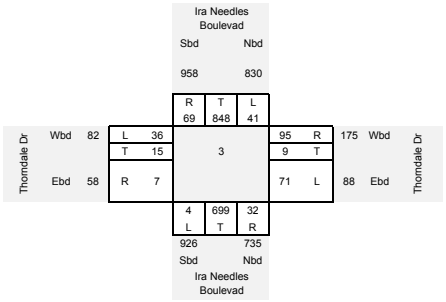
Ira Neeles Blvd at Thorndale Dr - AM Peak Hour

Origins \ Destinations	North	East	South	West	Total	Target	Factor
North	0	41	848	69	**958**	*1082*	1.129
East	95	0	71	9	**175**	*230*	1.314
South	699	32	0	4	**735**	*1482*	2.016
West	36	15	7	0	**58**	*63*	1.086
Total	**830**	**88**	**926**	**82**	**1926**		
Target	*1593*	*120*	*1063*	*83*		*2858*	
	1.919	1.364	1.148	1.012			

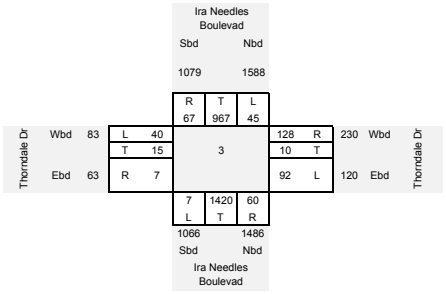
	0	46	958	78	**1082**	*1082*	1.000		0	44	962	66	**1072**	*1082*	1.010	1%
	125	0	93	12	**230**	*230*	1.000		126	0	94	10	**230**	*230*	0.999	0%
	1409	65	0	8	**1482**	*1482*	1.000		1427	61	0	7	**1495**	*1482*	0.991	1%
	39	16	8	0	**63**	*63*	1.000		40	15	8	0	**63**	*63*	1.006	1%
	1573	**127**	**1059**	**98**	**2857**				**1593**	**120**	**1063**	**83**	**2859**			
	1593	*120*	*1063*	*83*					*1593*	*120*	*1063*	*83*				
	1.012	0.944	1.004	0.848					1.000	1.000	1.000	1.000				
	1%	6%	0%	18%												
	0	44	971	67	**1082**	*1082*	1.000		0	44	963	66	**1073**	*1082*	1.008	1%
	126	0	94	10	**230**	*230*	1.000		127	0	93	10	**230**	*230*	1.000	0%
	1415	60	0	7	**1482**	*1482*	1.000		1426	60	0	7	**1493**	*1482*	0.993	1%
	40	15	8	0	**63**	*63*	1.000		40	15	8	0	**63**	*63*	0.996	0%
	1581	**120**	**1072**	**84**	**2857**				**1593**	**120**	**1063**	**83**	**2859**			
	1593	*120*	*1063*	*83*					*1593*	*120*	*1063*	*83*				
	1.008	1.000	0.991	0.993					1.000	1.000	1.000	1.000				
	1%	0%	1%	1%												
	0	45	971	67	**1082**	*1082*	1.000		0	45	963	66	**1074**	*1082*	1.007	1%
	127	0	93	10	**230**	*230*	1.000		128	0	92	10	**230**	*230*	1.000	0%
	1415	60	0	7	**1482**	*1482*	1.000		1425	60	0	7	**1491**	*1482*	0.994	1%
	40	15	8	0	**63**	*63*	1.000		40	15	8	0	**63**	*63*	0.996	0%
	1583	**120**	**1071**	**84**	**2857**				**1593**	**120**	**1063**	**83**	**2859**			
	1593	*120*	*1063*	*83*					*1593*	*120*	*1063*	*83*				
	1.007	1.001	0.993	0.994					1.000	1.000	1.000	1.000				
	1%	0%	1%	1%												
	0	45	970	67	**1082**	*1082*	1.000		0	45	964	67	**1076**	*1082*	1.006	1%
	128	0	92	10	**230**	*230*	1.000		129	0	91	10	**230**	*230*	1.000	0%
	1416	60	0	7	**1482**	*1482*	1.000		1424	60	0	7	**1490**	*1482*	0.995	1%
	40	15	8	0	**63**	*63*	1.000		40	15	7	0	**63**	*63*	0.997	0%
	1584	**120**	**1070**	**83**	**2857**				**1593**	**120**	**1063**	**83**	**2859**			
	1593	*120*	*1063*	*83*					*1593*	*120*	*1063*	*83*				
	1.006	1.001	0.994	0.995					1.000	1.000	1.000	1.000				
	1%	0%	1%	1%												

	North	East	South	West	Total	Target		
North	0	45	967	67	**1079**	*1082*	1.003	0%
East	128	0	92	10	**230**	*230*	1.000	0%
South	1420	60	0	7	**1486**	*1482*	0.997	0%
West	40	15	7	0	**63**	*63*	0.998	0%
Total	**1588**	**120**	**1066**	**83**	**2858**			
Target	*1593*	*120*	*1063*	*83*				
	1.003	1.000	0.997	0.997				
	0%	0%	0%	0%				

Existing AM



Forecasted 2031 AM



Wilmot Ln at Erb St - AM Peak Hour

Destinations

Origins	North	East	South	West	Total	Target	Factor
North	0	34		2	**36**	*80*	2.222
East	7	0		195	**202**	*211*	1.045
South							
West	6	668		0	**674**	*807*	1.197
Total	**13**	**702**		**197**	**912**		
Target	*18*	*878*		*202*		*1098*	
	1.385	1.251		1.025			

0	76		4	**80**	*80*	1.000		0	76	4	**80**	*80*	0.999	0%
7	0		204	**211**	*211*	1.000		9	0	198	**207**	*211*	1.020	2%
7	800		0	**807**	*807*	1.000		9	802	0	**811**	*807*	0.995	1%
14	**875**		**208**	**1098**				**18**	**878**	**202**	**1098**			
18	*878*		*202*					*18*	*878*	*202*				
1.242	1.003		0.971					1.000	1.000	1.000				
19%	0%		3%											

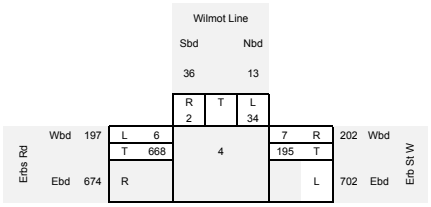
0	76		4	**80**	*80*	1.000		0	76	4	**80**	*80*	0.997	0%
9	0		202	**211**	*211*	1.000		9	0	198	**207**	*211*	1.019	2%
9	798		0	**807**	*807*	1.000		9	802	0	**811**	*807*	0.995	0%
18	**874**		**206**	**1098**				**18**	**878**	**202**	**1098**			
18	*878*		*202*					*18*	*878*	*202*				
0.992	1.005		0.980					1.000	1.000	1.000				
1%	0%		2%											

0	76		4	**80**	*80*	1.000		0	76	4	**80**	*80*	0.997	0%
9	0		202	**211**	*211*	1.000		9	0	198	**207**	*211*	1.018	2%
9	798		0	**807**	*807*	1.000		9	802	0	**811**	*807*	0.996	0%
18	**874**		**206**	**1098**				**18**	**878**	**202**	**1098**			
18	*878*		*202*					*18*	*878*	*202*				
0.992	1.005		0.981					1.000	1.000	1.000				
1%	0%		2%											

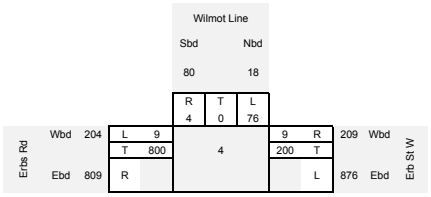
0	76		4	**80**	*80*	1.000		0	76	4	**80**	*80*	0.997	0%
9	0		202	**211**	*211*	1.000		9	0	198	**207**	*211*	1.018	2%
9	798		0	**807**	*807*	1.000		9	802	0	**810**	*807*	0.996	0%
18	**874**		**206**	**1098**				**18**	**878**	**202**	**1098**			
18	*878*		*202*					*18*	*878*	*202*				
0.993	1.004		0.982					1.000	1.000	1.000				
1%	0%		2%											

	North	East	South	West	Total	Target		
North	0	76		4	**80**	*80*	0.998	0%
East	9	0		200	**209**	*211*	1.009	1%
South								
West	9	800		0	**809**	*807*	0.998	0%
Total	**18**	**876**		**204**	**1098**			
Target	*18*	*878*		*202*				
	0.996	1.002		0.991				
	0%	0%		1%				

Existing AM



Forecasted 2031 AM



Platinum Drive at Erb Street - AM Peak Hour

Destinations

Origins	North	East	South	West	Total	Target	Factor
North	0	5	0	8	**13**	*173*	13.308
East	6	0	5	181	**192**	*891*	4.641
South	0	6	0	0	**6**	*16*	2.667
West	14	570	3	0	**587**	*763*	1.300
Total	**20**	**581**	**8**	**189**	**798**		
Target	*794*	*816*	*34*	*198*		*1843*	
	39.700	1.404	4.250	1.048			

0	67	0	106	**173**	*173*	1.000	
28	0	23	840	**891**	*891*	1.000	
0	16	0	0	**16**	*16*	1.000	
18	741	4	0	**763**	*763*	1.000	
46	**823**	**27**	**946**	**1843**			
794	*816*	*34*	*198*				
17.245	0.991	1.254	0.209				
94%	1%	20%	378%				

0	66	0	22	**88**	*173*	1.961	49%
480	0	29	176	**685**	*891*	1.301	23%
0	16	0	0	**16**	*16*	1.009	1%
314	734	5	0	**1053**	*763*	0.725	38%
794	**816**	**34**	**198**	**1842**			
794	*816*	*34*	*198*				
1.000	1.000	1.000	1.000				

0	129	0	44	**173**	*173*	1.000	
625	0	38	229	**891**	*891*	1.000	
0	16	0	0	**16**	*16*	1.000	
227	532	4	0	**763**	*763*	1.000	
852	**677**	**41**	**272**	**1843**			
794	*816*	*34*	*198*				
0.932	1.205	0.821	0.727				
7%	17%	22%	38%				

0	156	0	32	**188**	*173*	0.922	8%
582	0	31	166	**779**	*891*	1.143	13%
0	19	0	0	**19**	*16*	0.830	20%
212	641	3	0	**856**	*763*	0.892	12%
794	**816**	**34**	**198**	**1842**			
794	*816*	*34*	*198*				
1.000	1.000	1.000	1.000				

0	144	0	29	**173**	*173*	1.000	
665	0	36	190	**891**	*891*	1.000	
0	16	0	0	**16**	*16*	1.000	
189	571	3	0	**763**	*763*	1.000	
854	**731**	**38**	**219**	**1843**			
794	*816*	*34*	*198*				
0.929	1.116	0.892	0.903				
8%	10%	12%	11%				

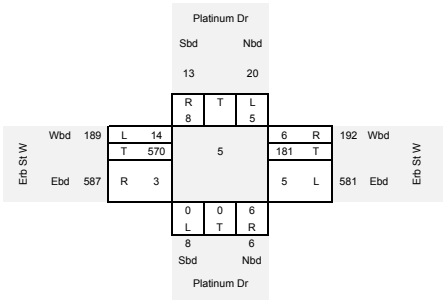
0	160	0	26	**187**	*173*	0.926	8%
618	0	32	172	**822**	*891*	1.084	8%
0	18	0	0	**18**	*16*	0.896	12%
176	638	2	0	**816**	*763*	0.935	7%
794	**816**	**34**	**198**	**1842**			
794	*816*	*34*	*198*				
1.000	1.000	1.000	1.000				

0	149	0	24	**173**	*173*	1.000	
671	0	34	186	**891**	*891*	1.000	
0	16	0	0	**16**	*16*	1.000	
164	597	2	0	**763**	*763*	1.000	
835	**761**	**37**	**211**	**1843**			
794	*816*	*34*	*198*				
0.951	1.072	0.931	0.941				
5%	7%	7%	6%				

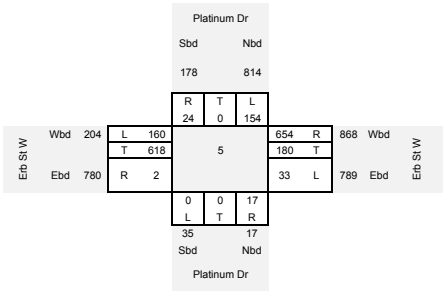
0	159	0	23	**182**	*173*	0.949	5%
638	0	32	175	**845**	*891*	1.055	5%
0	17	0	0	**17**	*16*	0.933	7%
156	640	2	0	**798**	*763*	0.956	5%
794	**816**	**34**	**198**	**1842**			
794	*816*	*34*	*198*				
1.000	1.000	1.000	1.000				

	North	East	South	West	Total	Target		
North	0	154	0	24	**178**	*173*	0.974	3%
East	654	0	33	180	**868**	*891*	1.027	3%
South	0	17	0	0	**17**	*16*	0.965	4%
West	160	618	2	0	**780**	*763*	0.978	2%
Total	**814**	**789**	**35**	**204**	**1843**			
Target	*794*	*816*	*34*	*198*				
	0.975	1.035	0.964	0.969				
	3%	3%	4%	3%				

Existing AM



Forecasted 2031 AM

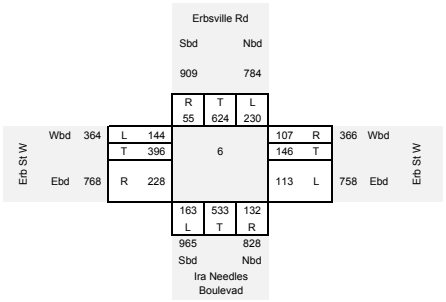


Ira Neeles Blvd/Erbsville Rd at Erb St - AM Peak Hour

Origins \ Destinations	North	East	South	West	Total	Target	Factor
North	0	230	624	55	**909**	*920*	1.012
East	107	0	113	146	**366**	*627*	1.713
South	533	132	0	163	**828**	*1584*	1.913
West	144	396	228	0	**768**	*997*	1.298
Total	**784**	**758**	**965**	**364**	**2871**		
Target	*1140*	*813*	*1078*	*1056*		*4108*	
	1.454	1.073	1.117	2.901			

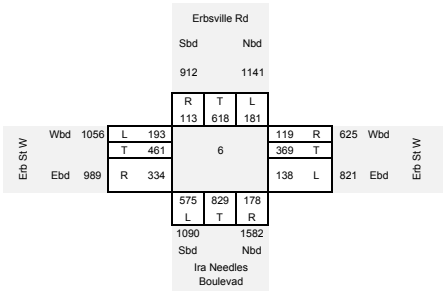
	0	233	632	56	**920**	*920*	1.000		0	189	607	95	**892**	*920*	1.032	3%
	183	0	194	250	**627**	*627*	1.000		150	0	186	428	**764**	*627*	0.821	22%
	1020	253	0	312	**1584**	*1584*	1.000		836	205	0	533	**1575**	*1584*	1.006	1%
	187	514	296	0	**997**	*997*	1.000		153	418	285	0	**856**	*997*	1.165	14%
	1390	**999**	**1121**	**618**	**4128**				**1140**	**813**	**1078**	**1056**	**4087**			
	1140	*813*	*1078*	*1056*					*1140*	*813*	*1078*	*1056*				
	0.820	0.814	0.962	1.710					1.000	1.000	1.000	1.000				
	22%	23%	4%	42%												
	0	195	626	98	**920**	*920*	1.000		0	179	608	105	**892**	*920*	1.031	3%
	123	0	153	351	**627**	*627*	1.000		123	0	148	376	**647**	*627*	0.969	3%
	841	207	0	536	**1584**	*1584*	1.000		839	189	0	575	**1603**	*1584*	0.988	1%
	179	487	331	0	**997**	*997*	1.000		178	445	322	0	**945**	*997*	1.055	5%
	1143	**889**	**1111**	**985**	**4128**				**1140**	**813**	**1078**	**1056**	**4087**			
	1140	*813*	*1078*	*1056*					*1140*	*813*	*1078*	*1056*				
	0.997	0.915	0.971	1.072					1.000	1.000	1.000	1.000				
	0%	9%	3%	7%												
	0	184	627	109	**920**	*920*	1.000		0	178	609	110	**897**	*920*	1.025	2%
	119	0	144	364	**627**	*627*	1.000		120	0	139	370	**629**	*627*	0.998	0%
	829	187	0	568	**1584**	*1584*	1.000		832	181	0	576	**1589**	*1584*	0.997	0%
	188	470	339	0	**997**	*997*	1.000		188	454	330	0	**972**	*997*	1.025	2%
	1136	**841**	**1110**	**1041**	**4128**				**1140**	**813**	**1078**	**1056**	**4087**			
	1140	*813*	*1078*	*1056*					*1140*	*813*	*1078*	*1056*				
	1.003	0.967	0.971	1.015					1.000	1.000	1.000	1.000				
	0%	3%	3%	1%												
	0	183	624	113	**920**	*920*	1.000		0	179	611	113	**903**	*920*	1.019	2%
	119	0	139	369	**627**	*627*	1.000		119	0	136	369	**624**	*627*	1.005	1%
	829	180	0	575	**1584**	*1584*	1.000		828	177	0	575	**1579**	*1584*	1.003	0%
	193	466	338	0	**997**	*997*	1.000		193	457	331	0	**981**	*997*	1.017	2%
	1142	**829**	**1101**	**1056**	**4128**				**1140**	**813**	**1078**	**1056**	**4087**			
	1140	*813*	*1078*	*1056*					*1140*	*813*	*1078*	*1056*				
	0.998	0.981	0.979	1.000					1.000	1.000	1.000	1.000				
	0%	2%	2%	0%												

Existing AM



Origins \ Destinations	North	East	South	West	Total	Target	Factor	
North	0	181	618	113	**912**	*920*	1.009	1%
East	119	0	138	369	**625**	*627*	1.003	0%
South	829	178	0	575	**1582**	*1584*	1.002	0%
West	193	461	334	0	**989**	*997*	1.008	1%
Total	**1141**	**821**	**1090**	**1056**	**4108**			
Target	*1140*	*813*	*1078*	*1056*				
	0.999	0.991	0.989	1.000				
	0%	1%	1%	0%				

Forecasted 2031 AM



Fischer-Halman Rd at Erb St - AM Peak Hour

Destinations

Origins	North	East	South	West	Total	Target	Factor
North	0	178	461	91	**730**	*845*	1.158
East	79	0	69	254	**402**	*553*	1.376
South	696	114	0	105	**915**	*1302*	1.423
West	233	680	138	0	**1051**	*1194*	1.136
Total	**1008**	**972**	**668**	**450**	**3098**		
Target	*1296*	*984*	*858*	*750*		*3891*	
	1.286	1.012	1.284	1.667			

0	206	534	105	**845**	*845*	1.000		0	178	583	131	**891**	*845*	0.948	6%
109	0	95	349	**553**	*553*	1.000		103	0	104	434	**641**	*553*	0.863	16%
990	162	0	149	**1302**	*1302*	1.000		941	140	0	185	**1267**	*1302*	1.028	3%
265	773	157	0	**1194**	*1194*	1.000		252	666	171	0	**1089**	*1194*	1.096	9%
1364	**1141**	**785**	**604**	**3894**				**1296**	**984**	**858**	**750**	**3888**			
1296	*984*	*858*	*750*					*1296*	*984*	*858*	*750*				
0.950	0.863	1.093	1.241					1.000	1.000	1.000	1.000				
5%	16%	8%	19%												

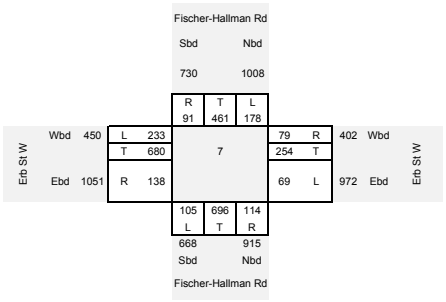
0	168	553	124	**845**	*845*	1.000		0	159	571	135	**865**	*845*	0.977	2%
89	0	90	374	**553**	*553*	1.000		87	0	93	408	**587**	*553*	0.942	6%
967	144	0	191	**1302**	*1302*	1.000		941	136	0	208	**1284**	*1302*	1.014	1%
276	730	188	0	**1194**	*1194*	1.000		268	689	194	0	**1152**	*1194*	1.037	4%
1332	**1043**	**830**	**689**	**3894**				**1296**	**984**	**858**	**750**	**3888**			
1296	*984*	*858*	*750*					*1296*	*984*	*858*	*750*				
0.973	0.944	1.034	1.089					1.000	1.000	1.000	1.000				
3%	6%	3%	8%												

0	155	558	132	**845**	*845*	1.000		0	152	566	136	**853**	*845*	0.990	1%
82	0	87	384	**553**	*553*	1.000		81	0	88	397	**566**	*553*	0.978	2%
954	138	0	210	**1302**	*1302*	1.000		941	134	0	217	**1293**	*1302*	1.007	1%
278	715	201	0	**1194**	*1194*	1.000		274	698	204	0	**1176**	*1194*	1.015	1%
1314	**1007**	**846**	**726**	**3894**				**1296**	**984**	**858**	**750**	**3888**			
1296	*984*	*858*	*750*					*1296*	*984*	*858*	*750*				
0.986	0.977	1.014	1.033					1.000	1.000	1.000	1.000				
1%	2%	1%	3%												

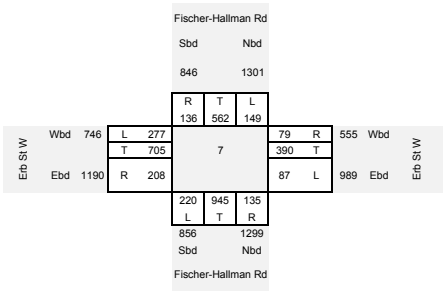
0	150	560	135	**845**	*845*	1.000		0	149	563	136	**848**	*845*	0.997	0%
79	0	86	388	**553**	*553*	1.000		78	0	87	392	**557**	*553*	0.992	1%
948	135	0	219	**1302**	*1302*	1.000		941	134	0	221	**1297**	*1302*	1.004	0%
278	708	207	0	**1194**	*1194*	1.000		277	701	208	0	**1186**	*1194*	1.007	1%
1305	**994**	**854**	**741**	**3894**				**1296**	**984**	**858**	**750**	**3888**			
1296	*984*	*858*	*750*					*1296*	*984*	*858*	*750*				
0.993	0.990	1.005	1.012					1.000	1.000	1.000	1.000				
1%	1%	1%	1%												

Origins	North	East	South	West	Total	Target	Factor	
North	0	149	562	136	**846**	*845*	0.998	0%
East	79	0	87	390	**555**	*553*	0.996	0%
South	945	135	0	220	**1299**	*1302*	1.002	0%
West	277	705	208	0	**1190**	*1194*	1.003	0%
Total	**1301**	**989**	**856**	**746**	**3891**			
Target	*1296*	*984*	*858*	*750*				
	0.997	0.995	1.003	1.006				
	0%	1%	0%	1%				

Existing AM



Forecasted 2031 AM



Erbsville Rd at Keats Way - AM Peak Hour

Destinations

Origins	North	East	South	West	Total	Target	Factor
North	0	55	558	22	**635**	*667*	1.050
East	60	0	67	26	**153**	*191*	1.248
South	640	50	0	19	**709**	*1030*	1.453
West	82	47	63	0	**192**	*212*	1.104
Total	**782**	**152**	**688**	**67**	**1689**		
Target	*1120*	*166*	*717*	*98*		*2101*	
	1.432	1.092	1.042	1.463			

0	58	586	23	**667**	*667*	1.000	
75	0	84	32	**191**	*191*	1.000	
930	73	0	28	**1030**	*1030*	1.000	
91	52	70	0	**212**	*212*	1.000	
1095	**182**	**739**	**83**	**2100**			
1120	*166*	*717*	*98*				
1.023	0.911	0.970	1.178				
2%	10%	3%	15%				

0	53	568	27	**648**	*667*	1.029	3%
77	0	81	38	**196**	*191*	0.975	3%
951	66	0	33	**1049**	*1030*	0.981	2%
93	47	67	0	**207**	*212*	1.023	2%
1120	**166**	**717**	**98**	**2101**			
1120	*166*	*717*	*98*				
1.000	1.000	1.000	1.000				

0	54	585	28	**667**	*667*	1.000	
75	0	79	37	**191**	*191*	1.000	
933	65	0	32	**1030**	*1030*	1.000	
95	48	69	0	**212**	*212*	1.000	
1103	**167**	**733**	**97**	**2100**			
1120	*166*	*717*	*98*				
1.016	0.992	0.978	1.008				
2%	1%	2%	1%				

0	54	572	28	**654**	*667*	1.020	2%
76	0	77	38	**191**	*191*	1.001	0%
948	64	0	32	**1045**	*1030*	0.986	1%
96	48	67	0	**212**	*212*	1.002	0%
1120	**166**	**717**	**98**	**2101**			
1120	*166*	*717*	*98*				
1.000	1.000	1.000	1.000				

0	55	583	29	**667**	*667*	1.000	
76	0	77	38	**191**	*191*	1.000	
935	63	0	32	**1030**	*1030*	1.000	
96	48	68	0	**212**	*212*	1.000	
1107	**166**	**729**	**98**	**2100**			
1120	*166*	*717*	*98*				
1.012	0.998	0.984	0.998				
1%	0%	2%	0%				

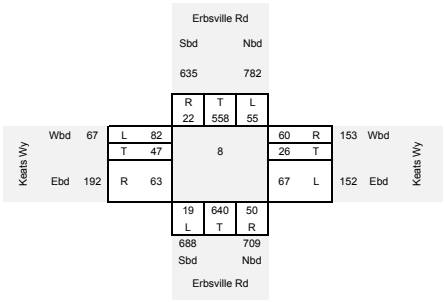
0	55	574	29	**658**	*667*	1.014	1%
77	0	76	38	**191**	*191*	1.002	0%
946	63	0	32	**1041**	*1030*	0.990	1%
97	48	67	0	**212**	*212*	1.000	0%
1120	**166**	**717**	**98**	**2101**			
1120	*166*	*717*	*98*				
1.000	1.000	1.000	1.000				

0	55	582	29	**667**	*667*	1.000	
77	0	76	38	**191**	*191*	1.000	
936	63	0	31	**1030**	*1030*	1.000	
97	48	67	0	**212**	*212*	1.000	
1110	**166**	**725**	**98**	**2100**			
1120	*166*	*717*	*98*				
1.009	0.999	0.989	0.998				
1%	0%	1%	0%				

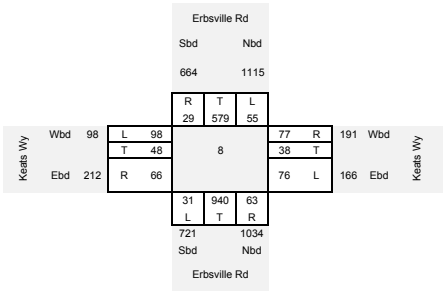
0	55	576	29	**660**	*667*	1.010	1%
78	0	75	38	**191**	*191*	1.001	0%
944	63	0	31	**1038**	*1030*	0.992	1%
98	48	66	0	**212**	*212*	1.000	0%
1120	**166**	**717**	**98**	**2101**			
1120	*166*	*717*	*98*				
1.000	1.000	1.000	1.000				

Origins	North	East	South	West	Total	Target		
North	0	55	579	29	**664**	*667*	1.005	1%
East	77	0	76	38	**191**	*191*	1.001	0%
South	940	63	0	31	**1034**	*1030*	0.996	0%
West	98	48	66	0	**212**	*212*	1.000	0%
Total	**1115**	**166**	**721**	**98**	**2101**			
Target	*1120*	*166*	*717*	*98*				
	1.004	1.000	0.994	0.999				
	0%	0%	1%	0%				

Existing AM



Forecasted 2031 AM



Erbsville Rd at Columbia St W - AM Peak Hour

Destinations

Origins	North	East	South	West	Total	Target	Factor
North	0	279	440	53	**772**	*975*	1.263
East	124	0	150	61	**335**	*522*	1.558
South	370	342	0	34	**746**	*1085*	1.454
West	124	234	58	0	**416**	*591*	1.421
Total	**618**	**855**	**648**	**148**	**2269**		
Target	*739*	*1277*	*681*	*475*		*3173*	
	1.196	1.494	1.051	3.209			

0	352	556	67	**975**	*975*	1.000		0	381	434	150	**965**	*975*	1.010	1%
193	0	234	95	**522**	*522*	1.000		157	0	183	214	**553**	*522*	0.943	6%
538	497	0	49	**1085**	*1085*	1.000		438	537	0	111	**1087**	*1085*	0.999	0%
176	332	82	0	**591**	*591*	1.000		143	359	64	0	**567**	*591*	1.043	4%
908	**1182**	**872**	**211**	**3173**				**739**	**1277**	**681**	**475**	**3172**			
739	*1277*	*681*	*475*					*739*	*1277*	*681*	*475*				
0.814	1.080	0.781	2.247					1.000	1.000	1.000	1.000				
23%	7%	28%	55%												

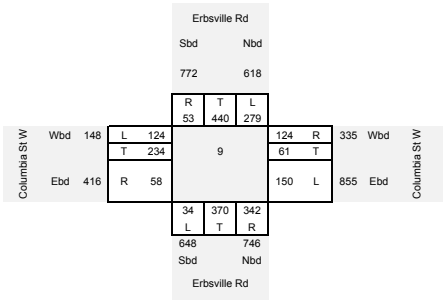
0	385	439	152	**975**	*975*	1.000		0	379	441	155	**975**	*975*	1.000	0%
148	0	172	201	**522**	*522*	1.000		149	0	173	206	**528**	*522*	0.988	1%
438	537	0	111	**1085**	*1085*	1.000		440	529	0	113	**1082**	*1085*	1.003	0%
150	374	67	0	**591**	*591*	1.000		150	369	67	0	**587**	*591*	1.007	1%
736	**1295**	**678**	**464**	**3173**				**739**	**1277**	**681**	**475**	**3172**			
739	*1277*	*681*	*475*					*739*	*1277*	*681*	*475*				
1.005	0.986	1.005	1.023					1.000	1.000	1.000	1.000				
0%	1%	0%	2%												

0	379	441	155	**975**	*975*	1.000		0	378	442	156	**975**	*975*	0.999	0%
147	0	171	204	**522**	*522*	1.000		147	0	171	204	**523**	*522*	0.998	0%
441	530	0	114	**1085**	*1085*	1.000		441	529	0	114	**1083**	*1085*	1.001	0%
151	372	68	0	**591**	*591*	1.000		151	371	68	0	**590**	*591*	1.002	0%
740	**1281**	**679**	**473**	**3173**				**739**	**1277**	**681**	**475**	**3172**			
739	*1277*	*681*	*475*					*739*	*1277*	*681*	*475*				
0.999	0.997	1.002	1.004					1.000	1.000	1.000	1.000				
0%	0%	0%	0%												

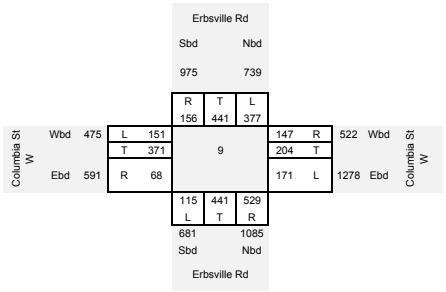
0	378	441	156	**975**	*975*	1.000		0	377	442	156	**975**	*975*	1.000	0%
147	0	171	204	**522**	*522*	1.000		147	0	171	204	**522**	*522*	1.000	0%
441	529	0	114	**1085**	*1085*	1.000		441	529	0	115	**1084**	*1085*	1.001	0%
152	371	68	0	**591**	*591*	1.000		151	371	68	0	**591**	*591*	1.001	0%
740	**1278**	**681**	**475**	**3173**				**739**	**1277**	**681**	**475**	**3172**			
739	*1277*	*681*	*475*					*739*	*1277*	*681*	*475*				
0.999	0.999	1.001	1.001					1.000	1.000	1.000	1.000				
0%	0%	0%	0%												

	North	East	South	West	Total	Target		
North	0	377	441	156	**975**	*975*	1.000	0%
East	147	0	171	204	**522**	*522*	1.000	0%
South	441	529	0	115	**1085**	*1085*	1.000	0%
West	151	371	68	0	**591**	*591*	1.000	0%
Total	**739**	**1278**	**681**	**475**	**3173**			
Target	*739*	*1277*	*681*	*475*				
	1.000	0.999	1.000	1.000				
	0%	0%	0%	0%				

Existing AM



Forecasted 2031 AM



Fischer-Halman Rd at Columbia St W - AM Peak Hour

Destinations

Origins	North	East	South	West	Total	Target	Factor
North	0	232	302	77	**611**	*620*	1.015
East	69	0	97	189	**355**	*442*	1.245
South	419	470	0	117	**1006**	*1143*	1.136
West	195	710	93	0	**998**	*1531*	1.534
Total	**683**	**1412**	**492**	**383**	**2970**		
Target	*887*	*1633*	*602*	*555*		*3707*	
	1.299	1.157	1.224	1.449			

	0	235	306	78	**620**	*620*	1.000		0	207	324	97	**628**	*620*	0.988	1%
	86	0	121	235	**442**	*442*	1.000		88	0	128	293	**509**	*442*	0.869	15%
	476	534	0	133	**1143**	*1143*	1.000		490	469	0	165	**1125**	*1143*	1.016	2%
	299	1089	143	0	**1531**	*1531*	1.000		308	957	151	0	**1416**	*1531*	1.081	8%
	861	**1859**	**570**	**446**	**3736**				**887**	**1633**	**602**	**555**	**3677**			
	887	*1633*	*602*	*555*					*887*	*1633*	*602*	*555*				
	1.030	0.879	1.056	1.243					1.000	1.000	1.000	1.000				
	3%	14%	5%	20%												

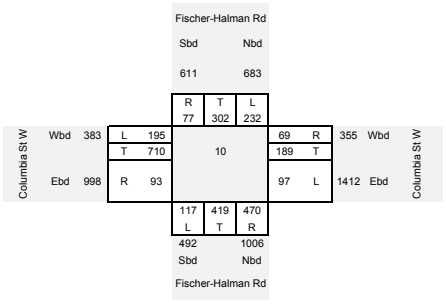
	0	204	320	96	**620**	*620*	1.000		0	194	324	103	**621**	*620*	0.998	0%
	77	0	111	254	**442**	*442*	1.000		75	0	112	272	**460**	*442*	0.961	4%
	498	477	0	168	**1143**	*1143*	1.000		487	454	0	180	**1120**	*1143*	1.020	2%
	333	1035	163	0	**1531**	*1531*	1.000		325	985	165	0	**1475**	*1531*	1.038	4%
	908	**1716**	**594**	**518**	**3736**				**887**	**1633**	**602**	**555**	**3677**			
	887	*1633*	*602*	*555*					*887*	*1633*	*602*	*555*				
	0.976	0.952	1.014	1.071					1.000	1.000	1.000	1.000				
	2%	5%	1%	7%												

	0	194	324	103	**620**	*620*	1.000		0	189	323	104	**615**	*620*	1.007	1%
	72	0	108	262	**442**	*442*	1.000		71	0	108	265	**444**	*442*	0.996	0%
	496	463	0	184	**1143**	*1143*	1.000		486	450	0	186	**1122**	*1143*	1.019	2%
	338	1022	172	0	**1531**	*1531*	1.000		330	994	171	0	**1496**	*1531*	1.024	2%
	906	**1679**	**603**	**548**	**3736**				**887**	**1633**	**602**	**555**	**3677**			
	887	*1633*	*602*	*555*					*887*	*1633*	*602*	*555*				
	0.979	0.973	0.998	1.013					1.000	1.000	1.000	1.000				
	2%	3%	0%	1%												

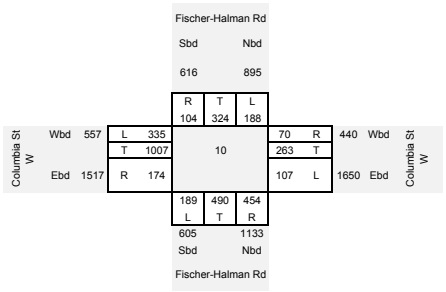
	0	190	325	105	**620**	*620*	1.000		0	186	322	104	**612**	*620*	1.012	1%
	70	0	107	264	**442**	*442*	1.000		69	0	106	263	**438**	*442*	1.009	1%
	495	459	0	189	**1143**	*1143*	1.000		486	450	0	188	**1124**	*1143*	1.017	2%
	338	1018	175	0	**1531**	*1531*	1.000		332	997	174	0	**1503**	*1531*	1.019	2%
	904	**1666**	**608**	**558**	**3736**				**887**	**1633**	**602**	**555**	**3677**			
	887	*1633*	*602*	*555*					*887*	*1633*	*602*	*555*				
	0.982	0.980	0.990	0.994					1.000	1.000	1.000	1.000				
	2%	2%	1%	1%												

	North	East	South	West	Total	Target		
North	0	188	324	104	**616**	*620*	1.006	1%
East	70	0	107	263	**440**	*442*	1.004	0%
South	490	454	0	189	**1133**	*1143*	1.009	1%
West	335	1007	174	0	**1517**	*1531*	1.009	1%
Total	**895**	**1650**	**605**	**557**	**3707**			
Target	*887*	*1633*	*602*	*555*				
	0.991	0.990	0.995	0.997				
	1%	1%	0%	0%				

Existing AM



Forecasted 2031 AM



Erbsville Rd at Laurelwood Dr - AM Peak Hour

Destinations

Origins	North	East	South	West	Total	Target	Factor
North	0	89	271	16	**376**	*487*	1.295
East	55	0	56	135	**246**	*271*	1.102
South	283	141	0	210	**634**	*705*	1.112
West	15	202	266	0	**483**	*550*	1.139
Total	**353**	**432**	**593**	**361**	**1739**		
Target	*425*	*446*	*775*	*368*		*2014*	
	1.204	1.032	1.307	1.019			

0	115	351	21	**487**	*487*	1.000		0	102	380	19	**501**	*487*	0.971	3%
61	0	62	149	**271**	*271*	1.000		66	0	67	136	**268**	*271*	1.010	1%
315	157	0	234	**705**	*705*	1.000		341	139	0	213	**693**	*705*	1.017	2%
17	230	303	0	**550**	*550*	1.000		19	204	328	0	**551**	*550*	0.998	0%
392	**502**	**716**	**403**	**2013**				**425**	**446**	**775**	**368**	**2014**			
425	*446*	*775*	*368*					*425*	*446*	*775*	*368*				
1.083	0.888	1.083	0.913					1.000	1.000	1.000	1.000				
8%	13%	8%	10%												

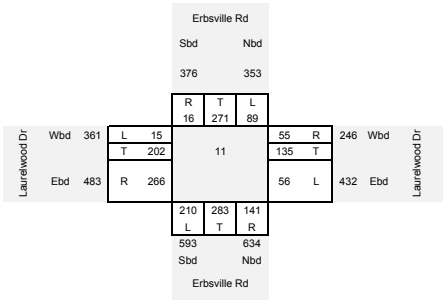
0	99	369	18	**487**	*487*	1.000		0	100	374	18	**492**	*487*	0.989	1%
66	0	67	137	**271**	*271*	1.000		65	0	68	136	**269**	*271*	1.006	1%
347	142	0	217	**705**	*705*	1.000		341	142	0	214	**698**	*705*	1.011	1%
18	204	328	0	**550**	*550*	1.000		18	204	332	0	**555**	*550*	0.991	1%
431	**445**	**764**	**372**	**2013**				**425**	**446**	**775**	**368**	**2014**			
425	*446*	*775*	*368*					*425*	*446*	*775*	*368*				
0.985	1.002	1.014	0.988					1.000	1.000	1.000	1.000				
1%	0%	1%	1%												

0	99	370	18	**487**	*487*	1.000		0	99	374	18	**490**	*487*	0.993	1%
66	0	69	136	**271**	*271*	1.000		65	0	69	135	**270**	*271*	1.004	0%
345	143	0	217	**705**	*705*	1.000		342	144	0	215	**701**	*705*	1.006	1%
18	203	329	0	**550**	*550*	1.000		18	203	332	0	**553**	*550*	0.994	1%
429	**445**	**769**	**371**	**2013**				**425**	**446**	**775**	**368**	**2014**			
425	*446*	*775*	*368*					*425*	*446*	*775*	*368*				
0.991	1.003	1.008	0.992					1.000	1.000	1.000	1.000				
1%	0%	1%	1%												

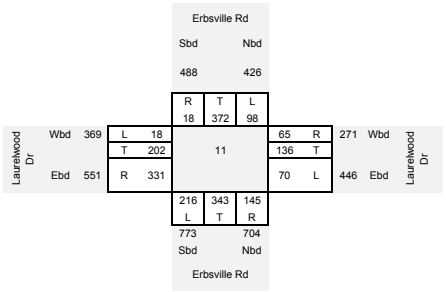
0	98	371	18	**487**	*487*	1.000		0	98	373	18	**489**	*487*	0.996	0%
65	0	70	136	**271**	*271*	1.000		65	0	70	135	**270**	*271*	1.002	0%
344	145	0	216	**705**	*705*	1.000		342	145	0	215	**702**	*705*	1.004	0%
18	202	330	0	**550**	*550*	1.000		18	203	332	0	**552**	*550*	0.996	0%
427	**445**	**771**	**370**	**2013**				**425**	**446**	**775**	**368**	**2014**			
425	*446*	*775*	*368*					*425*	*446*	*775*	*368*				
0.995	1.002	1.005	0.995					1.000	1.000	1.000	1.000				
1%	0%	1%	0%												

	North	East	South	West	Total	Target		
North	0	98	372	18	**488**	*487*	0.998	0%
East	65	0	70	136	**271**	*271*	1.001	0%
South	343	145	0	216	**704**	*705*	1.002	0%
West	18	202	331	0	**551**	*550*	0.998	0%
Total	**426**	**446**	**773**	**369**	**2014**			
Target	*425*	*446*	*775*	*368*				
	0.997	1.001	1.003	0.998				
	0%	0%	0%	0%				

Existing AM



Forecasted 2031 AM



Beaver Creek Dr at Laurelwood Dr - AM Peak Hour

Destinations

Origins	North	East	South	West	Total	Target	Factor
North	0	49	26	16	**91**	*218*	2.396
East	32	0	16	185	**233**	*295*	1.266
South	45	170	0	84	**299**	*329*	1.100
West	33	443	104	0	**580**	*619*	1.067
Total	**110**	**662**	**146**	**285**	**1203**		
Target	*185*	*703*	*272*	*306*		*1464*	
	1.682	1.062	1.863	1.074			

0	117	62	38	**218**	*218*	1.000		0	106	88	32	**226**	*218*	0.965	4%
41	0	20	234	**295**	*295*	1.000		60	0	28	196	**285**	*295*	1.036	3%
50	187	0	92	**329**	*329*	1.000		73	169	0	77	**320**	*329*	1.029	3%
35	473	111	0	**619**	*619*	1.000		52	428	156	0	**636**	*619*	0.974	3%
125	**777**	**194**	**365**	**1461**				**185**	**703**	**272**	**306**	**1466**			
185	*703*	*272*	*306*					*185*	*703*	*272*	*306*				
1.477	0.904	1.405	0.838					1.000	1.000	1.000	1.000				
32%	11%	29%	19%												

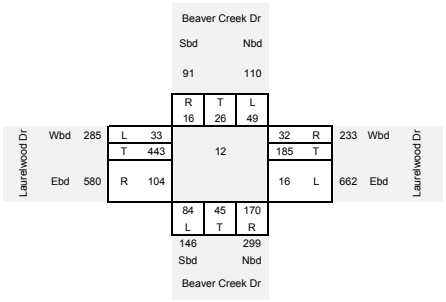
0	102	84	31	**218**	*218*	1.000		0	104	86	30	**221**	*218*	0.988	1%
62	0	30	203	**295**	*295*	1.000		61	0	30	198	**289**	*295*	1.019	2%
75	174	0	80	**329**	*329*	1.000		74	177	0	78	**328**	*329*	1.002	0%
51	416	152	0	**619**	*619*	1.000		50	422	155	0	**628**	*619*	0.986	1%
188	**693**	**266**	**314**	**1461**				**185**	**703**	**272**	**306**	**1466**			
185	*703*	*272*	*306*					*185*	*703*	*272*	*306*				
0.985	1.014	1.023	0.974					1.000	1.000	1.000	1.000				
2%	1%	2%	3%												

0	103	85	30	**218**	*218*	1.000		0	104	86	29	**219**	*218*	0.993	1%
62	0	31	202	**295**	*295*	1.000		62	0	31	200	**293**	*295*	1.008	1%
74	177	0	78	**329**	*329*	1.000		74	179	0	77	**330**	*329*	0.998	0%
49	417	153	0	**619**	*619*	1.000		49	421	155	0	**624**	*619*	0.991	1%
186	**696**	**269**	**310**	**1461**				**185**	**703**	**272**	**306**	**1466**			
185	*703*	*272*	*306*					*185*	*703*	*272*	*306*				
0.996	1.010	1.010	0.988					1.000	1.000	1.000	1.000				
0%	1%	1%	1%												

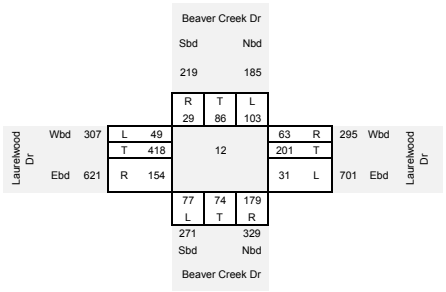
0	103	86	29	**218**	*218*	1.000		0	104	86	29	**219**	*218*	0.995	0%
63	0	31	201	**295**	*295*	1.000		63	0	31	200	**294**	*295*	1.002	0%
74	178	0	77	**329**	*329*	1.000		74	180	0	76	**330**	*329*	0.997	0%
49	417	153	0	**619**	*619*	1.000		49	420	154	0	**623**	*619*	0.994	1%
185	**698**	**270**	**307**	**1461**				**185**	**703**	**272**	**306**	**1466**			
185	*703*	*272*	*306*					*185*	*703*	*272*	*306*				
1.000	1.007	1.006	0.996					1.000	1.000	1.000	1.000				
0%	1%	1%	0%												

	North	East	South	West	Total	Target		
North	0	103	86	29	**219**	*218*	0.998	0%
East	63	0	31	201	**295**	*295*	1.001	0%
South	74	179	0	77	**329**	*329*	0.999	0%
West	49	418	154	0	**621**	*619*	0.997	0%
Total	**185**	**701**	**271**	**307**	**1464**			
Target	*185*	*703*	*272*	*306*				
	1.000	1.003	1.003	0.998				
	0%	0%	0%	0%				

Existing AM



Forecasted 2031 AM



Fischer-Halman Rd/Bearinger Rd at Laurelwood Dr - AM Peak Hour

Destinations

Origins	North	East	South	West	Total	Target	Factor
North	0	14	231	73	**318**	*465*	1.462
East	8	0	25	16	**49**	*62*	1.265
South	548	57	0	108	**713**	*904*	1.268
West	271	120	240	0	**631**	*675*	1.070
Total	**827**	**191**	**496**	**197**	**1711**		
Target	*1018*	*365*	*500*	*270*		*2130*	
	1.231	1.911	1.008	1.371			

0	20	338	107	**465**	*465*	1.000	
10	0	32	20	**62**	*62*	1.000	
695	72	0	137	**904**	*904*	1.000	
290	128	257	0	**675**	*675*	1.000	
995	**221**	**626**	**264**	**2106**			
1018	*365*	*500*	*270*				
1.023	1.651	0.799	1.023				
2%	39%	25%	2%				

0	34	270	109	**413**	*465*	1.127	11%
10	0	25	21	**56**	*62*	1.101	9%
711	119	0	140	**970**	*904*	0.932	7%
297	212	205	0	**714**	*675*	0.946	6%
1018	**365**	**500**	**270**	**2153**			
1018	*365*	*500*	*270*				
1.000	1.000	1.000	1.000				

0	38	304	123	**465**	*465*	1.000	
11	0	28	23	**62**	*62*	1.000	
662	111	0	131	**904**	*904*	1.000	
281	200	194	0	**675**	*675*	1.000	
954	**350**	**526**	**276**	**2106**			
1018	*365*	*500*	*270*				
1.067	1.044	0.951	0.977				
6%	4%	5%	2%				

0	40	289	120	**449**	*465*	1.036	3%
12	0	26	22	**61**	*62*	1.018	2%
707	116	0	128	**950**	*904*	0.952	5%
299	209	184	0	**693**	*675*	0.974	3%
1018	**365**	**500**	**270**	**2153**			
1018	*365*	*500*	*270*				
1.000	1.000	1.000	1.000				

0	41	299	124	**465**	*465*	1.000	
12	0	27	23	**62**	*62*	1.000	
672	110	0	121	**904**	*904*	1.000	
292	204	180	0	**675**	*675*	1.000	
976	**355**	**506**	**269**	**2106**			
1018	*365*	*500*	*270*				
1.043	1.027	0.988	1.006				
4%	3%	1%	1%				

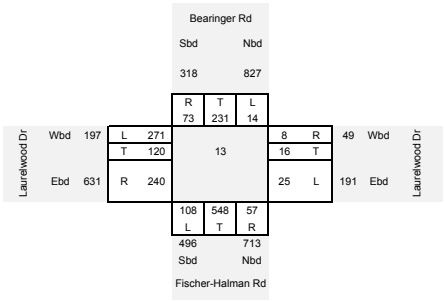
0	42	296	125	**463**	*465*	1.004	0%
13	0	27	23	**62**	*62*	0.995	1%
701	113	0	122	**936**	*904*	0.965	4%
304	209	178	0	**691**	*675*	0.977	2%
1018	**365**	**500**	**270**	**2153**			
1018	*365*	*500*	*270*				
1.000	1.000	1.000	1.000				

0	42	297	126	**465**	*465*	1.000	
13	0	26	23	**62**	*62*	1.000	
677	109	0	118	**904**	*904*	1.000	
297	205	173	0	**675**	*675*	1.000	
987	**356**	**497**	**266**	**2106**			
1018	*365*	*500*	*270*				
1.032	1.024	1.006	1.015				
3%	2%	1%	1%				

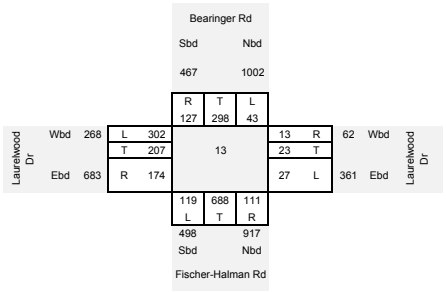
0	43	299	127	**470**	*465*	0.990	1%
13	0	27	23	**63**	*62*	0.986	1%
698	112	0	120	**930**	*904*	0.972	3%
306	209	175	0	**690**	*675*	0.978	2%
1018	**365**	**500**	**270**	**2153**			
1018	*365*	*500*	*270*				
1.000	1.000	1.000	1.000				

	North	East	South	West	Total	Target		
North	0	43	298	127	**467**	*465*	0.995	1%
East	13	0	27	23	**62**	*62*	0.993	1%
South	688	111	0	119	**917**	*904*	0.986	1%
West	302	207	174	0	**683**	*675*	0.989	1%
Total	**1002**	**361**	**498**	**268**	**2130**			
Target	*1018*	*365*	*500*	*270*				
	1.016	1.012	1.003	1.007				
	2%	1%	0%	1%				

Existing AM



Forecasted 2031 AM



Westmount Rd N at Bearinger Rd - AM Peak Hour

Destinations

Origins	North	East	South	West	Total	Target	Factor
North	0	144	254	220	**618**	*830*	1.343
East	51	0	60	106	**217**	*268*	1.235
South	274	74	0	1	**349**	*414*	1.186
West	516	332	2	0	**850**	*1050*	1.235
Total	**841**	**550**	**316**	**327**	**2034**		
Target	*1144*	*573*	*374*	*471*		*2562*	
	1.360	1.042	1.184	1.440			

0	193	341	295	**830**	*830*	1.000	
63	0	74	131	**268**	*268*	1.000	
325	88	0	1	**414**	*414*	1.000	
637	410	2	0	**1050**	*1050*	1.000	
1025	**691**	**418**	**428**	2562			
1144	*573*	*374*	*471*				
1.116	0.829	0.895	1.102				
10%	21%	12%	9%				

0	160	305	325	**791**	*830*	1.049	5%
70	0	66	144	**281**	*268*	0.954	5%
363	73	0	1	**437**	*414*	0.948	5%
711	340	2	0	**1053**	*1050*	0.997	0%
1144	**573**	**374**	**471**	2562			
1144	*573*	*374*	*471*				
1.000	1.000	1.000	1.000				

0	168	320	341	**830**	*830*	1.000	
67	0	63	138	**268**	*268*	1.000	
344	69	0	1	**414**	*414*	1.000	
709	339	2	0	**1050**	*1050*	1.000	
1120	**576**	**386**	**480**	2562			
1144	*573*	*374*	*471*				
1.022	0.995	0.969	0.981				
2%	1%	3%	2%				

0	167	311	335	**813**	*830*	1.021	2%
69	0	61	135	**265**	*268*	1.012	1%
351	69	0	1	**421**	*414*	0.983	2%
724	337	2	0	**1064**	*1050*	0.987	1%
1144	**573**	**374**	**471**	2562			
1144	*573*	*374*	*471*				
1.000	1.000	1.000	1.000				

0	171	317	342	**830**	*830*	1.000	
69	0	62	137	**268**	*268*	1.000	
345	67	0	1	**414**	*414*	1.000	
715	333	2	0	**1050**	*1050*	1.000	
1130	**571**	**381**	**480**	2562			
1144	*573*	*374*	*471*				
1.013	1.003	0.981	0.982				
1%	0%	2%	2%				

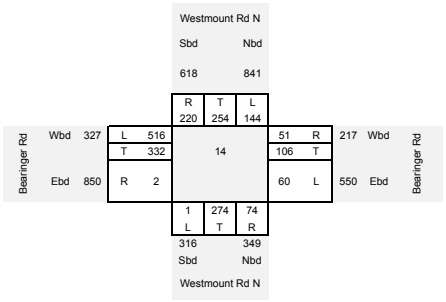
0	171	311	336	**818**	*830*	1.014	1%
70	0	61	134	**265**	*268*	1.011	1%
350	68	0	1	**419**	*414*	0.989	1%
724	334	2	0	**1060**	*1050*	0.991	1%
1144	**573**	**374**	**471**	2562			
1144	*573*	*374*	*471*				
1.000	1.000	1.000	1.000				

0	174	316	341	**830**	*830*	1.000	
71	0	62	136	**268**	*268*	1.000	
346	67	0	1	**414**	*414*	1.000	
717	331	2	0	**1050**	*1050*	1.000	
1134	**572**	**379**	**477**	2562			
1144	*573*	*374*	*471*				
1.009	1.003	0.987	0.987				
1%	0%	1%	1%				

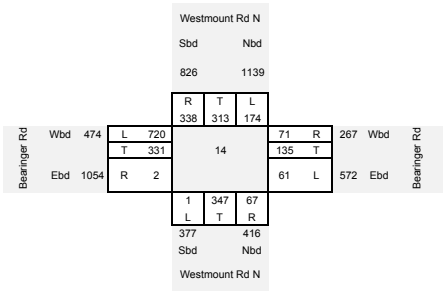
0	174	311	336	**822**	*830*	1.010	1%
72	0	61	134	**266**	*268*	1.007	1%
349	67	0	1	**417**	*414*	0.992	1%
724	332	2	0	**1057**	*1050*	0.993	1%
1144	**573**	**374**	**471**	2562			
1144	*573*	*374*	*471*				
1.000	1.000	1.000	1.000				

	North	East	South	West	Total	Target		
North	0	174	313	338	**826**	*830*	1.005	0%
East	71	0	61	135	**267**	*268*	1.004	0%
South	347	67	0	1	**416**	*414*	0.996	0%
West	720	331	2	0	**1054**	*1050*	0.997	0%
Total	**1139**	**572**	**377**	**474**	**2562**			
Target	*1144*	*573*	*374*	*471*				
	1.004	1.001	0.993	0.993				
	0%	0%	1%	1%				

Existing AM



Forecasted 2031 AM



Westmount Rd N at Northfield Dr - AM Peak Hour

Destinations

Origins	North	East	South	West	Total	Target	Factor
North	0	249		336	**585**	*785*	1.342
East	72	0		306	**378**	*488*	1.291
South							
West	169	666		0	**835**	*1138*	1.363
Total	**241**	**915**		**642**	**1798**		
Target	*291*	*1265*		*854*		*2411*	
	1.207	1.383		1.330			

0	334	451	**785**	*785*	1.000		
93	0	395	**488**	*488*	1.000		
230	908	0	**1138**	*1138*	1.000		
323	**1242**	**846**	**2411**				
291	*1265*	*854*					
0.900	1.019	1.010					
11%	2%	1%					

0	340	455	**796**	*785*	0.987	1%	
84	0	399	**482**	*488*	1.011	1%	
207	925	0	**1132**	*1138*	1.005	1%	
291	**1265**	**854**	**2410**				
291	*1265*	*854*					
1.000	1.000	1.000					

0	336	449	**785**	*785*	1.000		
85	0	403	**488**	*488*	1.000		
208	930	0	**1138**	*1138*	1.000		
293	**1265**	**853**	**2411**				
291	*1265*	*854*					
0.993	1.000	1.002					
1%	0%	0%					

0	336	450	**786**	*785*	0.999	0%	
84	0	404	**488**	*488*	1.000	0%	
207	929	0	**1136**	*1138*	1.002	0%	
291	**1265**	**854**	**2410**				
291	*1265*	*854*					
1.000	1.000	1.000					

0	335	450	**785**	*785*	1.000		
84	0	404	**488**	*488*	1.000		
207	931	0	**1138**	*1138*	1.000		
291	**1266**	**854**	**2411**				
291	*1265*	*854*					
0.999	0.999	1.001					
0%	0%	0%					

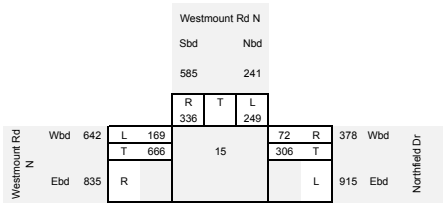
0	335	450	**785**	*785*	1.000	0%	
84	0	404	**488**	*488*	1.000	0%	
207	930	0	**1137**	*1138*	1.001	0%	
291	**1265**	**854**	**2410**				
291	*1265*	*854*					
1.000	1.000	1.000					

0	335	450	**785**	*785*	1.000		
84	0	404	**488**	*488*	1.000		
207	931	0	**1138**	*1138*	1.000		
291	**1266**	**854**	**2411**				
291	*1265*	*854*					
0.999	0.999	1.000					
0%	0%	0%					

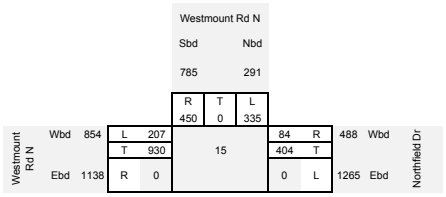
0	335	450	**785**	*785*	1.000	0%	
84	0	404	**488**	*488*	1.000	0%	
207	930	0	**1137**	*1138*	1.001	0%	
291	**1265**	**854**	**2410**				
291	*1265*	*854*					
1.000	1.000	1.000					

Origins	North	East	South	West	Total	Target	Factor	
North	0	335		450	**785**	*785*	1.000	0%
East	84	0		404	**488**	*488*	1.000	0%
South								
West	207	930		0	**1138**	*1138*	1.000	0%
Total	**291**	**1265**		**854**	**2411**			
Target	*291*	*1265*		*854*				
	1.000	1.000		1.000				
	0%	0%		0%				

Existing AM



Forecasted 2031 AM



Wilmot Ln at Conservation Dr - AM Peak Hour

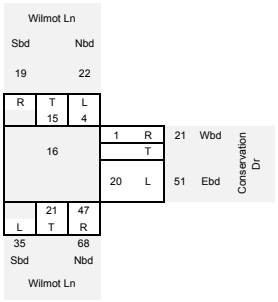
Destinations

Origins	North	East	South	West	Total	Target	Factor
North	0	4	15		**19**	*51*	2.684
East	1	0	20		**21**	*39*	1.857
South	21	47	0		**68**	*151*	2.221
West							
Total	**22**	**51**	**35**		**108**		
Target	*26*	*133*	*82*			*241*	
	1.182	2.608	2.343				

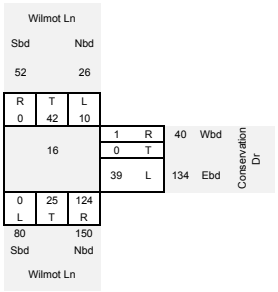
0	11	40	**51**	*51*	1.000		0	12	43	**55**	*51*	0.926	8%
2	0	37	**39**	*39*	1.000		1	0	39	**40**	*39*	0.967	3%
47	104	0	**151**	*151*	1.000		25	121	0	**146**	*151*	1.037	4%
48	**115**	**77**	**241**				**26**	**133**	**82**	**241**			
26	*133*	*82*					*26*	*133*	*82*				
0.536	1.155	1.059					1.000	1.000	1.000				
86%	13%	6%											
0	11	40	**51**	*51*	1.000		0	11	42	**53**	*51*	0.963	4%
1	0	38	**39**	*39*	1.000		1	0	40	**41**	*39*	0.948	6%
26	125	0	**151**	*151*	1.000		25	122	0	**147**	*151*	1.028	3%
27	**137**	**78**	**241**				**26**	**133**	**82**	**241**			
26	*133*	*82*					*26*	*133*	*82*				
0.967	0.974	1.057					1.000	1.000	1.000				
3%	3%	5%											
0	11	40	**51**	*51*	1.000		0	11	42	**53**	*51*	0.969	3%
1	0	38	**39**	*39*	1.000		1	0	40	**41**	*39*	0.957	5%
26	125	0	**151**	*151*	1.000		25	122	0	**148**	*151*	1.023	2%
27	**136**	**78**	**241**				**26**	**133**	**82**	**241**			
26	*133*	*82*					*26*	*133*	*82*				
0.975	0.978	1.047					1.000	1.000	1.000				
3%	2%	4%											
0	10	41	**51**	*51*	1.000		0	10	42	**52**	*51*	0.974	3%
1	0	38	**39**	*39*	1.000		1	0	40	**40**	*39*	0.964	4%
26	125	0	**151**	*151*	1.000		25	123	0	**148**	*151*	1.019	2%
27	**135**	**79**	**241**				**26**	**133**	**82**	**241**			
26	*133*	*82*					*26*	*133*	*82*				
0.980	0.982	1.038					1.000	1.000	1.000				
2%	2%	4%	####										

Origins	North	East	South	West	Total	Target		
North	0	10	42		**52**	*51*	0.987	1%
East	1	0	39		**40**	*39*	0.982	2%
South	25	124	0		**150**	*151*	1.009	1%
West								
Total	**26**	**134**	**80**		**241**			
Target	*26*	*133*	*82*					
	0.990	0.991	1.019					
	1%	1%	2%					

Existing AM



Forecasted 2031 AM



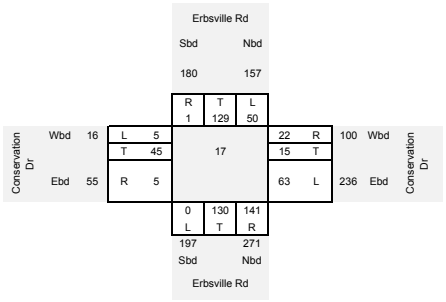
Erbsville Rd at Conservation Dr - AM Peak Hour

Origins \ Destinations	North	East	South	West	Total	Target	Factor
North	0	50	129	1	**180**	*239*	1.328
East	22	0	63	15	**100**	*130*	1.300
South	130	141	0	0	**271**	*295*	1.089
West	5	45	5	0	**55**	*141*	2.564
Total	**157**	**236**	**197**	**16**	**606**		
Target	*270*	*250*	*268*	*33*		*813*	
	1.720	1.059	1.360	2.063			

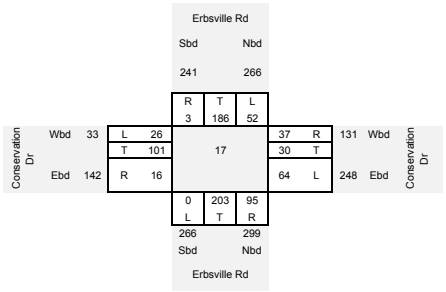
	0	66	171	1	**239**	*239*	1.000		0	50	173	2	**224**	*239*	1.066	6%
	29	0	82	20	**130**	*130*	1.000		42	0	83	31	**156**	*130*	0.835	20%
	142	153	0	0	**295**	*295*	1.000		209	114	0	0	**323**	*295*	0.912	10%
	13	115	13	0	**141**	*141*	1.000		19	86	13	0	**118**	*141*	1.196	16%
	183	**335**	**266**	**21**	**805**				**270**	**250**	**268**	**33**	**821**			
	270	*250*	*268*	*33*					*270*	*250*	*268*	*33*				
	1.476	0.746	1.008	1.584					1.000	1.000	1.000	1.000				
	32%	34%	1%	37%												
	0	53	184	2	**239**	*239*	1.000		0	51	184	3	**237**	*239*	1.008	1%
	35	0	69	26	**130**	*130*	1.000		38	0	69	30	**138**	*130*	0.945	6%
	191	104	0	0	**295**	*295*	1.000		207	100	0	0	**307**	*295*	0.960	4%
	23	103	15	0	**141**	*141*	1.000		25	99	15	0	**139**	*141*	1.015	1%
	248	**260**	**268**	**28**	**805**				**270**	**250**	**268**	**33**	**821**			
	270	*250*	*268*	*33*					*270*	*250*	*268*	*33*				
	1.087	0.961	0.999	1.176					1.000	1.000	1.000	1.000				
	8%	4%	0%	15%												
	0	51	185	3	**239**	*239*	1.000		0	52	187	3	**241**	*239*	0.992	1%
	36	0	65	29	**130**	*130*	1.000		38	0	66	30	**133**	*130*	0.974	3%
	199	96	0	0	**295**	*295*	1.000		206	97	0	0	**304**	*295*	0.972	3%
	25	100	16	0	**141**	*141*	1.000		26	101	16	0	**143**	*141*	0.986	1%
	260	**248**	**266**	**31**	**805**				**270**	**250**	**268**	**33**	**821**			
	270	*250*	*268*	*33*					*270*	*250*	*268*	*33*				
	1.039	1.009	1.008	1.052					1.000	1.000	1.000	1.000				
	4%	1%	1%	5%												
	0	51	185	3	**239**	*239*	1.000		0	52	187	3	**242**	*239*	0.986	1%
	37	0	64	29	**130**	*130*	1.000		38	0	65	30	**133**	*130*	0.981	2%
	201	94	0	0	**295**	*295*	1.000		206	96	0	0	**302**	*295*	0.976	2%
	26	100	16	0	**141**	*141*	1.000		26	102	16	0	**144**	*141*	0.981	2%
	263	**245**	**265**	**32**	**805**				**270**	**250**	**268**	**33**	**821**			
	270	*250*	*268*	*33*					*270*	*250*	*268*	*33*				
	1.027	1.019	1.013	1.025					1.000	1.000	1.000	1.000				
	3%	2%	1%	2%												

Origins \ Destinations	North	East	South	West	Total	Target		
North	0	52	186	3	**241**	*239*	0.993	1%
East	37	0	64	30	**131**	*130*	0.990	1%
South	203	95	0	0	**299**	*295*	0.988	1%
West	26	101	16	0	**142**	*141*	0.990	1%
Total	**266**	**248**	**266**	**33**	**813**			
Target	*270*	*250*	*268*	*33*				
	1.013	1.009	1.007	1.012				
	1%	1%	1%	1%				

Existing AM



Forecasted 2031 AM



Beaver Creek Dr at Conservation Dr - AM Peak Hour

Destinations

Origins	North	East	South	West	Total	Target	Factor
North							
East		0	60	94	**154**	*241*	1.565
South		99	0	11	**110**	*192*	1.745
West		199	8	0	**207**	*322*	1.556
Total		**298**	**68**	**105**	**471**		
Target		*435*	*147*	*174*		*756*	
		1.460	2.162	1.657			

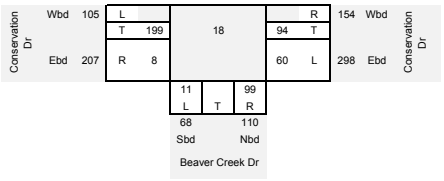
	0	94	147	**241**	*241*	1.000		0	130	154	**284**	*241*	0.849	18%
	173	0	19	**192**	*192*	1.000		156	0	20	**176**	*192*	1.091	8%
	310	12	0	**322**	*322*	1.000		279	17	0	**296**	*322*	1.086	8%
	482	**106**	**166**	**755**				**435**	**147**	**174**	**756**			
	435	*147*	*174*					*435*	*147*	*174*				
	0.902	1.382	1.046					1.000	1.000	1.000				
	11%	28%	4%											

	0	110	131	**241**	*241*	1.000		0	126	149	**275**	*241*	0.877	14%
	170	0	22	**192**	*192*	1.000		156	0	25	**181**	*192*	1.059	6%
	303	19	0	**322**	*322*	1.000		279	21	0	**300**	*322*	1.073	7%
	473	**129**	**153**	**755**				**435**	**147**	**174**	**756**			
	435	*147*	*174*					*435*	*147*	*174*				
	0.919	1.140	1.140					1.000	1.000	1.000				
	9%	12%	12%											

	0	110	131	**241**	*241*	1.000		0	122	145	**266**	*241*	0.904	11%
	166	0	26	**192**	*192*	1.000		155	0	29	**184**	*192*	1.042	4%
	299	23	0	**322**	*322*	1.000		280	25	0	**305**	*322*	1.055	5%
	465	**133**	**157**	**755**				**435**	**147**	**174**	**756**			
	435	*147*	*174*					*435*	*147*	*174*				
	0.936	1.104	1.107					1.000	1.000	1.000				
	7%	9%	10%											

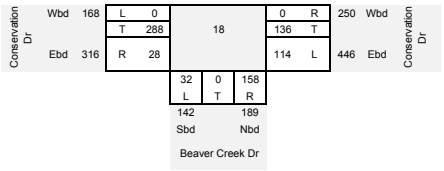
	0	110	131	**241**	*241*	1.000		0	118	141	**259**	*241*	0.929	8%
	161	0	31	**192**	*192*	1.000		154	0	33	**187**	*192*	1.029	3%
	295	27	0	**322**	*322*	1.000		281	29	0	**310**	*322*	1.039	4%
	457	**137**	**161**	**755**				**435**	**147**	**174**	**756**			
	435	*147*	*174*					*435*	*147*	*174*				
	0.952	1.075	1.078					1.000	1.000	1.000				
	5%	7%	7%											

Existing AM



Origins	North	East	South	West	Total	Target	Factor	
North								
East		0	114	136	**250**	*241*	0.963	4%
South		158	0	32	**189**	*192*	1.014	1%
West		288	28	0	**316**	*322*	1.019	2%
Total		**446**	**142**	**168**	**756**			
Target		*435*	*147*	*174*				
		0.976	1.036	1.038				
		3%	3%	4%				

Forecasted 2031 AM



Westmount Rd N at Conservation Dr - AM Peak Hour

Origins \ Destinations	North	East	South	West	Total	Target	Factor
North	0	12	190	17	**219**	*312*	1.425
East	12	0	35	26	**73**	*113*	1.548
South	162	17	0	74	**253**	*298*	1.178
West	114	26	247	0	**387**	*547*	1.413
Total	**288**	**55**	**472**	**117**	**932**		
Target	*321*	*87*	*657*	*205*		*1270*	
	1.115	1.582	1.392	1.752			

0	17	271	24	**312**	*312*	1.000	
19	0	54	40	**113**	*113*	1.000	
191	20	0	87	**298**	*298*	1.000	
161	37	349	0	**547**	*547*	1.000	
371	**74**	**674**	**152**	**1270**			
321	*87*	*657*	*205*				
0.866	1.178	0.975	1.352				
15%	15%	3%	26%				

0	20	260	32	**312**	*312*	1.000	
15	0	48	50	**113**	*113*	1.000	
161	23	0	114	**298**	*298*	1.000	
146	45	356	0	**547**	*547*	1.000	
321	**88**	**664**	**197**	**1270**			
321	*87*	*657*	*205*				
0.999	0.989	0.989	1.043				
0%	1%	1%	4%				

0	20	258	34	**312**	*312*	1.000	
15	0	47	51	**113**	*113*	1.000	
158	22	0	118	**298**	*298*	1.000	
147	45	355	0	**547**	*547*	1.000	
320	**87**	**661**	**203**	**1270**			
321	*87*	*657*	*205*				
1.004	0.998	0.995	1.011				
0%	0%	1%	1%				

0	20	258	34	**312**	*312*	1.000	
15	0	47	52	**113**	*113*	1.000	
158	22	0	118	**298**	*298*	1.000	
148	45	354	0	**547**	*547*	1.000	
320	**87**	**659**	**204**	**1270**			
321	*87*	*657*	*205*				
1.002	1.000	0.998	1.004				
0%	0%	0%	0%				

0	20	264	33	**317**	*312*	0.985	2%
16	0	53	54	**123**	*113*	0.916	9%
165	24	0	118	**307**	*298*	0.972	3%
140	43	340	0	**523**	*547*	1.045	4%
321	**87**	**657**	**205**	**1270**			
321	*87*	*657*	*205*				
1.000	1.000	1.000	1.000				

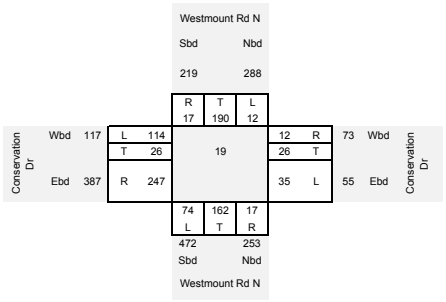
0	20	257	34	**310**	*312*	1.005	1%
15	0	48	52	**115**	*113*	0.986	1%
160	23	0	119	**302**	*298*	0.985	2%
146	45	352	0	**543**	*547*	1.008	1%
321	**87**	**657**	**205**	**1270**			
321	*87*	*657*	*205*				
1.000	1.000	1.000	1.000				

0	20	257	34	**311**	*312*	1.003	0%
15	0	47	52	**113**	*113*	0.997	0%
159	22	0	119	**300**	*298*	0.993	1%
148	45	353	0	**546**	*547*	1.002	0%
321	**87**	**657**	**205**	**1270**			
321	*87*	*657*	*205*				
1.000	1.000	1.000	1.000				

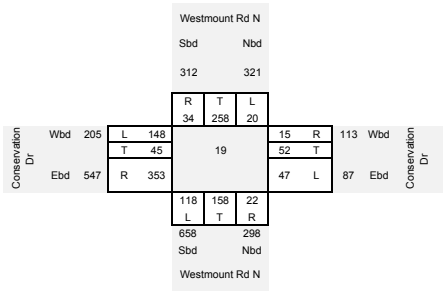
0	20	257	34	**312**	*312*	1.002	0%
15	0	47	52	**113**	*113*	0.999	0%
158	22	0	119	**299**	*298*	0.997	0%
148	45	353	0	**546**	*547*	1.001	0%
321	**87**	**657**	**205**	**1270**			
321	*87*	*657*	*205*				
1.000	1.000	1.000	1.000				

Origins \ Destinations	North	East	South	West	Total	Target	Factor	
North	0	20	258	34	**312**	*312*	1.001	0%
East	15	0	47	52	**113**	*113*	0.999	0%
South	158	22	0	118	**298**	*298*	0.999	0%
West	148	45	353	0	**547**	*547*	1.000	0%
Total	**321**	**87**	**658**	**205**	**1270**			
Target	*321*	*87*	*657*	*205*				
	1.001	1.000	0.999	1.002				
	0%	0%	0%	0%				

Existing AM



Forecasted 2031 AM



Columbia Street West at Platinum Drive- AM Peak Hour

Origins	Destinations: North	East	South	West	Total	Target	Factor
North		0	1	134	**135**	*556*	4.119
East		1	0	1	**2**	*21*	10.500
South		271	1	0	**272**	*652*	2.397
Total		**272**	**2**	**135**	**409**		
Target		*496*	*544*	*189*		*1229*	
		1.824	272.000	1.400			

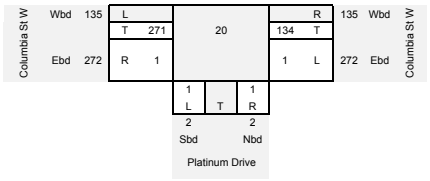
0	4	552	**556**	*556*	1.000	0	344	185	**529**	*556*	1.050	5%
11	0	11	**21**	*21*	1.000	8	0	4	**11**	*21*	1.839	46%
650	2	0	**652**	*652*	1.000	488	200	0	**688**	*652*	0.947	6%
660	**7**	**562**	**1229**			**496**	**544**	**189**	**1229**			
496	*544*	*189*				*496*	*544*	*189*				
0.751	83.492	0.336				1.000	1.000	1.000				
33%	99%	198%										

0	361	195	**556**	*556*	1.000	0	357	183	**540**	*556*	1.030	3%
15	0	6	**21**	*21*	1.000	15	0	6	**21**	*21*	0.991	1%
462	190	0	**652**	*652*	1.000	481	187	0	**668**	*652*	0.976	2%
477	**551**	**201**	**1229**			**496**	**544**	**189**	**1229**			
496	*544*	*189*				*496*	*544*	*189*				
1.040	0.988	0.939				1.000	1.000	1.000				
4%	1%	7%										

0	368	188	**556**	*556*	1.000	0	363	183	**546**	*556*	1.017	2%
15	0	6	**21**	*21*	1.000	15	0	6	**21**	*21*	0.991	1%
469	183	0	**652**	*652*	1.000	481	181	0	**661**	*652*	0.986	1%
484	**550**	**194**	**1229**			**496**	**544**	**189**	**1229**			
496	*544*	*189*				*496*	*544*	*189*				
1.024	0.989	0.972				1.000	1.000	1.000				
2%	1%	3%										

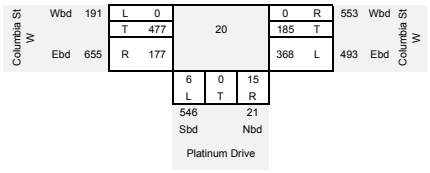
0	370	186	**556**	*556*	1.000	0	367	183	**550**	*556*	1.010	1%
15	0	6	**21**	*21*	1.000	15	0	6	**21**	*21*	0.994	1%
474	178	0	**652**	*652*	1.000	481	177	0	**657**	*652*	0.992	1%
489	**548**	**192**	**1229**			**496**	**544**	**189**	**1229**			
496	*544*	*189*				*496*	*544*	*189*				
1.014	0.993	0.984				1.000	1.000	1.000				
1%	1%	2%										

Existing AM



	North	East	South	West	Total	Target		
North								
East		0	368	185	**553**	*556*	1.005	1%
South		15	0	6	**21**	*21*	0.997	0%
West		477	177	0	**655**	*652*	0.996	0%
Total		**493**	**546**	**191**	**1229**			
Target		*496*	*544*	*189*				
	#DIV/0!	1.007	0.997	0.992				
	#DIV/0!	1%	0%	1%				

Forecasted 2031 AM



Erb Street at The Boardwalk - AM Peak Hour

Destinations

Origins	North	East	South	West	Total	Target	Factor
North		0	1	364	**365**	*1056*	2.893
East		1	0	1	**2**	*3*	1.500
South		581	1	0	**582**	*816*	1.402
Total		**582**	**2**	**365**	**949**		
Target		*997*	*21*	*891*		*1892*	
		1.713	10.500	2.441			

0	3	1053	**1056**	*1056*	1.000		
2	0	2	**3**	*3*	1.000		
815	1	0	**816**	*816*	1.000		
816	**4**	**1055**	**1875**				
997	*21*	*891*					
1.222	4.889	0.845					
18%	80%	18%					

0	14	890	**904**	*1056*	1.168	14%	
2	0	1	**3**	*3*	0.968	3%	
995	7	0	**1002**	*816*	0.814	23%	
997	**21**	**891**	**1909**				
997	*21*	*891*					
1.000	1.000	1.000					

0	17	1039	**1056**	*1056*	1.000		
2	0	1	**3**	*3*	1.000		
810	6	0	**816**	*816*	1.000		
812	**22**	**1041**	**1875**				
997	*21*	*891*					
1.228	0.950	0.856					
19%	5%	17%					

0	16	890	**906**	*1056*	1.166	14%	
2	0	1	**3**	*3*	0.930	8%	
995	5	0	**1000**	*816*	0.816	23%	
997	**21**	**891**	**1909**				
997	*21*	*891*					
1.000	1.000	1.000					

0	18	1038	**1056**	*1056*	1.000		
2	0	1	**3**	*3*	1.000		
812	4	0	**816**	*816*	1.000		
814	**23**	**1039**	**1875**				
997	*21*	*891*					
1.225	0.928	0.858					
18%	8%	17%					

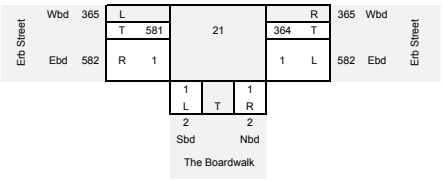
0	17	890	**907**	*1056*	1.164	14%	
2	0	1	**3**	*3*	0.904	11%	
995	4	0	**999**	*816*	0.817	22%	
997	**21**	**891**	**1909**				
997	*21*	*891*					
1.000	1.000	1.000					

0	20	1036	**1056**	*1056*	1.000		
2	0	1	**3**	*3*	1.000		
813	3	0	**816**	*816*	1.000		
815	**23**	**1037**	**1875**				
997	*21*	*891*					
1.223	0.911	0.859					
18%	10%	16%					

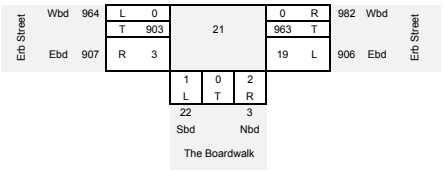
0	18	890	**908**	*1056*	1.163	14%	
3	0	1	**3**	*3*	0.884	13%	
994	3	0	**997**	*816*	0.818	22%	
997	**21**	**891**	**1909**				
997	*21*	*891*					
1.000	1.000	1.000					

	North	East	South	West	Total	Target		
North								
East		0	19	963	**982**	*1056*	1.075	7%
South		2	0	1	**3**	*3*	0.938	7%
West		903	3	0	**907**	*816*	0.900	11%
Total		**906**	**22**	**964**	**1892**			
Target		*997*	*21*	*891*				
		1.100	0.953	0.924				
		9%	5%	8%				

Existing AM



Forecasted 2031 AM



Ira Needles Blvd at University Ave - PM Peak Hour

Origins \ Destinations	North	East	South	West	Total	Target	Factor
North	0	96	438	116	**650**	*1428*	2.197
East	119	0	122	225	**466**	*684*	1.468
South	437	129	0	147	**713**	*1253*	1.757
West	112	176	146	0	**434**	*440*	1.014
Total	**668**	**401**	**706**	**488**	**2263**		
Target	*902*	*619*	*1778*	*494*		*3799*	
	1.350	1.544	2.518	1.012			

0	211	962	255	**1428**	*1428*	1.000	
175	0	179	330	**684**	*684*	1.000	
768	227	0	258	**1253**	*1253*	1.000	
114	178	148	0	**440**	*440*	1.000	
1056	**616**	**1289**	**843**	3805			
902	*619*	*1778*	*494*				
0.854	1.005	1.379	0.586				
17%	0%	27%	71%				

0	212	1327	149	**1688**	*1428*	0.846	18%
149	0	247	193	**590**	*684*	1.160	14%
656	228	0	151	**1035**	*1253*	1.211	17%
97	179	204	0	**480**	*440*	0.916	9%
902	**619**	**1778**	**494**	3793			
902	*619*	*1778*	*494*				
1.000	1.000	1.000	1.000				

0	179	1122	126	**1428**	*1428*	1.000	
173	0	287	224	**684**	*684*	1.000	
794	276	0	183	**1253**	*1253*	1.000	
89	164	187	0	**440**	*440*	1.000	
1056	**619**	**1596**	**534**	3805			
902	*619*	*1778*	*494*				
0.854	1.000	1.114	0.925				
17%	0%	10%	8%				

0	179	1251	117	**1547**	*1428*	0.923	8%
148	0	319	208	**675**	*684*	1.014	1%
678	276	0	170	**1123**	*1253*	1.115	10%
76	164	208	0	**448**	*440*	0.981	2%
902	**619**	**1778**	**494**	3793			
902	*619*	*1778*	*494*				
1.000	1.000	1.000	1.000				

0	165	1155	108	**1428**	*1428*	1.000	
150	0	324	211	**684**	*684*	1.000	
757	307	0	189	**1253**	*1253*	1.000	
74	161	204	0	**440**	*440*	1.000	
981	**634**	**1683**	**507**	3805			
902	*619*	*1778*	*494*				
0.920	0.976	1.057	0.973				
9%	2%	5%	3%				

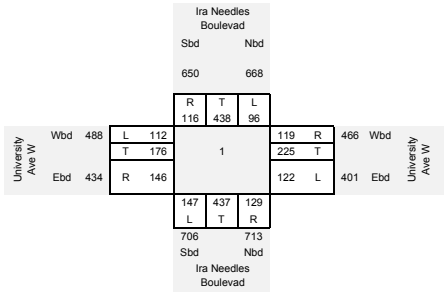
0	162	1220	105	**1487**	*1428*	0.961	4%
138	0	342	205	**685**	*684*	0.999	0%
696	300	0	184	**1180**	*1253*	1.062	6%
68	157	216	0	**442**	*440*	0.996	0%
902	**619**	**1778**	**494**	3793			
902	*619*	*1778*	*494*				
1.000	1.000	1.000	1.000				

0	155	1172	101	**1428**	*1428*	1.000	
138	0	342	205	**684**	*684*	1.000	
739	319	0	195	**1253**	*1253*	1.000	
68	157	215	0	**440**	*440*	1.000	
945	**631**	**1729**	**501**	3805			
902	*619*	*1778*	*494*				
0.955	0.982	1.029	0.986				
5%	2%	3%	1%				

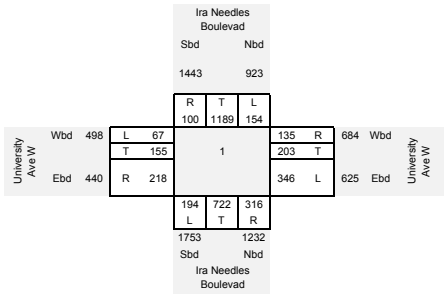
0	152	1205	99	**1457**	*1428*	0.980	2%
131	0	351	202	**685**	*684*	0.999	0%
705	313	0	193	**1211**	*1253*	1.035	3%
65	154	221	0	**440**	*440*	1.000	0%
902	**619**	**1778**	**494**	3793			
902	*619*	*1778*	*494*				
1.000	1.000	1.000	1.000				

Origins \ Destinations	North	East	South	West	Total	Target		
North	0	154	1189	100	**1443**	*1428*	0.990	1%
East	135	0	346	203	**684**	*684*	1.000	0%
South	722	316	0	194	**1232**	*1253*	1.017	2%
West	67	155	218	0	**440**	*440*	1.000	0%
Total	**923**	**625**	**1753**	**498**	**3799**			
Target	*902*	*619*	*1778*	*494*				
	0.977	0.991	1.014	0.993				
	2%	1%	1%	1%				

Existing PM



Forecasted 2031 PM



Fischer-Halman Rd at University Dr W - PM Peak Hour

Destinations

Origins	North	East	South	West	Total	Target	Factor
North	0	16	768	129	**913**	*1430*	1.566
East	12	0	400	486	**898**	*1064*	1.185
South	758	120	0	287	**1165**	*1501*	1.288
West	109	241	195	0	**545**	*704*	1.292
Total	**879**	**377**	**1363**	**902**	**3521**		
Target	*1205*	*560*	*2020*	*913*		*4699*	
	1.371	1.485	1.482	1.012			

0	25	1203	202	**1430**	*1430*	1.000	
14	0	474	576	**1064**	*1064*	1.000	
977	155	0	370	**1501**	*1501*	1.000	
141	311	252	0	**704**	*704*	1.000	
1132	**491**	**1929**	**1148**	4699			
1205	*560*	*2020*	*913*				
1.065	1.141	1.047	0.796				
6%	12%	5%	26%				

0	29	1260	161	**1449**	*1430*	0.987	1%
15	0	496	458	**970**	*1064*	1.097	9%
1040	176	0	294	**1510**	*1501*	0.994	1%
150	355	264	0	**769**	*704*	0.916	9%
1205	**560**	**2020**	**913**	4698			
1205	*560*	*2020*	*913*				
1.000	1.000	1.000	1.000				

0	28	1243	159	**1430**	*1430*	1.000	
17	0	545	503	**1064**	*1064*	1.000	
1033	175	0	292	**1501**	*1501*	1.000	
137	325	242	0	**704**	*704*	1.000	
1187	**529**	**2029**	**954**	4699			
1205	*560*	*2020*	*913*				
1.015	1.059	0.995	0.957				
1%	6%	0%	4%				

0	30	1237	152	**1419**	*1430*	1.008	1%
17	0	542	481	**1040**	*1064*	1.023	2%
1049	186	0	280	**1514**	*1501*	0.991	1%
139	344	240	0	**724**	*704*	0.972	3%
1205	**560**	**2020**	**913**	4698			
1205	*560*	*2020*	*913*				
1.000	1.000	1.000	1.000				

0	30	1247	153	**1430**	*1430*	1.000	
17	0	555	492	**1064**	*1064*	1.000	
1040	184	0	277	**1501**	*1501*	1.000	
135	335	234	0	**704**	*704*	1.000	
1192	**549**	**2035**	**923**	4699			
1205	*560*	*2020*	*913*				
1.011	1.020	0.993	0.990				
1%	2%	1%	1%				

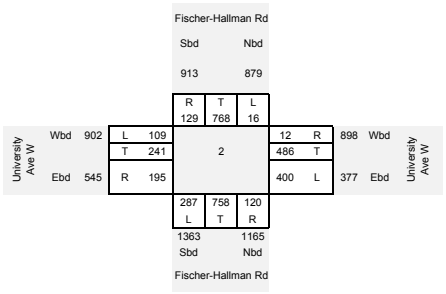
0	31	1238	151	**1420**	*1430*	1.007	1%
17	0	550	487	**1055**	*1064*	1.009	1%
1051	188	0	275	**1513**	*1501*	0.992	1%
137	342	232	0	**710**	*704*	0.991	1%
1205	**560**	**2020**	**913**	4698			
1205	*560*	*2020*	*913*				
1.000	1.000	1.000	1.000				

0	31	1247	153	**1430**	*1430*	1.000	
18	0	555	491	**1064**	*1064*	1.000	
1042	186	0	272	**1501**	*1501*	1.000	
136	338	230	0	**704**	*704*	1.000	
1196	**556**	**2032**	**916**	4699			
1205	*560*	*2020*	*913*				
1.008	1.008	0.994	0.997				
1%	1%	1%	0%				

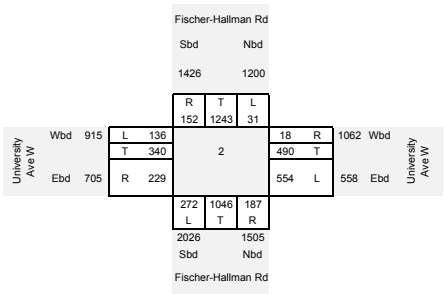
0	31	1239	152	**1423**	*1430*	1.005	1%
18	0	552	490	**1059**	*1064*	1.004	0%
1051	188	0	271	**1510**	*1501*	0.994	1%
137	341	229	0	**706**	*704*	0.997	0%
1205	**560**	**2020**	**913**	4698			
1205	*560*	*2020*	*913*				
1.000	1.000	1.000	1.000				

	North	East	South	West	Total	Target		
North	0	31	1243	152	**1426**	*1430*	1.003	0%
East	18	0	554	490	**1062**	*1064*	1.002	0%
South	1046	187	0	272	**1505**	*1501*	0.997	0%
West	136	340	229	0	**705**	*704*	0.998	0%
Total	**1200**	**558**	**2026**	**915**	**4699**			
Target	*1205*	*560*	*2020*	*913*				
	1.004	1.004	0.997	0.998				
	0%	0%	0%	0%				

Existing PM



Forecasted 2031 PM



Ira Neeles Blvd at Thorndale Dr - PM Peak Hour

Origins \ Destinations	North	East	South	West	Total	Target	Factor
North	0	65	1071	88	**1224**	*2055*	1.679
East	96	0	59	22	**177**	*251*	1.418
South	913	71	0	1	**985**	*1257*	1.276
West	149	40	24	0	**213**	*219*	1.028
Total	**1158**	**176**	**1154**	**111**	**2599**		
Target	*1441*	*232*	*1983*	*126*		*3782*	
	1.244	1.318	1.718	1.135			

0	109	1798	148	**2055**	*2055*	1.000	
136	0	84	31	**251**	*251*	1.000	
1165	91	0	1	**1257**	*1257*	1.000	
153	41	25	0	**219**	*219*	1.000	
1454	**241**	**1906**	**180**	3782			
1441	*232*	*1983*	*126*				
0.991	0.963	1.040	0.699				
1%	4%	4%	43%				

0	105	1870	103	**2079**	*2055*	0.989	1%
135	0	87	22	**244**	*251*	1.030	3%
1154	87	0	1	**1243**	*1257*	1.012	1%
152	40	26	0	**217**	*219*	1.009	1%
1441	**232**	**1983**	**126**	3782			
1441	*232*	*1983*	*126*				
1.000	1.000	1.000	1.000				

0	104	1849	102	**2055**	*2055*	1.000	
139	0	90	22	**251**	*251*	1.000	
1168	88	0	1	**1257**	*1257*	1.000	
153	40	26	0	**219**	*219*	1.000	
1460	**232**	**1964**	**125**	3782			
1441	*232*	*1983*	*126*				
0.987	0.999	1.009	1.004				
1%	0%	1%	0%				

0	104	1866	103	**2073**	*2055*	0.991	1%
137	0	90	23	**250**	*251*	1.003	0%
1153	88	0	1	**1242**	*1257*	1.012	1%
151	40	26	0	**217**	*219*	1.008	1%
1441	**232**	**1983**	**126**	3782			
1441	*232*	*1983*	*126*				
1.000	1.000	1.000	1.000				

0	103	1850	102	**2055**	*2055*	1.000	
138	0	91	23	**251**	*251*	1.000	
1167	89	0	1	**1257**	*1257*	1.000	
152	40	26	0	**219**	*219*	1.000	
1457	**233**	**1968**	**125**	3782			
1441	*232*	*1983*	*126*				
0.989	0.998	1.008	1.006				
1%	0%	1%	1%				

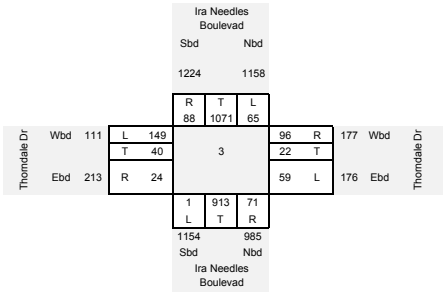
0	103	1865	102	**2070**	*2055*	0.993	1%
136	0	91	23	**250**	*251*	1.003	0%
1154	89	0	1	**1244**	*1257*	1.010	1%
151	40	27	0	**217**	*219*	1.007	1%
1441	**232**	**1983**	**126**	3782			
1441	*232*	*1983*	*126*				
1.000	1.000	1.000	1.000				

0	102	1851	102	**2055**	*2055*	1.000	
136	0	92	23	**251**	*251*	1.000	
1166	90	0	1	**1257**	*1257*	1.000	
152	40	27	0	**219**	*219*	1.000	
1454	**232**	**1970**	**125**	3782			
1441	*232*	*1983*	*126*				
0.991	0.998	1.007	1.005				
1%	0%	1%	1%				

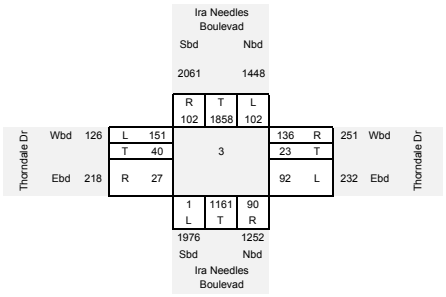
0	102	1864	102	**2068**	*2055*	0.994	1%
135	0	92	23	**250**	*251*	1.002	0%
1155	90	0	1	**1246**	*1257*	1.009	1%
150	40	27	0	**218**	*219*	1.006	1%
1441	**232**	**1983**	**126**	3782			
1441	*232*	*1983*	*126*				
1.000	1.000	1.000	1.000				

Origins \ Destinations	North	East	South	West	Total	Target	Factor	
North	0	102	1858	102	**2061**	*2055*	0.997	0%
East	136	0	92	23	**251**	*251*	1.001	0%
South	1161	90	0	1	**1252**	*1257*	1.004	0%
West	151	40	27	0	**218**	*219*	1.003	0%
Total	**1448**	**232**	**1976**	**126**	**3782**			
Target	*1441*	*232*	*1983*	*126*				
	0.995	0.999	1.003	1.003				
	0%	0%	0%	0%				

Existing PM



Forecasted 2031 PM



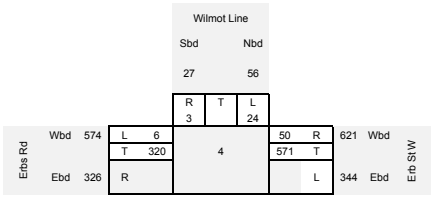
Wilmot Ln at Erb St - PM Peak Hour

Origins	Destinations North	East	South	West	Total	Target	Factor
North	0	24		3	**27**	*30*	1.111
East	50	0		571	**621**	*822*	1.324
South							
West	6	320		0	**326**	*362*	1.110
Total	**56**	**344**		**574**	**974**		
Target	*132*	*373*		*704*		*1212*	
	2.357	1.084		1.226			

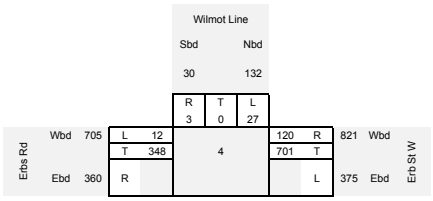
0	27		3	**30**	*30*	1.000	0	26	3	**29**	*30*	1.030	3%
66	0		756	**822**	*822*	1.000	120	0	701	**821**	*822*	1.001	0%
7	355		0	**362**	*362*	1.000	12	347	0	**359**	*362*	1.008	1%
73	**382**		**759**	**1214**			**132**	**373**	**704**	**1209**			
132	*373*		*704*				*132*	*373*	*704*				
1.812	0.976		0.927				1.000	1.000	1.000				
45%	2%		8%										
0	27		3	**30**	*30*	1.000	0	27	3	**30**	*30*	1.009	1%
120	0		702	**822**	*822*	1.000	120	0	701	**821**	*822*	1.002	0%
12	350		0	**362**	*362*	1.000	12	346	0	**359**	*362*	1.010	1%
132	**377**		**705**	**1214**			**132**	**373**	**704**	**1209**			
132	*373*		*704*				*132*	*373*	*704*				
0.998	0.990		0.998				1.000	1.000	1.000				
0%	1%		0%										
0	27		3	**30**	*30*	1.000	0	27	3	**30**	*30*	1.009	1%
120	0		702	**822**	*822*	1.000	120	0	701	**821**	*822*	1.002	0%
12	350		0	**362**	*362*	1.000	12	346	0	**359**	*362*	1.009	1%
132	**377**		**705**	**1214**			**132**	**373**	**704**	**1209**			
132	*373*		*704*				*132*	*373*	*704*				
0.998	0.991		0.998				1.000	1.000	1.000				
0%	1%		0%										
0	27		3	**30**	*30*	1.000	0	27	3	**30**	*30*	1.008	1%
120	0		702	**822**	*822*	1.000	120	0	701	**820**	*822*	1.002	0%
12	350		0	**362**	*362*	1.000	12	346	0	**359**	*362*	1.009	1%
132	**376**		**705**	**1214**			**132**	**373**	**704**	**1209**			
132	*373*		*704*				*132*	*373*	*704*				
0.998	0.991		0.998				1.000	1.000	1.000				
0%	1%		0%										

	North	East	South	West	Total	Target	Factor	
North	0	27		3	**30**	*30*	1.004	0%
East	120	0		701	**821**	*822*	1.001	0%
South								
West	12	348		0	**360**	*362*	1.004	0%
Total	**132**	**375**		**705**	**1212**			
Target	*132*	*373*		*704*				
	0.999	0.995		0.999				
	0%	0%		0%				

Existing PM



Forecasted 2031 PM



Platinum Drive at Erb Street - PM Peak Hour

Destinations

Origins	North	East	South	West	Total	Target	Factor
North	0	50	2	75	**127**	*934*	7.354
East	16	0	21	506	**543**	*872*	1.606
South	1	27	0	4	**32**	*62*	1.938
West	22	229	4	0	**255**	*284*	1.114
Total	**39**	**306**	**27**	**585**	**957**		
Target	*304*	*1020*	*43*	*786*		*2153*	
	7.795	3.333	1.593	1.344			

0	368	15	552	**934**	*934*	1.000	
26	0	34	813	**872**	*872*	1.000	
2	52	0	8	**62**	*62*	1.000	
25	255	4	0	**284**	*284*	1.000	
52	**675**	**53**	**1372**	2152			
304	*1020*	*43*	*786*				
5.831	1.511	0.813	0.573				
83%	34%	23%	75%				

0	556	12	316	**884**	*934*	1.057	5%
150	0	27	466	**643**	*872*	1.357	26%
11	79	0	4	**95**	*62*	0.654	53%
143	385	4	0	**532**	*284*	0.534	87%
304	**1020**	**43**	**786**	2153			
304	*1020*	*43*	*786*				
1.000	1.000	1.000	1.000				

0	587	13	334	**934**	*934*	1.000	
203	0	37	632	**872**	*872*	1.000	
7	52	0	3	**62**	*62*	1.000	
76	206	2	0	**284**	*284*	1.000	
287	**845**	**52**	**969**	2152			
304	*1020*	*43*	*786*				
1.059	1.207	0.831	0.812				
6%	17%	20%	23%				

0	709	10	271	**991**	*934*	0.943	6%
215	0	31	513	**759**	*872*	1.149	13%
8	62	0	2	**73**	*62*	0.854	17%
81	248	2	0	**331**	*284*	0.858	17%
304	**1020**	**43**	**786**	2153			
304	*1020*	*43*	*786*				
1.000	1.000	1.000	1.000				

0	669	10	256	**934**	*934*	1.000	
247	0	36	589	**872**	*872*	1.000	
7	53	0	2	**62**	*62*	1.000	
69	213	1	0	**284**	*284*	1.000	
324	**935**	**47**	**847**	2152			
304	*1020*	*43*	*786*				
0.940	1.091	0.919	0.928				
6%	8%	9%	8%				

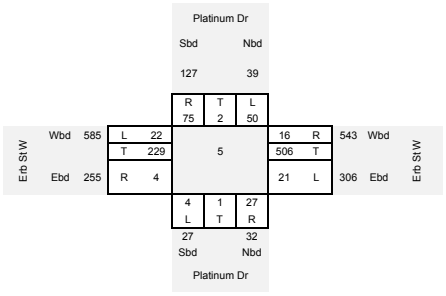
0	729	9	237	**976**	*934*	0.957	4%
233	0	33	547	**812**	*872*	1.074	7%
6	58	0	2	**66**	*62*	0.935	7%
65	233	1	0	**299**	*284*	0.950	5%
304	**1020**	**43**	**786**	2153			
304	*1020*	*43*	*786*				
1.000	1.000	1.000	1.000				

0	698	9	227	**934**	*934*	1.000	
250	0	35	587	**872**	*872*	1.000	
6	54	0	2	**62**	*62*	1.000	
62	221	1	0	**284**	*284*	1.000	
317	**973**	**45**	**816**	2152			
304	*1020*	*43*	*786*				
0.958	1.048	0.956	0.963				
4%	5%	5%	4%				

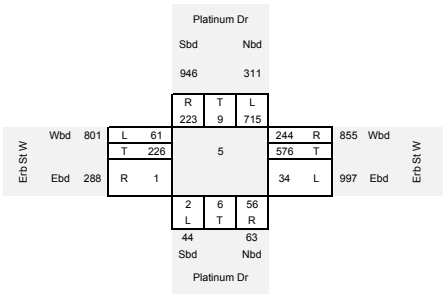
0	732	8	219	**959**	*934*	0.974	3%
239	0	34	566	**838**	*872*	1.040	4%
6	57	0	2	**64**	*62*	0.964	4%
59	231	1	0	**292**	*284*	0.973	3%
304	**1020**	**43**	**786**	2153			
304	*1020*	*43*	*786*				
1.000	1.000	1.000	1.000				

	North	East	South	West	Total	Target	Factor	
North	0	715	9	223	**946**	*934*	0.987	1%
East	244	0	34	576	**855**	*872*	1.020	2%
South	6	56	0	2	**63**	*62*	0.982	2%
West	61	226	1	0	**288**	*284*	0.986	1%
Total	**311**	**997**	**44**	**801**	**2153**			
Target	*304*	*1020*	*43*	*786*				
	0.978	1.023	0.978	0.981				
	2%	2%	2%	2%				

Existing PM



Forecasted 2031 PM



Ira Neeles Blvd/Erbsville Rd at Erb St - PM Peak Hour

Destinations

Origins	North	East	South	West	Total	Target	Factor
North	0	186	674	151	**1011**	*1413*	1.398
East	141	0	187	528	**856**	*925*	1.081
South	819	144	0	337	**1300**	*1559*	1.199
West	219	268	347	0	**834**	*1550*	1.859
Total	**1179**	**598**	**1208**	**1016**	**4001**		
Target	*1276*	*790*	*2039*	*1340*		*5446*	
	1.082	1.321	1.688	1.319			

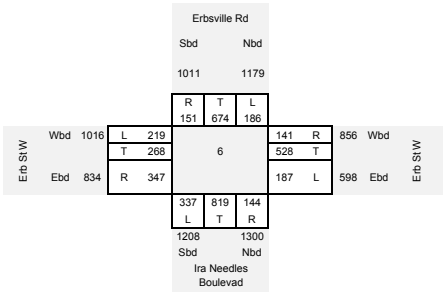
0	260	942	211	**1413**	*1413*	1.000	0	221	1074	238	**1533**	*1413*	0.922	8%
152	0	202	571	**925**	*925*	1.000	126	0	230	645	**1001**	*925*	0.924	8%
982	173	0	404	**1559**	*1559*	1.000	813	147	0	457	**1416**	*1559*	1.101	9%
407	498	645	0	**1550**	*1550*	1.000	337	423	735	0	**1495**	*1550*	1.037	4%
1542	**931**	**1789**	**1186**	5447			**1276**	**790**	**2039**	**1340**	5445			
1276	*790*	*2039*	*1340*				*1276*	*790*	*2039*	*1340*				
0.828	0.849	1.140	1.130				1.000	1.000	1.000	1.000				
21%	18%	12%	12%											

0	203	990	220	**1413**	*1413*	1.000	0	200	1027	223	**1451**	*1413*	0.974	3%
117	0	213	596	**925**	*925*	1.000	109	0	221	606	**936**	*925*	0.989	1%
895	161	0	503	**1559**	*1559*	1.000	839	159	0	511	**1509**	*1559*	1.033	3%
349	438	762	0	**1550**	*1550*	1.000	328	431	791	0	**1550**	*1550*	1.000	0%
1361	**803**	**1965**	**1318**	5447			**1276**	**790**	**2039**	**1340**	5445			
1276	*790*	*2039*	*1340*				*1276*	*790*	*2039*	*1340*				
0.938	0.984	1.038	1.016				1.000	1.000	1.000	1.000				
7%	2%	4%	2%											

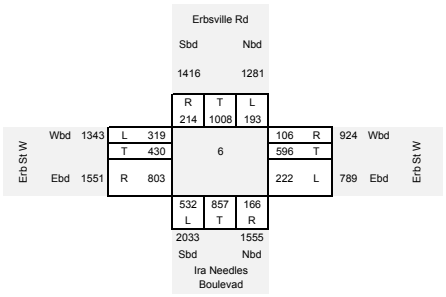
0	195	1000	218	**1413**	*1413*	1.000	0	195	1015	217	**1427**	*1413*	0.990	1%
108	0	218	599	**925**	*925*	1.000	106	0	221	597	**924**	*925*	1.001	0%
867	164	0	528	**1559**	*1559*	1.000	849	164	0	526	**1540**	*1559*	1.013	1%
328	431	791	0	**1550**	*1550*	1.000	321	431	803	0	**1555**	*1550*	0.997	0%
1303	**790**	**2010**	**1344**	5447			**1276**	**790**	**2039**	**1340**	5445			
1276	*790*	*2039*	*1340*				*1276*	*790*	*2039*	*1340*				
0.980	1.000	1.014	0.997				1.000	1.000	1.000	1.000				
2%	0%	1%	0%											

0	193	1005	215	**1413**	*1413*	1.000	0	193	1011	214	**1418**	*1413*	0.996	0%
106	0	222	597	**925**	*925*	1.000	105	0	223	595	**923**	*925*	1.002	0%
860	166	0	533	**1559**	*1559*	1.000	853	166	0	531	**1551**	*1559*	1.005	1%
320	430	800	0	**1550**	*1550*	1.000	317	431	805	0	**1553**	*1550*	0.998	0%
1286	**789**	**2027**	**1345**	5447			**1276**	**790**	**2039**	**1340**	5445			
1276	*790*	*2039*	*1340*				*1276*	*790*	*2039*	*1340*				
0.992	1.001	1.006	0.996				1.000	1.000	1.000	1.000				
1%	0%	1%	0%											

Existing PM



Forecasted 2031 PM



	North	East	South	West	Total	Target		
North	0	193	1008	214	**1416**	*1413*	0.998	0%
East	106	0	222	596	**924**	*925*	1.001	0%
South	857	166	0	532	**1555**	*1559*	1.003	0%
West	319	430	803	0	**1551**	*1550*	0.999	0%
Total	**1281**	**789**	**2033**	**1343**	**5446**			
Target	*1276*	*790*	*2039*	*1340*				
	0.996	1.001	1.003	0.998				
	0%	0%	0%	0%				

Fischer-Halman Rd at Erb St - PM Peak Hour

Origins	Destinations: North	East	South	West	Total	Target	Factor
North	0	125	733	206	**1064**	*1390*	1.306
East	141	0	99	711	**951**	*977*	1.027
South	473	85	0	186	**744**	*1104*	1.484
West	129	330	101	0	**560**	*764*	1.364
Total	**743**	**540**	**933**	**1103**	**3319**		
Target	*976*	*742*	*1279*	*1262*		*4247*	
	1.314	1.374	1.371	1.144			

0	163	958	269	**1390**	*1390*	1.000		0	164	1023	266	**1453**	*1390*	0.957	5%
145	0	102	730	**977**	*977*	1.000		138	0	109	723	**970**	*977*	1.008	1%
702	126	0	276	**1104**	*1104*	1.000		670	127	0	273	**1069**	*1104*	1.032	3%
176	450	138	0	**764**	*764*	1.000		168	452	147	0	**767**	*764*	0.996	0%
1023	**740**	**1197**	**1276**	4235				**976**	**742**	**1279**	**1262**	4259			
976	*742*	*1279*	*1262*					*976*	*742*	*1279*	*1262*				
0.954	1.003	1.068	0.989					1.000	1.000	1.000	1.000				
5%	0%	6%	1%												

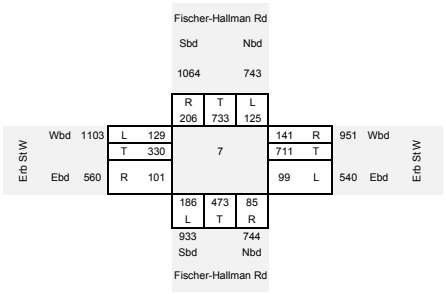
0	157	979	255	**1390**	*1390*	1.000		0	158	1014	254	**1425**	*1390*	0.975	3%
139	0	109	728	**977**	*977*	1.000		136	0	113	727	**976**	*977*	1.001	0%
691	131	0	282	**1104**	*1104*	1.000		676	131	0	281	**1089**	*1104*	1.014	1%
167	450	147	0	**764**	*764*	1.000		164	453	152	0	**768**	*764*	0.994	1%
998	**737**	**1235**	**1265**	4235				**976**	**742**	**1279**	**1262**	4259			
976	*742*	*1279*	*1262*					*976*	*742*	*1279*	*1262*				
0.978	1.006	1.036	0.998					1.000	1.000	1.000	1.000				
2%	1%	3%	0%												

0	154	988	248	**1390**	*1390*	1.000		0	155	1009	248	**1412**	*1390*	0.985	2%
136	0	114	727	**977**	*977*	1.000		135	0	116	728	**979**	*977*	0.998	0%
686	133	0	285	**1104**	*1104*	1.000		680	134	0	286	**1099**	*1104*	1.004	0%
163	450	151	0	**764**	*764*	1.000		161	453	154	0	**769**	*764*	0.994	1%
985	**737**	**1253**	**1260**	4235				**976**	**742**	**1279**	**1262**	4259			
976	*742*	*1279*	*1262*					*976*	*742*	*1279*	*1262*				
0.991	1.006	1.021	1.001					1.000	1.000	1.000	1.000				
1%	1%	2%	0%												

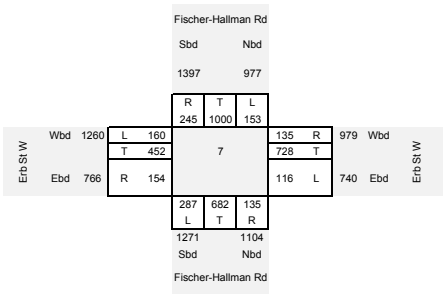
0	152	993	244	**1390**	*1390*	1.000		0	153	1007	245	**1405**	*1390*	0.989	1%
135	0	116	727	**977**	*977*	1.000		135	0	117	729	**981**	*977*	0.996	0%
682	135	0	287	**1104**	*1104*	1.000		681	136	0	288	**1105**	*1104*	0.999	0%
160	450	153	0	**764**	*764*	1.000		160	453	155	0	**769**	*764*	0.994	1%
978	**737**	**1262**	**1258**	4235				**976**	**742**	**1279**	**1262**	4259			
976	*742*	*1279*	*1262*					*976*	*742*	*1279*	*1262*				
0.998	1.006	1.013	1.003					1.000	1.000	1.000	1.000				
0%	1%	1%	0%											

	North	East	South	West	Total	Target		
North	0	153	1000	245	**1397**	*1390*	0.995	1%
East	135	0	116	728	**979**	*977*	0.998	0%
South	682	135	0	287	**1104**	*1104*	1.000	0%
West	160	452	154	0	**766**	*764*	0.997	0%
Total	**977**	**740**	**1271**	**1260**	**4247**			
Target	*976*	*742*	*1279*	*1262*				
	0.999	1.003	1.007	1.002				
	0%	0%	1%	0%				

Existing PM



Forecasted 2031 PM



Erbsville Rd at Keats Way - PM Peak Hour

Destinations

Origins	North	East	South	West	Total	Target	Factor
North	0	39	766	26	**831**	*1159*	1.395
East	55	0	71	55	**181**	*188*	1.039
South	562	81	0	38	**681**	*779*	1.144
West	34	39	30	0	**103**	*207*	2.010
Total	**651**	**159**	**867**	**119**	**1796**		
Target	*742*	*269*	*1183*	*138*		*2333*	
	1.140	1.692	1.364	1.160			

0	54	1068	36	**1159**	*1159*	1.000		0	65	1051	37	**1153**	*1159*	1.006	1%
57	0	74	57	**188**	*188*	1.000		55	0	73	58	**185**	*188*	1.014	1%
643	93	0	43	**779**	*779*	1.000		621	111	0	44	**775**	*779*	1.005	0%
68	78	60	0	**207**	*207*	1.000		66	94	59	0	**219**	*207*	0.946	6%
768	**225**	**1202**	**137**	2333				**742**	**269**	**1183**	**138**	2332			
742	*269*	*1183*	*138*					*742*	*269*	*1183*	*138*				
0.966	1.193	0.984	1.008					1.000	1.000	1.000	1.000				
4%	16%	2%	1%												

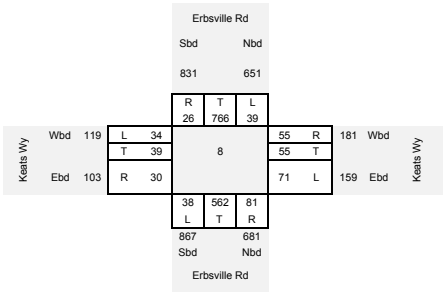
0	65	1057	37	**1159**	*1159*	1.000		0	66	1054	36	**1156**	*1159*	1.002	0%
56	0	74	58	**188**	*188*	1.000		56	0	73	58	**187**	*188*	1.004	0%
624	111	0	44	**779**	*779*	1.000		624	113	0	44	**780**	*779*	0.999	0%
62	88	56	0	**207**	*207*	1.000		62	90	56	0	**208**	*207*	0.994	1%
742	**265**	**1187**	**139**	2333				**742**	**269**	**1183**	**138**	2332			
742	*269*	*1183*	*138*					*742*	*269*	*1183*	*138*				
1.000	1.016	0.997	0.991					1.000	1.000	1.000	1.000				
0%	2%	0%	1%												

0	66	1056	37	**1159**	*1159*	1.000		0	67	1054	36	**1157**	*1159*	1.002	0%
56	0	74	58	**188**	*188*	1.000		56	0	74	58	**188**	*188*	1.001	0%
623	113	0	44	**779**	*779*	1.000		624	113	0	44	**780**	*779*	0.999	0%
62	89	56	0	**207**	*207*	1.000		62	90	56	0	**207**	*207*	0.999	0%
741	**268**	**1185**	**138**	2333				**742**	**269**	**1183**	**138**	2332			
742	*269*	*1183*	*138*					*742*	*269*	*1183*	*138*				
1.001	1.002	0.998	0.998					1.000	1.000	1.000	1.000				
0%	0%	0%	0%												

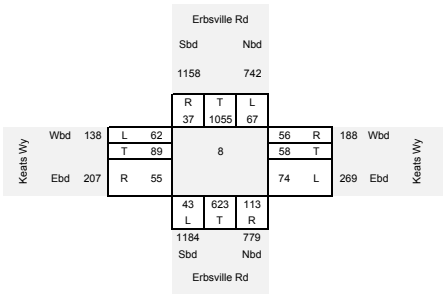
0	67	1056	37	**1159**	*1159*	1.000		0	67	1054	37	**1157**	*1159*	1.001	0%
56	0	74	58	**188**	*188*	1.000		56	0	73	58	**188**	*188*	1.000	0%
623	113	0	43	**779**	*779*	1.000		623	113	0	43	**780**	*779*	0.999	0%
62	89	55	0	**207**	*207*	1.000		62	89	55	0	**207**	*207*	1.000	0%
741	**269**	**1185**	**138**	2333				**742**	**269**	**1183**	**138**	2332			
742	*269*	*1183*	*138*					*742*	*269*	*1183*	*138*				
1.001	1.000	0.998	1.000					1.000	1.000	1.000	1.000				
0%	0%	0%	0%												

	North	East	South	West	Total	Target	Factor	
North	0	67	1055	37	**1158**	*1159*	1.001	0%
East	56	0	74	58	**188**	*188*	1.000	0%
South	623	113	0	43	**779**	*779*	1.000	0%
West	62	89	55	0	**207**	*207*	1.000	0%
Total	**742**	**269**	**1184**	**138**	**2333**			
Target	*742*	*269*	*1183*	*138*				
	1.001	1.000	0.999	1.000				
	0%	0%	0%	0%				

Existing PM



Forecasted 2031 PM



Erbsville Rd at Columbia St W - PM Peak Hour

Destinations

Origins	North	East	South	West	Total	Target	Factor
North	0	188	413	62	**663**	*872*	1.315
East	279	0	431	178	**888**	*1275*	1.436
South	387	197	0	46	**630**	*721*	1.144
West	50	114	46	0	**210**	*627*	2.986
Total	**716**	**499**	**890**	**286**	**2391**		
Target	*963*	*784*	*1232*	*518*		*3496*	
	1.345	1.571	1.384	1.811			

0	247	543	82	**872**	*872*	1.000	
401	0	619	256	**1275**	*1275*	1.000	
443	225	0	53	**721**	*721*	1.000	
149	340	137	0	**627**	*627*	1.000	
993	**813**	**1299**	**390**	**3495**			
963	*784*	*1232*	*518*				
0.970	0.964	0.948	1.329				
3%	4%	5%	25%				

0	238	515	108	**862**	*872*	1.012	1%
389	0	587	340	**1315**	*1275*	0.970	3%
430	217	0	70	**717**	*721*	1.006	1%
145	328	130	0	**603**	*627*	1.039	4%
963	**784**	**1232**	**518**	**3497**			
963	*784*	*1232*	*518*				
1.000	1.000	1.000	1.000				

0	241	521	110	**872**	*872*	1.000	
377	0	569	329	**1275**	*1275*	1.000	
432	219	0	70	**721**	*721*	1.000	
151	341	135	0	**627**	*627*	1.000	
959	**801**	**1225**	**509**	**3495**			
963	*784*	*1232*	*518*				
1.004	0.979	1.005	1.017				
0%	2%	1%	2%				

0	236	524	112	**872**	*872*	1.000	0%
378	0	572	335	**1285**	*1275*	0.992	1%
434	214	0	72	**719**	*721*	1.002	0%
151	334	136	0	**621**	*627*	1.010	1%
963	**784**	**1232**	**518**	**3497**			
963	*784*	*1232*	*518*				
1.000	1.000	1.000	1.000				

0	236	524	112	**872**	*872*	1.000	0%
375	0	567	332	**1275**	*1275*	1.000	0%
435	215	0	72	**721**	*721*	1.000	0%
153	337	137	0	**627**	*627*	1.000	0%
963	**788**	**1229**	**516**	**3495**			
963	*784*	*1232*	*518*				
1.000	0.995	1.002	1.005				
0%	0%	0%	0%				

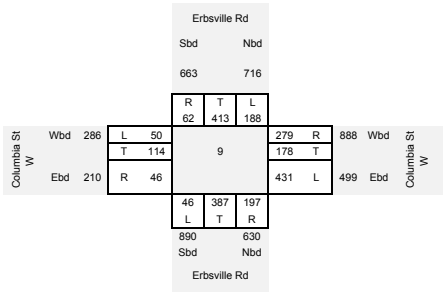
0	235	525	112	**873**	*872*	0.999	0%
375	0	569	334	**1278**	*1275*	0.998	0%
435	213	0	72	**721**	*721*	1.001	0%
153	335	138	0	**626**	*627*	1.002	0%
963	**784**	**1232**	**518**	**3497**			
963	*784*	*1232*	*518*				
1.000	1.000	1.000	1.000				

0	235	525	112	**872**	*872*	1.000	0%
375	0	567	333	**1275**	*1275*	1.000	0%
435	214	0	72	**721**	*721*	1.000	0%
153	336	138	0	**627**	*627*	1.000	0%
963	**785**	**1231**	**517**	**3495**			
963	*784*	*1232*	*518*				
1.000	0.999	1.001	1.002				
0%	0%	0%	0%				

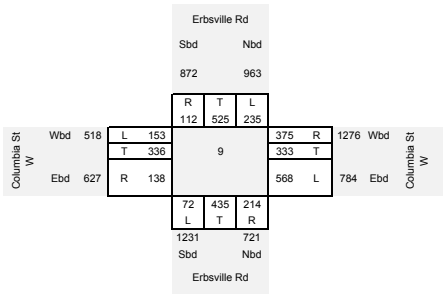
0	235	526	112	**873**	*872*	0.999	0%
375	0	568	334	**1276**	*1275*	0.999	0%
435	213	0	72	**721**	*721*	1.000	0%
153	336	138	0	**627**	*627*	1.000	0%
963	**784**	**1232**	**518**	**3497**			
963	*784*	*1232*	*518*				
1.000	1.000	1.000	1.000				

	North	East	South	West	Total	Target	Factor	
North	0	235	525	112	**872**	*872*	1.000	0%
East	375	0	568	333	**1276**	*1275*	0.999	0%
South	435	214	0	72	**721**	*721*	1.000	0%
West	153	336	138	0	**627**	*627*	1.000	0%
Total	**963**	**784**	**1231**	**518**	**3496**			
Target	*963*	*784*	*1232*	*518*				
	1.000	1.000	1.001	1.001				
	0%	0%	0%	0%				

Existing PM



Forecasted 2031 PM



Fischer-Halman Rd at Columbia St W - PM Peak Hour

Destinations

Origins	North	East	South	West	Total	Target	Factor
North	0	126	579	230	**935**	*1085*	1.160
East	262	0	346	656	**1264**	*1604*	1.269
South	281	124	0	147	**552**	*756*	1.370
West	99	269	74	0	**442**	*779*	1.762
Total	**642**	**519**	**999**	**1033**	**3193**		
Target	*812*	*658*	*1215*	*1541*		*4225*	
	1.265	1.268	1.216	1.492			

0	146	672	267	**1085**	*1085*	1.000	
332	0	439	832	**1604**	*1604*	1.000	
385	170	0	201	**756**	*756*	1.000	
174	474	130	0	**779**	*779*	1.000	
892	**790**	**1241**	**1301**	4224			
812	*658*	*1215*	*1541*				
0.911	0.833	0.979	1.185				
10%	20%	2%	16%				

0	122	658	316	**1096**	*1085*	0.990	1%
303	0	430	986	**1719**	*1604*	0.933	7%
350	141	0	239	**730**	*756*	1.035	3%
159	395	128	0	**681**	*779*	1.143	13%
812	**658**	**1215**	**1541**	4226			
812	*658*	*1215*	*1541*				
1.000	1.000	1.000	1.000				

0	121	651	313	**1085**	*1085*	1.000	
283	0	401	920	**1604**	*1604*	1.000	
363	146	0	247	**756**	*756*	1.000	
182	451	146	0	**779**	*779*	1.000	
827	**718**	**1198**	**1480**	4224			
812	*658*	*1215*	*1541*				
0.982	0.916	1.014	1.041				
2%	9%	1%	4%				

0	110	660	326	**1097**	*1085*	0.989	1%
277	0	407	958	**1642**	*1604*	0.977	2%
356	134	0	257	**747**	*756*	1.012	1%
178	413	148	0	**740**	*779*	1.053	5%
812	**658**	**1215**	**1541**	4226			
812	*658*	*1215*	*1541*				
1.000	1.000	1.000	1.000				

0	109	653	322	**1085**	*1085*	1.000	
271	0	397	936	**1604**	*1604*	1.000	
360	136	0	260	**756**	*756*	1.000	
188	435	156	0	**779**	*779*	1.000	
819	**680**	**1206**	**1518**	4224			
812	*658*	*1215*	*1541*				
0.991	0.967	1.007	1.015				
1%	3%	1%	1%				

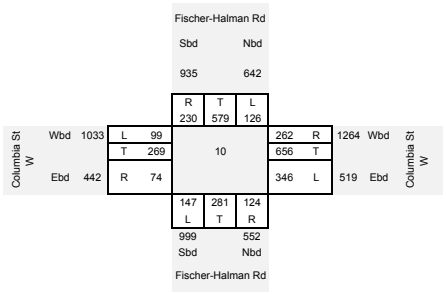
0	106	658	327	**1091**	*1085*	0.995	1%
269	0	400	950	**1619**	*1604*	0.991	1%
357	131	0	264	**752**	*756*	1.005	0%
186	421	157	0	**764**	*779*	1.019	2%
812	**658**	**1215**	**1541**	4226			
812	*658*	*1215*	*1541*				
1.000	1.000	1.000	1.000				

0	105	654	326	**1085**	*1085*	1.000	
266	0	396	941	**1604**	*1604*	1.000	
359	132	0	265	**756**	*756*	1.000	
190	429	160	0	**779**	*779*	1.000	
815	**666**	**1211**	**1532**	4224			
812	*658*	*1215*	*1541*				
0.996	0.988	1.003	1.006				
0%	1%	0%	1%				

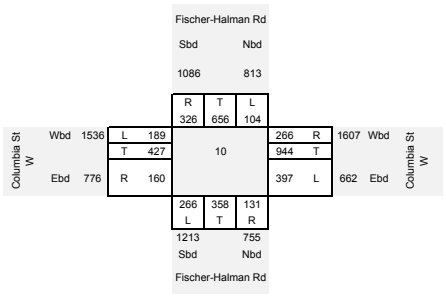
0	104	657	327	**1088**	*1085*	0.997	0%
265	0	398	947	**1610**	*1604*	0.996	0%
358	130	0	267	**755**	*756*	1.002	0%
189	424	161	0	**774**	*779*	1.007	1%
812	**658**	**1215**	**1541**	4226			
812	*658*	*1215*	*1541*				
1.000	1.000	1.000	1.000				

Origins	North	East	South	West	Total	Target	Factor	
North	0	104	656	326	**1086**	*1085*	0.999	0%
East	266	0	397	944	**1607**	*1604*	0.998	0%
South	358	131	0	266	**755**	*756*	1.001	0%
West	189	427	160	0	**776**	*779*	1.003	0%
Total	**813**	**662**	**1213**	**1536**	**4225**			
Target	*812*	*658*	*1215*	*1541*				
	0.998	0.994	1.002	1.003				
	0%	1%	0%	0%				

Existing PM



Forecasted 2031 PM



Erbsville Rd at Laurelwood Dr - PM Peak Hour

Destinations

Origins	North	East	South	West	Total	Target	Factor
North	0	53	300	20	**373**	*501*	1.343
East	81	0	140	168	**389**	*403*	1.036
South	271	107	0	142	**520**	*712*	1.369
West	19	88	134	0	**241**	*275*	1.141
Total	**371**	**248**	**574**	**330**	**1523**		
Target	*435*	*280*	*727*	*449*		*1891*	
	1.173	1.129	1.267	1.361			

0	71	403	27	**501**	*501*	1.000		0	63	418	31	**511**	*501*	0.980	2%
84	0	145	174	**403**	*403*	1.000		77	0	150	198	**425**	*403*	0.949	5%
371	147	0	194	**712**	*712*	1.000		339	129	0	221	**688**	*712*	1.034	3%
22	100	153	0	**275**	*275*	1.000		20	88	159	0	**267**	*275*	1.031	3%
477	**318**	**701**	**395**	1891				**435**	**280**	**727**	**449**	1891			
435	*280*	*727*	*449*					*435*	*280*	*727*	*449*				
0.913	0.880	1.037	1.136					1.000	1.000	1.000	1.000				
10%	14%	4%	12%												

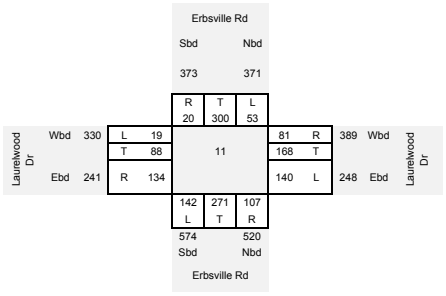
0	61	410	30	**501**	*501*	1.000		0	60	416	30	**506**	*501*	0.990	1%
73	0	143	188	**403**	*403*	1.000		71	0	145	189	**405**	*403*	0.995	1%
350	133	0	228	**712**	*712*	1.000		344	131	0	230	**704**	*712*	1.011	1%
20	91	163	0	**275**	*275*	1.000		20	89	166	0	**275**	*275*	0.999	0%
443	**286**	**716**	**446**	1891				**435**	**280**	**727**	**449**	1891			
435	*280*	*727*	*449*					*435*	*280*	*727*	*449*				
0.981	0.979	1.015	1.007					1.000	1.000	1.000	1.000				
2%	2%	2%	1%												

0	60	412	30	**501**	*501*	1.000		0	59	415	30	**504**	*501*	0.994	1%
71	0	144	188	**403**	*403*	1.000		70	0	145	187	**403**	*403*	1.000	0%
347	132	0	233	**712**	*712*	1.000		345	132	0	232	**708**	*712*	1.005	1%
20	89	166	0	**275**	*275*	1.000		20	89	167	0	**276**	*275*	0.997	0%
438	**281**	**722**	**450**	1891				**435**	**280**	**727**	**449**	1891			
435	*280*	*727*	*449*					*435*	*280*	*727*	*449*				
0.992	0.997	1.007	0.997					1.000	1.000	1.000	1.000				
1%	0%	1%	0%												

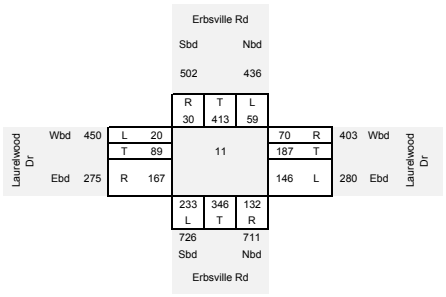
0	59	412	30	**501**	*501*	1.000		0	59	414	29	**503**	*501*	0.997	0%
70	0	145	187	**403**	*403*	1.000		70	0	146	187	**403**	*403*	1.000	0%
347	132	0	233	**712**	*712*	1.000		345	132	0	233	**710**	*712*	1.003	0%
20	89	167	0	**275**	*275*	1.000		20	89	167	0	**276**	*275*	0.998	0%
437	**280**	**724**	**450**	1891				**435**	**280**	**727**	**449**	1891			
435	*280*	*727*	*449*					*435*	*280*	*727*	*449*				
0.996	1.000	1.004	0.998					1.000	1.000	1.000	1.000				
0%	0%	0%	0%												

	North	East	South	West	Total	Target		
North	0	59	413	30	**502**	*501*	0.998	0%
East	70	0	146	187	**403**	*403*	1.000	0%
South	346	132	0	233	**711**	*712*	1.001	0%
West	20	89	167	0	**275**	*275*	0.999	0%
Total	**436**	**280**	**726**	**450**	**1891**			
Target	*435*	*280*	*727*	*449*				
	0.998	1.000	1.002	0.999				
	0%	0%	0%	0%				

Existing PM



Forecasted 2031 PM



Beaver Creek Dr at Laurelwood Dr - PM Peak Hour

Destinations

Origins	North	East	South	West	Total	Target	Factor
North	0	47	64	70	**181**	*284*	1.569
East	50	0	124	440	**614**	*648*	1.055
South	22	62	0	49	**133**	*295*	2.218
West	23	219	46	0	**288**	*319*	1.108
Total	**95**	**328**	**234**	**559**	**1216**		
Target	*263*	*374*	*323*	*598*		*1552*	
	2.768	1.140	1.380	1.070			

0	74	100	110	**284**	*284*	1.000	
53	0	131	464	**648**	*648*	1.000	
49	138	0	109	**295**	*295*	1.000	
25	243	51	0	**319**	*319*	1.000	
127	**454**	**282**	**683**	1546			
263	*374*	*323*	*598*				
2.070	0.824	1.144	0.876				
52%	21%	13%	14%				

0	61	115	96	**272**	*284*	1.045	4%
109	0	150	407	**666**	*648*	0.973	3%
101	113	0	95	**310**	*295*	0.953	5%
53	200	58	0	**311**	*319*	1.026	3%
263	**374**	**323**	**598**	1558			
263	*374*	*323*	*598*				
1.000	1.000	1.000	1.000				

0	63	120	100	**284**	*284*	1.000	
106	0	146	396	**648**	*648*	1.000	
96	108	0	91	**295**	*295*	1.000	
54	205	60	0	**319**	*319*	1.000	
257	**377**	**326**	**587**	1546			
263	*374*	*323*	*598*				
1.024	0.993	0.992	1.019				
2%	1%	1%	2%				

0	63	119	103	**284**	*284*	1.000	
109	0	145	403	**657**	*648*	0.987	1%
99	107	0	92	**298**	*295*	0.989	1%
55	204	59	0	**318**	*319*	1.002	0%
263	**374**	**323**	**598**	1558			
263	*374*	*323*	*598*				
1.000	1.000	1.000	1.000				

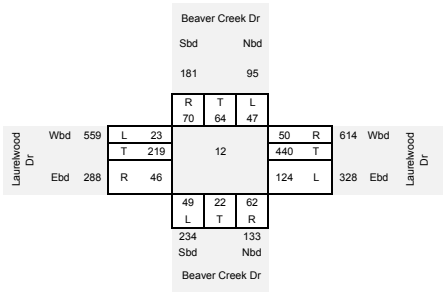
0	63	119	102	**284**	*284*	1.000	
107	0	143	398	**648**	*648*	1.000	
98	106	0	91	**295**	*295*	1.000	
56	204	59	0	**319**	*319*	1.000	
261	**373**	**321**	**591**	1546			
263	*374*	*323*	*598*				
1.009	1.002	1.006	1.011				
1%	0%	1%	1%				

0	63	120	103	**286**	*284*	0.993	1%
108	0	144	402	**654**	*648*	0.990	1%
98	106	0	92	**297**	*295*	0.993	1%
56	205	60	0	**320**	*319*	0.996	0%
263	**374**	**323**	**598**	1558			
263	*374*	*323*	*598*				
1.000	1.000	1.000	1.000				

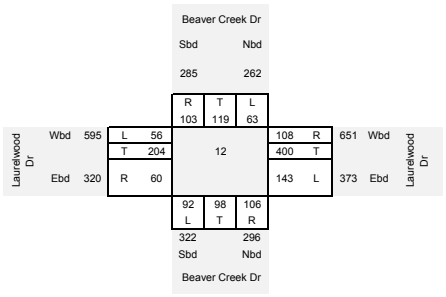
0	63	119	103	**284**	*284*	1.000	
107	0	142	398	**648**	*648*	1.000	
98	106	0	92	**295**	*295*	1.000	
56	204	60	0	**319**	*319*	1.000	
261	**372**	**320**	**593**	1546			
263	*374*	*323*	*598*				
1.008	1.006	1.008	1.009				
1%	1%	1%	1%				

0	63	120	104	**286**	*284*	0.992	1%
108	0	143	402	**654**	*648*	0.992	1%
98	106	0	93	**297**	*295*	0.993	1%
56	205	60	0	**321**	*319*	0.994	1%
263	**374**	**323**	**598**	1558			
263	*374*	*323*	*598*				
1.000	1.000	1.000	1.000				

Existing PM



Forecasted 2031 PM



	North	East	South	West	Total	Target	Factor	
North	0	63	119	103	**285**	*284*	0.996	0%
East	108	0	143	400	**651**	*648*	0.996	0%
South	98	106	0	92	**296**	*295*	0.996	0%
West	56	204	60	0	**320**	*319*	0.997	0%
Total	**262**	**373**	**322**	**595**	**1552**			
Target	*263*	*374*	*323*	*598*				
	1.004	1.003	1.004	1.004				
	0%	0%	0%	0%				

Fischer-Halman Rd/Bearinger Rd at Laurelwood Dr - PM Peak Hour

Origins \ Destinations	North	East	South	West	Total	Target	Factor
North	0	36	630	243	**909**	*1087*	1.196
East	27	0	98	98	**223**	*305*	1.368
South	250	75	0	201	**526**	*683*	1.298
West	112	55	121	0	**288**	*338*	1.174
Total	**389**	**166**	**849**	**542**	**1946**		
Target	*630*	*204*	*997*	*573*		*2409*	
	1.620	1.229	1.174	1.057			

	0	43	753	291	**1087**	*1087*	1.000		0	43	730	243	**1015**	*1087*	1.071	7%
	37	0	134	134	**305**	*305*	1.000		47	0	130	112	**289**	*305*	1.055	5%
	325	97	0	261	**683**	*683*	1.000		415	97	0	218	**730**	*683*	0.936	7%
	131	65	142	0	**338**	*338*	1.000		168	64	138	0	**370**	*338*	0.914	9%
	493	**205**	**1029**	**686**	**2413**				**630**	**204**	**997**	**573**	**2404**			
	630	*204*	*997*	*573*					*630*	*204*	*997*	*573*				
	1.278	0.995	0.969	0.836					1.000	1.000	1.000	1.000				
	22%	0%	3%	20%												

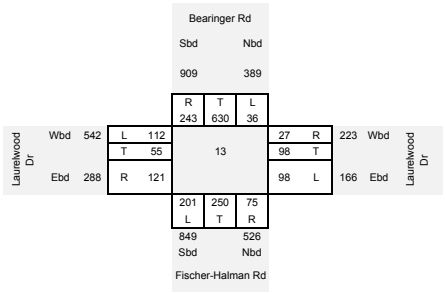
0	46	781	260	**1087**	*1087*	1.000		0	48	746	256	**1050**	*1087*	1.035	3%
50	0	137	118	**305**	*305*	1.000		53	0	131	116	**300**	*305*	1.016	2%
388	91	0	204	**683**	*683*	1.000		413	95	0	201	**709**	*683*	0.963	4%
154	59	126	0	**338**	*338*	1.000		164	61	120	0	**345**	*338*	0.980	2%
592	**195**	**1044**	**582**	**2413**				**630**	**204**	**997**	**573**	**2404**			
630	*204*	*997*	*573*					*630*	*204*	*997*	*573*				
1.065	1.045	0.955	0.984					1.000	1.000	1.000	1.000				
6%	4%	5%	2%												

0	50	772	265	**1087**	*1087*	1.000		0	50	753	263	**1066**	*1087*	1.019	2%
54	0	133	118	**305**	*305*	1.000		55	0	130	117	**302**	*305*	1.008	1%
398	91	0	193	**683**	*683*	1.000		410	93	0	192	**695**	*683*	0.983	2%
160	60	118	0	**338**	*338*	1.000		165	61	115	0	**341**	*338*	0.993	1%
612	**201**	**1023**	**577**	**2413**				**630**	**204**	**997**	**573**	**2404**			
630	*204*	*997*	*573*					*630*	*204*	*997*	*573*				
1.029	1.015	0.974	0.994					1.000	1.000	1.000	1.000				
3%	1%	3%	1%												

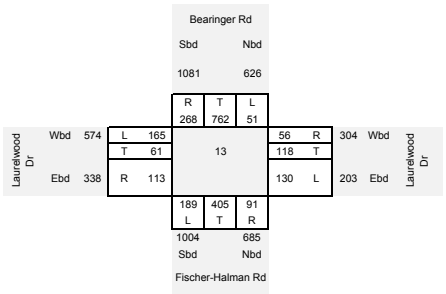
0	51	767	268	**1087**	*1087*	1.000		0	52	756	267	**1075**	*1087*	1.011	1%
56	0	131	118	**305**	*305*	1.000		57	0	129	118	**303**	*305*	1.006	1%
403	91	0	189	**683**	*683*	1.000		408	92	0	188	**687**	*683*	0.994	1%
164	61	114	0	**338**	*338*	1.000		166	61	112	0	**339**	*338*	0.998	0%
622	**203**	**1012**	**576**	**2413**				**630**	**204**	**997**	**573**	**2404**			
630	*204*	*997*	*573*					*630*	*204*	*997*	*573*				
1.012	1.005	0.985	0.995					1.000	1.000	1.000	1.000				
1%	1%	1%	0%												

	North	East	South	West	Total	Target		
North	0	51	762	268	**1081**	*1087*	1.006	1%
East	56	0	130	118	**304**	*305*	1.003	0%
South	405	91	0	189	**685**	*683*	0.997	0%
West	165	61	113	0	**338**	*338*	0.999	0%
Total	**626**	**203**	**1004**	**574**	**2409**			
Target	*630*	*204*	*997*	*573*				
	1.006	1.003	0.993	0.998				
	1%	0%	1%	0%				

Existing PM



Forecasted 2031 PM



Westmount Rd N at Bearinger Rd - PM Peak Hour

Destinations

Origins	North	East	South	West	Total	Target	Factor
North	0	48	433	597	**1078**	*1358*	1.260
East	120	0	84	334	**538**	*543*	1.009
South	294	81	0	3	**378**	*439*	1.161
West	266	177	2	0	**445**	*685*	1.539
Total	**680**	**306**	**519**	**934**	**2439**		
Target	*995*	*320*	*594*	*1116*		*3025*	
	1.463	1.046	1.145	1.195			

0	60	545	752	**1358**	*1358*	1.000		0	45	512	768	**1325**	*1358*	1.025	2%
121	0	85	337	**543**	*543*	1.000		138	0	80	344	**562**	*543*	0.966	4%
341	94	0	3	**439**	*439*	1.000		390	70	0	4	**464**	*439*	0.947	6%
409	272	3	0	**685**	*685*	1.000		467	204	3	0	**674**	*685*	1.016	2%
872	**427**	**633**	**1093**	3025				**995**	**320**	**594**	**1116**	3025			
995	*320*	*594*	*1116*					*995*	*320*	*594*	*1116*				
1.141	0.749	0.938	1.021					1.000	1.000	1.000	1.000				
12%	33%	7%	2%												

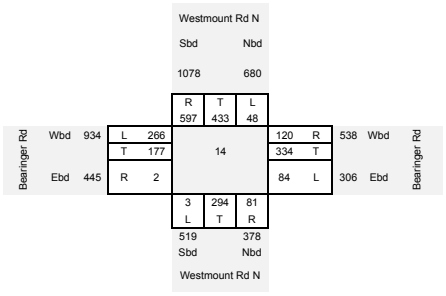
0	46	524	787	**1358**	*1358*	1.000		0	46	516	782	**1344**	*1358*	1.010	1%
134	0	77	333	**543**	*543*	1.000		136	0	76	331	**542**	*543*	1.002	0%
369	67	0	3	**439**	*439*	1.000		376	67	0	3	**446**	*439*	0.985	2%
475	207	3	0	**685**	*685*	1.000		483	207	3	0	**693**	*685*	0.988	1%
977	**321**	**604**	**1123**	3025				**995**	**320**	**594**	**1116**	3025			
995	*320*	*594*	*1116*					*995*	*320*	*594*	*1116*				
1.018	0.998	0.983	0.994					1.000	1.000	1.000	1.000				
2%	0%	2%	1%												

0	47	521	790	**1358**	*1358*	1.000		0	47	516	784	**1348**	*1358*	1.008	1%
136	0	76	331	**543**	*543*	1.000		138	0	75	329	**541**	*543*	1.003	0%
370	66	0	3	**439**	*439*	1.000		374	66	0	3	**444**	*439*	0.989	1%
478	205	3	0	**685**	*685*	1.000		483	206	3	0	**692**	*685*	0.989	1%
984	**317**	**599**	**1125**	3025				**995**	**320**	**594**	**1116**	3025			
995	*320*	*594*	*1116*					*995*	*320*	*594*	*1116*				
1.011	1.009	0.991	0.992					1.000	1.000	1.000	1.000				
1%	1%	1%	1%												

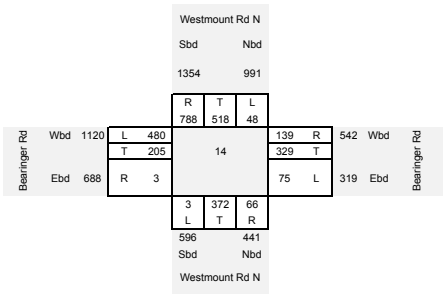
0	48	520	790	**1358**	*1358*	1.000		0	48	517	785	**1350**	*1358*	1.006	1%
138	0	75	330	**543**	*543*	1.000		139	0	75	328	**542**	*543*	1.003	0%
370	66	0	3	**439**	*439*	1.000		373	66	0	3	**443**	*439*	0.992	1%
478	204	3	0	**685**	*685*	1.000		482	206	3	0	**691**	*685*	0.992	1%
986	**317**	**598**	**1123**	3025				**995**	**320**	**594**	**1116**	3025			
995	*320*	*594*	*1116*					*995*	*320*	*594*	*1116*				
1.009	1.008	0.993	0.994					1.000	1.000	1.000	1.000				
1%	1%	1%	1%												

	North	East	South	West	Total	Target		
North	0	48	518	788	**1354**	*1358*	1.003	0%
East	139	0	75	329	**542**	*543*	1.001	0%
South	372	66	0	3	**441**	*439*	0.996	0%
West	480	205	3	0	**688**	*685*	0.996	0%
Total	**991**	**319**	**596**	**1120**	**3025**			
Target	*995*	*320*	*594*	*1116*				
	1.004	1.004	0.996	0.997				
	0%	0%	0%	0%				

Existing PM



Forecasted 2031 PM



Westmount Rd N at Northfield Dr - PM Peak Hour

Origins \ Destinations	North	East	South	West	Total	Target	Factor
North	0	93		254	**347**	*526*	1.516
East	253	0		934	**1187**	*1511*	1.273
South							
West	295	400		0	**695**	*1010*	1.453
Total	**548**	**493**		**1188**	**2229**		
Target	*702*	*876*		*1468*		*3047*	
	1.281	1.777		1.236			

0	141	385	**526**	*526*	1.000	
322	0	1189	**1511**	*1511*	1.000	
429	581	0	**1010**	*1010*	1.000	
751	**722**	**1574**	3047			
702	*876*	*1468*				
0.935	1.213	0.933				
7%	18%	7%				

0	171	359	**530**	*526*	0.992	1%
301	0	1109	**1410**	*1511*	1.072	7%
401	705	0	**1106**	*1010*	0.913	9%
702	**876**	**1468**	3046			
702	*876*	*1468*				
1.000	1.000	1.000				

0	170	356	**526**	*526*	1.000	
323	0	1188	**1511**	*1511*	1.000	
366	644	0	**1010**	*1010*	1.000	
689	**814**	**1545**	3047			
702	*876*	*1468*				
1.019	1.077	0.950				
2%	7%	5%				

0	183	339	**521**	*526*	1.009	1%
329	0	1129	**1458**	*1511*	1.036	3%
373	693	0	**1066**	*1010*	0.947	6%
702	**876**	**1468**	3046			
702	*876*	*1468*				
1.000	1.000	1.000				

0	184	342	**526**	*526*	1.000	
341	0	1170	**1511**	*1511*	1.000	
353	657	0	**1010**	*1010*	1.000	
694	**841**	**1512**	3047			
702	*876*	*1468*				
1.011	1.042	0.971				
1%	4%	3%				

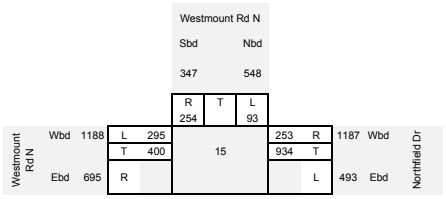
0	192	332	**524**	*526*	1.004	0%
345	0	1136	**1481**	*1511*	1.020	2%
357	684	0	**1041**	*1010*	0.970	3%
702	**876**	**1468**	3046			
702	*876*	*1468*				
1.000	1.000	1.000				

0	193	333	**526**	*526*	1.000	
352	0	1159	**1511**	*1511*	1.000	
347	663	0	**1010**	*1010*	1.000	
698	**856**	**1493**	3047			
702	*876*	*1468*				
1.005	1.023	0.984				
1%	2%	2%				

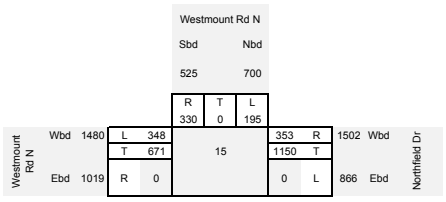
0	197	328	**525**	*526*	1.002	0%
354	0	1140	**1494**	*1511*	1.011	1%
348	679	0	**1027**	*1010*	0.983	2%
702	**876**	**1468**	3046			
702	*876*	*1468*				
1.000	1.000	1.000				

	North	East	South	West	Total	Target		
North	0	195		330	**525**	*526*	1.001	0%
East	353	0		1150	**1502**	*1511*	1.006	1%
South								
West	348	671		0	**1019**	*1010*	0.992	1%
Total	**700**	**866**		**1480**	**3047**			
Target	*702*	*876*		*1468*				
	1.003	1.011		0.992				
	0%	1%		1%				

Existing PM



Forecasted 2031 PM



Wilmot Ln at Conservation Dr - PM Peak Hour

Destinations

Origins	North	East	South	West	Total	Target	Factor
North	0	1	17		**18**	*20*	1.111
East	2	0	62		**64**	*186*	2.906
South	11	18	0		**29**	*76*	2.621
West							
Total	**13**	**19**	**79**		**111**		
Target	*44*	*40*	*164*			*265*	
	3.385	2.105	2.076				

0	1	19	**20**	*20*	1.000	
6	0	180	**186**	*186*	1.000	
29	47	0	**76**	*76*	1.000	
35	**48**	**199**	282			
44	*40*	*164*				
1.270	0.828	0.824				
21%	21%	21%				

0	1	16	**16**	*20*	1.214	18%
7	0	148	**156**	*186*	1.194	16%
37	39	0	**76**	*76*	1.004	0%
44	**40**	**164**	248			
44	*40*	*164*				
1.000	1.000	1.000				

0	1	19	**20**	*20*	1.000	
9	0	177	**186**	*186*	1.000	
37	39	0	**76**	*76*	1.000	
46	**40**	**196**	282			
44	*40*	*164*				
0.965	0.991	0.836				
4%	1%	20%				

0	1	16	**17**	*20*	1.183	15%
9	0	148	**157**	*186*	1.187	16%
35	39	0	**74**	*76*	1.022	2%
44	**40**	**164**	248			
44	*40*	*164*				
1.000	1.000	1.000				

0	1	19	**20**	*20*	1.000	
10	0	176	**186**	*186*	1.000	
36	40	0	**76**	*76*	1.000	
46	**41**	**195**	282			
44	*40*	*164*				
0.949	0.974	0.843				
5%	3%	19%				

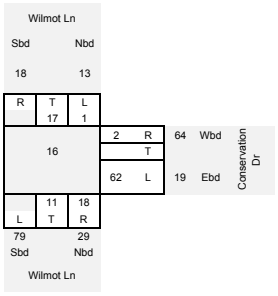
0	1	16	**17**	*20*	1.175	15%
10	0	148	**158**	*186*	1.178	15%
34	39	0	**73**	*76*	1.039	4%
44	**40**	**164**	248			
44	*40*	*164*				
1.000	1.000	1.000				

0	1	19	**20**	*20*	1.000	
11	0	175	**186**	*186*	1.000	
36	40	0	**76**	*76*	1.000	
47	**42**	**193**	282			
44	*40*	*164*				
0.935	0.958	0.849				
7%	4%	18%	####			

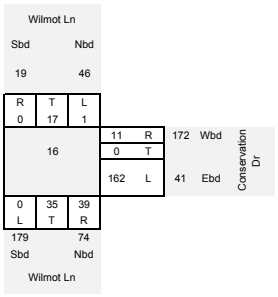
0	1	16	**17**	*20*	1.167	14%
11	0	148	**159**	*186*	1.171	15%
33	39	0	**72**	*76*	1.056	5%
44	**40**	**164**	248			
44	*40*	*164*				
1.000	1.000	1.000				

Origins	North	East	South	West	Total	Target	Factor	
North	0	1	17		**19**	*20*	1.077	7%
East	11	0	162		**172**	*186*	1.079	7%
South	35	39	0		**74**	*76*	1.027	3%
West								
Total	**46**	**41**	**179**		**265**			
Target	*44*	*40*	*164*			*265*		
	0.966	0.979	0.918					
	3%	2%	9%					

Existing PM



Forecasted 2031 PM



Erbsville Rd at Conservation Dr - PM Peak Hour

Destinations

Origins	North	East	South	West	Total	Target	Factor
North	0	29	137	4	**170**	*376*	2.212
East	45	0	146	46	**237**	*240*	1.013
South	137	131	0	6	**274**	*358*	1.307
West	1	18	5	0	**24**	*44*	1.833
Total	**183**	**178**	**288**	**56**	**705**		
Target	*270*	*198*	*357*	*180*		*1012*	
	1.475	1.112	1.240	3.214			

0	64	303	9	**376**	*376*	1.000		0	47	235	25	**308**	*376*	1.222	18%
46	0	148	47	**240**	*240*	1.000		54	0	115	133	**302**	*240*	0.796	26%
179	171	0	8	**358**	*358*	1.000		213	126	0	22	**362**	*358*	0.989	1%
2	33	9	0	**44**	*44*	1.000		2	24	7	0	**34**	*44*	1.307	24%
226	**268**	**460**	**63**	**1018**				**270**	**198**	**357**	**180**	**1005**			
270	*198*	*357*	*180*					*270*	*198*	*357*	*180*				
1.193	0.738	0.776	2.845					1.000	1.000	1.000	1.000				
16%	36%	29%	65%												

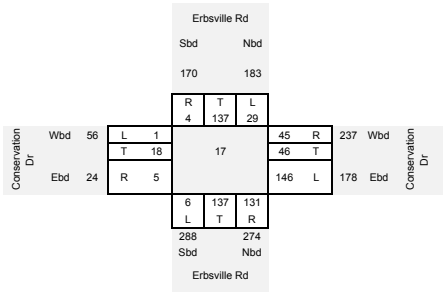
0	58	287	31	**376**	*376*	1.000		0	53	264	35	**353**	*376*	1.066	6%
43	0	91	105	**240**	*240*	1.000		45	0	84	120	**249**	*240*	0.963	4%
211	125	0	22	**358**	*358*	1.000		222	115	0	25	**362**	*358*	0.989	1%
3	32	9	0	**44**	*44*	1.000		3	29	9	0	**41**	*44*	1.075	7%
257	**215**	**388**	**158**	**1018**				**270**	**198**	**357**	**180**	**1005**			
270	*198*	*357*	*180*					*270*	*198*	*357*	*180*				
1.050	0.923	0.920	1.137					1.000	1.000	1.000	1.000				
5%	8%	9%	12%												

0	57	282	37	**376**	*376*	1.000		0	56	271	38	**364**	*376*	1.033	3%
44	0	81	115	**240**	*240*	1.000		44	0	78	117	**239**	*240*	1.004	0%
219	114	0	25	**358**	*358*	1.000		222	111	0	25	**359**	*358*	0.997	0%
3	32	9	0	**44**	*44*	1.000		3	31	9	0	**43**	*44*	1.024	2%
266	**202**	**372**	**178**	**1018**				**270**	**198**	**357**	**180**	**1005**			
270	*198*	*357*	*180*					*270*	*198*	*357*	*180*				
1.015	0.978	0.960	1.014					1.000	1.000	1.000	1.000				
1%	2%	4%	1%												

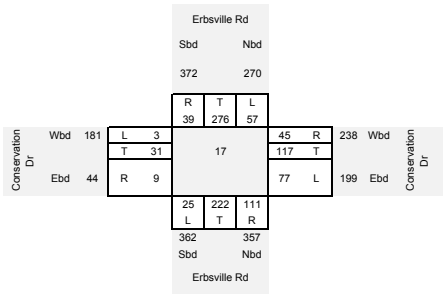
0	57	279	39	**376**	*376*	1.000		0	57	272	39	**368**	*376*	1.022	2%
45	0	78	118	**240**	*240*	1.000		45	0	76	116	**237**	*240*	1.013	1%
222	111	0	25	**358**	*358*	1.000		222	110	0	25	**357**	*358*	1.003	0%
3	32	9	0	**44**	*44*	1.000		3	31	9	0	**43**	*44*	1.013	1%
270	**200**	**366**	**182**	**1018**				**270**	**198**	**357**	**180**	**1005**			
270	*198*	*357*	*180*					*270*	*198*	*357*	*180*				
1.001	0.989	0.974	0.991					1.000	1.000	1.000	1.000				
0%	1%	3%	1%												

	North	East	South	West	Total	Target		
North	0	57	276	39	**372**	*376*	1.011	1%
East	45	0	77	117	**238**	*240*	1.006	1%
South	222	111	0	25	**357**	*358*	1.002	0%
West	3	31	9	0	**44**	*44*	1.007	1%
Total	**270**	**199**	**362**	**181**	**1012**			
Target	*270*	*198*	*357*	*180*				
	1.001	0.994	0.987	0.995				
	0%	1%	1%	0%				

Existing PM



Forecasted 2031 PM



Beaver Creek Dr at Conservation Dr - PM Peak Hour

Origins \ Destinations	North	East	South	West	Total	Target	Factor
North							
East		0	104	133	**237**	*389*	1.641
South		60	0	13	**73**	*185*	2.534
West		114	17	0	**131**	*210*	1.603
Total		**174**	**121**	**146**	**441**		
Target		*293*	*224*	*267*		*784*	
		1.684	1.851	1.829			

	0	171	218	**389**	*389*	1.000		0	193	232	**425**	*389*	0.915	9%
	152	0	33	**185**	*185*	1.000		133	0	35	**168**	*185*	1.101	9%
	183	27	0	**210**	*210*	1.000		160	31	0	**191**	*210*	1.101	9%
	335	**198**	**251**	**784**				**293**	**224**	**267**	**784**			
	293	*224*	*267*					*293*	*224*	*267*				
	0.875	1.132	1.063					1.000	1.000	1.000				
	14%	12%	6%											

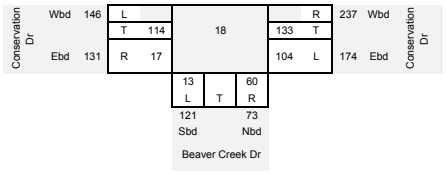
	0	177	212	**389**	*389*	1.000		0	188	226	**414**	*389*	0.940	6%
	146	0	39	**185**	*185*	1.000		133	0	41	**174**	*185*	1.063	6%
	176	34	0	**210**	*210*	1.000		160	36	0	**196**	*210*	1.071	7%
	323	**211**	**251**	**784**				**293**	**224**	**267**	**784**			
	293	*224*	*267*					*293*	*224*	*267*				
	0.908	1.063	1.065					1.000	1.000	1.000				
	10%	6%	6%											

	0	177	212	**389**	*389*	1.000		0	184	222	**405**	*389*	0.960	4%
	141	0	44	**185**	*185*	1.000		132	0	45	**178**	*185*	1.040	4%
	171	39	0	**210**	*210*	1.000		161	40	0	**201**	*210*	1.046	4%
	313	**215**	**256**	**784**				**293**	**224**	**267**	**784**			
	293	*224*	*267*					*293*	*224*	*267*				
	0.937	1.041	1.043					1.000	1.000	1.000				
	7%	4%	4%											

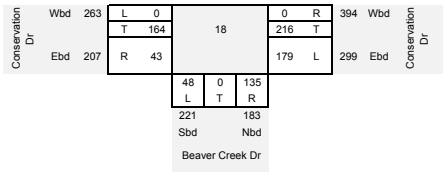
	0	176	213	**389**	*389*	1.000		0	181	218	**399**	*389*	0.974	3%
	138	0	47	**185**	*185*	1.000		132	0	49	**181**	*185*	1.024	2%
	168	42	0	**210**	*210*	1.000		161	43	0	**204**	*210*	1.029	3%
	306	**218**	**260**	**784**				**293**	**224**	**267**	**784**			
	293	*224*	*267*					*293*	*224*	*267*				
	0.959	1.025	1.027					1.000	1.000	1.000				
	4%	2%	3%											

	North	East	South	West	Total	Target		
North								
East		0	179	216	**394**	*389*	0.987	1%
South		135	0	48	**183**	*185*	1.012	1%
West		164	43	0	**207**	*210*	1.014	1%
Total		**299**	**221**	**263**	**784**			
Target		*293*	*224*	*267*				
		0.979	1.013	1.013				
		2%	1%	1%				

Existing PM



Forecasted 2031 PM



Westmount Rd N at Conservation Dr - PM Peak Hour

Origins \ Destinations	North	East	South	West	Total	Target	Factor
North	0	10	203	122	**335**	*372*	1.110
East	3	0	12	25	**40**	*139*	3.475
South	207	21	0	299	**527**	*661*	1.254
West	58	16	94	0	**168**	*315*	1.875
Total	**268**	**47**	**309**	**446**	**1070**		
Target	*539*	*50*	*478*	*468*		*1511*	
	2.011	1.064	1.547	1.049			

	0	11	225	135	**372**	*372*	1.000		0	8	243	106	**357**	*372*	1.041	4%
	10	0	42	87	**139**	*139*	1.000		15	0	45	68	**128**	*139*	1.087	8%
	260	26	0	375	**661**	*661*	1.000		369	20	0	294	**683**	*661*	0.968	3%
	109	30	176	0	**315**	*315*	1.000		155	22	190	0	**367**	*315*	0.858	17%
	379	**67**	**443**	**597**	**1487**				**539**	**50**	**478**	**468**	**1535**			
	539	*50*	*478*	*468*					*539*	*50*	*478*	*468*				
	1.423	0.741	1.078	0.783					1.000	1.000	1.000	1.000				
	30%	35%	7%	28%												

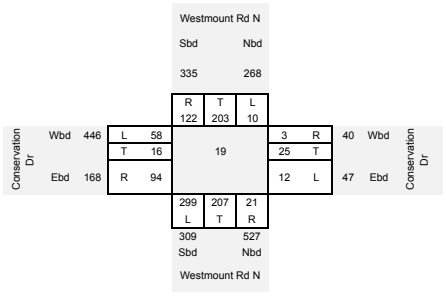
0	9	253	110	**372**	*372*	1.000		0	9	260	110	**380**	*372*	0.980	2%
16	0	49	74	**139**	*139*	1.000		17	0	50	74	**141**	*139*	0.984	2%
358	19	0	284	**661**	*661*	1.000		381	20	0	284	**685**	*661*	0.965	4%
133	19	163	0	**315**	*315*	1.000		141	20	168	0	**329**	*315*	0.956	5%
507	**47**	**465**	**469**	**1487**				**539**	**50**	**478**	**468**	**1535**			
539	*50*	*478*	*468*					*539*	*50*	*478*	*468*				
1.064	1.074	1.028	0.998					1.000	1.000	1.000	1.000				
6%	7%	3%	0%												

0	9	255	108	**372**	*372*	1.000		0	9	262	111	**383**	*372*	0.972	3%
17	0	49	73	**139**	*139*	1.000		18	0	51	75	**143**	*139*	0.971	3%
367	20	0	274	**661**	*661*	1.000		381	20	0	282	**684**	*661*	0.967	3%
135	20	160	0	**315**	*315*	1.000		140	20	165	0	**325**	*315*	0.968	3%
519	**48**	**465**	**455**	**1487**				**539**	**50**	**478**	**468**	**1535**			
539	*50*	*478*	*468*					*539*	*50*	*478*	*468*				
1.038	1.037	1.029	1.029					1.000	1.000	1.000	1.000				
4%	4%	3%	3%												

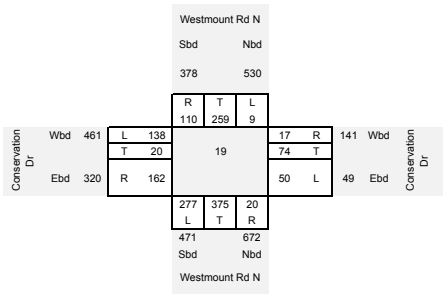
0	9	255	108	**372**	*372*	1.000		0	9	263	112	**384**	*372*	0.970	3%
17	0	49	73	**139**	*139*	1.000		18	0	51	75	**143**	*139*	0.969	3%
369	20	0	273	**661**	*661*	1.000		381	20	0	281	**683**	*661*	0.968	3%
136	20	160	0	**315**	*315*	1.000		140	20	164	0	**325**	*315*	0.969	3%
521	**48**	**464**	**453**	**1487**				**539**	**50**	**478**	**468**	**1535**			
539	*50*	*478*	*468*					*539*	*50*	*478*	*468*				
1.034	1.033	1.031	1.032					1.000	1.000	1.000	1.000				
3%	3%	3%	3%												

	North	East	South	West	Total	Target		
North	0	9	259	110	**378**	*372*	0.985	2%
East	17	0	50	74	**141**	*139*	0.984	2%
South	375	20	0	277	**672**	*661*	0.984	2%
West	138	20	162	0	**320**	*315*	0.984	2%
Total	**530**	**49**	**471**	**461**	**1511**			
Target	*539*	*50*	*478*	*468*				
	1.017	1.016	1.015	1.016				
	2%	2%	1%	2%				

Existing PM



Forecasted 2031 PM



Columbia Street West at Platinum Drive- PM Peak Hour

Origins \ Destinations	North	East	South	West	Total	Target	Factor
North		0	1	119	**120**	*423*	3.525
East		1	0	1	**2**	*585*	292.5
South		143	1	0	**144**	*346*	2.403
Total		**144**	**2**	**120**	**266**		
Target		*779*	*81*	*493*		*1354*	
		5.410	40.500	4.108			

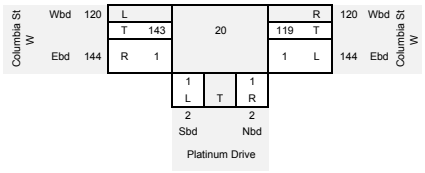
	0	4	419	**423**	*423*	1.000		0	0	48	290	**339**	*423*	1.249	20%
	293	0	293	**585**	*585*	1.000		0	358	0	203	**561**	*585*	1.043	4%
	344	2	0	**346**	*346*	1.000		0	421	33	0	**454**	*346*	0.763	31%
	636	**6**	**712**	**1354**				**0**	**779**	**81**	**493**	**1353**			
	779	*81*	*493*					*0*	*779*	*81*	*493*				
	1.225	13.664	0.692					#DIV/0!	1.000	1.000	1.000				
	18%	93%	44%												

	0	60	363	**423**	*423*	1.000		0	0	57	312	**369**	*423*	1.147	13%
	374	0	211	**585**	*585*	1.000		0	419	0	181	**601**	*585*	0.974	3%
	321	25	0	**346**	*346*	1.000		0	360	24	0	**384**	*346*	0.902	11%
	695	**85**	**574**	**1354**				**0**	**779**	**81**	**493**	**1353**			
	779	*81*	*493*					*0*	*779*	*81*	*493*				
	1.121	0.951	0.859					#DIV/0!	1.000	1.000	1.000				
	11%	5%	16%												

	0	66	357	**423**	*423*	1.000		0	0	61	330	**391**	*423*	1.082	8%
	408	0	177	**585**	*585*	1.000		0	434	0	163	**597**	*585*	0.980	2%
	325	21	0	**346**	*346*	1.000		0	345	20	0	**365**	*346*	0.948	5%
	733	**87**	**534**	**1354**				**0**	**779**	**81**	**493**	**1353**			
	779	*81*	*493*					*0*	*779*	*81*	*493*				
	1.063	0.930	0.923					#DIV/0!	1.000	1.000	1.000				
	6%	7%	8%												

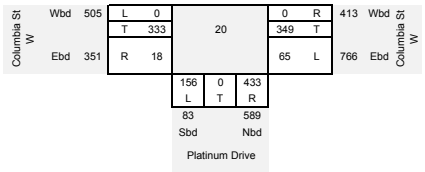
	0	66	357	**423**	*423*	1.000		0	0	63	341	**403**	*423*	1.048	5%
	425	0	160	**585**	*585*	1.000		0	440	0	152	**593**	*585*	0.987	1%
	327	19	0	**346**	*346*	1.000		0	339	18	0	**357**	*346*	0.970	3%
	752	**85**	**517**	**1354**				**0**	**779**	**81**	**493**	**1353**			
	779	*81*	*493*					*0*	*779*	*81*	*493*				
	1.036	0.953	0.954					#DIV/0!	1.000	1.000	1.000				
	3%	5%	5%												

Existing PM



	North	East	South	West	Total	Target	Factor	
North								
East		0	65	349	**413**	*423*	1.024	2%
South		433	0	156	**589**	*585*	0.993	1%
West		333	18	0	**351**	*346*	0.985	2%
Total		**766**	**83**	**505**	**1354**			
Target		*779*	*81*	*493*				
		1.017	0.976	0.976				
		2%	2%	2%				

Forecasted 2031 PM



Erb Street at The Boardwalk - AM Peak Hour

Destinations

Origins	North	East	South	West	Total	Target	Factor
North							
East		0	1	1016	**1017**	*1340*	1.318
South		1	0	1	**2**	*18*	9.000
West		306	1	0	**307**	*1020*	3.322
Total		**307**	**2**	**1017**	**1326**		
Target		*1550*	*10*	*872*		*2405*	
		5.049	5.000	0.857			

	0	1	1339	**1340**	*1340*	1.000	
	9	0	9	**18**	*18*	1.000	
	1017	3	0	**1020**	*1020*	1.000	
	1026	**5**	**1348**	2378			
	1550	*10*	*872*				
	1.511	2.155	0.647				
	34%	54%	55%				

	0	3	866	**869**	*1340*	1.542	35%
	14	0	6	**19**	*18*	0.927	8%
	1536	7	0	**1544**	*1020*	0.661	51%
	1550	**10**	**872**	2432			
	1550	*10*	*872*				
	1.000	1.000	1.000				

	0	4	1336	**1340**	*1340*	1.000	
	13	0	5	**18**	*18*	1.000	
	1015	5	0	**1020**	*1020*	1.000	
	1028	**9**	**1341**	2378			
	1550	*10*	*872*				
	1.508	1.098	0.650				
	34%	9%	54%				

	0	5	868	**873**	*1340*	1.534	35%
	19	0	4	**23**	*18*	0.799	25%
	1531	5	0	**1536**	*1020*	0.664	51%
	1550	**10**	**872**	2432			
	1550	*10*	*872*				
	1.000	1.000	1.000				

	0	7	1333	**1340**	*1340*	1.000	
	15	0	3	**18**	*18*	1.000	
	1017	3	0	**1020**	*1020*	1.000	
	1032	**11**	**1335**	2378			
	1550	*10*	*872*				
	1.502	0.924	0.653				
	33%	8%	53%				

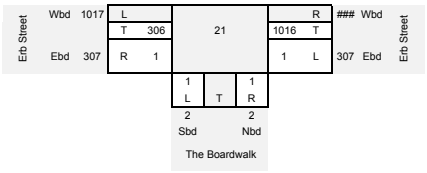
	0	7	870	**877**	*1340*	1.528	35%
	23	0	2	**25**	*18*	0.730	37%
	1527	3	0	**1530**	*1020*	0.667	50%
	1550	**10**	**872**	2432			
	1550	*10*	*872*				
	1.000	1.000	1.000				

	0	10	1330	**1340**	*1340*	1.000	
	17	0	1	**18**	*18*	1.000	
	1018	2	0	**1020**	*1020*	1.000	
	1035	**13**	**1331**	2378			
	1550	*10*	*872*				
	1.498	0.798	0.655				
	33%	25%	53%				

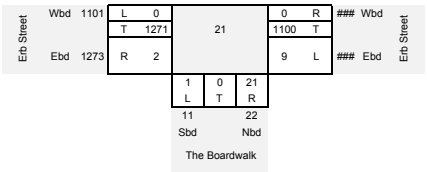
	0	8	871	**879**	*1340*	1.524	34%
	25	0	1	**26**	*18*	0.697	44%
	1525	2	0	**1527**	*1020*	0.668	50%
	1550	**10**	**872**	2432			
	1550	*10*	*872*				
	1.000	1.000	1.000				

Origins	North	East	South	West	Total	Target		
North								
East		0	9	1100	**1110**	*1340*	1.208	17%
South		21	0	1	**22**	*18*	0.821	22%
West		1271	2	0	**1273**	*1020*	0.801	25%
Total		**1292**	**11**	**1101**	**2405**			
Target		*1550*	*10*	*872*				
		1.199	0.888	0.792				
		17%	13%	26%				

Existing PM



Forecasted 2031 PM



APPENDIX

H PIC NO. 1

APPENDIX

H-1 PIC NO.1 NOTICE



THE CITY OF Waterloo

NOTICES

NOTICE OF PUBLIC INFORMATION CENTRE (PIC) #1

INTEGRATED MULTI-MODAL TRANSPORTATION STUDY, WATERLOO WEST SIDE

THE STUDY

The City of Waterloo has initiated an Integrated Multi-Modal Transportation Study (IMMTS) for the Waterloo West Side. The purpose of the IMMTS is to evaluate the implications of increased development and growth on the west side of Waterloo and provide recommendations on:

- transportation network and operational improvements to accommodate growth
- opportunities to expand, connect, and integrate active transportation and transit in the study area

The study will evaluate existing traffic relative to the current transportation network, evaluate active transportation and transit within the study area, forecast future traffic, and provide recommendations for improving all modes of travel.

PUBLIC INFORMATION CENTRE - WE WANT TO HEAR FROM YOU:

Public participation will form an integral part of this study to ensure that the ongoing concerns of the public and affected groups within the study area are identified, documented and assessed. The project team invites public input and comments, and will incorporate them into the project documentation. A Public Information Centre (PIC) will be held to present the existing conditions and receive public input at the following time and location:

DATE: **Tuesday, April 4, 2017**

TIME: **5:00 p.m. – 7:30 p.m.** (drop-in open house format)

LOCATION: **Kitchener-Waterloo Bilingual School**
600 Erb Street West, Waterloo, Ontario N2J 3Z4

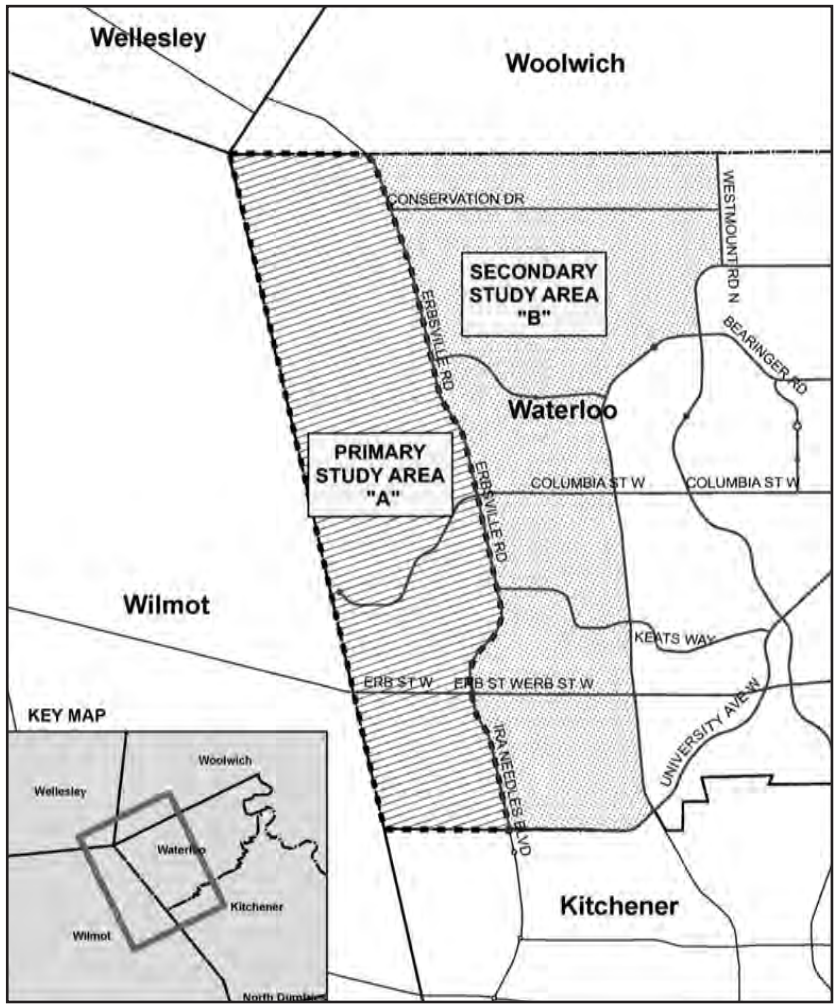
If you are unable to attend the public meeting, and would like to provide comment, there is an opportunity at any time during this process for interested persons to review outstanding issues and bring concerns to the attention of the Project Managers below:

Philip Hewitson, P.Eng.
Manager, Active Transportation & LRT Integration
City of Waterloo
Engineering Services
Integrated Planning & Public Works
Phone: 519-747-8660
Email: philip.hewitson@waterloo.ca

Mehemed Delibasic, M.Sc., P.Eng.
Project Manager - Consultant
WSP Canada Inc.
Phone: 905-882-1100 ext. 6967
Email: Mehemed.Delibasic@wspgroup.com

Please contact the City's Project Manager regarding disability accommodation requirements for the PIC by March 27, 2017.

Information will be collected in accordance with the Freedom of Information and Protection of Privacy Act. With the exception of personal information, all comments will become part of the public record.



APPENDIX

H-2 PIC NO.1 BOARDS

INTEGRATED MULTI-MODAL TRANSPORTATION STUDY, WATERLOO WEST SIDE

CITY OF WATERLOO

PUBLIC INFORMATION CENTRE (PIC) #1

THE CITY OF Waterloo

April 4, 2017

WSP

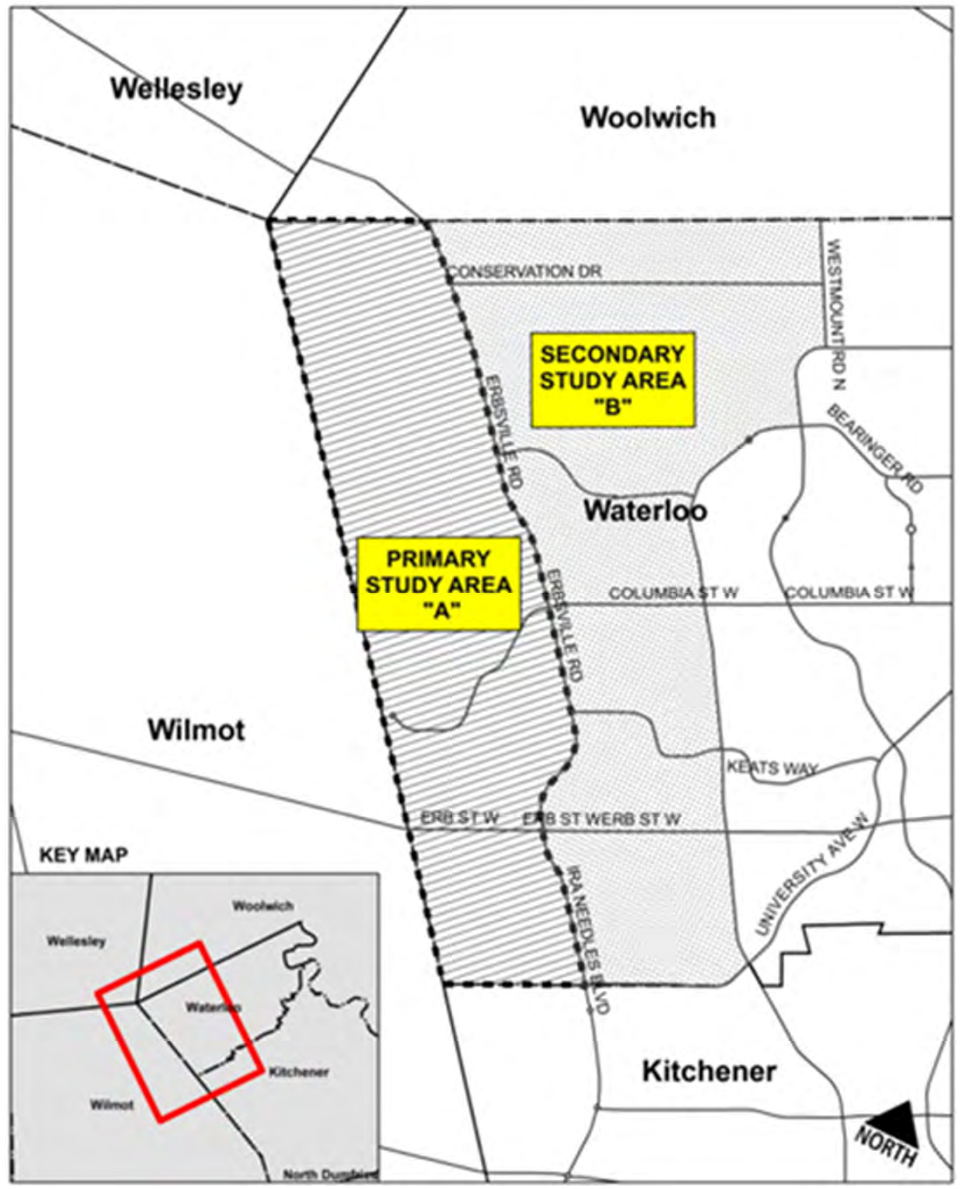
PURPOSE OF PIC #1

- To review existing conditions and obtain public input and comments on the Integrated Multi-Modal Transportation Study.
    - City of Waterloo and WSP (consultants) staff are available to discuss the project with you.
- We would like to hear your comments:

Please complete a comment sheet before leaving.

STUDY OVERVIEW

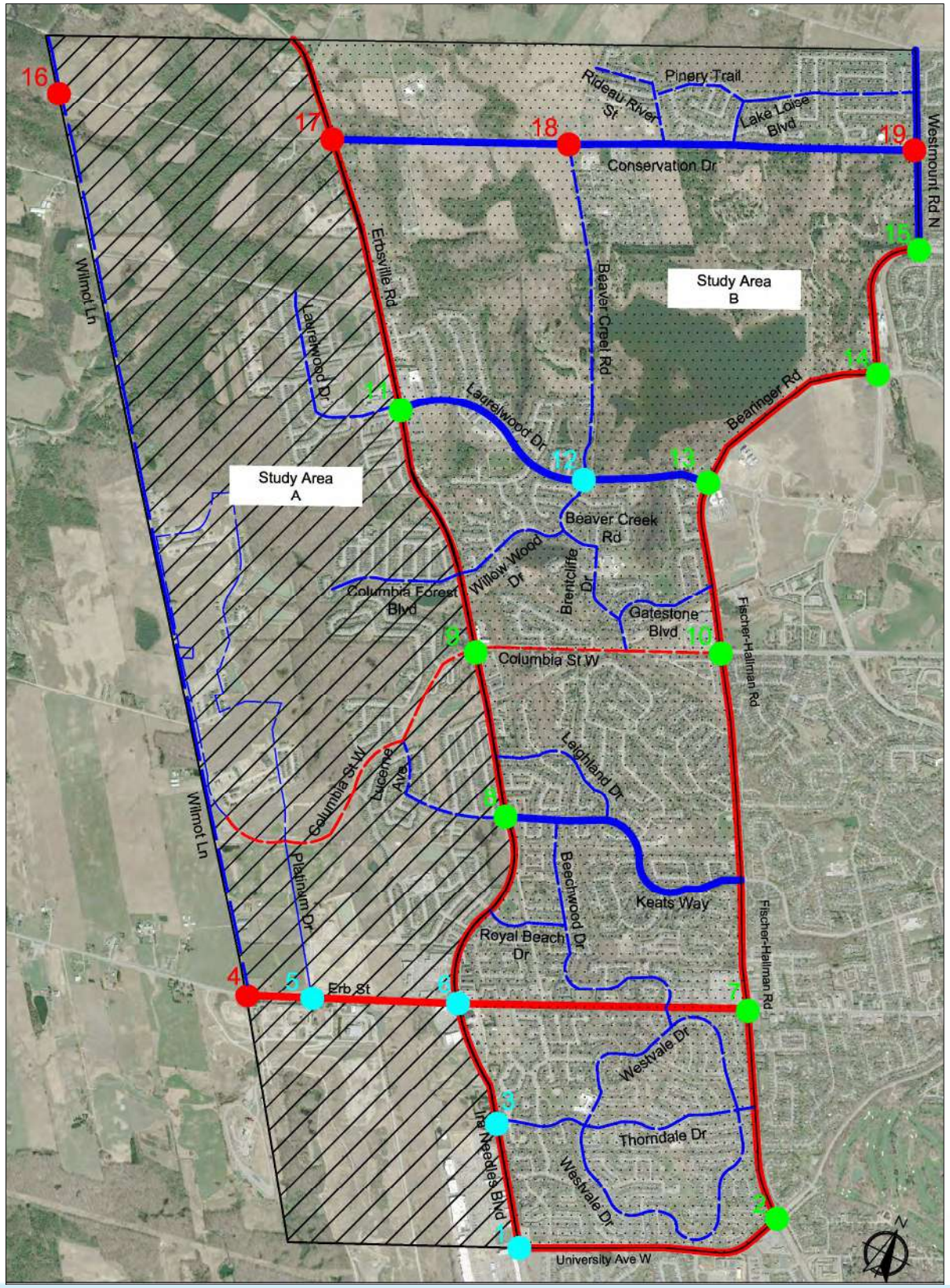
- The City of Waterloo has initiated an Integrated Multi-Modal Transportation Study (IMMTS) for the Waterloo West Side. The purpose of the IMMTS is to evaluate the implications of increased development in west Waterloo on the transportation system, and provide recommendations on:
  - transportation network and operational improvements to respond to growth
  - how to expand, connect, and integrate active transportation and transit in the study area



STUDY STEPS

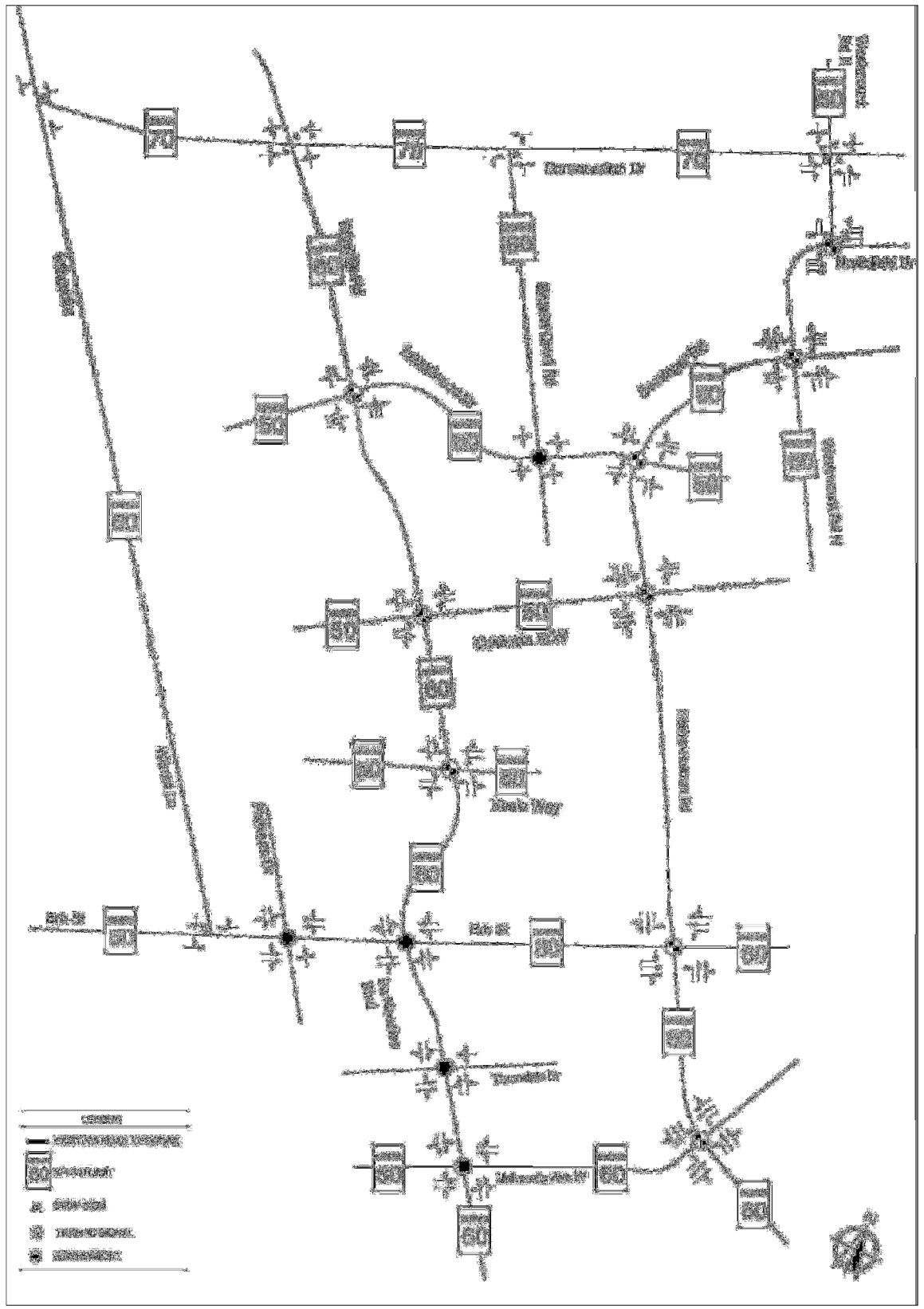

Project Initiation Meeting
Region and City Consultation
Existing Conditions Analysis
Describe Planned Roadway Improvements
We are here:
Public Information Centre #1
There is an opportunity at Public Information Centres (PIC) to provide input.
Forecast and Analyze Future Conditions
Recommend and Evaluate Improvements
Public Information Centre #2
Draft Report and Council Presentation
Final Report

EXISTING ROADWAY CHARACTERISTICS

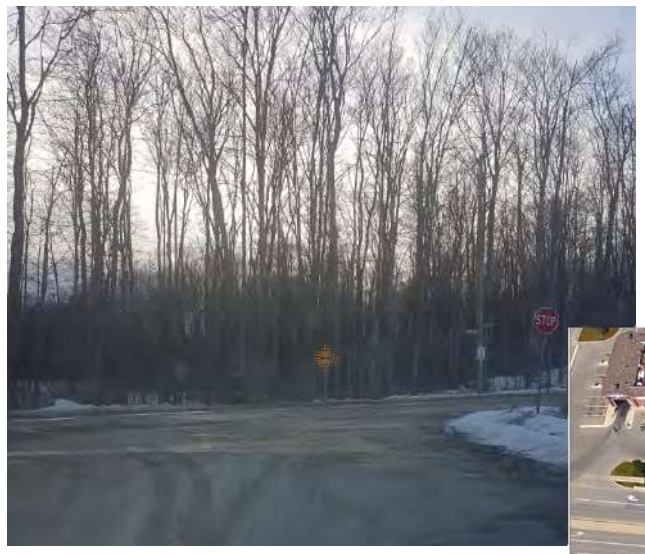


- Type of intersection control:
  - 5 unsignalized intersections
  - 5 roundabouts
  - 9 signalized intersections
- Jurisdiction of intersections:
  - 4 intersections - City of Waterloo
  - 15 intersections - Region of Waterloo

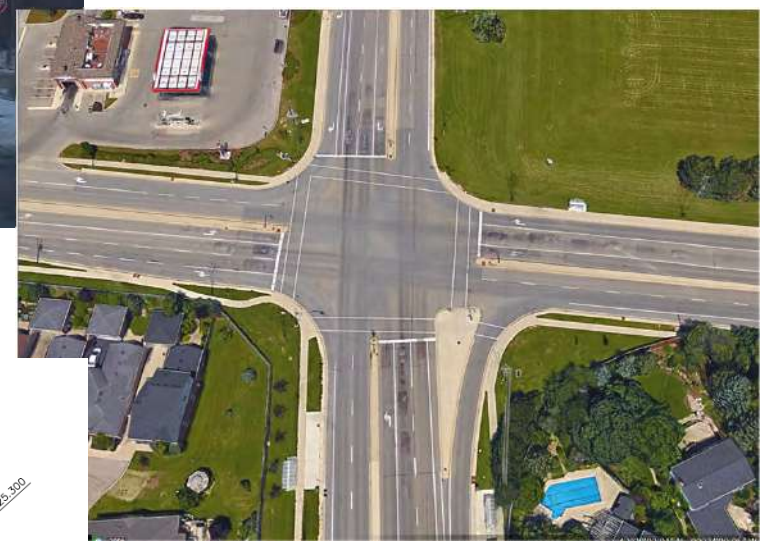
EXISTING LANE CONFIGURATIONS



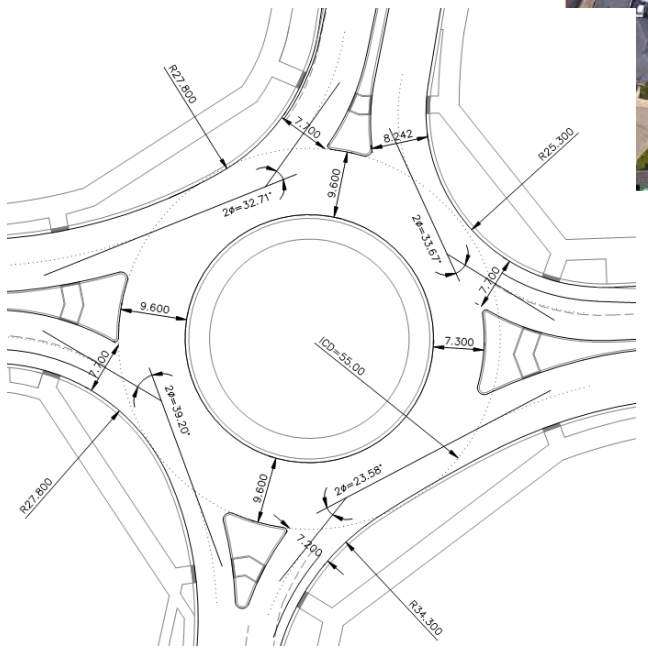
- Various configurations and type of control:



Conservation Dr looking westbound at Wilmot Ln

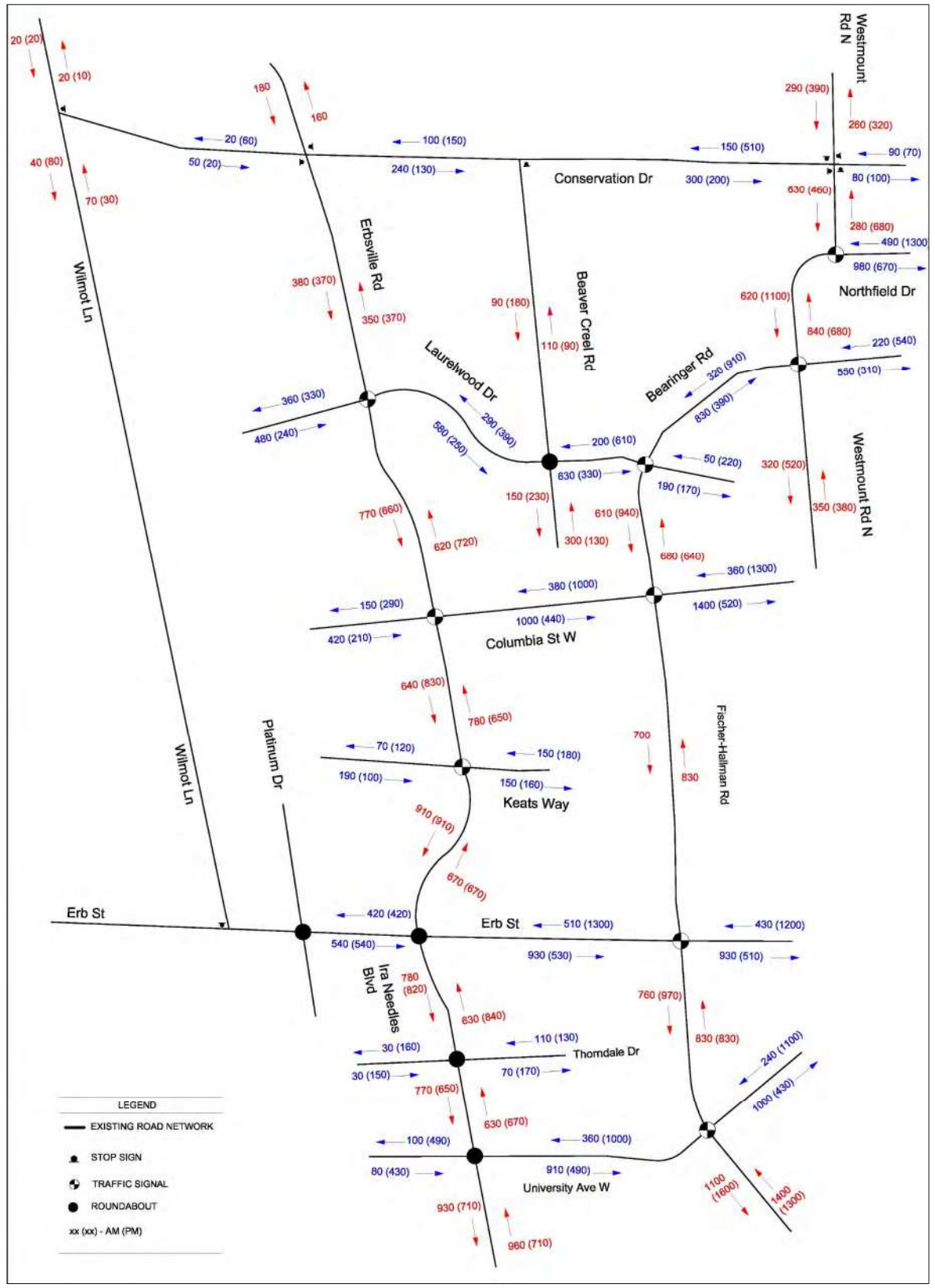


Columbia St W at Fischer Hallman Rd



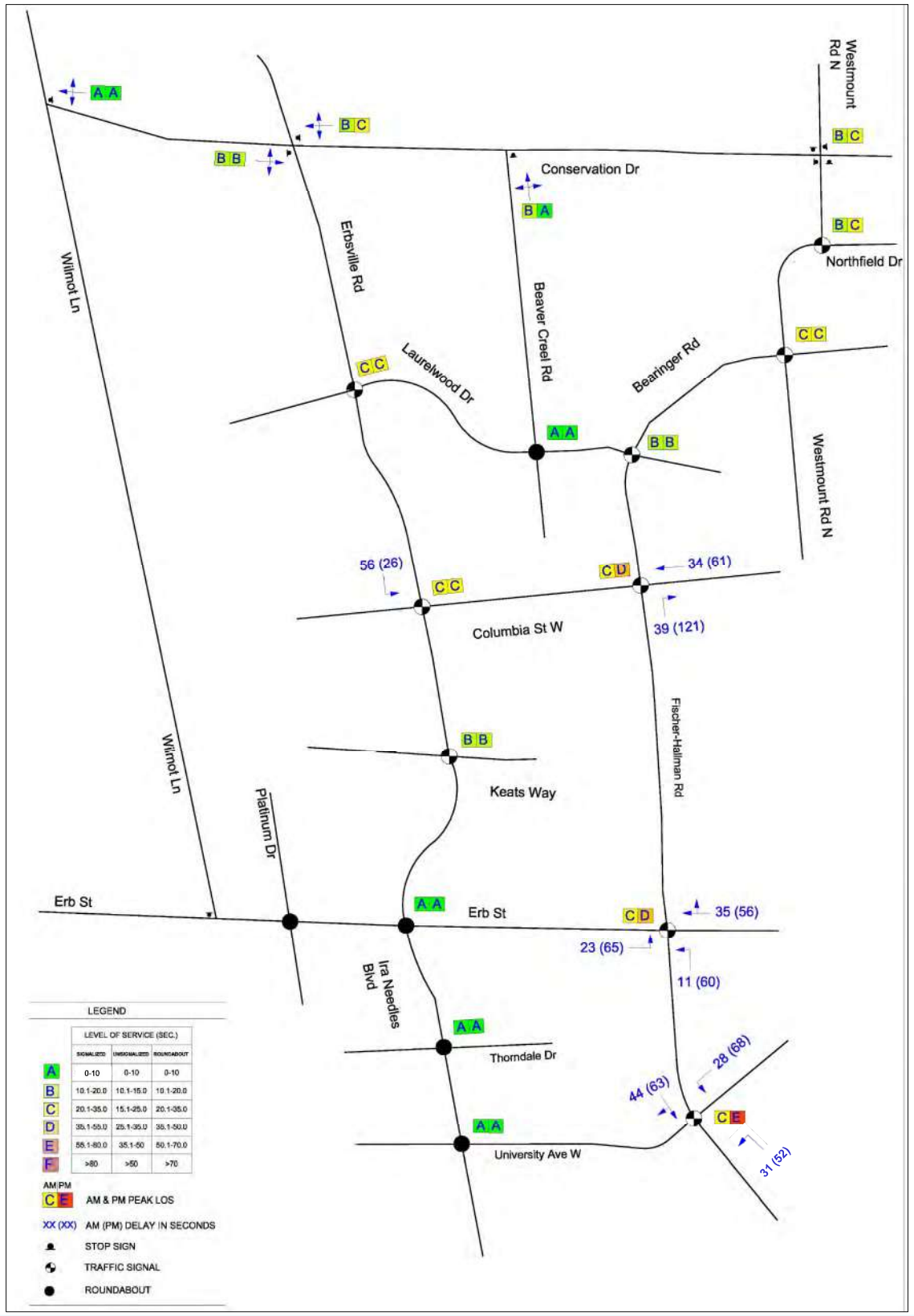
Erb St at Ira Needles Blvd

EXISTING TRAFFIC VOLUMES



- Existing Turning Movement Counts (TMC) were provided by the Region and City for the study intersections
- The TMC are provided for the peak hours
- The TMC data is from 2011 to 2016
- No TMC for Erb St at Platinum Dr
- The Region and City are updating TMC at 8 intersections – analysis results will be presented at PIC#2

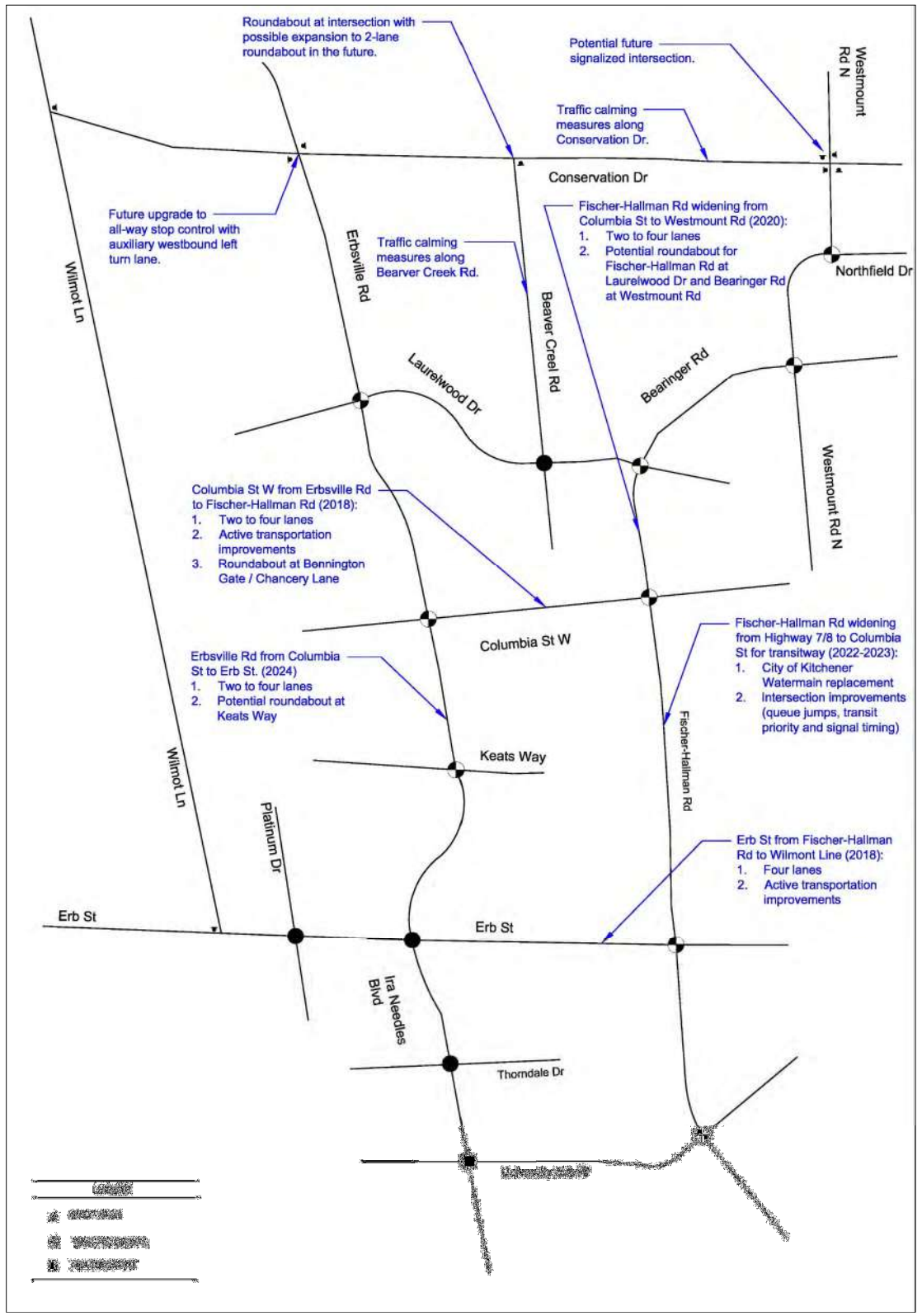
EXISTING INTERSECTION OPERATIONS



- All intersections operate at acceptable levels
- There are some movements that experience longer delays (LOS E or F)
- Potential existing conditions improvements will be investigated with new counts and presented at PIC 2

Level of Service	Description
A	Little or no delay.
B	Short traffic delay.
C	Average traffic delay.
D	Long traffic delay.
E	Very long traffic delay.
F	Extreme delay encountered with queuing, which may cause severe congestion affecting other traffic movements in the intersection.

PLANNED CITY/REGION ROADWAY IMPROVEMENTS



- A number of roadway improvements are planned in the study area.
- The identified roadway improvements are based on the following sources:
  - 2016-2015 Draft Capital Projects
  - Completed and ongoing EA's
  - Stantec Consulting prepared a Transportation Overview Study, November 2015 for Beaver Creek Road and Conservation Drive Upgrades and Extension Municipal Class EA

ACTIVE TRANSPORTATION VISION

The vision for Active Transportation (AT) comes from two core policy plans

- **City of Waterloo Transportation Master Plan (2011)**
  - "Balance of social, cultural, environmental and economic successes through the implementation of a balanced transportation network."
  - Recognizes that automobiles are part of the existing and future system
  - A multi-modal system of walking, cycling and transit will provide the needed transportation balance
  - **"Complete Streets"** - roads are designed to safely accommodate cars, bicyclists, pedestrians, wheelchairs and transit users

- **Walk Cycle Waterloo Region: Region of Waterloo Active Transportation Master Plan (2014)**
  - Increase mode share of walking and cycling trips from 7.8% (2014) to 12% by 2031
  - Increase the number of kilometres of walking and cycling facilities on Regional roads
  - Create an integrated network of City and Regional active transportation facilities

ACTIVE TRANSPORTATION (AT)

How is AT being addressed in the IMMTS?

- Review the current status of the active transportation network in Study Areas A and B (refer to map display); desktop and field investigations
- Identify key gaps in the network where new AT facilities should be added
- Identify locations for improvements to the existing AT network
- Provide AT connections
  - to important community destinations and schools
  - across barriers to active transportation such as major roads, railway lines, creeks
  - Connect the AT system to transit stops













Typical Types of Active Transportation Facilities Found in Study Areas A and B

1. Walkway, Brentcliffe Drive at Beaver Creek Road
2. Multi-use Trail near Mary Johnston Public School, Keats Way
3. Boulevard Multi-use Trail, Fischer Hallman Road north of Keats Way
4. Signed Cycling Route, Wideman Road west of Erbsville Road
5. Paved Shoulder, Erbsville Road, north of Keats Way
6. Bike Lane, Laurelwood Drive east of Erbsville Road

EXISTING ACTIVE TRANSPORTATION NETWORK



Existing On-Road Cycling Facilities	
Type	**Length (km)**
Bike Lane	23.5
Paved Shoulder	5.6
Signed Route	1.6
Existing Trails / Walkways	
Type	**Length (km)**
Community Trail	40.6
In-Boulevard Multi-Use Trail	7.9
Walkway	7.1
Sidewalk	160.9

Note: Lengths provided are based on existing data provided by the City of Waterloo and Region of Waterloo. Select field investigations are required.

LEGEND

Destinations
- Points of Interest
- Schools
- Bicycle Parking

Existing On-Road Cycling Facilities
- Bike Lane
- Paved Shoulder
- Signed Route

Existing Trails / Walkways
- Community Trail
- In-Boulevard Multi-Use Trail Route
- Walkway
- Sidewalk

Other
- Roads
- Creeks
- City Parks
- Study Area A
- Study Area B

GRT FAST FACTS

GRAND RIVER TRANSIT

SYSTEM

Grand River Transit connects the three cities of Kitchener, Waterloo and Cambridge



FLEET

250+ Fully Accessible Buses

12 Hybrid Buses

35 MobilityPLUS Buses

ROUTES

59 Regular Routes

5 iXpress Routes



Top routes include #7, #8 & #12

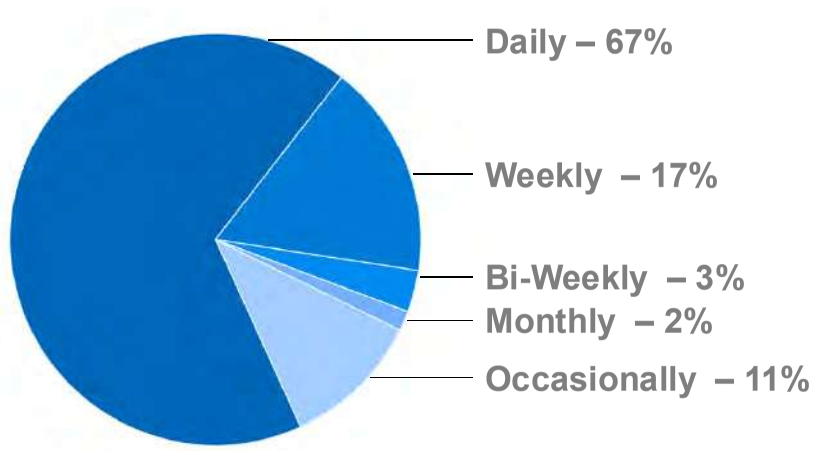
TEAM

500+



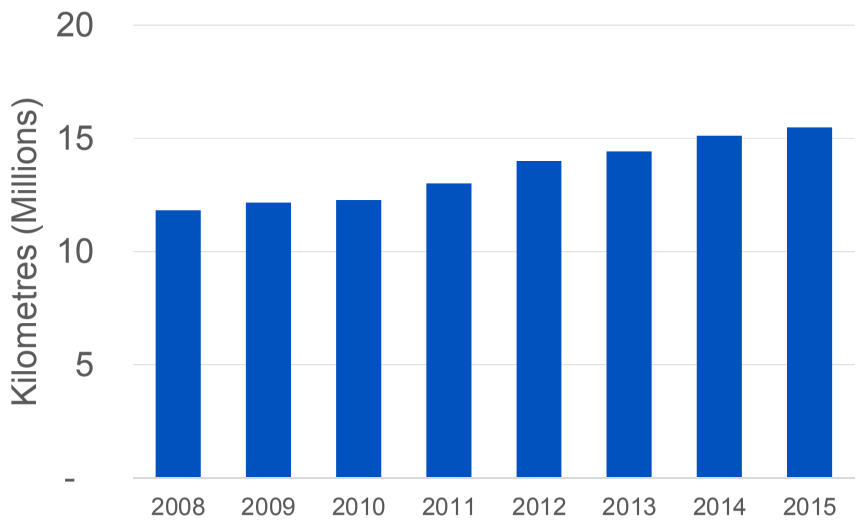
Over 500 employees working in various areas to keep the service running each day.

67% Use transit daily

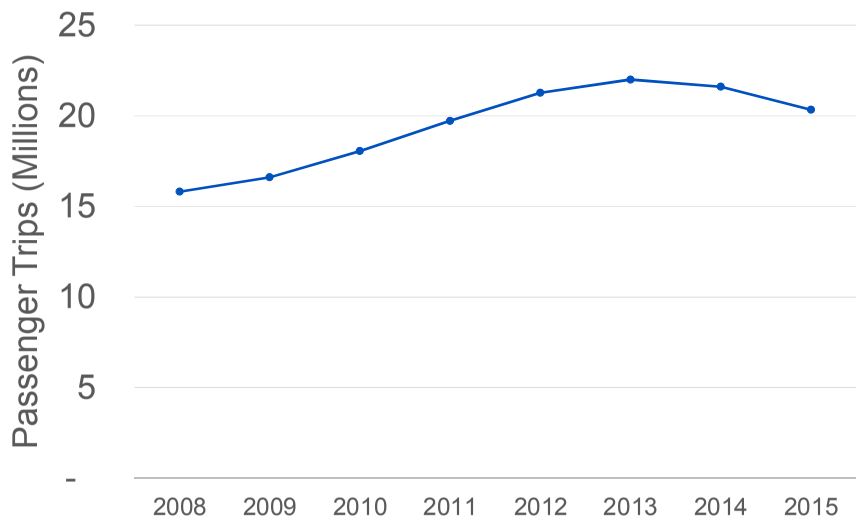


Source: 2014/2015 Customer Satisfaction Survey

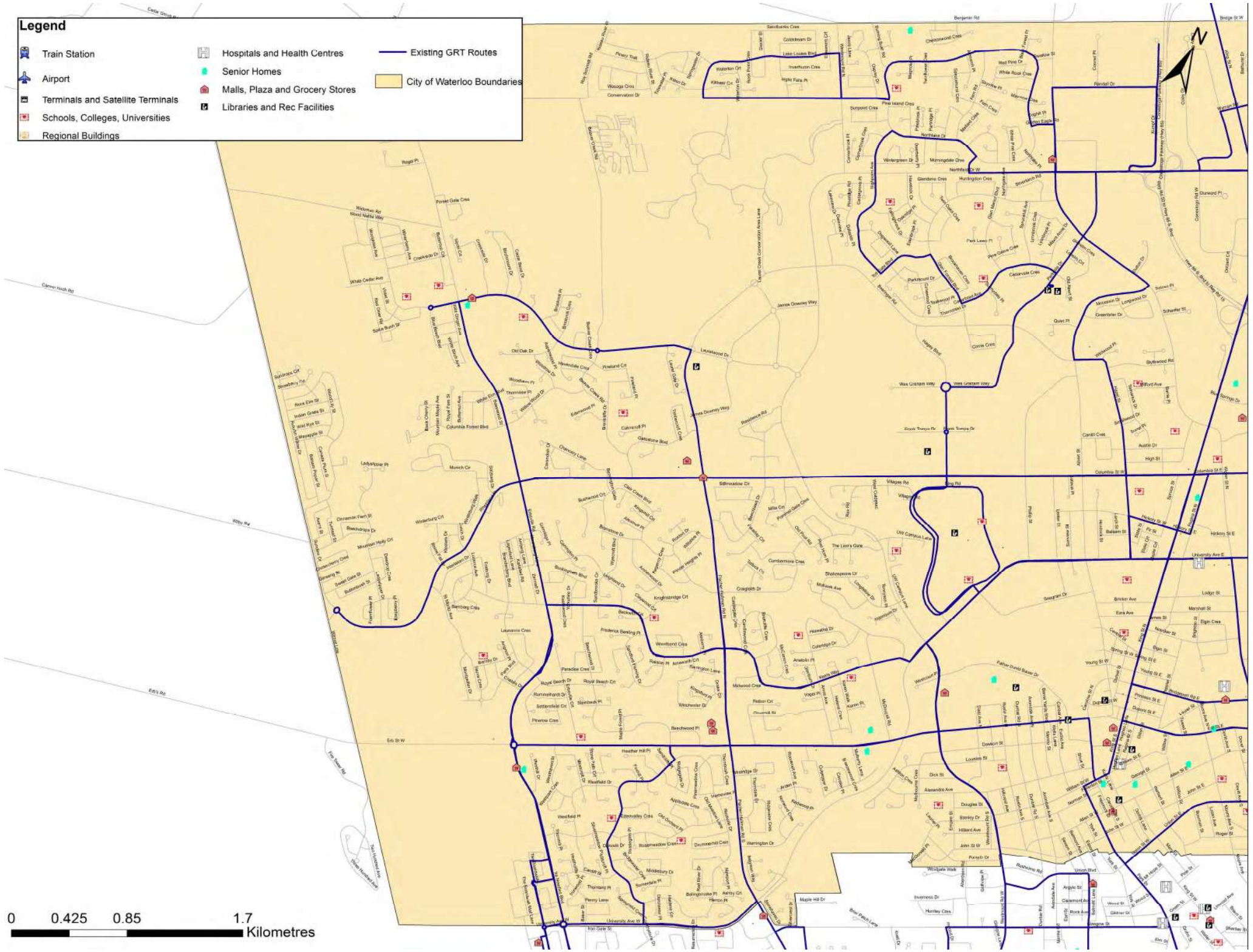
14+ Million Kilometres Travelled in 2015



20+ Million Riders in 2015



EXISTING TRANSIT ROUTES



NEXT STEPS AND STUDY CONTACTS

Following this Public Information Centre, the Study Team will:

- Review all comments
- Forecast and analyze future conditions
- Recommend and evaluate improvements
- Host PIC#2 to present recommended improvements
- Draft report and Council presentation
- Final report

Please talk with a Study Team member and drop your comment form in the box before leaving

You can also provide comments via email or phone to:

Mehemed Delibasic, M.Sc., P.Eng.
Project Manager
WSP Canada Inc.
100 Commerce Valley Drive West
Thornhill, Ontario L3T 0A1
Email: Mehemed.Delibasic@wspgroup.com
Phone: (905) 882-1100 ext. 6967

Philip Hewitson, P.Eng.
Manager, Active Transportation & LRT Integration
City of Waterloo
Engineering Services
Integrated Planning & Public Works
Email: philip.hewitson@waterloo.ca
Phone: 519-747-8660

APPENDIX

H-3 PIC NO.1 SIGN IN LIST AND COMMENTS

City of Waterloo
Integrated Multi-Modal Transportation Study Waterloo West Side
Public Information Centre (PIC) #1 SIGN-IN
Tuesday, April 4, 2017
Kitchener-Waterloo Bilingual School, Waterloo, Ontario

Name	Address	E-mail	Phone No.	Add to Mailing List	
1. Susan Smith	1163 Carmel-Koch Rd	suziesmith@shaw.ca		Yes ☑	No ☐
2. Jane Schneider	567 Wilmot Line	fjs1431@bell.net	746-1886	Yes ☑	No ☐
3. Greg Vorsin		greg@vorsindevelopments.ca	741-4614	Yes ☑	No ☐
4. Nicole Kanku-Beier	427 Winchester Dr.	nicole@23family.net		Yes ☒	No ☐
5. Vince Varga, Varga Planning	9 Grand River Drive, Waterloo	vince@vplan.ca.	519-741-1123	Yes ☑	No ☐
6. Jeff Martens		jmartens@mte85.com	519-743-6500	Yes ☑	No ☐
7. DAVID WEREZAK	300 AMBERWOOD DR	werezak@gmail.com		Yes ☑	No ☐
8. Alisa Pfeifle	665 Keatswood Cres	alisapfeifle@hotmail.com	519-725-1044	Yes ☑	No ☐
9. AL MUELLER		Al.Mueller@stantec.com	519-585-7261	Yes ☐	No ☐
10. Deb Swidrovich	720 Wilmot Line, Waterloo	dbswid@gmail.com	519-746-5287	Yes ☑	No ☐
11. Geoffrey Keyworth	Region of Waterloo	gkeyworth@regionofwaterloo.ca	519-575-4089	Yes ☒	No ☐
12. KEVIN THOMASON	1115 CEDAR GROVE RD. WATERLOO, ONT	KevinThomason@mac.com	519-888-6519	Yes ☑	No ☐

Note: Comments and information regarding this project are being collected in accordance with the *Municipal Freedom of Information & Protection of Privacy Act*. With the exception of personal information, all comments will become a part of the public record.

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Tuesday, April 4, 2017
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Name	Address	E-mail	Phone No.	Add to Mailing List	
13. Jacqueline Humphreys	561 Grasslands Ct. Waterloo	jhhumphreys@yahoo.ca	519 498 2135	Yes ☐	No ☒
14. ROBERT HUMPHREYS	561 GRASSLANDS COURT	HUMPHREYS.ALL@SYMPATICO.CA	519-883-1840	Yes ☒	No ☐
15. Marny St. Pierre	810 Munich Circle	paulmarn@sympatico.ca	519-883-8367	Yes ☒	No ☐
16. BRIAN BOURKE	WATERLOO, ON			Yes ☐	No ☒
17. DIANA BOURKE	WATERLOO, ON.	dianabourke60@HOTMAIL.com		Yes ☐	No ☒
18. Krista Walkey	300 Hagey Blvd Waterloo	krista.walkey@stantec.com	519-575-4133	Yes ☒	No ☐
19. DIANA + RON LAITAR	813 AUTUMN WILLOW DR., WATERLOO		519-746-4493	Yes ☐	No ☒
20. Krystina Bednarowski + Glen Worthington	570 Royal Beech Dr. Waterloo	Kbednarowski@hotmail.com	519-745-6431	Yes ☒	No ☐
21. Dave Aston	540 Bingeman Centre Dr Kitchener ON	dastone mhbcplan.com	519-576-3650	Yes ☒	No ☐
22. Kyle Swidrovich	51 DIETZ AVE S, WATERLOO, ON	kyle@kylenol.com	519-498-4655	Yes ☒	No ☐
23. Nancy Carlisle-Weaver	38 Coral Cr. Kitchener (property at Sunfish Lake)	ncwdw@rogers.com		Yes ☒	No ☐
24. Jane Mitchell	604 Dogwood Lane Waterloo N2L4X9	jmitchell@regionofwaterloo.ca	519-886-9626	Yes ☒	No ☐

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Name	Address	E-mail	Phone No.	Add to Mailing List	
25. LAURIE ROBERTSON	839 LAURELWOOD DR. WATERLOO	familyrobertson@rogers.com	519-880-0905	Yes ☑	No ☐
26. Don McMurtry	714 Wideman Rd	donmemurtry@gmail.com	519-581-7443	Yes ☑	No ☐
27. Mike & LORI Zybala	554 Rheinland Pl.	mikezybala@gmail.com	599-954-1077	Yes ☑	No ☐
28. Jeff Deutschlander	674 Conservation Drive	jeff@deutschie.com	519 591-4616	Yes ☑	No ☐
29. Gloria Deutschlander	" " "	gloriaad@sympatico.ca	519-884-0835	Yes ☑	No ☐
30.				Yes ☐	No ☐
31.				Yes ☐	No ☐
32.				Yes ☐	No ☐
33.				Yes ☐	No ☐
34.				Yes ☐	No ☐
35.				Yes ☐	No ☐
36.				Yes ☐	No ☐

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City of Waterloo
Integrated Multi-Modal Transportation Study
Municipal Class Environmental Assessment Study Waterloo West Side
Public Information Centre (PIC) #1

Tuesday, April 4, 2017
Kitchener-Waterloo Bilingual School, Waterloo, Ontario

COMMENT SHEET

Please provide us with your comments regarding any of the material presented today or in regards to any other issues that you feel are relevant to this project.

Please drop your completed comment sheet in the box provided, or mail / email by April 30, 2017 to:

Philip Hewitson, P.Eng.
Manager, Active Transportation & LRT Integration
Waterloo City Centre
100 Regina St. S.
Waterloo, ON N2J 4A8
Phone: 519-747-8660
Email: philip.hewitson@waterloo.ca

Mehemed Delibasic, M.Sc., P.Eng.
Consultant Project Manager
WSP Canada Inc.
100 Commerce Valley Drive West
Thornhill, Ontario L3T 0A1
Phone: (905) 882-1100 ext. 6967
Email: mehemed.delibasic@wspgroup.com

PLEASE PRINT

Name: Alisa Pfeifle

Address: 665 Keatswood Cres

Waterloo Postal Code: N2T 2R7

E-Mail: alisapfeifle@hotmail.com Phone: 519-725-1044

COMMENTS:

(1) Construction for Erb St (F-H to Erbsville) + Columbia St (F-H to Erbsville) are both scheduled for 2018. It would be helpful for east-west traffic flow to have closures at different times, ie. please do not reduce traffic flow on both Columbia + Erb St at the same time!

(2) Please have safe bike lanes on Erbsville, Erb St, + other streets (including Wilmot Ln + Conservation)

THE CITY OF Waterloo

You may use the reverse of this page if additional space is required.

WSP

Thank you for your participation!

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Thornhill, Ontario L3T 0A1
Phone: (905) 882-1100 ext. 6967
Email: mehemed.delibasic@wspgroup.com

PLEASE PRINT

Name: JACQUELINE HUMPHREYS

Address: 561 GRASSLANDS COURT

WATERLOO Postal Code: N2V 2R5

E-Mail: jhhumphreys@yahoo.ca Phone: 519-998-2135

COMMENTS:

Please consider using roundabouts rather than traffic signals at all intersections where space allows.
More bike lanes (segregated would be ideal)
GRT needs more routes on the west side. Conservation Meadows only has a rush hour service so outside of those hours we would have to walk some distance to the nearest regular stop. As we get older this gets more difficult especially in the winter. Also there is no easy way to get to the medical offices on Ira Needles Blvd by bus. Even to get to the UWRC involves considerable walking and 2 buses but is very easy to get to by car. →

THE CITY OF Waterloo

You may use the reverse of this page if additional space is required.

WSP

We are happy to see traffic calming measures planned for Conservation Drive. The speed limit should not be raised here. There is a park and children's playground and high speed traffic is a real danger.

Thank you for your participation!

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City of Waterloo
Integrated Multi-Modal Transportation Study
Municipal Class Environmental Assessment Study Waterloo West Side
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100 Commerce Valley Drive West
Thornhill, Ontario L3T 0A1
Phone: (905) 882-1100 ext. 6967
Email: mehemed.delibasic@wspgroup.com

PLEASE PRINT

Name: Glen Worthington

Address: 570 Royal Beech Drive, Waterloo

Postal Code: N2T 1Z8

E-Mail: - Phone: 519-745-6431

COMMENTS:

- Wilmot + Conservation could use wider sidewalks
- No dog park / parks on westend: drives across the city.

THE CITY OF Waterloo

You may use the reverse of this page if additional space is required.

WSP

Thank you for your participation!

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Municipal Class Environmental Assessment Study Waterloo West Side
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100 Commerce Valley Drive West
Thornhill, Ontario L3T 0A1
Phone: (905) 882-1100 ext. 6967
Email: mehemed.delibasic@wspgroup.com

PLEASE PRINT

Name: Krystina Bednarowski

Address: 570 Royal Beech Dr. Waterloo.

Postal Code: N2T 1Z8

E-Mail: kbednaro@uwaterloo.ca Phone: 5197456431

COMMENTS:

Super wide bike/running lanes up Wilmont, conservation and Erbsville North to avoid being run over.
Missing side walk along Erb road that connects Costco with the stores (where canadian tire is)
*Special request for leash free dog area that is accessible and walkable from Royal Beech Drive - perhaps behind Costco! Please! ☺

THE CITY OF Waterloo

You may use the reverse of this page if additional space is required.

WSP

Thank you for your participation!

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APPENDIX

H-4 PIC NO. 1 COMMENTS AND CONSIDERATION OF COMMENTS RECEIVED

Comments Provided By	Summary of Comments Received	Consideration of Comments Received
Written Comments		
Resident Comment	1. The proposed roadway improvements for Erb St and Columbia St are both scheduled for 2018. It is recommended that potential closure of east west traffic associated with construction for these two projects occur at different times. 2. Safe bike lanes should be provided on Erb St, Erbsville Rd, Wilmot Ln, Conservation Dr and other roadways.	1. Improvements for Columbia St will commence in 2017 whereas the Erb St EA is still ongoing. The construction for Columbia St roadway improvements will occur before the ones for Erb St. 2. Response to provision of safe bike lanes: a. The Erb St EA is currently ongoing. The preferred option including active transportation improvements with provisions for cyclist. b. The Stantec Consulting Transportation Overview Study for Beaver Creek Meadows notes that as part of the BCM District Plan and EA study, Conservation Drive, west of Beaver Creek Rd is proposed to be urbanized with bike lanes. c. The future EA for Erbsville Rd improvements from Columbia St to Erb St will consider all modes of transportation.
Resident Comment	1. Consider using roundabouts rather than traffic signals at all intersections where space allows 2. More bike lanes (segregated) would be ideal. 3. GRT needs more routes on the west side. 4. Conservation Meadows has only rush hour service. Off-peak service should be provided. 5. No direct bus service provided to medical offices on Ira Needles Blvd. 6. Resident supports the traffic calming measures planned for Conservation Dr.	1. Many roundabouts will be considered in the study area: a. The future EA for Erbsville from Columbia St to Erb St will investigate the potential for a roundabout at Keats Way. b. The Stantec Consulting Transportation Overview Study for Beaver Creek Meadows recommended a roundabout for the Beaver Creek Rd intersection with Conservation Dr. c. The future EA for Fischer Hallman Rd widening from Columbia St to Westmount Rd will investigate the potential for roundabouts on Fischer Hallman Rd at Laurelwood Dr and Westmount Rd. 2. This study will identify existing and proposed bike lanes and identify potential gaps in the network. 3. to 5. GRT has identified the west side of Waterloo as a growth area and service will be provided by 2021. Conservation Meadows would be a candidate for alternative service delivery strategies for off-peak. Two bus routes at 10 and 15 minute frequencies go along Ira Needles Blvd past the medical centres. Customer information should be made accessible. 6. WSP acknowledges this comment.
Resident Comment	1. Provide wide sidewalks on Wilmot Ln and Conservation Dr. 2. Provide a dog park at the west end of the City.	1. Wilmot Ln currently includes gravel shoulders. There are no current plans to improve active transportation on Wilmot Ln. The Beaver Creek Meadows EA recommended cross-section for Conservation Dr identifies 1.5m sidewalks on both sides of the roadway. 2. The mandate of this study does not include investigating alternative land use designations. Land use suggestions should be provided during the development of the City OP.
Resident Comment	1. Provide wide bike lanes along Wilmot Ln, Conservation Dr and Erbsville Rd (north end). 2. There are missing sidewalks on Erb St that connects Costco with the nearby stores. 3. Special request for a leash free dog area should be provided on the west end that is accessible and walkable from Royal Beach Drive. Suggestion was made that this be provided behind the Costco site.	1. Wilmot Ln currently includes gravel shoulders. There are no current plans to improve active transportation on Wilmot Ln. The Beaver Creek Meadows EA recommended cross-section for Conservation Dr identifies 1.5m sidewalks on both sides of the roadway. The current 2016-2015 Capital project does not identify improvements on Erbsville Rd, north of Columbia St. However, WSP identified Erbsville Rd as a potential corridor for separated cycling facilities as part of this study. 2. The Erb St EA is currently ongoing and will be recommending active transportation improvements.

Comments Provided By	Summary of Comments Received	Consideration of Comments Received
		3. The mandate of this study does not include investigating alternative land use designations. Land use suggestions should be provided during the development of the City OP.
Comments Discussed During the PIC		
Resident Comment	1. The subdivisions north of Columbia St and east of Wilmot Ln have emergency accesses from Wilmot Ln. There are times when the emergency access is blocked by snow as a result of snow removal operations. As a consequence there was an incident where the emergency response time significantly increased as the emergency vehicle travelled via Conservation Dr and Erbsville Rd to access the subdivision.	1. As a part of this study WSP will recommend that City of Waterloo traffic operations investigate snow cleaning practices at the emergency accesses from Wilmot Ln.
Developer Comment	1. The study should consider a collector road between Erb St and University Ave, west of Ira Needless Blvd.	2. This study recommends connecting the Boardwalk with Erb St. The Boardwalk would be a continuous north-south roadway (proposed to be a collector road) between Erb St and University Ave.
Developer Comment	1. The developer team for the Boardwalk is developing options to create a new road connection to bypass the Erb/Ira Needles intersection in the southwest quadrant. The preliminary concept includes a new road connection between Erb St opposite the Westside Marketplace signal (converted to a roundabout), along the west boundary of the commercial properties (beside the hydro corridor), swinging easterly to connect to Ira Needles Blvd opposite West Hill Drive as a right turns only connection.	2. This study recommends connecting the Boardwalk with Erb St. The Boardwalk would be a continuous north-south roadway (proposed to be a collector road) between Erb St and University Ave. Based on discussion with the City the connection with Erb St would be a roundabout. A separate study should be undertaken to determine the alignment and cross-section of the roadway.
Resident Comment	1. Don't like standard bike lanes on the busy arterial roads such as Fischer Hallman. Bike lanes on collector roads are more comfortable to use because there are fewer cars and they travel more slowly.	1. Recommendations for active transportation include facilities with more separation than standard bike lanes, following a similar approach to the section of Columbia Street currently being reconstructed with separated cycling facilities and a boulevard multi-use trail(s) and sidewalk(s).
Resident Comment	1. There is no convenient and safe route for cyclists to get from the west side to Uptown, routes are discontinuous and not very direct/convenient.	1. Recommended Active Transportation improvements include east-west corridors, such as separated cycling facilities on arterial roads, similar to what is currently being implemented on Columbia Street; improving connectivity / closing gaps in the hydro corridor trail parallel to Keats Way and improved pedestrian and cyclist crossings of arterial roads at key locations (e.g. the hydro corridor trail south of Keats Way at Erbsville Road.
Resident Comment	1. Wilmot Line is not good for cycling, truck volumes and speeds are high. Wildlife road kills are a problem along Wilmot near the wetlands – road widening to add cycling /pedestrian facilities would worsen this condition.	1. This study does not include recommendations for cycling or pedestrian facilities on Wilmot Line.
Resident Comment	1. Would like to see a Multi-use Trail on Columbia all the way from Vista Hills to Erbsville, currently it only exists on the western most portion.	1. This study recommends Active Transportation improvements on arterial roads to include separated cycling and multi-use trails / sidewalks facilities on arterial roads, similar to what is currently being implemented on Columbia Street.
Resident Comment	1. There is no direct pedestrian connection between Blue Beech Blvd. and Royal Fern St. Pedestrians have to walk along Erbsville Road. Children would be able to walk to school if a connection was made between these 2 neighbourhoods.	1. This study suggests a pedestrian/trail connection be developed in this area when the land becomes available.
Resident Comment	1. The bike lanes on Laurelwood, especially near Columbia are narrow.	1. This study recommends Laurelwood be considered for separated cycling by reallocating existing space and narrowing vehicle travel lane widths.

Comments Provided By	Summary of Comments Received	Consideration of Comments Received
Resident Comment	1. How do we get bike lanes, busy lanes and sidewalks through the Erbsville Village area – houses are old and very close to the road.	1. This study recommends the current paved shoulder be maintained through the Erbsville Village area.

APPENDIX

PIC NO. 2

APPENDIX

I-1 PIC NO.2 NOTICE



NOTICE OF PUBLIC INFORMATION CENTRE (PIC) #2

INTEGRATED MULTI-MODAL TRANSPORTATION STUDY, WATERLOO WEST SIDE

THE STUDY

The City of Waterloo has initiated an Integrated Multi-Modal Transportation Study (IMMTS) for the Waterloo West Side. The purpose of the IMMTS is to evaluate the implications of increased development and growth on the west side of Waterloo and provide recommendations on:

- transportation network and operational improvements to accommodate growth
- opportunities to expand, connect, and integrate active transportation and transit in the study area

The study will evaluate existing traffic relative to the current transportation network, evaluate active transportation and transit within the study area, forecast future traffic, and provide recommendations for improving all modes of travel.

PUBLIC INFORMATION CENTRE - WE WANT TO HEAR FROM YOU:

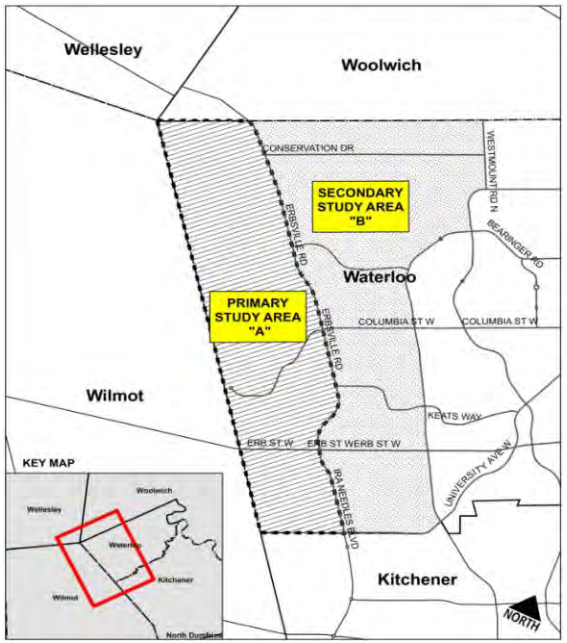
Public Participation will form an integral part of this study to ensure that the ongoing concerns of the public and affected groups within the study area are identified, documented and assessed. The Project Team invites public input and comments, and will incorporate them into the project documentation. The second Public Information Centre (PIC) will be held to present the future conditions and recommendations and receive public input at the following time and location:

DATE: Tuesday, June 5, 2018
TIME: **4**:30 p.m. – 7:30 p.m. (drop-in open house format)
LOCATION: Hauser Haus, Waterloo Memorial Recreation Complex, 101 Father David Bauer Drive, Waterloo, Ontario N2L 0B4

If you are unable to attend the public meeting, and would like to provide comment, there is an opportunity at any time during this process for interested persons to review outstanding issues and bring concerns to the attention of the Project Managers below:

Philip Hewitson, P.Eng.
Manager, Active Transportation & LRT Integration
City of Waterloo
Engineering Services
Integrated Planning & Public Works
Phone: 519-747-8660
Email: philip.hewitson@waterloo.ca

David Lukezic, M.Eng., LEL, RPP
Project Manager - Consultant
WSP Canada Inc.
Phone: 905-882-1100 ext. 6622
Email: David.Lukezic@wsp.com



The map above shows the study area.

Please contact the City's Project Manager regarding disability accommodation requirements for the PIC by June 1, 2018.

Information will be collected in accordance with the *Freedom of Information and Protection of Privacy Act*. With the exception of personal information, all comments will become part of the public record.

This Notice is posted on the City of Waterloo website and May 31 2018 edition of the Waterloo Chronicle.

APPENDIX

I-2 PIC NO.2 BOARDS

INTEGRATED MULTI-MODAL TRANSPORTATION STUDY, WATERLOO WEST SIDE

CITY OF WATERLOO

PUBLIC INFORMATION CENTRE (PIC) #2

THE CITY OF Waterloo

June 5, 2018

WSP

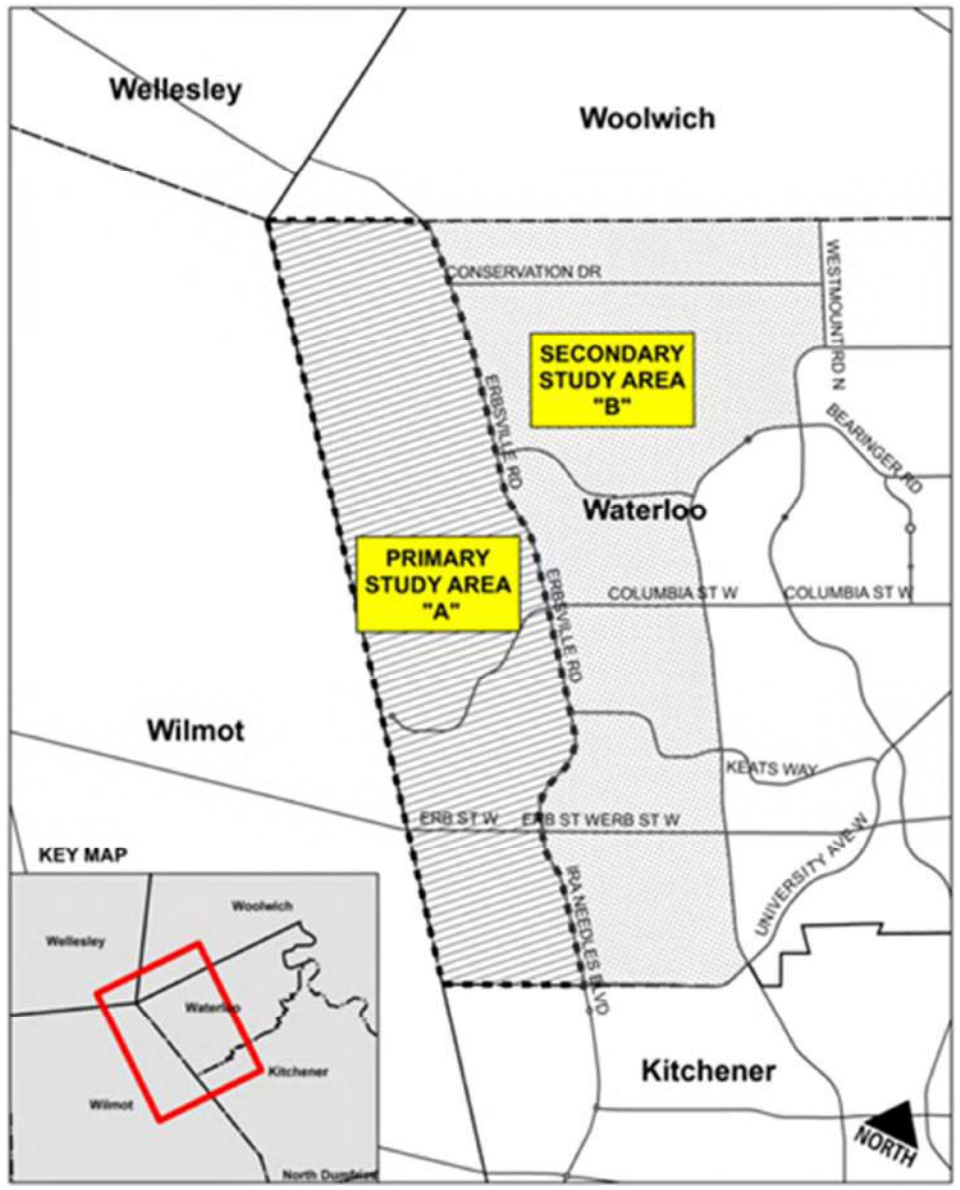
PURPOSE OF PIC #2

- To review future conditions and recommendations and obtain public input and comments on the Integrated Multi-Modal Transportation Study.
    - City of Waterloo and WSP (consultants) staff are available to discuss the project with you.
- We would like to hear your comments:

Please complete a comment sheet before leaving.

STUDY OVERVIEW

- The City of Waterloo has initiated an Integrated Multi-Modal Transportation Study (IMMTS) for the Waterloo West Side. The purpose of the IMMTS is to evaluate the implications of increased development in west Waterloo on the transportation system, and provide recommendations on:
  - transportation network and operational improvements to respond to growth
  - how to expand, connect, and integrate active transportation and transit in the study area

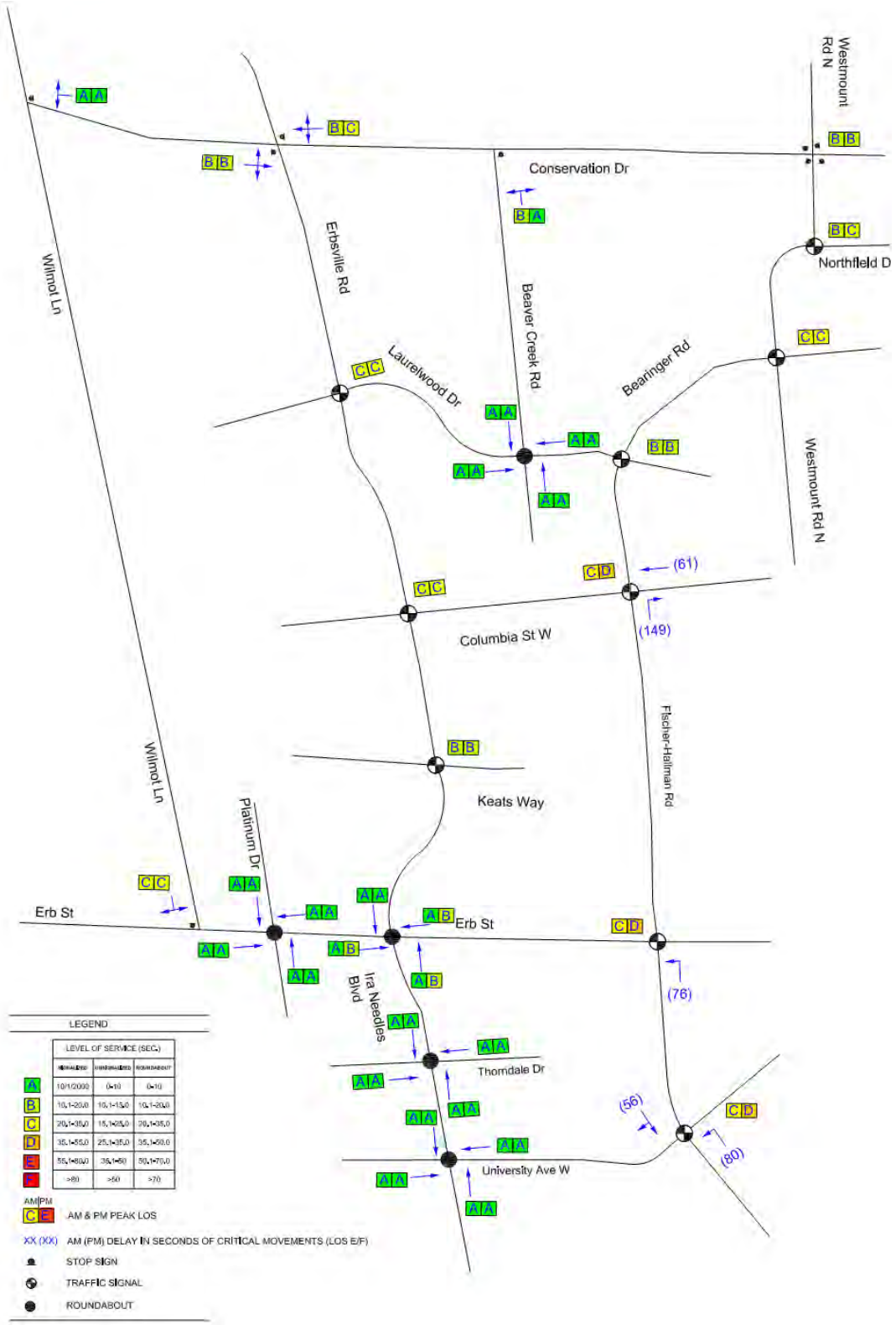


STUDY STEPS



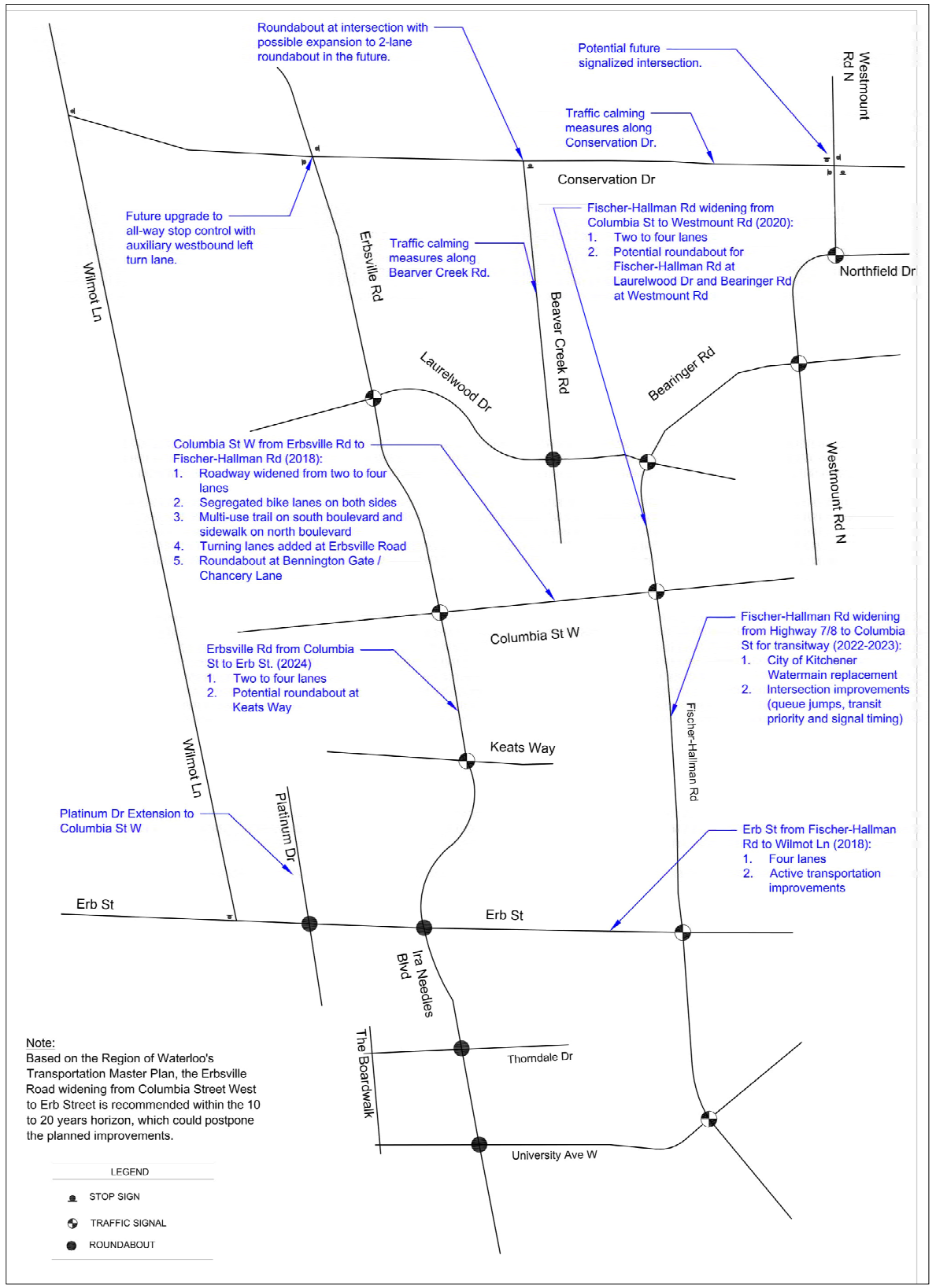
There is an opportunity at Public Information Centres (PIC) to provide input.

EXISTING INTERSECTION OPERATIONS



- All intersections operate at acceptable levels
- There are some movements that experience longer delays (LOS E or F)

PLANNED CITY/REGION ROADWAY IMPROVEMENTS



- A number of roadway improvements are planned in the study area.
- The identified roadway improvements are based on the following sources:
  - Capital Projects
  - Completed and ongoing EA's
  - Stantec Consulting prepared a Transportation Overview Study, November 2015 for Beaver Creek Road and Conservation Drive Upgrades and Extension Municipal Class EA

WHAT DID WE HEAR AT PIC#1

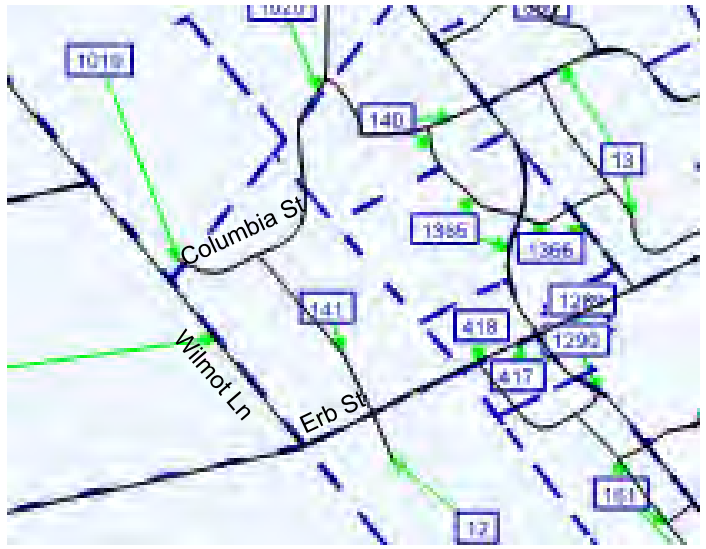
- Most comments were associated with AT where residents suggested exclusive bike lanes (Erb St, Erbsville Rd, Wilmot Ln, Conservation Dr and other roadways), wider sidewalks (Wilmot Ln and Conservation Dr), missing sidewalks on Erb St.
- Improve transit in the study area (better routes and off-peak service)
- Snow removal operations occasionally block emergency access to a subdivision from Wilmot Line resulting for increased emergency response times.
- Collector road between Erb St and University Ave, west of Ira Needless Blvd.
- Bypass the Erb St at Ira Needles Blvd intersection in the southwest quadrant.

ESTIMATED GROWTH

Year	Population[1]	Total Employment	Industrial	Warehouse	Retail	Office	Education	Service
2017	499,731	244,516	67,099	21,043	31,308	52,961	22,129	49,976
2031 Region's Model	599,003	285,568	85,907	25,669	37,518	57,170	24,201	55,103
2031 Proposed for This Study	599,003	293,568	91,907	25,669	37,518	59,170	24,201	55,103

Note: 1 Population includes people with age 10 or over

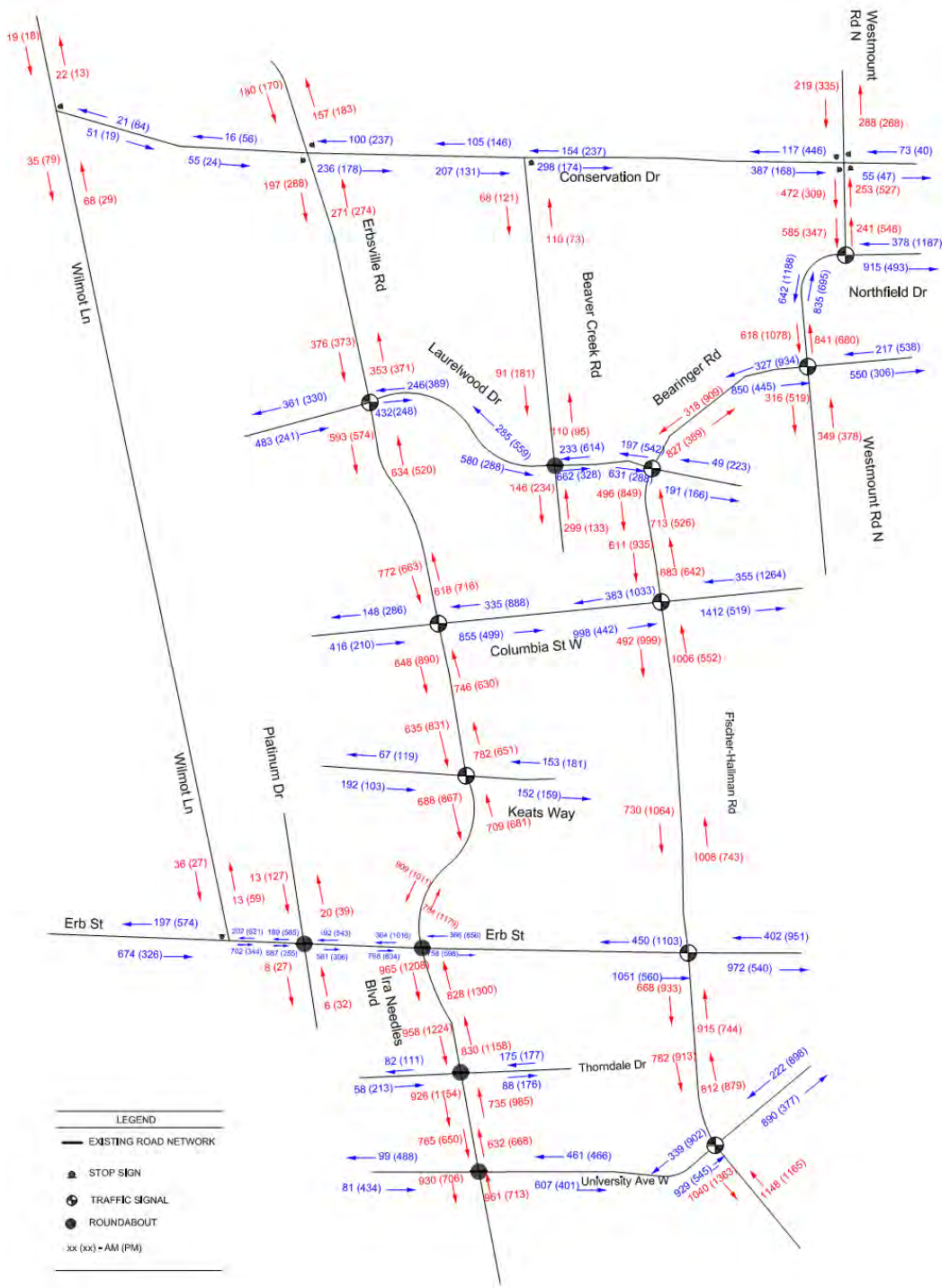
+8,000 employees in Zone 141
(75% industrial and 25% office)



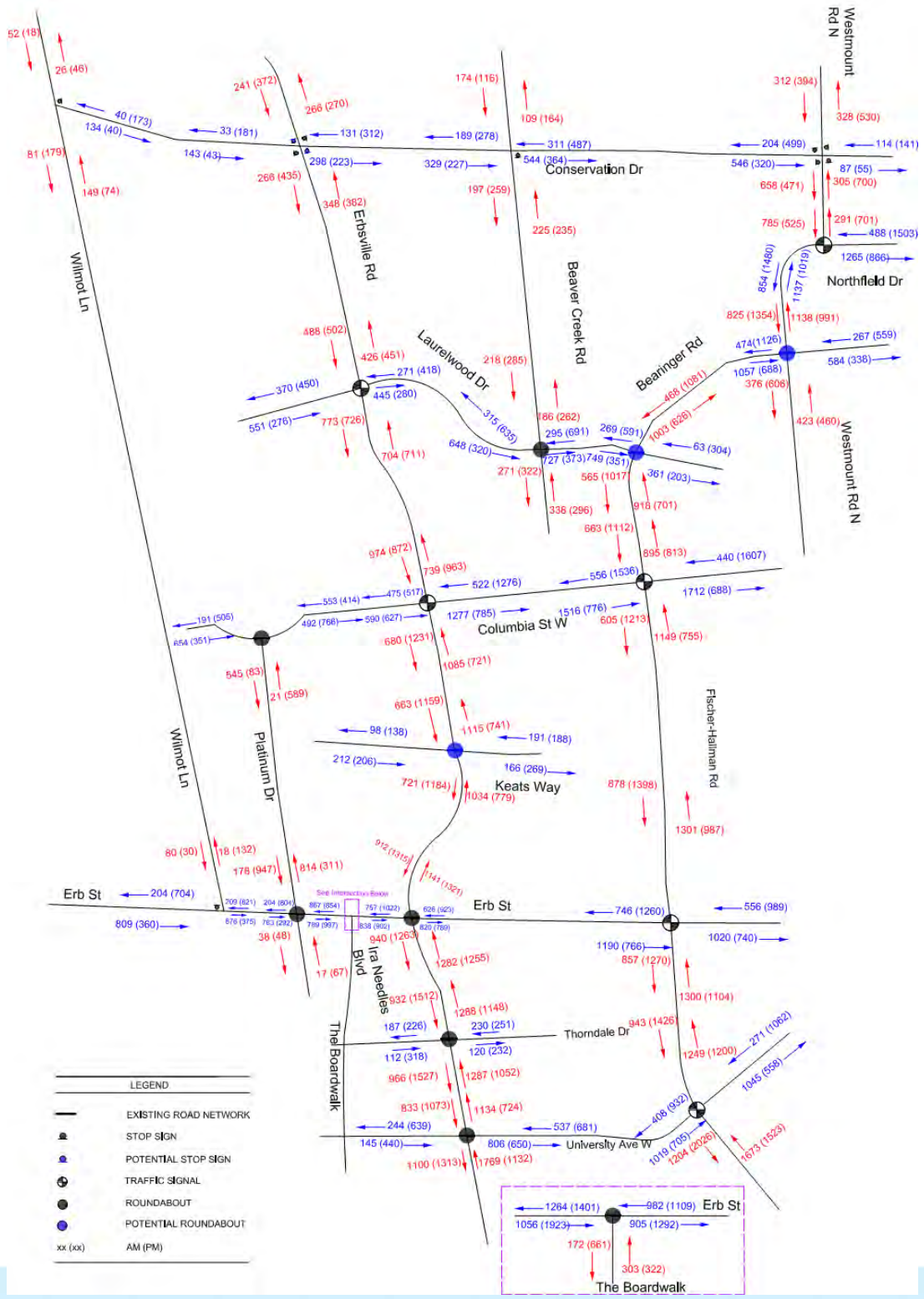
- Based on Region's VISUM model, between 2017 and 2031 population (age 10 and over) in the Region is estimated to grow by 100,000 (20%) and employment by 41,000 (17%)
- For this study additional 8,000 employees was modeled in Zone 141

FORECASTED 2031 LINK TRAFFIC VOLUMES

Existing Traffic

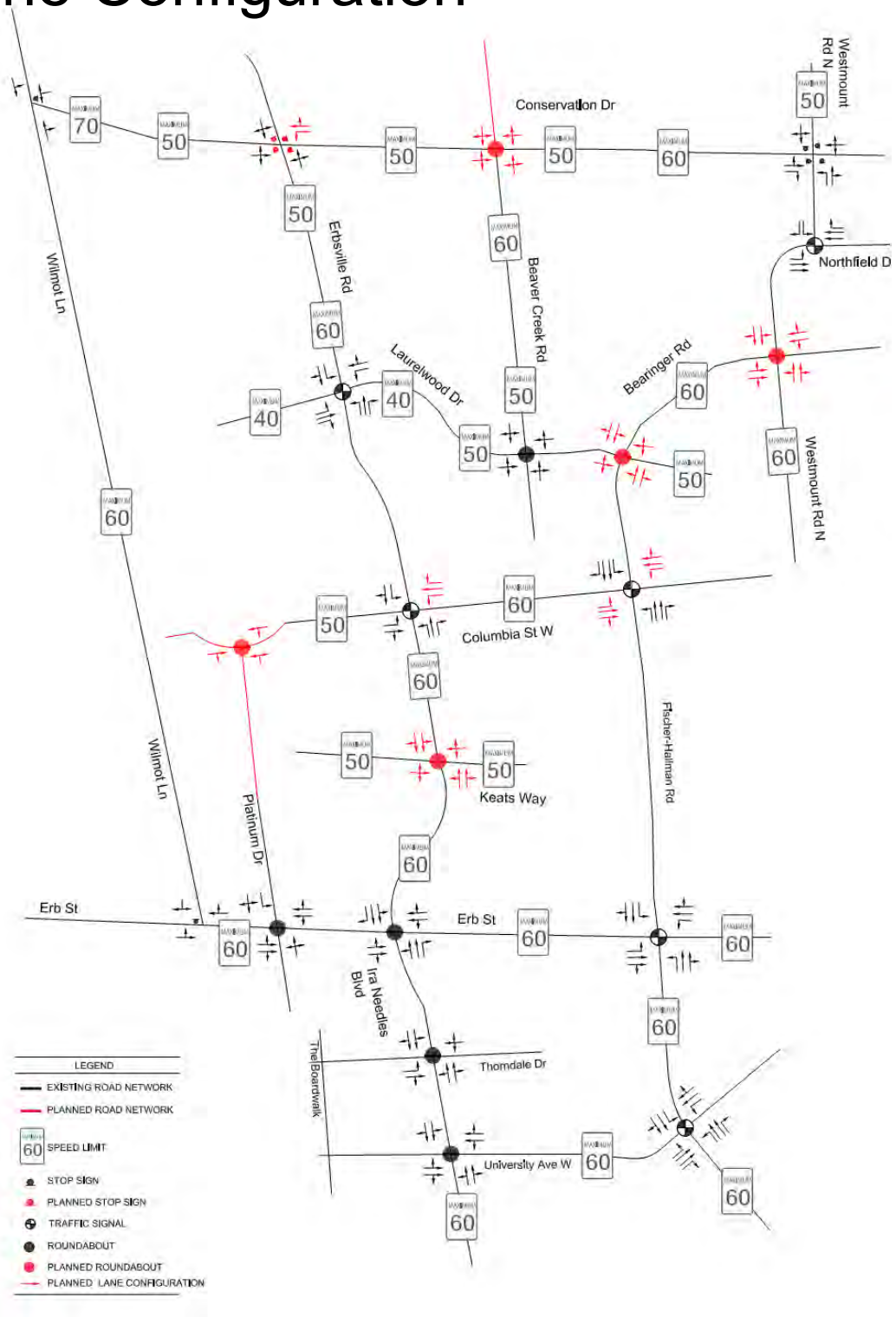


2031 Traffic

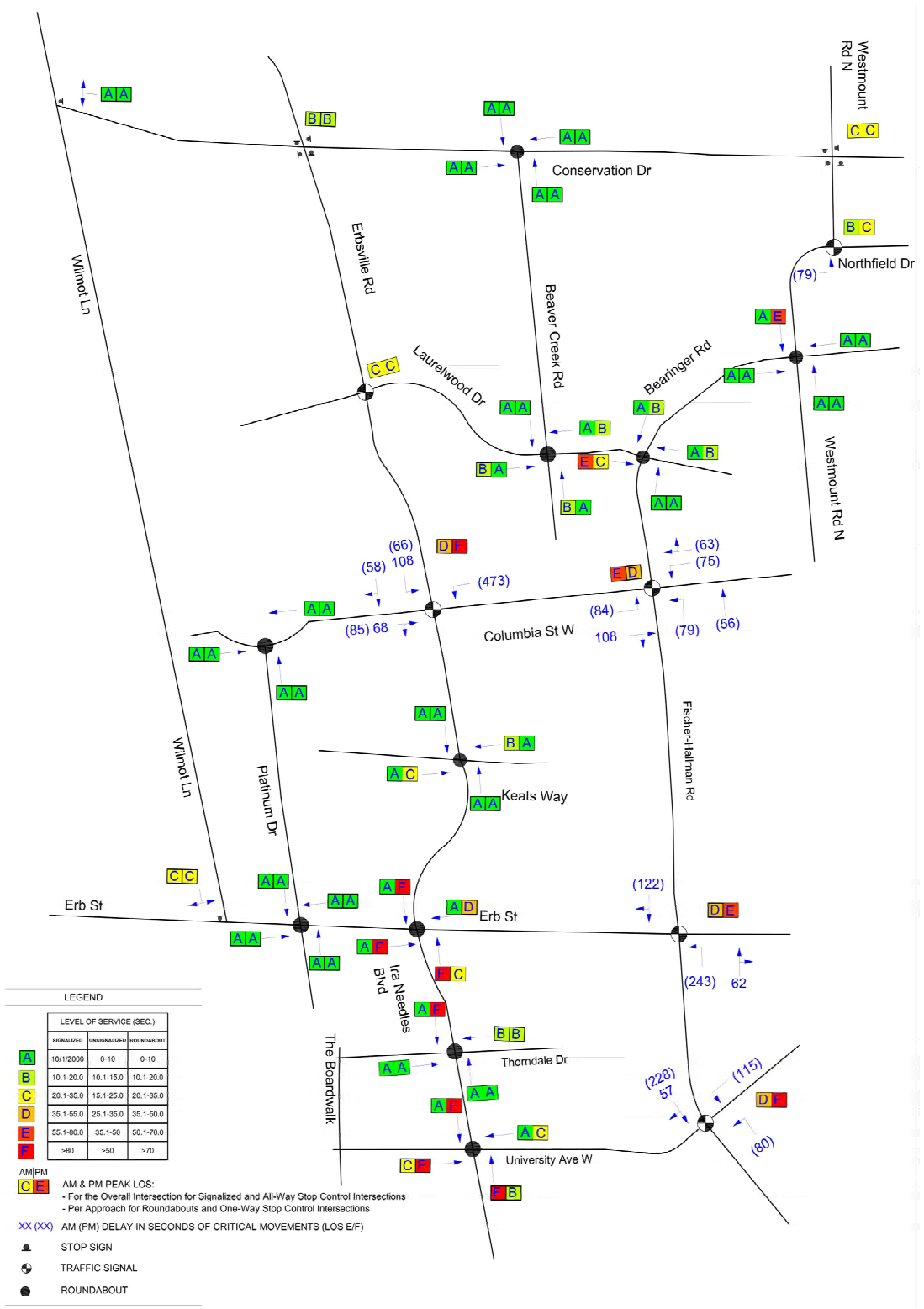


2031 Traffic Operations with Planned Improvements

Planned Lane Configuration

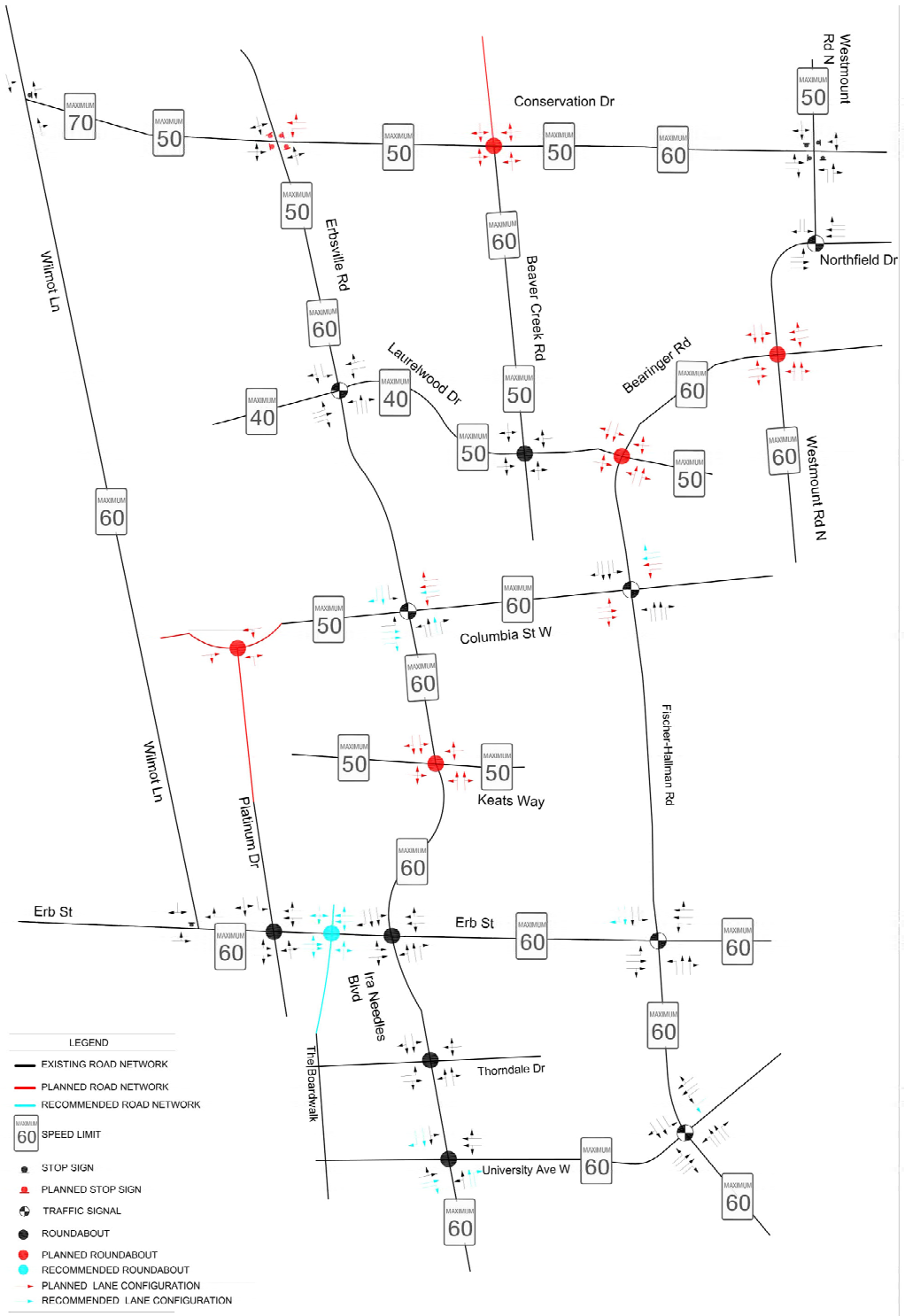


LOS

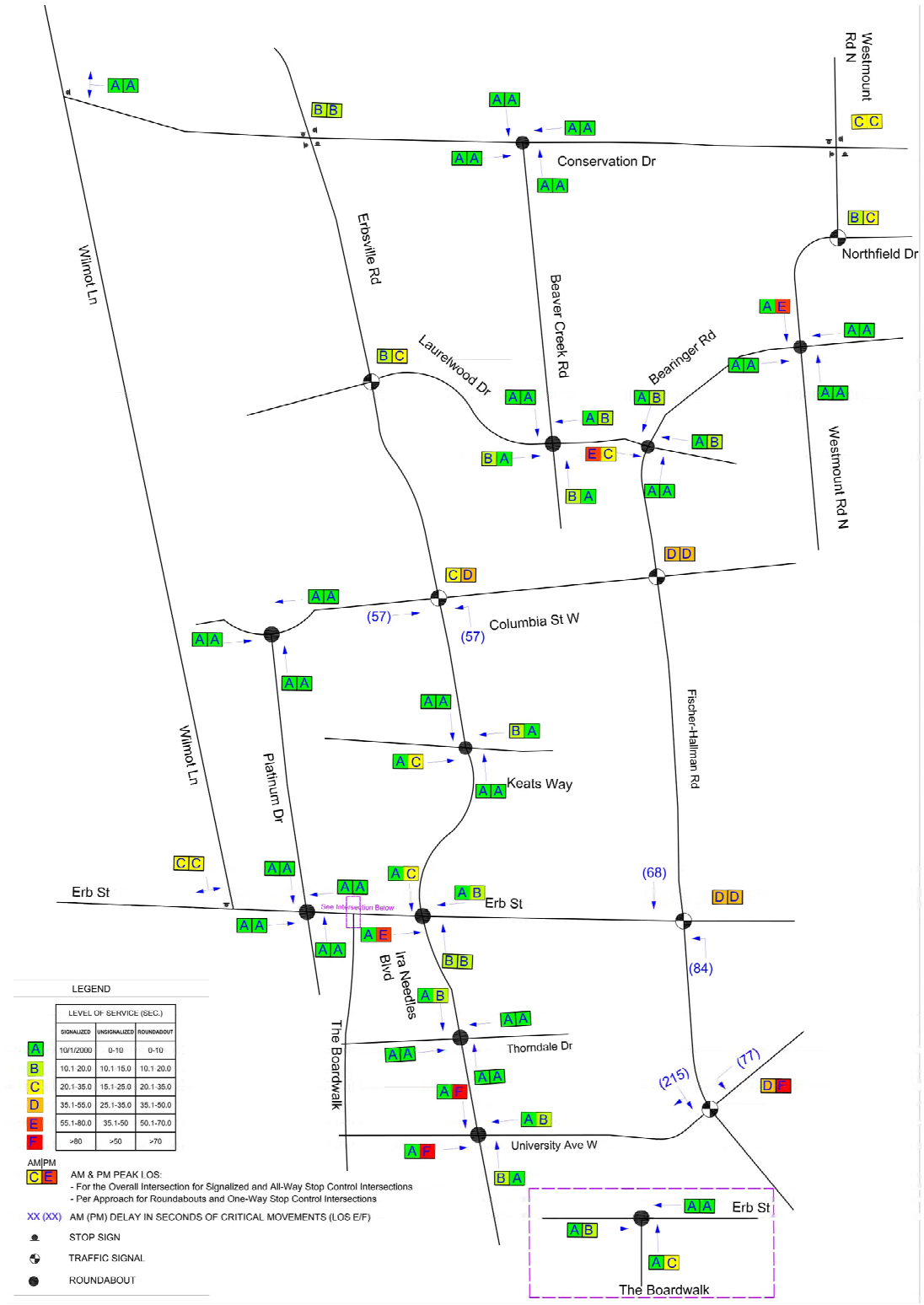


2031 Traffic Operations with Additional Improvements

Lane Configuration



LOS



Active Transportation

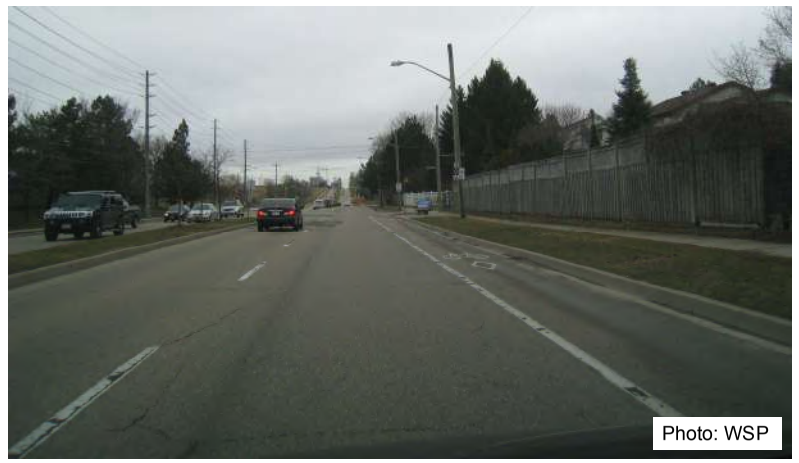
EXISTING CONDITIONS

WHAT WE HEARD

- Desire for more off-road cycling facilities, such as separated bike lanes and multi-use trails
- Some existing active transportation facilities are too narrow, and increasing the width will improve user comfort
- Closing gaps in the active transportation network will improve connectivity and make travel more efficient and convenient
- Complete sidewalk networks around schools are needed so that children can walk safely and comfortably to school
- Need for reduced speed limits, particularly near parks and schools
- Existing sidewalks are not wide enough in some locations



Some existing off-road trails need upgrading such as the hydro corridor trail between Erbsville Road and Fischer Hallman Road.



Existing bike lanes on busy arterial roads are not comfortable for users. Wider, separated facilities are preferred.



Desire for more off-road cycling facilities in locations such as open space and hydro corridors.



Erbsville Road at Brandenburg Blvd., facing south. No formal pedestrian crossing is provided.

PLANNED RECONSTRUCTION AND CONSTRUCTION PROJECTS

- Erb Street West reconstruction between Wilmot Line and Fischer Hallman Road to include multi-use trails
- Conservation Drive reconstruction between Wilmot Line and Beavercreek Road to include active transportation facilities
- Beavercreek Road reconstruction between Conservation Drive and 450m north of Laurelwood Drive to include active transportation facilities
- Columbia Street West extension to Wilmot Line (2018)
- Bearinger Road widening between Westmount Road North and Columbia Street West (2020)
- Fischer Hallman Road widening between Highway 7/8 to accommodate a transitway (2022)

Active Transportation Improvement Strategies


Toronto, ON., Photo: WSP



Photo: City of Waterloo


Caledon East ON., Photo: WSP


Photo: Toronto Coalition for Active Transportation

Prioritize Active School Travel

- Work with the Waterloo Region District School Board and Waterloo Catholic District School Board to conduct School Travel Planning for all of the schools in the Primary and Secondary Study Areas
- Implement the recommendations that come out of the School Travel Plans, specifically recommendations that remove barriers from the built environment


Calgary AB., Photo: WSP


Waterloo, ON., Photo: WSP

Provide Separated Cycling Facilities

- Particularly on arterial streets with higher vehicle volumes and speeds, to increase the level of comfort for cyclists

Enhance Traffic-calming in Neighbourhoods

- Implement measures such as speed tables, pavement markings and signage to slow vehicle traffic


Bell Street Park Shared Street Photo: NACTO

Incorporate Active Transportation Measures During the Development Approvals Process

- Require developers to:
  - provide connections from municipal sidewalks to the main entrance of commercial complexes and office buildings
  - provide end of trip facilities such as properly located bicycle parking for Active Transportation users at all commercial and office buildings



St. Thomas ON., Photo: WSP

Improve Pedestrian and Cyclist Crossings

- Improve intersections to create the conditions necessary for people to feel more comfortable walking and cycling
- Reduce pedestrian crossing distances at intersections by reducing curb radii and adding pedestrian refuges
- Provide controlled mid-block crossings at key locations including where major trails intersect with arterial roads


Cambridge ON., Photo: WSP

Improve Sidewalk Connectivity

- Add sidewalks to close gaps in the sidewalk network, with priority around schools, seniors' centres, medical centres, commercial and retail nodes, and locations with beaten footpaths
- Widen narrow sidewalks

INTEGRATED MULTI-MODAL TRANSPORTATION STUDY WATERLOO WEST SIDE

CITY OF WATERLOO JUNE 2018



Potential Active Transportation Initiatives identified by WSP

Potential Off-Road Trail / Walkway Corridors

Potential off-road trail / walkway corridors have been identified and create an off-road active transportation network through the study area. These potential off-road trails / walkways are intended to take advantage of assets such as public open space and hydro corridors to create a more comprehensive off-road network throughout the study area.

Potential Off-Road Trail / Walkway Connections

Potential off-road trail / walkway connections are locations where two existing or potential off-road trails / walkways currently do not intersect.

Connecting these will result in a more continuous and longer off-road network. In some locations the potential off-road connections may require a structure such as a bridge or boardwalk.

Potential Crossing Improvements at Major Intersection

Potential crossing improvements at intersections are suggested to improve the safety and comfort of pedestrians, cyclists, and transit users. A detailed active transportation audit of major intersections will inform the list of improvements for each location.

Some suggested improvements to be considered include:

- Adding prominent pavement markings to identify crossing locations and increase visibility of the pedestrian crossing zone
- Reducing curb radii to decrease motor vehicle speeds and decrease pedestrian crossing distance
- Installing pedestrian countdown signal heads where none currently exist
- Adding pedestrian refuge/median space in the intersection to reduce pedestrian crossing distance
- Considering elements of protected crossings at key locations (e.g. 2-stage left turns for cyclists)

Potential Locations for Pedestrian Crossing Improvements

Pedestrian Crossing Improvements have been identified at locations where pedestrians face challenging conditions when trying to cross the streets. Such conditions may include high vehicle volumes, high vehicle speeds, or visibility constraints associated with sight lines etc.

The City should evaluate the potential locations for pedestrian crossing improvements in order to identify solutions for creating a safer and more comfortable crossing experience. Where crossings involve Regional roads collaboration with the Region of Waterloo will be required.

Examples of potential crossing improvements include:

- Installing higher order crossing enhancements such as Mid-block Pedestrian Signals, Pedestrian Crossovers (PXOs) at key mid-block bus stop locations and trail crossings
- Adding pavement markings illustrating crossing zones locations (in accordance with guidelines - OTM Book 15)
- Adding signage to accompany pavement markings
- Creating wider pedestrian refuge islands where possible

Potential Corridors for Separated Cycling Facilities

A number of arterial road corridors have been recommended to include separated cycling facilities, increasing level of separation between cyclists and motor vehicles on major roads and the overall length of the separated cycling network within the study area.

Planned Reconstruction / Construction Projects as identified by the Region of Waterloo and the City of Waterloo

Planned Reconstruction / Construction Projects

Erb Street West (Fischer Hallman Road to Wilmot Line)
- Reconstruction scheduled for 2018
- Active Transportation facilities are planned to be included

Conservation Drive (Wilmot Line to Beavercreek Road)
- Reconstruction scheduled for 2018
- Active Transportation facilities are planned to be included

Beavercreek Road (Conservation Drive to 450m north of Laurelwood Drive)
- Reconstruction scheduled for 2018
- Active Transportation facilities are planned to be included

Columbia Street West extension to Wilmot Line
- Construction scheduled for 2018

Hydro Corridor Trail (south of Columbia Street West)
- Project planned for 2020

Bearinger Road (Westmount Road North to Columbia Street West)
- Widening from 2 lanes to 4 lanes scheduled for 2020

Fischer Hallman Road (Highway 7/8 to Columbia Street)
- Widening for transitway scheduled for 2022

Planned Roundabout Locations

The following locations have been identified (either through an Environmental Assessment or through preliminary analysis) as being potential locations for a future roundabout.

Fischer Hallman Road / Bearinger Road at Laurelwood Drive
Bearinger Road at Wesmount Road
Beaver Creek Road at Conservation Drive

LEGEND

Destinations
- Points of Interest
- Schools
- GRT Bus Stop

Existing Off-Road Trails
- Community Trail
- In-Boulevard Multi-Use Trail
- Walkway

Existing On-Road Cycling Facilities
- Separated Bike Lane
- Bike Lane
- Paved Shoulder
- Signed Route

Other
- Roads
- Creeks
- Lake / Pond
- City Parks
- Study Area A
- Study Area B

THE CITY OF Waterloo

WSP

Recommended Transit Strategies

EXISTING CONDITIONS

WHAT WE HEARD:

- More transit routes needed
- Full-day transit service
- More direct service

TRANSIT FACTS FOR WEST WATERLOO:

- GRT has identified west side of Waterloo as a growth area
- Currently 12 bus routes and 3 iXpress routes operate in the study area
- Major bus terminal: Conestoga Mall, the Boardwalk
- Nearby terminals: Charles St Terminal, St. Jacob's Farmers Market

TRANSIT INITIATIVES

- Special Event Fares
- Short Trip Fares
- Transit Oriented Development
- Multi-modal Solutions
- Mobility-as-a-Service
- Emerging Technologies
- Expansion of Service Hours/Area
- Barrier-Free System
- Increase Accessibility

TRANSIT STRATEGIES



INFRASTRUCTURE IMPROVEMENTS

New LRT stations offer the opportunity to better integrate transit into existing and redeveloping communities. Stations can be positioned to become the economic and cultural centre of their neighbourhoods and serve as a focal point for active transportation networks.
An assessment and asset inventory of all transit infrastructure, including bus stops, will help determine the best improvements to enhance the customer experience.



CONNECTIVITY

GRT is planning annual service improvements between 2017 and 2021 based on three key principles:
1) Completing the iXpress network of limited-stop bus routes
2) Realigning routes to more of a grid network, focused on ION LRT stations
3) Providing frequent service on high ridership routes



ALTERNATIVE DELIVERY

Alternative transit service delivery models should be explored for isolated transit-dependent facilities. Opportunities to retrofit sidewalks, roadway and walkway links that improve access to transit service should be pursued. In addition, staff will continue to work with Regional and municipal planners to ensure better support for transit-oriented development.

Community Bus Route

Purpose: Serve lower-density areas with the urban municipalities.
Implementation: 1) Pilot route with grant funding 2) Design route based on local needs 3) 'Flex-route' option allows the bus to deviate from the route alignment 4) Use a smaller vehicle.

Home to Hub

Purpose: Serve lower-density areas with the urban municipalities.
Implementation: Use MobilityPLUS service to provide trips from riders homes in low-density areas to the nearest transit hub. Trips can be pre-scheduled with predictable and stable costs of service.

Subsidized Taxi

Purpose: Cost-effective way to serve low density areas
Implementation: Subsidize riders use of taxis to provide service in areas where conventional bus service cannot be provided cost-effectively. Requires 1) Regulated service 2) Favorable rates 3) Set subsidy rates with providers.

Ridesharing

Purpose: Cost-effective way to serve low density areas
Implementation: Similar process for subsidized taxis, but caveats due to demand-based pricing often associated with Transportation Network Companies (TNCs).

Best Practices

PEER TRANSIT INITIATIVES

YORK REGION TRANSIT (YRT)

- Implementing strong transit oriented development (TOD) policies to increase accessibility and proximity to high-quality transportation services
- Improving regional integration with other transit agencies to provide seamless cross-jurisdictional trips
- Increasing the overall service provided by expanding coverage areas, extending service hours, and providing a family of services

TORONTO TRANSIT COMMISSION (TTC)

- Creating a barrier-free system by making all vehicles and stations fully accessible, increasing coverage area for accessible services, and facilitating multi-modal trips
- Growing the overall network by adding new LRT and RRT lines in under-serviced areas
- Improving fare payment by switching to PRESTO as the primary fare medium, adding mobile and contactless payment options, and integrating fares with nearby agencies

TRANSPORT FOR LONDON (TFL)

- Improving accessibility for persons with disabilities with the 'turn-up and go' service, upgrading rail and Tube stations to step-free, and helping persons with hidden disabilities self-identify
- Using technology to improve the overall experience by adding 4G connectivity in Underground tunnels, introducing automation to fleets, and sharing data so developers can create mobile apps
- Marketing campaigns with major brand names like Scrabble and Nike, and a strong social media presence to engage customers and promote services

ALTERNATE DELIVERY

System	Community Bus	Home to Hub	Subsidized Taxi	Ridesharing
York Region Transit	Five fixed routes Uses shorter buses Connects major destinations Regular YRT fare Operates daily	Multiple GO Shuttle routes connecting directly from neighbourhoods to major rail stations Available under the 'Dial-a-Ride' program which requires customers to call ahead for service	A subsidiary of the paratransit 'Mobility Plus' service Contracted service to taxi vendors Regular YRT fare	Offered through the 'Dial-a-Ride' program Uses taxi or specialized bus Operates during periods of low ridership Requires customers to call ahead for service
Oakville Transit	Five fixed 'Senior Special' bus routes Three regular fare routes, two free routes Uses conventional buses Operates daily	A subsidiary of the paratransit 'care-A-van' service Direct pickup at doorstep and takes customers to major transit terminals	Taxi service provided for specialized transit trips	Combined with Home to Hub service to provide transit services for people within the same geographical area
Toronto Transit Commission	Six local fixed routes Uses specialized buses Regular TTC fare Operates daily	A subsidiary of the paratransit 'Wheel-Trans' service Connects customers to transfer points Uses mini-buses	A subsidiary of the paratransit 'Wheel-Trans' service Contracted service to four taxi vendors Regular TTC fare	Offered through the 'Wheel-Trans' service wherever convenient for operations

Community Bus Route

Purpose: Serve lower-density areas with the urban municipalities.
Implementation: 1) Pilot route with grant funding 2) Design route based on local needs 3) 'Flex-route' option allows the bus to deviate from the route alignment 4) Use a smaller vehicle.

Home to Hub

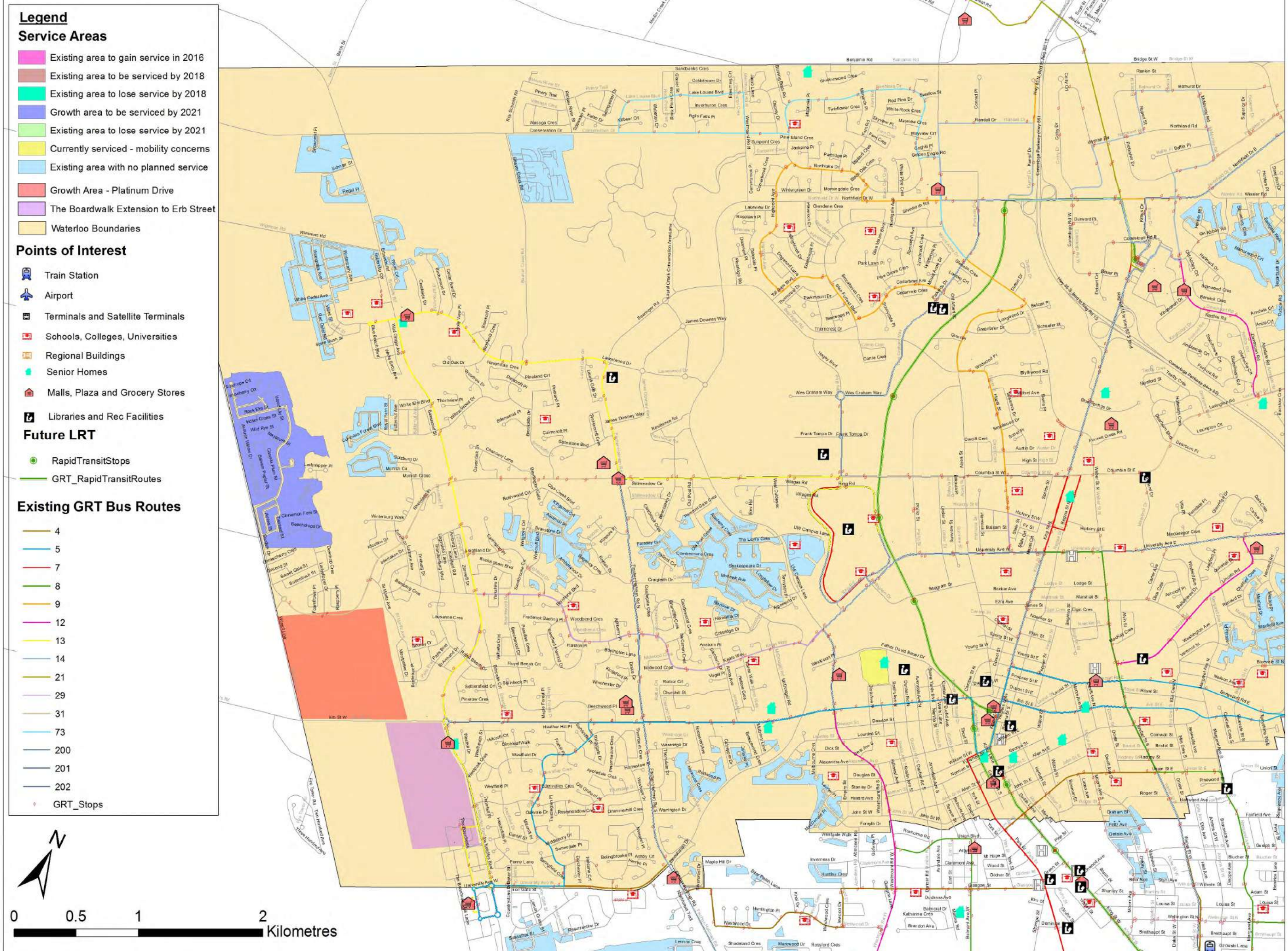
Purpose: Serve lower-density areas with the urban municipalities.
Implementation: Use MobilityPLUS service to provide trips from riders homes in low-density areas to the nearest transit hub. Trips can be pre-scheduled with predictable and stable costs of service.

Subsidized Taxi

Purpose: Cost-effective way to serve low density areas
Implementation: Subsidize riders use of taxis to provide service in areas where conventional bus service cannot be provided cost-effectively. Requires 1) Regulated service 2) Favorable rates 3) Set subsidy rates with providers.

Ridesharing

Purpose: Cost-effective way to serve low density areas
Implementation: Similar process for subsidized taxis, but caveats due to demand-based pricing often associated with Transportation Network Companies (TNCs).


Legend
Service Areas
Existing area to gain service in 2016
Existing area to be serviced by 2018
Existing area to lose service by 2018
Growth area to be serviced by 2021
Existing area to lose service by 2021
Currently serviced - mobility concerns
Existing area with no planned service
Growth Area - Platinum Drive
The Boardwalk Extension to Erb Street
Waterloo Boundaries
Points of Interest
Train Station
Airport
Terminals and Satellite Terminals
Schools, Colleges, Universities
Regional Buildings
Senior Homes
Malls, Plaza and Grocery Stores
Libraries and Rec Facilities
Future LRT
RapidTransitStops
GRT_RapidTransitRoutes
Existing GRT Bus Routes
4
5
7
8
9
12
13
14
21
29
31
73
200
201
202
GRT_Stops
N
0
0.5
1
2
Kilometres

Legend

Service Areas

- Existing area to gain service in 2016
- Existing area to be serviced by 2018
- Existing area to lose service by 2018
- Growth area to be serviced by 2021
- Existing area to lose service by 2021
- Currently serviced - mobility concerns
- Existing area with no planned service
- Growth Area - Platinum Drive
- The Boardwalk Extension to Erb Street
- Waterloo Boundaries

Points of Interest

- Train Station
- Airport
- Terminals and Satellite Terminals
- Schools, Colleges, Universities
- Regional Buildings
- Senior Homes
- Malls, Plaza and Grocery Stores
- Libraries and Rec Facilities

Future LRT

- RapidTransitStops
- GRT_RapidTransitRoutes

2018 Bus Service Plan

- Local
- BusPlus
- Express

N

0 0.5 1 2 Kilometres

NEXT STEPS AND STUDY CONTACTS

Following this Public Information Centre, the Study Team will:

- Review all comments
- Draft report and Council presentation
- Final report

Please talk with a Study Team member and drop your comment form in the box before leaving.

You can also provide comments via email or phone to:

David Lukezic, M.Eng., LEL, RPP
Project Manager
WSP Canada Inc.
100 Commerce Valley Drive West
Thornhill, Ontario L3T 0A1
Email: David.Lukezic@wsp.com
Phone: (905) 882-1100 ext. 6622

Philip Hewitson, P.Eng.
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City of Waterloo
Engineering Services
Integrated Planning & Public Works
Email: philip.hewitson@waterloo.ca
Phone: 519-747-8660

APPENDIX

I-3 PIC NO.2 SIGN IN LIST AND COMMENTS

City of Waterloo
Integrated Multi-Modal Transportation Study Waterloo West Side
Public Information Centre (PIC) #2 SIGN-IN

Tuesday, June 5th, 2018
Hauser Haus, Waterloo Memorial Recreation Complex, Waterloo, Ontario

Name	Address	E-mail	Phone No.	Add to Mailing List	
1. LARRY MASSEO	55 COLUMBIA ST E, WATERLOO	larry.masseo@activa.ca	519-886-9400	Yes ☑	No ☐
2. Nancy Carlisle-Weaver	38 Coral Cr. Kitchener (Sunfish Lake)	ncwdw@rogers.com		Yes ☐	No ☐
3. MATT NINOMIYA	100-300 HAGEY BLVD, WATERLOO	matt.ninomiya@stantec.com	519-585-7294	Yes ☒	No ☐
4. Tim M'Cormick	100-300 HAGEY BLVD, WATERLOO	Tim.M'Cormick@STANTEC.com	519.585.7451	Yes ☒	No ☐
5. BRAD MORRIS	100-300 HAGEY BLVD. WATERLOO	BRAD.MORRIS@STANTEC.COM	519-585-7325	Yes ☒	No ☐
6. [illegible]	92 Mcdougall St	isym@edu.uwaterloo.ca		Yes ☐	No ☒
7. Mildred Chan	330 Phillip Street	mwkchan@edu.uwaterloo.ca		Yes ☐	No ☒
8. Byron Clee	330 Philip Street	b79lee@edu-uwaterloo-ca		Yes ☒	No ☐
9. Christopher Algeo	330 Philip Street Waterloo	Christopheralgeo1@gmail.com		Yes ☒	No ☐
10. ROBERT HUMPHREYS	561 GRASSLANDS COURT, WATERLOO	HUMPHREYS.ALL@SYMPATICO.CA	519-883-1843	Yes ☒	No ☐
11. Jan d'Ailly	32 Academy Cr.	Jan@kana.ca		Yes ☒	No ☐
12. TIM OSLAND	529 HAVENDALE PL	presidente@laurelwood.ca		Yes ☒	No ☐

Note: Comments and information regarding this project are being collected in accordance with the *Municipal Freedom of Information & Protection of Privacy Act*. With the exception of personal information, all comments will become a part of the public record.

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Name	Address	E-mail	Phone No.	Add to Mailing List	
13. SANDY LITTLE	CITY OF WATERLOO	sandy.little@waterloo.ca	519.747.6064	Yes ☑	No ☐
14. Greg Romanick	Stantec Consulting Ltd	greg.romanick@stantec.com	519-575-4108	Yes ☑	No ☐
15. Jeff Martens	MTE	jmartens@mte85.com	519-577-9456	Yes ☑	No ☐
16. RAJAN PHILIPS	Paradigm			Yes ☐	No ☐
17.				Yes ☐	No ☐
18.				Yes ☐	No ☐
19.				Yes ☐	No ☐
20.				Yes ☐	No ☐
21.				Yes ☐	No ☐
22.				Yes ☐	No ☐
23.				Yes ☐	No ☐
24.				Yes ☐	No ☐

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Name	Address	E-mail	Phone No.	Add to Mailing List	
49. KEVIN THOMASON	115 CEDAR GROVE RD. WATERLOO, ONT. N2J 3Z4	Kevinthomason@mac.com	519-888-0519	Yes ☑	No ☐
50. Deb Swidrovich	720 Wilmot Line Waterloo N2J 3Z4	deswid@gmail.com	519-746-5257	Yes ☑	No ☐
51.				Yes ☐	No ☐
52.				Yes ☐	No ☐
53.				Yes ☐	No ☐
54.				Yes ☐	No ☐
55.				Yes ☐	No ☐
56.				Yes ☐	No ☐
57.				Yes ☐	No ☐
58.				Yes ☐	No ☐
59.				Yes ☐	No ☐
60.				Yes ☐	No ☐

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City of Waterloo
Integrated Multi-Modal Transportation Study
Municipal Class Environmental Assessment Study Waterloo West Side
Public Information Centre (PIC) #2

Tuesday, June 5th, 2018
Hauser Haus, Waterloo Memorial Recreation Complex, Waterloo, Ontario

COMMENT SHEET

Please provide us with your comments regarding any of the material presented today or in regards to any other issues that you feel are relevant to this project.

Please drop your completed comment sheet in the box provided, or mail / email by June 8th, 2018 to:

Philip Hewitson, P.Eng.
Manager, Active Transportation & LRT Integration
Waterloo City Centre
100 Regina St. S.
Waterloo, ON N2J 4A8
Phone: 519-747-8660
Email: philip.hewitson@waterloo.ca

David Lukezic, M.Eng., LEL, RPP
Consultant Project Manager
WSP Canada Inc.
100 Commerce Valley Drive West
Thornhill, Ontario L3T 0A1
Phone: (905) 882-1100 ext. 6622
Email: david.lukezic@wsp.com

PLEASE PRINT

Name: KEVIN THOMASON

Address: 1115 CEDAR GROVE RD.

WATERLOO, ONT. Postal Code: N2J 3Z4.

E-Mail: Kevinthomason@mac.com Phone: 519-888-0519

COMMENTS:

- NEED TO FIND WAYS TO REDUCE TRAFFIC IN ESL (THE WILMOT LINE, WIDEMAN, CONSERVATION). WATER & PEOPLE AHEAD OF CARS!
- NEED TO DEAL WITH BETTER ALTERNATIVES TO IRA NEEDLES - NEW REGIONAL ROAD ALONGSIDE LANDFILL FROM COLUMBIA - ERB - HIGHLAND EXT. (INCLUDING GLASGOW, WESTVALE, UNIVERSITY. ETC).
- NEED FEWER BOTTLENECKS - BETTER FLOW AT INTERSECTIONS - COLUMBIA & ERBSVILLE, NORTHFIELD & WESTMOUNT, IRA NEEDLES & ERB ST. ETC.

THE CITY OF Waterloo

You may use the reverse of this page if additional space is required.

WSP

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Integrated Multi-Modal Transportation Study
Municipal Class Environmental Assessment Study Waterloo West Side
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Phone: (905) 882-1100 ext. 6622
Email: david.lukezic@wsp.com

PLEASE PRINT

Name: Ivis Yu

Address: 92 Mcdougall Rd.

Postal Code: N2L 3G5

E-Mail: iyyu@pdeo.uwaterloo.ca Phone:

COMMENTS:

- Road + traffic maps were very informative
- Bike lanes/sidewalks feel limited in existing conditions. Right now I feel that the residential areas (near Keats way) are not that accessible to the stores and do not feel pedestrian friendly. The roads nearby feel like they are busy with cars at high speeds.

THE CITY OF Waterloo

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100 Commerce Valley Drive West
Thornhill, Ontario L3T 0A1
Phone: (905) 882-1100 ext. 6622
Email: david.lukezic@wsp.com

PLEASE PRINT

Name: Christopher Algeo

Address: 330 Philip Street

Postal Code: N2L 3G5

E-Mail: Christopheralgeo1@gmail.com Phone: 647 444 7842

COMMENTS:

Has pedestrian/cycling interface with roundabouts been analyzed for safety and user comfort? Lots of people nervous and busy trying to drive through roundabouts, may not be alert or aware to pedestrians trying to cross. Maybe move cross walks further back from traffic circle for driver visability and awareness

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Municipal Class Environmental Assessment Study Waterloo West Side
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Email: david.lukezic@wsp.com

PLEASE PRINT

Name: ROBERT HUMPHREYS

Address: 561 GRASSLANDS COURT

WATERLOO Postal Code: N2V 2R5

E-Mail: HUMPHREYS.ALC@SYMPATICO.CA Phone: 519-883-1840

COMMENTS:

TRAFFIC OPERATIONS PLAN & ADDITIONAL IMPROVEMENTS
ACTIVE TRANSPORTATION PLANNED PROJECTS

SLIDES 10, 11 & 12 ARE ALL GOOD IDEAS THAT SHOULD BE STARTED ASAP.
GET TO IT!!

RA Humphreys

THE CITY OF Waterloo

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Municipal Class Environmental Assessment Study Waterloo West Side
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Email: david.lukezic@wsp.com

PLEASE PRINT

Name: Nancy Carlisle-Weaver

Address: 38 Coral Cr

Kitchener Postal Code: N2M 3H2

E-Mail: ncwdw@rogers.com Phone:

COMMENTS:

-interested to see the plans for improvements → make sure Conservation Dr. between Erbsville Rd & Wilmot Ln stays as it is now - no widening/sidewalks etc. (on poster misleading as it is - says Wilmot Ln to Beaver Cr.)

THE CITY OF Waterloo

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wsp

Westside Waterloo Multimodal Study Open House #2 Feedback
June 14, 2018
By Kevin Thomason

For almost two decades myself and a myriad of other citizens have faced horrendous planning issues on the Westside of Waterloo where it seems individual applications and developments have been approved with little co-ordination or regard to other developments. The result has been an ongoing series of traffic issues that have required a variety of remedies and the acknowledgement that the long-term traffic prognosis is not good, with tens of thousands of residents and new employment positions hoping to be located in an area that is already facing bottlenecks, traffic issues, and a lack of transportation infrastructure in areas.

The Westside Multimodal Study was undertaken to finally have a complete, overarching multimodal transportation analysis to help determine the optimal long-term plan for the success of the Westside of Waterloo.

- disappointment there is no vision
- there is no innovation
- there is no addressing of many of the most serious issues that lead to the commissioning of the study in the first place
- too many errors
- no report
- little citizen engagement – no focus groups, no panels, no advisory committees, charettes or engagement of neighbourhood associations, community groups, etc.
- years with no feedback to the community
- no involvement of the media
- no co-ordination with other municipalities as envisioned

Feedback to Slides

1) Study Overview
- missing all the Wilmot Line issues
- how to deal with more traffic and density than ever envisioned in this area

2) Study Steps
- where are the recommend and evaluate improvements
- where is the vision?
- where are the alternatives on how to protect the Laurel Creek Headwaters ESL???
    - try to find original wording from years ago

3) Existing intersections

- on average operates okay
- neglects peaks at high school every day, Costco every weekend, landfill each Spring/Fall
- Ira Needles rush hour backlogs are greater already than what is reflected here – even with the recent four laning.

- doesn't reflect the massive growth in this area in the past decade – triple traffic on Wilmot Line, massive new developments – Boardwalk, Costco, etc.
- Ira Needles didn't even exist ten years ago….

4) Planned Roadway Improvements are insufficient and reflect the highly constrained nature of access to the area… - thousands of new residents coming to an area with a few east west connections and three north/south connections, only one road – Erb Street goes to the west
- massive amounts of traffic forced onto local streets that were never intended to operate as arteries – Keats Way, Berletts Road, Wideman Road, Clair Hills Roads…. Not good design….

5) PIC #1 Comments
- gridlock concerns – Regional forecasts for Erb Street, Ira Needles Roundabout
- considerable Columbia and Erbsville intersection concerns
- new collector road needed from Columbia Street all the way to Highland or beyond – not just Erb and University
- Wilmot Line / ESL concerns

6) Estimate Growth
- +8,000 employees in an area that has almost no employees currently
- 8,000/41,000 is almost 20% of all new jobs in the entire region is going to be in this one highly concentrated and hard to access part of the region and city... with no rapid transit options and almost no other transit options except for a couple of existing bus routes.

- what about the massive population growth in new residents coming to this area with the build out of Clair Hills, Vista Hills, Conservation Meadows, Erbsville, Erbsville South, etc. – tens of thousands of new vehicle trips each and every day!!!!!!!

7) Existing Traffic, 2031 projections
- no idea what data is being used for traffic projections – previous projections have been so erroneous, inadequate and incomplete they have not even been believeable – hence much of the rationale for this entire study.

- shows on average traffic more than doubling for most of the area

- Wilmot Line more than doubleing of traffic which has already tripled from ten and fifteen years ago. – Not sustainable – 1,000 VPD limit already being exceeded – need to implement measures to reduce traffic in this area – not double it!

- as much traffic on Platnium Drive as Erbsville Road – really?????

8) 2031 LOS – certainly dismal along Columbia Street and Ira Needles as almost every intersection is LOS E or F – failure
- even Laurelwood and Westmount Drive face pretty dismal travel times
- experience has shown that reality is usually worse than these optimistic projections – ie. all of Ira Needles Blvd needing four laning years ahead of schedule

9) 2031 LOS with new improvements
- great to see Boardwalk connector going all the way to Erb Street – needs to go further – all the way to Columbia and all the way to Highland
- good to see the roundabouts at Westmount, Bearinger, Laurelwood, Keats Way
- still need to do something about Columbia Street gridlock, FisherHallman Gridlock

10) Active Transportation
- good to see the awareness and ideas
- Conservation Drive not being improved past Snowcrest – not to Wilmot Line
- Columbia not being improved or connected to Wilmot Line
- FisherHallman transitway should be an LRT – not BRT
    - connect to GO Trains at railway track north of Victoria, South of Glasgow

11) Great Active Transportation Improvement Strategies
- more off road trails for cycling – 8/80….
- too much traffic volume coming in the future for safe road network cycling for anyone but the boldest of cyclists

12) Planned Improvements
- no improvements of Conservation west of SnowCrest
- Erbsville Road and Conservation should be a roundabout too
- No Columbia Street West Extension to Wilmot Line!!!!!!!!!!********!!!!!
    In 2018??? Really – we've already fought this for decades….

- Hydro corridor trail needs to be a Regional Road – not a just a cycle path
- need to show Platnium construction in Red like other projects
-

- need to connect Laurelwood Drive to Westmount Road to Tech Business Park – UW Road

- need to Show Laurel Creek Conservation Area as Green Parkland

- great to see segregated cycling but that still isn't enough – not 8/80 – need to create off-road trail network for really safe and practical active transportation

- no planning or vision in this visionary study – need road network for Conservation Meadows expansion included here – show all their trails and trail network – ensure connectivity for the thousands of people coming to that area!!!!!

- need to look at where people will want to go – no flow pattern created here – just following existing roads. People are going to want to go to:
    - employment lands
    - Costco
    - Boardwalk
    - downtown
    - transit corridor
    - neighbourhoods
    - library, senior homes, shopping centers
    - draw these destinations on the map and see the bottlenecks!!!!

13) Transit Strategies

– the closest LRT station is kilometers from any part of this West side

- only one bus terminal anywhere close…

- volume and density is going to be too great for alternate delivery

- need to plan for Phase 3 LRT in this area – the RGMS already is!!!!

14) Best Practices for Peer Transit

- no comment

15) Future GRT Expansion

- no comment

16) Same

17) Next Steps
    - timeline????

Westside Waterloo Multimodal Study
Open House #2 Feedback
June 14, 2018
By Kevin Thomason

First of all I have to admit how disappointed I am with process for the Westside Multimodal Study and the results presented so far. I appreciate the effort of Phil Hewitson and other staff members though what is being delivered to the community differs greatly from the original goals and ambition of the previous Council that undertook the initiative for this study.

After waiting several years with little feedback or communications for the comprehensive study that was to originally have be completed back in 2015 there has been only occasional spurts of sporadic activity over long gaps of silence and little communication.

Even with regards to the most recent Open House despite being heavily involved in all aspects of this study for years I received no notice either by mail, e-mail or other means of the Public Information.

Instead, I learned from an e-mail forwarded by a neighbour that after months and months with no news (despite numerous enquiries) there was going to be an Open House in just a couple days. There was no information online, no report for the public to review in advance, not even when I specifically inquired to staff was there any information available in advance, and it even took a full day after the Open House for the information boards presented to be available online with no explanation or further information for review or for those who weren't able to make it to the single Open House event – an event that was held in another part of the city and not even in the Westside of Waterloo that is the focus of the study.

Background:

For almost two decades myself and a myriad of other citizens have faced horrendous planning issues on the Westside of Waterloo where it seems individual applications and developments have been approved with little co-ordination or regard to other developments – not only within the City of Waterloo but also between adjacent municipalities such as the City of Kitchener, Wilmot Township, Wellesley Township and Woolwich Township as well as the Region of Waterloo.

The result has been an ongoing series of traffic issues that have required a variety of remedies and the acknowledgement that the long-term traffic prognosis is not good, with tens of thousands of residents and new employment positions hoping to be

located in an area that is already facing bottlenecks, significant traffic issues, and a lack of transportation infrastructure in several areas.

The Westside Multimodal Study was undertaken to finally have a complete, overarching multimodal transportation analysis to help determine the optimal long-term plan for the success of the entire Westside of Waterloo.

The original concept of the study was to include the Region of Waterloo and the neighbouring municipalities to develop a co-ordinated, comprehensive plan to ensure future success and not an entire part of our city and region reduced to daily gridlock with traffic speeds in some places reduced to less than walking speeds as some traffic forecasts predicted.

To the credit of the City of Waterloo, it has proceeded with the study independently without any of the other partners on a greatly extended timeline. However, it appears that the original ambitions, scope, and goals for the study have been greatly diminished.

It is very disappointing that there is no overall vision for the Westside or specific goals that are either articulated or targeted. For example, are there goals for traffic speeds, commute times, transit modal share, active transportation levels that we are striving for? Do we have any vision or goals for this vital part of the city?

If we are to succeed and become a world-class city we can not have part of our city reduced to gridlock daily – a part of the city that is already far removed from rapid transit, rail transit, expressways and main arterial highways.

Already there is only one road that exits the city to the West (Erb Street) as all other routes out of the city dead-end, turn the wrong direction, or end in a local collector road.

There are only a couple of major roads north and south and these already face bottlenecks and congestion issues at times.

There is extremely limited capacity for road expansion or any new roads despite goals/desires to move tens of thousands of more people into this area to live and work.

We need to ensure that there is a strong vision with clear, specific goals and targets for our transportation network – what sort of community are we creating and do we want to live in?

We need to have a clear vision of what we are all working towards and ensure that there are no surprises – not only for future residents but for current and long-time residents as well.

We need to ensure that the most serious issues that lead to the commissioning of this study in the first place are addressed – specifically:

- How do we deal with the rapidly increasing amounts of traffic on the Westside?
- How do we protect the Laurel Creek Headwaters Environmentally Sensitive Landscape from dramatically increasing amounts of traffic cutting through this essential natural preserve and groundwater recharge area?
- How do we prevent the forecasted future gridlock?
- How do we better provision active transportation in this area?
- How do we better provision public transit – including future rapid transit – to this area?

Unfortunately, as already mentioned there is no report or detailed information available to the public so far, the 18 information boards at the Westside Multimodal Study Public Information Centre #2 contained no goals, no vision, no targets or any idea of what we hope to achieve or the kind of community we are working towards.

Instead the Board simply provided a variety of intersection traffic counts, some feedback points from PIC #1 held more than a year ago, and photographs of active transportation and transit improvement strategies.

Unfortunately, there were many errors on the boards, countless omissions and some of the information is quite misleading. Many major things were missed or overlooked completely – such as the entire need to limit traffic on the Wilmot Line and protect the Laurel Creek Headwaters ESL despite a City of Waterloo Council resolution specifically directing that traffic be kept below 1,000 vehicles per day – a number already frequently exceeded.

There has been little citizen engagement to date. There have been no focus groups, no panels, no advisory committees, charettes, or engagement of neighbourhood associations or community groups.

There has been considerable gaps in time with no feedback to the community, there has been no involvement or engagement of the media, and very little information shared with any of the tens of thousands of citizens that already live in this area – most of who I believe have very strong interest and opinions on future transportation.

Also, as mentioned there seems to be little co-ordination with other municipalities involved which is part of the original problem in the first place as each municipality is planning with little regard for surrounding municipalities or impacts.

Specific Feedback to Information Boards Presented

1) Title Slide
- nice slide but no information who at the City or WSP is undertaking this study or who to contact

2) Purpose of PIC #1
- no overview, context or purpose of the entire study is even provided
- no information or outcomes from PIC #1 is provided despite the slide title
- no Integrated Multi-modal Transportation Study has been provided to comment on

3) Study Overview
- missing any sort of goals, targets, vision for the city or community
- missing all the Wilmot Line issues and the need to better protect the Laurel Creek Headwaters ESL
- omits how to deal with more traffic and density than ever originally envisioned in this area
- provides no information on current population, future anticipated population/employment levels
- map shows no road connections or any information in surrounding municipalities

4) Study Steps
- good overview of some steps involved in the project
- missing all dates, timeline, and milestones
- if we are already past the step of "Recommend and Evaluate Improvements" where are the recommendations and evaluations?
- where is the vision?
- what is the anticipated timeline for the next steps, report to council, etc.?
- where are the alternatives on how to protect the Laurel Creek Headwaters ESL???
- the original study plan from several years ago was to investigate a wide variety of options for the Westside such as closing the Wilmot Line, closing Wideman Road, closing Conservation Drive, making the Wilmot Line one-way, building a new arterial road under the hydro corridor parallel to Ira Needles Blvd, etc. Will this be in the final report or how will limiting traffic to comply with DSO4-42 be addressed?

5) Existing Intersections
- how can a slide have only two bullet points that are completely contradictory?
- how can all intersections operate at acceptable levels but some already be experiencing delays of LOS E or F which are unacceptable levels?
- by using an average this neglects significant peaks at the Sir John A. MacDonald High School every day, Costco every weekend, the Regional Landfill each Spring/Fall

- Ira Needles rush hour backlogs are greater already than what is reflected here – even with the recent four laneing.
- this slide doesn't reflect the massive growth in this area in the past decade – triple traffic on Wilmot Line, massive new developments – Boardwalk, Costco, etc.
- this slide fails to note that some road such as Ira Needles Blvd didn't even exist ten years ago yet is already so congested that some roundabouts experience considerable queues at peak periods.

6) Planned Roadway Improvements

- planned improvements are insufficient and reflect the highly constrained nature of access to the area… - thousands of new residents coming to an area with a few east west connections and three north/south connections, only one road – Erb Street goes to the west
- massive amounts of traffic forced onto local streets that were never intended to operate as arteries – Keats Way, Berlett's Road, Wideman Road, Clair Hills Roads…. Not good design….

7) PIC #1 Comments

- most concerns at the PIC were not about active transportation but about the rapidly increasing traffic and numerous issues already being experienced in the area.
- gridlock concerns – Regional forecasts for Erb Street and Ira Needles Roundabout show significant future congestion issues with few options for remedy.
- considerable Columbia and Erbsville intersection concerns were raised yet no improvements were made to the intersection despite the recent four laneing of Columbia Street.
- the need for a new collector road from Columbia Street all the way south to Highland and beyond – not just Erb and University was discussed extensively
- numerous concerns about traffic on the Wilmot Line and in the Laurel Creek Headwaters ESL were raised.

8) Estimated Growth

- this is a very misleading slide because there is no context provided and only partial information:
- +8,000 employees in an area that has almost no employees currently
- 8,000/41,000 is almost 20% of all new jobs in the entire region is going to be in this one highly concentrated and hard to access part of the region and city... with no rapid transit options and almost no other transit options except for a couple of existing bus routes.
- this slide appears to completely overlook all the massive population growth in new residents coming to this area with the build out of Clair Hills, Vista Hills, Conservation Meadows, Erbsville, and Erbsville South, neighourhoods – tens of thousands of new vehicle trips each and every day!!!!!!!

- the projected population growth for Erbsville alone is greater than the entire town of Collingwood – all into an area with only three roads reaching it! None of this is reflected in this estimated growth slide.

9) Existing Traffic, 2031 Traffic Volume Projections

- no idea what data is being used for traffic projections – all previous projections have been so erroneous, inadequate and incomplete they have not even been believable – hence much of the rationale and impetus for this entire study.
- shows on average traffic more than doubling for most of the area
- Wilmot Line more than doubling of traffic which has already tripled from ten and fifteen years ago. – Not sustainable – 1,000 VPD limit already being exceeded – not acceptable - need to implement measures to reduce traffic in this area not double it!
- as much traffic on Platinium Drive as Erbsville Road – really????? Not credible projections at all.

10) 2031 Traffic Operations with Planned Improvements

– certainly dismal along Columbia Street and Ira Needles as almost every intersection is LOS E or F – failure
- even Laurelwood Drive and Westmount Drive face pretty dismal travel times
- experience has shown that reality is usually worse than these optimistic projections – i.e. all of Ira Needles Blvd needing four laneing years ahead of schedule/projections

11) 2031 Traffic Operations with Additional Improvements

- great to see Boardwalk connector going all the way to Erb Street – needs to go further – all the way north to Columbia Street and all the way south to Highland Ave!
- good to see the roundabouts at Westmount, Bearinger, Laurelwood, Keats Way
- still need to do something about Columbia Street gridlock, Fisher Hallman gridlock

12) Active Transportation

- good to see the awareness and ideas
- Conservation Drive is not being improved past Snowcrest – not to Wilmot Line
- Columbia is not being improved or connected to Wilmot Line!
- Fisher Hallman transitway needs to be an LRT – not BRT- see latest draft of RGMS
- connect to GO Trains at railway track north of Victoria, South of Glasgow at Ira Needles – opportunity to create a West Waterloo GO Train station here

13) Great Active Transportation Improvement Strategies

- more off road trails are needed for cycling – we need to be an 8/80 community and too often it would not be safe for an 8 year old or and 80 year old to be using the

existing unprotected cycling lanes on our busy arterial roads with such fast moving traffic.
- too much traffic volume coming in the future for safe road network cycling for anyone but the boldest of cyclists

14) Planned Improvements
- nice slide but several errors including - no improvements of Conservation Drive west of SnowCrest Place
- Erbsville Road and Conservation Drive needs to be a roundabout too – particularly for safety given the odd angle of this intersection where most drivers would be turning left. Also there needs to be a way to discourage traffic from cutting through the Laurel Creek ESL.
- the Laurel Creek Headwaters Environmentally Sensitive Landscape needs to be shown on this map
- the Laurel Creek Conservation Area needs to be shown on this map
- adjacent municipalities and their roads need to be shown on this map! The whole point of this study is to look at the entire multimodal transportation and connectivity situation on the Westside. The map completely missing this point and showing no roads in adjacent municipalities highlight just how off-track this study has gotten!
- no Columbia Street West Extension to Wilmot Line!!!!
    - In 2018??? Really – we've already fought this for decades…. Columbia is not to connect to the Wilmot Line – ever! It was a condition of the entire Vista Hills District Plan approval.
- Hydro corridor trail needs to be a Regional Road to provide an alternative and backup to Ira Needles Blvd – not a just a cycle path
- need to show Platinium Drive construction in red like other planned projects
- need to connect Laurelwood Drive to Westmount Road in the David Johnson Research and Technology Business Park for better east-west connectivity
- great to see segregated cycling but that still isn't enough – not 8/80 – need to create off-road trail network for really safe and practical active transportation
- no planning or vision in this visionary study – need road network for Conservation Meadows expansion included here – show all their trails and trail network – ensure connectivity for the thousands of people coming to that area!!!!! Many of these roads have already been designed and approved by Council.
- need to look at where people will want to go – no flow pattern created here – just following existing roads. People are going to want to go to:
    - employment lands
    - Costco
    - Boardwalk
    - downtown
    - transit corridor
    - neighbourhoods
    - library, senior homes, shopping centers

- draw these destinations on the map and see the bottlenecks or how difficult some routes are to get there!

15) Recommended Transit Strategies
- this slide is totally misleading and most of it not even relevant for this area
- the closest LRT station is kilometers from any part of this West side
- only one bus terminal anywhere close… at the Boardwalk
- volume and density is going to be too great for alternate delivery
- need to plan for Phase 3 LRT in this area – an East-West LRT route through the Region – the RGMS already is!

16) Best Practices for Transit
- peer examples provided are obvious and common sense (i.e. all transit systems need to be accessible and connected, of course increasing service improves ridership, etc.).
- good to see alternative delivery ideas but they are not viable solutions for the Westside without significant new funding.

17) Future GRT Expansion
- good to see future GRT expansion
- future LRT needs to show potential Phase 3 (East-West) routes

18) Future GRT Expansion
- good to see future GRT expansion
- future LRT needs to show potential Phase 3 (East-West) routes

19) Next Steps and Contacts
- needs to provide study timeline and anticipated timeline for Draft Report and Council Presentation

Conclusion

Hopefully this helps to provide some feedback and ideas for improvements to the study.

I really hope that there will be additional dialog and opportunity for feedback prior to any Council Presentation and Final Report – particularly given so many outstanding issues and concerns for the future of this area. If we are going to succeed as a community we need to get this planning right.

I have attached below a PDF of a map that I drew several years ago at an earlier point in the Westside Multi-Modal Study showing the potential route for a Westside Collector Road parallel to Ira Needles Blvd that would provide an alternative and help to alleviate many of the bottlenecks facing this area. It also shows future active transit, GO Train and LRT stations.

There needs to be more dialog, more collaboration with the community, more involvement of adjacent municipalities. There needs to be more information considered, more innovation and solutions presented and we need to then rally everyone to work towards the agreed upon solutions and vision over the coming decades.

Thank you for all the work and efforts to date and I look forward to continuing to try to create the best possible community for everyone. Please feel free to contact me any time with questions, ideas, or for clarification.

Sincerely,
Kevin Thomason

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Waterloo, Ontario
N2J 3Z4

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Potential Westside Waterloo Road and Transportation Improvements



Map Courtesy of Google Maps 2014

Waterloo Westside Roads

- Costco Location
- Proposed GO Train Station
- Possible LRT Stations

- Existing Road (no change)
- Upgraded Road (already planned)
- Proposed New Road/Upgrade
- Proposed New Multi-use Trail
- Possible Future LRT Route - Phase 3

Kevin Thomason
April 9, 2015

APPENDIX

I-4 PIC NO. 2 COMMENTS AND CONSIDERATION OF COMMENTS RECEIVED

Comments Provided By	Summary of Comments Received	Consideration of Comments Received
Written Comments		
Resident Comment	1. Reduce traffic on Wilmont Ln, Wideman Rd and Conservation Dr. 2. Water and people should have priority over cars. 3. Better alternatives to Ira Needles Blvd – new Regional Rd alongside Land Fill from Columbia St – Erb St – Highland St, including Glasgow St, University Ave, etc.). 4. Need fewer bottlenecks – better flow at intersections – Columbia St at Erbsville Rd, Norfield Dr at Westmount Rd, Ira Needles Blvd at Erb St, etc.	1. Traffic on Wilmont Ln, Wideman Rd and Conservation Dr is expected to increase as a result of development and background growth. No additional connections are proposed to Wilmot Ln. With the planned roadway improvements the intersections along Conservation Dr and Wilmot Ln are predicted to operate at LOS C or better. 2. This study is a multi-modal transportation study and focuses on all modes of travel (vehicles, active transportation and transit). 3. The study recommends that the Boardwalk connects to Erb St. The Boardwalk would connect between Erb St and University Dr and Platinum Dr would connect between Columbia St and Erb St providing an alternative to travelling along Ira Needles Blvd. Both roadways would be under the City's jurisdiction. 4. WSP recommended additional improvements along Columbia Street and Erbsville Rd: • Introduce an Eastbound Right-turn Lane • Introduce a Second Eastbound Through Lane • Introduce a Second Westbound Through Lane • Introduce a Second Northbound Through Lane • Introduce a Southbound Right-turn Lane • Improve Signal Timing Plan • Include improvements for active transportation With these additional improvements the intersection operation is expected to improve from LOS D to LOS C in the AM peak hour and from LOS F to LOS D in the PM peak hours. Northfield Dr at Westmount Rd is expected to operate at LOS B in the AM peak hour and LOS C in the PM peak hour. No additional improvements are recommended for this intersection. With the planned growth and planned improvements Ira Needles Blvd and Erb St would operate with an RFC exceeding 1.0 for several approaches. Therefore, WSP recommends connecting the Boardwalk to Erb St, which would divert some traffic from Ira Needles Blvd at Erb St and improve the operations.
Resident Comment	1. Road and traffic maps were informative 2. Bike lanes / sidewalks feel limited in existing conditions. Residential areas near Keats Way are not accessible to stores and do not feel pedestrian friendly. The roads nearby feel like they are busy with cars at high speeds.	1. WSP acknowledges this comment. 2. WSP identified Keats Way as a potential corridor with separated cycling facilities as well as several locations for pedestrian crossing improvements.
Resident Comment	1. Has pedestrian/cycling interface with roundabouts been analyzed for safety and user comfort? 2. Lots of people nervous and busy trying to drive through roundabouts, may not be alert or aware of pedestrians trying to cross. Maybe move crosswalks further back from traffic circles for driver visibility and awareness	1. Safety was not assessed as part of this study as it was not included in the scope of work. 2. It is acknowledged that roundabouts can be challenging for pedestrians to cross due to inconsistent drive behaviour. The Region of Waterloo website has tips to educate drivers and pedestrians on navigating roundabouts. Education is, and will continue to be an important aspect of improving the transportation network for all user groups/modes.
Resident Comment	1. Traffic Operations for planned and additional improvements, active transportation are all good ideas that should be started ASAP.	1. Some of the planned improvements have associated schedules as per the Town and Regional capital programs. This study identifies proposed additional improvements. These

Comments Provided By	Summary of Comments Received	Consideration of Comments Received
		improvements will be confirmed through monitoring traffic, future TMP's, future EA's and individual intersection studies. Once these future projects are confirmed they would be included in the City and Regional capital programs.
Resident Comment	1. Interested to see the plan for improvements 2. Make sure Conservation Dr between Erbsville Rd and Wilmot Ln stays at it is now – no widening / sidewalks etc. Poster misleading as it is – says Wilmot Ln to Beaver Cr.	1. The recommended improvements were shown at the PIC: • Board #6 showed planned roadway improvements • Board #11 showed additional recommended roadway improvements • Board #14 showed planned and additional recommended active transportation improvements • Board #17 and #18 showed planned transit improvements 2. The City of Waterloo has completed a Schedule 'C' municipal class environmental assessment (EA) study for the section of Conservation Dr from Beaver Creek Rd to Wilmot Ln and Beaver Creek Rd. The Class EA was completed to identify and implement infrastructure upgrades to service proposed growth within the area known as Beaver Creek Meadows. The final environmental study report was completed on December 14, 2015. With the completion of the EA study in January 2016, Stantec Consulting is proceeding with the detailed design for the preferred Conservation Dr and Beaver Creek Rd reconstruction and associated infrastructure servicing works identified through the EA process. No active transportation improvements are planned between Wilmot Ln and Snowcrest Place, and the active transportation improvements figure was updated accordingly.
Resident Comment	1.Resident stated the following regarding the overall study: • disappointment there is no vision, goals or targets • there is no innovation • there is no addressing of many of the most serious issues that lead to the commissioning of the study in the first place (dealing with increasing traffic, protection of the Laurel Creek Headwaters environmentally sensitive landscape, prevention of future gridlocks, providing better active transportation and public transit (including rapid transit)) • too many errors and omissions, such as limiting traffic on Wilmot Line and protecting the Laurel Creek Headwaters ESL despite City of Waterloo Council resolution to specifically keep traffic below 1,000 veh/day, a number frequently exceeded. • no report • little citizen engagement – no focus groups, no panels, no advisory committees, charettes or engagement of neighbourhood associations, community groups, etc. • years with no feedback to the community • no involvement of the media • no co-ordination with other municipalities as envisioned Resident stated the following regarding the PIC Boards:	1. The study being completed by WSP is to evaluate the implications of increased development in the west Waterloo on the transportation system and provide recommendations. The study is currently ongoing and a report will be prepared as part of the study. The City of Waterloo and WSP have worked together to obtain feedback from the community. Two PICs were held on April 4th, 2017, and June 5th, 2018, the first to discuss existing conditions and operations within the study area and the second to discuss the proposed recommendations to the study area made as part of this study. Feedback received through consultation was an integral part of the study and for developing recommendations.

Comments Provided By	Summary of Comments Received	Consideration of Comments Received
	2.Board #1: no information who at the City or WSP is undertaking this study or who to contact 3.Board #2: - no overview, context or purpose of the entire study is even provided -no information or outcomes from PIC#1 is provided despite the title -no Integrated Multi-modal Transportation Study has been provided to comment on 4.Board #3: -missing any sort of goal , targets or vision for the city or community -missing all Wilmot Line issues -how to deal with more traffic and density than ever envisioned in this area -provides no information on current population, future anticipated population/employment levels -map shows no road connections or any information in surrounding municipalities 5.Board #4: -missing all dates, timeline and milestones -where are the recommend and evaluated improvement? -where is the vision -where are the alternatives on how to protect the Laurel Creek Headwaters ESL? - try to find original wording from years ago - the original study plan from several years ago was to investigate a wide variety of options for the Westside such as closing the Wilmot Line, closing Wideman Road, closing Conservation Drive, making the Wilmot Line one-way, building a new arterial road under the hydro corridor parallel to Ira Needles Blvd, etc. Will this be in the final report or how will limiting traffic to comply with DSO4-42 be addressed? -what is the anticipated timeline for the next steps, report to council, etc.? 6.Board #5: -how can a slide have only two bullet points that are completely contradictory? -how can all intersections operate at acceptable levels but some already be experiencing delays of LOS E or F which are unacceptable levels? - neglects peaks at high school every day, Costco every weekend, landfill each Spring/Fall - Ira Needles rush hour backlogs are greater already than what is reflected here – even with the recent four laning -doesn't reflect the massive growth in this area in the past decade – triple traffic on Wilmot Line, massive new developments – Boardwalk, Costco, etc. -Ira Needles didn't even exist ten years ago and is yet already so congested 7.Board #6: -Planned Roadway Improvements are insufficient and reflect the highly constrained nature of access to the area… - thousands of new residents coming to an area with a few east west connections and three	2. Board #1: Contact information has been provided on Board #19 of the PIC. 3. Board #2 provides information on the purpose of PIC#2, which was focused on the review of future conditions and recommendations made to the study area. Comments provided by PIC#1 have been provided in Board #7. At the time of the PIC the study was not finalized as feedback obtained at public information centres is considered within the analysis. 4. Board #3 provides a summarized overview of the study objectives, which is to evaluate the implications of increased development in the west Waterloo on the transportation system and provide recommendations. The study objectives and study area were identified in the RFP. Wilmot Line is included in the study area but this is not a stand-alone corridor study focusing on Wilmot Line. The population and employment growth are set by the municipalities (Region and City) in their Official Plans. Current and projected population and employment densities are included in Board #8. 5. Board #4 provides each steps of the Integrated Multi-Modal Transportation Study Process as an overview for residents to see what is involved in the study and at what points each PIC occurs. The recommended and evaluated roadway improvements are included in Board #11, active transportation improvement are included in Board #14 and transit strategies in Board #15. Protection of the Laurel Creek Headwaters is not part of the scope this Study as the study solely relates to transportation (traffic, transit and active transportation). The creation of new roadways, or the closure of existing roadways is not part of the scope of this study. The next step for this study is a presentation of the study findings to City Council on June 25th, 2018. 6. Board #5: The intersections operate with acceptable overall level of service under existing conditions. Some turning movements within the intersections operate at LOS E or F. The periods of analysis included within the study are the weekday a.m. and p.m. peak hours. It is also professional practice to assess the aforementioned peak hours as they are generally when roadways carry most traffic and are traditionally evaluated during these periods. It would not be appropriate to assess the network based on high school peak hours. Seasonal event that generate high volumes of traffic (such as the landfill) are not doing so on a year long basis and are not to be used as the basis for potential signal timing or geometric recommendations. The summary of traffic operations included in Board #5 is based on recent traffic volumes collected within the last 3 years. 7. Board #6: Planned roadway improvements are based on the City / Region capital plans and individual EA's.

Comments Provided By	Summary of Comments Received	Consideration of Comments Received
	north/south connections, only one road – Erb Street goes to the west - massive amounts of traffic forced onto local streets that were never intended to operate as arteries – Keats Way, Berletts Road, Wideman Road, Clair Hills Roads…. -Not good design… 8.Board #7: - most concerns at the PIC were not about active transportation but about the rapidly increasing traffic and numerous issues already being experienced in the area - gridlock concerns – Regional forecasts for Erb Street, Ira Needles Roundabout - considerable Columbia and Erbsville intersection concerns - new collector road needed from Columbia Street all the way to Highland or beyond – not just Erb and University - Wilmot Line / ESL concerns 9.Board #8: -this is a very misleading slide because there is no context provided and only partial information - +8,000 employees in an area that has almost no employees currently - 8,000/41,000 is almost 20% of all new jobs in the entire region is going to be in this one highly concentrated and hard to access part of the region and city... with no rapid transit options and almost no other transit options except for a couple of existing bus routes. - what about the massive population growth in new residents coming to this area with the build out of Clair Hills, Vista Hills, Conservation Meadows, Erbsville, Erbsville South, etc. – tens of thousands of new vehicle trips each and every day!!!!!!! -the projected population growth for Erbsville alone is greater than the entire town of Collingwood – all into an area with only three roads reaching it! None of this is reflected in this estimated growth slide 10.Board #9: - no idea what data is being used for traffic projections – previous projections have been so erroneous, inadequate and incomplete they have not even been believable – hence much of the rationale for this entire study. -shows on average traffic more than doubling for most of the area -Wilmot Line more than doubling of traffic which has already tripled from ten and fifteen years ago. – Not sustainable – 1,000 VPD limit already being exceeded – need to implement measures to reduce traffic in this area – not double it! -as much traffic on Platinum Drive as Erbsville Road – really????? 11.Board #10: – certainly dismal along Columbia Street and Ira Needles as almost every intersection is LOS E or F – failure - even Laurelwood and Westmount Drive face pretty dismal travel times - experience has shown that reality is usually worse than these optimistic projections – ie. all	8. Board #7: this board summarizes the comments received in PIC#1. 9. Board #8: The City directed to assess additional 8,000 employees in Zone 141 and to assess and its impact of the surrounding road network. As part of this study, recommendations to the existing network are proposed to accommodate the proposed employment lands as per the PIC boards. The population is also estimated to increase in the Study Area A and B by 6,400 (21% increase). 10.Board #9: The 2031 projected traffic volumes contained within this study have been derived from the Regional forecasting model, with the growth from the forecasted years 2017 to 2031 contained within the model applied to the existing 2017 volumes. 11.Board #10: This board shows projected traffic operations of the 2031 volumes operating with the projected growth and planned roadway improvements. The planned roadway improvements would not be sufficient to accommodate the anticipated growth and operational constraints would be experience at many intersections. Additional improvements are

Comments Provided By	Summary of Comments Received	Consideration of Comments Received
	of Ira Needles Blvd needing four laning years ahead of schedule 12.Board #11: - great to see Boardwalk connector going all the way to Erb Street – needs to go further – all the way to Columbia and all the way to Highland - good to see the roundabouts at Westmount, Bearinger, Laurelwood, Keats Way - still need to do something about Columbia Street gridlock, Fisher-Hallman Gridlock 13.Board #12: - good to see the awareness and ideas - Conservation Drive not being improved past Snowcrest – not to Wilmot Line - Columbia not being improved or connected to Wilmot Line - Fisher-Hallman transitway should be an LRT – not BRT - connect to GO Trains at railway track north of Victoria, South of Glasgow 14.Board #13: Great Active Transportation Improvement Strategies - more off-road trails for cycling – 8/80…. - too much traffic volume coming in the future for safe road network cycling for anyone but the boldest of cyclists 15.Comment about overall Study Improvements: - no improvements of Conservation west of SnowCrest - Erbsville Road and Conservation Drive needs to be a roundabout too – particularly for safety given the odd angle of this intersection where most drivers would be turning left. Also there	recommended as shown in Board #11 to improve traffic operations. 12.Board #11: This board shows traffic operations with applied recommendations to the boundary road network. Intersections northwest of Erbsville Road at Erb Street are projected to operate with good overall LOS C or better, which does not warrant an extension of The Boardwalk to the north. 13.Board #12: The City of Waterloo has completed a Schedule 'C' municipal class environmental assessment (EA) study for the section of Conservation Dr from Beaver Creek Rd to Wilmot Ln and Beaver Creek Rd. The Class EA was completed to identify and implement infrastructure upgrades to service proposed growth within the area known as Beaver Creek Meadows. The final environmental study report was completed on December 14, 2015. With the completion of the EA study in January 2016, Stantec Consulting is proceeding with the detailed design for the preferred Conservation Dr and Beaver Creek Rd reconstruction and associated infrastructure servicing works identified through the EA process. No active transportation improvements are planned between Wilmot Ln and Snowcrest Place, and the active transportation improvements figure was updated accordingly. WSP corrected the board and acknowledges that Columbia St is not being connected to Wilmot Line. The type of transit vehicle (LRT vs BRT) on Fisher-Hallman will be determined in the future EA for the corridor. 14.Board #13: WSP is recommending that key existing off-road trails be upgraded to a minimum width of 3.0m, with a paved /asphalt surface and be upgraded to “Major Active Transportation Routes”, as recognized in the City of Waterloo Transportation Master Plan (2011). The following existing off-road trail facilities are recommended to be included as “Major Active Transportation Routes”: • Bennington Gate Hydro Corridor (Bennington Gate to Erbsville Road); • Bennington Gate Hydro Corridor (West) (Erbsville Road to Path to Brandenburg Blvd.); and • Keatsway Hydro Corridor (Erbsville Road to Fischer Hallman Road). A major opportunity exists in utilizing the north-south hydro, which would allow for the implementation of a major off-road active transportation corridor connecting Columbia Street West with Erb Street West. 15.Regarding the comments about the overall improvements recommended as part of this study: - Recommendations have been made based on projected traffic operations of the study intersections contained within the scope of this IMMTS. Intersections outside of this study scope were not assessed.

Comments Provided By	Summary of Comments Received	Consideration of Comments Received
	needs to be a way to discourage traffic from cutting through the Laurel Creek ESL. - the Laurel Creek Headwaters Environmentally Sensitive Landscape needs to be shown on this map - the Laurel Creek Conservation Area needs to be shown on this map - adjacent municipalities and their roads need to be shown on this map! The whole point of this study is to look at the entire multimodal transportation and connectivity situation on the Westside. The map completely missing this point and showing no roads in adjacent municipalities highlight just how off-track this study has gotten - No Columbia Street West Extension to Wilmot Line!!!!!!!!!********!!! In 2018??? Really – we've already fought this for decades…. - Hydro corridor trail needs to be a Regional Road – not a just a cycle path - need to show Platinum construction in Red like other projects - need to connect Laurelwood Drive to Westmount Road to Tech Business Park – UW Road - need to Show Laurel Creek Conservation Area as Green Parkland - great to see segregated cycling but that still isn't enough – not 8/80 – need to create off-road trail network for really safe and practical active transportation - no planning or vision in this visionary study – need road network for Conservation Meadows expansion included here – show all their trails and trail network – ensure connectivity for the thousands of people coming to that area!!!!! - need to look at where people will want to go – no flow pattern created here – just following existing roads. People are going to want to go to: - employment lands - Costco - Boardwalk - downtown - transit corridor - neighbourhoods - library, senior homes, shopping centers - draw these destinations on the map and see the bottlenecks!!!! 16.Board #15: -this slide is totally misleading and most of it not even relevant for this area - the closest LRT station is kilometers from any part of this West side - only one bus terminal anywhere close… - volume and density is going to be too great for alternate delivery - need to plan for Phase 3 LRT in this area - an East-West LRT route through the Region - the RGMS already is!!!! 17.Board #16: - peer examples provided are obvious and common sense (i.e. all transit systems need to be accessible and connected, of course increasing service improves ridership, etc.)	- WSP has not made recommendations to improve Conservation Drive west of Snow Crest - WSP has not made recommendation to connect Columbia St to Wilmot Line - Future roundabouts are planned and were determined by the Region and City. The intersection of Erbsville Road at Columbia Street is projected to operate at LOS D or better with applied recommendations, which is deemed acceptable. - The Laurel Creek Headwaters ESL and Conservation Area were not included within the scope of this study, similarly with any intersection and roadway not included within the PIC presentation. - The feasibility of the Hydro Corridor becoming a regional road is an assessment that is outside of the scope of this study. - WSP acknowledges the comment regarding Platinum being in red in the figures, as other planned improvements. - The intersection of Laurelwood Drive with Westmount Road is not part of the scope of this study and was not considered in the analysis or shown on the figures. - WSP has made a number of recommendations regarding off-road trail as identified in above responses - The area of Conservation Meadows was assessed in detail in the Stantec Consulting Transportation Overview Study, November 2015 for Beaver Creek Road and Conservation Drive Upgrades and Extension Municipal Class EA - The Regional Travel Demand Forecasting Model is a comprehensive model transportation model that include four steps that are standard practice: trip generation, trip distribution, mode choice and trip assignment. It is not simply based on existing patterns. 16.Board #15: WSP acknowledges these comments. However alternative delivery options work in areas where ridership volumes may be inconsistent and in locales of similar geography. In the future if ridership volumes present themselves in favour of fixed route transit services they will be considered by GRT. Lastly future phases of LRT will be based on the success of the first phase of ION to determine whether the benefits act in favour of the overall urban plan. 17.Board # 16: The examples provided show that other transit systems have implemented alternative delivery. However alternative delivery options work

Comments Provided By	Summary of Comments Received	Consideration of Comments Received
	- good to see alternative delivery ideas but they are not viable solutions for the Westside without significant new funding 18.Boards #17 and #18: - good to see future GRT expansion - future LRT needs to show potential Phase 3 (East-West) routes 19.Board #19: - needs to provide study timeline and anticipated timeline for Draft Report and Council Presentation	in areas where ridership volumes may be inconsistent and in locales of similar geography. 18. Board # 17 and #18: Future phases of LRT will be based on the success of the first phase of ION to determine whether the benefits act in favour of the overall urban plan. 19.Board #19: The next step as part of the study process is a presentation to City Council on June 25th, 2018 after which a draft report will be posted for 30 days. The Council will make the decision on September 10, 2018.
Comments Discussed During the PIC		
Resident Comment	1. Measures should be taken to reduce traffic on Wilmot Ln. There are concerns regarding speeding, safety and environmental concerns.	1. Two-way traffic on Wilmot Ln is predicted to increase by 130 vehicles in the AM peak hour (total traffic of 230 vehicles) and 150 vehicle in the PM peak hour (total traffic of 250 vehicles) as a result of development and background growth. Based on the Region's VISUM model, the two-way capacity of the roadway is 1,800 vehicles per hour and there is significant reserve capacity. The intersections along Wilmot Ln are predicted to operate at LOS C or better. No additional connections are proposed to Wilmot Ln that would add traffic from the subdivisions. There are no adverse effects on this roadway from a capacity or traffic operations perspective. WSP has not reviewed / assessed speed, safety / collisions and environmental impacts for this corridor as it was not within the scope of this study. A separate corridor study or EA would need to be undertaken to review and assess these matters. Wilmot Ln is within the jurisdiction of Wilmot Township and WSP understands that currently no corridor study or EA is planned.
Resident Comment	1. The west side of Waterloo (and Waterloo as a whole) lacks "good" east-west active transportation corridors.	1. Recommended Active Transportation improvements include east-west corridors, such as separated cycling facilities on arterial roads, similar to what is currently being implemented on Columbia Street; improving connectivity / closing gaps in the hydro corridor trail parallel to Keats Way and improved pedestrian and cyclist crossings of arterial roads at key locations (e.g. the hydro corridor trail south of Keats Way at Erbsville Road.
Resident Comment	1. Trail requested on the south side of Bearinger Road (Laurelwood Drive to Westmount Road).	1. A multi-use trail link on the south side of Bearinger Road between Laurelwood Drive and Westmount Road was added to the recommended Active Transportation improvements.
Resident Comment	1. Preference for wider multi-use paths on both sides of major streets for cycling in addition to sidewalks on both sides of the street. Multi-use paths should not always be used to replace sidewalks but should complement them.	1. Recommended Active Transportation improvements include separated cycling facilities, multi-use trails and sidewalks on arterial roads. Depending on location /context, designs for individual sections may include a sidewalk and multi-use trail on both sides or a sidewalk on one side and multi-use trail on the opposite side.
Resident Comment **Resident Comment**	1. There is a need for an active transportation bridge over Laurel Creek (behind the "Waterloo Sports Park"), providing an active transportation connection between Westmount Road/Laurelwood Drive and the trail network on the east side of Laurel Creek.	1. A multi-use trail link from Laurelwood Drive, crossing Laurel Creek, connecting to the existing trail on the east side of Laurel Creek was added to the recommended Active Transportation improvements. Although this link is outside of the study area it has been included because of the significant trail connectivity it creates.
Resident Comment	1. Pedestrians have difficulty crossing roundabouts, particularly at rush hour.	1. It is acknowledged that roundabouts can be challenging for pedestrians to cross due to inconsistent drive behaviour.

Comments Provided By	Summary of Comments Received	Consideration of Comments Received
	2. lane roundabouts are especially challenging, as one driver may stop for pedestrians but another won't.	2. The Region of Waterloo website has tips to educate drivers and pedestrians on navigating roundabouts. Education is, and will continue to be an important aspect of improving the transportation network for all user groups/modes.
Resident Comment	1. Strong dislike for curb-face sidewalks. Would much prefer to see a grass buffer between the street and the sidewalk.	1. A buffer between the edge of sidewalk and curb is preferred where space permits, particularly along roads where vehicle traffic volumes and speeds are higher.
Resident Comment	1. Support for using hydro corridors as off–road "bike highways" 2. Strong support for north-south hydro corridor as bikeway (parallel to The Boardwalk), providing pedestrian and cyclist access to the Boardwalk and future employment lands.	1. Recommended active transportation improvements include improved connectivity and upgrades to existing trails within hydro corridors, for example the hydro corridor trail parallel to Keats Way. 2. Recommended active transportation network improvements include a multi-use trail within the hydro corridor parallel to St. Moritz Ave., south across Erb St. West and along the west side of The Boardwalk. This multi-use trail would include direct connections into the future employment area and The Boardwalk at strategic locations.
Resident Comment	1. Pedestrians and cyclists are often seen using the emergency access off Wilmot Line (e.g. between Wilmot Line and Rock Elm St.). The gates at these entrances should be made to be more pedestrian and cyclist friendly, otherwise they are forced to go out of their way.	1. The City of Waterloo has completed a Schedule 'C' municipal class environmental assessment (EA) study for the section of Conservation Dr from Beaver Creek Rd to Wilmot Ln and Beaver Creek Rd. The Class EA was completed to identify and implement infrastructure upgrades to service proposed growth within the area known as Beaver Creek Meadows. The final environmental study report was completed on December 14, 2015. With the completion of the EA study in January 2016, Stantec Consulting is proceeding with the detailed design for the preferred Conservation Dr and Beaver Creek Rd reconstruction and associated infrastructure servicing works identified through the EA process. No active transportation improvements are planned between Wilmot Ln and Snowcrest Place.
Resident Comment	1. Comment that the Region does not want trails in Schaeffer's Woods.	1. Recommended active transportation improvements do not include trails in Schaffer's Wood.

Appendix J

WESTHILL DISTRICT
NORTH-SOUTH COLLECTOR ROAD STUDY
WATERLOO, ONTARIO

STAGE 1 ENVIRONMENT IMPACT STUDY



Prepared By:

WSP Canada Group Ltd.
December 2018

TABLE OF CONTENTS

TABLE OF CONTENTS I

1.0 INTRODUCTION & SITE OVERVIEW 1

2.0 STUDY APPROACH 2

2.1 Field Survey Chronology 4

2.1.1 Area 1 (Waterloo Commons, HEPC, RMOW, Home Hardware) 4

2.1.2 Area 2 (1130814 Ontario Inc. property) 7

3.0 EXISTING CONDITIONS 8

3.1 Past and Present Land Use 8

3.2 Natural Heritage Features 11

3.3 Vegetation & Flora 12

3.3.1 Approach 12

3.3.2 Results 13

3.3.2.1 Floristics 13

3.3.2.2 Vegetation Communities Overview 14

3.4 Wildlife 20

3.4.1 General Wildlife Inventory & Habitat Assessment 20

3.4.1.1 Approach 20

3.4.1.2 Results 20

3.4.2 Birds (Avifauna) 21

3.4.2.1 Approach 21

3.4.2.2 Results 22

3.4.3 Amphibians 22

3.4.3.1 Approach 22

3.4.3.2 Results 23

3.4.4 Turtles 24

3.4.4.1 Approach 24

3.4.4.2 Results 24

3.4.5 Bats 25

3.4.5.1 Approach 25

3.4.5.2 Results 26
3.4.6 Wildlife Movement Opportunities 27

3.5 Aquatic Resources 27
3.5.1 Approach 27
3.5.1.1 Aquatic Habitat Assessment 27
3.5.1.2 Fish Habitat Assessment 28
3.5.2 Results 28
3.5.2.1 Overview of Surface Water Features 28
3.5.2.1 Fish Community Sampling 31

3.6 Hydrogeology 32
3.6.1 Approach 32
3.6.2 Results 33

4.0 NATURAL HERITAGE STATUS & SIGNIFICANCE 36

4.1 Fisheries Act 36
4.1.1 Overview of Key Policies 36
4.1.2 Study Assessment 37
4.1.2.1 Presence of fish subject to the Fisheries Act 37
4.1.2.2 Future Study Requirements 37

4.2 Species at Risk Act (2002) 38
4.2.1 Overview of Key Policies 38
4.2.2 Study Assessment 39
4.2.2.1 Applicability 39
4.2.2.2 Survey Results 39
4.2.2.3 Individuals and Residences 39
4.2.2.4 Critical Habitat: 39

4.3 Endangered Species Act (2007) 39
4.3.1 Overview of Key Polices 39
4.3.2 Assessment 40
4.3.2.1 Applicability 40
4.3.2.2 Habitat Assessment / Screening 41
4.3.2.3 Results and Conclusions 41

4.4 Provincial Policy Statement (2014)..... 42
4.4.1 Overview of Key Policies..... 42
4.4.2 Study Assessment..... 42

4.5 Regional / Municipal..... 44
4.5.1 Waterloo Regional Official Plan (ROP) (2015)..... 44
4.5.1.1 Overview of Key Policies..... 44
4.5.1.2 Study Assessment..... 45
4.5.2 City of Waterloo Official Plan (2016)..... 46
4.5.2.1 Overview of Key Policies..... 46
4.5.2.2 Study Assessment..... 46
4.5.3 Grand River Conservation Authority..... 49
4.5.3.1 Overview of Key Policies..... 49
4.3.3.2 Study Assessment..... 50

5.0 CONCLUSIONS.....50

6.0 REFERENCES.....51

LIST OF TABLES

Table 1. Field survey chronology, Westhill District North South Collector Road, Area 1 5

Table 2. Vegetation community overview 16

Table 3. Amphibians - Maximum Calling Code by Station and Species 23

Table 4. Summary of the surface water features within the Waterloo Commons study area. 29

Table 5. Fish community sampling results. 31

LIST OF FIGURES

Figure 1: Study Area

Figure 2: Natural Heritage Features

Figure 3: Vegetation Communities

Figure 4: Wildlife Survey Locations and Results

Figure 5: Aquatic Survey Locations and Results

Figure 6: Conceptual Route Alternatives

LIST OF APPENDICES

Appendix A Terms of Reference

Appendix B Erb Street Pond Chronology (MTE; Dec. 2018)

Appendix C Vascular Plant Species List

Appendix D Breeding Bird Survey Results

Appendix E Species at Risk Habitat Assessment

Appendix F Evaluation of Significant Wildlife Habitat

1.0 INTRODUCTION & SITE OVERVIEW

WSP Canada Limited (WSP), was retained in 2016 by Waterloo Commons Inc. to undertake an ecological study as input to an analysis of transportation improvement options which seek to address increased traffic flow volumes from local businesses. The focus of the improvement options is on the creation of a by-pass road that would connect Erb Street to Ira Needles Boulevard and establish a servicing strategy.

The study area, shown on Figure 1, is located in the upper reach of the Subwatershed 314 – Laurel Creek Watershed and is owned by a variety of landowners: the Region of Waterloo; the City of Waterloo; Waterloo Commons JV Inc.; the INCC Corporation; Hydro One; Home Hardware; and 1130814 Ontario Inc. The study area generally includes a small portion of the Region of Waterloo's Waterloo Landfill at 925 Erb Street West, a small portion of the Hydro One corridor (south of Erb Street West), the residences at 87, 73, and 65 Ira Needles Boulevard, the Westhill Meadows Golf course at 41 Ira Needles Boulevard, and the Waterloo Commons commercial development at 653-659 Erb Street West. These properties will be herein referred to as the 'subject lands'.

The study area includes a mix of: developed lands (retail stores, rural residential property / landscaping); agricultural fields; a golf course; two active Stormwater Management (SWM) ponds near Erb Street; naturally regenerating vegetation, including wetland, in the vicinity of the SWM ponds; and a mosaic of old field / manicured grass and remnant wetlands on lands owned by 1130814 Ontario Inc. The easterly SWM pond near Erb Street, installed prior to 2004, is owned and operated by the Region of Waterloo, and treats runoff from Ira Needles Boulevard, Waterloo Commons and lands east of Ira Needles Boulevard. The westerly SWM pond in the hydro corridor, installed in the early/mid 1990s, is owned and operated by the Region of Waterloo, and treats runoff from the Regional landfill site.

Surrounding lands include: urban residential / commercial lands to the south, east and north; and a hydro-electric power corridor (HEPC) and Regional Landfill site to the west / southwest.

This area has been subject to considerable study since the mid-1990s, with key studies reference, considered and summarized herein.

2.0 STUDY APPROACH

This study is informed by a Terms of Reference (TOR; included in Appendix A) based on input from City of Waterloo, Region of Waterloo and Grand River Conservation Authority (GRCA) staff. Per agency direction, the EIS will be completed in three stages, with each stage reviewed and accepted prior to moving to the next stage:

- Stage 1: Existing conditions characterization for ecological and hydrological features and functions of wetlands and watercourse within the study area
- Stage 2: evaluation of alternatives, identification of the preferred alternative, and recommended mitigation
- Stage 3: property-specific, focused evaluation

The current report addresses Stage 1 and includes the following components:

- Review of available **background information**, as relevant and available:
    - Historic aerial photography
    - Ministry of Natural Resources and Forestry (MNRF) Natural Heritage Information Centre (NHIC) Biodiversity Explorer database and mapping
    - Land Information Ontario (LIO) database information
    - Topographic mapping (OBM, NTS) and aerial photography
    - GRCA - resource mapping
    - City of Waterloo Official Plan (2016)
    - Region of Waterloo Regional Official Plan (2015)
    - Existing technical reports
        - Subwatershed 314 Management Plan (Mark Dorfman Planner Inc.; 1996)
        - Ira Needles Boulevard Environmental Report (Natural Resource Solutions Inc; October 2001)
        - Technical Design Brief (SWM) & Scoped Environmental Impact Study: Erb St Pond (MTE, GRCA, NRSI and City of Waterloo; 2003)
        - Final SWM Report & Scoped Environmental Impact Study: Erb Street Pond. In Support of the Ira Needles Boulevard Project. Kitchener - Waterloo, Ontario (MTE Consultants; April 2004)
        - Westhill District Plan (1998; updated 2009)

- Westhill District Plan. Final Stormwater Management Report. Ira Needles Boulevard & Erb Street, Waterloo, Ontario (MTE Consultants; January 2011)
- Technical Design Overview, West Waterloo, Westhill District (WW-WD) North/South Collector Rd (NS-CR) (MTE September 2018)
- Surface Water Monitoring West Waterloo, Westhill District (WW-WD) North/South Collector Rd (NS-CR) (MTE September 2018)
- Hydrogeological Assessment, West Waterloo, Westhill District (WW-WD) North/South Collector Rd (NS-CR) (MTE September 2018)
- Erb Street Pond Chronology, West Waterloo, Westhill District (WW-WD) North/South Collector Rd (NS-CR) (MTE September 2018)

- **Field surveys**. Scope of field surveys was informed by existing background information, including natural heritage designations, site characteristics (i.e., habitat suitability for various wildlife guilds) and landscape context.
  - **Aquatic Resources**: aquatic habitat characterization; fish community and fish habitat assessment
  - **Vegetation**: vegetation community classification and description; botanical inventory; natural feature delineation
  - **Wildlife**: breeding bird surveys; spring amphibian breeding surveys; turtle basking surveys; bat habitat assessment; general wildlife inventory and habitat assessment; Species at Risk (SAR) and Species of conservation Concern (SCC)[1] habitat assessment surveys
- Consideration of relevant natural heritage planning and policy documents, including:
  - Fisheries Act (1985)
  - Migratory Birds Convention Act, MBCA (1994)
  - Species at Risk Act, SARA (2002)
  - Endangered Species Act, ESA (2007)
  - Provincial Policy Statement, PPS (2014)

[1] Defined as Species designated as Special Concern provincially, assigned a conservation status (S-Rank) of S1 to S3 or SH, or designated as Special Concern, Threatened, or Endangered by the Committee for the Status of Endangered Wildlife in Canada (COSEWIC) or under the federal SARA

- Region of Waterloo Official Plan (2015)
- City of Waterloo Official Plan (2016)
- GRCA Regulation 150/06 (2006) and associated policies (2003, 2015)

Ecological field survey methodologies and results are discussed in Section 3 of this report.

2.1 Field Survey Chronology

Existing background information, as outlined above, was compiled and reviewed as input to determination of field survey requirements.

Comprehensive natural heritage field surveys have been undertaken as part of previous studies. Work was completed in two broad survey areas – Area 1 and Area 2, as shown on Figure 1.

2.1.1 Area 1 (Waterloo Commons, HEPC, RMOW, Home Hardware)

Extensive flora, fauna and aquatic field surveys were undertaken in on 16 separate dates in 2016, 2017 and 2018, as listed in Table 1.

Table 1. Field survey chronology, Westhill District North South Collector Road, Area 1

Date	Task	Effort (person hours)	Coverage	Weather Conditions
October 14, 2016	Vegetation inventory and preliminary ELC delineation	6	Entire Study Area 1	
November 3, 2016	Setting minnow traps to conduct fish community assessment; aquatic habitat assessment	4	Golf Course Pond 1, Golf Course Pond 2, Golf Course Pond 3, SWM (Pond 4), Wetland	
November 4, 2016	Fish community assessment and aquatic habitat assessment	12	Entire Study Area 1	
November 4, 2016	General Wildlife Habitat Assessment and bat habitat suitability assessment (partial leaf-off)	12	Entire Study Area 1	
March 27, 2017	Spring Amphibian Breeding Survey - Round 1	1	AC1-5	**Air Temp**: Start - 12, End - 11.5; **RH**: Start - 80%, End - 88%; **Sky**: Start - 2, End - 2; **Wind**: Start - 1, End - 1; **Precipitation**: No
April 10, 2017	Turtle Basking Survey # 1	3	Golf Course Pond 1, Golf Course Pond 2, Golf Course Pond 3, SWM (Pond 4), Wetland	Air: 19-20^{0}C; Sky: 0-2: Wind: 5-6
April 18, 2017	Turtle Basking Survey # 2	1.5	Golf Course Pond 1, Golf Course Pond 2, Golf Course Pond 3, SWM (Pond 4), Wetland	Air: 10-11^{0}C; Sky: 0-0: Wind: 3-4
May 17, 2017	Spring Amphibian Breeding Survey - Round 2	2	AC1-6	**Air Temp**: Start - 24, End - 22; **RH**: Start - 50%, End - 56%; **Sky**: Start - 1, End - 1; **Wind**: Start - 3, End - 3; **Precipitation**: No

Date	Task	Effort (person hours)	Coverage	Weather Conditions
June 2, 2017	Breeding Bird Survey #1; General Wildlife Survey	5.5	Entire Study Area 1	Air: 8-15^{0}C; Wind: 3-2; Sky: 0-0
June 13, 2017	Spring Amphibian Breeding Survey - Round 3	1.25	AC1-6	**Air Temp**: Start - 23, End - 20; **RH**: Start - 69%, End - 78%; **Sky**: Start - 1, End - 1; **Wind**: Start - 2, End - 3; **Precipitation**: No
June 15, 2017	Breeding Bird Survey # 2; Turtle Nest Searches	6	Entire Study Area 1	Air: 16-18^{0}C; Wind: 3-2; Sky: 2-2
June 16, 2017	Botanical Inventory and ELC assessment	6	Entire Study Area 1	Air: 19-23^{0}C; Wind: 1-2; Sky: 2-1
July 31, 2017	Botanical Inventory and ELC assessment	6	Entire Study Area 1	Air: 22-29^{0}C; Wind ;1-1; Sky 1-1
August 17, 2017	Botanical Inventory and ELC assessment	7	Focus on wetland communities	
May 11, 2018	Bat habitat suitability assessment	3	Units 3-8, SWM Pond 4, SWM Pond 5	Air: 11-12; Wind: 1-1; Sky 1-1
June 22, 2018	Breeding Bird Survey #1; General Wildlife Survey; vegetation survey / update	5.5	Entire Study Area 1 and 2	Air: 14-18^{0}C; Wind ;0-2; Sky 1-1
July 10, 2018	Breeding Bird Survey #2; General Wildlife Survey; vegetation survey / update	6	Entire Study Area 1	Air: 20-29^{0}C; Wind ;1-1; Sky 1-2

2.1.2 Area 2 (1130814 Ontario Inc. property)

Flora and fauna field surveys were undertaken in on 14 separate dates in 2010, 2014, 2016 and 2018, as follows:

- 2010 (results reported in Ecoplans; February 2011 and Ecoplans; July 2011):
  - May 27: site reconnaissance, breeding bird survey (1), preliminary wetland delineation.
  - June 15: botanical inventory, habitat classification, wetland delineation.
  - June 18: botanical inventory, breeding bird survey (2).
  - July 6: wetland delineation refinements with soil probes.
  - November 12: preliminary wetland flagging.
  - November 22: site walk with GRCA to confirm wetland limits.
- 2014 (results reported in MMM; December 2014):
  - June 3: botanical inventory, habitat classification, wetland delineation
  - June 4: botanical inventory, habitat classification, wetland delineation.
  - June 17: breeding bird survey; general wildlife survey and habitat assessment
  - July 4: breeding bird survey; general wildlife survey and habitat assessment
  - July 4: site walk with GRCA to confirm wetland limits
- 2016 (results reported in WSP; May 2016):
  - May 9: survey for nesting birds re; Migratory Birds Convention Act (MBCA) compliance
- 2018:
  - June 22, 2018: Breeding Bird Survey #1; General Wildlife Survey and SAR habitat assessment; vegetation survey / update
  - July 10, 2018: Breeding Bird Survey #2; General Wildlife Survey and SAR habitat assessment; vegetation survey / update

3.0 EXISTING CONDITIONS

3.1 Past and Present Land Use

As noted, the study area is currently a mosaic of habitats, reflecting the long anthropogenic land use history in the area. Based on review of historic air photos (see MTE memo; Appendix B) and background studies, we note the following study area attributes and key study results / conclusions.

The study area was a rural agricultural landscape until the early 1980s when urban development began approaching from the east:

- **1954 -1971.** Study area is entirely agricultural fields. No wetlands, watercourses, ponds or natural vegetation are evident. No defined watercourse is evident north of Erb Street. Faint evidence of a wet area on the 1130814 Ontario Inc. lands.
- **1982**. Landfill construction evident to the west. Reconstruction of Erb Street and formation of the 'Erb Street Pond', which is evident, but not strongly defined. Road works created a damming effect south of Erb Street. Wetland is not the same configuration as in the 1990s and 2000s.
- **1990.** Landfill construction more evident. Construction north of Erb Street and approaching from the east. Erb Street Pond is vaguely evident as a much smaller feature. No watercourses, ponds or natural vegetation are evident. No defined watercourse is evident north of Erb Street.
- **1995.** Similar to 1990 with additional development to the north and east. Erb Street Pond is evident as a slightly larger feature. No watercourses, ponds or natural vegetation are evident. No defined watercourse is evident north of Erb Street. Very small wet area evidence at north property limit on the 1130814 Ontario Inc. lands.
- **2000-2006**. Standing water and wet areas evidence south of Erb St. and on the 1130814 Ontario Inc. lands. Dug golf course ponds evident.

These interpretations are consistent with results from various background studies. Key results from those studies include the following:

- **1996**. Subwatershed 314 Management Plan. The "Erb Street Pond and Wetland", which at that time, was 2 wetland features immediately south of Erb Street, approximately 275-375 m west of Westhill Drive was recognized as an important ecological feature, but one

that could continue to be used for water quantity control. Other key findings and recommendations include the following:

- S. 5.2.6. "The wetland upstream of Erb Street has potential to detain a significant amount of runoff and with only moderate changes outlet pipe, could continue to be used for water quantity control for all runoff generated from upstream of Erb Street.
- The pond and wetland are an important ecological feature within the subwatershed, and are sensitive to siltation and nutrient enrichment. P.84
- On Map11 (Environmental Constraint Areas), the wetland is identified as "Constraint Level One"
- On Map 19 (Subwatershed 314 Greenspace System), the wetland is identified as "Primary Supporting Areas and Linkages", defined as "… areas of significant or high-quality vegetation which are close to Core Areas. Further, they can provide a connection between Core Areas and PSWs, where they exist" (S. 5.3.3). Adjacent areas are identified as "Primary Supporting Areas and Linkages" and "Buffer Areas"
- The Erb Street Pond and Wetland System includes the following components: Headwater swales, pond ecosystem with permanent discharge to a storm sewer, wetlands associated with shallow ponds and floodplain environments. The headwater streams for the most part are ephemeral and are frequently sufficiently dry to preclude establishment of wetland vegetation
- The function of the existing communities revolves mainly around the provision of stormwater management; however, the willow thicket, reed swamp, mixed fen and open water communities indicates biological richness and ecological value. The system provides shelter, forage and nesting sites for a wide variety of wildlife.
- The most diverse and significant wetland in the subwatershed is the Erb Street wetland and pond system. The site has waterfowl populations included resident Mallard and occasional Black Duck, Blue-winged Teal and Canada Goose. Swamp Sparrow, Red-winged Blackbird and Bronzed Grackle are wetland species which breed.
- Objectives for the Erb Street Pond and Wetland System are to: maintain and enhance vegetation cover; provide wildlife cover; maintain water and sediment quality; extend woody vegetation cover around the pond and the wetland. Objectives are based on the following rationale: maintain pond to moderate downstream flows; conserve ecological uses; protect waterbird breeding; feeding and shelter areas; develop site as a natural urban ecosystem.

- Subwatershed Management Plan Management Measures include: retaining the Erb Street Pond as a significant storage area for surface water runoff south of Erb Street; maintain function of swale discharge to the tributary creek (swale or storm sewer); protect form and function to maintain and enhance ecological processes, biological diversity and life-support systems; maintain surface water discharge into natural areas; prepare a management plan for the Erb Street Pond /wetland (enhance vegetation cover, protect from development and remove Phragmites)

- **2003** - preliminary design report for the Ira Needles Blvd project. This included a SWM report which addressed drainage, resulted in identification of 8 SWM zones, each with their own strategy. The study area is in SWM zone 6 (Ira Needles Blvd; Westhill Meadows Golf Course; Waterloo Commons; Wong property; and Erb Street). The recommended SWM strategy was to construct a SWM pond and use the existing wetland feature this was consistent with recommendations made under the approved Subwatershed Study (Subwatershed 314 Management Plan, 1996).

- **2003** – MTE, GRCA, NRSI and City prepared the Technical Design Brief (SWM) & Scoped Environmental Impact Study: Erb St Pond. That study outlined SWM strategy and allowed acquisition of the Waterloo Commons property to proceed.

- **2004** Final SWM Report & Scoped Environmental Impact Study: Erb Street Pond (MTE). EIS report prepared by MTE consultants focuses on final details of the SWM pond / strategy presented in the 2003 Tech Brief / EIS. The intent of that report was to serve as a basis for future SWM requirements and obtain permits from GRCA, approval from City and MOE approval leading to construction of the SWM pond (proposed for 2014). The SWM design elements included the following:

  - SWM pond constructed outside wetland limit (but within buffer), includes a trapezoidal vegetated/grassed channel, sediment forebay, discharging into wetland pond. The wetland pond was to be excavated to increase the permanent pool component, a new pond would also be constructed in the wetland in the south. One objective was to draw waterfowl away from Erb Street by installing an additional pond and sediment forebay. The crossing structure at Erb was also to be replaced with a larger diameter concrete storm sewer. Pond was shared by Region/City – now Region. Design results in direct discharge of storm sewer flows to the wetland (by-passes SWM pond).

- **2009** – The Westhill District Plan was prepared. That report included commentary on the existing SWM pond, but no discussion of the wetland area in the vicinity.

3.2 Natural Heritage Features

Refer to Figure 2 for locations of features described below.

- No provincially designated features (e.g., Provincially Significant Wetland [PSW]; Areas of Natural or Scientific Interest [ANSI]) are found on or immediately adjacent to the study area.
- No regulated watercourses are present in the study area.
- There is intermittent drainage from the two SWM facilities towards the outlet / culvert at Erb Street and from a dug pond on the golf course northerly into the wet area adjacent to the Region SWM facility.

  From the culvert at Erb Street, stormwater runoff is conveyed underground via a piped municipal drain to a SWM pond approximately 750m to the north and ultimately into Clair Creek.
- Portions of the *Waldau East Wetland Complex* (evaluated, non-provincially significant wetland) are located on the landfill lands to the west
  - This wetland is designated as a *Core Natural Feature* in Schedule A4 of the City of Waterloo Official Plan and *Core Environmental Feature* on Map 4 of the Region of Waterloo Official Plan (2015)
- Five ponds / unevaluated wetlands are present in the study area. Additional wetlands are present on HEPC lands to the west / southwest.
  - All wetlands (not including the golf course ponds) as mapped by GRCA are regulated by GRCA under O. Reg. 150/06
  - Regenerating areas in the vicinity of the two SWM ponds are designated as *Supporting Natural Features* in Schedule A4 of the City of Waterloo Official Plan.
  - The regenerating area in the vicinity of the Landfill SWM pond is designated as *Open Space (Parks and Other Green Space)* in Schedule A3 of the City of Waterloo Official Plan
  - The pond/wetland area in the vicinity of the two SWM facilities (the “Erb Street Pond and Wetland System”) was identified as a *Constraint Level 1* feature in the Laurel Creek Subwatershed 314 Management Plan (Mark L. Dorfman, Planner Inc., 1996).

The wetland in the vicinity of the Region SWM facility (W1) was delineated in 2003 by staff from the City of Waterloo, GRCA and NRSI in 2003 and surveyed by MTE, as shown on GRCA online mapping and Figures 2 and 3 herein.

3.3 Vegetation & Flora

3.3.1 Approach

A three-season botanical inventory and vegetation assessment was conducted in the study area and adjacent lands[2] on October 14, 2016, June 26, 2017, July 31, 2017, August 18, 2017, June 22, 2018 and July 10, 2018. These surveys documented the characteristics of the natural and culturally influenced vegetation communities, with a focus on the natural features. Vegetation field work and associated data assessment involved:

- Botanical inventory and preparation of a vascular plant species list (Appendix C)
    - Plant species status was evaluated using the Waterloo Region Significant Species List (Regional Municipality of Waterloo. 1999) for regional significance; the NHIC website for provincial rarity ranks (i.e., S-Ranks); the Species at Risk in Ontario list (MNRF; updated periodically) for provincial status designations; and the Canadian Species at Risk list (COSEWIC; updated periodically) for national status designations
    - Analysis of floristics of all inventoried plant species was completed by using their *Coefficient of Conservatism* (CC) and *Coefficient of Wetness* (CW), per the Floristic Quality Assessment System for Southern Ontario (Oldham et al. 1995), which uses an objective, quantitative method to compare the relative quality of two or more vegetation communities. The quality of a particular vegetation community can be reflected in its richness of conservative species (Oldham et al. 1995).
- Classifying, mapping and evaluating vegetation communities within the study area. Vegetation communities were classified using the Ecological Land Classification for Southern Ontario (ELC) (Lee et al. 1998) and ELC Ecosystem Catalogue: 2008 Version (Lee 2008), where applicable.

[2] Where landowner permission was granted

- Vegetation community significance was evaluated using Natural Heritage Resources of Ontario: Vegetation Communities of Southern Ontario (Bakowsky 1996; NHIC website).

- Approximate delineation of wetland W1 boundaries in the vicinity of the Region SWM facility, as shown via ELC vegetation community boundaries on Figure 3.
- General notes were taken on community health and site disturbance and representative photos were taken.

3.3.2 Results

3.3.2.1 Floristics

Previous Study (NRSI 2003)

Based on site surveys on October 2-3, 2003, 104 vascular plant species were recorded, none of which were regionally or provincially rare. Results are generally consistent with current findings.

Current Findings

A vascular plant species list of the species recorded during WSP field surveys is provided in Appendix C. In total, 116 plant species have been identified within the study area. An additional seven records were identified to genus only.

Of the 116 species recorded by WSP:

- 69 (61%) are native and 45 (39%) are non-native.
- Species are a mix of wetland and meadow plants, or non-native species typical of old field and disturbed areas. Planted species are also present.
- None is provincially or nationally rare (i.e., Srank S1-S3; Grank G1-G3). All recorded native species have a provincial ranking of S4 or S5 [apparently secure (S4) or secure (S5) in Ontario].
- None is listed as a *Species at Risk* (SAR) subject to the provisions of the ESA (2007) or SARA (2002)
- One species, Virginia Creeper (*Parthenocissus quinquefolia*), is listed as significant in the Region of Waterloo, if demonstrably indigenous, as most populations are thought to be of non-indigenous origin. This species was recorded in 2016 in Unit 2b (CUM/CUT) on HEPC lands, but not recorded in 2018 surveys.

Note that one addition potentially regionally significant species was recorded: Big Bluestem (*Andropogon gerardii*). These are planted and not considered regionally significant.

- Of the 69 naturally occurring native species recorded for which CC values are provided, CC values range from 0 to 6, with the majority between 2 and 4 (i.e., "tolerant" to "moderately conservative"). No "conservative" or "highly conservative" species were recorded.

Results are generally consistent with previous findings in terms of composition and richness.

3.3.2.2 Vegetation Communities Overview

Previous Study (NRSI 2003)

The study noted that the wetland feature in the vicinity of the SWM pond had received considerable study and that the 1996 Subwatershed 314 Management Plan identified this feature (the "Erb Street Pond" a.k.a. the "Dutton Pond") as a "distributed" SWM facility that would require grading and ecological enhancement. Note that this feature was also considered part of the SWM facility in the 2004 Final SWM and Scoped EIS (MTE)

Site surveys were completed on October 2nd and 3rd 2003. Five community types were delineated in the "Erb Street Pond" area immediately south of Erb Street:

- CUM1: Mineral Cultural Meadow
- MAM2-2: Reed Canary Grass Meadow Marsh
- MAS2-1: Cattail Mineral Shallow Marsh
- SWT2-2: Willow Thicket Mineral Swamp
- SWD4-1: Willow Mineral Deciduous Swamp
- An "open water" community was also identified immediately south of Erb Street.

Current Findings

Field surveys documented the characteristics of the natural and culturally influenced vegetation communities occurring within the study area, with a focus on the regenerating natural features in the vicinity of Erb Street. Results are generally consistent with previous findings, though some vegetation communities have succeeded (e.g., CUM to CUT, SWT and SWD) and/or boundaries have shifted slightly.

Thirteen vegetation units were delineated within the study area, as described in Table 2, with approximate boundaries shown on Figure 3. Some are a mosaic of habitat types or have inclusions within the primary vegetation community. The following vegetation community types were identified:

Cultural Communities – Units 2 and 6

- CUM1-1. Dry-Moist Mineral Cultural Meadow (Unit 2b; Unit 6; Unit 10)
- CUT1. Mineral Cultural Thicket (Unit 2b)

Wetland Communities – Units 3, 4, 5, 7, 8, 9, 11, 12 and 13

- MAM2-2. Reed-Canary Grass Mineral Meadow Marsh (Unit 2a; Unit 3; Unit 13)
- MAMM1-12. European Common Reed Meadow Marsh (Unit 7)
- MAS2-1. Cattail Shallow Mineral Marsh (Inclusion within Unit 4)
- MAS2-2. Bulrush Mineral Shallow Marsh (Unit 12)
- SWT2. Mineral Thicket Swamp (Unit 4)
- SWT2-2: Willow Thicket Mineral Swamp (Unit 11)
- SWT2-5. Red Osier Dogwood Mineral Thicket Swamp (Unit 2a)
- SWD4-5 Poplar Mineral Deciduous Swamp (Unit 5; Unit 8)
- SAS1-1. Pondweed Submerged Shallow Aquatic

None of these vegetation community types is considered provincially significant (per Bakowsky 1996 / NHIC).

W1 is comprised of Units 3, 4, 5, 7, 8 and 9

W2: is comprised of Units 2a and 2c

W3: is comprised of Units 12 and 13[3]

W4: is comprised of Unit 11

[3] Unit 12 and Unit 13 wetlands were approved for removal per GRCA Permit No. 755/15

Table 2. Vegetation community overview

Unit	ELC Vegetation Type		Component Species (dominant / most abundant)	Rare Species and Additional Attributes
1	**CGL_1 Golf Course** **Inclusions:** **CUM1-1** Dry-Moist Old Field Meadow	**Canopy / Sub-canopy**	Overall sparse cover (<10%) of primarily planted and non-native species, such as Norway Maple White Ash, Common Apple, Colorado Spruce, Black Locust, Littleleaf Linden.	Species of Conservation Concern: None recorded Total Species Recorded: 39 spp. Other: Age: pioneer / early-successional Disturbance: high – recreational use as a golf course Early successional meadow where golf course grass is un-mowed. Dominated by typical disturbance tolerant / early successional forbs and graminoids.
		Understory / Shrub Layer	Red-osier Dogwood, European Spindle-tree, and Common Crabapple at < 10 % cover	
		Ground Layer	Dominated by turfgrass. Other species present off fairways include: Common Milkweed, Creeping Thistle (Canada Thistle), Queen Anne's Lace, Fuller's Teasel, Field Horsetail, Philadelphia Fleabane, Flat-top Fragrant Goldenrod, Virginia Strawberry, St. John's-wort, Elecampane Flower, Creeping Jenny, Black Medic, White Sweet Clover, Reed Canary Grass, Kentucky Bluegrass, Curly Dock, Tall Goldenrod, Canada Goldenrod, Field Sowthistle, Panicled Aster, New England Aster, Common Dandelion, Meadow Goat's-beard, White Clover, Colt's Foot, Tufted Vetch.	
2	**Successional Meadow/Thicket** **2a. Marsh/Thicket** **MAM2-2** Reed Canary Grass Mineral Marsh Meadow **SWT2-5** Red Osier Dogwood Mineral Deciduous Thicket Swamp **2b. Meadow / Thicket** **CUM1-1** Dry-Moist Old Field Meadow **CUT** Cultural Thicket **2c. marsh** **MAS2-1** Cattail Mineral Shallow Marsh	**Canopy / Sub-canopy**	Manitoba maple at < 10% in patches throughout the areas of CUT and CUM1-1. Peach-leaved willow at < 10% within MAS2-1.	Species of Conservation Concern: • Virginia Creeper – Waterloo Regional Significant Species. Recorded in 2016; no longer present in 2018 Total Species Recorded: 40 spp. Other: Age: Young Disturbance: high; Invasive species widespread and moderate – abundant. Unit in close proximity to active agricultural lands Contains a diverse assemblage of native shrub species forming thickets, subdominant to the buckthorn thickets. Cultural Meadow predominantly on mound and marsh in depression, but quite transitional overall.
		Understory / Shrub Layer	Dominant Red-osier Dogwood (especially in SWT2-5 patches), abundant Thicket Creeper, and Common Buckthorn, and frequent to occasional, Cottony Willow, Nannyberry, Riverbank Grape Virginia Creeper, and Eastern Ninebark.	
		Ground Layer	CUM1-1/CUT: Common Milkweed, Meadow Sedge, Creeping Thistle (Canada Thistle), Queen Anne's Lace, Fuller's Teasel, Field Horsetail, Philadelphia Fleabane, , Black Medic, White Sweet Clover, Kentucky Bluegrass, Curly Dock, Canada Goldenrod, Wild Red Raspberry, Field Sowthistle, Panicled Aster, New England Aster, Common Dandelion, Meadow Goat's-beard, White Clover. MAM2-2: Reed Canary Grass, Common Reed, Flat-top Fragrant Goldenrod, Elecampane Flower, Purple Loosestrife, Fox Sedge and Colt's Foot MAS2-1: Dominant Narrow-leaved and Blue Cattail with occasional Purple Loosestrife	
3	**Marsh Meadow** **MAM2-2** Reed Canary Grass Mineral Marsh Meadow	**Canopy / Sub-canopy**	Balsam Poplar, Quaking Aspen, White Willow.at < 10% cover and scattered throughout.	Species of Conservation Concern: None recorded Total Species Recorded: 16 spp. Other: Age: Young Disturbance: Moderate/high; Invasive species widespread. Scattered clusters of swamp thicket vegetation are present throughout Unit 4
		Understory / Shrub Layer	Red-osier Dogwood, Common Buckthorn, Pussy Willow.	
		Ground Layer	Spotted Jewelweed, Blueflag, Rice Cutgrass, Purple Loosestrife, Reed Canary Grass, European Common Reed, Fowl Bluegrass, Panicled Aster, Narrow-leaf and Blue Cattail.	

Unit	ELC Vegetation Type		Component Species (dominant / most abundant)	Rare Species and Additional Attributes
4	**Thicket Swamp** **SWT2** Mineral Thicket Swamp (mosaic) ***Inclusion of:*** **MAS2-1** Cattail Shallow Mineral Marsh	**Canopy / Sub-canopy**	Freeman's Maple, Quaking Aspen, White Willow, American Elm at a total of > 75% canopy cover combined and mostly located along the edge of unit 7.	Species of Conservation Concern: None recorded Total Species Recorded: 38 spp. Other: Age: mature Disturbance: Low - moderate; few invasive species. Swamp thicket formed by a mosaic of patches of Red-osier dogwood, Willow spp., and nannyberry, with dogwood slightly dominant.
		Understory / Shrub Layer	Gray Dogwood, Red-osier Dogwood, Pussy Willow, Sandbar Willow, Meadow Willow, Cottony Willow, and Tartarian Honeysuckle.	
		Ground Layer	Bebb's Sedge, Yellow Sedge, Graceful Sedge, Greater Bladder Sedge, Sedge Species, Creeping Thistle (Canada Thistle), Flat-top Fragrant Goldenrod, Virginia Strawberry, Yellow Avens, White Avens, Rough Avens, Spotted Jewelweed, American Bugleweed, Fringed Loosestrife, Purple Loosestrife, Black Medic, Sensitive Fern, Reed Canary Grass, European Common Reed, Fowl Bluegrass, Tall Goldenrod, Canada Goldenrod, White Heath Aster, New England Aster, Narrow-leaf Cattail.	
5	**Deciduous Swamp** **SWD4-5** Poplar Mineral Deciduous Swamp	**Canopy / Sub-canopy**	Quaking Aspen, Green Ash, American Basswood at > 80% canopy cover	Species of Conservation Concern: None recorded Total Species Recorded: 30 spp. Other: Age: Immature / mid-aged; aerial records suggest unit is approximately 15 years old, but recent fill / veg removal and hydrological alterations are evident Disturbance: moderate; species assemblage indicative of anthropogenic origin. Invasive species present. Directly adjacent to active agriculture.
		Understory / Shrub Layer	Red-osier Dogwood, Nannyberry, Guelder-rose Viburnum.	
		Ground Layer	Lesser Burdock, Common Milkweed, Creeping Thistle (Canada Thistle), White-top Fleabane, Flat-top Fragrant Goldenrod, Virginia Strawberry, Yellow Avens, White Avens, Virginia Waterleaf, Purple Deadnettle, American Bugleweed, Purple Loosestrife, Black Medic, Reed Canary Grass, European Common Reed, Fowl Bluegrass, Canada Goldenrod, White Heath Aster, New England Aster, Smooth White Violet, Marsh Blue Violet, Downy Yellow Violet.	
6	**Early Successional Meadow** **CUM1-1** Dry-Moist Old Field Meadow	**Canopy / Sub-canopy**	Manitoba Maple Balsam Poplar, Black Locust.	Species of Conservation Concern: No naturally occurring species recorded (Big Bluestem is planted) Total Species Recorded: 42 spp. Other: Age: pioneer / early-successional. Disturbance: high – located between Erb Street West and active agriculture. Width of upland margin likely varies year to year depending on limits of ploughing.
		Understory / Shrub Layer	Sandbar Willow, Russian Olive.	
		Ground Layer	Common Milkweed, Creeping Thistle (Canada Thistle), Queen Anne's Lace, Fuller's Teasel, , Field Horsetail, Philadelphia Fleabane, Virginia Strawberry, Willow-leaf Lettuce, Black Medic, White Sweet Clover, Catnip, European Common Reed, English Plantain, Kentucky Bluegrass, Norway Cinquefoil, Curly Dock, Tall Goldenrod, Canada Goldenrod, Field Sowthistle, Panicled Aster, New England Aster, Common Dandelion, Meadow Goat's-beard, White Clover, Colt's Foot, Tufted Vetch, Bouncing Bet, Common Tansy, and Common Chicory. Additional planted / seeded species include Grey-headed Prairie Coneflower, Wild Bergamot, Perennial Flax, Blanket-flower, and Big Bluestem.	

Unit	ELC Vegetation Type		Component Species (dominant / most abundant)	Rare Species and Additional Attributes
7	**Meadow Marsh** **MAMM1-12** European Common Reed Meadow Marsh	**Canopy / Sub-canopy**	Balsam Poplar, Quaking Aspen, White Willow.at < 10% cover and scattered throughout.	Species of Conservation Concern: None recorded. Total Species Recorded: 13 spp. Other: Age: Young Disturbance: High - dominated by non-native species
		Understory / Shrub Layer	Sandbar Willow, Freeman's Maple	
		Ground Layer	Marsh Bedstraw, Spotted Jewelweed, Slender Rush, Lesser Duckweed, Duckweed Species, Star Duckweed, European Common Reed, Peach-leaved Willow.	
8	**Deciduous Swamp** **SWD4-5** Poplar Mineral Deciduous Swamp	**Canopy**	Quaking Aspen, Green Ash, and Cottonwood > 80% canopy cover	Species of Conservation Concern: None recorded Total Species Recorded: 21 spp. Other: Age: Pioneer / early-successional. Disturbance: Moderate/high; non-native species abundant
		Understory / Shrub Layer	Red-osier Dogwood, Common Buckthorn, Pussy Willow	
		Ground Layer	Spotted Jewelweed, Rice Cutgrass, Purple Loosestrife, Reed Canary Grass, European Common Reed, Fowl Bluegrass, Panicled Aster, -Narrow-leaf and Blue Cattail.	
9	**Shallow Open Water** **SAS1-1** Pondweed Submerged Shallow Aquatic	**Canopy**	None	Species of Conservation Concern: None recorded Total Species Recorded: 3 spp. Other: Age: Young Disturbance: Moderate/high; receives SWM discharge, with sedimentation and with variable water levels. Rubbish noted in the area.
		Understory / Shrub Layer	None	
		Ground Layer	Spotted Jewelweed, Soft Rush, Lesser Duckweed	
10	**Early Successional Meadow** **CUM1-1** Dry-Moist Old Field Meadow	**Canopy**	Box Elder, Common Apple, Crack Willow	Species of Conservation Concern: None recorded Total Species Recorded: 21 spp. Other: Age: Pioneer / early-successional • Disturbance: Moderate-high; early successional habitat with non-native species widespread and abundant.
		Understory / Shrub Layer	Red-osier Dogwood, Buckthorn, Red Elderberry, Riverbank Grape.	
		Ground Layer	Common Milkweed, Awnless Brome, Creeping Thistle (Canada Thistle), Fuller's Teasel, Great Hedge Bedstraw, Oxeye Daisy, Alfalfa, Meadow Timothy, Kentucky Bluegrass, Tall Goldenrod, Panicled Aster, Common Dandelion, Meadow Goat's-beard, Tufted Vetch.	
11	**Swamp Thicket**	**Canopy**	Box Elder, Crack Willow.	Species of Conservation Concern: None recorded Total Species Recorded: 11 spp.
		Understory / Shrub Layer	European Elder, Red Elderberry, Red Raspberry, Bebb's Willow.	

Unit	ELC Vegetation Type		Component Species (dominant / most abundant)	Rare Species and Additional Attributes
	SWT2-2 Willow Thicket Mineral Swamp	**Ground Layer**	Bittersweet Nightshade, Lesser Burdock, Common Milkweed, Beggar's Ticks Species	Other: Age: Mid-aged • Disturbance: moderate. This is a very small isolated feature surrounded by early successional meadow - vulnerable to edge effects.
12	**Remnant** **Shallow Marsh** **MAS2-2** Bulrush Mineral Shallow Marsh	**Canopy**	Red-osier Dogwood.	Species of Conservation Concern: None recorded Total Species Recorded: 8 spp. Other: Age: Mid-aged • Disturbance: high; small feature with non-native species widespread and abundant / dominant. • Recent filling for Boardwalk road extension in accordance with GRCA Permit No. 755/15
		Understory / Shrub Layer	Riverbank Grape.	
		Ground Layer	Broad-leaved Water-plantain, Spikerush species, Rush species, Reed Canary Grass, Woolgrass Bulrush, Broad-leaf Cattail.	
13	**Remnant** **Meadow Marsh** **MAM2-2** Reed Canary Grass Mineral Meadow Marsh	**Canopy**	None	Species of Conservation Concern: None recorded Total Species Recorded: 7 spp. Other: Age: Young • Disturbance: high; small feature with non-native species widespread and abundant / dominant. • Recent filling for Boardwalk road extension in accordance with GRCA Permit No. 755/15
		Understory / Shrub Layer	Red-osier Dogwood - patches	
		Ground Layer	Dominated by Reed Canary Grass Woolgrass Bulrush, Spotted Jewelweed, Purple Loosestrife, Fowl Bluegrass, Panicled Aster,	

3.4 Wildlife

3.4.1 General Wildlife Inventory & Habitat Assessment

3.4.1.1 Approach

Background Information Review

- Correspondence with MNRF Guelph District and review of the NHIC database provided records for the following wildlife SAR in the vicinity of the study area:
    - Gray Fox (Threatened under ESA) –2015 record within the Waterloo Landfill on adjacent lands to the west (MNRF pers. Comm. Nov. 1 2016)
    - Black Tern (Special Concern under ESA), 1979 record;
    - Eastern Ribbonsnake (Special Concern under ESA), 1977 record.

Field Surveys

In addition to the targeted surveys described in following sections, a General Wildlife Survey and Habitat Assessment was undertaken during all field surveys, as follows:

- Recording all direct wildlife observations and wildlife signs (including browse, track / trails, animal scat, bird nesting activity, tree cavities, burrows and vocalizations) and identifying potential wildlife usage and habitat functions associated with vegetation communities.
- Assessing habitat availability for Species At Risk (SAR) within the study area.
- Inspecting structures for evidence of use by nesting migratory birds.
- Assessing potential for *Significant Wildlife Habitat* (SWH) features within the study area.

3.4.1.2 Results

Key results from the General Wildlife Survey and Habitat Assessment are as follows:

- In addition to breeding birds and herpetofauna results described in corresponding sections below, evidence of the following mammal and invertebrate species was recorded:
    - Mammals (7 species):
        - Eastern Cottontail – 1 individual recorded in each of Units 1, 2 and 7

- Long-tailed Weasel – 1 observed on the golf course; den present under golf course admin building)
- Muskrat – 1 dead observed in golf course pond
- Raccoon – scat observed in study area
- Red Squirrel – 1 observed in Unit 2 / Unit 5
- White-tailed Deer - scat observed in study area
- Groundhog – 1 observed in agricultural field

o Invertebrates (3 species):

- Meadowhawk sp. – 1 individual recorded in Unit 3
- Monarch - 1 individual recorded in Unit 4
- Chimney Crayfish – marsh habitats in Unit 2 and Unit 4 abutting agricultural field

- The ponds on the golf course provide confirmed habitat for turtles and the SWM pond provides potential habitat for turtles
- There are a few structures on the golf course which could provide potential breeding habitat for bats and birds
- There are a few cavity trees in the study area which could provide potential breeding habitat for bats and cavity nesting birds

3.4.2 Birds (Avifauna)

3.4.2.1 Approach

A Breeding Bird Survey was undertaken across the entire study area, as follows:

- Surveys were undertaken by qualified, experienced staff under appropriate weather conditions (i.e. no precipitation, low winds) and during appropriate seasonal timing windows (between May 24th and July 10th) and daily timing windows (between dawn and up to 5 hours after dawn).
- Survey areas were partitioned into separate units based on broad habitat characteristics and continuity (See Figure 4). These areas were thoroughly covered by walking random transects.
- Bird species presence, abundance and level of breeding evidence was recorded according to the Ontario Breeding Bird Atlas [OBBA] protocols (Bird Studies Canada 2003).
- Incidental observations were noted during other surveys.

3.4.2.2 Results

In total, 36 species were recorded within the study area (See Table D.1, Appendix D). Of these:

- 32 species are considered 'breeding' (i.e., 'possible', 'probable' or 'confirmed' breeding evidence). Four species are potential breeders within the local landscape but with no evidence of nesting within the study area: American Crow, Great Blue Heron, Turkey Vulture and Red-tailed Hawk (observed flying overhead or perched overhead)
- None is a Species at Risk
- None is a provincially or nationally rare species (i.e., Srank S1-S3; Grank G1-G3).
- Two species, Great Blue Heron and Turkey Vulture, are considered regionally significant in Waterloo; however, as mentioned above, no breeding evidence was observed for these species in the study area.
- None is considered *Area-Sensitive* by MNRF (2000; 2015).
- 25 species are subject to provisions of the Migratory Birds Convention Act, MBCA (1994)
- **Habitat Specialists**. The following 'habitat-specific' species (per Freemark and Collins, 1989) were recorded:
    - **Forest Interior Species**: one species (Coopers Hawk) observed near the SWM Pond Associated with the landfill
    - **Interior/Edge or Edge Species**: 25 species widely distributed across all habitats
    - **Marsh / Fen Species** (twelve) and **Treed Swamp / Bog Species** (six): four species generally associated with wetlands / ponds, though not exclusively

3.4.3 Amphibians

3.4.3.1 Approach

Spring amphibian breeding (calling) surveys were completed according to the Marsh Monitoring Program (MMP) protocol (Bird Studies Canada, 2008) as follows:

- Three surveys were conducted at six stations by qualified experienced staff under appropriate conditions (i.e. dusk/evening survey with suitable air temperatures and wind strength) on the following dates: March 27; May 17; and June 13, 2017. Refer to Figure 4 for survey station locations.

- Night time air temperatures were ≥5°C for the 'first' survey, ≥10°C for the 'second' survey and ≥17°C for the 'third' survey
- Each calling station was surveyed for 3 minutes
- Surveys were completed between ½ hour after sunset and midnight
- Amphibian calling activity was rated using three levels: Level 1 (individual calls can be counted with no overlap), Level 2 (some calls can be counted or estimated, some overlap) or Level 3 (calls continuous and overlapping, individuals not distinguishable).
- Incidental observations were noted during other surveys.

3.4.3.2 Results

In total, 3 anuran species were recorded during MMP surveys: American Toad; Green Frog; and Northern Leopard Frog (see Table 3). No additional amphibian species were recorded during other field surveys.

Table 3. Amphibians - Maximum Calling Code by Station and Species

Species	AC1 (Unit 1)	AC2 (Unit 1)	AC3 (Unit 1)	AC4 (SWM / Pond 4)	AC5 (Unit 7)	AC6 (SWM / Pond 5)	# of Stations where recorded
American Toad	1			1	1		3
Green Frog	1	1	1	2	1	1	6
Northern Leopard Frog					2	1	2
Species Richness	**2**	**1**	**1**	**2**	**3**	**2**	

3.4.4 Turtles

3.4.4.1 Approach

Turtle Surveys involved the following components:

- Turtle Emergence Surveys on two dates in early spring to determine potential use of ponds and wetland as hibernation habitat. Surveys were carried out on sunny days with ambient temperatures of ≥10°C and no precipitation to increase the potential of observing basking turtles. Coverage: all open water habitats except SWM Facility / Pond 5.
- A Nesting Survey on one date in mid-June to determine potential turtle nesting areas by looking for evidence of suitable nesting habitat, nesting individuals, turtle tracks and predated nests. Coverage: entire site, wherever sun-exposed soils were present (i.e., agricultural fields, gravel lots, golf course, cultural meadow / mowed areas).
- Incidental observations, as recorded during other field surveys.

3.4.4.2 Results

Two turtle species were recorded: Midland Painted Turtle and Red-eared Slider.

The Early Spring Turtle Emergence Surveys resulted in the following observations:

- Pond 1 (golf course):
  - 6 Midland Painted Turtles confirmed hibernating
- Pond 2 (golf course):
  - 2 Midland Painted Turtles and 1 Red-Eared Slider (non-native species) confirmed hibernating in golf course Pond 2
- Pond 3 (golf course):
  - No turtles confirmed hibernating
- Pond 4 (SWM Pond # 1):
  - 8 Midland Painted Turtles confirmed hibernating
- Wetland (Unit 7 marsh):
  - 2 Midland Painted Turtles confirmed hibernating

The Turtle Nesting Surveys / habitat assessment resulted in the following observations:

- No nesting turtles or predated turtle nests were recorded

- Nesting habitat suitability:
    - There is some limited turtle nesting habitat potential to the west of the Unit 7 Wetland (small pockets of exposed gravel within the Cultural Meadow habitat in the HEPC) and east of Unit 7 (in the garden area at the top of the embankment adjacent to the parking lot).
    - The gravel parking lot on the golf course and the adjacent agricultural fields have very compact substrates not suitable for turtle nesting.
    - Overall, however, the study area does not maintain any ideal turtle nesting habitat and turtles likely nest in unsuitable areas which result in low nest success.

3.4.5 Bats

3.4.5.1 Approach

Three SAR bats have potential to occur within the study area: Little Brown Myotis (*Myotis lucifugus*); Northern Myotis *(Myotis septentrionalis*); and Tri-colored Bat (*Perimyotis subflavus*. These species are listed as *Endangered* provincially and subject to the provisions of the ESA (2007).

As input to the current process, we have considered potential ESA / planning implications for SAR bats by undertaking a preliminary bat habitat suitability assessment. At present, there is no *General Habitat Description or Habitat Regulation* for any of these four bat SAR. The following has informed our assessment of bat habitat:

- Correspondence with MNRF staff on multiple dates from 2014 - 2018
- Technical Note, Species at Risk (SAR) Bats (MNRF Regional Operations Division, June 2015)
- Bat and Bat Habitat Surveys of Treed Habitats (MNRF Guelph District, August 2014)
- Use of Buildings and Isolated Trees by Species at Risk Bats. Survey Methodology (MNRF Guelph District, October 2014)
- Survey Protocol for Species at Risk Bats within Treed Habitats. Little Brown Myotis, Northern Myotis & Tri-Colored Bat (MNRF April 2017).

Targeted SAR bat habitat suitability assessments were undertaken on November 4, 2016 and May 11, 2018, supplemented by information collected during other field surveys (e.g., ELC work). Methodology is as follows:

- Structures: Three structures which are potentially suitable maternal roosting habitat for SAR bats are present in the study area; an office and two sheds, all on the golf course lands. Each was inspected to assess potential for bat habitat and notes were recorded regarding features or characteristics that indicate high potential for bat habitat including: large openings in the walls or roof; abundance of gaps or sheltered spaces for roosting; suitable adjacent foraging habitat (e.g., agricultural fields, cultural meadow, and wetlands); and building age (i.e., older).
- Treed Areas: Per MNRF (2017), "…any coniferous, deciduous or mixed wooded ecosite, including treed swamps, that includes trees at least 10cm diameter at breast height (dbh) should be considered suitable maternity roost habitat".

Two small treed vegetation communities / inclusions are present: Unit 5 (SWD4-5) and Unit 8 (SWD4-5). Within these communities, a more refined assessment of potential bat maternity roosting trees was undertaken in November and May during partial leaf-off. Trees were examined from multiple vantage points using binoculars to visually inspect potential cavities. Detailed information was collected for each identified 'cavity tree', including the following characteristics: UTM coordinates; tree species; DBH (visually estimated); Decay Class; relative tree height (meters above / below average surrounding tree heights; visually estimated); open areas in surrounding canopy (visually estimated %); and type of roosting feature(s) and descriptions (number, height above ground, size).

3.4.5.2 Results

Key findings from the bat habitat suitability assessments are as follows:

- Two treed vegetation communities are present: Unit 5 (SWD4-5) and Unit 8 (SWD4-5). These are small (0.33 ha and 0.11 ha) immature treed swamp communities dominated by Trembling Aspen and Green Ash, with occasional Cottonwood and Willow.
- In terms of site context, large forest blocks (i.e., greater than 100-200ha) are present in the local landscape, including lands to the southwest and north, within 600m of the study area (Forested Hills ESPA and St. Agatha Forest ESPA). Lands to the east are predominantly urban residential.
- There is suitable foraging habitat within the study area and local landscape (agricultural fields, woodland, waterbodies etc.)
- Three buildings on the golf course provide potential maternity roosting habitat; however, only one structure has obvious openings for bat access.

- Three potentially suitable bat maternity roost trees are present in the study area. However, only one is within a treed community (Tree#1 in Unit 8 – a small deciduous swamp in a predominantly meadow marsh habitat matrix). Attributes are summarized below:
    - Tree 1: In Unit 8 (a small deciduous swamp); 45 cm DBH Eastern Cottonwood; 55% open canopy surrounding the tree; decay class 2; 1 cavity ~16 m above ground (long narrow crevice on underside of branch; 50 cm x 5 cm).
    - Tree 2: In Unit 4 (swamp thicket); 40 cm DBH Willow; within decay class 1-3; loose bark.
    - Tree 3: In Unit 4 (swamp thicket);45 cm DBH Willow; within decay class 1-3; loose bark.

3.4.6 Wildlife Movement Opportunities

The study area is isolated, with built / approved or planned urban development to the north, east and south and landfill / active croplands to the west. In addition, two major roads (Erb Street and Ira Needles Boulevard) to the north and east are barriers to wildlife movement.

3.5 Aquatic Resources

3.5.1 Approach

3.5.1.1 Aquatic Habitat Assessment

An aquatic habitat assessment was undertaken to identify surface water and drainage features in the study area. To facilitate the comprehensive review of watercourse mapping and drainage condition, topographic maps and aerial photography was used to compile an understanding of the land features prior to field investigations. Existing background information was also reviewed, all of which informed field investigations.

Surface water features have been identified via all field surveys, with targeted aquatic assessments completed on November 3rd and 4th, 2016 where permission-to-enter was granted. Aquatic field surveys included detailed habitat mapping, collection of representative photographs, and notes on the following:

- Flow condition, clarity, general gradient and velocities
- Channel dimensions and general character
- Morphology (e.g., riffles, pools)

- Cover opportunities (i.e., woody debris, undercut banks, boulders, aquatic vegetation)
- Substrate type
- Bank height, character and stability / evidence of erosion
- Riparian vegetation (general)
- Physical barriers to fish movement
- Potential specialized and important habitat areas including potential spawning habitat, good nursery cover, holding habitat (deeper refuge pools)
- Evidence of groundwater discharge
- Disturbances, habitat limitations and potential habitat enhancement opportunities

3.5.1.2 Fish Habitat Assessment

- Fish community sampling was carried out using baitfish traps in accessible surface water features with depths greater than 0.35 m (i.e., Pond 1, Pond 2, Pond 4 and SWM Facility / Pond 4). Refer to Figure 5 for trap locations. These traps were set within 1-2 m from the shoreline for 20 – 24 hours and baited with dry dog kibble.
- An assessment of fish habitat was then undertaken based on findings of fish community sampling, available background fisheries information, consideration of surface water connectivity and relevant policy / guidance.

3.5.2 Results

3.5.2.1 Overview of Surface Water Features

Under current conditions, there are no defined watercourses in the study area, though there are several dug ponds, two SWM facility ponds and several drainage features (i.e., swales, diffuse flow areas). See Figure 5.

Surface water for the study area is conveyed via diffuse flow to a culvert at Erb Street West, then conveyed northerly via a municipal drain for approximately 750 m, outletting to a SWM Pond outside the study area. Ultimately, this runoff is conveyed to Clair Creek, a tributary of the Grand River.

Table 4. Summary of the surface water features within the Waterloo Commons study area.

Feature	Location (UTM)	Size / Dimensions	Surface Water Connectivity	Permanency	General Notes
Pond 1 (Golf Course)	43.443851 80.568547	0.06 ha Circular pond ~25-30 m diameter.	• No defined surface water inflows (rainfall and diffuse overland flow only) • At high water levels, discharges to Pond 2 via underground pipe • No direct surface connection to fish habitat	Permanent (may dry out significantly during periods of drought / low rainfall)	• Dug pond on Westhill Meadows Golf Course used for irrigation • Open water, no trees in vicinity • Limited natural vegetation around perimeter • Aquatic vegetation – sparse graminoids
Pond 2 (Golf Course)	43.444239 80.569158	0.04 ha Oval pond ~18 x 29m	• Surface water input from Pond 1 during high water levels, plus rainfall and diffuse overland flow • At high water levels, discharges to Pond 3 via underground pipe • No direct surface connection to fish habitat	Permanent (may dry out significantly during periods of drought / low rainfall)	• Dug pond on Westhill Meadows Golf Course used for irrigation • Open water, no trees in vicinity • Limited natural vegetation around perimeter • Aquatic vegetation – sparse graminoids
Pond 3 (Golf Course)	43.443631 80.569722	0.15 ha Rectangular pond ~45 x 32m	• Surface water input from Pond 2 during high water levels, plus rainfall and diffuse overland flow • At high water levels, discharges northerly towards the SWM Facility / Pond 4 via a poorly defined surface drainage swale (Drainage Feature 3) • No direct surface connection to fish habitat	Permanent (may dry out significantly during periods of drought / low rainfall)	• Dug pond on Westhill Meadows Golf Course used for irrigation • Open water, no trees in vicinity • Limited natural vegetation around perimeter • Aquatic vegetation – abundant algae
SWM Facility / Pond 4 Region of Waterloo SWM (adjacent to Waterloo Commons)	43.444504 80.571523	0.17 ha Long, narrow pond ~150 m in length by 10-25m wide	• Receives surface water inputs from piped discharge from Ira Needles Blvd and diffuse overland flow via Drainage Features 3 and 4 • Discharges to Unit 7 wetland via poorly defined channel (Drainage Feature 2), then to the culvert at Erb Street leading to the municipal drain to the north • No direct surface connection to fish habitat – separated from downstream fish habitat by an underground municipal drain for 750+m	Permanent	• SWM facility adjacent to Waterloo Commons property – treats runoff from Ira Needles Blvd and golf course lands • Dense cattail and Phragmites at perimeter
SWM Facility / Pond 5 Recycling Centre SWM (adjacent to landfill)	43.443960 80.575552	~.63 ha Rectangular pond ~150 m length by 40 m wide	• Receives surface water inputs from landfill to the west • Discharges to Unit 7 wetland via poorly defined channel (Drainage Feature 1), then to the culvert at Erb Street leading to the municipal drain to the north • No direct surface connection to fish habitat – separated from downstream fish habitat by an underground municipal drain for 750+m; additional barriers to movement with riprap area at outlet	Permanent	• SWM facility on adjacent lands to the west • to Waterloo Commons property – treats runoff from Ira Needles Blvd and golf course lands • Dense cattail and Phragmites at perimeter of pond
Vegetation Unit 7/9	43.445083 80.573400	1.16 ha	• Mosaic of meadow marsh and open water habitat • Receives surface water inputs from SWM Facilities (Pond 4 and Pond 5) via Drainage Features 1 and 2 • Barriers to fish movement – intermittent water levels; dense vegetation; culvert / pipe at Erb Street • No direct surface connection to fish habitat – separated from downstream fish habitat by an underground municipal drain for 750+m	Intermittent – depending on seasonal and storm inputs from SWM ponds	• Mosaic of meadow marsh and shallow open water vegetation communities • Anthropogenic feature – created via SWM discharge and impoundment of flows at Erb Street
Drainage Feature 1	43.444399 80.574339	~0.85 m wide; estimated depth 3-8 cm	• Poorly defined channel that conveys flows out of SWM Facility / Pond 5 towards Unit 7 wetland	Intermittent - seasonal and storm events.	• Narrow, poorly defined and densely vegetated drainage feature

Feature	Location (UTM)	Size / Dimensions	Surface Water Connectivity	Permanency	General Notes
Outlet from SWM Facility / Pond 5			• Narrow, densely vegetated with herbaceous plants • Barriers to fish movement – riprap at upper end; perched twin CSP culverts; dense vegetation • No direct surface connection to fish habitat		• Conveys flows out of SWM Facility / Pond 5 towards Unit 7 wetland
Drainage Feature 2 Outlet from SWM Facility / Pond 4	43.445310 80.573507	Braided channels through dense in-stream vegetation ~ 2.5 m wide; estimated depth 5-20 cm	• Poorly defined channel that conveys flows out of SWM Facility / Pond 4 to Unit 7 wetland • Narrow, densely vegetated with herbaceous plants • No direct surface connection to fish habitat	Intermittent - seasonal and storm events.	• Narrow, poorly defined and densely vegetated drainage feature • Conveys flows out of SWM Facility / Pond 4 towards Unit 7 wetland
Drainage Feature 3 Outlet from Pond 3		~0.4 m wide; estimated depth 0-5 cm	• No surface connectivity – isolated pond with intermittent surface outflow only	Intermittent - seasonal and storm events.	• Narrow, poorly defined drainage feature • Conveys flows out of Pond 3 across golf course lands towards SWM Facility / Pond 4
Drainage Feature 4 Agricultural fields to the southwest		No measurable size/dimension (Dry)	• No surface connectivity – intermittent surface flows through poorly defined feature with no direct connectivity with downstream SWM	Intermittent - seasonal and storm events.	• Narrow, poorly defined drainage feature • Agricultural swale in upper end – no vegetation • Densely vegetated through lower reach • Conveys runoff from an agricultural field to the south towards SWM Facility / Pond 4 through Unit 3

3.5.2.1 Fish Community Sampling

Three fish species were captured, as listed in Table 5: Fathead Minnow (*Pimphales promelas*); Brown Bullhead (*Ameirus nebulosus*); and Goldfish (*Carassius auratus*).

Table 5. Fish community sampling results.

Feature	# of Traps Set	Fish Species	Number Captured
Pond 1	6	• Fathead Minnow	187
Pond 2	6	• Fathead Minnow	271
Pond 3	8	• Fathead Minnow • Brown Bullhead	28
Pond 4 (Erb St. SWM Facility)	8	• Fathead Minnow • Brown Bullhead • Goldfish	610
Pond 5 (Landfill SMW Facility)	Not Trapped – No PTE	• n/a	-
Drainage Feature 1- Outlet from SWM Facility / Pond 5	Not Trapped – Water level too low	• n/a	-
Unit 9 pond	Not Trapped – Inaccessible due to sediment load	• Intermittent connectivity with SWM / Pond 4 suggests similar fish community composition • Fish (species unknown) observed	-
Drainage Feature 1 Outlet from SWM Facility / Pond 5	Not trapped – intermittent flow and insufficient depth	n/a	-
Drainage Feature 2 Outlet from SWM Facility / Pond 4	Not trapped – intermittent flow and insufficient depth	n/a	-
Drainage Feature 3 Outlet from Pond 3	Not trapped – intermittent flow and insufficient depth	n/a	-
Drainage Feature 4 Agricultural Swale	Not trapped – intermittent flow and insufficient depth	n/a	-

The aquatic habitat within the trapped Ponds 1, 2, 3 and SWM / 4 support warmwater fish communities consisting of either baitfish (Fathead Minnow) and/or sportfish (Brown Bullhead) species that are common in southern Ontario. These features do not provide commercial, recreational or aboriginal (CRA) fisheries.

All aquatic features in the study area are considered 'disconnected' from downstream fisheries (i.e., Clair Creek and Clair Lake): fish present in the downstream habitats cannot move upstream to the study area features as they are separated by more than 750m of underground pipe / municipal drain.

3.6 Hydrogeology

3.6.1 Approach

MTE Studies

Characterization of hydrogeology within the study area has been undertaken by MTE Consultants, as documented in the following reports:

- Surface Water Monitoring West Waterloo, Westhill District (WW-WD) North/South Collector Rd (NS-CR) (MTE December 2018)
- Hydrogeological Assessment, West Waterloo, Westhill District (WW-WD) North/South Collector Rd (NS-CR) (MTE December 2018)
- Erb Street Pond Chronology, West Waterloo, Westhill District (WW-WD) North/South Collector Rd (NS-CR) (MTE December 2018)

The Hydrogeological Assessment (MTE 2018) was intended to:

- Assess the local and regional hydrogeological characteristics;
- Determine local surface water and groundwater elevations; and
- Assess local wetland and groundwater interactions across the study area.

Work included background information review and the following field investigations:

- Review of existing wells within and adjacent to the site

- Installation of two shallow groundwater monitoring wells, two mini-piezometers and five surface water piezometers within the Subject Lands.
- Manual measurement of stabilized surface water and groundwater levels.
- Grain size analysis of select soil samples.
- Collection of surface water and groundwater samples to document pre-development water chemistry (to be analyzed for general water quality parameters).
- Installation of electronic pressure transducers (data loggers) for continuous monitoring of groundwater and surface water levels.

Those data were analyzed, with the following characterized:

- Geologic and hydrogeological summary.
- Preparation of geological cross-sections through the study area.
- Determination of shallow groundwater system properties: horizontal hydraulic gradient; average linear groundwater velocity; and shallow groundwater flow patterns.
- Assessment of surface water and groundwater interactions associated with wetland features

WSP

Additional / supplementary information has been collected by WSP ecologists through field surveys listed herein. This includes observations of surface water features and functions, as described in preceding sections.

3.6.2 Results

Key findings from the hydrogeological analyses are presented below.

Hydrogeology

- Stratigraphic conditions beneath the Study Area primarily consist of fine grained cohesive (silt and clayey silt till) materials;
- Topography across the Study Area was determined to range between 377 m and 394 m amsl, decreasing in elevation along the northwesterly direction;
- Groundwater levels in the Study Area were measured to range from 0.34 m bgs to 3.39 m bgs in installed monitoring wells and mini-piezometers;

- The local scale groundwater table elevation, interpreted based on collected water levels and historic levels, was interpreted to generally follow the Study Area topography and ranged between 377 m and 382.5 m amsl with the direction of groundwater flow being inferred to be northwesterly;
- The horizontal gradient of shallow groundwater table beneath the Study Area is estimated to be 0.004 m/m;
- Maximum and minimum hydraulic conductivity values for the groundwater table beneath the Study Area were calculated to range between $1.3x10^{-7}$ m/sec and $2.7x10^{-9}$ with a geometric mean of $2.5x10^{-8}$ m/sec; and
- The average linear groundwater velocity beneath the Study Area was estimated to be less than 0.10 m/year.
- Regional groundwater flow direction is generally to the south across the study area. Local scale shallow groundwater flow was interpreted to generally be in the northwesterly direction converging towards the Waterloo Commons SWM / wetland W1 and ultimately flowing towards Clair Creek.

Surface Water

- A comparison of measured average surface water elevations and ground surface elevations at HEPC North (W2; Veg. Unit 2a/2c) and 1130814 Ontario Inc. West (W4; Veg. Unit 11) determined that these wetland features remained generally dry during the monitoring period (i.e. standing water levels of <0.03 m). This suggests that these features are likely topographic depressions which temporarily retain water following precipitation events, then become dry as a result of evapotranspiration and infiltration losses. Standing water was observed at the Waterloo Commons and 1130814 Ontario Inc. east wetland W3. MTE has surface and groundwater monitoring at this location and it will be on-going. The Region of Waterloo Landfill pond is a known man-made SWM facility which drains into the W1 wetland/SWM facility.

Water Quality

Surface water and groundwater samples were collected from the Waterloo Commons wetland (W1) and 1130814 Ontario Inc. East wetland (W3) to assess background groundwater quality in the Study Area. A supplementary surface water sample was also collected from the Region of Waterloo Land's SWM pond. Results did not provide conclusive evidence regarding the interaction of groundwater and surface water at these. Overall trends identified from samples collected from the Study Area suggest the following:

- Groundwater concentrations of anions, nutrients, and total metals are generally lower than surface water concentrations;
- Surface water concentrations of anion, nutrients, and total metals generally increase across the Study Area to the north / northeast, following the inferred direction of surface water drainage;
- Groundwater concentrations of anion, nutrients, and total metals generally increase across the Study Area to the north / northeast, following the inferred direction of groundwater flow; and
- The elevated concentrations of sodium and chloride at W1 are interpreted to be a result of road salt application on the roadways located to the north and east.

Groundwater – wetland interaction

- It is interpreted that the Waterloo Commons wetland W1 receives minor volumes of groundwater discharge and is primarily sustained by surface water runoff. Surface water runoff directed to the wetland feature is general conveyed from the surrounding lands, Ira Needles Boulevard, and the hydraulically up-gradient Regional Landfill SWM pond.
- It is interpreted that the 1130814 Ontario Inc. East wetland W3 formerly provided minor recharge volumes to the underlying groundwater table. Based on its small size, it was concluded that recharge volumes generated through this feature were relatively insignificant and that local groundwater was therefore likely not sustained by this wetland. The remnant 1130814 Ontario Inc. East wetland has since been partially removed in accordance with GRCA Permit No. 755/15.
- An in-depth groundwater-wetland interaction assessment of the smaller unevaluated wetland features (HEPC North (W2), HEPC South, and 1130814 Ontario Inc. West (W4) was not completed based on review of collected surface water level data and the relatively small areas of the wetland features. Surface water level data at these locations suggest that the wetland features would generally behave as depression features, retaining water following precipitations events and then becoming dry as a result of evapotranspiration and infiltration losses.

4.0 NATURAL HERITAGE STATUS & SIGNIFICANCE

Per input from City and GRCA staff during the scoping of work, an analysis of the significance and status of the natural features and, as it relates to the City's Official Plan, whether the wetlands are *Locally Significant Wetlands* or *Other Wetlands*, thereby identifying the applicable policy framework.

As input to this analysis, relevant natural heritage policies have been considered, as discussed below. Per the TOR, a full policy compliance analysis will be completed in subsequent stages, with a proposed road alignment and impact / mitigation review.

4.1 Fisheries Act

4.1.1 Overview of Key Policies

The Canadian Fisheries Act provides provisions for the protection of fish and fish habitat. Section 35 (1) of the Fisheries Act states:

> "No person shall carry on any work, undertaking or activity that results in serious harm to fish that are part of a commercial, recreational or Aboriginal fishery, or to fish that support such a fishery."

The Act interprets 'serious harm to fish' as "the death of fish or any permanent alteration to, or destruction of, fish habitat". Proponents that plan to undertake activities in or near water have potential to negatively affect fisheries, as such, are responsible for avoiding, mitigating, and offsetting '*serious harm to fish*'. Avoidance is achieved by undertaking measures which completely prevent serious harm to fish. These measures include project design considerations, location of activity, and timing of works. Mitigation is implemented by following best practices such as those described in the '*measures to avoid harm*' to fish and fish habitat'. Any residual impacts are then required to be addressed by offsetting. An offsetting measure is one that counterbalances *serious harm* to fish resulting from a project, where serious harm remains after all feasible mitigation measures have been applied.

4.1.2 Study Assessment

4.1.2.1 Presence of fish subject to the Fisheries Act

There are no features which provide a commercial, recreational or aboriginal fishery in the study area.

Downstream habitat in Clair Creek / Clair Lake potentially provides a commercial and recreational fishery. However, as noted above, those features are at least 750m downstream of the study area and disconnected from aquatic features in the study area by a long section of piped municipal drain (into which the two SWM ponds in the study area outlet).

Inputs from SWM discharge to the municipal drain conveying flows to Clair Creek likely contribute allochthonous materials to those downstream fish habitats and those inputs should be maintained to avoid causing serious harm to the downstream fish community).

4.1.2.2 Future Study Requirements

We anticipate that this project (road construction and SWM pond modifications) will not require DFO review under the self-assessment process as it involves "artificial waterbodies that are not connected to a waterbody that contains fish at any time during any given year, such as…commercial ponds, stormwater management ponds, agricultural drains and ditches…"

The project will still need to following best practices to avoid causing harm to fish and comply with the Fisheries Act and other applicable legislation. These may include:

- Following appropriate timing windows for warmwater: permissible construction timing window of July 1st to March 31st (i.e., no in-water works allowed from April 1st to June 30th in any given year)
- Developing an Erosion and Sediment Control (ESC) plan for agency approval
- Developing a Spills Management Plan
- Re-vegetating and stabilizing soils exposed through works in a timely fashion
- Developing guidelines for operation of machinery (e.g., access, refueling, storage etc.).

4.2 Species at Risk Act (2002)

4.2.1 Overview of Key Policies

The federal Species at Risk Act (SARA) includes a number of prohibitions to protect individuals of listed Species at Risk, including:

- No person shall kill, harm, harass, capture or take an individual of a threatened, endangered or extirpated species.
- No person shall possess, collect, buy, sell or trade an individual of a threatened, endangered or extirpated species, or any part or derivative of such an individual.
- No person shall damage or destroy the residence of one or more individuals of a threatened or endangered species, or of an extirpated species if a recovery strategy has recommended the reintroduction of the species into the wild in Canada.

These prohibitions apply on private lands throughout Canada only to aquatic species and species of migratory birds protected by the Migratory Birds Convention Act listed as Endangered, Threatened, or Extirpated under Schedule 1 of SARA. For other listed wildlife species, these prohibitions apply only in federal lands. However, the Governor in Council may, by order, apply these prohibitions to non-federal lands if the Minister of the Environment is of the opinion that the laws of a province do not effectively protect a listed species or the residences of a listed species.

On the recommendation of the Minister of the Environment, the Minister of Fisheries and Oceans or the Minister of Canadian Heritage, the Governor in Council may also apply these prohibitions on federal lands to species that are not listed by COSEWIC but are designated *endangered* or *threatened* by a provincial or territorial minister.

SARA also includes provisions to protect *critical habitat*; these are complex and vary according to the species in question and the location of the critical habitat. SARA's provisions also permit the Minister of the Environment, the Minister of Fisheries and Oceans and the Minister of Canadian Heritage broad discretionary powers to implement (or not) prohibitions to protect critical habitat. Generally, critical habitat protection applies to Threatened, Endangered and Extirpated species.

4.2.2 Study Assessment

4.2.2.1 Applicability

The project is on non-federal (private / municipal) lands and there is no order by Governor in Council; hence SARA applies to aquatic and migratory bird species / habitat.

4.2.2.2 Survey Results

There is potential habitat for aquatic and migratory birds subject to SARA within the study area. Habitat suitability and presence / use was evaluated through field inventories and habitat assessments as described in Section 3.

4.2.2.3 Individuals and Residences

No SARA-listed aquatic or migratory bird species were recorded in the study area and we are aware of no recent records.

We are aware of no downstream critical habitat for aquatic SAR species which would be impacted by the proposed activities, with proper implementation of recommended mitigation and protection measures.

4.2.2.4 Critical Habitat:

No critical habitat for aquatic species is present within the proposed area of works and none is known on adjacent lands where there is potential for indirect impact.

4.3 Endangered Species Act (2007)

4.3.1 Overview of Key Polices

Species designated as *Threatened or Endangered* by the Committee on the Status of Species at Risk in Ontario (COSSARO), otherwise known as Species at Risk in Ontario (SARO), and their habitats (e.g. areas essential for breeding, rearing, feeding, hibernation and migration) are automatically afforded legal protection under the Endangered Species Act (ESA) (Government of Ontario 2007). ESA Subsection 9(1) states that:

"No person shall,

(a) kill, harm, harass, capture or take a living member of a species that is listed on the Species at Risk in Ontario List as an extirpated, endangered or threatened species;

(b) possess, transport, collect, buy, sell, lease, trade or offer to buy, sell, lease or trade,

(i) a living or dead member of a species that is listed on the Species at Risk in Ontario List as an extirpated, endangered or threatened species,

(ii) any part of a living or dead member of a species referred to in subclause (i),

(iii) anything derived from a living or dead member of a species referred to in subclause (i); or

(c) sell, lease, trade or offer to sell, lease or trade anything that the person represents to be a thing described in subclause (b) (i), (ii) or (iii).

Clause 10(1)(a) of the ESA states that:

"No person shall damage or destroy the habitat of a species that is listed on the Species at Risk in Ontario list as an endangered or threatened species"

The ESA also calls for the development of species-specific Recovery Strategies and Habitat Regulations. Unlike the *general habitat* of a species, *regulated habitat* may include areas that are currently unoccupied by the species. These areas are commonly referred to as "recovery habitat."

In order to balance social and economic considerations with protection and recovery goals, the ESA also enables the MNRF to issue permits or enter into agreements with proponents in order to authorize activities that would otherwise be prohibited by subsections 9(1) or 10(1) of the Act provided the legal requirements of the Act are met.

4.3.2 Assessment

4.3.2.1 Applicability

Potentially suitable habitat is present and species afforded protection under the ESA (2007) and their habitats have been recorded within the study area.

4.3.2.2 Habitat Assessment / Screening

Direction from MNRF to assess the potential presence of SAR has been to undertake a screening exercise to identify which SAR have reasonable potential to be present within a given study area based on known occurrences of the species and the habitats present. The screening exercise involved developing a list of SAR known to occur within the vicinity of study area or region from review of various sources including: species indicated by MNRF through correspondence, NHIC data extracted from online Biodiversity Explorer tool, MNRF Species at Risk website regional species list, and DFO SAR mapping.

Once the list of species was developed, each species known preferred habitat was then cross-referenced against habitats identified within the study area or adjacent lands, with consideration of species distribution and range, to determine the reasonable likelihood of the species being present - based on the 'key habitats used by species' (based on MNRF provided definitions or MNRF website habitat descriptions). Considering findings of surveys and habitat suitability, we then assessed 'likelihood and magnitude of impacts to species or habitats'.

The full SAR habitat evaluation is provided in Appendix E.

We conclude that for the majority of the listed species, no suitable habitat is present or only a small amount / marginally suitable habitat is present and the likelihood of occurrence is low. For species where potential habitat is present and likelihood of occurrence is greater, we completed the field surveys / habitat assessments described in Sections 3.3, 3.4 and 3.5 and summarized below. We concluded that no additional targeted / specialized surveys were required.

Based on the screening, potentially suitable habitat for a number of SAR (flora and fauna) was identified in the study area or general vicinity. To assess potential, we completed field inventories and habitat assessments as described in preceding sections; this included 3-season surveys on 17 separate dates.

4.3.2.3 Results and Conclusions

No *Endangered* or *Threatened* SAR species were recorded during surveys and we are aware of no recent records within the study area

For all other SAR species with some potentially suitable habitat in the vicinity of the proposed works, but not recorded during field surveys, the likelihood and magnitude of impacts is 'none' or 'minimal', based on the size and/or quality of habitat, low likelihood of occurrence and presence of abundant (and generally much larger / higher quality) habitat in the local landscape.

4.4 Provincial Policy Statement (2014)

4.4.1 Overview of Key Policies

The Ontario Provincial Policy Statement (PPS) was issued under Section 3 of the Ontario Planning Act. Section 3 of the Planning Act requires that decisions affecting planning matters "shall be consistent with" policy statements issued under the Act (OMMAH 1990). The PPS provides policy direction on land use planning and development matters that are of provincial interest which protect the natural environment as well as public health and safety. The natural heritage provisions of the PPS (Section 2.1.) provide protection for the following features:

1. Significant Habitats of Endangered and Threatened Species
2. Provincially Significant Wetlands (PSW)
3. Significant Woodlands
4. Significant Valleylands
5. Significant Wildlife Habitat (SWH)
6. Significant Areas of Natural and Scientific Interest
7. Fish Habitat

Development and site alteration is not permitted within features 1 and 2, although may be permitted within the remaining features (3 through 7), and adjacent to all features if the ecological function has been evaluated and it has been demonstrated that there will be no negative impacts on the natural features or on their ecological functions.

4.4.2 Study Assessment

An assessment of PPS natural heritage policies was undertaken, as described herein.

- **Endangered or Threatened Species**[4]. None was recorded in the study area.

[4] Note that the "significant habitat of Endangered and Threatened species is also considered a Core Environmental Feature in the Regional Official Plan – policy 7.C.1 (a).

- Conclusion: no potential for impact to endangered or threatened species or their habitat. Impacts to potential habitat mitigated by implementation of recommended protection, mitigation and enhancement measures.

- **PSW**. None is present within the study area.
  - Conclusion: no potential impacts to PSW

- **Significant Woodlands**. None is present within the study area.
  - Conclusion: no potential impacts to significant woodland.

- **Significant Valleylands**. None is present within the study area.
  - Conclusion: no potential impacts to significant valleyland.

- **Significant Wildlife Habitat**. An evaluation of *Significant Wildlife Habitat* was undertaken using the Significant Wildlife Habitat Ecoregion Criteria Schedules, Ecoregion 6E (MNRF 2015). The full assessment is included in Appendix F with conclusions and recommendations summarized below.
  - Within the study area, candidate SWH was identified for 11 criteria. Based on field survey results, SWH was confirmed for two criteria: Terrestrial Crayfish - Chimney Crayfish confirmed SWH in Unit 2 (CUT) and Unit 4 (SWT); and Special Concern and Rare Wildlife Species - confirmed SWH for Monarch (Special Concern) in Unit 4 (SWT).
  - Conclusion: Anticipated activities will not result in negative impacts to SWH for terrestrial crayfish with maintenance of suitable habitat on adjacent lands and creation of habitat through restoration works post-construction. Additional mitigation measures such as relocation of individuals to suitable habitat could be considered, as required.

    Anticipated activities will not result in negative impacts to SWH for Monarch given the low abundance (1 individual), and since the location in which Monarch was recorded (Unit 4; SWT) would not be critical habitat for any component of this species life cycle. Moreover, abundant larval and adult habitat is present in the local landscape.

- **ANSI**. No ANSIs are present within the study area.

- Conclusion: no potential impact to ANSIs.

- **Fish Habitat**. The anthropogenic aquatic features within the study area provide habitat for a few common fish species but do not provide a commercial, recreational or aboriginal (CRA) fishery and are not connected to downstream CRA fisheries. They likely do contribute nutrients and allochthonous material to downstream fish habitat.

    - Conclusion: proposed works will not result in serious harm to fish that are part of a commercial, recreational or Aboriginal fishery, or to fish that support such a fishery – with implementation of recommended protection, mitigation and enhancement measures.

4.5 Regional / Municipal

4.5.1 Waterloo Regional Official Plan (ROP) (2015)

4.5.1.1 Overview of Key Policies

The Regional Official Plan (ROP; 2015) identifies a 'Greenlands Network' of *environmental features* and *linkages* among them. Policies of the ROP have the goal of maintaining, enhancing, or where feasible restoring the Greenlands Network. The Greenlands Network (ROP Map 4)is comprised of *Landscape Level Systems (including Environmental Significant Landscapes), Core Environmental Features* (CEF), Fish Habitat, *Supporting Environmental Features*, and the *linkages* between them.

As per policies of the ROP, development and site alteration proposed adjacent to the above noted features requires the completion of an *Environmental Impact Statement* to evaluate potential impacts.

4.5.1.2 Study Assessment

No ROP designated natural features are present within the study area. A *Core Environmental Feature* (CEF) is present on lands to the east: this is part of the Waldau East Wetland Complex.

Considering results of the current study (background review + field survey findings), no features which meet criteria for inclusion in the Greenlands Network (per Section 7 of the ROP) are present in the study area, as follows:

Landscape Level Systems:

- none is present

Core Environmental Features (CEF), as defined in Section 7.C of the ROP – which states that the CEF designation applies to lands that meet the following criteria:

- Significant Habitat of Endangered or Threatened Species
    - None is present. See Section 4.3
- Provincially Significant Wetlands
    - None is present on or adjacent to the study area. Wetlands within the study area are small, anthropogenically influenced and generally comprised of tolerant flora and fauna.
- Environmentally Sensitive Policy Areas
    - None is present. Features within the study area do not meet ESPA criteria.
- Significant Woodlands
    - None is present. Treed habitats are limited to two small, immature areas.
- Environmentally Significant Valley Features
    - None is present. No defined watercourse / floodplains are present.
- Significant Areas of Natural and Scientific Interest
    - None is present.

- Fish Habitat
    - No anticipated impacts to fish habitat subject to the provisions of the Fisheries Act. See Section 3.5.
- *Supporting Environmental Features* (SEF), including
    - Identified by municipalities. See Section 4.6
    - Includes areas that are regulated by the GRCA under the Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses (Ontario Regulation 150/06). See Section 4.5.3.
    - Includes *Linkages* – none is present as the site is isolated and bordered by major roads and urban development.

4.5.2 City of Waterloo Official Plan (2016)

4.5.2.1 Overview of Key Policies

The City of Waterloo Official Plan (2016; under appeal to the OMB) includes a *Natural System* consisting of Landscape Level Systems, Core Natural Features, and Supporting Natural Features, as well as fish habitat, Restoration Areas, and Linkages. Landscape Level Systems, Core Natural Features and fish habitat are discussed in Section 4.3.1.

4.5.2.2 Study Assessment

The study area has the follow Official Plan environmental designations:

- Schedule A3: *Parks and Other Green Space* – including a portion of the HEPC North / wetland W2 south of Erb Street
- Schedule A4: *Supporting Natural Features* – wetland W1 south of Erb Street

An evaluation of Supporting "A" and Supporting "B" Natural Features is provided below.

Supporting "A" Natural Features

Supporting "A" Natural Features include the following:

(a) Locally Significant Wetlands[5]

- Of the three wetlands currently identified on Schedule A4 (W1, W2 and W3), one would be considered a Locally Significant Wetland: W1 (comprised of Vegetation Units 3 / 4 / 5 / 7 / 8 / 9), a wetland of anthropogenic origin with a total estimated area of ~ 3.4 ha
- W2 (comprised of Vegetation Units 2a and 2c), is a wetland of anthropogenic origin, with a total estimated area of ~ 0.95 ha, below the 2ha threshold
- W3 (comprised of Vegetation Units 12 and 13), is a wetland of anthropogenic origin approved for removal, and partially removed in accordance with GRCA Permit No. 755/15
- One additional wetland not currently mapped in the City Official Plan, W4 (comprised of Vegetation Unit 11), is a wetland or anthropogenic origin and a total estimated area of ~ 0.95 ha, below the 2ha threshold

(b) Locally Significant Woodlands[6]

- None is present. Two woodlands are present: Unit 5 SWD (0.33 ha); and Unit 8 SWD (0.11 ha). Neither meets the size threshold for 'Locally Significant Woodlands'

(c) Significant Wildlife Habitat

- SWH for two criteria is present, but works are anticipated to have no impact. See Section 4.4.2.

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[5] **Locally Significant Wetlands** – Wetlands that are naturally-occurring and 0.5 hectares or greater in size or anthropogenic in origin and 2 hectares or greater in size, which are not classified as Provincially Significant Wetlands.

[6] **Locally Significant Woodlands** – Woodlands that are 1 hectare or greater in size, generally excluding adjoining hedgerows and treed areas on small individual lots, that consist primarily of native tree species, which do not meet the criteria of a Regionally Significant Woodland. Cultivated fruit or nut orchards, actively managed plantations, or plantations established for the purpose of producing Christmas Trees or nursery stock are not included.

(d) Perennial Watercourses[7]

- None is present

Supporting “B” Natural Features

Supporting “B” Natural Features include:

(a) Intermittent Watercourses[8]

- Four intermittent watercourses are present: Drainage Features 1 through 4, as shown on Figure 5. These convey intermittent flows / discharge from dug ponds, SWM ponds and agricultural fields.

(b) Other Wetlands[9]

- W2 and W4, as noted above

(c) Other Woodlands[10]

- None is present. The two woodlands present (Unit 5 SWD (0.33 ha) and Unit 8 SWD (0.11 ha)) do not meet the size threshold for ‘other woodlands’

7 **Perennial Watercourse** – A watercourse that continually flows in an average year

8 **Intermittent Watercourse** – A watercourse that is dry at times of the year but generally flows during wet seasons.

9 **Other Wetlands** – Wetlands that are naturally-occurring and less than 0.5 hectares in size or anthropogenic in origin and less than 2 hectares in size, which are not classified as Provincially Significant Wetlands

10 **Other Woodlands** – Woodlands that are greater than 0.5 hectares but less than 1 hectare in size, generally excluding adjoining hedgerows and treed areas on small individual lots that consist primarily of native tree species. Cultivated fruit or nut orchards, actively managed plantations, or plantations established for the purpose of producing Christmas Trees or nursery stock are not included. Prior to development or site alteration, Other Woodlands must be evaluated to determine their significance and the need for protection

(d) Environmentally Significant Discharge Areas[11] and Environmentally Significant Recharge Areas[12].

- The conclusion of the MTE hydrogeology study is that it is not considered a significant discharge or re-charge area.

(e) Linkages[13]

- None is present. The study area is isolated, with urban development and major roads to the north, east and south and the landfill to the west. There are no existing natural corridors and limited potential for establishment given the barriers and landscape context.

4.5.3 Grand River Conservation Authority

4.5.3.1 Overview of Key Policies

The Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses (Ontario Regulation 150/06), is a regulation issued under the Conservation Authorities Act, R.S.O. 1990. Through this, GRCA has the responsibility to regulate activities in natural and hazardous areas (e.g., areas in and near rivers, streams, floodplains, wetlands, slopes and shorelines).

[11] **Environmentally Significant Discharge Areas** – Lands where groundwater discharges to the surface of the soil or to surface water bodies to sustain wetlands, fisheries, or other specialized natural habitats.

[12] **Environmentally Significant Recharge Areas** – Lands where water infiltrates into the ground to replenish an aquifer that sustains, in full or in part, natural features.

[13] **Linkages** – Areas that connect natural features along which plants and animals can propagate, genetic interchange can occur, populations can move in response to environmental changes and life-cycle requirements, and species can be replenished from other natural features. Linkages can also include those areas currently performing, or with the potential to perform, through restoration, linkage functions. Although linkages help to maintain and improve natural features, they can also serve as important natural features in their own right.

4.3.3.2 Study Assessment

Three regulated wetland features are present in the study area, within the vicinity of the proposed alignments: W1, W2 and W4. As noted above, W3 has been approved for removal and the HEPC south wetland is a least 140m from the closest alignment.

As part of Stage 2, the proposed alignments (Figure 6) will be assessed in consideration of Grand River Conservation Authority Policy for the Administration of the Development, Interference with Wetlands and Alterations to Shorelines and Watercourses Regulation (GRCA 2015) and a permit under O.Reg. 150/06 is required to proceed with site alteration within regulated areas.

5.0 CONCLUSIONS

Based on analysis presented herein, the wetlands within the study area are concluded to be:

- *Locally Significant Wetlands*: W1 (comprised of Vegetation Units 3 / 4 / 5 / 7 / 8 / 9), a wetland of anthropogenic origin with a total estimated area of ~ 3.4 ha
- *Other Wetlands*: W2 and W4, as noted above

Other wetlands:

- W3 – approved for removal in accordance with GRCA Permit No. 755/15
- HEPC south wetland – not in proximity to any of the proposed alignments, and no expected impacts

Next Steps

Following acceptance of this Stage 1 EIS, Stage 2 will be undertaken, including: evaluation of alternatives, identification of the preferred alternative, and recommended mitigation.

Yours sincerely,

WSP Canada Group Limited



Jeff Gross
Senior Ecologist, Project Manager

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Appendix K

WEST WATERLOO, WESTHILL DISTRICT NORTH/SOUTH COLLECTOR ROAD

Technical Memorandums

Project Location:
Ira Needles Boulevard & Erb Street
City of Waterloo

Prepared for:
Westhill Land Owners

Prepared by:
MTE Consultants Inc.
520 Bingemans Centre Drive
Kitchener, ON N2B 3X9

December 4, 2018
May 28, 2020
Revised July 6, 2020

MTE File No.: 34280-101



TECHNICAL MEMORANDUMS

The following MTE Technical Memorandums are included in this document under the following Tabs.

Click on the tabs below to take you directly to the Technical Memo

TAB 1 - Erb Street Pond Chronology

TAB 2 - Hydrogeological Assessment

TAB 3 - Surface Water Monitoring

TAB 4 - Technical Design Overview

TAB 5 - Municipal Services and Utilities

TAB 6 – Stormwater Management Alternatives Considered
Updated May 28, 2020 to include Alternative 5

TAB 1

TECHNICAL MEMORANDUM

MTE FILE NO.:	C 34280-101
DATE:	December 4, 2018
Prepared By:	Charles Carré, E.I.T.

Re: Erb Street Pond Chronology
West Waterloo, Westhill District (WW-WD)
North/South Collector Rd (NS-CR)

1.0 INTRODUCTION

MTE Consultants Inc. (MTE) was retained to complete the existing conditions characterization for the proposed road connection from The Boardwalk extension to the proposed connection between Erb Street West and Ira Needles Boulevard, in the City of Waterloo.

This technical memorandum presents the chronology of historical events that led to the creation of the Erb Street SWM Pond and surrounding wetland features. It is intended to provide additional background information for the historical and existing stormwater management (SWM) strategies for the study area, and is to be considered during the identification, assessment, and determination of an appropriate preferred route alternative for the north south collector road from Thorndale Drive to the proposed connection between Erb Street West. This technical memo provides background information for the assessment of the north south collector road alternatives.

This document draws upon the existing information found in several previous reports and studies completed by public agencies and private developers relating to projects undertaken within the study area. It also catalogues a series of historical aerial photos of the study area in order to establish a timeline as to when the Erb Street Pond began to form.

2.0 STUDY AREA

The proposed WW-WD, NS-CR is located west of Ira Needles Boulevard, in the southwestern portion of the City of Waterloo. The internal private road (The Boardwalk) begins at the south end of the big box commercial development, near the entrance to Walmart. The road continues northwest, through the development, to its current terminus at the north end of the Boardwalk commercial development, at the existing roundabout extension of the municipally owned Thorndale Drive.

The study area is located in the upper reach of the Subwatershed 314 – Laurel Creek Watershed and is owned by a variety of landowners, including; the Region of Waterloo, the City of Waterloo, the INCC Corporation, Hydro One, Home Hardware, and the Cressman family. The study area generally includes a small portion of the Region of Waterloo's Waterloo Landfill at 925 Erb Street West, a small portion of the

Hydro One corridor (south of Erb Street West), the residences at 87, 73, and 65 Ira Needles Boulevard, the Westhill Meadows Golf course at 41 Ira Needles Boulevard, and the Waterloo Commons commercial development at 653-659 Erb Street West. These properties will be herein referred to as the 'Subject Lands'.

3.0 HISTORICAL BACKGROUND

A series of historical aerial photographs of the study area were used to address concerns regarding the timeline of the formation of the Erb Street Pond. It is suspected that the major earthworks associated with the creation of the Region of Waterloo's landfill, located to the west of the pond, are primarily responsible for disturbing the natural stormwater management that occurred at that time.

The photos of the study area between 1930 and 1971 show no presence of any wetland or surface water feature near the location of what is now considered the Erb Street Pond; southwest of the intersection of Erb Street West and Ira Needles Boulevard. Sometime between the years 1971 and 1975, work began on constructing the Region's landfill site. It appears that the earthworks associated with this construction began to disturb existing drainage paths as well as increase the runoff generated on the previously farmed lands; which would have otherwise absorbed a majority of the annual precipitation. An aerial photo from 1975 demonstrates significant ponding near the Erb Street Pond location. It appears that the pond began to collect surface runoff from the Region's landfill site and the surrounding areas south of Erb Street where other work was being done.

Historically, the properties between 101 Ira Needles Boulevard and Erb Street, which encompass the study area, included multiple topographic low lying depressions with no natural surface runoff outfalls. Following rainfall events, surface water would collect in these depressions and would eventually infiltrate back into the ground. In order to prevent surface water from ponding on their properties, the land owners collectively installed a 250mm diameter underground clay tile drain through the properties to drain the excess surface and sub-surface water. The drain was installed in two sections; the first in the 1930s and the second in the 1950s. The completed drain was installed from just south of what is now Westhill Meadows Golf Course and extended north, well beyond Erb Street West. Before major development was undertaken in the area, the drain would outlet into a channel on the north side of Erb Street West and be conveyed north to Clair Creek. Based on the land owners' testimonies, the installation of the tile drain significantly improved the drainage situation on their properties.

In the spring of 1996, construction of the Westhill Meadows Golf Course began. The golf course property, 41 Ira Needles Boulevard, was significantly graded and reshaped during this time. Based on the adjacent land owners' testimonies, the contractor used heavy equipment to move large quantities of soil (approximately 14,000m^3 of soil was used to construct the golf course. Unfortunately, much of the grading work was done during rainy days, where the heavy equipment often sank deep into mud. Per their testimonies, the adjacent landowners tried to have the contractor alter the equipment operations for fear of having the underground tile drain become damaged or destroyed. However, their pleas were neglected. Soon after completion of the golf course, the homeowners to the south started noticing significant surface ponding on their properties. This ponded water would last for several weeks, rather than the usual days it took to drain a significant rainfall event in prior years.

As a result, the City of Waterloo required the owner of the golf course to install a drainage ditch across the course. The course's consultant suggested a 150mm diameter underground pipe that led to an onsite storage pond complete with a control valve. Unfortunately, this system was incorrectly installed at elevations

that could only collect surface water. The golf course drain could not properly drain the sub-surface water that was causing problems on the neighboring sites; which was previously being adequately drained by the underground clay tile drain. After a series of site visits and investigations into the problem, it was concluded that the previously installed drain must have been damaged or destroyed by the grading activities that took place to construct the golf course.

An investigation into the downstream wetland, what is now considered the Erb Street Pond, suggested that the overall size of the wetland had dramatically increased due to ongoing activities upstream. However, the wetland water level was measured to be approximately 3.0m lower than the surface ponding on the properties south of the golf course.

In May of 1997, the Region/City of Waterloo staff cleaned the area near the culvert installed under Erb Street West; the outlet for the Erb Street Pond. After debris was removed, water was observed to be draining through the culvert; from the south side of Erb Street West to the north side. A new field survey revealed that the surface water elevations on the properties south of Erb Street West had dropped, but not enough to actually dry out the newly formed wetlands. It was therefore concluded that the condition of the Erb Street West culvert would have a minimal impact on drainage of these adjacent properties.

Presently, the wetlands which formed on the properties south of the golf course still exist. The location and condition of the original clay tile drain running underneath the golf course is unknown at this time. However, it is evident by the presence of the wetlands that the tile is not functioning as it was originally designed.

Refer to the appended chronological aerial photography figures for more details.

4.0 SUPPORTING DOCUMENTATION

Laurel Creek Watershed Study (January 1993)

The report concentrates primarily on the Laurel Creek watershed catchment. Referenced in the study is a water quality assessment of Laurel Creek, which was completed in 1973 by the Ministry of the Environment (MOE) (now the Ministry of Environment, Conservation, and Parks). Also referenced are Clair Creek floodline maps, which were prepared in 1981. The study analyses the underlying soils within the watershed and suggests that water quality and quantity controls are imperative throughout the study area to encourage groundwater recharge (infiltration), reduce streamflow erosion, and protect the overall quality of the groundwater baseflow and the water courses.

Laurel Creek Subwatershed 314 Management Plan (October 1996)

This plan concluded that the Erb Street Pond was located in a Constraint Level One Area. An assessment established that the pond received runoff from the landfill area and future development lands south of Erb Street West. This pond provided significant storage (approximately 150,000m^3) before spilling onto Erb Street West. The pond and storm sewer outlet were designed to limit runoff into the Clair Creek tributary, to protect it from things like streamflow erosion. The designed 600mm diameter storm sewer outlet provided 48 hour detention of the 25mm storm. It was strongly suggested that this outlet should be maintained in its existing location and form, or at least be relocated somewhere to achieve the same levels of control. The Plan concluded that it was imperative that the Region of Waterloo, the City of Waterloo, landowners/developers, and the GRCA prepare a management plan for the Erb Street Pond/wetland and maintain it as a significant storage area for stormwater runoff from the areas south of Erb Street West.

Final SWM Report & Scoped Environmental Impact Study: Erb Street Pond (April 2004)

As part of the Ira Needles Boulevard (INB) development project, it was determined that the best SWM strategy for Zone 6 (INB R.O.W. from STA 24+575 to STA 24+960) of the development would be the construction of a SWM facility in conjunction with the existing wetland and pond (Erb Street Pond). The objective of this report was to:

- Secure approval from the Grand River Conservation Authority (GRCA) and the issuance of a Fill Permit;
- Secure approval from the City of Waterloo and serve as basis for future SWM requirements for the adjacent lands that currently drain to the Erb Street Pond; and
- Secure approval from the MOE and the issuance of a certificate of approval of municipal and private sewage works.

Once all the approvals were received, the forebay into the Erb Street Pond was constructed for all upstream lands in the ultimate developed conditions. Revisions were made to the outlet of the pond, which was to be sized to service the entire lands. The existing 600mm diameter CSP culvert was replaced with a 900mm diameter concrete sewer, complete with a 550mm diameter orifice plate.

The design strategy proposed some grading (which provided additional storage) and some additional landscaping around the forebay. It demonstrated that with some excavation of the wetland, grading the SWM facility would provide the quantity and quality controls necessary to service the entire upstream developed conditions. The future needs of the pond upgrades were discussed, but not implemented at this time.

Engineering Report for Proposed Commercial Development, Erb Street & Ira Needles Boulevard (For Rock Developments by Odan Detech, Revised July 10th, 2009)

This report proposed the Erb Street Pond as the principle stormwater management facility to provide quality and quantity control for the proposed development. This development is now known as Waterloo Commons.

Westhill District Plan – Final Stormwater Management Report (January 2011)

MTE was responsible for the design and construction of the regrading of the forebay, similar to the future pond upgrades discussed above in the 2004 EIS. This SWM report proposed that the design of the forebay, and associated pond works, would have to meet the MOE's "Normal" Level 2 water quality control criterion. The proposed SWM quantity control was to have the pond's outlet changed from the 900mm pipe with 550mm diameter orifice plate to a multiple staged outlet. A 220mm diameter round orifice and a 200x1725mm slot orifice was proposed to be installed in a discharge control manhole downstream of the pond. However, this new discharge control structure was never implemented and the outlet remained as is.

Due to ownership issues, no regrading of the wetland was proposed. This report was prepared as an alternative solution to provide the required SWM controls without entering Rock's land to complete the work.

The following is a list of key dates as they relate to the design and implementation of the works proposed in the Final Stormwater Management Report:

- June 23, 2010 – A meeting with the governing agencies. Discussions included buying the wetland from Rock and transferring ownership of the forebay from the Region to the City.
- August 26, 2010 – Original report dated and submitted to the City, the Region, and the GRCA.
- October 8, 2010 – MTE received City comments.
- MTE revised the original report on November 9, 2010 to address the City's comments.
- November 12, 2010 – MTE received Region comments.
- December 10, 2010 – MTE received GRCA comments.
- MTE revised the new report on January 25, 2011 to address the Region's and the GRCA's comments.
- MTE submitted response letters to the comments received by the City, the Region, and the GRCA.
- March 30, 2011 – New comments are received from the GRCA.
- April 7, 2011 – A design brief is created and submitted to the GRCA to address their new comments.
- Aug. 9, 2011 – An addendum is submitted to the City, the Region, and the GRCA to address all the revisions that have taken place since the original report submission.
- Oct. 13, 2011 – The GRCA provides MTE with an approval letter for the proposed works.

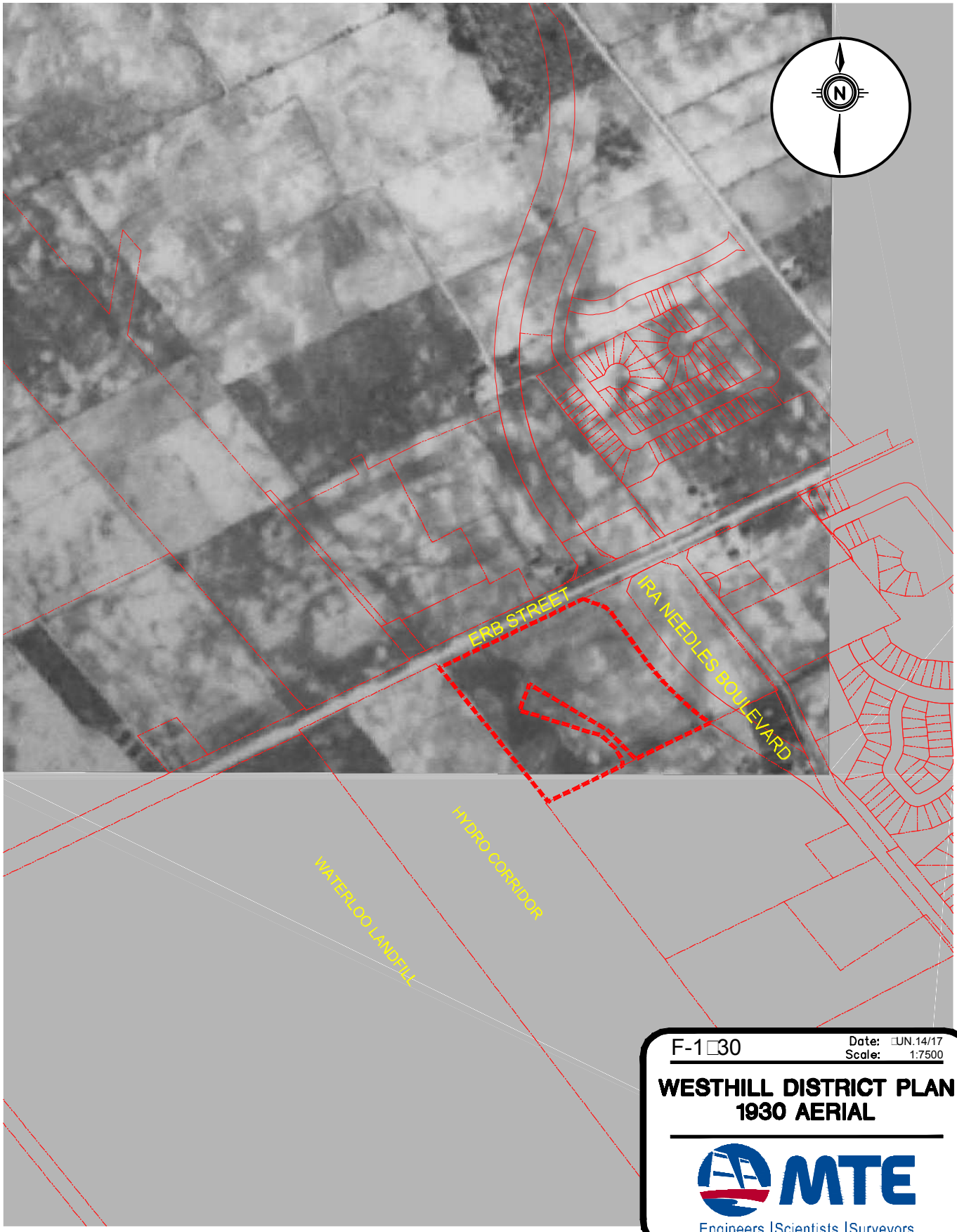
5.0 CONCLUSIONS

Based on the analysis of the chronology of historical events that led to the creation of the Erb Street Pond and surrounding wetland features, the following conclusions are provided:

1. Based on historical aerial photography, it appears that the formation of the Erb Street Pond began between the years 1971 and 1975, which coincides with start date of the construction work on the adjacent Region of Waterloo's landfill site.

2. Works related to the construction of the Westhill Meadows Golf Course in 1996 appears to have damaged or destroyed an existing tile drain, which was installed by adjacent landowners, throughout the study area. This drain was originally installed to eliminate ponding surface water on the adjacent sites. However, due to it being damaged, permanent wetland features began to appear throughout the properties south (upstream) of the Erb Street Pond.

MTE Consultants Inc. www.mte85.com
520 Bingemans Centre Drive
Kitchener, Ontario N2B 3X9
Phone: 519-743-6500
Fax: 519-743-6513



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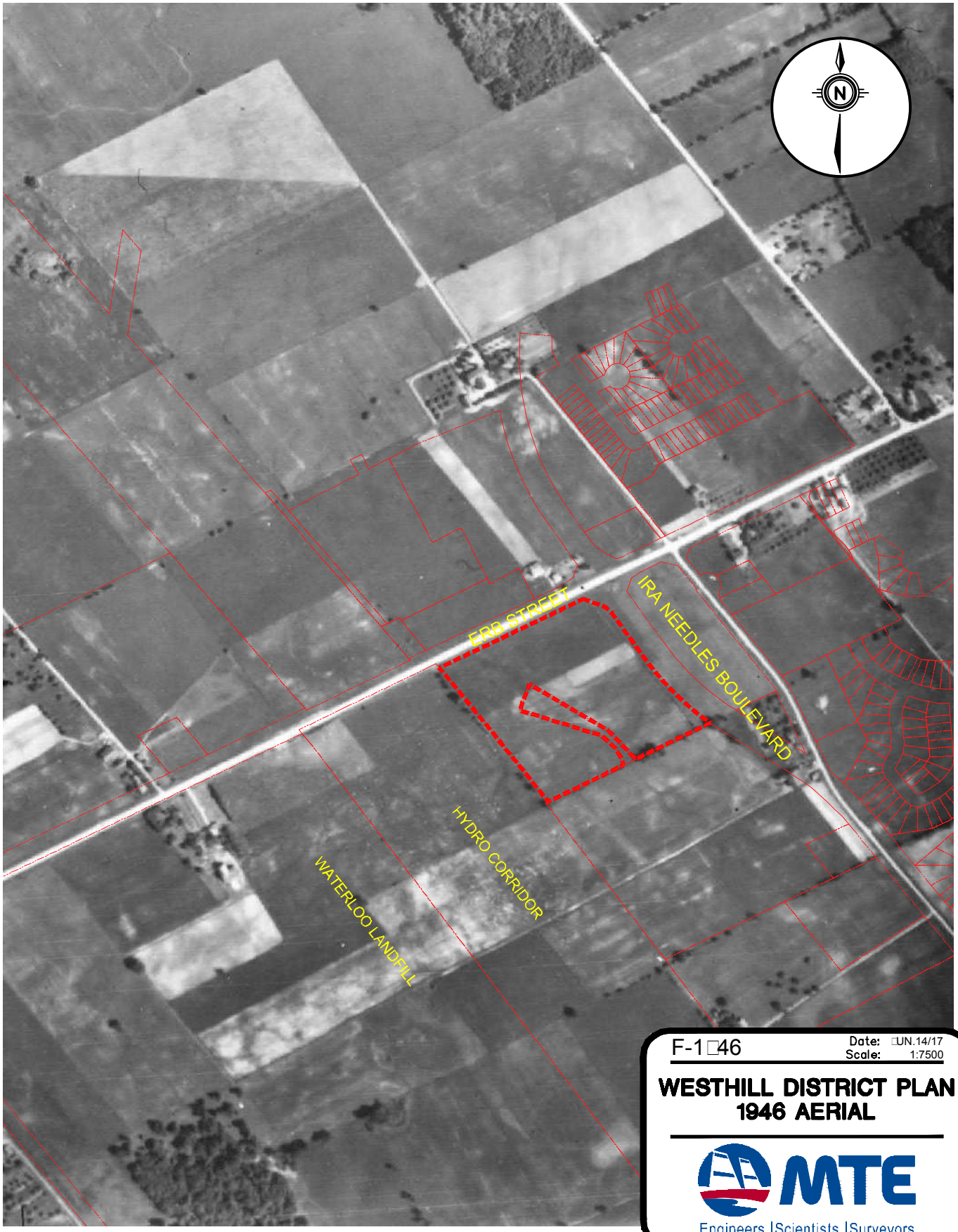
WESTHILL DISTRICT PLAN
1930 AERIAL

MTE
Engineers | Scientists | Surveyors

Project No.: 34280-101

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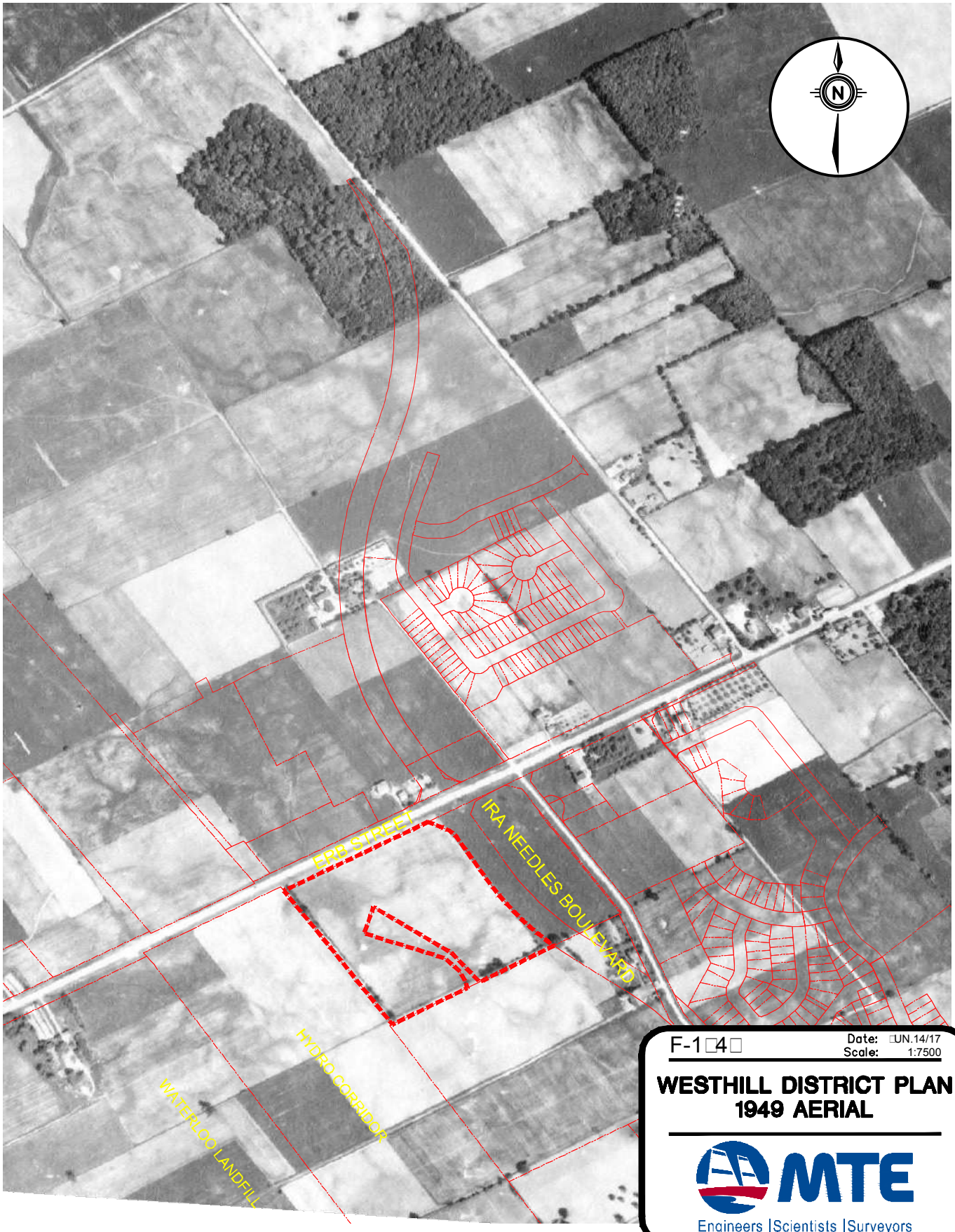
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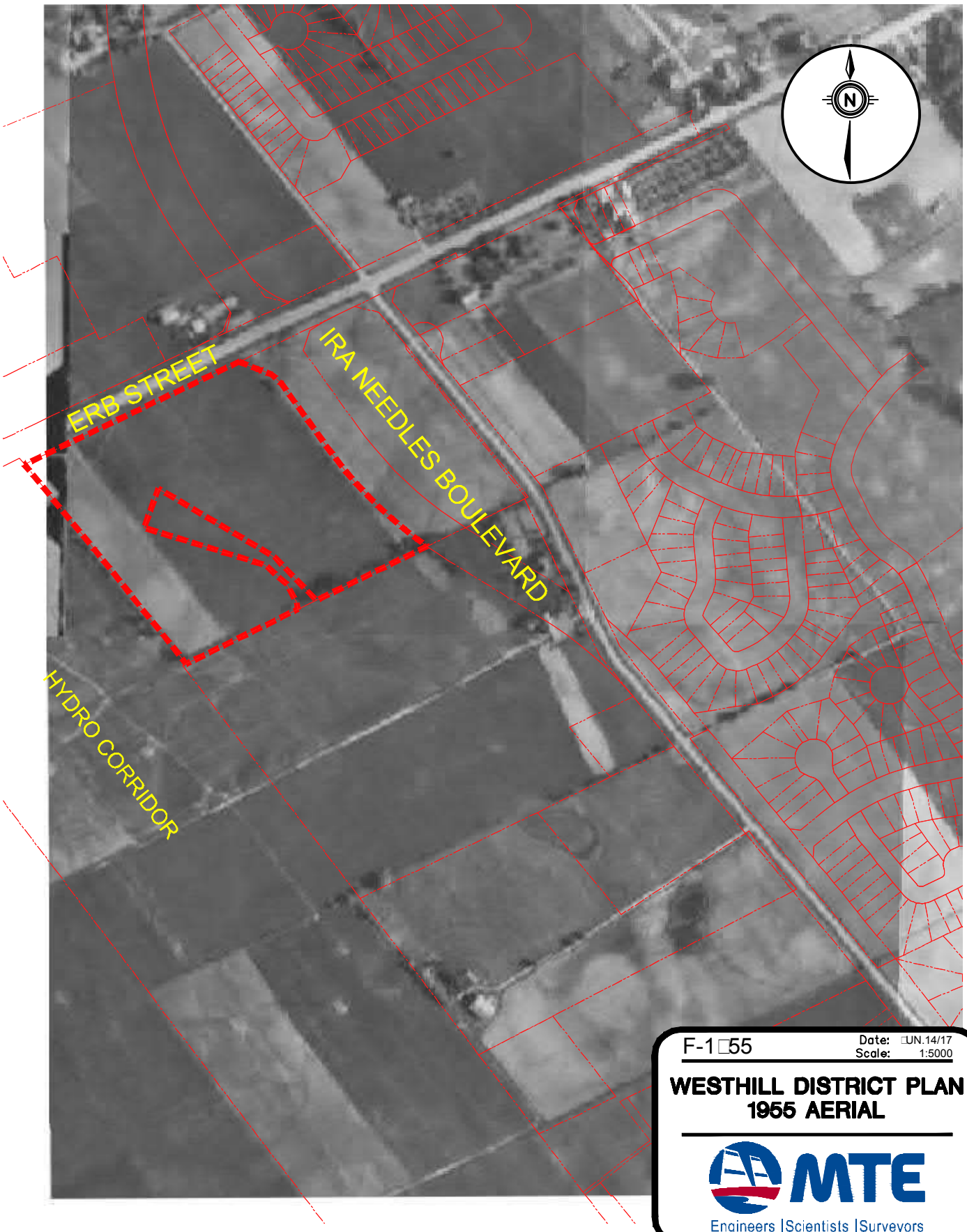
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1949 AERIAL

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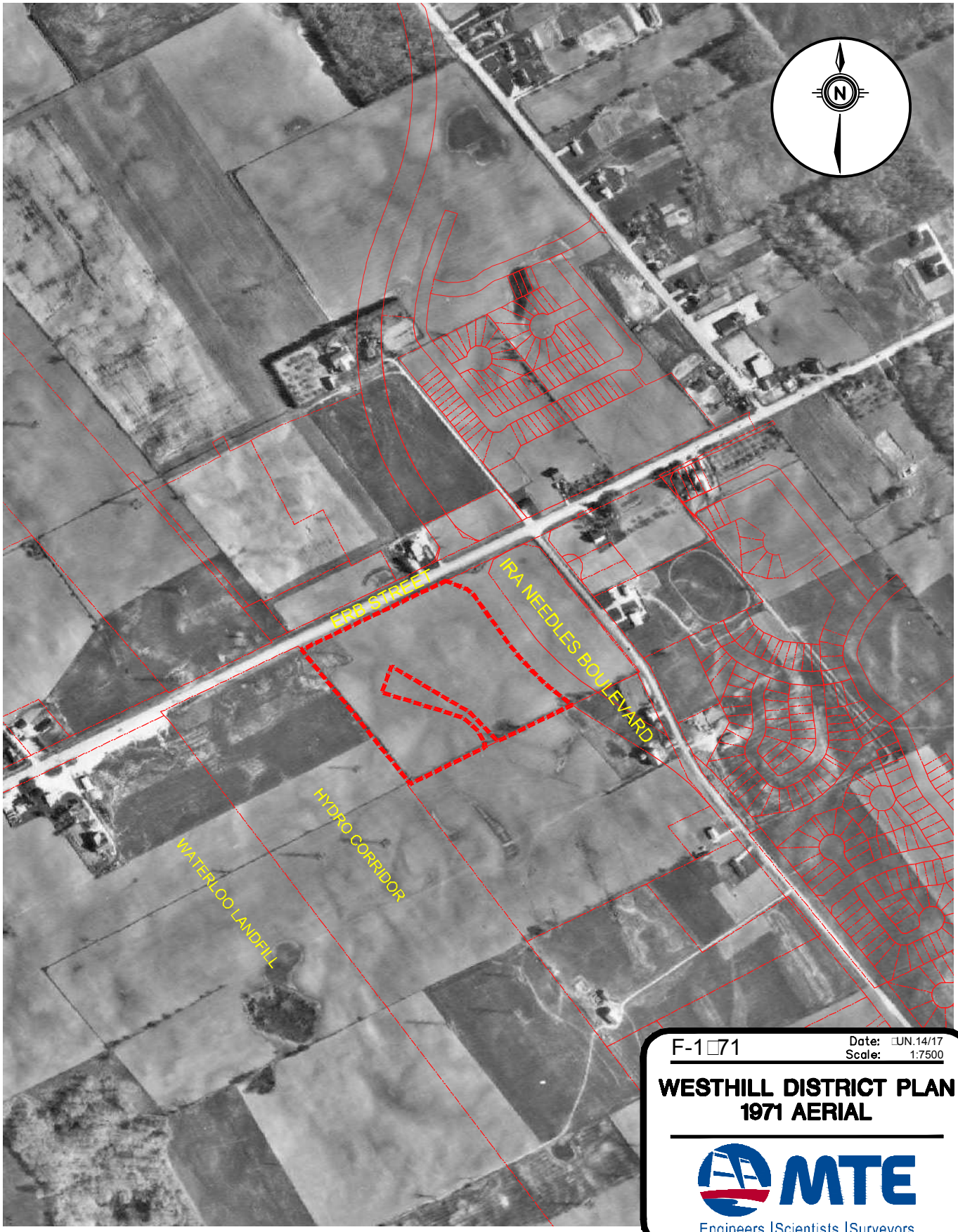
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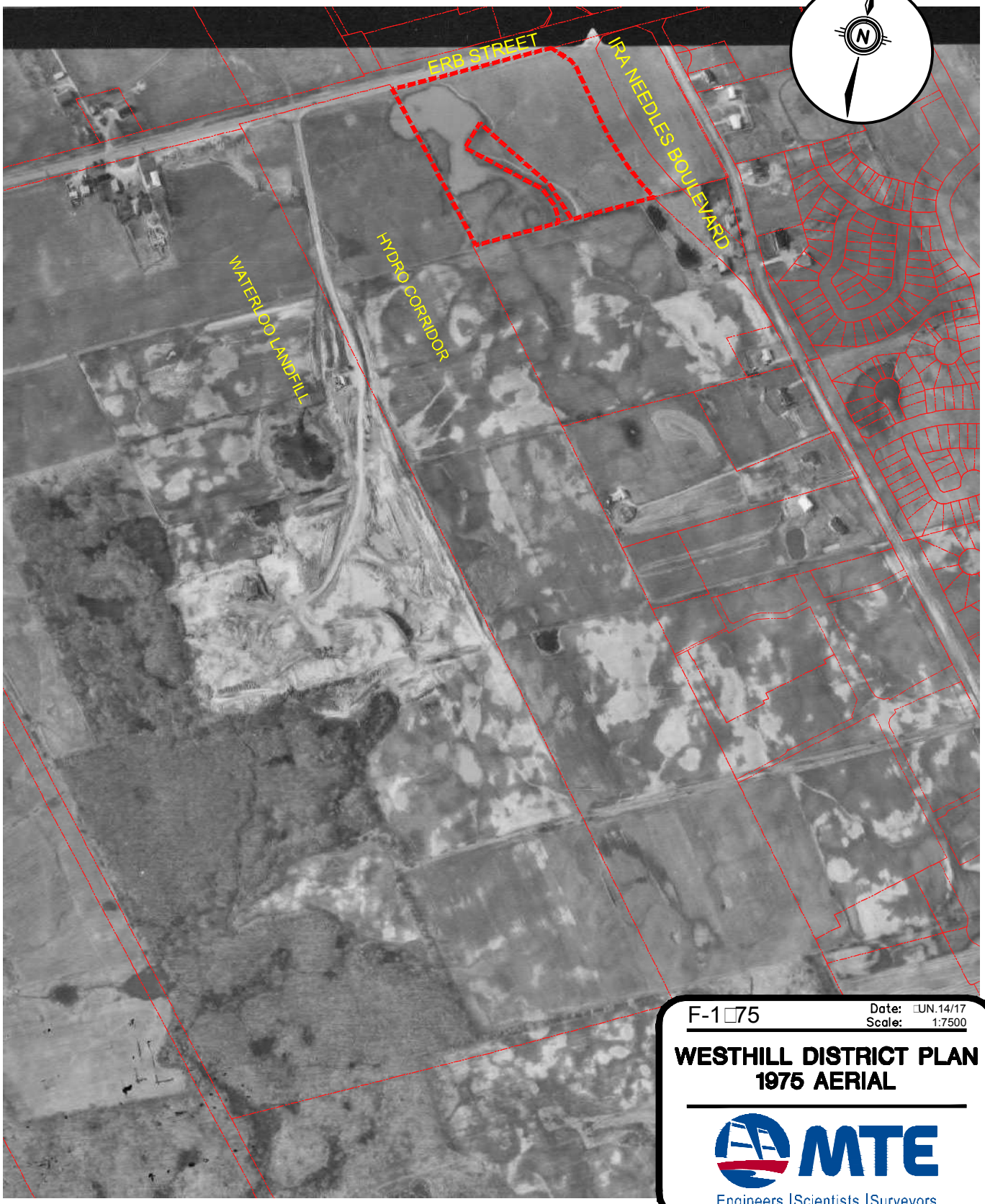
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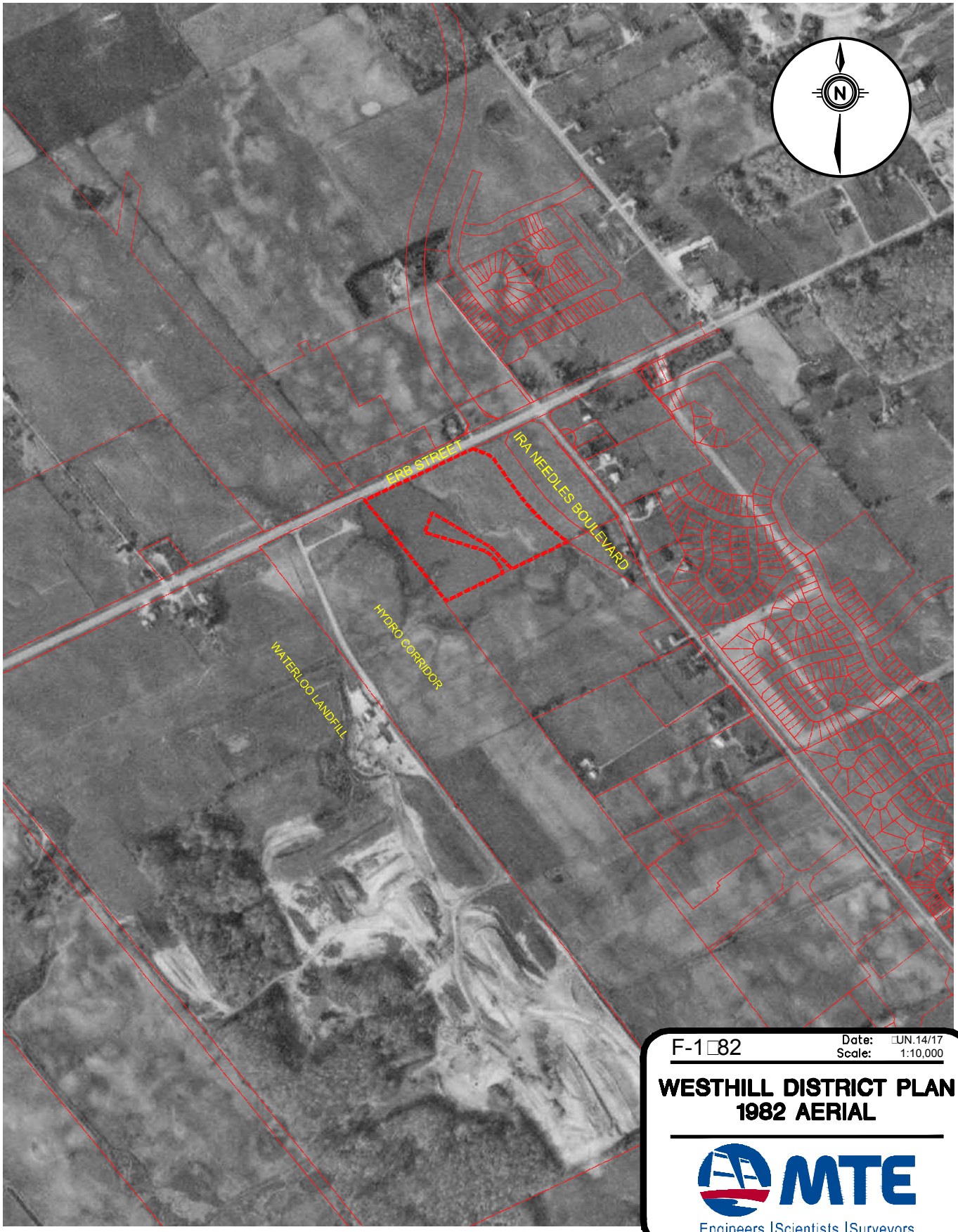
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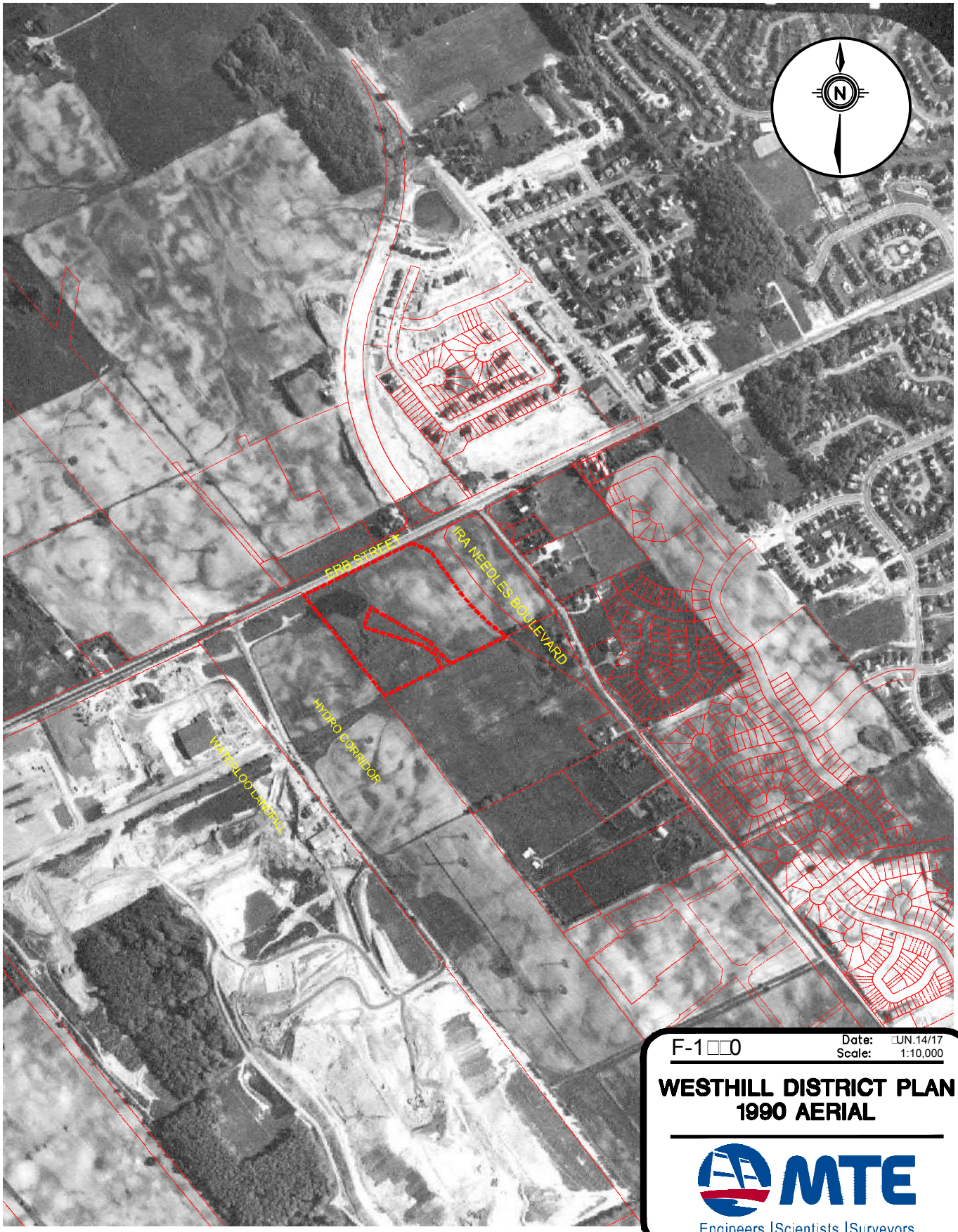
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1982 AERIAL

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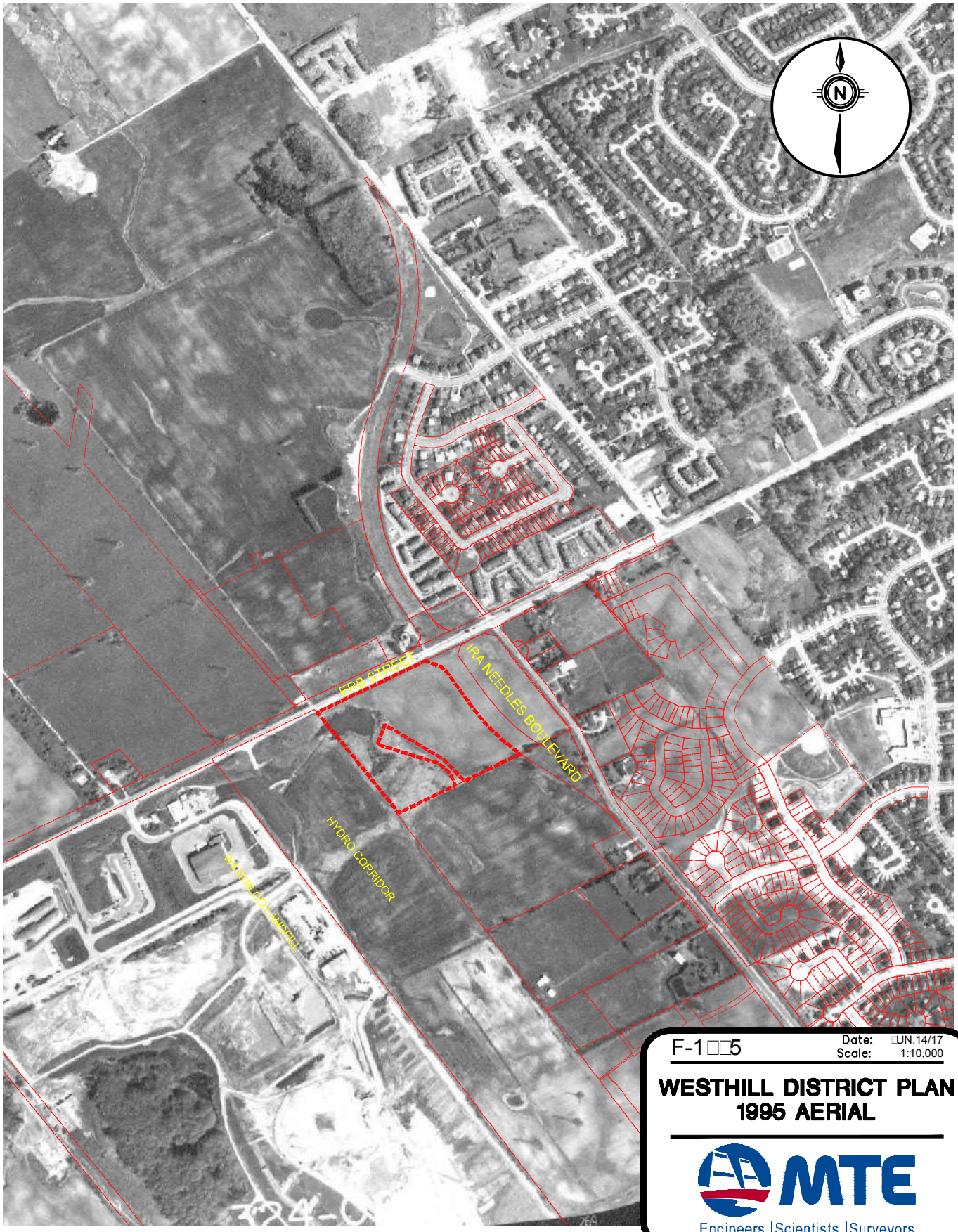
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1990 AERIAL

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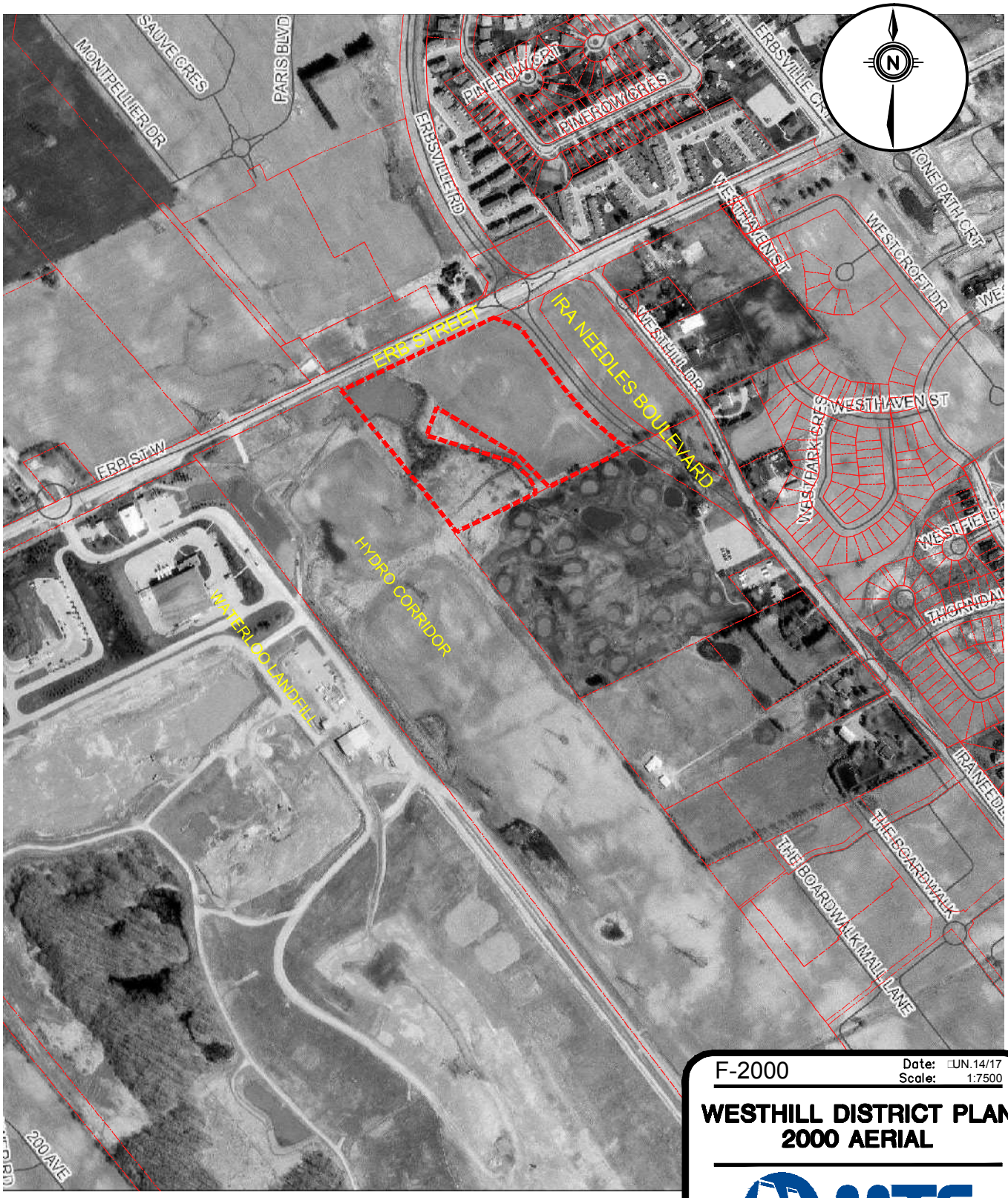
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1995 AERIAL

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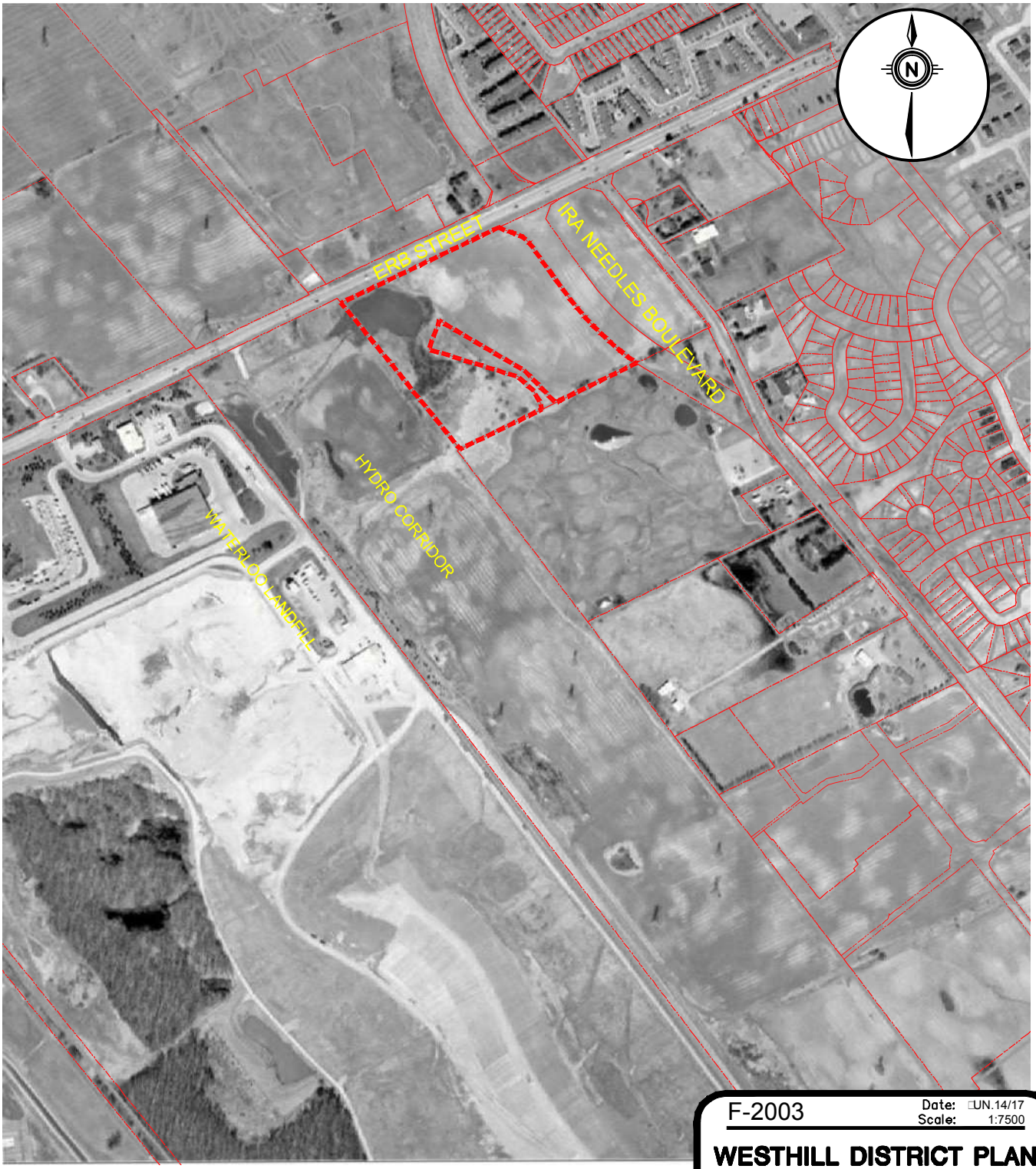
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2000 AERIAL

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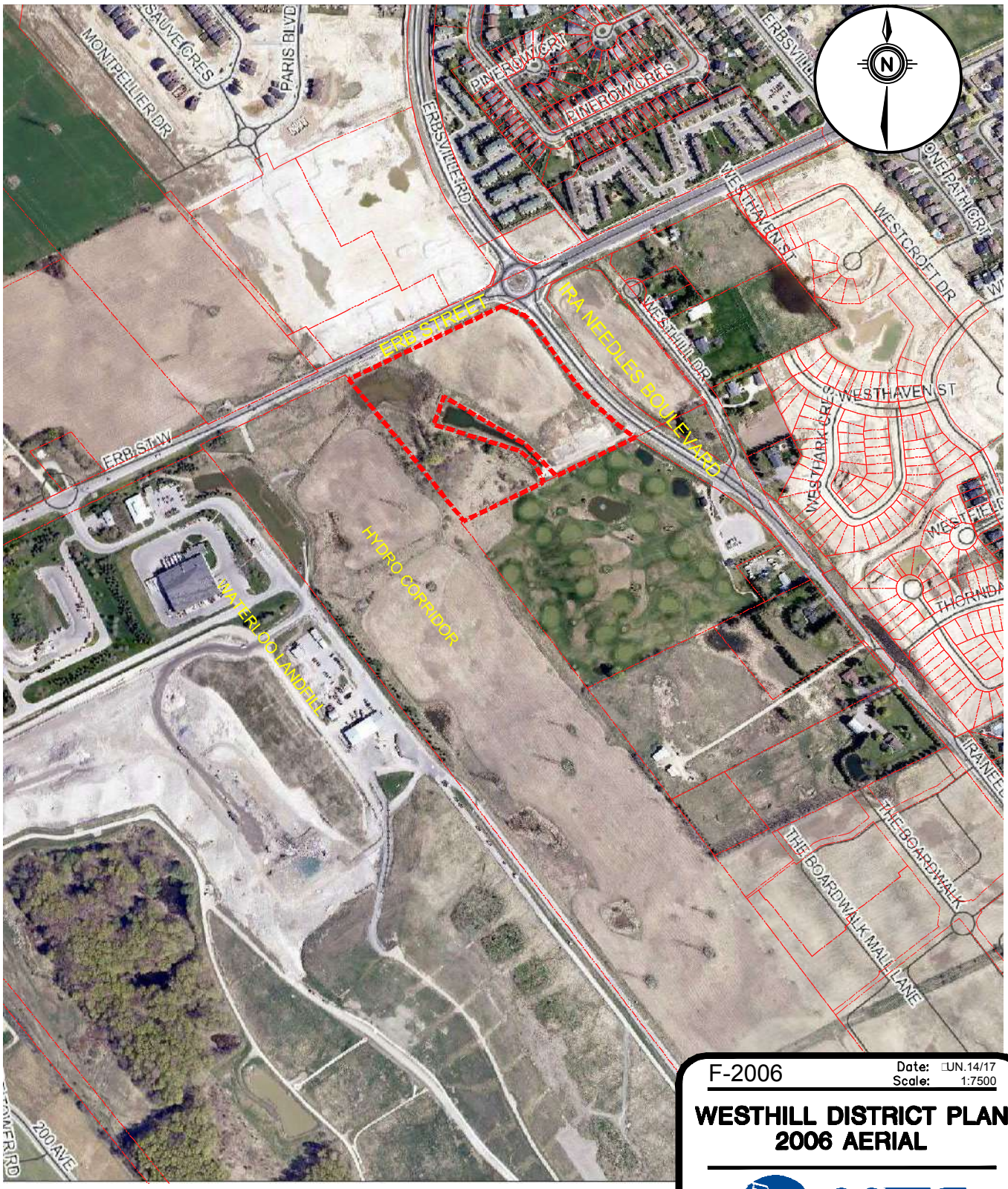
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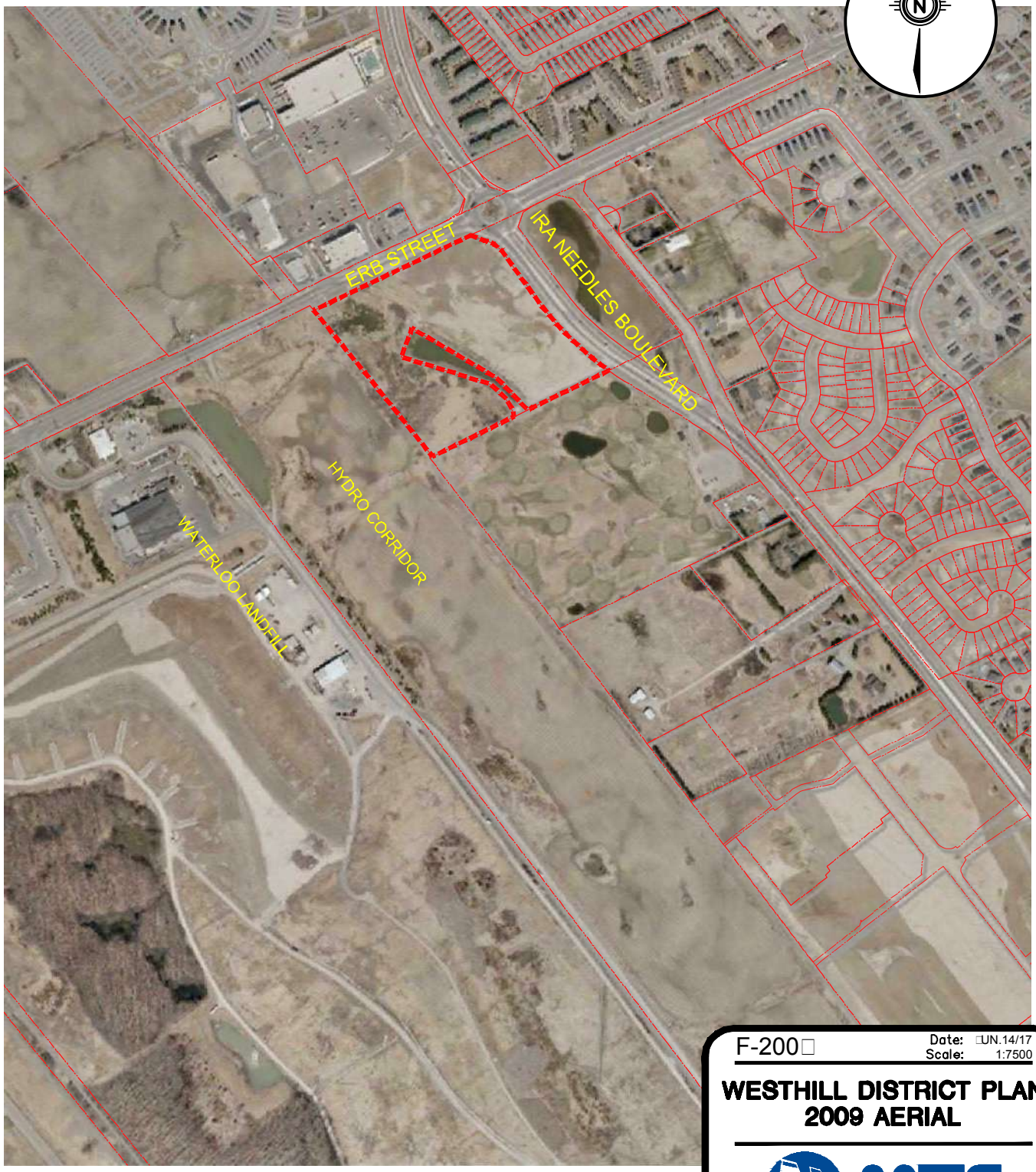
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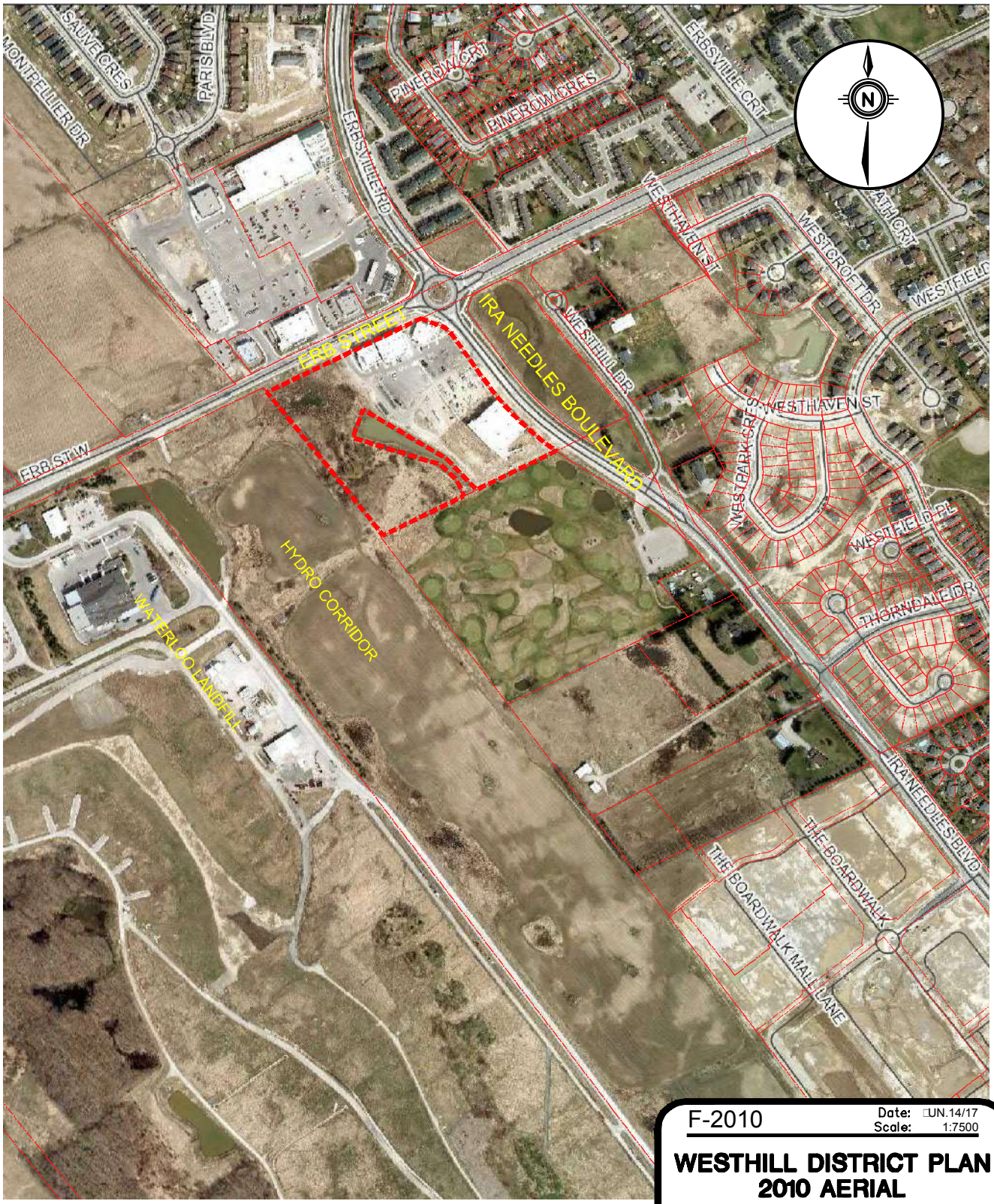
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2009 AERIAL

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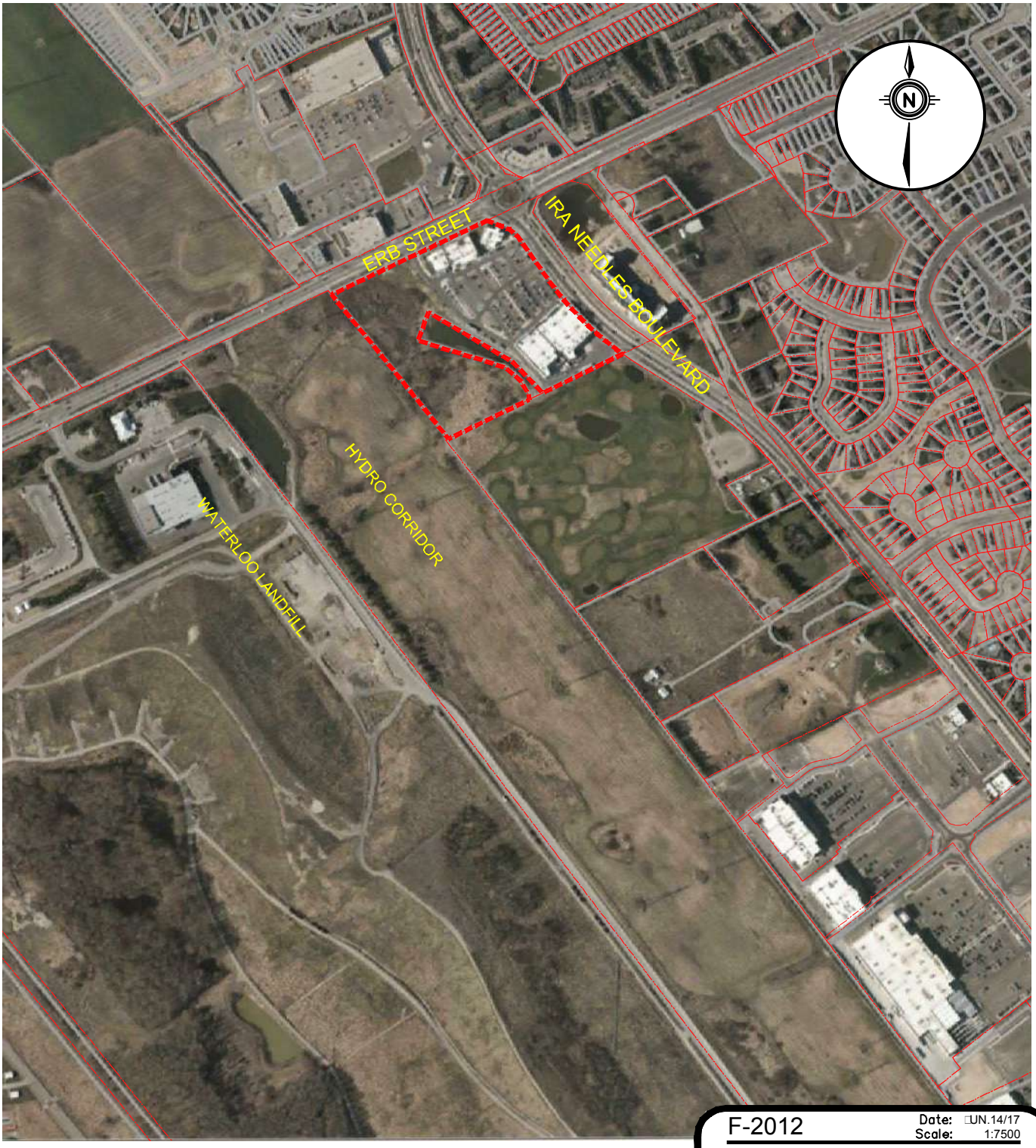
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2010 AERIAL

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WESTHILL DISTRICT PLAN
2012 AERIAL

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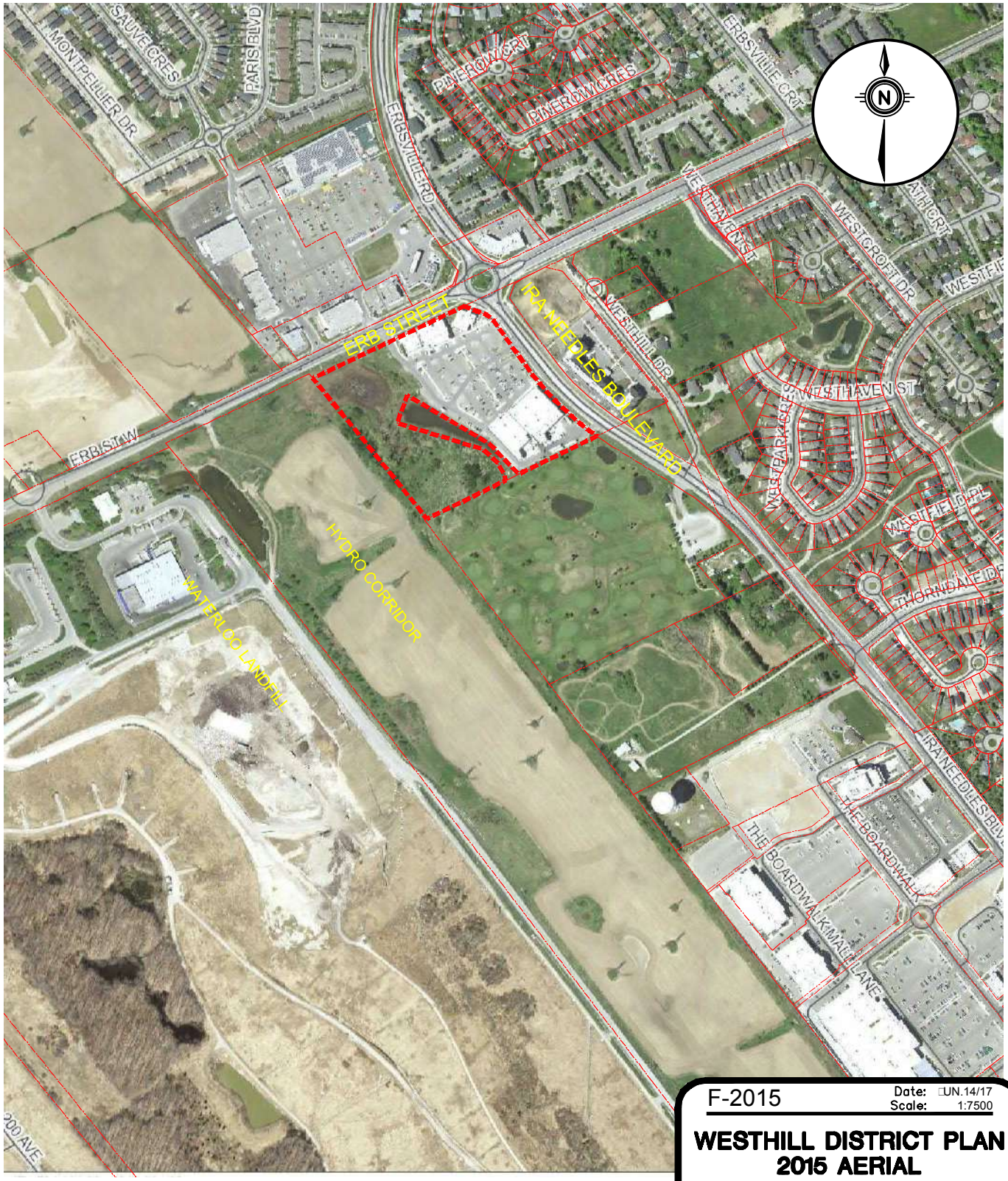
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MTE
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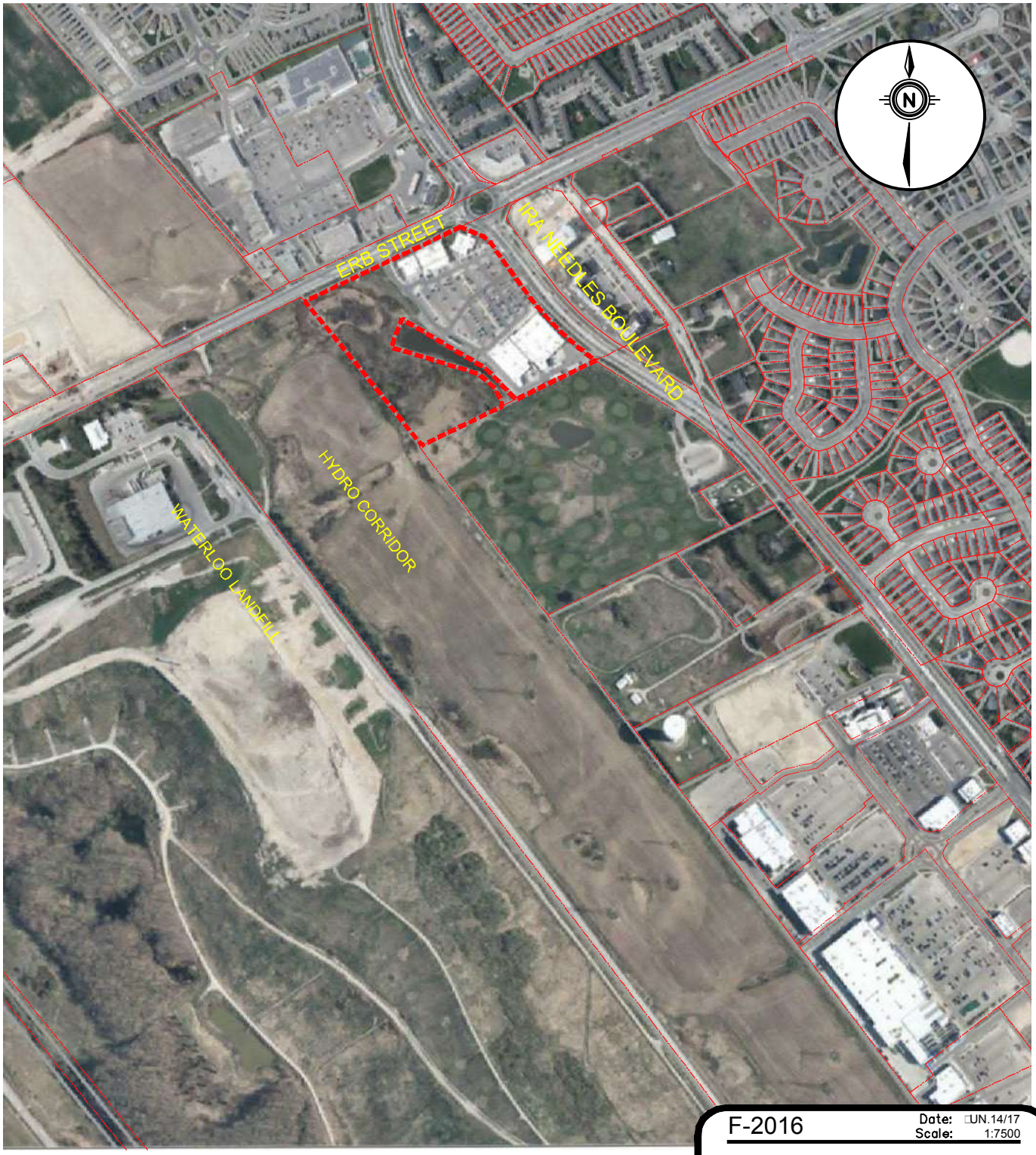
WESTHILL DISTRICT PLAN
2015 AERIAL

MTE
Engineers | Scientists | Surveyors

Project No.: 34280-101

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F-2016

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WESTHILL DISTRICT PLAN
2016 AERIAL

MTE
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WESTHILL DISTRICT PLAN
2017 AERIAL

MTE
Engineers | Scientists | Surveyors

Project No.: 34280-101

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TAB 2

TECHNICAL MEMORANDUM

MTE FILE NO.: C 34280-101
DATE: December 4, 2018
Prepared By: Farouk Abu-Hijleh, E.I.T.

Re: Hydrogeological Assessment
West Waterloo, Westhill District (WW-WD)
North/South Collector Rd (NS-CR)

1.0 INTRODUCTION

MTE Consultants Inc. (MTE) was retained to complete the hydrogeological characterization and assessment of properties associated with the proposed road connection from The Boardwalk extension to the proposed connection between Erb Street West and Ira Needles Boulevard, in the City of Waterloo.

This technical memorandum aims to characterize and assess the geological and hydrogeological conditions within the study area for the Erb Street Connection. Information provided in this document is to be considered during the identification, assessment, and determination of an appropriate preferred route alternative for the north south collector road from Thorndale Drive to Erb Street. This study satisfies the requirements of the hydrogeological characterization for the assessment of alternatives for the north south collector road.

This memorandum should be read in conjunction with the following documents prepared and submitted by MTE for the Subject Lands:

- Erb Street Pond Chronology – WW-WD, NS-CR (MTE, 2018)
- Municipal Services and Utilities – WW-WD, NS-CR (MTE, 2018)
- Surface Water Monitoring – WW-WD, NS-CR (MTE, 2018)
- Technical Design Overview – WW-WD, NS-CR (MTE, 2018)
- Stormwater Management Strategy - WW-WD, NS-CR (MTE, 2018)

1.1 Study Area

The proposed WW-WD, NS-CR is located in southwest Waterloo, west of Ira Needles Boulevard, in the City of Waterloo. The proposed road extension is understood to include the following properties:

- 41, 65, 73, and 87 Ira Needles Boulevard;
- 651 and 663 Erb Street West (Waterloo Commons); and
- Part of Lots 39, 40, and 41 of the German Company Tract (Hydro One Corridor).

The above mentioned properties are herein referred to as the "Subject Lands" for the purposes of this memorandum. **Figure 1** illustrates the Subject Lands Key Map. The Study Area further includes a portion of the Region of Waterloo's Landfill located at 925 Erb Street West. **Figure 2a** and **Figure 2b** illustrate the boundaries of the Study Area and features considered for this hydrogeological assessment.

2.0 SCOPE AND METHODOLOGY

A scoped hydrogeological investigation was completed for the Study Area. The objective of the scoped hydrogeological investigation is to identify and evaluate the hydrogeological features located with the Study Area. More specifically, this investigation aims to:

- Assess the local and regional hydrogeological characteristics;
- Determine local surface water and groundwater elevations; and
- Assess local wetland and groundwater interactions across the Subject Lands.

In order to meet these objectives, the following scope of work was implemented:

1) Site Classification:
    - Review of available published reports relating to Subject Lands.
    - Brief description of Study Area features and existing conditions.
    - Ministry of the Environment, Conservation, and Parks (MECP) well records review.
    - Published Map review:
        - Ontario Base Maps;
        - Quaternary Geology Maps; and
        - Bedrock Geology Maps.
    - Review of interactive online mapping tools:
        - Grand River Conservation Authority (GRCA) Source Water Protection Plan;
        - GRCA Regulation Areas;
        - MECP Source Water Protection Atlas. and
        - Ministry of Natural Resources and Forestry (MNRF) Natural Heritage Areas Map.
2) Field Investigation:
    - Review of select off-Site wells within 500 m of the Site to identify:
        - Neighboring wells;
        - Well depths;
        - Well construction details; and
        - Local geological information.
    - Installation of two shallow groundwater monitoring wells within the Subject Lands.
    - Installation of one mini-piezometer within the Subject Lands.
    - Installation of five surface water piezometers within the Subject Lands.
    - Manual measurement of stabilized surface water and groundwater levels.
    - Grain size analysis of select soil samples.
    - Collection of surface water and groundwater samples to document pre-development water chemistry (to be analyzed for general water quality parameters).
    - Installation of electronic pressure transducers (data loggers) for continuous monitoring of groundwater and surface water levels.

3) Analysis and Reporting:
   - Geologic and hydrogeological summary.
   - Preparation of geological cross-sections through the Subject Lands.
   - Determination of shallow groundwater system properties:
     - Horizontal hydraulic gradient;
     - Average linear groundwater velocity; and
     - Shallow groundwater flow patterns.
   - Assessment of surface water and groundwater interactions associated with wetland features located on the Subject Lands.

3.0 BACKGROUND REVIEW

The following documents relating to the Subject Lands were available for review by MTE staff as part of the hydrogeological assessment:

- Westhill Meadows Golf Course, 41 Ira Needles Boulevard, Waterloo, ON Preliminary Geotechnical Investigation completed by CMT Engineering Inc. (CMT) October 9, 2008;
- Westhill Meadows Golf Course, 41 Ira Needles Boulevard, Waterloo, ON Phase II Environmental Site Assessment completed by MTE October 24, 2008;
- 73 and 86 Ira Needles Boulevard Waterloo, ON Groundwater- Wetland Interaction at Westhill District Plan Update Technical Memorandum completed by MTE January 26, 2011;
- Proposed Kitchener-Waterloo Zone 6 Elevated Tank and Related Services, Geotechnical Investigation completed by Genivar Consultants LP (Genivar) November 11, 2011;
- 87 and 101 Ira Needles Boulevard Waterloo, ON Phase II Environmental Site Assessment completed by MTE January 26, 2016;
- Proposed Thorndale Drive Extension, 87 Ira Needles Boulevard Waterloo, ON Geotechnical Investigation completed by CVD January 27, 2016;
- Proposed Medical Building, 101 Ira Needle Boulevard, Waterloo, ON Geotechnical Investigation completed by Chung and Vander Doelen (CVD) February 10, 2016; and
- Waterloo Commons, 651-663 Erb Street West Waterloo, ON Phase II Environmental Site Assessment completed by MTE April 21, 2017.

Information pertinent to the hydrogeological assessment is briefly summarized below:

Preliminary Geotechnical Investigation - CMT (October 9, 2008)

CMT conducted a preliminary geotechnical investigation of 41 Ira Needles Boulevard, Waterloo, ON. As part of the investigation, five boreholes were advanced (CMT-BH01-08 through to CMT-BH05-08) to depths ranging from 4.9 metres to 7.3 metres below ground surface (mBGS), where ground surface elevations ranged between 378.55 metres and 384.03 metres above mean sea level (mAMSL). One of the five boreholes (CMT-BH01-08) was installed as a monitoring well. Drilling locations are illustrated on **Figure 2b**.

Stratigraphy beneath the property was generally described to consist of topsoil atop a layer of loose silty sand fill material, underlain by a clayey silt till, followed by a layer of silty clay. CMT staffed noted the presence of a 0.7 m thick layer of peat, a 0.15 m thick seam of sand, and a 0.1 m thick seam of sand at CMT-BH01-08, CMT-BH02-08, and CMT-BH03-08, respectively. Groundwater was measured to be 0.54 mBGS (380.63 mAMSL) at CMT-BH01-08 on October 8, 2008. No significant groundwater was reported to be found in the remaining boreholes during drilling. CMT borehole logs are provided in **Appendix A**.

Phase II Environmental Site Assessment - MTE (October 24, 2008)

MTE completed a Phase II Environmental Site Assessment (ESA) for 41 Ira Needles Boulevard, Waterloo, ON. The purpose of the Phase II was to evaluate the environmental condition of the property as part of a Record of Site Condition (RSC) process at the time of the report. The Phase II was completed in conjunction with the geotechnical investigation completed by CMT in 2008 and therefore references the monitoring well and boreholes (CMT-BH01-08 through to CMT-BH05-08) discussed in the previous section.

Soil samples were collected from CMT-BH01-08, CMT-BH03-08, and CMT-04-08. Select samples were submitted under chain of custody to ALS Laboratories for analysis of pH, Phenoxy Acid Herbicides, Miscellaneous / Organochlorine Pesticides, Petroleum Hydrocarbons fractions F1-F4 and VOCs. The analytical results for submitted soil samples did not indicate the presence of environmental impacts on the property.

A surface water sample was collected from an on-site irrigation pond (SW1) and groundwater samples were collected from CMT-BH01-08 and an on-site irrigation well (labelled Deep Well). Samples were submitted under chain of custody to ALS Laboratories for analysis of Petroleum Hydrocarbons fractions (F1-F4) and Benzene, Toluene, Ethylbenzene and Xylene (BTEX), and Volatile Organic Compounds (VOCs). The analytical results for submitted surface water and groundwater samples did not indicate the presence of environmental impacts on the property.

Wetland Interaction at Westhill District Plan Update Technical Memorandum - MTE (January 26, 2011)

MTE completed a technical memorandum for the assessment of groundwater-wetland interaction for wetland features located in the southeast portion of the Study Area. The memorandum provides an overview of the background hydrogeological information and fieldwork to characterize the nature of the wetland-groundwater interactions of wetland features located at 73 and 83 Ira Needles Boulevard. As part of the field activities, four test trenches (MTE-TT1-11 through to MTE-TT4-11) were excavated to depths ranging from 3 m to 3.6 mBGS. Test trench locations are illustrated on **Figure 2b**.

Stratigraphy within the test trenches was generally described to consist of topsoil underlain by silt till which ranged from ground surface to the maximum investigated depth of 3.6 mBGS. MTE staff identified the presence of 1.22 m of clayey silt fill material overlaying the silt till at TT4-11. MTE Test Trench logs are provided in **Appendix B.**

In general, findings from the test trench excavations were reported to reveal dry sub-grade conditions at investigated locations. Based on this information, the isolated wetland features located at 73 and 87 Ira Needles Boulevard were interpreted to not exhibit a groundwater connection. These wetland features are described to likely be dominated by climate (e.g. precipitation and snow melt events) and retain water due to the fine grained nature of the underlying low permeable materials, and the inflow of surface and stormwater.

Geotechnical Investigation - Genivar (November 11, 2011)

Genivar completed a geotechnical investigation for the Kitchener-Waterloo Zone 6 elevated tank and related services located along Ira Needles Boulevard Waterloo ON. As part of the investigation, 10 boreholes were advanced (GEN-BH10-1 through to GEN-BH10-10) to depths ranging from 6.6 m to 15.7 mBGS. Four of the 10 boreholes (GEN-BH10-1, GEN-BH10-4, GEN-BH10-7, and GEN-BH10-10) were installed as monitoring wells. Drilling locations are illustrated on **Figure 2b**.

Stratigraphy beneath the property was generally described to consist of lacustrine silty clay and clay soils with some seams of silt, silty sand and gravelly sand, within 6 m to 8 mBGS. The two deeper boreholes (GEN-BH10-9 and GEN-BH10-10) extended to 15.7 mBGS and stratigraphy was described to consist of sand, silty sand, and non-plastic sandy silt soils overlain by a predominantly clayey soil upper zone. Genivar borehole logs are provided in **Appendix C.**

The groundwater table in the general site area was interpreted to be below the maximum drilling depth of 15.7 mBGS (370.1 mAMSL) as soils encountered during the drilling of GEN-BH10-9 and GEN-BH10-10 were described as ‘dry to moist’. Some free groundwater was observed within the upper layered soils and described to be indicative of perched water conditions with the coarser sand, silt and gravelly sand seams within the generally clayey soil zones. Groundwater levels measured in monitoring wells recorded to range from 1.1 m to 5.88 mBGS (378.3 mAMSL to 385.3 mAMSL).

Hydraulic conductivities of the silty clay and clayey silt materials were estimated to range between 10^{-9} and 10^{-10} m/sec.

Phase II Environmental Site Assessment - MTE (January 26, 2016)

MTE completed a Phase II ESA for 87 and 101 Ira Needles Boulevard, Waterloo, ON. The purpose of the Phase II was to evaluate the environmental condition of the property for due diligence purposes in advance of the proposed land conveyance. As part of the ESA, three boreholes were advanced (MTE-BH101-15 through to MTE-BH103-15) to depths ranging from 3.05 m to 6.10 mBGS. Additionally, the Phase II was completed in parallel with the geotechnical investigations completed by CVD in 2016 and therefore references the boreholes (CVD-BH104-15 through to CVD-BH109-15 and CVD-BH201-15 through to CVD-BH206-15) discussed in the below sections. Drilling locations are illustrated on **Figure 2b**.

Stratigraphy beneath the property was generally described to consist of topsoil and silty sand fill above a mixture of clayey silt with sand seams and peat. Wet to saturated conditions were encountered between 1.3 m and 6.1 m mBGS. Detailed soil identification was completed by CVD as part of the geotechnical investigations and provided under a separate cover. MTE borehole logs are provided in **Appendix D**.

Although monitoring wells were not permanently installed as part of the ESA, a temporary PVC riser pipe with a 3 metre long, 32 mm diameter, slotted PVC screen was set in place to allow for the collection of stabilized water levels in CVD-BH202-15. CVD-BH202-15 was measured to be dry upon completion on December 22, 2015; however a stabilized water level of 0.66 mBGS (381.15 mAMSL) was measured by MTE staff on January 3, 2015 in the temporary PVC riser.

Soil samples were collected from MTE-BH101-15 through to MTE-BH103-15 and CVD-201-15 through to CVD-206-15. Select samples were submitted under chain of custody to Maxxam Analytics located in Mississauga, ON for analysis of pH, metals, F1-F4, VOCs, BTEX, OC Pesticides, and polychlorinated biphenyls (PCBs). The analytical results for submitted soil samples did not indicate the presence of environmental impacts on the property.

Groundwater samples were collected from MTE-BH102-15, CVD-BH201-15, and CVD-BH202-15. Samples were submitted under chain of custody to Maxxam Analytics located in Mississauga, ON for analysis of pH, metals, F1-F4, VOCs, and BTEX. The analytical results for submitted groundwater samples did not indicate the presence of environmental impacts on the property.

Geotechnical Investigation - CVD (January 27, 2016)

CVD completed a geotechnical investigation for the extension of Thorndale Drive, currently known as the Boardwalk, located on the property at 87 Ira Needles Boulevard, Waterloo, ON. As part of this investigation, six boreholes were advanced (CVD-BH201-15 through to CVD-BH206-15) to depths ranging from 3.66 to 5.18 mBGS. Drilling locations are illustrated on **Figure 2b**.

Stratigraphy beneath the property was generally described to consist of clayey silt with some sand and frequent saturated sand seams, extending down to the maximum drilling depth of 5.18 mBGS. Fill material generally comprised of sand, clayey silt, gravel, and brick was encountered at CVD-BH201-15, extending down to a depth of 1.8 mBGS. A brown to grey layer of organic silt with rootlets and peat layers was encountered at CVD-BH205-15, extending to a depth of 2.2 mBGS. CVD borehole logs have been provided in **Appendix E**.

Monitoring wells were not installed as part of the geotechnical investigation. Groundwater conditions were monitored following the completion of the sampling of the boreholes. Water levels at CVD-BH201-15 and CVD-BH203-15 through to CVD-BH205-15 were measured at depths ranging from 1.5 mBGS to 4.3 mBGS (378.18 to 382.03 mAMSL). The clayey silt was reported to have numerous saturated sand seams which released water at variable rates. Perched water was interpreted to be present in the fill and organic silt layers. No free water was reported in CVD-BH202-15 and CVD-BH206-15 upon completion.

Geotechnical Investigation - CVD (February 10, 2016)

CVD completed a geotechnical investigation for the medical building located at 101 Ira Needles Boulevard, Waterloo, ON. As part of this investigation, six boreholes were advanced (CVD-BH104-15 through to CVD-BH-109-15) to depths ranging from 5.18 to 8.23 mBGS. Drilling locations are illustrated on **Figure 2b**.

Stratigraphy beneath the property was generally described to consist of fill material, underlain by sand, sand silt, and silty soils to maximum depths of 6.9 mBGS. These soils were reported to be underlain by brown to grey clayey silt extending down to 8.23 mBGS with some sand to sandy silt with occasion wet/saturated sandy seams. CVD borehole logs have been provided in **Appendix F.**

Monitoring wells were not installed as part of the geotechnical investigation. Groundwater conditions were monitored following the completion of the sampling of the boreholes. Free water was measured at a depth of 6.5 mBGS at CVD-BH105-15. No free water was observed following the completion of the remaining five boreholes. Based upon observations of retrieved soil samples and measured moisture contents, perched water and/or wet to saturated lenses/seams were interpreted to exist within the native deposits.

Phase II Environmental Site Assessment - MTE (April 21, 2017)

MTE completed a Phase II ESA for the commercial development located at 651-663 Erb Street West, Waterloo, ON (currently known as the 'Waterloo Commons'). The purpose of the Phase II was to evaluate the environmental condition of the property for due diligence purposes following the completion of a Phase I ESA. As part of the Phase II ESA, four boreholes were advanced (MTE-MW101-16 through to MTE-MW103-16 and MTE-BH104-16) to depths ranging from 4.57 m to 7.62 mBGS. Three of the four boreholes (MTE-MW101-16 through to MTE-MW103-16) were installed as monitoring wells. Drilling locations are illustrated on **Figure 2b**.

Stratigraphy beneath the property was generally described to consist of fill material to a maximum depth of 2.1 mBGS underlain by native soil generally consisting of silty sand, clayey silt, and silty clay to the maximum depth explored. Wet to saturated conditions were observed at depths ranging from 1.5 m to 4.0 mBGS in the clayey silt and silty clay units. MTE borehole logs have been provided in **Appendix G**.

Groundwater levels were measured to range from 1.6 m to 3.4 mBGS between March 2016 and April 2017. Groundwater elevations indicated that groundwater beneath the property generally flows in the southwesterly direction towards the lower lying stormwater facility.

Soil samples were collected from MTE-MW101-16 through to MTE-BH104-16. Select samples were submitted under chain of custody to Maxxam Analytics located in Mississauga, ON for analysis of pH, metals, F1-F4, VOCs, BTEX, OC Pesticides, Electrical Conductivity (EC), and Sodium Adsorption Ratio (SAR). The analytical results for submitted soil samples did not indicate the presence of environmental concerns on the property.

Groundwater samples were collected from MTE-MW101-16 through to MTE-MW103-16. Samples were submitted under chain of custody to Maxxam Analytics located in Mississauga, ON for analysis of pH, metals, F1-F4, and VOCs. The analytical results for submitted groundwater samples did not indicate the presence of environmental concerns on the property.

Surface water samples were collected from two locations in the storm water management facility. Samples were submitted under chain of custody to Maxxam Analytics located in Mississauga, ON for analysis of general chemistry parameters, metals, Petroleum Hydrocarbons (PHCs), and BTEX compounds. The analytical results for submitted groundwater samples did not indicate the presence of environmental concerns on the property.

4.0 STUDY AREA DESCRIPTION

The Study Area comprises an area of approximately 42.6 ha (105 acres) and is located southwest of the intersection of Erb Street West and Ira Needles Boulevard in Waterloo, Ontario. The Study Area for the Subject Lands, including property boundaries, geological cross-section locations, monitoring well locations and existing features is illustrated on **Figures 2b** and **3**. The locations of boreholes completed as part of previous investigations have also been illustrated on these figures and are discussed in **Section 3.0**.

The land use within the Study area is considered to be commercial, employment and open space. Currently, the Study Area generally includes a portion of the Region of Waterloo's Landfill at 925 Erb Street West, the Hydro One corridor, 101 Ira Needles Boulevard, 87 Ira Needles Boulevard, 73 Ira Needles Boulevard, 65 Ira Needles Boulevard, the Westhill Meadows Golf Course at 41 Ira Needles Boulevard, and the Waterloo Commons commercial development at 651-663 Erb Street West. The City of Waterloo Official Plan classifies the East portion of the Study Area as being a "Designated Greenfield Area" and the west portion to be a "Built Up Area". The Official Plan also classifies the northeast portion of the Study Area as "Mixed-Use Neighborhood Commercial", the southeast portion as "Business Employment", and the remaining portions as "Parks and Open Space"; with the landfill being indicated as a "Landfill".

GRCA mapping does not indicate the presence of any surface water courses transecting the Study Area. According to the GRCA mapping, there are eight surface water features present within the Study Area, illustrated on **Figure 2b**. These surface water features are identified to include:

- One Stormwater Management Facility (SWM) facility located at 925 Erb Street West (the Region of Waterloo's Landfill);
- One surface water/stormwater management feature located at 651-663 Erb Street West (Waterloo Commons - Erb Street Pond);
- One SWM facility (forebay) servicing Ira Needles Boulevard (up-gradient of surface water feature located at 651 Erb Street west);
- Four surface water features located at 41 Ira Needles Boulevard (the Westhill Meadows Golf Course); and
- One surface water feature located at between 73 and 87 Ira Needles Boulevard.

GRCA mapping identifies a total of five wetland features to be located within the Study Area. These wetlands are described to be "unevaluated" and therefore are unnamed. These surface water features will be referred to as:

- Waterloo Commons Wetland – located adjacently west of 651 Erb Street West (Waterloo Commons)
- HEPC North Wetland – located in the north portion of the Hydro One corridor;
- HEPC-South Wetland – located in the south portion of the Hydro One corridor;
- The Former Cressman East Wetland – located between 73 and 87 Ira Needles Boulevard; and
- Cressman West Wetland – located at 87 Ira Needles Boulevard.

MNRF mapping only displays four wetland features (HEPC North, HEPC South, the Former Cressman East, and Waterloo Commons) to be located within the Study Area and classifies the wetlands to be "unevaluated". GRCA and MNRF mapping currently illustrate the presence of the Former Cressman East wetland within the Study Area. This wetland feature was approved to be removed by the GRCA in 2016 and is no longer a wetland present on the property. The surface water feature which remains is a proposed SWM retention area. A copy of the GRCA wetland removal permit and the SWM facility design drawing has been provided in **Appendix H**. Based on this information, the outlined Former Cressman East wetland (hereby referred to as "the SWM Retention Area") will not be considered throughout this hydrogeological assessment.

The locations of the remaining four wetland features (Waterloo Commons, HEPC North, HEPC South, and Cressman West) are illustrated on **Figure 2b.**

5.0 WATER WELL RECORD SEARCH

Hydrogeological data related to water supply wells within 500m of the Study Area was obtained from the MECP water well records on file with the MECP. Based on data in the MECP well database, a total of 66 well records were located within 500m of the Study Area. Of the 66 wells identified:

- 17 wells were identified as being irrigation, livestock, or domestic water supply wells;
- 31 wells were identified as being monitoring wells and/or test holes;
- Five wells were identified as being municipal wells;
- Nine wells were identified as abandoned or "not used"; and
- Four wells records did not specify the well use.

Further investigation into the wells classified as municipal wells determined that three of the wells (Well ID #'s: 7213873, 7213876, and 7213877) were installed as municipal observation wells and one of the wells (Well ID #: 7213879) was abandoned. Well ID # 6503773 is classified by the MECP as a municipal supply well, however 6503773 is not illustrated to be present on the GRCA online mapping and is not referenced within the Lake Erie Source Protection: Grand River Assessment Report (LESPR, 2015) as being part of the municipal well systems for the Waterloo Area. Based on the water well record search and available GRCA mapping tools, there are no municipal production wells identified to exist within 500 m of the Study Area.

The closest municipal well fields (MWF) are identified to be the Erb Street MWF, the Strange Street MWF, and the William Street MWF which are located approximately 1.9 km west, 2.5 km southeast, and 2.5 km northeast of the Study Area. The Erb Street MWF wells include W06A, W06B, W07, and W08 with screen depths ranging from 32 to 56 mBGS. The Strange Street MWF wells include K10A, K11A, K13, K18 and K19 with screen depths ranging from 17 to 38 mBGS. The William Street MWF wells include W01B, W01C, W02, and W03 with screen depths ranging from 20 to 34 mBGS (LESPR, 2015).

6.0 REGIONAL GEOLOGY AND HYDROGEOLOGY

6.1 Physiography

The Study Area is located within the physiographic region known as the Waterloo Hills, as shown on **Figure 4a**. This region primarily consists of sandy hills, some of which are ridges of sandy till and others are kame or kame moraines, with outwash sands in between (Chapman and Putnam, 1984). **Figure 4b** illustrates the Study Area as being located within kame moraines deposits; consistent with the Waterloo Hills region.

6.2 Quaternary Deposits

The Quaternary Geology Map (**Figure 5)** identifies the presence of ice-contact stratified deposits of sand and gravel across the most of the City of Waterloo. The Study Area is shown to be located completely within an underlying till unit known as the Maryhill Till. The Maryhill Till, described as a fine textured clay rich till, is closely associated with glaciolacustrine sediments and is subdivided into three units (Upper, Middle, and Lower Maryhill Till). The Maryhill Till is considered to be a significant regional aquitard and will “act as a significant barrier to vertical water movement where present in a thickness greater than five metres” (Terraqua Ltd., 1995). The Maryhill Till is compositionally distinct and can be observed to a large degree across the RMOW (Farvolden et. al., 1987).

6.3 Paleozoic Bedrock Geology

The City of Waterloo is underlain by the Salina Formation (**Figure 6**), composed of carbonate rocks and minor evaporitic sequences of the Salina Formation. The Salina Formation is a shale unit that is grey-brown in colour and can be heavily weathered and/or fractured.

6.4 Regional Cross-Section

Regional Cross-Section (A-A’) (**Figure 7)** was generated using the Cross-Section Viewer (Versions 1.1) developed by the Ontario Geological Survey (OGS, 2008). The cross-section extends approximately 900 m southeast through the Study Area along the Waterloo Commons, Westhill Meadows Golf Course, 73 and 87 Ira Needles Boulevard, stopping at the Boardwalk terminus. Major geological units beneath the Study Area include bedrock, Canning Drift (ATE1), Catfish Creek Sand and Gravel (AFC1), Lower Maryhill Till (ATC1), Middle Maryhill Till (ATB2), the Waterloo Moraine (AFB1), and the Upper Maryhill Till/ Port Stantley Till/ Tavistock Till deposits (ATB1). Upper Maryhill Till deposits are illustrated to range from 10 to 50 mBGS across the Study Area.

6.5 Regional Groundwater Table

The interpreted regional groundwater flow direction was determined using publically available groundwater data from the GRCA completed as part of a watershed scale study, shown on **Figure 8**. Groundwater elevations contours are identified to range between 377 m and 381 mAMSL within the Study Area. Shallow groundwater flow direction is generally interpreted to be southerly beneath the Study Area, with the exception of the northern portion where groundwater flow is interpreted to be northeasterly.

7.0 FIELD PROGRAM

A scoped hydrogeological investigation was completed in order to identify and evaluate the hydrogeological features located with the Study Area. Field work completed was oriented towards assessing geological and hydrogeological conditions surrounding the wetland features located within the Study Area. Field work was primarily focused on the Waterloo Commons wetland feature based on the size of the wetland feature and the presence of a surface water feature identified on GRCA mapping.

7.1 Borehole Advancement and Monitoring Well

Borehole (BH) advancement and monitoring well (MW) construction was conducted on June 22, 2018 and included the advancement of two boreholes (labelled MTE-MW101-18 and MTE-MW102-18) to depths of approximately 6.1 mBGS. Boreholes were completed by a licensed drilling contractor and were observed by MTE staff. Both boreholes were completed as 50 mm diameter PVC groundwater monitoring wells with 1.5 m length slotted and filtered screens. Bentonite seals were placed to near ground surface and protective casings were cemented in place as per Ontario Regulation 903 (as amended). The monitoring well locations and ground surface elevations were surveyed and referenced to a geodetic datum by MTE.

The monitoring wells allowed for the continued assessment of the geological and hydrogeological characteristics of the Study Area, including stabilized groundwater elevations and groundwater flow direction interpretations. Monitoring well locations are illustrated on **Figure 3**. Borehole logs are provided in **Appendix I**.

Soil conditions observed during borehole advancement at the Study Area generally consist of topsoil ranging from 0.3 to 0.6 mbgs, underlain by native silt till material ranging from 4.6 m to 5.8 m in thickness; observed to the maximum investigated depth of 6.1 mBGS. A 0.9 m layer of silt was observed to overlay the till unit at MTE-MW101-18 ranging from 0.3 m to 1.5 mBGS. Observed subsurface conditions encountered during borehole advancement are generally consistent with the observed regional geology for the Study Area. Bedrock was not encountered in any of the boreholes advanced in the Study Area.

7.2 Mini-Piezometer Installation

Mini-piezometer (MP) installation was completed on June 22, 2018 and included the installation of one mini-piezometer (MTE-MP101-18) within close proximity to MW101-18. MTE-MP101-18 was installed to depth an approximate depth 1.4 mBGS within the footprint of the Waterloo Commons wetland; as outlined by the GRCA online mapping tool. The mini-piezometer was installed by MTE staff and was completed using a Solinst 25 mm stainless steel drive-point piezometer with 0.3 m length filtered screen. Soil conditions observed during the installation of MTE-MP101-18 generally consisted of approximately 0.3 m of topsoil underlain by clayey silt extending to 1.3 mBGS.

The mini-piezometer allows for the further assessment of the local scale hydrogeological characteristics of the Waterloo Commons wetland through the collection of stabilized water levels. The location and groundwater surface elevation of MTE-MP101-18 was surveyed and referenced to a geodetic datum by MTE. The location of MTE-MP101-18 is illustrated on **Figure 3**.

7.3 Surface Piezometer Installation

Surface piezometers (installation was completed on June 22, 2018 and included the installation of five surface piezometers (230P through to 235P) within the footprints of the Waterloo Commons, HEPC North, Cressman West, the SWM Retention Area, HEPC South, and Region of Waterloo Landfill SWM pond,

respectively. Surface piezometers were installed by MTE staff and were completed using perforated PVC pipe tethered to steel bars for support. The steel bars were driven into the underlying soil, while the surface piezometers were placed at the base of the feature and tethered to the steel bars. The surface piezometer locations and ground elevations were surveyed and referenced to a geodetic datum by MTE. Surface piezometer locations are illustrated on **Figure 3**.

7.4 Groundwater Levels

MTE completed multiple rounds of manual groundwater level measurements between June 22, 2018 and November 23, 2018. Manually measured groundwater levels and elevations within the monitoring wells and mini-piezometer are presented in **Table 7.4a, Table 7.4b**, and **Table7.4c.** In addition, pressure transducers (data loggers) were installed within MTE-MW101-18, MTE-MW102-18, and MTE-MP101-18. A data logger was also installed in the pre-existing MTE-MW102-16 based on its close proximity to MTE-MW101-18. Data loggers measure the pressure (in centimeters of water) above the logger at a predetermined time interval, which can then be used to calculate a groundwater level and elevation. The data loggers installed in the monitoring wells and mini-piezometer were set to record a pressure at a one hour time interval. Hydrographs illustrating continuous groundwater elevations within the monitoring wells are provided in **Appendix J**. It is noted that data displayed on these hydrographs has been reviewed and filtered to present data consistent with manual water level measurements. Data collected immediately following the installation and sampling of monitoring wells and the mini-piezometer (i.e. recovery curves) has not been included as it does not accurately reflect stabilized groundwater levels.

Supplementary water levels were collected from the pre-existing MTE-MW101-16 and MTE-MW103-16 during the September and November, 2018 monitoring events. The manual water level measurements were collected from these locations to provide additional water level elevation data used to generate local groundwater table elevation contours and interpret the direction of shallow groundwater flow within the Study Area. Manual water levels collected from MTE-MW101-16, MTE-MW102-16, MTE-MW103-16 (including historical levels collected by MTE during the previously completed Phase II and the 2018 monitoring events) are presented in **Table 7.4a, Table 7.4b**, and **Table7.4c**.

7.5 Surface Water Levels

MTE completed multiple rounds of manual surface water level measurements between June 22, 2018 and November 23, 2018. In addition, pressure transducers (data loggers) were installed within all five surface piezometers. Data loggers measure the pressure (in centimeters of water) above the logger at a predetermined time interval, which can then be used to calculate a surface water level and elevation. The data loggers installed in the surface piezometers were set to record a pressure at one hour time intervals. Hydrographs illustrating continuous surface elevations within the surface piezometers are provided in the Surface Water Monitoring Technical Memorandum.

7.6 Groundwater and Surface Water Sampling

MTE collected groundwater samples from MTE-MW101-18 and MTE-MW102-18 and surface water samples from 230 P (the Waterloo Commons wetland) and 233P on July 5, 2018. A supplementary round of surface water samples was collected from 230P, 233P, and 235P (the Region of Waterloo SWM pond) on August 10, 2018. Prior to the collection of groundwater samples, MTE-MW101-18 and MTE-MW102-18 were developed using Waterra™ Surge Blocks to remove any accumulated sediments from the bottom of the well and to remove fine materials from the well screen and sand pack. A minimum of five well volumes was purged from MTE-MW101-18 and MTE-MW102-18 based on the recorded water levels.

The groundwater and surface water samples were placed in laboratory supplied sample containers and transported on ice, under chain-of-custody to ALS Laboratories in Waterloo, Ontario. Standard QA/QC protocols were followed as outlined by the (MECP) guidance documents.

Sampling of MTE-MP101-18 could not be completed due to an insufficient water column being present in the mini-piezometer. Furthermore, surface water samples could not be collected from the remaining wetlands (HEPC North, HEPC South, and Cressman West) as no standing water was observed to be present by MTE field staff during the sampling events.

7.7 Hydraulic Conductivity Testing

Qualitatively, hydraulic conductivity (K) is a parameter describing the ease with which groundwater flows through a porous medium. Relatively high K values are attributed to permeable units, i.e. sand and gravel, while low values are attributed to less permeable material, i.e. silt or clay. Representative values for hydraulic conductivity for various soil types are presented in Freeze and Cherry (1979).

Following installation, MTE-MW101-18 and MTE-MW102-18 were measured to be dry. A review of hydrograph data measured using data loggers suggests a relatively slow recovery rate. MTE therefore conducted single well hydraulic response tests on MTE-MW101-18 and MTE-MW102-18 on July 5, 2018 following development and well sampling. Based on the relatively slow recovery rate, each well was purged dry and the water level in the well was then allowed to recover as a means of inducing an immediate groundwater level response (rising head test). Groundwater level recovery was monitored using a data logger programmed to collect groundwater levels every hour.

Each recovery test from MTE-MW101-18 and MTE-MW102-18 was selected and analyzed using the Hvorselv model in the AquiferTest© Pro software program (Waterloo Hydrogeologic Inc., 2016) to estimate the horizontal hydraulic conductivity (K) of the unconfined saturated materials beneath the Study Area.

7.8 Infiltration Rate Estimation

Soil samples were collected from MTE-MW101-18 and MTE-MW102-18 during drilling and submitted to MTE's Canadian Council of Independent Laboratories (CCIL) certified geotechnical laboratory for grain size distribution analysis and hydraulic conductivity estimates. Infiltration rates were then calculated based on estimated hydraulic conductivity values determined from grain size analysis. Soil samples selected for grain size analysis were collected from depths ranging between approximately 4.6 and 5.6 mBGS, which were selected based on soil conditions encountered in the field. Infiltration rates as a result of grain size analysis are presented later in this report.

8.0 STUDY AREA HYDROGEOLGICAL SETTING

8.1 Study Area Cross-Sections

Boreholes and monitoring wells installed by CMT, CVD, Genivar, MTE, and MECP Water Well Records were used to interpret local scale hydrostratigraphic units and generate two cross-sections.

Local scale geological-sections (Cross-section B-B' and Cross-section C-C') are presented on **Figures 9 and 10, respectively.** The cross-section stratigraphy was drawn using HydroGeo Analyst (HGA), which is a relational database system used to store and query the project database to create cross-sections.

*Geological Cross-section B-B' (**Figure 9**):*

- Extends approximately 215 m from the northwest to the southeast through the Waterloo Commons wetland feature;
- Illustrates flat undulating topography gradually increasing in elevation towards the southeast, with the exception of the elevated topography in the northwest direction due to the presence of the Erb Street West roadway;
- Illustrates a fine grained (clayey silt and sandy silt till) unit extending from ground surface to maximum explored depths of approximately 6 mBGS (372 mAMSL) throughout the entire length of the cross-section;
- Illustrates the presence of coarse sand and gravel fill and sand overlaying the till unit in the northwest; likely associated with municipal services installed below the Erb Street West Roadway; and
- Infers the shallow groundwater table elevation at the northeast portion of the Study Area to range between elevations of approximately 377 mAMSL and 381 mAMSL.

This local cross-section is therefore generally consistent with regional geology and the Regional Cross-Section A-A' discussed in **Section 6.5**.

*Geological Cross-section C-C' (**Figure 10**):*

- Extends approximately 415 m from the southwest to the northeast through the Waterloo Commons wetland feature;
- Illustrates flat undulating topography gradually decreasing in elevation from the southwest and northeast towards the low-lying Waterloo Commons wetland feature;
- Illustrates the presence of coarse sand unit in the southwest and northeast directions extending from ground surface to approximately 1 mBGS;
- Illustrates a fine grained (clayey silt and sandy silt till) unit underlying the sand unit and appearing at ground surface below the Waterloo Commons wetland feature. This silt till unit is illustrated to extend to maximum explored depths of approximately 6 mBGS (372 mAMSL) throughout the entire length of the cross-section; and
- Infers the shallow groundwater table elevation at the northeast portion of the Study Area to range between elevations of approximately 377 mAMSL and 381 mAMSL.

This local cross-section is therefore generally consistent with regional geology and the Regional Cross-Section A-A' discussed in **Section 6.5**.

8.2 Groundwater Levels

Groundwater elevations in close proximity of the Waterloo Commons wetland (MTE-MW102-16, MTE-MW101-18, and MTE-MP101-18) were measured to range between approximately 376.56 mAMSL and 379.81 mAMSL. The average groundwater levels at MTE-MW102-16, MTE-MW101-18 and MTE-MP101-18 were calculated to be 2.47 mBGS (379.55 mAMSL), 0.86 mBGS (377.69 mAMSL), and 0.46 mBGS (377.15 mAMSL), respectively.

Water levels collected using the continuous data logger in MTE-MP101-18 were observed to steadily increase over time, resembling a water level recovery curve, and reached a maximum elevation of 377.55 mAMSL on November 23, 2018. **Hydrograph 3** suggests the water level in MTE-MP101-18 is beginning to generally stabilize at the recorded maximum level of 0.06 mbgs (377.55 mAMSL). This elevation is therefore interpreted to be representative of the stabilized water level at the MTE-MP101-18 monitoring location.

Groundwater elevations in MTE-MW102-18 were measured to range between approximately 378.75 mAMSL and 380.27 mAMSL. The average groundwater level at MTE-MW102-18 was calculated to be 1.94 mBGS (379.55 mAMSL).

Continuous monitoring of groundwater elevation data will allow for the assessment of seasonal fluctuations of the water table and provide additional information on the short-term responses to precipitation events.

8.3 Surface Water Levels

Table 8.3 provides a summary of surface water elevations measured across the Study Area within the four wetland features (Waterloo Commons, HEPC North, Cressman West, and HEPC South), the SWM Retention Area and the Region of Waterloo Landfill SWM pond. Average surface water elevations ranged between 377.26 mAMSL (Waterloo Commons) and 382.28 mAMSL (Cressman West).

TABLE 8.3: MEASURED SURFACEWATER LEVELS – STUDY AREA

Station Number	Location	Surface Water Elevations (mAMSL)			
		Max	Min	Average	Ground
230P	Waterloo Commons	377.66	377.16	377.28	376.95
231P	HEPC North	379.69	379.67	379.68	379.68
232P	Cressman West	382.34	382.23	382.28	382.28
233P	SWM Retention Area	380.24	379.89	380.02	279.95
234P	HEPC South	382.35	381.99	382.08	382.01
235P	RoW Landfill SWMP	379.70	378.74	379.36	378.74

- 231P and 233P were noted to be frozen on November 23, 2018. As a result, data from 231P and 233P ranges from June, 2018 to Sept, 2018.

A comparison of measured average surface water elevations and ground surface elevations at HEPC North, Cressman West, SWM Retention Area, and HEPC South determined that these features remained generally dry during the monitoring period (i.e. standing water levels of <0.08 m). This suggests that these unevaluated features are likely topographic depressions which temporarily retain water following

precipitation events. Standing water was observed at the Waterloo Commons wetland feature which suggests the need for further evaluation of this location (**Section 9.0**). The Region of Waterloo Landfill pond is a known man-made SWM facility which drains into the wetland/SWM facility which straddles the Waterloo Commons and hydro lands. Further discussion regarding the measured surface water levels is provided in the Surface Water Monitoring Technical Memorandum.

8.4 Hydraulic Conductivity

The single well hydraulic response test analysis results in K values ranging from $1.7x10^{-8}$ m/sec (MTE-MW101-18) to $6.6x10^{-8}$ m/sec (MTE-MW102-18). Estimated K values determined using the single well hydraulic response test analysis were compared to K values determined by MTE's CCIL certified geotechnical laboratory which were estimated using grain size distribution analysis and empirical formulas. Estimated K values using grain size distribution analysis ranged from $2.7x10^{-9}$ m/sec (MTE-MW101-18) to $1.3x10^{-7}$ m/sec (MTE-MW102-18). **Table 8.4** summarizes the hydraulic conductivity estimates for each monitoring well location. A geometric mean hydraulic conductivity of $2.5x10^{-8}$ m/sec for the Study area was calculated and is consistent with the average published values for silt till soils (Freeze and Cherry, 1979). **Appendix K** provides the Aquifer Test Pro data analysis summary sheets.

TABLE 8.4: HYDRAULIC CONDUCTIVITY VALUES (M/SEC) – JULY 2018

Analysis	Estimated K Value Determined Using Single Well Response Test (m/sec)	Estimated K Value Determined Grain Size Distribution Analysis (m/sec)
MTE-MW101-18	$1.7x10^{-8}$	$2.7 x10^{-9}$
MTE-MW102-18	$6.6 x10^{-8}$	$1.3 x10^{-7}$
Geometric Mean	$2.5x10^{-8}$	

Notes: Hydraulic conductivity values determined using grain size distribution analysis were estimated using the Kaubisch, method where applicable.

Hydraulic conductivity results between the two monitoring well locations are generally consistent (i.e. MTE-MW101-18 has a higher K value than MTE-MW102-18), however there is some variability between the two estimation methods. The difference between the estimated K values determined using the single well hydraulic response test and the grain size analysis is attributed to the method of testing. Conductivity values determined through single well response testing are based on recorded in-situ water level recovery rates observed in the field, while estimated infiltration rates provided by the geotechnical laboratory are based on the results of grain size analysis and the application of empirical formulas.

8.5 Groundwater Flow Direction

Local scale groundwater elevation contours, illustrated on **Figure 11**, were generated for the Study Area using available current and historical water level data. Groundwater elevation data was further supplemented using a historical water level identified from a MECP monitoring well (MECP ID#: 7239926) located adjacent to the Region of Waterloo Landfill SWM pond. MECP records describe 7239926 as being completed to a depth of 8.5 mBGS in 2016 with a water level of approximately 2.1 mBGS (279.3 mAMSL).

Interpreted groundwater elevation contours were estimated to range between 377 m and 382.5 mAMSL within the Study Area. Groundwater elevation contours generally follow surface topography of the Study Area, which ranges between 377 m and 394 mAMSL. Based on this information, local scale shallow

groundwater flow was interpreted to generally be in the northwesterly direction converging towards the Waterloo Commons SWM/wetland feature.

Local scale groundwater elevations are generally consistent with the regional groundwater table elevations discussed in **Section 6.5**. However, the interpreted local scale shallow groundwater flow direction is noted to vary from the regional groundwater flow direction beneath the Study Area. The variability between the interpreted groundwater flow directions is attributed to the scale used to generate each set of groundwater flow contours. Groundwater contours generated using GRCA data are based on a watershed scale study and therefore reflect regional groundwater elevations and general flow directions across the GRCA limits. Groundwater contours generated for the Study Area are based on multiple sets of water levels located with the bounds of the Study Area and are therefore more representative of local scale groundwater contours and topography.

Local scale groundwater contours were integrated with the GRCA regional groundwater table contours discussed in **Section 6.5**, as shown in **Figure 12**, to further infer the direction of groundwater flow surrounding the Study Area. Based on this, groundwater was inferred to generally flow in the northeasterly direction towards Clair Creek, with the exception of groundwater in the southeastern portion of the property which was inferred to generally flow in the southeasterly direction due to an interpreted groundwater divide. Integrated groundwater contours (MTE and GRCA Data) are based on an interpretation of available groundwater level data sources and may vary from actual groundwater elevations observed throughout the year.

8.6 Average Linear Groundwater Velocity

The horizontal hydraulic gradient is a measurement of the slope of the water table surface which is simply the change in hydraulic head over the change in distance between two or more monitoring points. The estimated horizontal hydraulic gradient for the Study Area determined using average groundwater elevations from MTE-MW101-18 (377.69 mAMSL) and MTE-MW102-18 (379.55 mAMSL) was approximately 0.003 m/m, based on the local scale groundwater flow map (**Figure 11**).

The average linear groundwater velocity was estimated based on three variables: hydraulic conductivity, horizontal hydraulic gradient and effective porosity. The equation for calculating groundwater velocity is:

$$q = (-KI_h)/n_e \qquad \text{[Eq.1.]}$$

Where:

q = groundwater flux (m^3/m^2/time)

K = effective hydraulic conductivity ($2.5x10^{-8}$ m/sec)

$\mathbf{I_h}$ = horizontal hydraulic gradient (dh/dl) (0.003 m/m)

$\mathbf{n_e}$= effective soil porosity (0.2 typical for a silt and clay soil, Freeze and Cherry, 1979)

With respect to the above values, the average linear groundwater velocity (q) using Darcy's Law (Eq.1.) within the shallow groundwater at the Study Area was estimated to be approximately less than 0.1 m/year, based on the local scale groundwater flow map (**Figure 11**).

8.7 On-site Infiltration

A summary of the calculated infiltration rates based soil samples collected by MTE, from MTE-MW101-18 and MTE-MW102-18, is presented in **Table 8.7**, below. Infiltration rates were estimated to range between 4 and 11 mm/hr and are based on the estimated hydraulic conductivity values discussed in **Section 8.4**. Particle grain size distributions are provided in **Appendix L**.

TABLE 8.6: SUMMARY OF INFILTRATION RATES (mm/hr)

Test Location	Test Depth Interval (mbgs)	Dominant Soil Type	Observed Unit Thickness (m)	Applied Factor of Safety	Estimated Infiltration Rate Provided by MTE Geotechnical Laboratory (mm/hr)
MTE-MW101 - 18	4.6-5.6	Silt Till	>4.6*	2.5	4
MTE-MW102 - 18	4.6-5.3	Silt Till	>5.8*	2.5	11

* Based on interpolation from drilling program

8.8 Groundwater Chemistry

Groundwater samples were submitted and analyzed for general chemistry in order to determine the background groundwater chemistry in close proximity to the Waterloo Commons and the SWM Retention Area. The analytical results are summarized in **Table 8.8.** Laboratory Certificates of Analysis are provided in **Appendix M**.

8.8.1 Waterloo Commons SWM/Wetland Feature

Anions and Nutrients

As shown, detectable concentrations of Ammonia (0.28 mg/L), Chloride (527 mg/L), Fluoride (0.12 mg/L), and Sulfate (79.4 mg/L) were reported for the sample collected from MTE-MW101-18. Alkalinity (as $CaCO_3$) was reported to be 363 mg/L. All other reported results for Anion and Nutrient compounds were below their detectable limits for the MTE-MW101-18 sample collected.

Total Metals

The followings compounds were detected in the MTE-MW101-18 groundwater sample collected:

- Antimony (0.00029 mg/L)
- Arsenic (0.00048 mg/L)
- Barium (0.191 mg/L)
- Boron (0.028 mg/L)
- Cadmium (0.000079 mg/L)
- Calcium (198 mg/L)
- Cesium (0.000019 mg/L)
- Cobalt (0.00105 mg/L)
- Copper (0.0123 mg/L)
- Lead (0.0003 mg/L)
- Magnesium (82.2 mg/L)
- Manganese (0.153 mg/L)
- Molybdenum (0.00358 mg/L)
- Nickel (0.0076 mg/L)

- Potassium (6.67 mg/L)
- Rubidium (0.00269 mg/L)
- Selenium (0.000596 mg/L)
- Silicon (7.88 mg/L)
- Sodium (156 mg/L)
- Strontium (0.477 mg/L)
- Sulfur (30.2 mg/L)
- Thallium (0.000029 mg/L)
- Tin (0.00092 mg/L)
- Uranium (0.00613 mg/L)
- Vanadium (0.00088 mg/L)
- Zinc (0.0105 mg/L)

All other reported results for Total Metals compounds were below their detectable limits for the sample collected from MTE-MW101-18. The elevated concentrations of sodium and chloride are interpreted to be a result of road salt application on the roadways located and north and east of the Waterloo Commons wetland feature.

8.8.2 SWM Retention Area

Anions and Nutrients

As shown, detectable concentrations of Ammonia (0.094 mg/L), Chloride (6.5 mg/L), Fluoride (0.12 mg/L), and Sulfate (58.1 mg/L) were reported for the sample collected from MTE-MW101-18. Alkalinity (as $CaCO_3$) was reported to be 337 mg/L. All other reported results for Anion and Nutrient compounds were below their detectable limits for the MTE-MW102-18 sample collected.

Total Metals

The followings compounds were detected in the MTE-MW102-18 groundwater sample collected:

- Aluminum (0.016 mg/L)
- Antimony (0.00016 mg/L)
- Arsenic (0.00063 mg/L)
- Barium (0.199 mg/L)
- Boron (0.011 mg/L)
- Cadmium (0.000028 mg/L)
- Calcium (102 mg/L)
- Cobalt (0.00046 mg/L)
- Copper (0.0044 mg/L)
- Lead (0.00024 mg/L)
- Magnesium (34.3 mg/L)
- Manganese (0.0727 mg/L)
- Molybdenum (0.00304 mg/L)
- Nickel (0.00145 mg/L)
- Potassium (1.69 mg/L)
- Rubidium (0.00093 mg/L)
- Selenium (0.000186 mg/L)
- Silicon (7.32 mg/L)
- Sodium (12.8 mg/L)
- Strontium (0.227 mg/L)
- Sulfur (19.4 mg/L)
- Thallium (0.000011 mg/L)
- Tin (0.00038 mg/L)
- Uranium (0.00227 mg/L)
- Vanadium (0.00063 mg/L)
- Zinc (0.0067 mg/L)

All other reported results for Total Metals compounds were below their detectable limits for the sample collected from MTE-MW102-18. It is noted that total metal concentrations at MTE-102-18 were generally lower than groundwater samples collected from MTE-MW101-18. However, there are no other consistent trends observed between these two sample locations.

8.9 Surface Water Chemistry

Surface water samples were submitted and analyzed for general chemistry in order to determine the background surface water chemistry in the Waterloo Commons wetland feature, SWM Retention Area, and the Region of Waterloo Landfill's SWM pond. Analytical results for the surface water sample collected from the Waterloo Commons were compared to the analytical results from groundwater samples (**Section 8.7**) in order to identify potential surface water and groundwater interactions. The analytical results are summarized in **Table 8.7.** Laboratory Certificates of Analysis are provided in **Appendix M**.

8.9.1 Waterloo Commons SWM/Wetland Feature

Anions and Nutrients

As shown, detectable concentrations of Ammonia (0.02 mg/L), Chloride (344-767 mg/L), Fluoride (0.12 mg/L), Nitrate (as N) (0.11 mg/L), Phosphorus (0.135 mg/L), Orthophosphate (as P) (0.0099 mg/L) and Sulfate (15.2 mg/L) were reported for the samples collected from monitoring location 230P. Alkalinity (as $CaCO_3$) was reported to be 198 mg/L. All other reported results for Anion and Nutrient compounds were below their detectable limits for the 230P samples collected.

Total Metals

The followings compounds were detected in the 230P surface water samples collected:

- Aluminum (1.73 mg/L)
- Arsenic (0.0051 mg/L)
- Barium (0.117 mg/L)
- Calcium (102 mg/L)
- Cesium (0.000018 mg/L)
- Cobalt (0.0011 mg/L)
- Copper (0.0025 mg/L)
- Iron (4.86 mg/L)
- Lead (0.00069-0.00414 mg/L)
- Magnesium (21.6 mg/L)
- Manganese (0.56 mg/L)
- Molybdenum (0.00253 mg/L)
- Phosphorus (0.0545-0.74 mg/L)
- Potassium (3.9 mg/L)
- Rubidium (0.0036 mg/L)
- Silicon (7.1 mg/L)
- Sodium (409 mg/L)
- Strontium (0.386 mg/L)
- Uranium (0.00096 mg/L)
- Vanadium (0.0074 mg/L)
- Zinc (0.0087 mg/L)

All other reported results for Total Metals compounds were below their detectable limits for the sample collected from MTE-MW101-18. There are no noted trends observed between the surface water sample collected from the 230P and the groundwater sample collected from MTE-MW101-18, with the exception of elevated sodium and chloride concentrations. The elevated concentrations of sodium and chloride are interpreted to be a result of road salt application on the roadways located and north and east of the Waterloo Commons wetland feature.

8.9.2 SWM Retention Area

Anions and Nutrients

As shown, detectable concentrations of Ammonia (0.023 mg/L), Chloride (3.11-30.1 mg/L), Fluoride (0.076 mg/L), Nitrate (as N) (0.066 mg/L), Phosphorus (0.815 mg/L), and Sulfate (2.12 mg/L) were reported for the samples collected from monitoring location 233P. Alkalinity (as $CaCO_3$) was reported to be 192 mg/L. All other reported results for Anion and Nutrient compounds were below their detectable limits for the 233P samples collected.

Total Metals

The followings compounds were detected in the 233P surface water samples collected:

- Aluminum (0.035 mg/L)
- Antimony (0.00012 mg/L)
- Arsenic (0.0023 mg/L)
- Barium (0.0188 mg/L)
- Boron (0.03 mg/L)
- Calcium (54.2 mg/L)
- Cobalt (0.00015 mg/L)
- Copper (0.036 mg/L)
- Iron (0.941 mg/L)
- Lead (0.0168 mg/L)
- Magnesium (13 mg/L)
- Manganese (0.0641 mg/L)
- Molybdenum (0.000402 mg/L)
- Phosphorus (0.059-0.0766 mg/L)
- Potassium (3.93 mg/L)
- Rubidium (0.00063 mg/L)
- Selenium (0.000123 mg/L)
- Silicon (0.6 mg/L)
- Sodium (17.5 mg/L)
- Strontium (0.175 mg/L)
- Sulphur (0.86 mg/L)
- Uranium (0.000482 mg/L)
- Zinc (0.109 mg/L)

All other reported results for Total Metals compounds were below their detectable limits for the sample collected from 233P. It is noted that total metal concentrations at 233P were generally lower than samples collected from MTE-MW102-18 and 230P. However, there are no other consistent trends observed between these three sample locations.

8.9.3 Region of Waterloo Landfill SWM Pond

The Region of Waterloo Landfill (ROW) SWM pond was sampled analyzed for select anions, nutrients, and metals. This location was sampled for comparative purposes as the SWM pond is located hydraulically up-gradient of the Waterloo Commons wetland features (i.e. drains into the Waterloo Commons wetland feature). A summary of these results is provided below:

Anions and Nutrients

As shown, detectable concentrations of Chloride (293 mg/L) and Phosphorus (0.0785 mg/L) were reported for the sample collected from the ROW SWM pond. All other reported results for Anion and Nutrient compounds were below their detectable limits for the ROW SWM pond sample collected.

Total Metals
The followings compounds were detected in the ROW SWM pond sample collected:

- Copper (0.0021 mg/L)
- Lead (0.00088 mg/L)
- Phosphorus (0.0155 mg/L)
- Zinc (0.0099 mg/L)

It is noted that total metal concentrations at the ROW SWM pond were generally lower the surface water sample collected from 230P. However, there are no other consistent trends observed between these two sample locations.

Overall trends identified from water quality samples collected from the Study Area suggest the following:

- Groundwater concentrations of anions, nutrients, and total metals are generally lower than surface water concentrations;
- Surface water concentrations of anion, nutrients, and total metals generally increase across the Study Area moving in the north to northeasterly direction; and
- Groundwater concentrations of anion, nutrients, and total metals generally increase across the Study Area moving in the north to northeasterly direction.

These trends are consistent with topography, surface water drainage patterns, and the interpreted groundwater flow direction for the Study Area discussed in **Section 8.5**.

9.0 GROUNDWATER – WETLAND INTERACTION ASSESSMENT

The interaction between groundwater and surface water in wetlands represents an important factor in site characterization as it can provide insight into whether groundwater recharge is occurring or whether groundwater is discharging to the wetland (Scott & Winter, 2006). A groundwater–wetland interaction assessment was therefore completed for the Waterloo Commons wetland feature based on groundwater and surface water data collected from the Study Area.

An in depth assessment of the remaining unevaluated wetland features (HEPC North, HEPC South, and Cressman West) and the SWM Retention Area was not completed based on review of collected surface water level data and the relatively small footprints of the features. Surface water level data at these locations suggest that these features would generally behave as depressional features, retaining water following precipitations events and then becoming dry as a result of evapotranspiration and infiltration losses. Further discussion regarding the remaining wetland features is provided in the Surface Water Monitoring Technical Memorandum.

9.1 Waterloo Commons SWM/Wetland Feature

The interaction between groundwater and the Waterloo Commons wetland feature was assessed by comparing available continuous surface water and groundwater elevation data collected from the 230P surface piezometer, MTE-MW101-18, MTE-MP101-18, and GRCA precipitation data, as shown in **Hydrograph 5**. Average surface water elevations in 230P and MTE-MW101-18 have been calculated and

summarized in **Table 9.1** below. Water levels collected using the continuous data logger in MTE-MP101-18 were observed to steadily increase over time and reached a maximum elevation of 377.55 mAMSL on November 23, 2018. **Hydrograph 3** suggests the water level in MTE-MP101-18 is beginning to generally stabilize at the recorded maximum elevation (377.55 mAMSL).

TABLE 9.1: AVERAGE WATER LEVELS (WATERLOO COMMONS)

Location	Water Level Elevation (mAMSL)
230P Surface Piezometer	377.28
MTE-MW101-18	377.69
MTE-MP101-18	377.55*

* A maximum observed water level was used for MTE-MP101-18 as this value was interpreted to be more representative of the stabilized water table elevation at this location.

Surface water and groundwater levels are generally consistent between the three monitoring locations with the average groundwater elevation in MTE-MW101-18 being measured to be approximately 0.41 m higher than the average surface water elevation in the 230P surface piezometer. Surface water and groundwater levels in 230P and MTE-MW101-18 were noted to express similar fluctuations following precipitation events.

The interaction of groundwater and surface water is inferred to vary throughout the year, as shown in **Hydrograph 5**. Groundwater and surface water elevations measured during dry periods were observed to be generally consistent, therefore implying minimal volumes of groundwater being contributed to the wetland during these periods. Groundwater levels were measured to temporarily increase above surface water levels following significant precipitation events and then gradually recover to lower levels more consistent with surface water levels, therefore resulting in the potential for groundwater to temporarily discharge into the wetland feature.

Surface water elevations were measured to fluctuate around 377.20 mAMSL being controlled by the elevation of the pond outlet orifice located adjacent to the 230P surface piezometer. Measured surface water levels may therefore inaccurately reflect surface water levels within the pond due to the presence of this drainage feature.

A vertical hydraulic gradient was calculated to further assess the interpreted interaction of groundwater and the Waterloo Commons wetland feature. Vertical hydraulic gradients provide insight into whether the wetland was gaining (i.e. receiving groundwater from below) or losing (i.e. recharging the shallow groundwater table through infiltration).

The vertical hydraulic gradient between MTE-MW101-18 and intermediate MTE-MP101-18 was calculated using the following equation:

[Eq.2.]

$$I_v = (MWL - MPL) / (MWS-MPS)$$

Where:

I_v = hydraulic gradient (m/m)

MWL =Average water level inside monitoring well (measured using continuous data logger) (377.69 mAMSL)
MPL =Maximum water level inside mini-piezometer (measured using continuous data logger) (377.55 mAMSL)
MWS = Mid-Screen elevation of monitoring well (373.29 mAMSL)
MPS = Mid-Screen elevation of mini=piezometer (376.40 mAMSL)

* A maximum observed water level was used for MTE-MP101-18 as this value was interpreted to be more representative of the stabilized water table elevation at this location.

The vertical hydraulic gradient within the Waterloo Commons SWM/wetland feature was calculated to be approximately - 0.045 m/m therefore suggesting an upward flow direction (i.e. gaining-receiving groundwater from below).

A survey of the Waterloo Commons SWM/wetland bathymetry determined the maximum lowest elevation of the wetland feature to approximately 376.84 mAMSL. Using the average groundwater elevation in MTE-MW101-18 (377.69 masl), the wetland intersects below the shallow groundwater table by approximately 0.85 m. GRCA mapping data determines the area of the wetland to be approximately 10000 m^2, resulting in a contributing surface area of approximately 10450 m^2 and a wetland volume of approximately 8500 m^3. The volume of water within the wetland was therefore estimated to be approximately 5100 m^3 using the following approach:

[Eq.3.]

$$V_w = V_s + V_p$$

Where:

V_w = Volume of water in wetland
V_s = Volume of standing water in wetland (based on field observations, approximately half the wetland volume is considered to be made up of standing water; 4250 m^2)
V_p = Volume of water in soil pores (the remaining volume of the wetland (850 m^2) x effective porosity of clayey silt material (0.2); 1200 m^3)

The soils surrounding the wetland feature were found to consist of sandy silt and clayey silt, with an estimated infiltration rate of approximately 4 mm/hr. The groundwater discharge rate at this wetland feature is therefore expected to be very low. A preliminary assessment of the potential groundwater contribution to the Waterloo Commons wetland feature was calculated using a variation of the Darcy Flux approach and is presented in the equation below:

[Eq.4.]

$$Q = - (K I_v A) / n_e$$

Where:

Q = Groundwater discharge (m^3/ unit of time)
K = Hydraulic conductivity (2.2 x 10^{-3} m/day)
I_v = vertical hydraulic gradient (-0.045 m/m)
A = Surface area of wetland below groundwater table (an approximate area of 10,000 m^2 and a conservatively high intersection depth of 0.6; 10260 m^3)
n_e = effective porosity of clayey silt material (0.2)

A Darcy flux based on the total surface area of the wetland intersecting the shallow groundwater table was used to estimate the discharge seepage (groundwater contribution to the wetland). Based on a conductivity value of 2.2 x 10^{-3} m/day (2.5 x 10^{-8} m/sec) and an effective porosity of 0.2, the resulting groundwater discharge is estimated to be approximately 5.1m^3/day (0.1% of the total estimated volume of the wetland). This can alternatively be expressed a 0.5 L/m^2 of groundwater discharge occurring within the boundaries of the wetland. Losses occurring through evapotranspiration (ET) were calculated to be approximately 7.5m^3/day based on the published Ministry of Environment (MOE) SWM Design Manual average ET rate for the Region of Waterloo (approximately 550 mm/year) and a conservatively low contributing surface area of 5000 m^2 (half the area of the wetland feature). Water losses in the wetland feature as a result of ET are therefore estimated to be approximately equal to or greater than volumes generated from groundwater discharge.

Based on this information, it is interpreted that the Waterloo Commons SWM/wetland feature receives minor volumes of groundwater discharge and is primarily sustained by surface water runoff. Surface water runoff directed to the wetland feature is generally conveyed from the surrounding Subject Lands, Ira Needles Boulevard, and the hydraulically up-gradient Region of Waterloo Landfill's SWM pond.

10.0 SOURCE WATER PROTECTION

10.1 Wellhead Protection Areas

Wellhead Protection Areas (WHPAs) are established for each municipal supply well through the delineation of well "capture zones". These capture zones are defined as:

> *"the projection onto the land surface of the portion of the three-dimensional volume through which groundwater travels towards a water supply well within a defined period of time."* (AquaResource Inc., 2010)

WHPAs are divided into four categories based on travel time to the well, and are summarized in the table below.

Category	Description
WHPA-A	A radius of 100 m from the outer boundary of the well
WHPA-B	Time-of-travel to the well ≤2 years (not including WHPA-A)
WHPA-C	Time-of-travel to the well is >2 years, but ≤ 5 years
WHPA-D	Time-of-travel to the well is >5 years, but ≤ 25 years

A review of the MECP online interactive Source Water Protection Information Atlas (MECP, 2018) and the GRCA online mapping tool found that the Study Area is not located within a WHPA, shown on **Figure 13**.

10.2 Intrinsic Vulnerability

MTE reviewed the GRCA Grand River Information Network (GRIN) interactive on-line map for information pertaining to the aquifer Intrinsic Vulnerability. The Intrinsic Vulnerability of an aquifer is based on the nature of the soil and/or bedrock and how easily surface water can reach the aquifer. Intrinsic Vulnerability is ranked as low, medium or high and does not take into consideration the properties of the contaminant itself (Liggett, Lapcevic, & Miller, May 2011).

As shown on **Figure 14**, the majority of Study Area is classified as having a low intrinsic vulnerability. It is noted that a small portion of the Study Area located in the east is classified as having a medium intrinsic vulnerability; however this portion is primarily comprised of the roadways which already make up Ira Needles Boulevard and the Boardwalk Avenue.

10.3 WHPA Vulnerability

WHPA vulnerability scores are assigned by overlaying the WHPAs with the intrinsic vulnerability of the aquifer (LERSPC, 2015). Vulnerability scores range from 2 to 10, with 10 representing the highest vulnerability. Vulnerability adjustments are made based on the presence of transport pathways which can provide easier routes of access between a contaminant and an aquifer, increasing the aquifers susceptibility to contamination.

As shown in **Figure 13**, the Study does not fall within a WHPA and therefore does not have a WHPA vulnerability score.

10.4 Significant Groundwater Recharge Area

Groundwater recharge occurs where precipitation and snowmelt infiltrate into the ground to feed aquifers, watercourses and wetlands. SGRAs are typically associated with coarse-grained soils (i.e. sands and gravels) or very shallow overburden material covering upland areas on the landscape.

The MECP on-line interactive Source Water Protection Information Atlas and GRCA online mapping tool show the Study Area to not be located within a SGRA. Quaternary geology in the area illustrate the Study Area to be located with a fine-textured glaciolacustrine silt and clay unit known as the Maryhill Till, which poorly facilitates infiltration and percolation of surface water to groundwater. The calculated infiltration rates for the MTE-MW101-18 and MTE-MW102-18 support the identification that the Study Area is not within a SGRA. This is further supported by the presence of the Region of Waterloo Landfill being located adjacently west of the Study Area.

10.5 Issue Contributing Areas (ICAs)

ICAs are developed by identifying areas where the current or trending concentration of a contaminant within the groundwater may deteriorate the quality of the groundwater used as a drinking water source (LERSPC, 2015). An ICA is defined by the Grand River Source Protection Plan as:

> "*The area within which activities have or are likely to contribute to the elevated contaminant at the well...in most cases, an ICA is the 25 year time-of-travel capture zone."* (Grand River Conservation Authority, 2015)

The MECP online interactive Source Water Protection Information Atlas GRCA online mapping tool show that the Study Area is not located within an ICA area**.**

11.0 CONCLUSIONS

Based on this scope hydrogeological investigation, MTE offers the following findings:

Study Area Hydrogeological Characteristics

- Stratigraphic conditions beneath the Study Area primarily consist of fine grained cohesive (silt and clayey silt till) materials;
- Topography across the Study Area was determined to range between 377.0 mAMSL and 394.0 mAMSL, decreasing in elevation along the northwesterly direction;
- Groundwater levels in the Study Area were measured to range from 377.19 mAMSL to 380.27 mAMSL in installed monitoring wells and the mini-piezometer;
- The local scale groundwater table elevation, interpreted based on collected water levels, regional groundwater elevation contours, and historical levels, was interpreted to generally follow the Study Area topography and ranged between 377.0 m and 382.5 mAMSL with the direction of groundwater flow being inferred to be northwesterly towards Clair Creek;
- The horizontal gradient of shallow groundwater table beneath the Study Area is estimated to be 0.003 m/m;
- Maximum and minimum hydraulic conductivity values for the groundwater table beneath the Study Area were calculated to range between $1.3x10^{-7}$ m/sec and $2.7x10^{-9}$ with a geometric mean of $2.5x10^{-8}$ m/sec; and
- The average linear groundwater velocity beneath the Study Area was estimated to be less than 0.10 m/year.

Continuous monitoring of groundwater elevation data will allow for the assessment of seasonal fluctuations of the water table and determine the seasonal high groundwater table.

An in depth groundwater-wetland interaction assessment of the smaller unevaluated wetland features (HEPC North, HEPC South, and Cressman West) was not completed based on review of collected surface water level data and the relatively small areas of the wetland features. Surface water level data at these locations suggest that the wetland features would generally behave as depression features, retaining water following precipitations events and then becoming dry as a result of evapotranspiration and infiltration losses. The Former Cressman East wetland feature was approved to be removed by the GRCA in 2016 and is no longer present on the property. The surface water feature which remains is a proposed SWM Retention Area which was not assessed as part of this hydrogeological assessment.

Surface water samples were collected from the Waterloo Commons and SWM Retention Area to assess background surface water quality in the Study Area. A supplementary surface water sample was also collected from the Region of Waterloo Landfill's SWM pond. Groundwater samples were collected from MTE-MW101-18 and MTE-MW102-18 to assess background groundwater quality data in the Study Area. Results did not provide conclusive evidence regarding groundwater and surface water interactions.

Overall trends identified from samples collected from the Study Area suggest the following:

- Groundwater concentrations of anions, nutrients, and total metals are generally lower than surface water concentrations;
- Surface water concentrations of anion, nutrients, and total metals generally increase across the Study Area moving in the north to northeasterly direction, following the inferred direction of surface water drainage;
- Groundwater concentrations of anion, nutrients, and total metals generally increase across the Study Area moving in the north to northeasterly direction, following the inferred direction of groundwater flow; and
- The elevated concentrations of sodium and chloride at the Waterloo Commons wetland feature are interpreted to be a result of road salt application on the roadways located and north and east of the Waterloo Commons wetland feature.

A more detailed groundwater–wetland interaction assessment was therefore completed for the Waterloo Commons and based on groundwater and surface water data collected from the Study Area. Based on the available information, MTE offers the following finds:

Waterloo Commons SWM/Wetland Feature

- The average groundwater elevation in MTE-MW101-18 (377.69 mAMSL) was measured to be approximately 0.41 m higher than the average surface water elevation in the 230P surface piezometer (377.28 mAMSL);
- The soils surrounding the wetland feature were found to consist of sandy silt and clayey silt till with an infiltration rate of 4 to 11 mm/hr;
- The vertical hydraulic gradient within the Waterloo Commons wetland was calculated to be approximately - 0.045 m/m therefore suggesting an upward flow direction (i.e. gaining- receiving groundwater from below);
- The total volume of water within the Waterloo Commons wetland feature was estimated to be approximately 5100 m^3 based on available GRCA mapping tools and field observations;
- Based on a Study Area conductivity value of 2.5 x 10^{-8} and an effective porosity of 0.2 for silt material, the resulting groundwater discharge was estimated to be approximately 5.1m^3/day (0.1% of the total estimated volume of the wetland); and
- Losses occurring through evapotranspiration (ET) were calculated to be approximately 7.5 m^3/day based on an average ET rate of approximately 550 mm/year and a contributing surface area of 5000 m^2.

Based on this information, it is interpreted that the Waterloo Commons SWM/wetland feature receives minor volumes of groundwater discharge and is primarily sustained by surface water runoff. Surface water runoff directed to the wetland feature is generally conveyed from the surrounding Subject Lands, Ira Needles Boulevard, and the hydraulically up-gradient Region of Waterloo Landfill's SWM pond.

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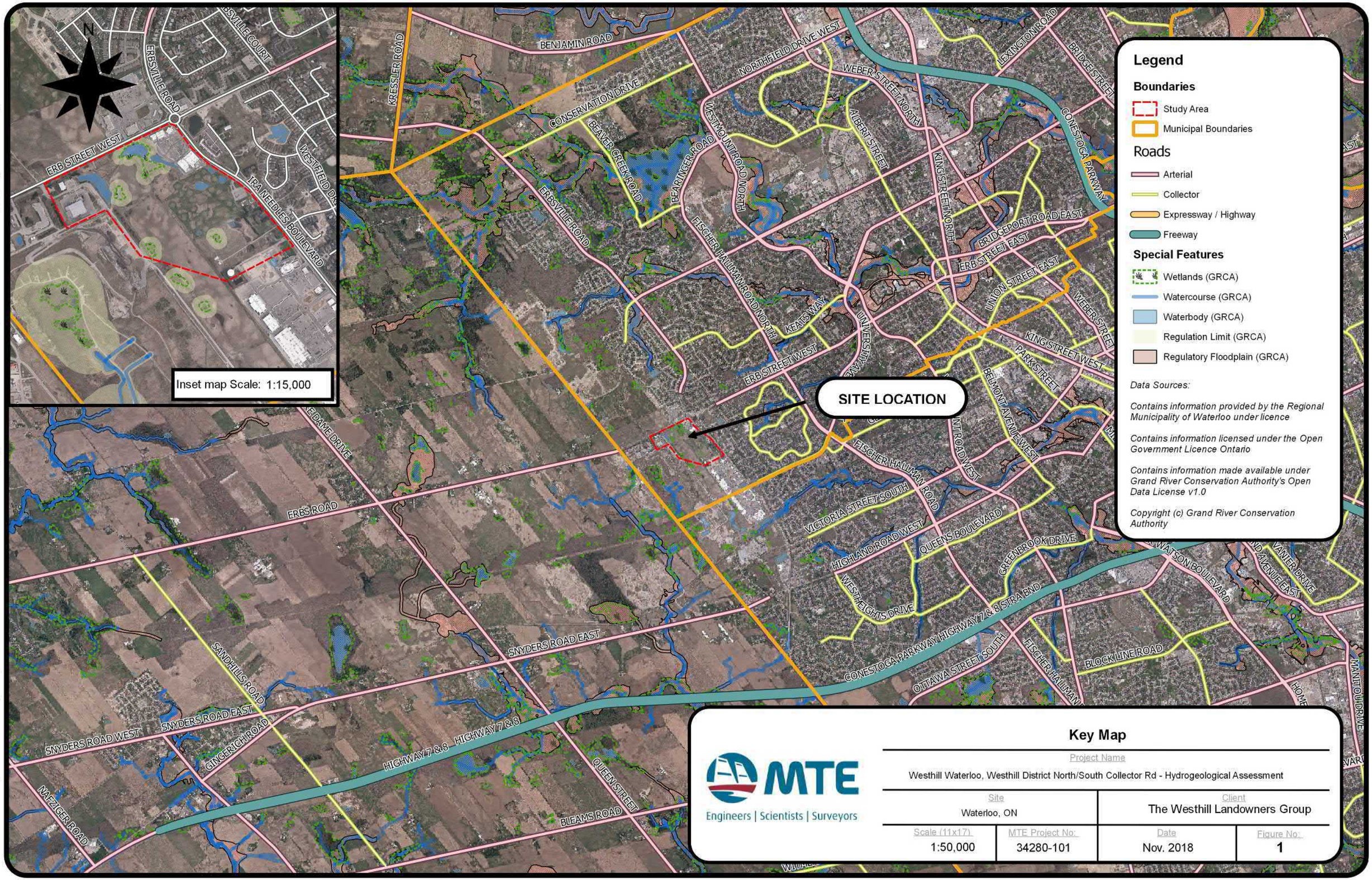
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Waterloo Hydrogeologic, 2015, *Aquifer Test Pro Software.*

MTE Consultants Inc. **www.mte85.com**
520 Bingemans Centre Drive
Kitchener, Ontario N2B 3X9
Phone: 519-743-6500
Fax: 519-743-6513

FIGURES



Legend

Boundaries

- Study Area
- Municipal Boundaries

Roads

- Arterial
- Collector
- Expressway / Highway
- Freeway

Special Features

- Wetlands (GRCA)
- Watercourse (GRCA)
- Waterbody (GRCA)
- Regulation Limit (GRCA)
- Regulatory Floodplain (GRCA)

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Key Map

Project Name			
Westhill Waterloo, Westhill District North/South Collector Rd - Hydrogeological Assessment			
Site: Waterloo, ON		Client: The Westhill Landowners Group	
Scale (11x17): 1:50,000	MTE Project No: 34280-101	Date: Nov. 2018	Figure No: 1

Project No: 34280-101 Q:\34280\101\Hydrogeology\34280-101 QGIS.qgs
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N

ST MORITZ AVENUE
BRANDENBURG BOULEVARD
ERBSVILLE ROAD
PARADISE CRESCENT
ROYAL BEECH DRIVE
ERBSVILLE COURT
BEECHWOOD DRIVE
ERB STREET WEST
BERNAY DRIVE
PARIS BOULEVARD
PINEROW CRESCENT
WILMOT LINE
ERBS ROAD
WESTFIELD DRIVE
THORNDALE DRIVE
CARDIFF STREET
BAKER STREET
PENNY LANE
IRA NEEDLES BOULEVARD
COUNTRYSTONE DRIVE
RESURRECTION DRIVE

6508344
7287726
7217850
6507781
7217851
6509436
6503093
6509919
7261566
7261568
7234539
7111295
6509435
7261567
6501390
7234537
7140394
6501309
6503952
6501391
6503346
7050641
7287730
7239929
6507997
7114304
7234538
7177568
7239926
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6504166
6504153
6501388
6503643
7239927
6507206
7162785
7162784
7119476
7119473
7213873
7213876
7281491
7281492
7213879
7115869
6503015

Legend

Boundaries
- Study Area
- Study Area - 500 m Radius

Roads
- Arterial
- Collector
- Local / Street

Special Features
- Wetlands (GRCA)
- Watercourse (GRCA)
- Waterbody (GRCA)

Monitoring Locations

MECP Monitoring Locations
- Domestic
- Irrigation
- Livestock
- Monitoring
- Monitoring and Test Hole
- Municipal
- Not Used
- Other
- Test Hole

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Study Area

Project Name: Westhill Waterloo, Westhill District North/South Collector Rd - Hydrogeological Assessment

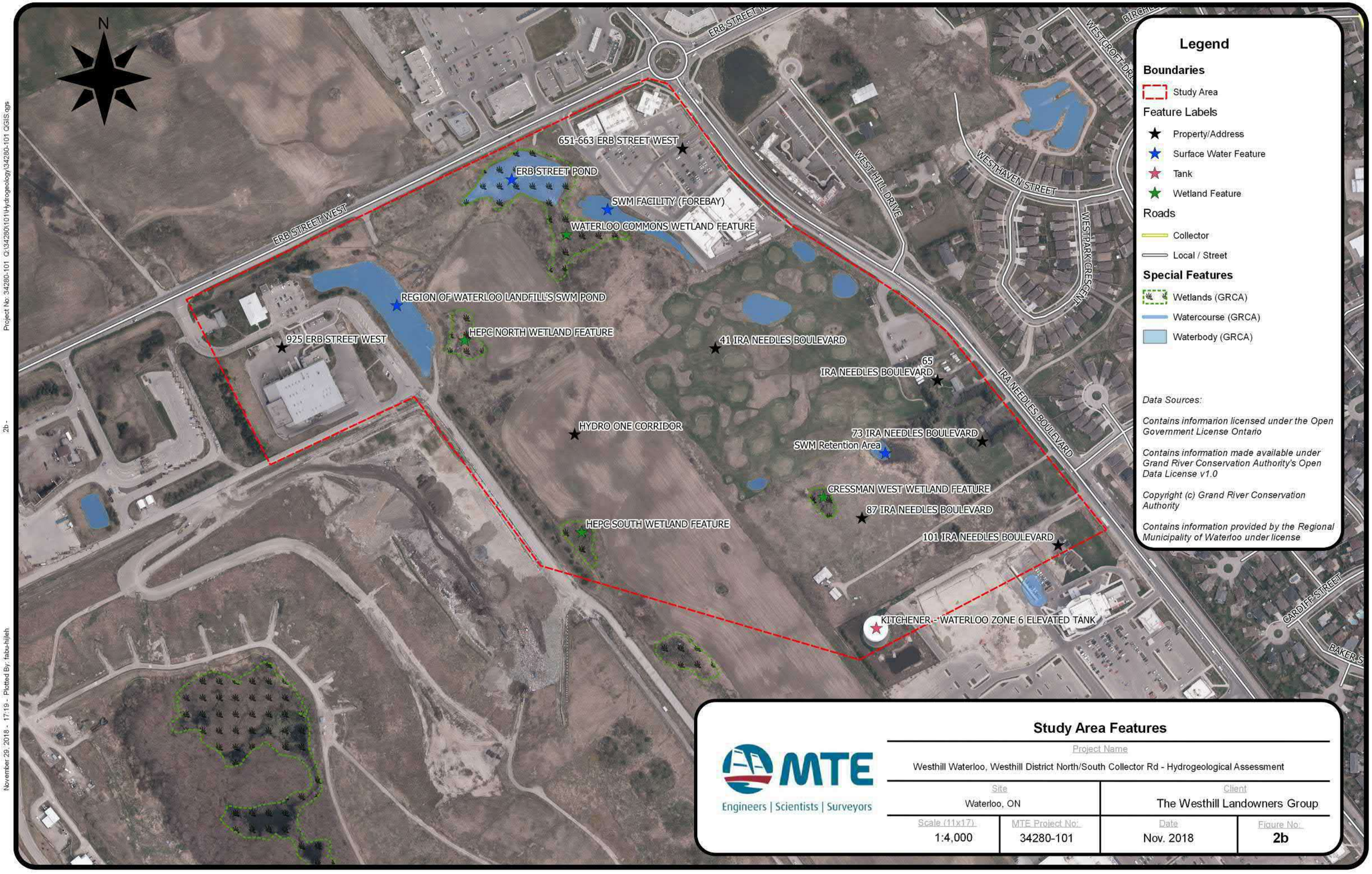
Site	Client
Waterloo, ON	The Westhill Landowners Group

Scale (11x17)	MTE Project No:	Date	Figure No:
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Project No: 34280-101 Q:\34280\101\Hydrogeology\34280-101 GIS.qgs

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2a -



Project No: 34280-101 Q:\34280\101\Hydrogeology\34280-101 GIS.qgs

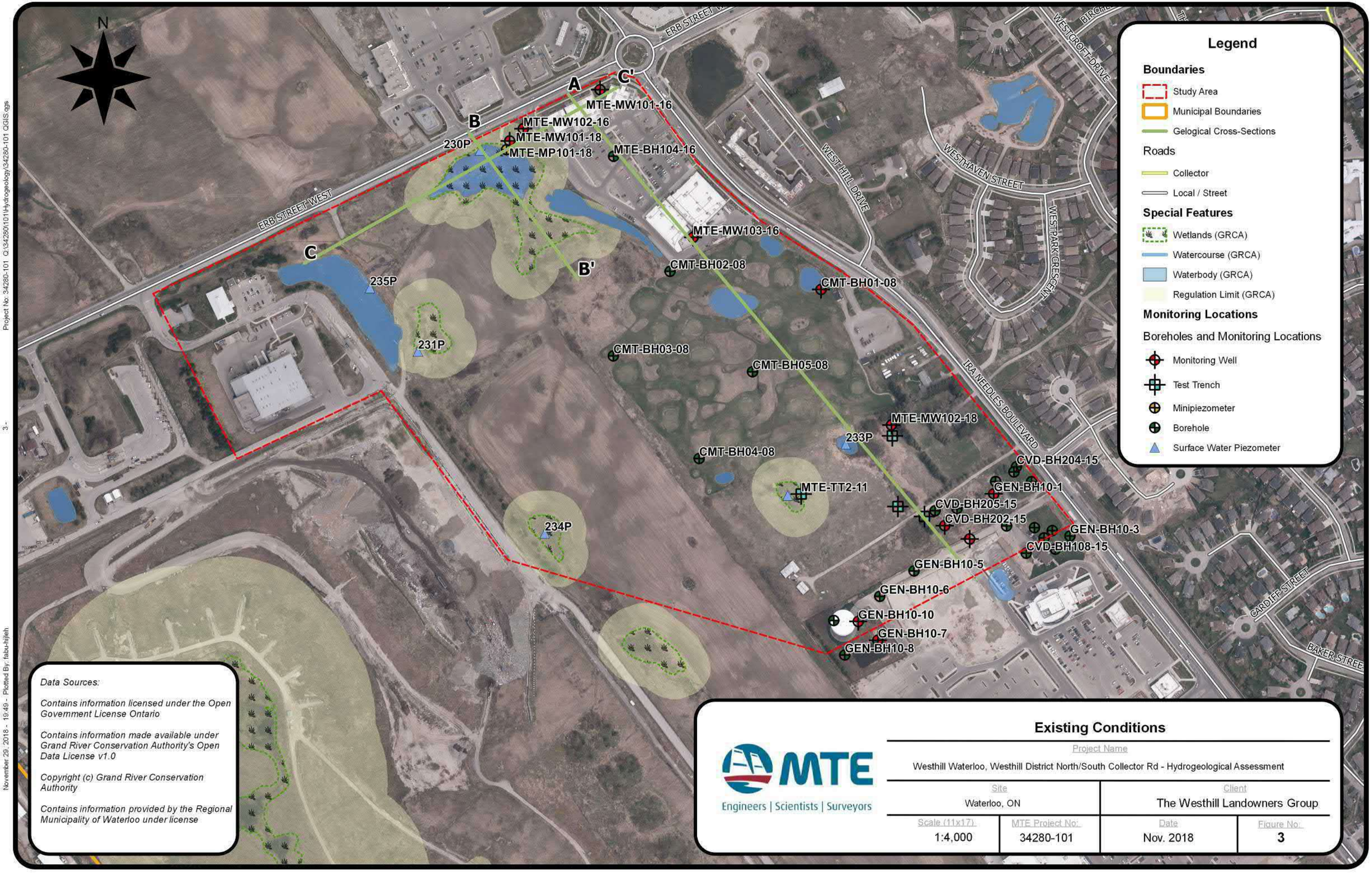
2b -

November 29, 2018 - 17:19 - Plotted By: fatou-hijleh

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Study Area Features

Project Name			
Westhill Waterloo, Westhill District North/South Collector Rd - Hydrogeological Assessment			
Site: Waterloo, ON		Client: The Westhill Landowners Group	
Scale (11x17): 1:4,000	MTE Project No: 34280-101	Date: Nov. 2018	Figure No: **2b**



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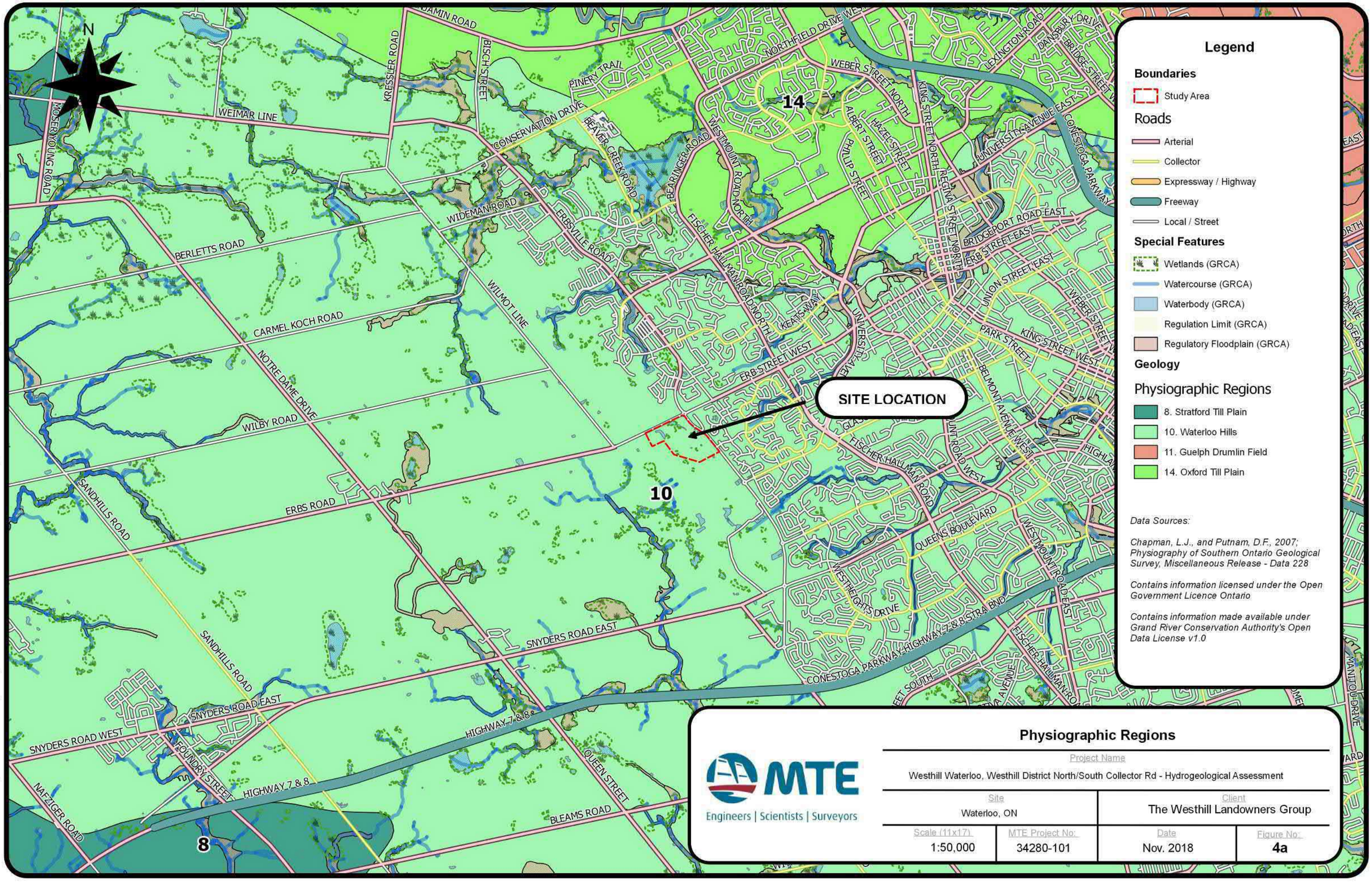
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Existing Conditions

Project Name			
Westhill Waterloo, Westhill District North/South Collector Rd - Hydrogeological Assessment			
Site: Waterloo, ON		Client: The Westhill Landowners Group	
Scale (11x17): 1:4,000	MTE Project No: 34280-101	Date: Nov. 2018	Figure No: 3

Project No: 34280-101 Q:\34280\101\Hydrogeology\34280-101 GIS.qgs
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Legend

Boundaries

- Study Area

Roads

- Arterial
- Collector
- Expressway / Highway
- Freeway
- Local / Street

Special Features

- Wetlands (GRCA)
- Watercourse (GRCA)
- Waterbody (GRCA)
- Regulation Limit (GRCA)
- Regulatory Floodplain (GRCA)

Geology

Physiographic Regions

- 8. Stratford Till Plain
- 10. Waterloo Hills
- 11. Guelph Drumlin Field
- 14. Oxford Till Plain

Data Sources:

Chapman, L.J., and Putnam, D.F., 2007; Physiography of Southern Ontario Geological Survey, Miscellaneous Release - Data 228

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Physiographic Regions

Project Name			
Westhill Waterloo, Westhill District North/South Collector Rd - Hydrogeological Assessment			
Site: Waterloo, ON		Client: The Westhill Landowners Group	
Scale (11x17): 1:50,000	MTE Project No: 34280-101	Date: Nov. 2018	Figure No: 4a

Project No: 34280-101 Q:\34280\101\Hydrogeology\34280-101 GIS\.qgs
4a -
November 29, 2018 - 17:34 - Plotted By: fabu-hijleh

N

SITE LOCATION

Legend

Boundaries

- Study Area

Roads

- Arterial
- Collector
- Expressway / Highway
- Freeway
- Local / Street

Special Features

- Wetlands (GRCA)
- Watercourse (GRCA)
- Waterbody (GRCA)
- Regulation Limit (GRCA)
- Regulatory Floodplain (GRCA)

Geology

Physio Landforms

- 3. Spillways
- 4. Kame Moraines
- 5. Till Plains (Undrumlinized)
- 6. Till Plains (Drumlinized)

Data Sources:

Chapman, L.J., and Putnam, D.F., 2007; Physiography of Southern Ontario; Ontario Geological Survey, Miscellaneous Release - Data 228

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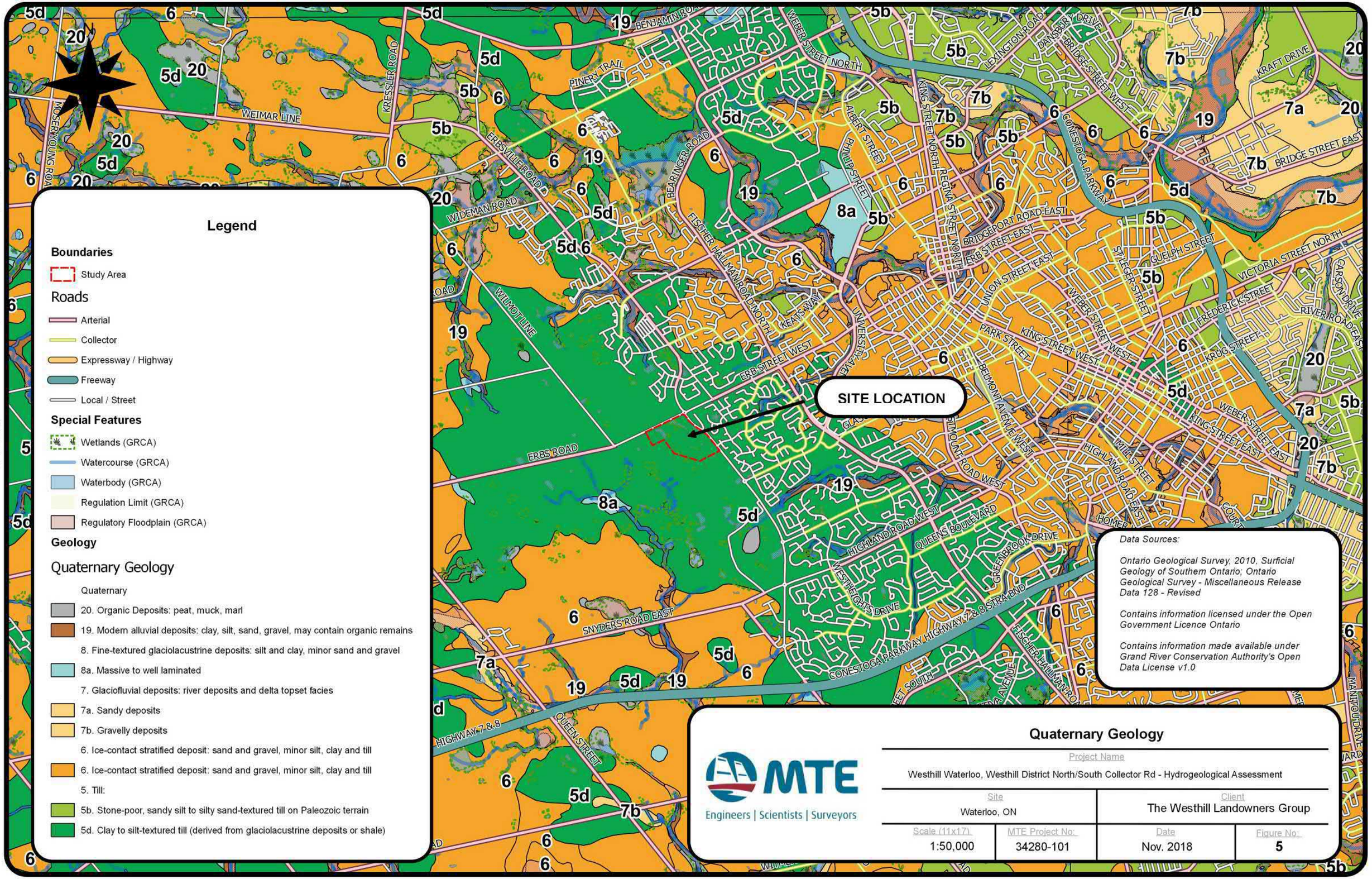
Physiographic Landforms

Project Name			
Westhill Waterloo, Westhill District North/South Collector Rd - Hydrogeological Assessment			
Site: Waterloo, ON		Client: The Westhill Landowners Group	
Scale (11x17): 1:50,000	MTE Project No: 34280-101	Date: Nov. 2018	Figure No: **4b**

Project No: 34280-101 Q:\34280\101\Hydrogeology\34280-101 QGIS.qgs

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4b -



Legend

Boundaries

- Study Area

Roads

- Arterial
- Collector
- Expressway / Highway
- Freeway
- Local / Street

Special Features

- Wetlands (GRCA)
- Watercourse (GRCA)
- Waterbody (GRCA)
- Regulation Limit (GRCA)
- Regulatory Floodplain (GRCA)

Geology

Quaternary Geology

Quaternary

- 20. Organic Deposits: peat, muck, marl
- 19. Modern alluvial deposits: clay, silt, sand, gravel, may contain organic remains
- 8. Fine-textured glaciolacustrine deposits: silt and clay, minor sand and gravel
- 8a. Massive to well laminated
- 7. Glaciofluvial deposits: river deposits and delta topset facies
- 7a. Sandy deposits
- 7b. Gravelly deposits
- 6. Ice-contact stratified deposit: sand and gravel, minor silt, clay and till
- 6. Ice-contact stratified deposit: sand and gravel, minor silt, clay and till
- 5. Till:
- 5b. Stone-poor, sandy silt to silty sand-textured till on Paleozoic terrain
- 5d. Clay to silt-textured till (derived from glaciolacustrine deposits or shale)

Data Sources:

Ontario Geological Survey, 2010, Surficial Geology of Southern Ontario; Ontario Geological Survey - Miscellaneous Release Data 128 - Revised

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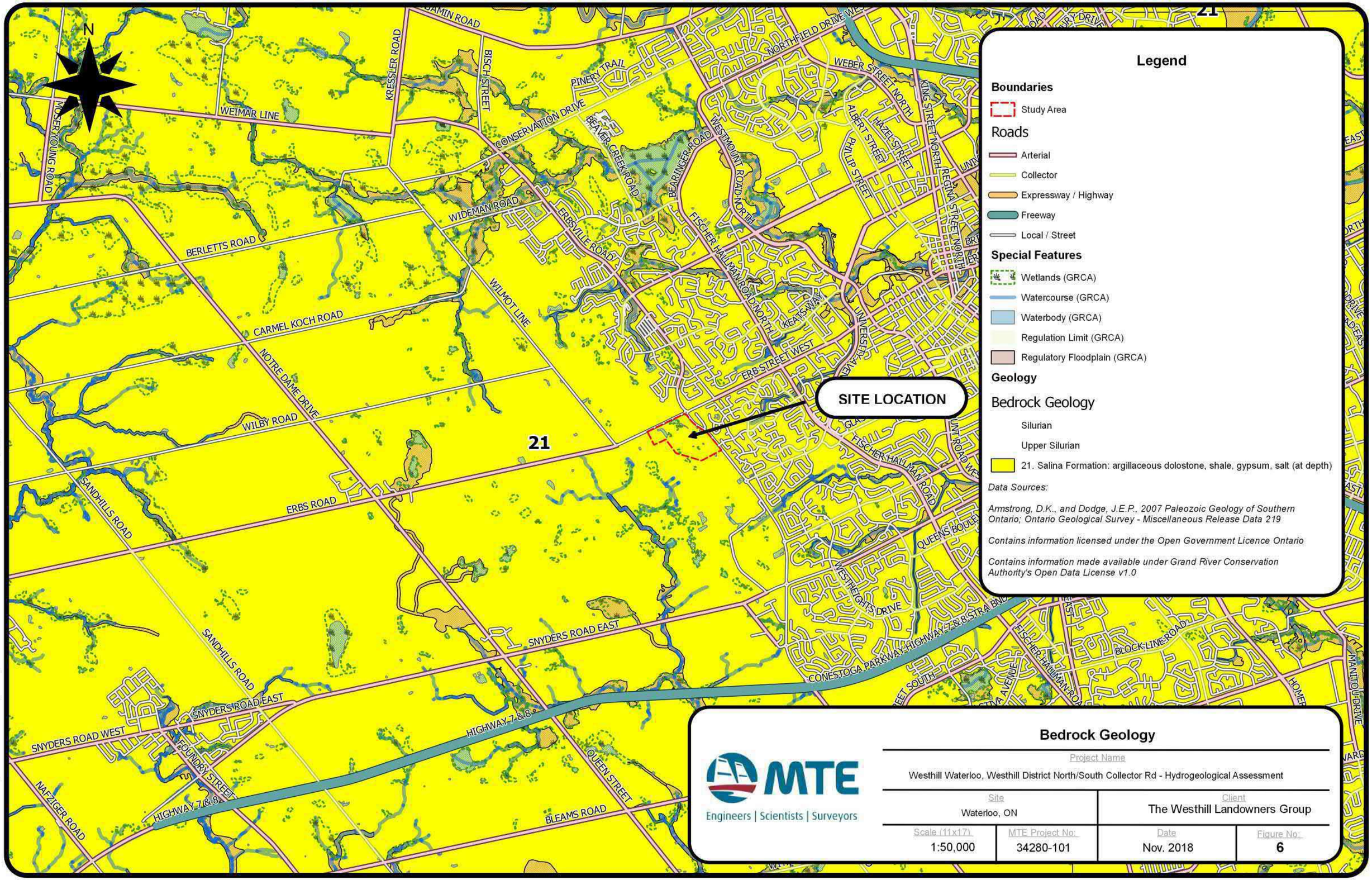
Quaternary Geology

Project Name: Westhill Waterloo, Westhill District North/South Collector Rd - Hydrogeological Assessment

Site	Client
Waterloo, ON	The Westhill Landowners Group

Scale (11x17)	MTE Project No:	Date	Figure No:
1:50,000	34280-101	Nov. 2018	5

Project No: 34280-101 Q:\34280\101\Hydrogeology\34280-101 QGIS.qgs
5 - Quaternary
November 29, 2018 - 17:39 - Plotted By: fabu-hijleh



Legend

Boundaries

- Study Area

Roads

- Arterial
- Collector
- Expressway / Highway
- Freeway
- Local / Street

Special Features

- Wetlands (GRCA)
- Watercourse (GRCA)
- Waterbody (GRCA)
- Regulation Limit (GRCA)
- Regulatory Floodplain (GRCA)

Geology

Bedrock Geology

- Silurian
- Upper Silurian
- 21. Salina Formation: argillaceous dolostone, shale, gypsum, salt (at depth)

Data Sources:

Armstrong, D.K., and Dodge, J.E.P., 2007 Paleozoic Geology of Southern Ontario; Ontario Geological Survey - Miscellaneous Release Data 219

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Bedrock Geology

Project Name			
Westhill Waterloo, Westhill District North/South Collector Rd - Hydrogeological Assessment			
Site: Waterloo, ON		Client: The Westhill Landowners Group	
Scale (11x17): 1:50,000	MTE Project No: 34280-101	Date: Nov. 2018	Figure No: 6

Project No: 34280-101 Q:\34280\101\Hydrogeology\34280-101 GIS\.qgs

6 - Bedrock

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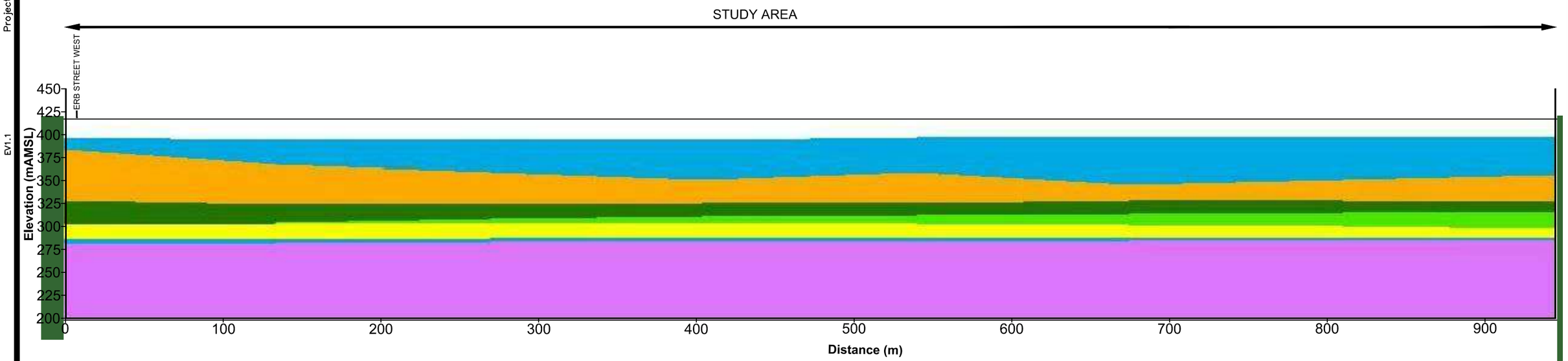
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LEGEND

- UPPER MARYHILL TILL / PORT STANLEY TILL / TAVISTOCK TILL
  (Silty to clayey tills)
- WATERLOO MORAINE
  (Aquifer and equivalents. Consists primarily of fine to medium sand with localized accumulations of gravel)
- MIDDLE MARYHILL TILL
  (Fine grained units of till or glacio lacustrine sediments)
- LOWER MARYHILL TILL
  (Fine textured glacio lacustrine sediments)
- CATFISH CREEK SAND & GRAVEL
  (Glaciofluvial deposits that contains stratified sand & gravel deposits)
- CANNING DRIFT
  (Till and associated fine textured lake deposits that are silty to clayey in texture)
- BEDROCK
  (Carbonates and shales)

Source: Bajc and Shirota, 2007.

STUDY AREA



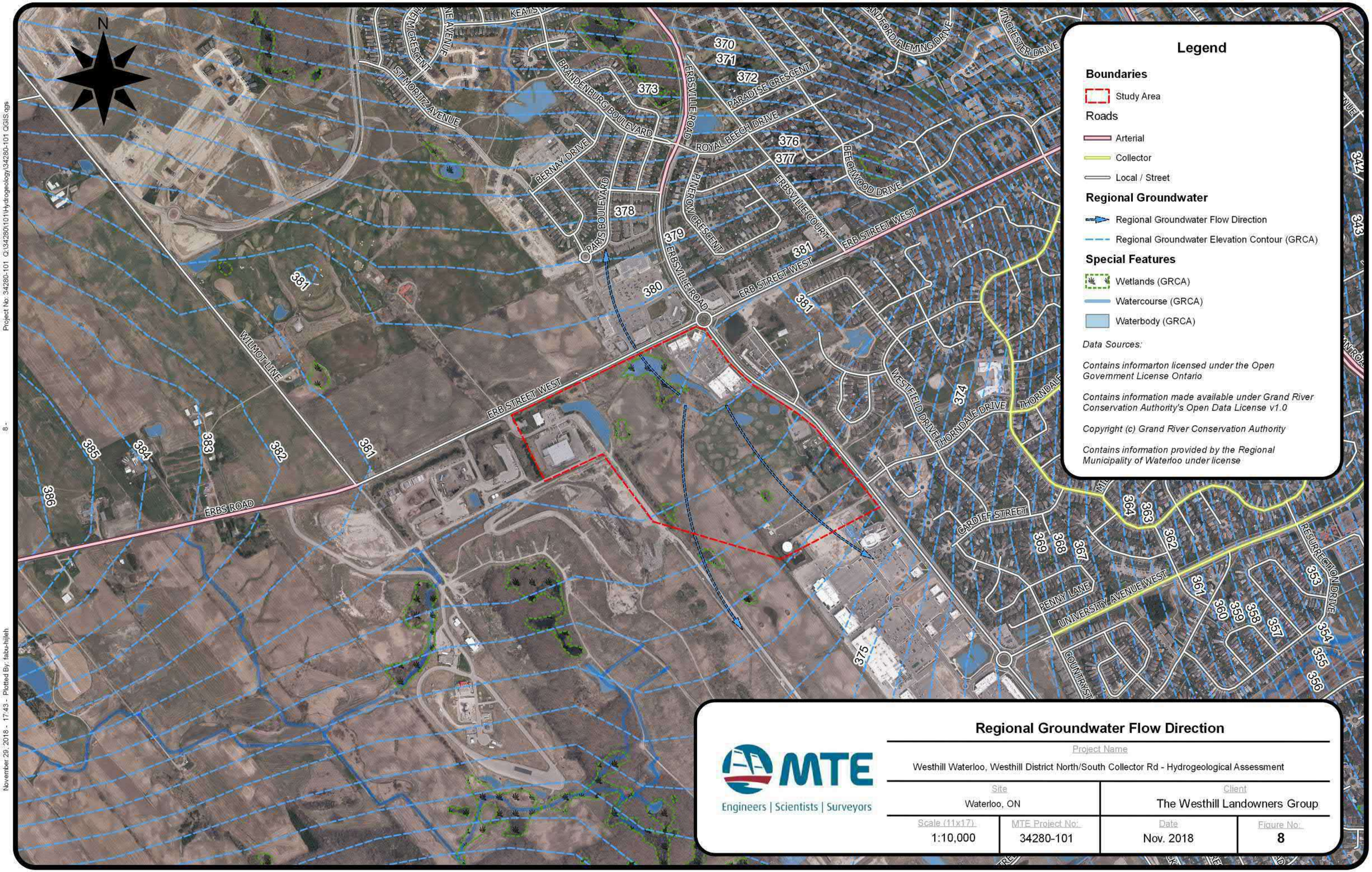
Notes:

This cross-section was generated using the Cross-Section Viewer (Version 1.1) developed by the Ontario Geological Survey (OGS, 2008)

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Geological Cross-Section A-A'

Project Name			
West Waterloo Westhill District North / South Collector Rd - Hydrogeological Investigation			
Site: Waterloo, ON		Client: The Westhill Landowners Group	
Scale: As shown	MTE Project No.: 34280-101	Date: Nov 2018	Figure No.: 7



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Regional Groundwater Flow Direction

Project Name			
Westhill Waterloo, Westhill District North/South Collector Rd - Hydrogeological Assessment			
Site: Waterloo, ON		Client: The Westhill Landowners Group	
Scale (11x17): 1:10,000	MTE Project No: 34280-101	Date: Nov. 2018	Figure No: 8

Project No: 34280-101 Q:\34280\101\Hydrogeology\34280-101 GIS.qgs

November 29, 2018 - 17:43 - Plotted By: fabu-hiljeh

Project: 44000-200 CAD: P:\P\34280\101\34280-101-EV2.DWG EV1.2

LEGEND

Borehole Lithology

- Topsoil
- Fill
- Sand
- Silty Sand
- Silt
- Clayey Silt
- Clay
- Silt Till

Inferred Geology

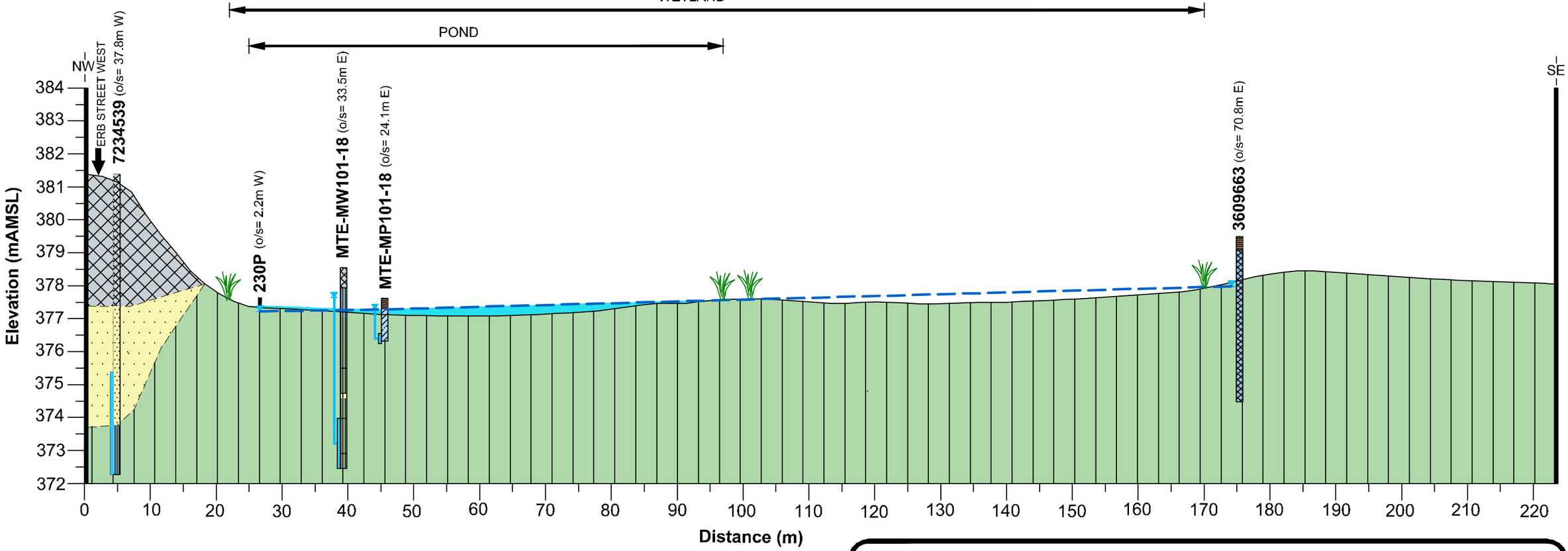
- Fill
- Sand
- Silt Till

- Ground Surface (Inferred)
- Water Table (Inferred)
- 230P — Surface Water Station
- 3609663 (o/s= 70.8m E) — Well ID; Offset Distance (m) and Direction
- Static Water Level (as of Sept. 5/18)
- Monitoring Well / Minipiezometer
- Well Screen

STUDY AREA

WETLAND

POND



Vertical Exaggeration (5X)

Notes:

Geological sequence is based on professional interpretation from the soils encountered during drilling and geological descriptions provided from the MECP online well records database. Actual geological conditions may vary between the tested locations.

The interpreted groundwater surface has been projected on the geological cross-section. Differences between the groundwater surface and wells presented on the geological cross-section is a result of offset distances.

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Geological Cross-Section B-B'

Project Name			
West Waterloo Westhill District North / South Collector Rd - Hydrogeological Investigation			
Site: Waterloo, ON		Client: The Westhill Landowners Group	
Scale: As shown	MTE Project No.: 34280-101	Date: Nov 2018	Figure No.: 9

Project: 44000-200 CAD: P:\P\34280\101\34280-101-EV2.DWG EV1.3

LEGEND

Borehole Lithology

- Topsoil
- Fill
- Sand
- Silty Sand
- Silt
- Clayey Silt
- Silty Clay
- Silt Till

Inferred Geology

- Fill
- Sand
- Silt Till

- Ground Surface (Inferred)
- Water Table (Inferred)

– 230P Surface Water Station

3609663 (o/s= 70.8m E) Offset Distance (m) and Direction

Well ID

Static Water Level (as of Sept. 5/18)

Monitoring Well / Minipiezometer

Well Screen

STUDY AREA

651 - 663 ERB STREET WEST

EXISTING BUILDING

EXISTING BUILDING

WETLAND

POND

SW

NE

7239926 (o/s= 190.4m S)

7239929 (o/s= 25.7m S)

– 230P (o/s= 14.8m N)

MTE-MP101-18 (o/s= 0.1m S)

MTE-MW101-18 (o/s= 7.3m N)

MTE-MW102-16 (o/s= 12.1m N)

MTE-MW101-16 (o/s= 7.6m N)

Elevation (mAMSL)

Distance (m)

Vertical Exaggeration (5X)

Notes:

Geological sequence is based on professional interpretation from the soils encountered during drilling and geological descriptions provided from the MECP online well records database. Actual geological conditions may vary between the tested locations.

The interpreted groundwater surface has been projected on the geological cross-section. Differences between the groundwater surface and wells presented on the geological cross-section is a result of offset distances.

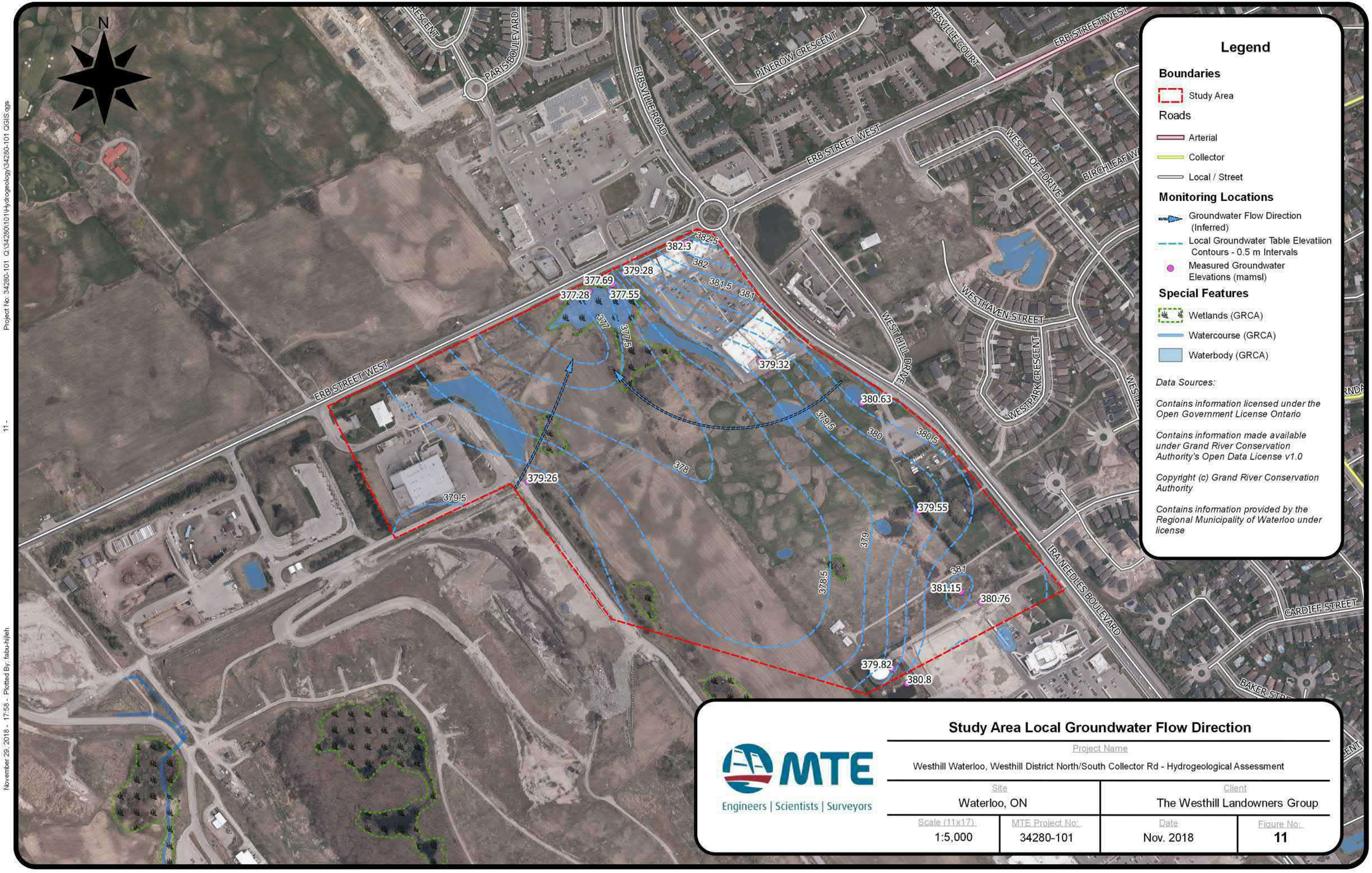
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Geological Cross-Section C-C'

Project Name: **West Waterloo Westhill District North / South Collector Rd - Hydrogeological Investigation**

Site	Client
Waterloo, ON	The Westhill Landowners Group

Scale	MTE Project No.	Date	Figure No.
As shown	34280-101	Nov 2018	10



Legend

Boundaries

- Study Area

Roads

- Arterial
- Collector
- Local / Street

Monitoring Locations

- Groundwater Flow Direction (Inferred)
- Local Groundwater Table Elevatiion Contours - 0.5 m Intervals
- Measured Groundwater Elevations (mamsl)

Special Features

- Wetlands (GRCA)
- Watercourse (GRCA)
- Waterbody (GRCA)

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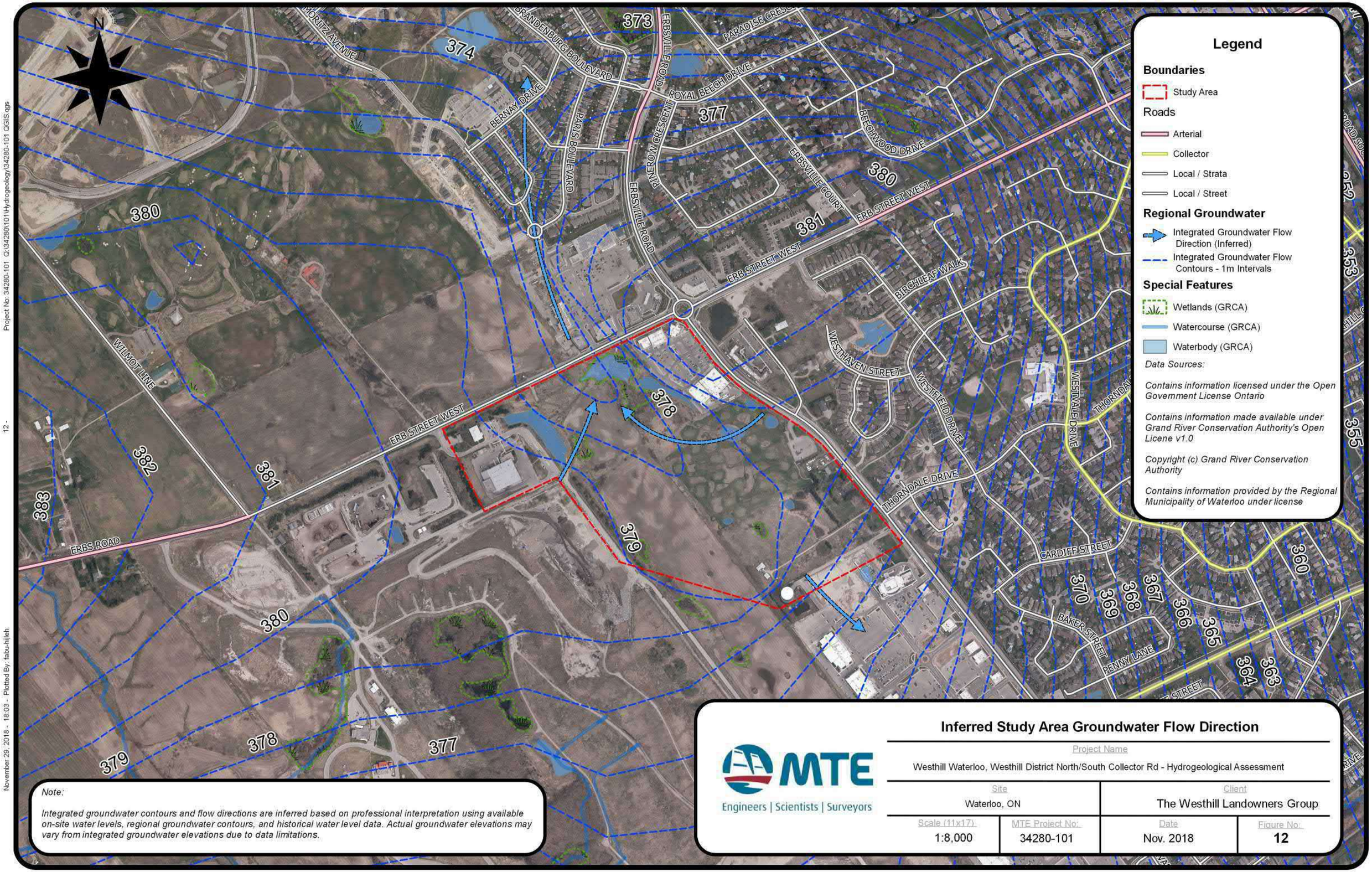
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Study Area Local Groundwater Flow Direction

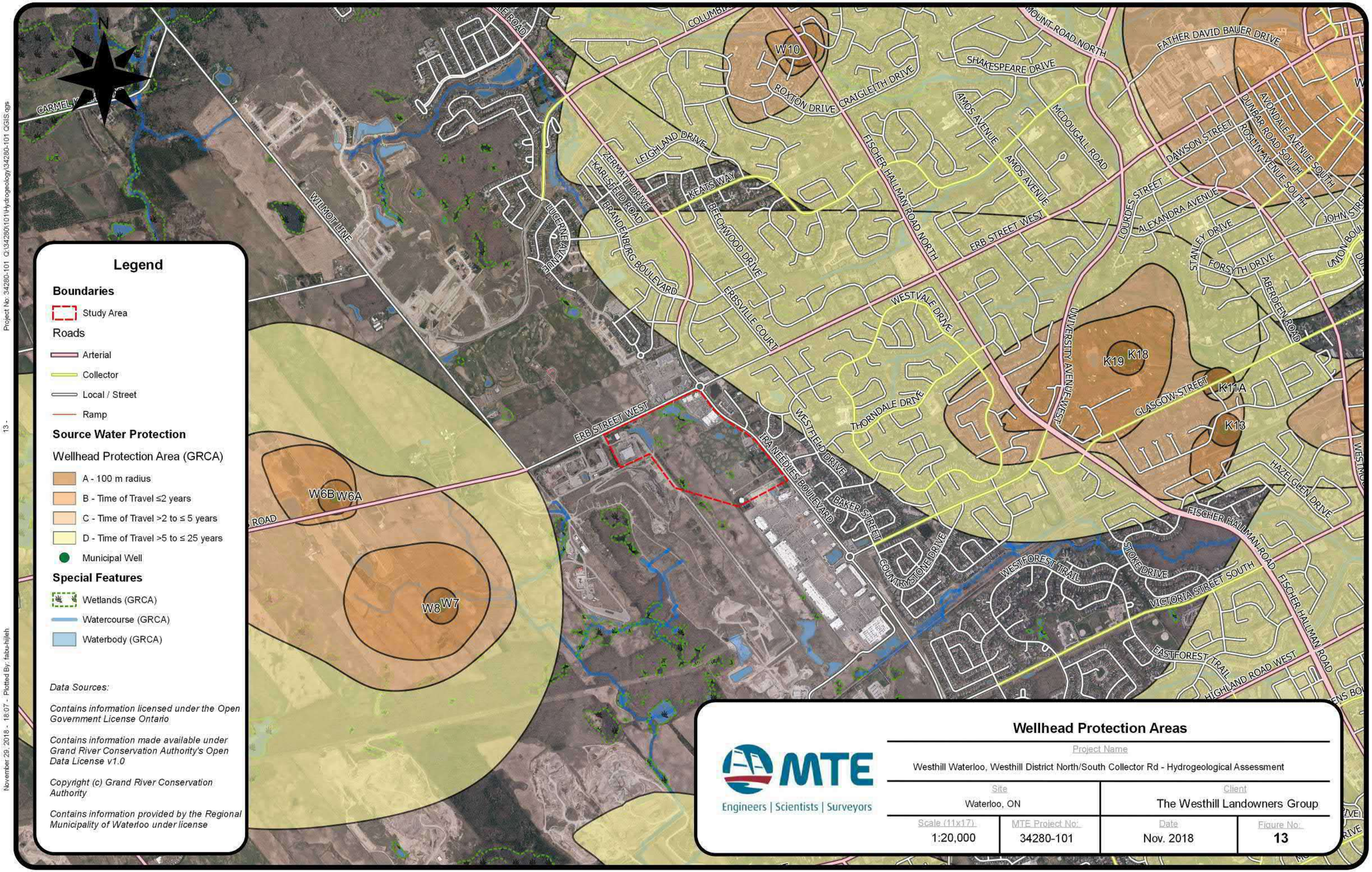
Project Name			
Westhill Waterloo, Westhill District North/South Collector Rd - Hydrogeological Assessment			
Site: Waterloo, ON		Client: The Westhill Landowners Group	
Scale (11x17): 1:5,000	MTE Project No: 34280-101	Date: Nov. 2018	Figure No: **11**

Project No: 34280-101 Q:\34280\101\Hydrogeology\34280-101 GIS\.qgs
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11 -



Project No: 34280-101 Q:\34280\101\Hydrogeology\34280-101 GIS\.gps

November 29, 2018 - 16:03 - Plotted By: fatou-hijleh



Legend

Boundaries

- Study Area

Roads

- Arterial
- Collector
- Local / Street
- Ramp

Source Water Protection

Wellhead Protection Area (GRCA)

- A - 100 m radius
- B - Time of Travel ≤2 years
- C - Time of Travel >2 to ≤ 5 years
- D - Time of Travel >5 to ≤ 25 years
- Municipal Well

Special Features

- Wetlands (GRCA)
- Watercourse (GRCA)
- Waterbody (GRCA)

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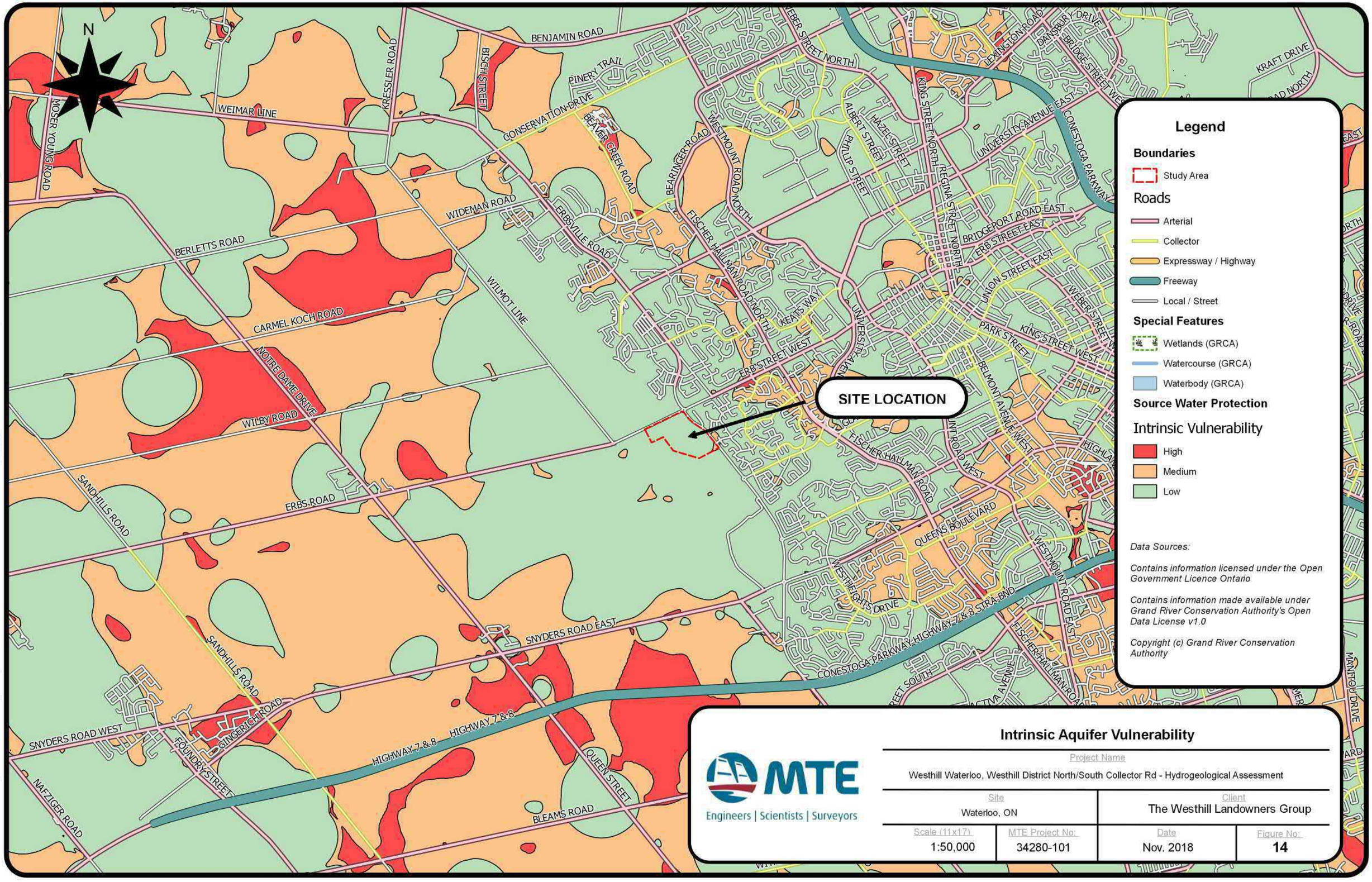
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Wellhead Protection Areas

Project Name			
Westhill Waterloo, Westhill District North/South Collector Rd - Hydrogeological Assessment			
Site: Waterloo, ON		Client: The Westhill Landowners Group	
Scale (11x17): 1:20,000	MTE Project No: 34280-101	Date: Nov. 2018	Figure No: 13

Project No: 34280-101 Q:\34280\101\Hydrogeology\34280-101 GIS.qgs
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Project No: 34280-101 Q:\34280\101\Hydrogeology\34280-101 GIS\.qgs

14 - Intrinsic

November 29, 2018 - 18:09 - Plotted By: fabu-hijleh

MTE
Engineers | Scientists | Surveyors

Intrinsic Aquifer Vulnerability

Project Name			
Westhill Waterloo, Westhill District North/South Collector Rd - Hydrogeological Assessment			
Site: Waterloo, ON		Client: The Westhill Landowners Group	
Scale (11x17): 1:50,000	MTE Project No: 34280-101	Date: Nov. 2018	Figure No: 14

TABLES

Table 7.4a: Groundwater Levels (mBPVC)

Date	Well ID						
	MTE-MW101-16	MTE-MW102-16	MTE-MW103-16	MTE-MW101-18	MTE-MW102-18	MTE-MP101-18 (in)	MTE-MP101-18 (out)
21-Mar-16	2.08	2.78	3.30	NI	NI	NI	NI
4-Apr-17	1.44	1.95	1.79	NI	NI	NI	NI
22-Jun-18	-	2.63	-	dry	dry	dry	dry/damp
5-Jul-18	-	2.92	-	2.13	2.35	2.45	dry/damp
26-Jul-18	-	3.16	-	2.10	2.80	2.36	dry/damp
7-Aug-18	-	3.31	-	2.23	3.11	2.10	dry/damp
5-Sep-18	2.56	3.34	3.12	1.83	3.10	1.77	dry/damp
23-Nov-18	2.04	2.33	2.58	1.29	2.25	1.45	dry/damp

Notes: mBTPVC= metres below top of PVC pipe
NI = Not Installed
- = no measurement

Table 7.4b: Groundwater Levels (mBGS)

Date	Well ID						
	MTE-MW101-16	MTE-MW102-16	MTE-MW103-16	MTE-MW101-18	MTE-MW102-18	MTE-MP101-18 (in)	MTE-MP101-18 (out)
Stick up (m)	-0.16	-0.05	-0.09	0.92	1.01	1.43	1.43
21-Mar-16	2.24	2.83	3.39	NI	NI	NI	NI
4-Apr-17	1.60	2.00	1.88	NI	NI	NI	NI
22-Jun-18	-	2.68	-	dry	dry	dry	dry/damp
5-Jul-18	-	2.97	-	1.21	1.34	1.02	dry/damp
26-Jul-18	-	3.21	-	1.18	1.79	0.93	dry/damp
7-Aug-18	-	3.36	-	1.31	2.10	0.67	dry/damp
5-Sep-18	2.72	3.39	3.21	0.91	2.09	0.34	dry/damp
23-Nov-18	2.20	2.38	2.67	0.37	1.24	0.02	dry/damp

Notes: mBGS= metres below top of PVC pipe
NI = Not Installed
- = no measurement

Table 7.4c: Groundwater Elevation (mAMSL)

Date	Well ID						
	MTE-MW101-16	MTE-MW102-16	MTE-MW103-16	MTE-MW101-18	MTE-MW102-18	MTE-MP101-18 (in)	MTE-MP101-18 (out)
TPVC Elevation (mamsl)	384.328	381.967	382.05	379.47	382.49	379.05	379.05
21-Mar-16	382.24	379.19	378.75	NI	NI	NI	NI
4-Apr-17	382.88	380.02	380.26	NI	NI	NI	NI
22-Jun-18	-	379.34	-	dry	dry	dry	dry/damp
5-Jul-18	-	379.05	-	377.34	380.14	376.60	dry/damp
26-Jul-18	-	378.81	-	377.37	379.69	376.69	dry/damp
7-Aug-18	-	378.66	-	377.24	379.38	376.95	dry/damp
5-Sep-18	381.77	378.63	378.93	377.64	379.39	377.28	dry/damp
23-Nov-18	382.29	379.64	379.47	378.18	380.24	377.60	dry/damp

Notes: mAMSL = metres above mean sea level
TPVC = top of PVC Pipe
NI = Not Installed
- = no measurement

Table 8.8: Groundwater and Surface Water Chemistry Summary - 2018

Parameter	Units	DL	MW101-18	MW102-18	Waterloo Commons Wetland (230)		SWM Retention Area (233)		Region of Waterloo SWMP (235)
			L2124640-1	L2124640-2	L2124641-1	L2143413-1	L2124641-2	L2143413-2	L2143413-3
			7/5/2018 2:10:00 PM	7/5/2018 3:00:00 PM	7/5/2018 1:45:00 PM	8/8/2018 10:00:00 AM	7/5/2018 1:45:00 PM	8/8/2018 10:00:00 AM	8/8/2018 2:00:00 PM
			Groundwater	Groundwater	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
Physical Tests									
Colour, Apparent	CU	2	37.2	33.6	295	-	62.4	-	-
Conductivity	umhos/cm	3	2340	755	2670	-	447	-	-
Hardness (as CaCO3)	mg/L	10	834	395	344	-	189	-	-
pH	pH units	0.1	7.71	7.89	7.89	-	8.13	-	-
Total Suspended Solids	mg/L	2	19700	4630	87.1	15.6	4.8	273	15.5
Total Dissolved Solids	mg/L	20	1640	570	1600	-	274	-	-
Turbidity	NTU	0.1	>4000	>4000	113	-	13.3	-	-
Anions and Nutrients									
Alkalinity, Total (as CaCO3)	mg/L	10	363	337	198	-	192	-	-
Ammonia, Total (as N)	mg/L	0.02	0.283	0.094	0.02	-	0.023	-	-
Chloride (Cl)	mg/L	0.5	527	6.5	767	344	30.1	3.11	293
Fluoride (F)	mg/L	0.02	0.12	0.12	0.12	-	0.076	-	-
Nitrate (as N)	mg/L	0.02	<0.10	<0.020	<0.10	0.11	<0.020	0.066	<0.020
Nitrite (as N)	mg/L	0.01	<0.050	<0.010	<0.050	-	<0.010	-	-
Total Phosphorus	mg/L	0.003	-	-	-	0.135	-	0.815	0.0785
Orthophosphate-Dissolved (as P)	mg/L	0.003	<0.0030	<0.0030	0.0099	-	<0.0030	-	-
Sulfate (SO4)	mg/L	0.3	79.4	58.1	15.2	-	2.12	-	-
Total Metals									
Aluminum (Al)-Total	mg/L	0.01	<0.010	0.016	1.73	-	0.035	-	-
Antimony (Sb)-Total	mg/L	0.0001	0.00029	0.00016	<0.0010	-	0.00012	-	-
Arsenic (As)-Total	mg/L	0.0001	0.00048	0.00063	0.0051	-	0.0023	-	-
Barium (Ba)-Total	mg/L	0.0002	0.191	0.199	0.117	-	0.0188	-	-
Beryllium (Be)-Total	mg/L	0.0001	<0.00010	<0.00010	<0.0010	-	<0.00010	-	-
Bismuth (Bi)-Total	mg/L	0.00005	<0.000050	<0.000050	<0.00050	-	<0.000050	-	-
Boron (B)-Total	mg/L	0.01	0.028	0.011	<0.10	-	0.03	-	-
Cadmium (Cd)-Total	mg/L	0.00001	0.000079	0.000028	<0.000050	-	<0.000010	-	-
Calcium (Ca)-Total	mg/L	0.5	198	102	102	-	54.2	-	-
Cesium (Cs)-Total	mg/L	0.00001	0.000019	<0.000010	0.00018	-	<0.000010	-	-
Chromium (Cr)-Total	mg/L	0.0005	<0.00050	<0.00050	<0.0050	-	<0.00050	-	-
Cobalt (Co)-Total	mg/L	0.0001	0.00105	0.00046	0.0011	-	0.00015	-	-
Copper (Cu)-Total	mg/L	0.001	0.0123	0.0044	<0.010	0.0025	<0.0010	0.036	0.0021
Iron (Fe)-Total	mg/L	0.05	<0.050	<0.050	4.86	-	0.941	-	-
Lead (Pb)-Total	mg/L	0.0001	0.0003	0.00024	0.00414	0.00069	<0.00010	0.0168	0.00088
Magnesium (Mg)-Total	mg/L	0.05	82.2	34.3	21.6	-	13	-	-
Manganese (Mn)-Total	mg/L	0.0005	0.153	0.0727	0.56	-	0.0641	-	-
Molybdenum (Mo)-Total	mg/L	0.00005	0.00358	0.00304	0.00253	-	0.000402	-	-
Nickel (Ni)-Total	mg/L	0.0005	0.0076	0.00145	<0.0050	-	0.00057	-	-
Phosphorus (P)-Total	mg/L	0.05	<0.050	<0.050	0.74	0.0545	0.059	0.0766	0.0155
Potassium (K)-Total	mg/L	0.05	6.76	1.69	3.9	-	3.93	-	-
Rubidium (Rb)-Total	mg/L	0.0002	0.00269	0.00093	0.0036	-	0.00063	-	-
Selenium (Se)-Total	mg/L	0.00005	0.000596	0.000186	<0.00050	-	0.000123	-	-
Silicon (Si)-Total	mg/L	0.1	7.88	7.32	7.1	-	0.6	-	-
Silver (Ag)-Total	mg/L	0.00005	<0.000050	<0.000050	<0.00050	-	<0.000050	-	-
Sodium (Na)-Total	mg/L	0.5	156	12.8	409	-	17.5	-	-
Strontium (Sr)-Total	mg/L	0.001	0.477	0.227	0.386	-	0.175	-	-
Sulfur (S)-Total	mg/L	0.5	30.2	19.4	<5.0	-	0.86	-	-
Tellurium (Te)-Total	mg/L	0.0002	<0.00020	<0.00020	<0.0020	-	<0.00020	-	-
Thallium (Tl)-Total	mg/L	0.00001	0.000029	0.000011	<0.00010	-	<0.000010	-	-
Thorium (Th)-Total	mg/L	0.0001	<0.00010	<0.00010	<0.0010	-	<0.00010	-	-
Tin (Sn)-Total	mg/L	0.0001	0.00092	0.00038	<0.0010	-	<0.00010	-	-
Titanium (Ti)-Total	mg/L	0.0004	<0.00030	0.00289	<0.060	-	<0.0010	-	-
Tungsten (W)-Total	mg/L	0.0001	<0.00010	<0.00010	<0.0010	-	<0.00010	-	-
Uranium (U)-Total	mg/L	0.00001	0.00613	0.00227	0.00096	-	0.000482	-	-
Vanadium (V)-Total	mg/L	0.0005	0.00088	0.00063	0.0074	-	<0.00050	-	-
Zinc (Zn)-Total	mg/L	0.003	0.0105	0.0067	<0.030	0.0087	<0.0030	0.109	0.0099
Zirconium (Zr)-Total	mg/L	0.0003	<0.00030	<0.00030	<0.0030	-	<0.00030	-	-

Notes:
DL = Detection Limit

APPENDIX A

CMT BOREHOLE LOGS (2008)

BOREHOLE 1

Date Drilled: September 29, 2008
Rig: Geoprobe 6620DT
Contractor: CMT Engineering Inc.
Drilling Method: SPT

Elevation: 381.17m
Logged by: D.T.

Project No.: 08-337
Project: Golf Course on Ira Neddles Blvd.
Location: Waterloo, ON

Depth (ft/m)	Sample Type	Recovery (%) / Sample Number	Symbols	SOIL DESCRIPTION	Elevation / Depth	Well Installation	Moisture Content % Wp [----X----] Wl (10 20 30 40)	Pocket Penetrometer kPa (100 300) / SPT (N) Blows/0.3 m (10 30 50 70 90)
0 ft / 0 m				Ground Surface (m)	381.17			
				TOPSOIL Loose, moist, black silty topsoil with rootlets (150mm)	0.00			
1	SS	1		***FILL*** Loose, moist, dark brown silty sand fill, trace rootlets and organics	380.57 / 0.60		10.9	9
2	SS	2		- becoming compact			Elev. - 380.66m Oct. 8/08	
3 / 1							14.9	11
4	SS	3		- becoming loose, very moist	379.97 / 1.20		23.6	9
5								
6					379.27			
7 / 2	SS	4		***PEAT*** Very loose, saturated, black peat with organics	1.90		45.03	
8					378.57			
9	SS	5		***SILTY CLAY*** Loose, moist, greyish silty clay, trace gravel	2.60		11.8	5
10 / 3					378.17			
11	SS	6		- becoming very loose	3.00		12.3	0
12					377.47			
13 / 4	SS	7		- becoming compact	3.70		11.4	12
14								
15	SS	8					11.6	21
16					376.27			
17 / 5				End of Borehole	4.90			

Well Installation: Flushmount cover; Bentonite seal; #3 Industrial sand filter; Pre-packed screen

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BOREHOLE 2

Date Drilled: September 29, 2008
Rig: Geoprobe 6620DT
Contractor: CMT Engineering Inc.
Drilling Method: SPT

Elevation: 378.55m
Logged by: D.T.

Project No.: 08-337
Project: Golf Course on Ira Needles Blvd.
Location: Waterloo, ON

Depth (ft/m)	Sample Type	Recovery (%) / Sample Number	Symbols	SOIL DESCRIPTION	Elevation / Depth	Well Installation	Moisture Content % Wp [----X----] Wl (10 20 30 40)	Pocket Penetrometer kPa (100 300) / SPT (N) Blows/0.3 m (10 30 50 70 90)
0 ft / 0 m				Ground Surface (m)	378.55			
				TOPSOIL Very loose, damp, brown silty sandy topsoil with rootlets and organics (150mm)	0.00			
1	SS	1					20.2	3
				FILL Loose, damp, brown silty sand fill with rootlets, some reddish staining and topsoil				
2								
3	SS	2					23.6	6
1 m								
4								
					377.05			
5	SS	3		**SAND** - 150mm sand layer	1.50		11.0	14
6				**CLAYEY SILT TILL** Compact, moist, greyish-brown clayey silt with some sand, trace gravel				
2 m	SS	4		- becoming loose			9.6	8
					376.15			
8				- becoming compact	2.40			
9	SS	5					13.4	27
					375.55			
10 3 m				- occasional small sand layers	3.00			
	SS	6			375.20		12.7	19
11				**SILTY CLAY** Compact, moist, grey silty clay, trace gravel	3.35			
12								
13 4 m	SS	7					13.5	13
14								
15	SS	8					13.4	23
16					373.65			
5 m				End of Borehole Borehole experienced wet cave at 1.2m upon completion	4.90			
17								

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BOREHOLE 3

Date Drilled: September 29, 2008
Rig: Geoprobe 6620DT
Contractor: CMT Engineering Inc.
Drilling Method: SPT

Elevation: 379.61m
Logged by: D.T.

Project No.: 08-337
Project: Golf Course on Ira Neddles Blvd.
Location: Waterloo, ON

Depth (ft/m)	Sample Type	Recovery (%) / Sample Number	Symbols	SOIL DESCRIPTION	Elevation / Depth	Well Installation	Moisture Content % Wp [----X----] Wl (10 20 30 40)	Pocket Penetrometer kPa (100 300) / SPT (N) Blows/0.3 m (10 30 50 70 90)
ft 0 / m 0				Ground Surface (m)	379.61			
				TOPSOIL Loose, moist, dark brown silty sandy topsoil with trace rootlets (130mm)	0.00			
1	SS	1					16.0	4
2				***FILL*** Loose, moist, brown silty sand fill, trace gravel, rootlets and organics	378.81 0.80			
3 / 1	SS	2					14.9	10
				CLAYEY SILT TILL Compact, moist, brown clayey silt	378.51 1.10			
4				***SAND*** - 100mm sand seam				
5	SS	3					14.0	24
				CLAYEY SILT TILL Compact, moist, brown clayey silt, some sand, trace gravel, some staining	377.81 1.80			
6 / 2				- trace staining				
7	SS	4					13.1	19
8								
	SS	5			376.91		13.2	26
9				***SILTY CLAY*** Compact, damp, grey silty clay, trace gravel	2.70			
10 / 3								
11	SS	6					14.3	13
12					375.91			
				- becoming loose, occasional sand pockets	3.70			
13 / 4	SS	7					14.4	5
14					375.31			
				- becoming compact	4.30			
15	SS	8					13.5	12
16					374.71			
5				End of Borehole	4.90			
17				Borehole experienced dry cave at 3.7m upon completion				

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BOREHOLE 4

Date Drilled: September 29, 2008
Rig: Geoprobe 6620DT
Contractor: CMT Engineering Inc.
Drilling Method: SPT

Elevation: 383.14m
Logged by: D.T.

Project No.: 08-337
Project: Golf Course on Ira Neddles Blvd.
Location: Waterloo, ON

Depth (ft/m)	Sample Type	Recovery (%)	Sample Number	Symbols	SOIL DESCRIPTION	Elevation	Depth	Well Installation	Moisture Content % Wp [----X----] Wl 10 20 30 40	Pocket Penetrometer kPa 100 300 / SPT (N) Blows/0.3 m 10 30 50 70 90
					Ground Surface (m)	383.14				
0					***TOPSOIL*** Loose, moist, dark brown silty sandy topsoil with trace rootlets (150mm)		0.00		16.6	4
1	SS	1								
2					***FILL*** Loose, moist, brown silty sand fill, trace gravel and rootlets	382.04	1.10		19.8	6
3	SS	2			***CLAYEY SILT TILL*** Loose, moist, brown clayey silt, some sand, trace gravel, some staining, occasional sand layers	381.34	1.80		11.1	7
4					- becoming compact	380.74	2.40		13.2	16
5	SS	3			- becoming dense				13.8	28
6									11.2	32
7	SS	4								
8										
9	SS	5							11.5	13
10									11.1	20
11	SS	6								
12						379.34	3.80		13.8	21
13	SS	7			***SILTY CLAY*** Compact, moist, grey silty clay, trace gravel, occasional small sand pockets				15.0	15
14										
15	SS	8							11.7	5
16										
17	SS	9							10.6	11
18										
19	SS	10								
20						377.04	6.10			
21	SS	11			- becoming loose	376.44	6.70			
22					- becoming compact					
23	SS	12				375.84	7.30			
24					End of Borehole Borehole experienced dry cave at 6.9m upon completion					
25										

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BOREHOLE 5

Date Drilled: September 29, 2008
Rig: Geoprobe 6620DT
Contractor: CMT Engineering Inc.
Drilling Method: SPT

Elevation: 384.03m
Logged by: D.T.

Project No.: 08-337
Project: Golf Course on Ira Neddles Blvd.
Location: Waterloo, ON

Depth (ft/m)	Sample Type	Recovery (%) / Sample Number	Symbols	SOIL DESCRIPTION	Well Installation	Moisture Content % Wp [----X----] Wl 10 20 30 40	Pocket Penetrometer kPa 100 300 / SPT (N) Blows/0.3 m 10 30 50 70 90
				Ground Surface (m) 384.03			
0				**TOPSOIL** 0.00 Loose, moist, brown silty sandy topsoil with rootlets (180mm)			
1	SS	1		**FILL** Loose, moist, brown silty sand fill, trace rootlets, staining and organics		10.9	8
2	SS	2				12.1	11
3				382.83 1.20			
4	SS	3		**CLAYEY SILT TILL** Compact, moist, brown clayey silt, some sand, trace gravel		12.0	26
5							
6	SS	4				13.5	17
7							
8	SS	5				12.6	28
9							
10	SS	6				12.4	23
11							
12				380.33 3.70			
13	SS	7		**SILTY CLAY** Compact, moist, grey silty clay, trace gravel		13.2	12
14							
15	SS	8				12.5	14
16				379.13 4.90			
17				End of Borehole Borehole experienced dry cave at 4.8m upon completion			

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APPENDIX B

MTE TEST TRENCH LOGS (2011)

Client: RBJ Schlegel Holdings Inc.

Project: Hydrogeology Study

Location: 87 Ira Needles Blvd, Waterloo, ON

Test Trench Number: TT1-11

Job Number: 34280-300

Date: January 25, 2011

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	Headspace (ppm)	Comments
0.0	0.00	Ground Elevation					
	0.00	**TOPSOIL** dark brown clayey silt, trace sand with rootlets and organcis, frozen		1	GS		
	-0.30 0.30	**SILT TILL** brown clayey silt till, moist occasional grey clayey layers between 0.5 m and 1.2 m					
	-0.61 0.61			2	GS		
10.0		Test Trench Terminated at 3 m.					Upon Completion Test Trench Walls Stable. No Free Groundwater

Reviewed By: ALB

Method: Backhoe

Notes:

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Logged By: ALB

Sheet: 1 of 1

Client: RBJ Schlegel Holdings Inc.

Project: Hydrogeology Study

Location: 87 Ira Needles Blvd, Waterloo, ON

Test Trench Number: TT2-11

Job Number: 34280-300

Date: January 25, 2011

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	Headspace (ppm)	Comments
0.0	0.00	Ground Elevation					
0.0	0.00	**TOPSOIL** dark brown clayey silt, trace sand with rootlets and organics, frozen		1	GS		
2.0		**SILT TILL** brown clayey silt till, moist					
6.0				2	GS		
12.0		Test Trench Terminated at 3.6 m.					Upon Completion Test Trench Walls Stable. Minor Groundwater Infiltration Encountered at 3.3m.

ft / m: 0.0 / 0.0; 2.0 / 4.0; 4.0 / 6.0; 6.0 / 8.0; 8.0 / 10.0; 10.0 / 12.0; 12.0 / 14.0; 14.0 / 16.0; 16.0 / 18.0; 18.0 / 20.0

Reviewed By: ALB

Method: Backhoe

Notes:

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Logged By: ALB

Sheet: 1 of 1

Client: RBJ Schlegel Holdings Inc.

Project: Hydrogeology Study

Location: 87 Ira Needles Blvd, Waterloo, ON

Test Trench Number: TT3-11

Job Number: 34280-300

Date: January 25, 2011

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	Headspace (ppm)	Comments
0.0	0.00	Ground Elevation					
	0.00	**TOPSOIL** dark brown clayey silt, trace sand with rootlets and organcis, frozen		1	GS		
2.0		**SILT TILL** brown clayey silt till, moist					
4.0	-1.22 1.22	Some sand and trace gravel encountered					
6.0				2	GS		
8.0							
10.0							Upon Completion Test Trench Walls Stable. No Free Groundwater
12.0		Test Trench Terminated at 3.6 m.					
14.0							
16.0							
18.0							
20.0							

ft / m: 0.0 / 0.0; 2.0 / 2.0; 4.0 / 4.0; 6.0 / 6.0

Reviewed By: ALB

Method: Backhoe

Notes:

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N2B 3X9
(519) 743-6500

Logged By: ALB

Sheet: 1 of 1

Client: RBJ Schlegel Holdings Inc.

Project: Hydrogeology Study

Location: 87 Ira Needles Blvd, Waterloo, ON

Test Trench Number: TT4-11

Job Number: 34280-300

Date: January 25, 2011

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	Headspace (ppm)	Comments
0.0	0.00	Ground Elevation					
	0.00	**FILL** Topsoil along with clayey silt and some clay moist to very moist		1	GS		
4.0	-1.22 1.22	**SILT TILL** brown clayey silt till, moist		2	GS		Upon Completion Test Trench Walls Stable. No Free Groundwater
10.0		Test Trench Terminated at 3 m.					

ft / m: 0.0, 2.0, 4.0, 6.0

Reviewed By: ALB

Method: Backhoe

Notes:

MTE Consultants Inc.
520 Bingemans Centre Drive
Kitchener, Ontario
N2B 3X9
(519) 743-6500

Logged By: ALB

Sheet: 1 of 1

APPENDIX C

GENIVAR BOREHOLE LOGS (2011)

BOREHOLE NO. BH10-1

PROJECT NAME: KITCHENER - WATERLOO ELEVATED TANK
PROJECT NO.: 03090996.00

CLIENT: REGION OF WATERLOO
DATE COMPLETED: May 26, 2010

BOREHOLE TYPE: 110 mm SOLID STEM AUGER / 50 mm O.D. SPLIT SPOON
SUPERVISOR: KMT

EX. GRADE C/L: 387.9 mASL
REVIEWER: REM

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE TYPE	SAMPLE N VALUE	SAMPLE % WATER	SAMPLE % RECOVERY	SAMPLE RQD (%)	CONE PENETRATION "N" VALUE / SHEAR STRENGTH	WATER CONTENT % (W_P – W_L)	REMARKS
0.0	TOPSOIL: DARK BROWN TOPSOIL, MOIST										
0.2	SILTY CLAY: DARK BROWN SILTY CLAY, TRACE SAND, OCCASIONAL GRAVEL, MOIST, STIFF			SS1	9	14.1	57				MONITOR MW10-1
1.0				SS2	4	19.4	100				
1.1	SILT TO SANDY SILT: BROWN LAYERS OF SILT TO SANDY SILT, SOME SEAMS OF CLAYEY SILT AND SILTY SAND, COMPACT, MOIST TO WET			SS3	7	16.4	94				
2.0											GROUNDWATER LEVEL IN MONITOR AT 1.98 m BELOW GROUND SURFACE ON MAY 26, 2010
				SS4	8	15.9	94				SS4 GSA: GRAVEL 1% SAND 46% SILT 37 % CLAY 16%
3.0				SS5	11	13.8	50				
3.8	CLAYEY SILT: BROWN CLAYEY SILT, TRACE TO SOME SAND, APL, , SOFT TO STIFF, SOME SEAMS OF SILT, WET, COMPACT										
4.0											
5.0				SS6	14	13.7	100				
6.0											
6.6	END OF HOLE			SS7	3	13.9	100				BOREHOLE OPEN AND DRY TO 6.1 m DEPTH UPON COMPLETION
7.0											
8.0											

JHL GEOLOGIC B/W (METRIC) 3090996.00.GPJ JAGGER HIMS BASIC.GDT 11/10/10

BOREHOLE NO. BH10-2

PROJECT NAME: KITCHENER - WATERLOO ELEVATED TANK
PROJECT NO.: 03090996.00

CLIENT: REGION OF WATERLOO
DATE COMPLETED: May 26, 2010

BOREHOLE TYPE: 110 mm SOLID STEM AUGER / 50 mm O.D. SPLIT SPOON
SUPERVISOR: KMT

EX. GRADE C/L: 386.1 mASL
REVIEWER: REM

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE TYPE	SAMPLE N VALUE	SAMPLE % WATER	SAMPLE % RECOVERY	SAMPLE RQD (%)	CONE PENETRATION "N" VALUE / SHEAR STRENGTH	WATER CONTENT % (W_P – W_L)	REMARKS
0.0											
0.2	TOPSOIL: DARK BROWN TOPSOIL, MOIST										
	CLAYEY SILT: BROWN CLAYEY SILT, SOME SAND, OCCASIONAL GRAVEL, MOIST, SOME LAYERS SILT AND SANDY SILT VERY STIFF TO HARD			SS1	4		53				
1.0				SS2	9		100				
				SS3	9		100				
2.0											
				SS4	12		100				
3.0											
3.2	SANDY SILT: BROWN SANDY SILT, OCCASIONAL COARSE SAND, TRACE CLAY, MOIST, COMPACT			SS5	17		100				
4.0											
4.1	SILTY CLAY: GREY SILTY CLAY, TRACE SAND, OCCASIONAL GRAVEL, A.T.P.L., MOIST, HARD TO VERY STIFF			SS6	22		89				
5.0											
6.0											
				SS7	8		100				
6.6	END OF HOLE										BOREHOLE OPEN TO 6.1 m DEPTH UPON COMPLETION, DRY
7.0											
8.0											

JHL GEOLOGIC B/W (METRIC) 3090996.00.GPJ JAGGER HIMS BASIC.GDT 11/10/10

GENIVAR

BOREHOLE NO. BH10-3

PROJECT NAME: KITCHENER - WATERLOO ELEVATED TANK
PROJECT NO.: 03090996.00
CLIENT: REGION OF WATERLOO
DATE COMPLETED: May 26, 2010
BOREHOLE TYPE: 110 mm SOLID STEM AUGER / 50 mm O.D. SPLIT SPOON
SUPERVISOR: KMT
EX. GRADE C/L: 388.3 mASL
REVIEWER: REM

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE TYPE	SAMPLE N VALUE	SAMPLE % WATER	SAMPLE % RECOVERY	SAMPLE RQD (%)	CONE PENETRATION "N" VALUE / SHEAR STRENGTH	WATER CONTENT % (W_P – W_L)	REMARKS
0.0											
0.2	TOPSOIL: DARK BROWN TOPSOIL, OCCASIONAL GRAVEL, MOIST										
	SILTY CLAY - CLAYEY SILT: BROWN LAYERS SILTY CLAY TO CLAYEY SILT SEAMS VERY STIFF TO HARD, OCCASAIONAL GRAVEL, OCCASIONAL SILT, A.T.P.L. TO W.T.P.L.			SS1	3	17.6	60				
1.0				SS2	5	24.3	100				
				SS3	9	21.9	100				
2.0											
				SS4	14	11.5	100				SS4 ATTERBERG: LIQUID LIMIT 20% PLASTIC LIMIT 13% PLASTICITY INDEX 7%
3.0											
				SS5	17	18.5	94				
4.0											
4.4	GRAVELLY SAND: BROWN GRAVELLY SAND (MEDIUM AND COARSE) SOME SILT, TRACE CLAY, SATURATED			SS6	20	14.4	78				BOREHOLE CAVED AT 4.6 m DEPTH UPON COMPLETION, WATER IN OPEN HOLE BELOW 3.1 m DEPTH SS6 GSA: GRAVEL 35% SAND 53% SILT 12% CLAY 0%
5.0											
6.0											
6.2	SILTY CLAY: GREY SILTY CLAY, SOME SAND, W.T.P.L., HARD			SS7	21	12.5	100				
6.6	END OF HOLE										
7.0											
8.0											

GENIVAR

BOREHOLE NO. BH10-4

PROJECT NAME: KITCHENER - WATERLOO ELEVATED TANK
PROJECT NO.: 03090996.00

CLIENT: REGION OF WATERLOO
DATE COMPLETED: May 26, 2010

BOREHOLE TYPE: 110 mm SOLID STEM AUGER / 50 mm O.D. SPLIT SPOON
SUPERVISOR: KMT

EX. GRADE C/L: 381.9 mASL
REVIEWER: REM

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE TYPE	SAMPLE N VALUE	SAMPLE % WATER	SAMPLE % RECOVERY	SAMPLE RQD (%)	CONE PENETRATION "N" VALUE / SHEAR STRENGTH	WATER CONTENT % (W_P – W_L)	REMARKS
0.0	TOPSOIL: DARK BROWN TOPSOIL, MOIST										MONITOR MW10-4 INSTALLED
0.3	SILTY CLAY: GREY SILTY CLAY, SOME SAND, W.T.P.L.			SS1	3		60				
0.9	CLAYEY SILT: GREY WITH ORANGE CLAYEY SILT, SOME SAND, OCCASIONAL GRAVEL, W.T.P.L., VERY STIFF			SS2	6		100				GROUNDWATER LEVEL IN MONITOR AT 1.14 m BELOW GROUND SURFACE ON MAY 26, 2010
1.8	SILTY SAND: BROWN SILTY FINE SAND TO SANDY SILT, WET			SS3	11		100				
2.1	CLAYEY SILT: GREY, WITH SOME ORANGE MOTTLING CLAYEY SILT, TRACE SAND, OCCASIONAL GRAVEL, W.T.P.L. TO A.T.P.L., STIFF			SS4	4		67				
				SS5	5		100				
4.1	SILTY CLAY: GREY SILTY CLAY, TRACE SAND, W.T.P.L., VERY SITFF			SS6	11		100				
				SS7	10		100				
6.6	END OF HOLE										

JHL GEOLOGIC B/W (METRIC) 3090996.00.GPJ JAGGER HIMS BASIC.GDT 11/10/10

GENIVAR

BOREHOLE NO. BH10-5

PROJECT NAME: KITCHENER - WATERLOO ELEVATED TANK
PROJECT NO.: 03090996.00

CLIENT: REGION OF WATERLOO
DATE COMPLETED: May 26, 2010

BOREHOLE TYPE: 110 mm SOLID STEM AUGER / 50 mm O.D. SPLIT SPOON
SUPERVISOR: KMT

EX. GRADE C/L: 383.2 mASL
REVIEWER: REM

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE TYPE	SAMPLE N VALUE	SAMPLE % WATER	SAMPLE % RECOVERY	SAMPLE RQD (%)	CONE PENETRATION "N" VALUE / SHEAR STRENGTH	WATER CONTENT % (W_P – W_L)	REMARKS
0.0	TOPSOIL: DARK BROWN TOPSOIL, MOIST										
0.3	SILTY CLAY: LIGHT BROWN SILTY CLAY, FISSURED, MOIST, HARD			SS1	5	18.4	60				
1.0				SS2	13	12.3	100				
1.3	SANDY SILT: LIGHT BROWN SANDY SILT, TRACE CLAY, MOIST, COMPACT			SS3	13	15.2	100				
2.0											
2.0	SILTY CLAY: LIGHT BROWN SILTY CLAY, FISSURED, MOIST, HARD			SS4	13	16.8	100				
3.0											
3.1	SANDY SILT - SILTY CLAY: BROWN TO GREY LAYERS SANDY SILT TO SILTY CLAY, WET, COMPACT OR VERY STIFF			SS5	10	14.9	89				
4.0											
4.3	SILTY CLAY: GREY SILTY CLAY, FISSURED, VERY STIFF TO STIFF			SS6	10	11.4	100				SS6 ATTERBERG: LIQUID LIMIT 18% PLASTIC LIMIT 13% PLASTICITY INDEX 5%
5.0											
6.0				SS7	8	17.1	100				
6.6	END OF HOLE										BOREHOLE OPEN TO 6.5 m DEPTH UPON COMPLETION, DRY
7.0											
8.0											

JHL GEOLOGIC B/W (METRIC) 3090996.00.GPJ JAGGER HIMS BASIC.GDT 11/10/10

BOREHOLE NO. BH10-6

PROJECT NAME: KITCHENER - WATERLOO ELEVATED TANK
PROJECT NO.: 03090996.00

CLIENT: REGION OF WATERLOO
DATE COMPLETED: May 26, 2010

BOREHOLE TYPE: 110 mm SOLID STEM AUGER / 50 mm O.D. SPLIT SPOON
SUPERVISOR: KMT

EX. GRADE C/L: 382.5 mASL
REVIEWER: REM

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE TYPE	SAMPLE N VALUE	SAMPLE % WATER	SAMPLE % RECOVERY	SAMPLE RQD (%)	CONE PENETRATION "N" VALUE / SHEAR STRENGTH	WATER CONTENT % (W_P – W_L)	REMARKS
0.0	TOPSOIL: DARK BROWN TOPSOIL, MOIST			SS1	2		60				
0.5	SILTY CLAY: GREY TO BROWN SILTY CLAY, A.T.P.L. TO W.T.P.L., FISSURED, STIFF SILTY SAND - SANDY SILT: LIGHT BROWN LAYERS GRAVELLY SILTY SAND TO SANDY SILT, MOIST, COMPACT			SS2	6		100				
1.0											
2.0				SS3	7		100				
2.4	CLAYEY SILT: LIGHT BROWN CLAYEY SILT, SOME SEAMS SANDY SILT, WET, VERY SILT OR COMPACT			SS4	17		78				
3.0											
3.1	SILTY CLAY: GREY SILTY CLAY, OCCASIONAL GRAVEL, A.T.P.L., FISSURED, STIFF			SS5	13		100				OPEN HOLE WATER LEVEL AT 3.1 m BELOW GROUND SURFACE IN COMPLETION
4.0											
5.0				SS6	19		83				
6.0											BOREHOLE CAVED TO 6 m BELOW GROUND SURFACE ON COMPLETION
6.6	END OF HOLE			SS7	16		89				
7.0											
8.0											

JHL GEOLOGIC B/W (METRIC) 3090996.00.GPJ JAGGER HIMS BASIC.GDT 11/10/10

GENIVAR

BOREHOLE NO. BH10-7

PROJECT NAME: KITCHENER - WATERLOO ELEVATED TANK
PROJECT NO.: 03090996.00

CLIENT: REGION OF WATERLOO
DATE COMPLETED: May 26, 2010

BOREHOLE TYPE: 110 mm SOLID STEM AUGER / 50 mm O.D. SPLIT SPOON
SUPERVISOR: KMT

EX. GRADE C/L: 385.6 mASL
REVIEWER: REM

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE TYPE	SAMPLE N VALUE	SAMPLE % WATER	SAMPLE % RECOVERY	SAMPLE RQD (%)	CONE PENETRATION "N" VALUE / SHEAR STRENGTH	WATER CONTENT % (W_P – W_L)	REMARKS
0.0											
0.2	TOPSOIL: DARK BROWN TOPSOIL, MOIST										
	CLAYEY SILT - SILTY CLAY: BROWN CLAYEY SILT TO SILTY CLAY, OCCASIONAL GRAVEL, A.T.P.L. TO W.T.P.L., FISSURED, STIFF TO HARD			SS1	5	21.3	60				MOINTOR MW10-7 INSTALLED
1.0				SS2	4	26	100				
				SS3	12	19	0				
2.0											
				SS4	15	11.7	100				SS4 GSA: GRAVEL 2% SAND 28% SILT 46% CLAY 24%
2.9											
3.0	CLAYEY SILT: BROWN CLAYEY SILT, SOME SILT SEAMS, MOIST, HARD										
				SS5	19	15	94				
3.8											
4.0	SILTY CLAY: GREY SILTY CLAY, OCCASIONAL COARSE SAND, A.T.P.L., SOME SILT AND CLAYEY SILT SEAMS, FISSURED, VERY STIFF										SS6 GSA: GRAVEL 4% SAND 26% SILT 46% CLAY 24%
				SS6	13	12.3	100				GROUNDWATER LEVEL IN MONITOR AT 4.8 m BELOW GROUND SURFACE ON MAY 26. 2010
5.0											
6.0											
				SS7	10	15.2	100				
6.6	END OF HOLE										
7.0											
8.0											

JHL GEOLOGIC B/W (METRIC) 3090996.00.GPJ JAGGER HIMS BASIC.GDT 11/10/10

GENIVAR

BOREHOLE NO. BH10-8

PROJECT NAME: KITCHENER - WATERLOO ELEVATED TANK
PROJECT NO.: 03090996.00

CLIENT: REGION OF WATERLOO
DATE COMPLETED: May 26, 2010

BOREHOLE TYPE: 110 mm SOLID STEM AUGER / 50 mm O.D. SPLIT SPOON
SUPERVISOR: KMT

EX. GRADE C/L: 386.9 mASL
REVIEWER: REM

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE TYPE	SAMPLE N VALUE	SAMPLE % WATER	SAMPLE % RECOVERY	SAMPLE RQD (%)	CONE PENETRATION "N" VALUE / SHEAR STRENGTH	WATER CONTENT % (W_P – W_L)	REMARKS
0.0	TOPSOIL: DARK BROWN TOPSOIL, MOIST			SS1	5		30		50/1		
0.6	CLAYEY SILT: BROWN CLAYEY SILT, SOME SAND, OCCASIONAL GRAVEL, D.T.P.L, WITH SEAMS OF SILTY CLAY, FISSURED, HARD			SS2	9		100				
1.0				SS3	20		100				SS3 GSA: GRAVEL 7% SAND 30% SILT 45% CLAY 18%
2.0				SS4	21		100				
3.0				SS5	28		100				SS5 GSA: GRAVEL 4% SAND 23% SILT 46% CLAY 27%
4.0											
4.7	SAND - CLAYEY SILT: LIGHT BROWN LAYERS SILTY FINE SAND, SANDY SILT AND CLAYEY SILT, HARD OR COMPACT, OCCASIONAL GRAVEL, MOIST TO DRY			SS6	34		100				
5.0											
6.0				SS7	44		100		44		BOREHOLE CAVED TO5.8 m BELOW GROUND SURFACE, DRY ON COMPLETION SS7 GSA: GRAVEL 0% SAND 65% SILT 19% CLAY 16%
6.6	END OF HOLE										
7.0											
8.0											

JHL GEOLOGIC B/W (METRIC) 3090996.00.GPJ JAGGER HIMS BASIC.GDT 11/10/10

GENIVAR

BOREHOLE NO. BH10-9

PROJECT NAME: KITCHENER - WATERLOO ELEVATED TANK
PROJECT NO.: 03090996.00

CLIENT: REGION OF WATERLOO
DATE COMPLETED: May 26, 2010

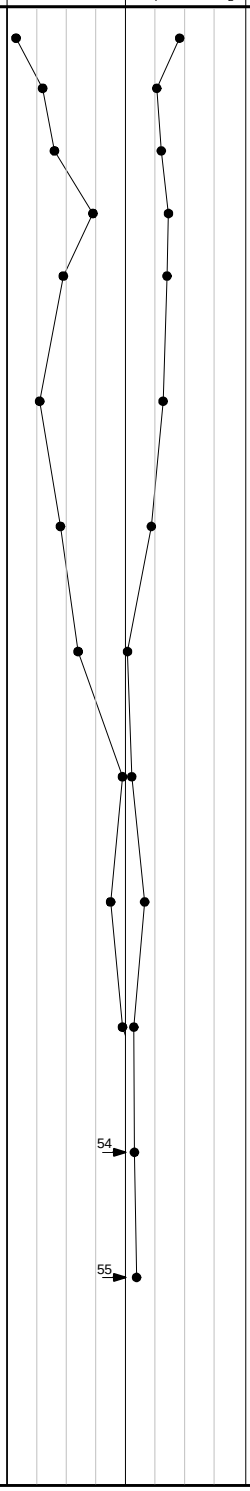
BOREHOLE TYPE: 110 mm SOLID STEM AUGER / 50 mm O.D. SPLIT SPOON
SUPERVISOR: KMT

EX. GRADE C/L: 386.2 mASL
REVIEWER: REM

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE TYPE	N VALUE	% WATER	% RECOVERY	RQD (%)	REMARKS
0.0									
0.9	TOPSOIL: DARK BROWN TOPSOIL, OCCASIONAL GRAVEL, MOIST			SS1	3	18	60		
1.0	CLAYEY SILT: BROWN CLAYEY SILT, OCCASIONAL GRAVEL, MOIST, FISSURED, HARD			SS2	12	10.4	100		
2.0				SS3	16	11.9	100		
2.6				SS4	29	14.3	100		
3.0	SILTY CLAY: BROWN TO GREY SILTY CLAY, OCCASIONAL GRAVEL, A.T.P.L., FISSURED, HARD TO VERY STIFF			SS5	19	13.8	100		SS5 ATTERBERG: LIQUID LIMIT 23% PLASTIC LIMIT 13% PLASTICITY INDEX 9%
4.0									
5.0				SS6	11	12.5	100		SS6 ATTERBERG: LIQUID LIMIT 21% PLASTIC LIMIT 13% PLASTICITY INDEX 8%
6.0									
6.2	SILTY SAND: LIGHT BROWN FINE SAND, TRACE TO SOME SILTY FINE SAND, MOIST, DENSE TO VERY DENSE			SS7	18	8.6	89		
7.0									
8.0				SS8	24	0.7	78		SS8 GSA: GRAVEL 0% SAND 59% SILT 37% CLAY 7%
9.0									
10.0				SS9	39	2.1	89		
11.0				SS10	35	6.4	61		SS10 GSA: GRAVEL 0% SAND 50% SILT 43% CLAY 7%
12.0									
13.0				SS11	39	2.8	78		
14.0				SS12	54	3	89		BOREHOLE CAVED AT 14.3 m DEPTH UPON COMPLETION, DRY
15.0									
15.0	SANDY SILT: LIGHT BROWN SANDY COARSE SILT, MOIST, VERY DENSE			SS13	55	3.7	94		
15.7	END OF HOLE								
16.0									
17.0									
18.0									

CONE PENETRATION "N" VALUE 10 20 30 — SHEAR STRENGTH

WATER CONTENT % 10 20 30 — W_P W_L



JHL GEOLOGIC B/W (METRIC) 3090996.00.GPJ JAGGER HIMS BASIC.GDT 11/10/10

GENIVAR

BOREHOLE NO. BH10-10

PROJECT NAME: KITCHENER - WATERLOO ELEVATED TANK
PROJECT NO.: 03090996.00

CLIENT: REGION OF WATERLOO
DATE COMPLETED: May 26, 2010

BOREHOLE TYPE: 110 mm SOLID STEM AUGER / 50 mm O.D. SPLIT SPOON
SUPERVISOR: KMT

EX. GRADE C/L: 385.7 mASL
REVIEWER: REM

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS	SAMPLE TYPE	SAMPLE N VALUE	SAMPLE % WATER	SAMPLE % RECOVERY	SAMPLE RQD (%)	CONE PENETRATION "N" VALUE / SHEAR STRENGTH	WATER CONTENT % (W_P – W_L)	REMARKS
0.0											
0.2	**TOPSOIL:** DARK BROWN TOPSOIL, OCCASIONAL GRAVEL, MOIST			SS1	3		60				MOINTOR MW10-10 INSTALLED
1.0	**SAND - SILT:** LAYERS BROWN SAND, SOME SILT TO SANDY SILT, SOME SEAMS OF CLAYEY SILT			SS2	6		72				
2.0				SS3	7		83				
2.1	**SILTY CLAY:** BROWN SILTY CLAY, TRACE GRAVEL, A.T.P.L., FISSURED, VERY STIFF			SS4	12		78				SS4 ATTERBERG: LIQUID LIMIT 23% PLASTIC LIMIT 14% PLASTICITY INDEX 9%
3.0				SS5	14		94				
4.0											
4.7	**SANDY SILT:** BROWN SANDY SILT, TRACE GRAVEL, WET, COMPACT			SS6	21		94				
5.0											
5.6	**SILTY CLAY:** GREY SILTY CLAY, TRACE GRAVEL, W.T.P.L., FISSURED, STIFF TO HARD										WATER LEVEL IN MONITOR AT 5.88 m BELOW GROUND SURFACE ON MAY 26, 2010, PERCHED WATER
6.0				SS7	8		61				SS7 ATTERBERG: LIQUID LIMIT 19% PLASTIC LIMIT 13% PLASTICITY INDEX 6%
7.0											
8.0				SS8	24		83				
9.0											
10.0				SS9	13		100				
10.2	**SAND - SILTY SAND:** LIGHT BROWN SAND, TRACE SILT TO SILTY SAND, MOIST TO DRY, COMPACT TO DENSE										
11.0				SS10	22		83				
12.0											
13.0				SS11	21		100				
14.0				SS12	34		89				
14.9	**SANDY SILT:** LIGHT BROWN SANDY SILT, MOIST, VERY DENSE										
15.0				SS13	67		94		67 →		
15.6	END OF HOLE										
16.0											
17.0											
18.0											

JHL GEOLOGIC B/W (METRIC) 3090996.00.GPJ JAGGER HIMS BASIC.GDT 11/10/10

APPENDIX D

MTE BOREHOLE LOGS (2016)

Client: The INCC Corp. & 1130814 Ontario Inc.

Borehole Number: BH101-15

Project: Phase II ESA

Job Number: 34280-401

Location: 87 & 101 Ira Needles Blvd., Waterloo, ON

Drill Date: December 11, 2015

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	Recovery (%)	Headspace (ppm)	Borehole
ft / m								
0.0 / 0.0	0.00	Ground Elevation						
0.0	0.00	**TOPSOIL**						
		FILL silty sand, soft, brown, some clay, moist, no noticeable staining or odours		1	DP	80	0.0	
4.0	-1.52 1.52	light brown						
6.0 / 2.0		**SAND** compact, brown, some silt and stones, saturated, no noticeable staining or odours		2	DP	95	0.2	Backfilled with Bentonite
8.0	-2.59 2.59	**SANDY SILT** firm, brown, some stones, moist, no noticeable staining or odours						
10.0	-3.05 3.05	light brown, some saturated sand seams, increasing silt content with depth Borehole terminated at 3.1 m bgs.						
12.0								
14.0 / 4.0								
16.0								
18.0								
20.0 / 6.0								
22.0								
24.0								
26.0 / 8.0								

Reviewed By: RJF

Method: GeoProbe 7822DT

Notes: Standing water in borehole at 1.7 m bgs

MTE Consultants Inc.
520 Bingemans Centre Drive
Kitchener, Ontario
N2B 3X9
(519) 743-6500

Logged By: FMK

Sheet: 1 of 1

Client: The INCC Corp. & 1130814 Ontario Inc.

Borehole Number: BH102-15

Project: Phase II ESA

Job Number: 34280-401

Location: 87 & 101 Ira Needles Blvd., Waterloo, ON

Drill Date: December 11, 2015

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	Recovery (%)	Headspace (ppm)	Borehole
ft / m		Ground Elevation						
0.0 / 0.0	0.00	**TOPSOIL**						
		FILL silty sand, soft, brown, some clay, moist, no noticeable staining or odours		1	DP	75	0.0	
4.0	-1.22 / 1.22	coarse grained sand						
	-1.52 / 1.52	**SAND** compact, brown, with silt and stones, moist, no noticeable staining or odours						
6.0 / 2.0				2	DP	80	0.4	Backfilled with Bentonite
	-2.29 / 2.29	saturated						
8.0		**SANDY SILT** firm, brown, some stones, moist, no noticeable staining or odours						
10.0								
	-3.35 / 3.35	saturated sand seams		3	DP	95	0.3	
12.0 / 4.0								
	-4.11 / 4.11	**CLAYEY SILT** stiff, brown, moist, no noticeable staining or odours						
14.0	-4.42 / 4.42	grey, wet						
16.0				4	DP	95	0.0	
18.0								
20.0 / 6.0	-6.10 / 6.10	Borehole terminated at 6.1 m bgs.						**Groundwater sampled in-situ with PVC screen (1.5 m long) and pipe installed at 2.7 m bgs.**
22.0								
24.0								
26.0 / 8.0								

Reviewed By: RJF

Method: GeoProbe 7822DT

Notes: Standing water in borehole at 1.5 m bgs

MTE Consultants Inc.
520 Bingemans Centre Drive
Kitchener, Ontario
N2B 3X9
(519) 743-6500

Logged By: FMK

Client: The INCC Corp. & 1130814 Ontario Inc.

Borehole Number: BH103-15

Project: Phase II ESA

Job Number: 34280-401

Location: 87 & 101 Ira Needles Blvd., Waterloo, ON

Drill Date: December 11, 2015

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	Recovery (%)	Headspace (ppm)	Borehole
ft / m								
0.0 / 0.0	0.00	Ground Elevation						
	0.00	**TOPSOIL**						
	-0.46 / 0.46	**FILL** silty sand, soft, brown, some stones and clay, moist, no noticeable staining or odours		1	DP	75	0.0	
4.0	-1.52 / 1.52	**SANDY SILT** firm, brown, some clay, moist, no noticeable staining or odours		2	DP	85	0.0	Backfilled with Bentonite
10.0 / 2.0	-3.05 / 3.05	Borehole terminated at 3.1 m bgs						
12.0								
14.0 / 4.0								
16.0								
18.0								
20.0 / 6.0								
22.0								
24.0								
26.0 / 8.0								

Reviewed By: RJF

Method: GeoProbe 7822DT

Notes: No standing water in borehole

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Logged By: FMK

Sheet: 1 of 1

APPENDIX E

CVD BOREHOLE LOGS (2016)
87 IRA NEEDLES

Enclosure No.: 1
Sheet 1 of 1

FILE No: G15225

BOREHOLE No. 201

Client: **MTE Consultants Inc.**

Project: **Proposed Thorndale Drive Extension**

Location: **87 Ira Needles Boulevard, Waterloo, ON**

EQUIPMENT DATA

Machine: **Geoprobe 7822DT**
Method: **Hollow Stem Augers**
Size: **76 mm ID**
Date: **Jan 04 / 16** TO **Jan 04 / 16**

SOIL LITHOLOGY

Ground Elevation: **383.53 m**

ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL
	very loose to compact brown FILL sand, silt, clayey silt, gravel, trace brick moist to saturated	0.5 1.0 1.5	
381.73 1.80	very stiff to firm brown to grey CLAYEY SILT some sand saturated sand seams, saturated gravelly seams moist saturated silty sand at 2.5 m depth	2.0 2.5 3.0 3.5 4.0	
	saturated sand at 4.5 m depth	4.5 5.0	
378.35 5.18	End of Borehole	5.5	

SAMPLE

SAMPLE ID	TYPE	N-VALUE
1	SS	2
2	SS	17
3	SS	10
4	SS	12
5	SS	23
6	SS	7

SHEAR STRENGTH (kPa)
FIELD VANE: Peak ⊗ Rem. ×
LAB TEST: Unc. ■ P.P. □
50 100 150 200
PENETRATION RESISTANCE
STANDARD ● DYN. CONE ○
20 40 60 80

WATER CONTENT (%)
W_P W W_L
10 20 30

WELL DATA

DEPTH (m)

REMARKS

- wet below 1.2 m depth
- water at 1.5 m, cave-in at 4.1 m depth below existing grade on removal of augers.
- grey below 4.3 m
- water at 1.5 m depth in well installed by MTE Consultants Inc. December 22, 2016

PROJECT MANAGER: **EYC**

CHUNG & VANDER DOELEN ENGINEERING LTD.
311 Victoria Street North
Kitchener, Ontario N2H 5E1
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CVD BOREHOLE (2015) G15225 MTE 807 IRA NEEDLES.GPJ CVD_ENG.GDT 10/2/16

Enclosure No.: 2
Sheet 1 of 1

FILE No: G15225

BOREHOLE No. 202

Client: **MTE Consultants Inc.**

Project: **Proposed Thorndale Drive Extension**

Location: **87 Ira Needles Boulevard, Waterloo, ON**

EQUIPMENT DATA

Machine: **Geoprobe 7822DT**
Method: **Hollow Stem Augers**
Size: **76 mm ID**
Date: **Jan 04 / 16** TO **Jan 04 / 16**

ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE
	Ground Elevation: **381.81 m**					
	very soft to very stiff brown to grey CLAYEY SILT some sand, trace to some gravel saturated sand seams, saturated gravelly seams moist	0.5		1	SS	1
		1.0		2	SS	4
		1.5		3	SS	8
		2.0				
		2.5		4	SS	21
		3.0				
378.15		3.5		5	SS	11
3.66	End of Borehole					

SHEAR STRENGTH (kPa)
FIELD VANE: Peak ⊗ Rem. ×
LAB TEST: Unc. ■ P.P. □
50 100 150 200
PENETRATION RESISTANCE
STANDARD ● DYN. CONE ○
20 40 60 80

WATER CONTENT (%)
W_P W W_L
10 20 30

WELL DATA

DEPTH (m)

REMARKS

- grey below 2.8 m depth
- no free water in open borehole on removal of augers
- water at 0.6 m depth in well installed by MTE Consultants Inc. December 22, 2016

PROJECT MANAGER: **EYC**

CHUNG & VANDER DOELEN ENGINEERING LTD.
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CVD BOREHOLE (2015) G15225 MTE 807 IRA NEEDLES.GPJ CVD_ENG.GDT 10/2/16

Enclosure No.: 3
Sheet 1 of 1

FILE No: G15225

BOREHOLE No. 203

Client: **MTE Consultants Inc.**

Project: **Proposed Thorndale Drive Extension**

Location: **87 Ira Needles Boulevard, Waterloo, ON**

EQUIPMENT DATA

Machine: **Geoprobe 7822DT**
Method: **Hollow Stem Augers**
Size: **76 mm ID**
Date: **Jan 04 / 16** TO **Jan 04 / 16**

ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	SHEAR STRENGTH (kPa) / PENETRATION RESISTANCE	WATER CONTENT (%)	WELL DATA	DEPTH (m)	REMARKS
	Ground Elevation: **382.48 m**						FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □ 50 100 150 200; PENETRATION RESISTANCE STANDARD ● DYN. CONE ○ 20 40 60 80	W_P W W_L 10 20 30			
	100 mm TOPSOIL										
	soft to very stiff brown CLAYEY SILT some sand, trace gravel, occasional cobble saturated sand seams	0.5		1	SS	2				0.5	
	moist	1.0		2	SS	6				1.0	
	saturated sandy seams at 1.6 m depth	1.5		3	SS	18				1.5	
	saturated sandy seams at 2.4 m depth	2.0		4	SS	10				2.0	
	saturated sandy seams at 3.8 m depth	2.5		5	SS	14				2.5	
	frequent cobbles	3.0								3.0	
		3.5								3.5	wet below 3.7 m depth
		4.0							▼	4.0	water and cave-in at 4.3 m depth in open borehole on removal of augers.
		4.5		6	SS	30				4.5	
377.30		5.0								5.0	
5.18	End of Borehole	5.5								5.5	

PROJECT MANAGER: **EYC**

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CVD BOREHOLE (2015) G15225 MTE 807 IRA NEEDLES.GPJ CVD_ENG.GDT 28/1/16

Enclosure No.: 4
Sheet 1 of 1

FILE No: G15225

BOREHOLE No. 204

Client: **MTE Consultants Inc.**

Project: **Proposed Thorndale Drive Extension**

Location: **87 Ira Needles Boulevard, Waterloo, ON**

EQUIPMENT DATA

Machine: **Geoprobe 7822DT**
Method: **Hollow Stem Augers**
Size: **76 mm ID**
Date: **Jan 04 / 16** TO **Jan 04 / 16**

Ground Elevation: **382.80 m**

ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE
	50 mm TOPSOIL					
	soft to stiff			1	SS	3
	brown to grey	0.5				
	CLAYEY SILT some sand					
	saturated sand seams					
	moist	1.0		2	SS	10
		1.5		3	SS	16
		2.0				
		2.5		4	SS	18
	saturated sand seam at 2.7 m depth	3.0				
		3.5		5	SS	16
	saturated sand seam at 3.5 m depth	4.0				
		4.5		6	SS	13
377.62		5.0				
5.18	End of Borehole	5.5				

SHEAR STRENGTH (kPa)
FIELD VANE: Peak ⊗ Rem. ×
LAB TEST: Unc. ■ P.P. □
50 100 150 200
PENETRATION RESISTANCE
STANDARD ● DYN. CONE ○
20 40 60 80

WATER CONTENT (%)
W_P W W_L
10 20 30

WELL DATA

DEPTH (m)

REMARKS

- water and cave-in at 4.1 m depth in open borehole on removal of augers.
- grey below 5 m depth

PROJECT MANAGER: **EYC**

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CVD BOREHOLE (2015) G15225 MTE 807 IRA NEEDLES.GPJ CVD_ENG.GDT 28/1/16

Enclosure No.: 5
Sheet 1 of 1

FILE No: G15225

BOREHOLE No. 205

Client: **MTE Consultants Inc.**

Project: **Proposed Thorndale Drive Extension**

Location: **87 Ira Needles Boulevard, Waterloo, ON**

EQUIPMENT DATA

Machine: **Geoprobe 7822DT**
Method: **Hollow Stem Augers**
Size: **76 mm ID**
Date: **Jan 04 / 16** TO **Jan 04 / 16**

SOIL LITHOLOGY

ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL
	Ground Elevation: **381.76 m**		
	firm dark brown to grey ORGANIC SILT rootlets, peat layers, moist to saturated	0.5 1.0	
	peat at 1.3 m depth	1.5	
	silt, grey with some sand below 1.8 m depth	2.0	
379.56 2.20	firm grey CLAYEY SILT some sand saturated sand seams moist	2.5 3.0 3.5	
378.10 3.66	End of Borehole	4.0 4.5 5.0 5.5	

SAMPLE

SAMPLE ID	TYPE	N-VALUE
1	SS	13
2	SS	2
3	SS	4
4	SS	9
5	SS	8

SHEAR STRENGTH (kPa)
FIELD VANE: Peak ⊗ Rem. ×
LAB TEST: Unc. ■ P.P. □
50 100 150 200
PENETRATION RESISTANCE
STANDARD ● DYN. CONE ○
20 40 60 80

WATER CONTENT (%)
W_P W W_L
10 20 30

44.5

WELL DATA

▼ water at 2.4 m depth in open borehole on removal of augers.

DEPTH (m)

REMARKS

- grey and wet below 1.8 m depth

PROJECT MANAGER: **EYC**

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CVD BOREHOLE (2015) G15225 MTE 807 IRA NEEDLES.GPJ CVD_ENG.GDT 28/1/16

Enclosure No.: 6
Sheet 1 of 1

FILE No: G15225

BOREHOLE No. 206

Client: **MTE Consultants Inc.**

Project: **Proposed Thorndale Drive Extension**

Location: **87 Ira Needles Boulevard, Waterloo, ON**

EQUIPMENT DATA

Machine: **Geoprobe 7822DT**
Method: **Hollow Stem Augers**
Size: **76 mm ID**
Date: **Jan 04 / 16** TO **Jan 04 / 16**

ELEV./ DEPTH (m)	SOIL LITHOLOGY: DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	SAMPLE TYPE	N-VALUE	SHEAR STRENGTH (kPa) / PENETRATION RESISTANCE	WATER CONTENT (%)	WELL DATA	DEPTH (m)	REMARKS
	Ground Elevation: **382.05 m**						FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □ 50 100 150 200; PENETRATION RESISTANCE STANDARD ● DYN. CONE ○ 20 40 60 80	W_P W W_L 10 20 30			
	firm to stiff brown to grey CLAYEY SILT some sand, oxidized fissure	0.5		1	SS	5				0.5	
	moist	1.0		2	SS	7				1.0	
		1.5		3	SS	12				1.5	
		2.0								2.0	
		2.5		4	SS	12				2.5	
		3.0								3.0	grey below 2.9 m depth
		3.5		5	SS	13				3.5	no free water in open borehole on removal of augers.
378.39											
3.66	End of Borehole	4.0								4.0	
		4.5								4.5	
		5.0								5.0	
		5.5								5.5	

PROJECT MANAGER: **EYC**

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CVD BOREHOLE (2015) G15225 MTE 807 IRA NEEDLES.GPJ CVD_ENG.GDT 28/1/16

APPENDIX F

CVD BOREHOLE LOGS (2016)
101 IRA NEEDLES

Enclosure No.: 1
Sheet 1 of 1

FILE No: G15219

BOREHOLE No. 104

Client: **INCC Corporation c/o MTE Consultants Inc.**

Project: **Proposed Medical Building**

Location: **101 Ira Needles Boulevard, Waterloo, ON**

EQUIPMENT DATA

Machine: **Geoprobe 7822DT**
Method: **Steel Casing**
Size: **75 mm OD**
Date: **Dec 11 / 15 TO Dec 11 / 15**

ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE
	Ground Elevation: **384.71 m**					
	250 mm TOPSOIL very loose brown FILL silt, some sand and clay moist	0.5 1.0		1 2	SS SS	4 2
383.31 1.40	compact brown Fine SAND trace to some silt moist	1.5		3	SS	10
382.71 2.00	very stiff brown CLAYEY SILT trace to some sand trace gravel damp to moist	2.0 2.5 3.0 3.5 4.0		4 5	SS SS	24 23
	---- grey occ. wet sandy lenses	4.5 5.0 5.5 6.0 6.5		6 7	SS SS	29 17
378.00 6.71	End of Borehole	7.0 7.5 8.0 8.5				

SHEAR STRENGTH (kPa)
FIELD VANE: Peak ⊗ Rem. ×
LAB TEST: Unc. ■ P.P. □
50 100 150 200
PENETRATION RESISTANCE
STANDARD ● DYN. CONE ○
20 40 60 80

WATER CONTENT (%)
W_P W W_L
10 20 30

WELL DATA

DEPTH (m)
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5

REMARKS
no free water in open borehole on removal of steel casing

PROJECT MANAGER: **EYC**

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Kitchener, Ontario N2H 5E1
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CVD BOREHOLE (2015) G15219 MTE IRA NEEDLES.GPJ CVD_ENG.GDT 5/2/16

Enclosure No.: 2
Sheet 1 of 1

FILE No: G15219

BOREHOLE No. 105

Client: **INCC Corporation c/o MTE Consultants Inc.**

Project: **Proposed Medical Building**

Location: **101 Ira Needles Boulevard, Waterloo, ON**

EQUIPMENT DATA

Machine: **Geoprobe 7822DT**
Method: **Steel Casing**
Size: **75 mm OD**
Date: **Dec 11 / 15** TO **Dec 11 / 15**

ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	SHEAR STRENGTH (kPa) / PENETRATION RESISTANCE	WATER CONTENT (%)	WELL DATA	DEPTH (m)	REMARKS
	Ground Elevation: **385.32 m**						FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □ 50 100 150 200; PENETRATION RESISTANCE STANDARD ● DYN. CONE ○ 20 40 60 80	W_P W W_L 10 20 30			
	loose, brown to dark brown FILL, silt, some sand, clay and topsoil	0.5		1	SS	5		41.4%		0.5	
384.52 0.80	moist										
	very stiff brown SANDY CLAYEY SILT trace gravel	1.0		2	SS	17				1.0	
		1.5								1.5	
		2.0		3	SS	17				2.0	
	moist with wet sandy lenses	2.5		4	SS	15				2.5	
		3.0								3.0	
		3.5		5	SS	18				3.5	
		4.0								4.0	
	----- grey	4.5								4.5	
		5.0		6	SS	17				5.0	
		5.5								5.5	
	moist to wet	6.0								6.0	
		6.5		7	SS	17			▽	6.5	water at 6.5 m depth in open borehole on removal of steel casing
378.61 6.71	End of Borehole										
		7.0								7.0	
		7.5								7.5	
		8.0								8.0	
		8.5								8.5	

PROJECT MANAGER: **EYC**

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Kitchener, Ontario N2H 5E1
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CVD BOREHOLE (2015) G15219 MTE IRA NEEDLES.GPJ CVD_ENG.GDT 5/2/16

FILE No: G15219

BOREHOLE No. 106

Client: **INCC Corporation c/o MTE Consultants Inc.**

Project: **Proposed Medical Building**

Location: **101 Ira Needles Boulevard, Waterloo, ON**

EQUIPMENT DATA

Machine: **Geoprobe 7822DT**
Method: **Steel Casing**
Size: **75 mm OD**
Date: **Dec 11 / 15 TO Dec 11 / 15**

Ground Elevation: **386.24 m**

ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE
386.09	150 mm TOPSOIL					
0.15	loose orangy brown SAND AND SILT trace to some clay moist	0.5 1.0 1.5		1 2	SS SS	5 5
384.64 1.60	loose brown Fine SAND some silt, trace gravel moist to wet	2.0 2.5		3 4	SS SS	7 7
383.34 2.90	stiff to very stiff brown SILT trace to some sand and clay trace gravel grey moist with wet sandy lenses/seams	3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5		5 6 7	SS SS SS	19 12 15
379.34 6.90	very stiff grey CLAYEY SILT trace gravel and sand moist	7.0 7.5 8.0		8	SS	15
378.01 8.23	End of Borehole	8.5				

SHEAR STRENGTH (kPa)
FIELD VANE: Peak ⊗ Rem. ×
LAB TEST: Unc. ■ P.P. □
50 100 150 200
PENETRATION RESISTANCE
STANDARD ● DYN. CONE ○
20 40 60 80

WATER CONTENT (%)
W_P W W_L
10 20 30

WELL DATA

DEPTH (m)

REMARKS

no free water in open borehole on removal of steel casing

PROJECT MANAGER: **EYC**

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CVD BOREHOLE (2015) G15219 MTE IRA NEEDLES.GPJ CVD_ENG.GDT 8/2/16

FILE No: G15219

BOREHOLE No. 107

Client: **INCC Corporation c/o MTE Consultants Inc.**

Project: **Proposed Medical Building**

Location: **101 Ira Needles Boulevard, Waterloo, ON**

EQUIPMENT DATA

Machine: **Geoprobe 7822DT**
Method: **Steel Casing**
Size: **75 mm OD**
Date: **Dec 11 / 15** TO **Dec 11 / 15**

SOIL LITHOLOGY

Ground Elevation: **386.47 m**

ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE
	280 mm TOPSOIL					
	loose to compact brown FILL clayey silt and sandy silt some gravel moist to damp	0.5		1	SS	4
		1.0		2	SS	21
385.07 1.40		1.5				
	stiff brown SILT trace to some clay and sand moist	2.0		3	SS	12
384.17 2.30		2.5		4	SS	23
	stiff to very stiff brown CLAYEY SILT trace to some sand trace gravel moist	3.0				
		3.5		5	SS	14
		4.0				
		4.5		6	SS	23
	----- grey	5.0				
		5.5				
		6.0		7	SS	29
	moist to wet	6.5				
		7.0				
		7.5				
		8.0		8	SS	16
378.24 8.23	End of Borehole	8.5				

SHEAR STRENGTH (kPa)
FIELD VANE: Peak ⊗ Rem. ×
LAB TEST: Unc. ■ P.P. □
50 100 150 200
PENETRATION RESISTANCE
STANDARD ● DYN. CONE ○
20 40 60 80

WATER CONTENT (%)
W_P W W_L
10 20 30

WELL DATA

DEPTH (m)

REMARKS

no free water in open borehole on removal of steel casing

PROJECT MANAGER: **EYC**

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CVD BOREHOLE (2015) G15219 MTE IRA NEEDLES.GPJ CVD_ENG.GDT 5/2/16

FILE No: G15219

BOREHOLE No. 108

Client: **INCC Corporation c/o MTE Consultants Inc.**

Project: **Proposed Medical Building**

Location: **101 Ira Needles Boulevard, Waterloo, ON**

EQUIPMENT DATA

Machine: **Geoprobe 7822DT**
Method: **Steel Casing**
Size: **75 mm OD**
Date: **Dec 11 / 15** TO **Dec 11 / 15**

SOIL LITHOLOGY

Ground Elevation: **386.04 m**

ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE
	330 mm TOPSOIL			1	SS	2
385.44	very loose, brown FILL, clayey silt	0.5				
0.60	firm to very stiff brown CLAYEY SILT trace to some sand trace gravel	1.0		2	SS	6
		1.5		3	SS	11
	moist with occ. wet sandy silt seams/lenses	2.0				
		2.5		4	SS	14
		3.0				
		3.5		5	SS	18
		4.0				
		4.5				
		5.0		6	SS	12
380.86						
5.18	End of Borehole					

SHEAR STRENGTH (kPa)
FIELD VANE: Peak ⊗ Rem. ×
LAB TEST: Unc. ■ P.P. □
50 100 150 200
PENETRATION RESISTANCE
STANDARD ● DYN. CONE ○
20 40 60 80

WATER CONTENT (%)
W_P W W_L
10 20 30

WELL DATA

DEPTH (m)

REMARKS

no free water in open borehole on removal of steel casing

PROJECT MANAGER: **EYC**

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CVD BOREHOLE (2015) G15219 MTE IRA NEEDLES.GPJ CVD_ENG.GDT 5/2/16

FILE No: G15219

BOREHOLE No. 109

Client: INCC Corporation c/o MTE Consultants Inc.
Project: Proposed Medical Building
Location: 101 Ira Needles Boulevard, Waterloo, ON

EQUIPMENT DATA
Machine: Geoprobe 7822DT
Method: Steel Casing
Size: 75 mm OD
Date: Dec 11 / 15 TO Dec 11 / 15

Ground Elevation: 384.49 m

ELEV./ DEPTH (m)	DESCRIPTION	SAMPLE ID	TYPE	N-VALUE
384.36 / 0.13	130mm Granular Base			
	loose to compact brown SAND and SILT trace clay moist to wet	1	SS	8
		2	SS	6
		3	SS	10
382.29 / 2.20	very soft to firm brown SILT some sand trace clay and gravel wet	4	SS	2
		5	SS	6
		6	SS	7
379.69 / 4.80	firm, grey CLAYEY SILT some sand wet	7	SS	4
		8	SS	5
378.55 / 5.94	End of Borehole			

SHEAR STRENGTH (kPa)
FIELD VANE: Peak ⊗ Rem. ×
LAB TEST: Unc. ■ P.P. □
50 100 150 200
PENETRATION RESISTANCE
STANDARD ● DYN. CONE ○
20 40 60 80

WATER CONTENT (%)
W_P W W_L
10 20 30

WELL DATA

DEPTH (m): 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5

REMARKS
no free water in open borehole on removal of steel casing

PROJECT MANAGER: EYC

CHUNG & VANDER DOELEN ENGINEERING LTD.
311 Victoria Street North
Kitchener, Ontario N2H 5E1
ph. (519) 742-8979, fx. (519) 742-7739

CVD BOREHOLE (2015) G15219 MTE IRA NEEDLES.GPJ CVD_ENG.GDT 5/2/16

APPENDIX G

MTE BOREHOLE LOGS (2017)

Client: Waterloo Commons Joint Venture

Project: Phase II ESA

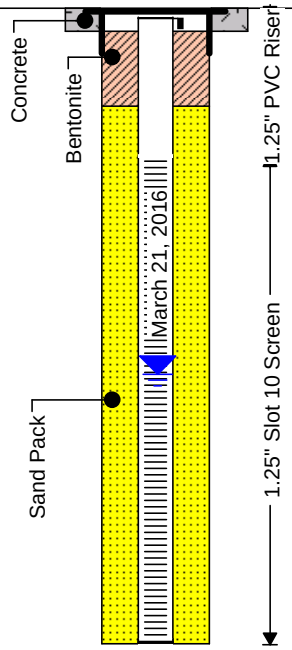
Location: 651-663 Erb Street West, Waterloo

Borehole Number: MW101-16

Job Number: 41179-100

Drill Date: March 14, 2016

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	Recovery (%)	Headspace (ppm)	Groundwater Observations and Well Details
ft / m		Ground Elevation						
0.0 / 0.0	99.69 / 0.00	**TOPSOIL**						
		FILL silty sand, compact, brown, trace clay and cobbles, moist, no noticeable staining or odour		1	DP	70	0.1	
2.0	98.78 / 0.91	**SAND** compact, brown, some silt, clay and stones, damp, no noticeable staining or odour						
4.0	98.17 / 1.52	wet at 1.5 m					0.1	
6.0 / 2.0	97.56 / 2.13	**CLAYEY SILT** dense, dark grey from 2.1-2.3 m, brown from 2.3-2.9 m, moist, no noticeable staining or odour		2	DP	60	0.2	
8.0	96.80 / 2.90	**SILTY SAND** compact, brown, trace clay, very wet, no noticeable staining or odour sand and gravel seam from 3.4-3.5 m, saturated		3	DP	100	0.1	
10.0 / 12.0 / 4.0	95.73 / 3.96	**SILTY CLAY** stiff, brown, with grey and red mottling, moist, no noticeable staining or odour					0.1	
14.0				4	DP	100		
16.0								
18.0	94.20 / 5.49	turning grey at 5.5 m						
20.0 / 6.0	93.59 / 6.10	Borehole terminated at 6.1 m bgs						
22.0								
24.0								
26.0								



Reviewed By: RJF

Method: Direct Push

Notes:

MTE Consultants Inc.
520 Bingemans Centre Drive
Kitchener, Ontario
N2B 3X9
(519) 743-6500

Logged By: KMK

Sheet: 1 of 1

Client: Waterloo Commons Joint Venture

Project: Phase II ESA

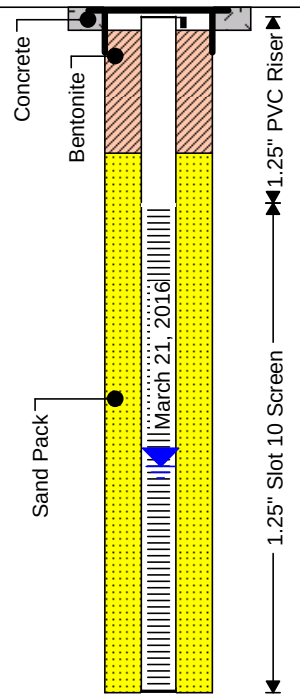
Location: 651-663 Erb Street West, Waterloo

Borehole Number: MW102-16

Job Number: 41179-100

Drill Date: March 14, 2016

Depth (ft)	Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	Recovery (%)	Headspace (ppm)	Groundwater Observations and Well Details
		97.26	Ground Elevation						
0.0	0.0	97.26 0.00	**TOPSOIL**						
			FILL silty sand, compact, brown, trace clay and cobbles, moist, no noticeable staining or odour		1	DP	60	0.1	
2.0									
4.0		95.74 1.52	**SILTY SAND** compact, brown grey, some stones, saturated, no noticeable staining or odour					0.2	
6.0	2.0	95.13 2.13	compact, dark brown, with rootlets, moist, no noticeable staining or odour		2	DP	70	0.2	
8.0		94.82 2.44	**CLAYEY SILT** compact, dark brown, moist, no noticeable staining or odour						
10.0		94.52 2.74	**SILTY SAND** loose to compact, brown, very wet, no noticeable staining or odour		3	DP	85	0.1	
12.0	4.0		**SILTY CLAY** stiff, brown, with grey and red mottling, moist, no noticeable staining or odour						
14.0									
16.0								0.2	
18.0					4	DP	90		
20.0	6.0								
22.0					5	DP	75		
24.0		90.25 7.01	turning grey at 7.0 m						
26.0		89.64 7.62	Borehole terminated at 7.6 m bgs						



Reviewed By: RJF

Method: Direct Push

Notes:

MTE Consultants Inc.
520 Bingemans Centre Drive
Kitchener, Ontario
N2B 3X9
(519) 743-6500

Logged By: KMK

Client: Waterloo Commons Joint Venture

Project: Phase II ESA

Location: 651-663 Erb Street West, Waterloo

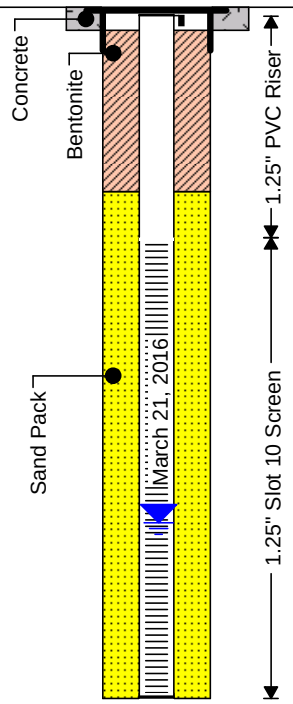
Borehole Number: MW103-16

Job Number: 41179-100

Drill Date: March 14, 2016

Depth (ft)	Depth (m)	Elevation (m)	Soil Description	Number	Type	Recovery (%)	Headspace (ppm)
		97.42	Ground Elevation				
0.0	0.0	0.00	**TOPSOIL**				
			FILL sand and gravel, compact, brown, moist, no noticeable staining or odour	1	DP	70	0.0
2.0		96.50 0.91	sandy silt, compact, brown, grey from 1.2-1.5 m, some stones, damp, no noticeable staining or odour				
4.0							
6.0	2.0	95.28 2.13					0.1
			TOPSOIL sandy silt, compact, brown to dark brown, some rootlets, no noticeable staining or odour	2	DP	85	
8.0			**SILTY SAND** compact, brown, trace clay, moist, no noticeable staining or odour				0.1
10.0		94.06 3.35	saturated				
12.0		93.61 3.81					0.0
	4.0		**SILTY CLAY** stiff, brown, with grey and red mottling, moist, no noticeable staining or odour	3	DP	100	
14.0							0.0
16.0							
18.0				4	DP	100	
20.0	6.0	91.32 6.10	Borehole terminated at 6.1 m bgs				
22.0							
24.0							
26.0	8.0						

Groundwater Observations and Well Details



Reviewed By: RJF

Method: Direct Push

Notes:

MTE Consultants Inc.
520 Bingemans Centre Drive
Kitchener, Ontario
N2B 3X9
(519) 743-6500

Logged By: KMK

Client: Waterloo Commons Joint Venture

Project: Phase II ESA

Location: 651-663 Erb Street West, Waterloo

MTE More Than Engineering

Borehole Number: BH104-16

Job Number: 41179-100

Drill Date: March 14, 2016

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	Recovery (%)	Headspace (ppm)	Borehole
ft / m		Ground Elevation						
0.0 / 0.0	0.00	**ASPHALT**						
		FILL sand and gravel, compact, brown, moist, no noticeable staining or odour					0.0	
2.0	0.61	silty sand, compact, brown, trace clay and cobbles, moist, no noticeable staining or odour		1	DP	60		
	0.91	**SILTY CLAY** stiff, brown, moist, no noticeable staining or odour						
4.0								
6.0 / 2.0				2	DP	100	0.1	Backfilled with Bentonite
8.0								
10.0								
12.0				3	DP	100		
14.0 / 4.0							0.0	
	4.57	Borehole terminated at 4.6 m bgs						
16.0								
18.0								
20.0 / 6.0								

Reviewed By: RJF

Method: Direct Push

Notes:

MTE Consultants Inc.
520 Bingemans Centre Drive
Kitchener, Ontario
N2B 3X9
(519) 743-6500

Logged By: KMK

Sheet: 1 of 1

APPENDIX H

GRCA WETLAND REMOVAL PERMIT AND CIVIL PLANS

400 Clyde Road, P.O. Box 729 Cambridge, ON N1R 5W6

Phone: 519.621.2761 **Toll free:** 866.900.4722 **Fax:** 519.621.4844 **Online:** www.grandriver.ca

January 19, 2016

1130814 Ontario Inc.
c/o Carol Cressman
1433 Berletts Road,
St. Agatha, ON, N0B 2L0

Dear Ms. Cressman,

Re: Application for Permission No. 755/15, Pursuant to Ontario Regulation 150/06 to construct a roadway and roundabout resulting in 0.8 hectares of wetland loss at 73 and 87 Ira Needles Boulevard, in the City of Waterloo

The Grand River Conservation Authority approved your application on January 19, 2016 to construct a roadway and roundabout resulting in 0.8 hectares of wetland loss at 73 and 87 Ira Needles Boulevard, in the City of Waterloo. We have enclosed the permit with the attached schedules.

The schedules form part of the permit and describe the work approved. Any changes to these plans must be reviewed and approved by the Grand River Conservation Authority. Please note that permission is based on existing information, policies and practices and does not bind or imply that any other permission will be forthcoming. Please notify our office on completion of the work.

If you have any questions regarding this letter or the conditions described on the permit, please contact me.

Yours truly,

Kaitlyn Smith
Resource Planner
Resource Management Division

KS*dg

Encl.

c.c. Clerk, City of Waterloo (letter only)
Building Inspector, City of Waterloo
Walterfedy

Received by
WALTERFEDY

FEB 04 2016

Project No.:
File Name:
Initials:

Permit No. #755/15

Grand River Conservation Authority

Under Ontario Regulation 150/06 made under the Conservation Authorities Act, R.S.O. 1990, Chapter C.27, permission is granted to:

1130814 Ontario Inc.
c/o Carol Cressman

Whose address for purposes pertaining to this project is:

1433 Berletts Road,
St. Agatha, ON
N0B 2L0

To execute proposed works in accordance with the following particulars and conditions:

Location of Work: 73 and 87 Ira Needles Boulevard,
City of Waterloo

Purpose of Work: To construct a roadway and roundabout resulting in 0.8 hectares of wetland loss at 73 and 87 Ira Needles Boulevard, in the City of Waterloo.

Nature of Work: To construct a roadway and roundabout resulting in 0.8 hectares of wetland loss.

This permit is valid from: **January 19, 2016**

and expires on: **January 19, 2018**

The attached Schedules form parts of this permit describing the approved work and must be implemented in order so that the true intent of the permit can be achieved.

The Permittee, by acceptance and in consideration of the issuance of this permit, agrees to the conditions listed on the reverse side of Schedule "A".

Dated at Cambridge, Ontario, this 19th day of January, 2016

GRAND RIVER CONSERVATION AUTHORITY

Joe Farwell

Joe Farwell,
Chief Administrative Officer

Grand River Conservation Authority

Administration Office:
400 Clyde Road, P.O. Box 729, Cambridge, Ontario N1R 5W6
Telephone: 519-621-2761 Fax: (519) 621-4945

GRCA USE ONLY
APPLICATION NUMBER
755/15

Schedule "A" - Application for Development, Interference With Wetlands and Alterations to Shorelines and Watercourses Permit (Pursuant to Ontario Regulation 150/06)

Please read, complete each section as required, attach fee and sign and date this application.

Owner's name: 1130814 Ontario Inc. E-mail: carolcressman@bell.net

Mailing address: 1433 Berletts Road City/Town: St. Agatha Postal Code: N0B 2L0

Telephone: Bus. (519) 885-2020 Res. (____) _____ Fax (____) _____

Agent's name (Consultant/Contractor): Dan Schipper, P.Eng. (WalterFedy)

Mailing address: 675 Queen St. S., Ste 111 City/Town: Kitchener Postal Code: N2M 1A1

Telephone: Bus. (519) 576-2150 Fax: (519) 576-5499 Email: dschipper@walterfedy.com

Location of proposed work:

Lot No. 40RP58R6504 Concession No. _____ Township _____

Municipal address of property: 87 Ira Needles Boulevard

City/Town/Village: Waterloo County/Region: Waterloo
(Circle One)

Application is hereby made for:

For examples of Minor, Standard and Major applications please refer to the Fee Schedule on pages 3 and 4.

- ☐ Minor Development
- ☐ Minor Interference with Wetlands, Alteration to Shorelines & Watercourses
- ☐ Standard Development
- ☐ Standard Interference with Wetlands, Alteration to Shorelines & Watercourses
- ☑ Major Development
- ☐ Major Interference with Wetlands, Alteration to Shorelines & Watercourses

Description of proposed work: Construction of the extension of Thorndale Drive to the west of Ira Needles Boulevard, complete with roundabout and connection to the adjacent development (Boardwalk), which includes placement of fill and adjustment of existing depressions.

This application must include four (4) folded copies of each appropriate plan(s) showing the proposed work.

Land Use: Present Vacant Proposed change (if any) Roadway/Commercial

I declare that I have read and agree to the General Conditions of Permit on the reverse of this form and that all information provided is true.

_____	2015/12/03	_____
Signature of Owner	Date	Signature of Agent

GENERAL CONDITIONS OF PERMIT

1. This permit does not absolve the permittee of the responsibility of obtaining necessary permission from applicable federal and provincial agencies or local municipalities.

2. The permittee agrees by acceptance of the permit:

   (a) to indemnity and save harmless, the Grand River Conservation Authority and its officers, employees, or agents, from and against all damage, injury, loss, costs, claims, demands, actions and proceedings, arising out of or resulting from any act or omission of the permittee or of any of his agents, employees or contractors relating to any of the particular terms or conditions of this permit.

   (b) that this permit shall not release the permittee from any legal liability or obligation and remains in force subject to all limitations, requirements and liabilities imposed by law.

   (c) that all complaints arising from the proposed works authorized under this permit shall be reported immediately by the permittee to the Grand River Conservation Authority. The permittee shall indicate any action which has been taken, or is planned to be taken, with regard to each complaint.

   (d) to provide certification of conformance to ensure compliance with the intent of the permit. This certification must be provided by an accredited professional and is to be submitted as may be specified in the permit.

3. Authorized representatives of the Grand River Conservation Authority will be granted entry at any time into lands and buildings which are the subject of this permit application in order to make such surveys, examinations, investigations, inspections or other arrangements which such representatives deem necessary.

4. The Grand River Conservation Authority may cancel this permit or may change any of the conditions at any time and without prior notice if it is determined that:

   (a) the works are not in conformance to the intent of the permission granted;

   (b) the information presented to obtain a permit is false;

   (c) the works or method of construction have detrimental impacts on the environment.

5. This permit shall not be assigned (non-transferable).

6. Permits are valid for two years. No notice will be issued on expiration of the permit and it is the responsibility of the permittee to ensure a valid permit is in effect at the time work is occurring.

7. The Grand River Conservation Authority may make copies of Schedule A, as required, for the purposes of assessing the proposal and, where approved, to form part of the permit issued.

NOTICE OF COLLECTION

Pursuant to section 29(2) of the Municipal Freedom of Information and Protection of Individual Privacy Act, 1989, the personal information contained on this form is collected under the legal authority of the Conservation Authorities Act, R.S.O. 1980, c85, as amended. This information is used to assess applications for and, where approved, issue the Permit. Information on this form may be disclosed to Government and Municipal Agencies for review and comment. The name of the applicant, location of the work and a description of the project may be published in GRCA documents including agendas, reports and meeting minutes which are posted on the GRCA website. Questions about the collection of personal information should be directed to the Freedom of Information Co-ordinator, Administration Division, Grand River Conservation Authority, 400 Clyde Road, P.O. Box 729, Cambridge, Ontario, N1R 5W6, (519) 621-2761.

PROPOSED AREA OF STORMWATER CATCHMENT
POND DATA
BOTTOM=379.90
TOP=380.62
VOLUME=840m³

GRCA IDENTIFIED BOUNDARY TO BE RETAINED

GRCA IDENTIFIED BOUNDARY (TO BE ELIMINATED)

GRADING LIMIT

FUTURE ROADWAY

THORNDALE ROAD

FUTURE BUILDING (BY OTHERS)
FF 384.20

10m REGIONAL WATER EASEMENT

MATCHLINE TO REGIONAL CONTRACT

THE IRA NEEDLES BOARDWALK DEVELOPMENT

FUTURE BUILDING BY OTHERS

EX. ASPHALT

EX. GRAVEL ROAD

EX. BLDG

SEPTIC TANK

INTERLOCKING BRICK

73 IRA NEEDLES BLVD.

SITE

KEY PLAN N.T.S.

THE CITY OF Waterloo

true north

project north

date	issued
2014.06.04	ISSUED FOR CITY REVIEW
2014.11.03	ISSUED TO MMM GROUP
2014.11.05	ISSUED FOR CIRCULATION
2014.11.13	ISSUED FOR EIS REPORT
2015.11.26	ISSUED FOR REVIEW
2016.01.28	ISSUED FOR CITY REVIEW
2016.02.19	ISSUED FOR MOE APPROVAL
2016.02.23	ISSUED FOR CITY APPROVAL
2016.02.26	ISSUED FOR MOE APPROVAL
2016.02.26	ISSUED FOR TENDER
2016.04.12	ISSUED FOR CONSTRUCTION

SITE BENCHMARK ELEV.:383.28m

IB LOCATED AT OLD FARM FENCE NORTHWEST CORNER OF PROPERTY OF 73 IRA NEEDLES, APPROXIMATELY 1m NORTHWEST CORNER OF SHED.
N:4810045.78m
E:535025.53m

MONUMENT ELEV.:388.72m

LOCATED SOUTHWEST CORNER OF WATER TOWER
N:480 707.062m
E:534 58.0 6m

date	revision	no.

customer

project
THORNDALE DRIVE EXTENSION

title
SCHEMATIC GRADING
OVERALL LAYOUT PLAN

WALTERFEDY
675 Queen Street South, Suite 111
Kitchener, Ontario, Canada N2M 1A1
T 519.576.2150 F 519.576.5489
walterfedy.com

LICENSED PROFESSIONAL ENGINEER D. A. SCHIPPER 100113544 PROVINCE OF ONTARIO

The contractor shall check and verify all dimensions and report any errors or omissions to the consultant before commencing or proceeding with any work. Do not scale this drawing.

Copyright © 2014 WalterFedy

scale:	1:500
date:	2014.05.14
job no.:	2014-0023-10
CAD file:	2014-0023-10
drawn by:	ACH
checked by:	

sheet no.:
44 of 48

P:\2014\(2023\)\0\dwg-(MMM)\DWG\2014-0023-10; 44 of 48; 1:25.4; ARCH full sheet D (24.00 x 36.00 inches); ...DWG To PDF no layers.ctb; Josh Zehr; 13/04/2016 10:11:00 AM

APPENDIX I

MTE STUDY AREA BOREHOLE LOGS (2018)

ID Number: MW 101-18

Project: West Waterloo Westhill District North/South Collector Rd

Project No: 34280-101

Client: The Westhill Landowners Group

Site Location: 651 Erb Street West, Waterloo, ON

Drill Date: 6/22/2018

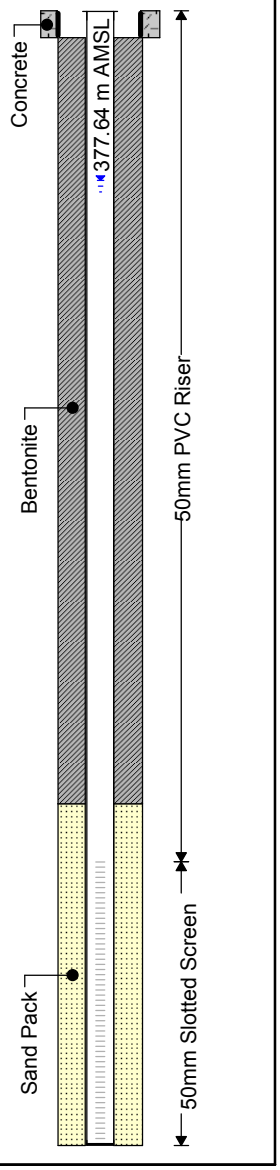
Drilling Contractor: Direct Environmental Drilling

Drill Rig: Geoprobe

Drill Method: Direct Push

Protective Cover: Monument

SUBSURFACE PROFILE			SAMPLE					HEADSPACE	
Depth (ft / m)	Symbol	Soil Description	Elevation (masl) Depth (m)	Number	Type	Recovery (%)	Soil Sample Lab Analysis	VOC ppm 20 40 60 80 / Hydrocarbon ppm 100 200 300 400	Well Completion Details
0 / 0		Ground Surface	378.6						
		FILL light brown topsoil fill. some organics and ontains trace sands with rootlets. damp.	0.0						
			377.9						
2		**SILT** light brown to grey. some clay and stones with trace sand. moist to very moist.	0.6	1	DP	100			
4			377.0						
		SILT TILL light brown to grey. sand and silt till. some stones and clay. very moist.	1.5						
6 / 2				2	DP	100			
8									
10			375.5						
		grey. some clay and trace sand. very moist to wet. red staining.	3.0						
12			374.7						
		SILTY SAND grey. sand seam. wet to saturated. red staining.	3.8	3	DP	100			
14 / 4		**SILT TILL** grey. clay and silt till. some clay and stones with trace sand. very moist to wet. red staining .							
			374.0						
		grey. some stones. wet.	4.6						
16									
18				4	DP	100			
			372.9						
		grey. clay silt till.some sand. wet.	5.6						
20 / 6			372.5						
			6.1						



Field Technician: FAH

Drafted by: JAK

Reviewed by: ALB

MTE

Sheet: 1 of 1

ID Number: MW 102-18

Project: West Waterloo Westhill District North/South Collector Rd

Project No: 34280-101

Client: The Westhill Landowners Group

Site Location: 73/87 Ira Needles Blvd, Waterloo, ON

Drill Date: 6/22/2018

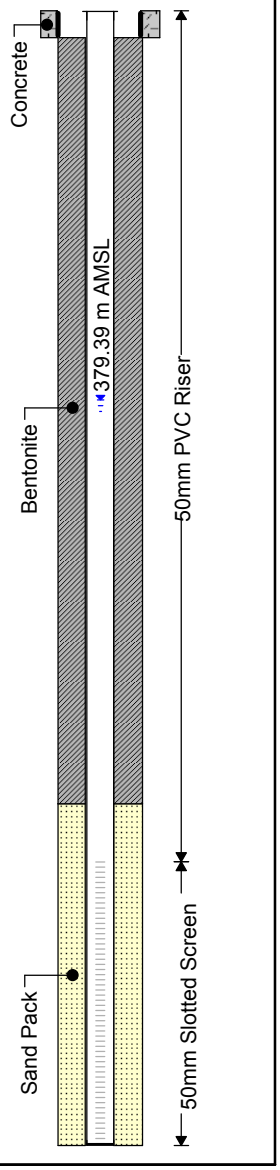
Drilling Contractor: Direct Environmental Drilling

Drill Rig: Geoprobe

Drill Method: Direct Push

Protective Cover: Monument

SUBSURFACE PROFILE			SAMPLE					HEADSPACE	
Depth (ft / m)	Symbol	Soil Description	Elevation (masl) Depth (m)	Number	Type	Recovery (%)	Soil Sample Lab Analysis	VOC ppm (20 40 60 80) / Hydrocarbon ppm (100 200 300 400)	Well Completion Details
0 ft / 0 m		Ground Surface	381.5						
		FILL llght brown topsoil fill.some sand and silt with rootlets and trace organics. Damp.	0.0						
			381.2						
		SILT TILL brown. clay silt Till. trace sand and stones. Moist with red staining.	0.3	1	DP	100			
4			380.0						
		brown transitioning to grey.. clay silt till. trace sand and stone. Very moist.	1.5	2	DP	100			
10 / 2			378.4						
		grey. sandy silt till. trace clay and stones. Wet.	3.0	3	DP	100			
14 / 4			376.9						
		grey. sandy silt till. some clay. trace stones. wet to saturated.	4.6	4	DP	100			
18 / 6			375.4						
20			6.1						



Field Technician: FAH

Drafted by: JAK

Reviewed by: ALB

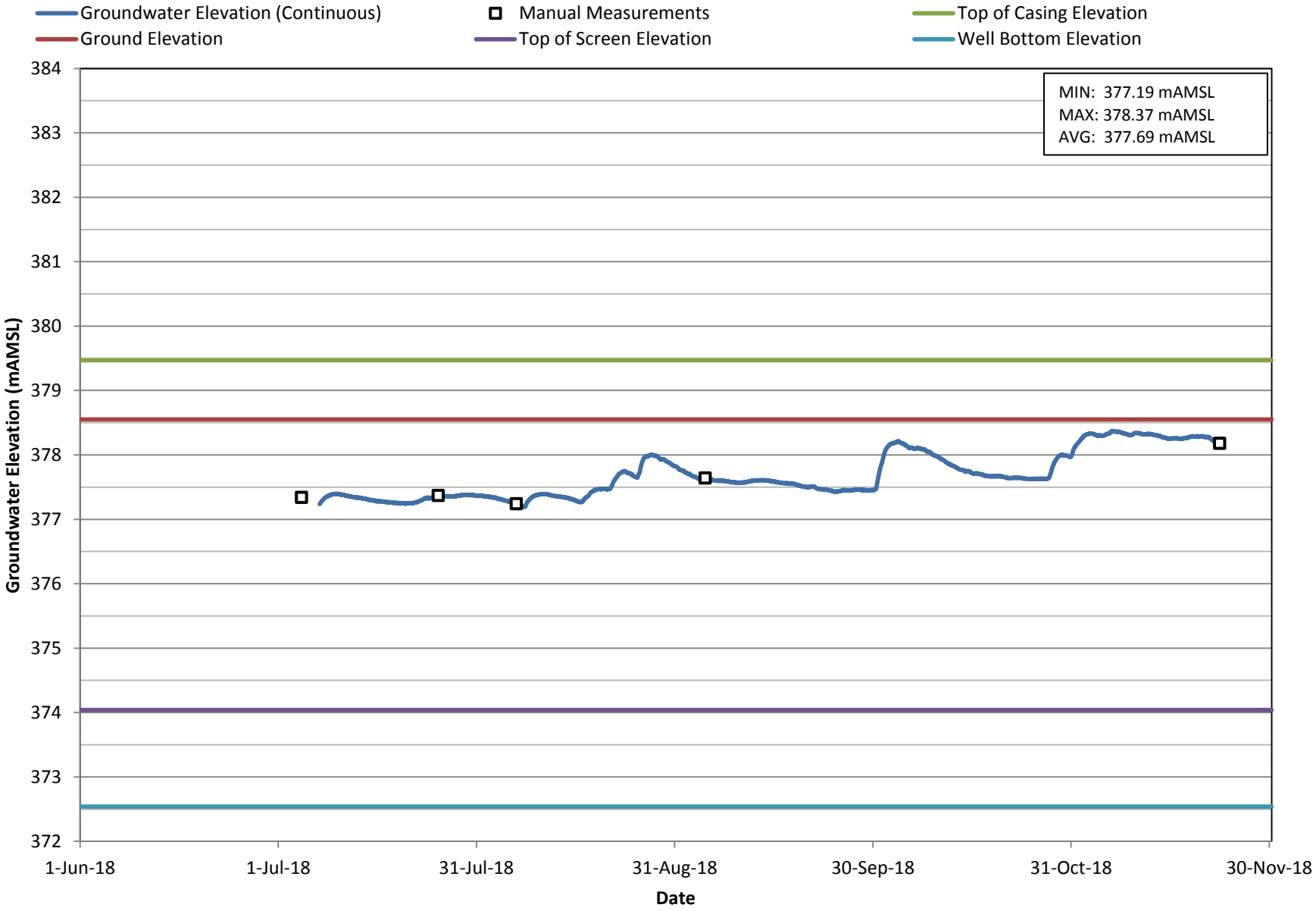
MTE

Sheet: 1 of 1

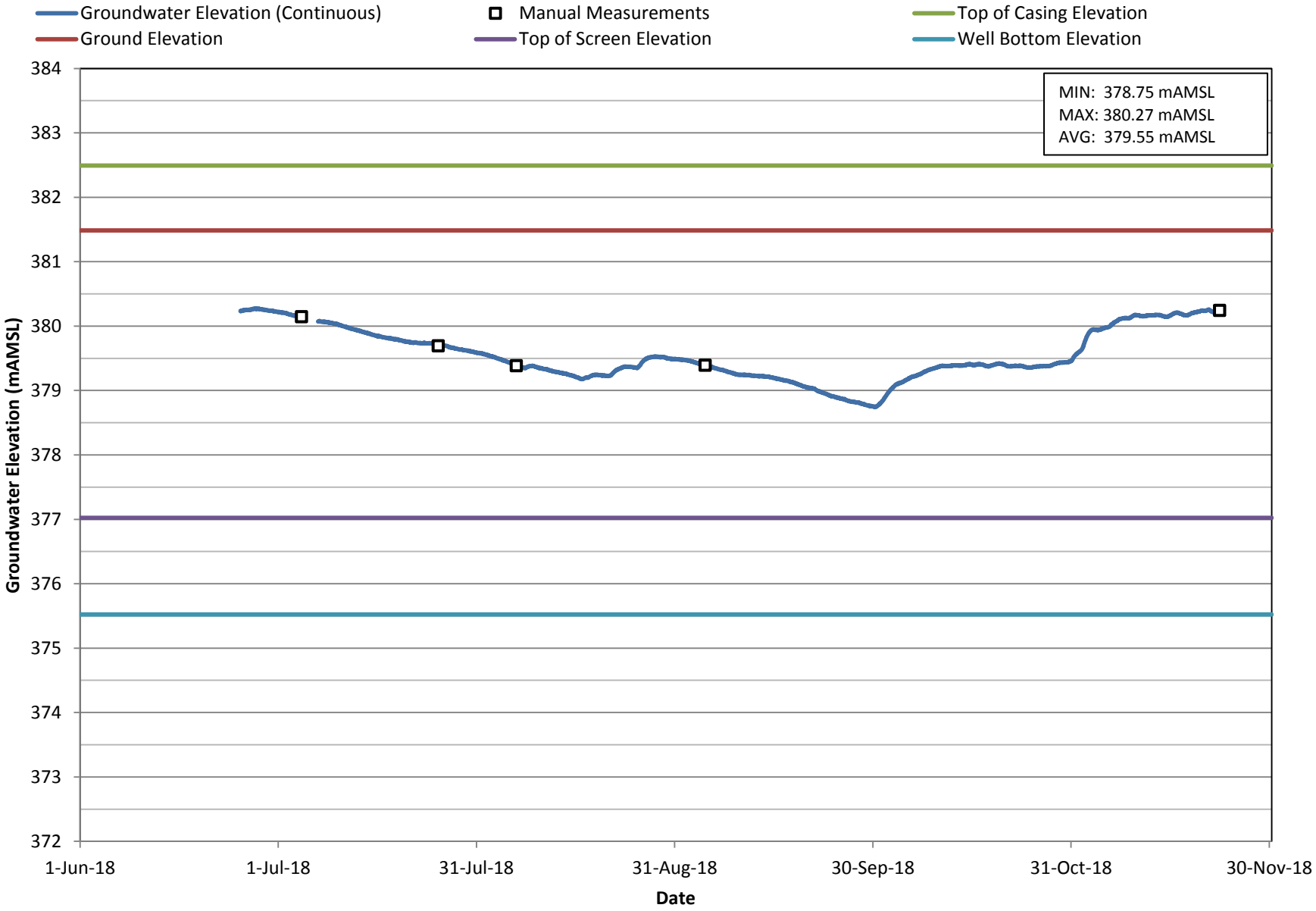
APPENDIX J

HYDROGRAPHS

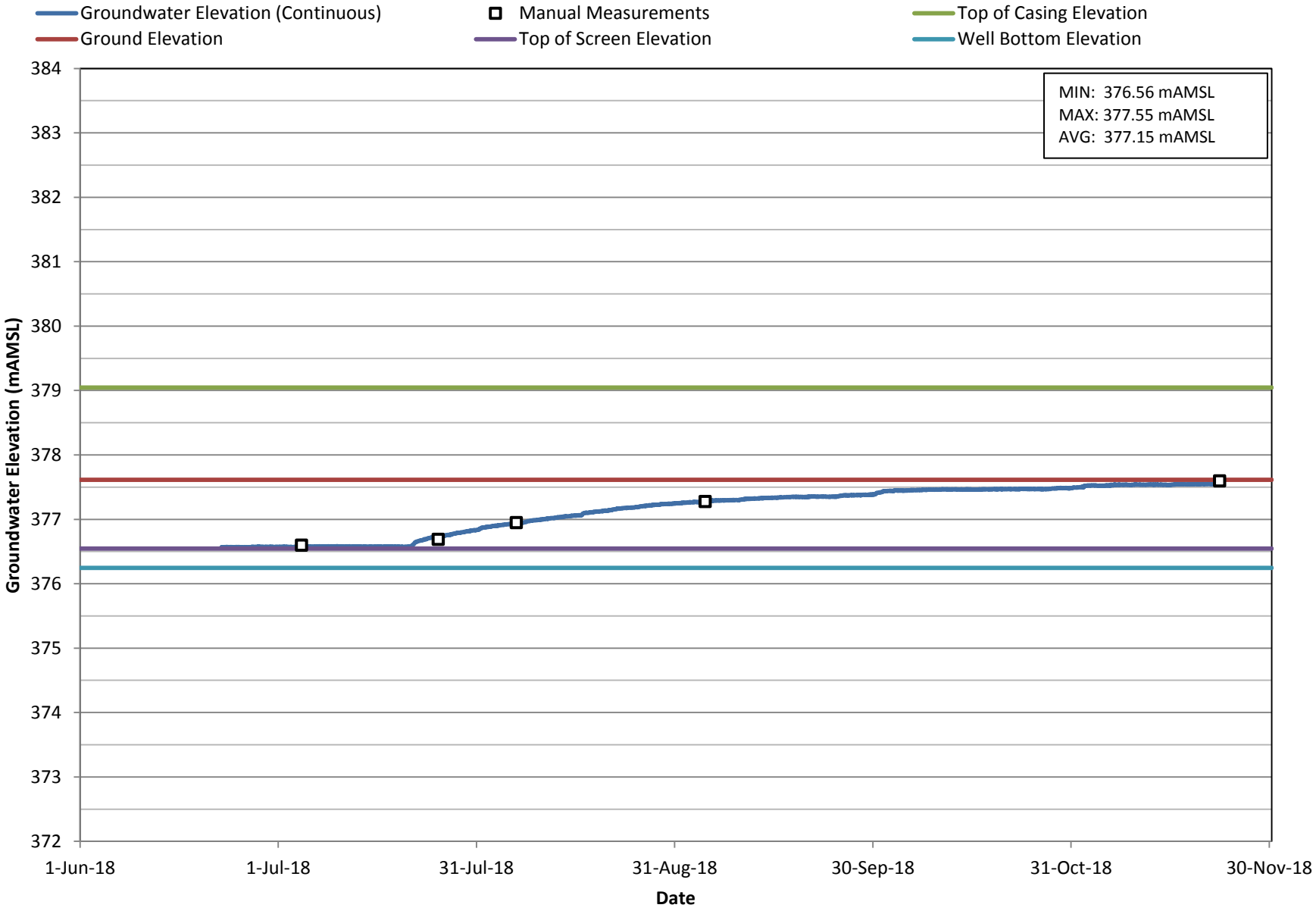
Hydrograph 1: Groundwater Elevations (mAMSL) - MW101-18



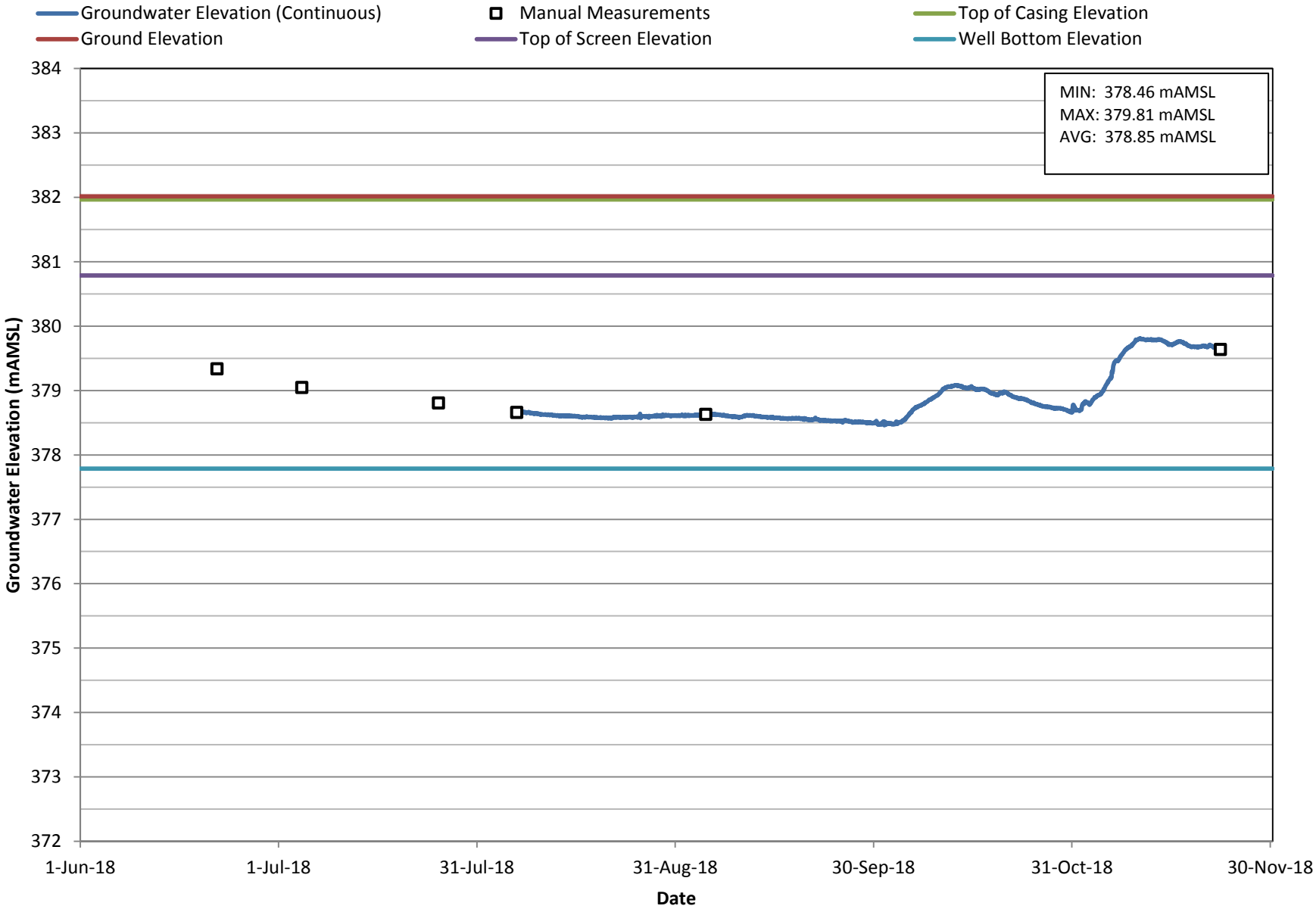
Hydrograph 2: Groundwater Elevations (mAMSL) - MW102-18



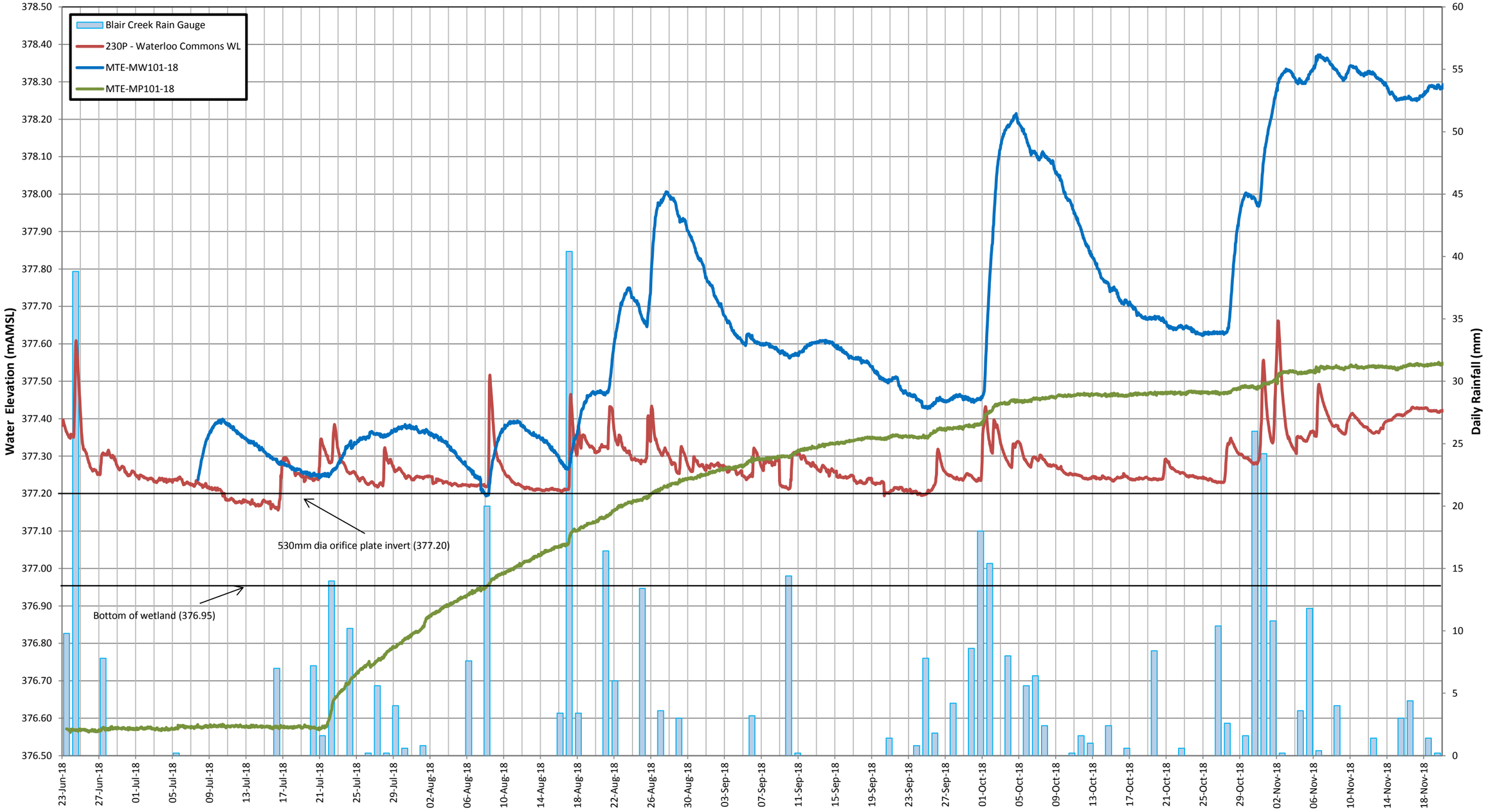
Hydrograph 3: Groundwater Elevations (mAMSL) - MP101-18



Hydrograph 4: Groundwater Elevations (mAMSL) - MW102-16



Hydrograph 5 - Waterloo Commons Wetland Feature Water Elevations (mAMSL)



APPENDIX K

AQUIFER TEST SUMMARY REPORTS

Drawing on experience...building on strength

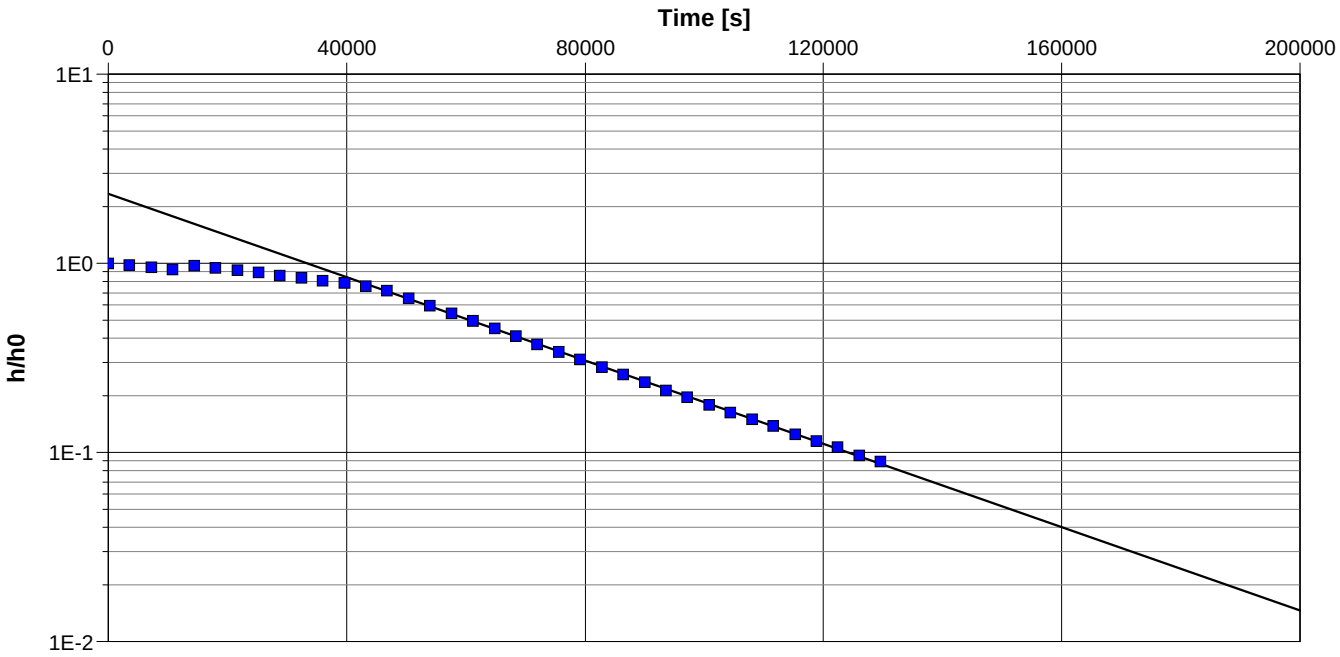
Slug Test Analysis Report

Project: Hydrogeological Assessment - West Waterloo Westhill District

Number: 34280-101

Client: The Westhill Landowners Group

Location: Waterloo. ON	Slug Test: MTE-MW101-18 Recovery Test 1	Test Well: MTE-MW101-18
Test Conducted by: FAH		Test Date: 9/6/2018
Analysis Performed by: FAH	MTE-MW101-18 Recovery Test 1	Analysis Date: 9/6/2018
Aquifer Thickness: 4.79 m		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
MTE-MW101-18	1.69×10^{-8}	

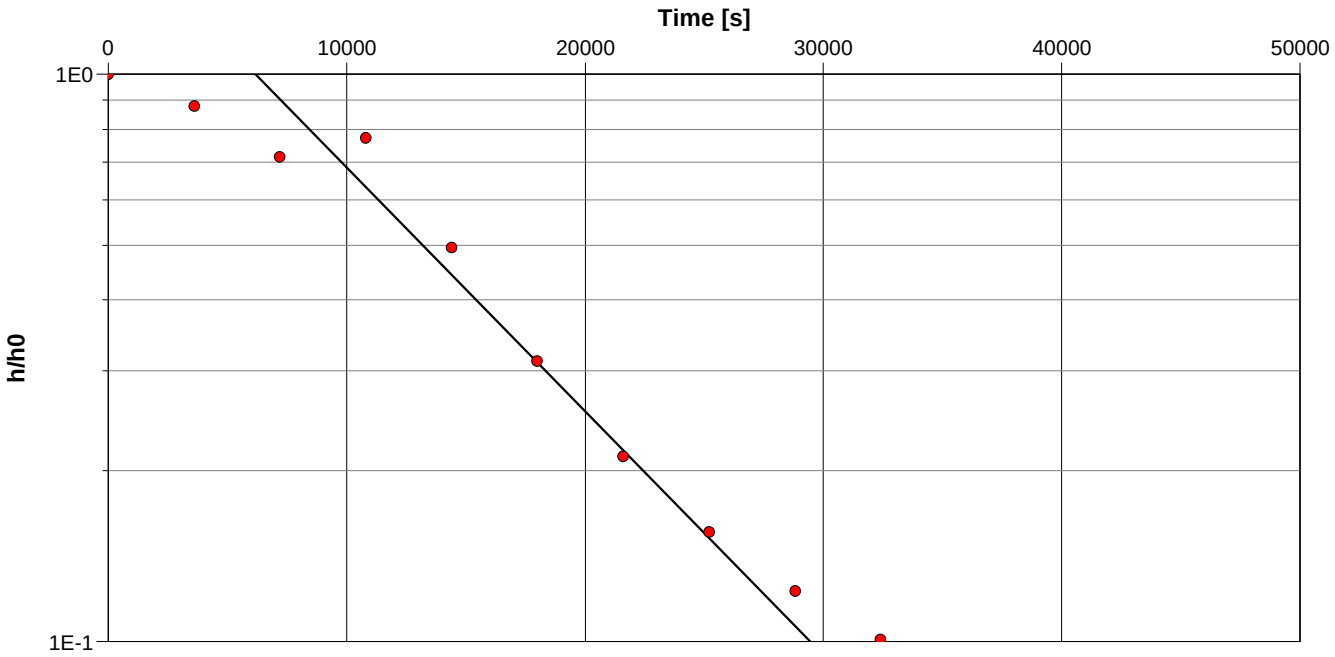
Slug Test Analysis Report

Project: Hydrogeological Assessment - West Waterloo Westhill District

Plan Number: 34280-101

Client: The Westhill Landowners Group

Location: Waterloo. ON	Slug Test: MTE-MW102-18 Recovery Test 1	Test Well: MTE-MW102-18
Test Conducted by:		Test Date: 9/6/2018
Analysis Performed by: FAH	MTE-MW102-18 Recovery Test 1	Analysis Date: 9/6/2018
Aquifer Thickness: 4.54 m		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
MTE-MW102-18	6.59×10^{-8}	

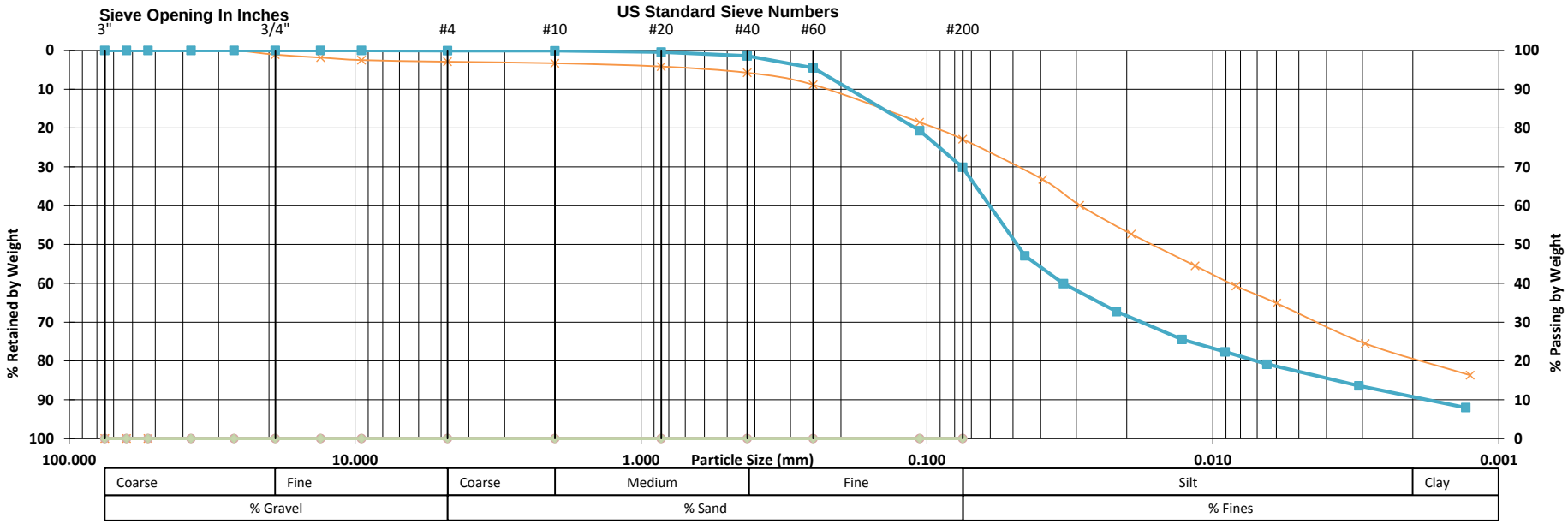
APPENDIX L

PARTICLE GRAIN SIZE DISTRIBUTION

Particle Size Distribution Analysis Test Results

PROJECT NAME: West Waterloo Westhill District North/South Collector Rd
CLIENT: The Westhill Landowners Group
DATE SAMPLED: July 31, 2018
DATE TESTED: Aug. 3-9, 2018
FILE No.: 34280-101
TABLE #: 1

Unified Soil Classification



Symbol	Borehole ID	Sample #	*Sample Depth*	Description
×—×—	MW101-18	N/A	4.57-5.64mbgs	Clayey Sandy SILT, trace Gravel
■—	MW102-18	N/A	4.57-5.33mbgs	Sandy SILT, some Clay

NOTES:

CERTIFIED BY CCIL Canadian Council of Independent Laboratories
For specific tests as listed on www.ccil.com

MTE Consultants Inc.
365 Home Street
Stratford, Ontario N5A 2A5
Phone: 519-271-7952
Fax: 519-271-3545
www.mte85.com

APPENDIX M

LABORATORY CERTIFICATES OF ANALYSIS

MTE CONSULTANTS INC.
ATTN: ANDREW BINGEMAN
520 BINGEMANS CENTRE DRIVE
KITCHENER ON N2B 3X9

Date Received: 05-JUL-18
Report Date: 11-JUL-18 16:55 (MT)
Version: FINAL

Client Phone: 519-743-6500

Certificate of Analysis

Lab Work Order #: L2124640

Project P.O. #: NOT SUBMITTED
Job Reference: 34280-101
C of C Numbers: 17-626142
Legal Site Desc:

Mary-Lynn Pike
Client Services Supervisor

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2124640-1 MW101-18 Sampled By: CLIENT on 05-JUL-18 @ 14:10 Matrix: WATER							
Physical Tests							
Colour, Apparent	37.2		2.0	CU		06-JUL-18	R4114336
Conductivity	2340		3.0	umhos/cm		06-JUL-18	R4114791
Hardness (as CaCO3)	834	HTC	10	mg/L		06-JUL-18	
pH	7.71		0.10	pH units		06-JUL-18	R4114791
Total Suspended Solids	19700	DLHC	40	mg/L	10-JUL-18	11-JUL-18	R4122187
Total Dissolved Solids	1640	DLDS	20	mg/L		09-JUL-18	R4119430
Turbidity	>4000		0.10	NTU		06-JUL-18	R4113972
Anions and Nutrients							
Alkalinity, Total (as CaCO3)	363		10	mg/L		09-JUL-18	R4120859
Ammonia, Total (as N)	0.283		0.020	mg/L		06-JUL-18	R4114383
Chloride (Cl)	527	DLDS	2.5	mg/L		09-JUL-18	R4120768
Fluoride (F)	0.12	DLDS	0.10	mg/L		09-JUL-18	R4120768
Nitrate (as N)	<0.10	DLDS	0.10	mg/L		09-JUL-18	R4120768
Nitrite (as N)	<0.050	DLDS	0.050	mg/L		09-JUL-18	R4120768
Orthophosphate-Dissolved (as P)	<0.0030		0.0030	mg/L		06-JUL-18	R4114407
Sulfate (SO4)	79.4	DLDS	1.5	mg/L		09-JUL-18	R4120768
Total Metals							
Aluminum (Al)-Total	<0.010		0.010	mg/L	06-JUL-18	06-JUL-18	R4113997
Antimony (Sb)-Total	0.00029		0.00010	mg/L	06-JUL-18	06-JUL-18	R4113997
Arsenic (As)-Total	0.00048		0.00010	mg/L	06-JUL-18	06-JUL-18	R4113997
Barium (Ba)-Total	0.191		0.00020	mg/L	06-JUL-18	06-JUL-18	R4113997
Beryllium (Be)-Total	<0.00010		0.00010	mg/L	06-JUL-18	06-JUL-18	R4113997
Bismuth (Bi)-Total	<0.000050		0.000050	mg/L	06-JUL-18	06-JUL-18	R4113997
Boron (B)-Total	0.028		0.010	mg/L	06-JUL-18	06-JUL-18	R4113997
Cadmium (Cd)-Total	0.000079		0.000010	mg/L	06-JUL-18	06-JUL-18	R4113997
Calcium (Ca)-Total	198		0.50	mg/L	06-JUL-18	06-JUL-18	R4113997
Cesium (Cs)-Total	0.000019		0.000010	mg/L	06-JUL-18	06-JUL-18	R4113997
Chromium (Cr)-Total	<0.00050		0.00050	mg/L	06-JUL-18	06-JUL-18	R4113997
Cobalt (Co)-Total	0.00105		0.00010	mg/L	06-JUL-18	06-JUL-18	R4113997
Copper (Cu)-Total	0.0123		0.0010	mg/L	06-JUL-18	06-JUL-18	R4113997
Iron (Fe)-Total	<0.050		0.050	mg/L	06-JUL-18	06-JUL-18	R4113997
Lead (Pb)-Total	0.00030		0.00010	mg/L	06-JUL-18	06-JUL-18	R4113997
Magnesium (Mg)-Total	82.2		0.050	mg/L	06-JUL-18	06-JUL-18	R4113997
Manganese (Mn)-Total	0.153		0.00050	mg/L	06-JUL-18	06-JUL-18	R4113997
Molybdenum (Mo)-Total	0.00358		0.000050	mg/L	06-JUL-18	06-JUL-18	R4113997
Nickel (Ni)-Total	0.00760		0.00050	mg/L	06-JUL-18	06-JUL-18	R4113997
Phosphorus (P)-Total	<0.050		0.050	mg/L	06-JUL-18	06-JUL-18	R4113997
Potassium (K)-Total	6.76		0.050	mg/L	06-JUL-18	06-JUL-18	R4113997
Rubidium (Rb)-Total	0.00269		0.00020	mg/L	06-JUL-18	06-JUL-18	R4113997
Selenium (Se)-Total	0.000596		0.000050	mg/L	06-JUL-18	06-JUL-18	R4113997
Silicon (Si)-Total	7.88		0.10	mg/L	06-JUL-18	06-JUL-18	R4113997

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2124640-1 MW101-18 Sampled By: CLIENT on 05-JUL-18 @ 14:10 Matrix: WATER							
Total Metals							
Silver (Ag)-Total	<0.000050		0.000050	mg/L	06-JUL-18	06-JUL-18	R4113997
Sodium (Na)-Total	156	DLHC	0.50	mg/L	06-JUL-18	06-JUL-18	R4113997
Strontium (Sr)-Total	0.477		0.0010	mg/L	06-JUL-18	06-JUL-18	R4113997
Sulfur (S)-Total	30.2		0.50	mg/L	06-JUL-18	06-JUL-18	R4113997
Tellurium (Te)-Total	<0.00020		0.00020	mg/L	06-JUL-18	06-JUL-18	R4113997
Thallium (Tl)-Total	0.000029		0.000010	mg/L	06-JUL-18	06-JUL-18	R4113997
Thorium (Th)-Total	<0.00010		0.00010	mg/L	06-JUL-18	06-JUL-18	R4113997
Tin (Sn)-Total	0.00092		0.00010	mg/L	06-JUL-18	06-JUL-18	R4113997
Titanium (Ti)-Total	<0.00030		0.00030	mg/L	06-JUL-18	06-JUL-18	R4113997
Tungsten (W)-Total	<0.00010		0.00010	mg/L	06-JUL-18	06-JUL-18	R4113997
Uranium (U)-Total	0.00613		0.000010	mg/L	06-JUL-18	06-JUL-18	R4113997
Vanadium (V)-Total	0.00088		0.00050	mg/L	06-JUL-18	06-JUL-18	R4113997
Zinc (Zn)-Total	0.0105		0.0030	mg/L	06-JUL-18	06-JUL-18	R4113997
Zirconium (Zr)-Total	<0.00030		0.00030	mg/L	06-JUL-18	06-JUL-18	R4113997
L2124640-2 MW102-18 Sampled By: CLIENT on 05-JUL-18 @ 15:00 Matrix: WATER							
Physical Tests							
Colour, Apparent	33.6		2.0	CU		06-JUL-18	R4114336
Conductivity	755		3.0	umhos/cm		06-JUL-18	R4114791
Hardness (as CaCO3)	395	HTC	10	mg/L		06-JUL-18	
pH	7.89		0.10	pH units		06-JUL-18	R4114791
Total Suspended Solids	4630	DLHC	40	mg/L	10-JUL-18	11-JUL-18	R4122187
Total Dissolved Solids	570	DLDS	20	mg/L		09-JUL-18	R4119430
Turbidity	>4000		0.10	NTU		06-JUL-18	R4113972
Anions and Nutrients							
Alkalinity, Total (as CaCO3)	337		10	mg/L		09-JUL-18	R4120859
Ammonia, Total (as N)	0.094		0.020	mg/L		06-JUL-18	R4114383
Chloride (Cl)	6.50		0.50	mg/L		09-JUL-18	R4120768
Fluoride (F)	0.120		0.020	mg/L		09-JUL-18	R4120768
Nitrate (as N)	<0.020		0.020	mg/L		09-JUL-18	R4120768
Nitrite (as N)	<0.010		0.010	mg/L		09-JUL-18	R4120768
Orthophosphate-Dissolved (as P)	<0.0030		0.0030	mg/L		06-JUL-18	R4114407
Sulfate (SO4)	58.1		0.30	mg/L		09-JUL-18	R4120768
Total Metals							
Aluminum (Al)-Total	0.016		0.010	mg/L	06-JUL-18	06-JUL-18	R4113997
Antimony (Sb)-Total	0.00016		0.00010	mg/L	06-JUL-18	06-JUL-18	R4113997
Arsenic (As)-Total	0.00063		0.00010	mg/L	06-JUL-18	06-JUL-18	R4113997
Barium (Ba)-Total	0.199		0.00020	mg/L	06-JUL-18	06-JUL-18	R4113997
Beryllium (Be)-Total	<0.00010		0.00010	mg/L	06-JUL-18	06-JUL-18	R4113997
Bismuth (Bi)-Total	<0.000050		0.000050	mg/L	06-JUL-18	06-JUL-18	R4113997
Boron (B)-Total	0.011		0.010	mg/L	06-JUL-18	06-JUL-18	R4113997

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2124640-2 MW102-18 Sampled By: CLIENT on 05-JUL-18 @ 15:00 Matrix: WATER							
Total Metals							
Cadmium (Cd)-Total	0.000028		0.000010	mg/L	06-JUL-18	06-JUL-18	R4113997
Calcium (Ca)-Total	102		0.50	mg/L	06-JUL-18	06-JUL-18	R4113997
Cesium (Cs)-Total	<0.000010		0.000010	mg/L	06-JUL-18	06-JUL-18	R4113997
Chromium (Cr)-Total	<0.00050		0.00050	mg/L	06-JUL-18	06-JUL-18	R4113997
Cobalt (Co)-Total	0.00046		0.00010	mg/L	06-JUL-18	06-JUL-18	R4113997
Copper (Cu)-Total	0.0044		0.0010	mg/L	06-JUL-18	06-JUL-18	R4113997
Iron (Fe)-Total	<0.050		0.050	mg/L	06-JUL-18	06-JUL-18	R4113997
Lead (Pb)-Total	0.00024		0.00010	mg/L	06-JUL-18	06-JUL-18	R4113997
Magnesium (Mg)-Total	34.3		0.050	mg/L	06-JUL-18	06-JUL-18	R4113997
Manganese (Mn)-Total	0.0727		0.00050	mg/L	06-JUL-18	06-JUL-18	R4113997
Molybdenum (Mo)-Total	0.00304		0.000050	mg/L	06-JUL-18	06-JUL-18	R4113997
Nickel (Ni)-Total	0.00145		0.00050	mg/L	06-JUL-18	06-JUL-18	R4113997
Phosphorus (P)-Total	<0.050		0.050	mg/L	06-JUL-18	06-JUL-18	R4113997
Potassium (K)-Total	1.69		0.050	mg/L	06-JUL-18	06-JUL-18	R4113997
Rubidium (Rb)-Total	0.00093		0.00020	mg/L	06-JUL-18	06-JUL-18	R4113997
Selenium (Se)-Total	0.000186		0.000050	mg/L	06-JUL-18	06-JUL-18	R4113997
Silicon (Si)-Total	7.32		0.10	mg/L	06-JUL-18	06-JUL-18	R4113997
Silver (Ag)-Total	<0.000050		0.000050	mg/L	06-JUL-18	06-JUL-18	R4113997
Sodium (Na)-Total	12.8		0.50	mg/L	06-JUL-18	06-JUL-18	R4113997
Strontium (Sr)-Total	0.227		0.0010	mg/L	06-JUL-18	06-JUL-18	R4113997
Sulfur (S)-Total	19.4		0.50	mg/L	06-JUL-18	06-JUL-18	R4113997
Tellurium (Te)-Total	<0.00020		0.00020	mg/L	06-JUL-18	06-JUL-18	R4113997
Thallium (Tl)-Total	0.000011		0.000010	mg/L	06-JUL-18	06-JUL-18	R4113997
Thorium (Th)-Total	<0.00010		0.00010	mg/L	06-JUL-18	06-JUL-18	R4113997
Tin (Sn)-Total	0.00038		0.00010	mg/L	06-JUL-18	06-JUL-18	R4113997
Titanium (Ti)-Total	0.00289		0.00030	mg/L	06-JUL-18	06-JUL-18	R4113997
Tungsten (W)-Total	<0.00010		0.00010	mg/L	06-JUL-18	06-JUL-18	R4113997
Uranium (U)-Total	0.00227		0.000010	mg/L	06-JUL-18	06-JUL-18	R4113997
Vanadium (V)-Total	0.00063		0.00050	mg/L	06-JUL-18	06-JUL-18	R4113997
Zinc (Zn)-Total	0.0067		0.0030	mg/L	06-JUL-18	06-JUL-18	R4113997
Zirconium (Zr)-Total	<0.00030		0.00030	mg/L	06-JUL-18	06-JUL-18	R4113997

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Total	MS-B	L2124640-1, -2
Matrix Spike	Boron (B)-Total	MS-B	L2124640-1, -2
Matrix Spike	Calcium (Ca)-Total	MS-B	L2124640-1, -2
Matrix Spike	Iron (Fe)-Total	MS-B	L2124640-1, -2
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2124640-1, -2
Matrix Spike	Manganese (Mn)-Total	MS-B	L2124640-1, -2
Matrix Spike	Phosphorus (P)-Total	MS-B	L2124640-1, -2
Matrix Spike	Potassium (K)-Total	MS-B	L2124640-1, -2
Matrix Spike	Rubidium (Rb)-Total	MS-B	L2124640-1, -2
Matrix Spike	Silicon (Si)-Total	MS-B	L2124640-1, -2
Matrix Spike	Sodium (Na)-Total	MS-B	L2124640-1, -2
Matrix Spike	Strontium (Sr)-Total	MS-B	L2124640-1, -2
Matrix Spike	Sulfur (S)-Total	MS-B	L2124640-1, -2
Matrix Spike	Zinc (Zn)-Total	MS-B	L2124640-1, -2

Sample Parameter Qualifier key listed:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
HTC	Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-WT	Water	Alkalinity, Total (as CaCO3)	EPA 310.2

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.

CL-IC-N-WT Water Chloride by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

COLOUR-APPARENT-WT Water Colour APHA 2120

Apparent Colour is measured spectrophotometrically by comparison to platinum-cobalt standards using the single wavelength method after sample decanting. Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

EC-WT Water Conductivity APHA 2510 B

Water samples can be measured directly by immersing the conductivity cell into the sample.

F-IC-N-WT Water Fluoride in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-WT Water Hardness APHA 2340 B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

MET-T-CCMS-WT Water Total Metals in Water by CRC EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

NH3-WT Water Ammonia, Total as N EPA 350.1

Sample is measured colorimetrically. When sample is turbid a distillation step is required, sample is distilled into a solution of boric acid and measured colorimetrically.

NO2-IC-WT Water Nitrite in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-IC-WT Water Nitrate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

Reference Information

PH-WT	Water	pH	APHA 4500 H-Electrode

Water samples are analyzed directly by a calibrated pH meter.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011). Holdtime for samples under this regulation is 28 days

PO4-DO-COL-WT	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P PHOSPHORUS

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

SO4-IC-N-WT	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

SOLIDS-TDS-WT	Water	Total Dissolved Solids	APHA 2540C

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

SOLIDS-TSS-WT	Water	Suspended solids	APHA 2540 D-Gravimetric

A well-mixed sample is filtered through a weighed standard glass fibre filter and the residue retained is dried in an oven at 104–1°C for a minimum of four hours or until a constant weight is achieved.

TURBIDITY-WT	Water	Turbidity	APHA 2130 B

Sample result is based on a comparison of the intensity of the light scattered by the sample under defined conditions with the intensity of light scattered by a standard reference suspension under the same conditions. Sample readings are obtained from a Nephelometer.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Chain of Custody Numbers:

17-626142

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid weight of sample
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: MTE CONSULTANTS INC.
520 BINGEMANS CENTRE DRIVE
KITCHENER ON N2B 3X9
Contact: ANDREW BINGEMAN

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-WT	**Water**							
Batch R4120859								
WG2817578-3 CRM		**WT-ALK-CRM**						
Alkalinity, Total (as CaCO3)			97.2		%		80-120	09-JUL-18
WG2817578-2 LCS								
Alkalinity, Total (as CaCO3)			101.5		%		85-115	09-JUL-18
WG2817578-1 MB								
Alkalinity, Total (as CaCO3)			<10		mg/L		10	09-JUL-18
CL-IC-N-WT	**Water**							
Batch R4120768								
WG2817301-12 LCS								
Chloride (Cl)			102.1		%		90-110	09-JUL-18
WG2817301-11 MB								
Chloride (Cl)			<0.50		mg/L		0.5	09-JUL-18
COLOUR-APPARENT-WT	**Water**							
Batch R4114336								
WG2815428-2 LCS								
Colour, Apparent			106.7		%		85-115	06-JUL-18
WG2815428-1 MB								
Colour, Apparent			<2.0		CU		2	06-JUL-18
EC-WT	**Water**							
Batch R4114791								
WG2815438-6 LCS								
Conductivity			97.4		%		90-110	06-JUL-18
WG2815438-5 MB								
Conductivity			<3.0		umhos/cm		3	06-JUL-18
F-IC-N-WT	**Water**							
Batch R4120768								
WG2817301-12 LCS								
Fluoride (F)			102.0		%		90-110	09-JUL-18
WG2817301-11 MB								
Fluoride (F)			<0.020		mg/L		0.02	09-JUL-18
MET-T-CCMS-WT	**Water**							
Batch R4113997								
WG2815378-2 LCS								
Aluminum (Al)-Total			102.0		%		80-120	06-JUL-18
Antimony (Sb)-Total			100.3		%		80-120	06-JUL-18
Arsenic (As)-Total			99.7		%		80-120	06-JUL-18
Barium (Ba)-Total			102.8		%		80-120	06-JUL-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	**Water**							
Batch R4113997								
WG2815378-2 LCS								
Beryllium (Be)-Total			98.6		%		80-120	06-JUL-18
Bismuth (Bi)-Total			102.0		%		80-120	06-JUL-18
Boron (B)-Total			93.8		%		80-120	06-JUL-18
Cadmium (Cd)-Total			99.5		%		80-120	06-JUL-18
Calcium (Ca)-Total			97.9		%		80-120	06-JUL-18
Chromium (Cr)-Total			96.4		%		80-120	06-JUL-18
Cesium (Cs)-Total			101.9		%		80-120	06-JUL-18
Cobalt (Co)-Total			99.0		%		80-120	06-JUL-18
Copper (Cu)-Total			98.5		%		80-120	06-JUL-18
Iron (Fe)-Total			97.1		%		80-120	06-JUL-18
Lead (Pb)-Total			103.6		%		80-120	06-JUL-18
Magnesium (Mg)-Total			98.4		%		80-120	06-JUL-18
Manganese (Mn)-Total			99.96		%		80-120	06-JUL-18
Molybdenum (Mo)-Total			102.5		%		80-120	06-JUL-18
Nickel (Ni)-Total			99.5		%		80-120	06-JUL-18
Phosphorus (P)-Total			100.0		%		70-130	06-JUL-18
Potassium (K)-Total			97.9		%		80-120	06-JUL-18
Rubidium (Rb)-Total			105.3		%		80-120	06-JUL-18
Selenium (Se)-Total			98.2		%		80-120	06-JUL-18
Silicon (Si)-Total			96.8		%		60-140	06-JUL-18
Silver (Ag)-Total			96.9		%		80-120	06-JUL-18
Sodium (Na)-Total			98.4		%		80-120	06-JUL-18
Strontium (Sr)-Total			102.7		%		80-120	06-JUL-18
Sulfur (S)-Total			92.4		%		80-120	06-JUL-18
Thallium (Tl)-Total			102.4		%		80-120	06-JUL-18
Tellurium (Te)-Total			98.3		%		80-120	06-JUL-18
Thorium (Th)-Total			104.6		%		70-130	06-JUL-18
Tin (Sn)-Total			99.8		%		80-120	06-JUL-18
Titanium (Ti)-Total			95.0		%		80-120	06-JUL-18
Tungsten (W)-Total			101.9		%		80-120	06-JUL-18
Uranium (U)-Total			107.4		%		80-120	06-JUL-18
Vanadium (V)-Total			100.6		%		80-120	06-JUL-18
Zinc (Zn)-Total			93.1		%		80-120	06-JUL-18
Zirconium (Zr)-Total			99.0		%		80-120	06-JUL-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	**Water**							
Batch R4113997								
WG2815378-1 MB								
Aluminum (Al)-Total			<0.0050		mg/L		0.005	06-JUL-18
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	06-JUL-18
Arsenic (As)-Total			<0.00010		mg/L		0.0001	06-JUL-18
Barium (Ba)-Total			<0.00010		mg/L		0.0001	06-JUL-18
Beryllium (Be)-Total			<0.00010		mg/L		0.0001	06-JUL-18
Bismuth (Bi)-Total			<0.000050		mg/L		0.00005	06-JUL-18
Boron (B)-Total			<0.010		mg/L		0.01	06-JUL-18
Cadmium (Cd)-Total			<0.000005C		mg/L		0.000005	06-JUL-18
Calcium (Ca)-Total			<0.050		mg/L		0.05	06-JUL-18
Chromium (Cr)-Total			<0.00050		mg/L		0.0005	06-JUL-18
Cesium (Cs)-Total			<0.000010		mg/L		0.00001	06-JUL-18
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	06-JUL-18
Copper (Cu)-Total			<0.0010		mg/L		0.001	06-JUL-18
Iron (Fe)-Total			<0.010		mg/L		0.01	06-JUL-18
Lead (Pb)-Total			<0.000050		mg/L		0.00005	06-JUL-18
Magnesium (Mg)-Total			<0.0050		mg/L		0.005	06-JUL-18
Manganese (Mn)-Total			<0.00050		mg/L		0.0005	06-JUL-18
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	06-JUL-18
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	06-JUL-18
Phosphorus (P)-Total			<0.050		mg/L		0.05	06-JUL-18
Potassium (K)-Total			<0.050		mg/L		0.05	06-JUL-18
Rubidium (Rb)-Total			<0.00020		mg/L		0.0002	06-JUL-18
Selenium (Se)-Total			<0.000050		mg/L		0.00005	06-JUL-18
Silicon (Si)-Total			<0.10		mg/L		0.1	06-JUL-18
Silver (Ag)-Total			<0.000050		mg/L		0.00005	06-JUL-18
Sodium (Na)-Total			<0.050		mg/L		0.05	06-JUL-18
Strontium (Sr)-Total			<0.0010		mg/L		0.001	06-JUL-18
Sulfur (S)-Total			<0.50		mg/L		0.5	06-JUL-18
Thallium (Tl)-Total			<0.000010		mg/L		0.00001	06-JUL-18
Tellurium (Te)-Total			<0.00020		mg/L		0.0002	06-JUL-18
Thorium (Th)-Total			<0.00010		mg/L		0.0001	06-JUL-18
Tin (Sn)-Total			<0.00010		mg/L		0.0001	06-JUL-18
Titanium (Ti)-Total			<0.00030		mg/L		0.0003	06-JUL-18
Tungsten (W)-Total			<0.00010		mg/L		0.0001	06-JUL-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	**Water**							
Batch R4113997								
WG2815378-1 MB								
Uranium (U)-Total			<0.000010		mg/L		0.00001	06-JUL-18
Vanadium (V)-Total			<0.00050		mg/L		0.0005	06-JUL-18
Zinc (Zn)-Total			<0.0030		mg/L		0.003	06-JUL-18
Zirconium (Zr)-Total			<0.00030		mg/L		0.0003	06-JUL-18
NH3-WT	**Water**							
Batch R4114383								
WG2815492-10 LCS								
Ammonia, Total (as N)			100.2		%		85-115	06-JUL-18
WG2815492-9 MB								
Ammonia, Total (as N)			<0.020		mg/L		0.02	06-JUL-18
NO2-IC-WT	**Water**							
Batch R4120768								
WG2817301-12 LCS								
Nitrite (as N)			101.8		%		70-130	09-JUL-18
WG2817301-11 MB								
Nitrite (as N)			<0.010		mg/L		0.01	09-JUL-18
NO3-IC-WT	**Water**							
Batch R4120768								
WG2817301-12 LCS								
Nitrate (as N)			101.1		%		70-130	09-JUL-18
WG2817301-11 MB								
Nitrate (as N)			<0.020		mg/L		0.02	09-JUL-18
PH-WT	**Water**							
Batch R4114791								
WG2815438-6 LCS								
pH			7.00		pH units		6.9-7.1	06-JUL-18
PO4-DO-COL-WT	**Water**							
Batch R4114407								
WG2815497-7 DUP		**L2124640-1**						
Orthophosphate-Dissolved (as P)		<0.0030	<0.0030	RPD-NA	mg/L	N/A	30	06-JUL-18
WG2815497-6 LCS								
Orthophosphate-Dissolved (as P)			102.9		%		70-130	06-JUL-18
WG2815497-5 MB								
Orthophosphate-Dissolved (as P)			<0.0030		mg/L		0.003	06-JUL-18
WG2815497-8 MS		**L2124640-1**						

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PO4-DO-COL-WT	**Water**							
Batch R4114407								
WG2815497-8 MS		**L2124640-1**						
Orthophosphate-Dissolved (as P)			98.2		%		70-130	06-JUL-18
SO4-IC-N-WT	**Water**							
Batch R4120768								
WG2817301-12 LCS								
Sulfate (SO4)			102.8		%		90-110	09-JUL-18
WG2817301-11 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	09-JUL-18
SOLIDS-TDS-WT	**Water**							
Batch R4119430								
WG2817308-2 LCS								
Total Dissolved Solids			97.7		%		85-115	09-JUL-18
WG2817308-1 MB								
Total Dissolved Solids			<10		mg/L		10	09-JUL-18
SOLIDS-TSS-WT	**Water**							
Batch R4122187								
WG2818030-2 LCS								
Total Suspended Solids			102.9		%		85-115	11-JUL-18
WG2818030-1 MB								
Total Suspended Solids			<2.0		mg/L		2	11-JUL-18
TURBIDITY-WT	**Water**							
Batch R4113972								
WG2815502-2 LCS								
Turbidity			107.0		%		85-115	06-JUL-18
WG2815502-1 MB								
Turbidity			<0.10		NTU		0.1	06-JUL-18

Quality Control Report

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2124640-COFC

COC Number: 17 - 626142

Page 2 of 2

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)
Company:	MTE	Select Report Format: PDF EXCEL EDD (DIGITAL)	Regular [R] Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	Andrew Bingeman	Quality Control (QC) Report with Report YES NO	PRIORITY (Business Days): 4 day [P4-20%]; 3 day [P3-25%]; 2 day [P2-50%]
Phone:	519 742 6500	Compare Results to Criteria on Report - provide details below if box checked	EMERGENCY: 1 Business day [E-100%]; Same Day, Weekend or Statutory holiday [E2-200% (Laboratory opening fees may apply)]
	Company address below will appear on the final report	Select Distribution: EMAIL MAIL FAX	
Street:	520 Bingemans Centre Dr	Email 1 or Fax: abingeman@mte85.com	Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm
City/Province:	Kitchener, ON	Email 2:	For tests that can not be performed according to the service level selected, you will be contacted.
Postal Code:	N2B 3X7	Email 3:	
Invoice To	Same as Report To: YES NO	**Invoice Distribution**	**Analysis Request**
	Copy of Invoice with Report: YES NO	Select Invoice Distribution: EMAIL MAIL FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:	MTE	Email 1 or Fax: accounting@mte85.com	
Contact:	Accounting	Email 2:	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:	34780-101	Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):	L2124640 COC	ALS Contact: MM	Sampler:

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total Metals	Gen Chem 1	TSS	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
	MW101-18	05-Jul-18	14:10	water	X	X	X			4
	MW102-18	↓	15:00	↓	X	X	X			4

Drinking Water (DW) Samples' (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? NO	Total metals
Are samples for human consumption/ use? NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen		SIF Observations	Yes		No
Ice Packs	Ice Cubes X	Custody seal intact	Yes		No
Cooling Initiated X					

INITIAL COOLER TEMPERATURES °C | FINAL COOLER TEMPERATURES °C: 25 20.1

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
Jeremy Jamieson	05-Jul-18	16:27				MW	July 05/18	16:15

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

JULY 2017 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

MTE CONSULTANTS INC.
ATTN: ANDREW BINGEMAN
520 BINGEMANS CENTRE DRIVE
KITCHENER ON N2B 3X9

Date Received: 05-JUL-18
Report Date: 11-JUL-18 16:55 (MT)
Version: FINAL

Client Phone: 519-743-6500

Certificate of Analysis

Lab Work Order #: L2124641

Project P.O. #: NOT SUBMITTED
Job Reference: 34280-101
C of C Numbers: 17-626141
Legal Site Desc:

Mary-Lynn Pike
Client Services Supervisor

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2124641-1 SW101 Sampled By: CLIENT on 05-JUL-18 @ 13:45 Matrix: WATER							
Physical Tests							
Colour, Apparent	295		2.0	CU		06-JUL-18	R4114336
Conductivity	2670		3.0	umhos/cm		06-JUL-18	R4114791
Hardness (as CaCO3)	344	HTC	10	mg/L		06-JUL-18	
pH	7.89		0.10	pH units		06-JUL-18	R4114791
Total Suspended Solids	87.1	DLHC	4.0	mg/L	10-JUL-18	11-JUL-18	R4122187
Total Dissolved Solids	1600	DLDS	20	mg/L		09-JUL-18	R4119430
Turbidity	113		0.10	NTU		06-JUL-18	R4113972
Anions and Nutrients							
Alkalinity, Total (as CaCO3)	198		10	mg/L		09-JUL-18	R4120859
Ammonia, Total (as N)	0.020		0.020	mg/L		06-JUL-18	R4114383
Chloride (Cl)	767	DLDS	2.5	mg/L		09-JUL-18	R4120768
Fluoride (F)	0.12	DLDS	0.10	mg/L		09-JUL-18	R4120768
Nitrate (as N)	<0.10	DLDS	0.10	mg/L		09-JUL-18	R4120768
Nitrite (as N)	<0.050	DLDS	0.050	mg/L		09-JUL-18	R4120768
Orthophosphate-Dissolved (as P)	0.0099		0.0030	mg/L		06-JUL-18	R4114407
Sulfate (SO4)	15.2	DLDS	1.5	mg/L		09-JUL-18	R4120768
Total Metals							
Aluminum (Al)-Total	1.73	DLHC	0.050	mg/L	06-JUL-18	06-JUL-18	R4113997
Antimony (Sb)-Total	<0.0010	DLHC	0.0010	mg/L	06-JUL-18	06-JUL-18	R4113997
Arsenic (As)-Total	0.0051	DLHC	0.0010	mg/L	06-JUL-18	06-JUL-18	R4113997
Barium (Ba)-Total	0.117	DLHC	0.0010	mg/L	06-JUL-18	06-JUL-18	R4113997
Beryllium (Be)-Total	<0.0010	DLHC	0.0010	mg/L	06-JUL-18	06-JUL-18	R4113997
Bismuth (Bi)-Total	<0.00050	DLHC	0.00050	mg/L	06-JUL-18	06-JUL-18	R4113997
Boron (B)-Total	<0.10	DLHC	0.10	mg/L	06-JUL-18	06-JUL-18	R4113997
Cadmium (Cd)-Total	<0.000050	DLHC	0.000050	mg/L	06-JUL-18	06-JUL-18	R4113997
Calcium (Ca)-Total	102	DLHC	0.50	mg/L	06-JUL-18	06-JUL-18	R4113997
Cesium (Cs)-Total	0.00018	DLHC	0.00010	mg/L	06-JUL-18	06-JUL-18	R4113997
Chromium (Cr)-Total	<0.0050	DLHC	0.0050	mg/L	06-JUL-18	06-JUL-18	R4113997
Cobalt (Co)-Total	0.0011	DLHC	0.0010	mg/L	06-JUL-18	06-JUL-18	R4113997
Copper (Cu)-Total	<0.010	DLHC	0.010	mg/L	06-JUL-18	06-JUL-18	R4113997
Iron (Fe)-Total	4.86	DLHC	0.10	mg/L	06-JUL-18	06-JUL-18	R4113997
Lead (Pb)-Total	0.00414	DLHC	0.00050	mg/L	06-JUL-18	06-JUL-18	R4113997
Magnesium (Mg)-Total	21.6	DLHC	0.050	mg/L	06-JUL-18	06-JUL-18	R4113997
Manganese (Mn)-Total	0.560	DLHC	0.0050	mg/L	06-JUL-18	06-JUL-18	R4113997
Molybdenum (Mo)-Total	0.00253	DLHC	0.00050	mg/L	06-JUL-18	06-JUL-18	R4113997
Nickel (Ni)-Total	<0.0050	DLHC	0.0050	mg/L	06-JUL-18	06-JUL-18	R4113997
Phosphorus (P)-Total	0.74	DLHC	0.50	mg/L	06-JUL-18	06-JUL-18	R4113997
Potassium (K)-Total	3.90	DLHC	0.50	mg/L	06-JUL-18	06-JUL-18	R4113997
Rubidium (Rb)-Total	0.0036	DLHC	0.0020	mg/L	06-JUL-18	06-JUL-18	R4113997
Selenium (Se)-Total	<0.00050	DLHC	0.00050	mg/L	06-JUL-18	06-JUL-18	R4113997
Silicon (Si)-Total	7.1	DLHC	1.0	mg/L	06-JUL-18	06-JUL-18	R4113997

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2124641-1 SW101 Sampled By: CLIENT on 05-JUL-18 @ 13:45 Matrix: WATER							
Total Metals							
Silver (Ag)-Total	<0.00050	DLHC	0.00050	mg/L	06-JUL-18	06-JUL-18	R4113997
Sodium (Na)-Total	409	DLHC	0.50	mg/L	06-JUL-18	06-JUL-18	R4113997
Strontium (Sr)-Total	0.386	DLHC	0.010	mg/L	06-JUL-18	06-JUL-18	R4113997
Sulfur (S)-Total	<5.0	DLHC	5.0	mg/L	06-JUL-18	06-JUL-18	R4113997
Tellurium (Te)-Total	<0.0020	DLHC	0.0020	mg/L	06-JUL-18	06-JUL-18	R4113997
Thallium (Tl)-Total	<0.00010	DLHC	0.00010	mg/L	06-JUL-18	06-JUL-18	R4113997
Thorium (Th)-Total	<0.0010	DLHC	0.0010	mg/L	06-JUL-18	06-JUL-18	R4113997
Tin (Sn)-Total	<0.0010	DLHC	0.0010	mg/L	06-JUL-18	06-JUL-18	R4113997
Titanium (Ti)-Total	<0.060	DLUI	0.060	mg/L	06-JUL-18	06-JUL-18	R4113997
Tungsten (W)-Total	<0.0010	DLHC	0.0010	mg/L	06-JUL-18	06-JUL-18	R4113997
Uranium (U)-Total	0.00096	DLHC	0.00010	mg/L	06-JUL-18	06-JUL-18	R4113997
Vanadium (V)-Total	0.0074	DLHC	0.0050	mg/L	06-JUL-18	06-JUL-18	R4113997
Zinc (Zn)-Total	<0.030	DLHC	0.030	mg/L	06-JUL-18	06-JUL-18	R4113997
Zirconium (Zr)-Total	<0.0030	DLHC	0.0030	mg/L	06-JUL-18	06-JUL-18	R4113997
L2124641-2 SW102 Sampled By: CLIENT on 05-JUL-18 @ 13:45 Matrix: WATER							
Physical Tests							
Colour, Apparent	62.4		2.0	CU		06-JUL-18	R4114336
Conductivity	447		3.0	umhos/cm		06-JUL-18	R4114791
Hardness (as CaCO3)	189	HTC	10	mg/L		06-JUL-18	
pH	8.13		0.10	pH units		06-JUL-18	R4114791
Total Suspended Solids	4.8		2.0	mg/L	10-JUL-18	11-JUL-18	R4122187
Total Dissolved Solids	274	DLDS	20	mg/L		09-JUL-18	R4119430
Turbidity	13.3		0.10	NTU		06-JUL-18	R4113972
Anions and Nutrients							
Alkalinity, Total (as CaCO3)	192		10	mg/L		09-JUL-18	R4120859
Ammonia, Total (as N)	0.023		0.020	mg/L		06-JUL-18	R4114383
Chloride (Cl)	30.1		0.50	mg/L		09-JUL-18	R4120768
Fluoride (F)	0.076		0.020	mg/L		09-JUL-18	R4120768
Nitrate (as N)	<0.020		0.020	mg/L		09-JUL-18	R4120768
Nitrite (as N)	<0.010		0.010	mg/L		09-JUL-18	R4120768
Orthophosphate-Dissolved (as P)	<0.0030		0.0030	mg/L		06-JUL-18	R4114407
Sulfate (SO4)	2.12		0.30	mg/L		09-JUL-18	R4120768
Total Metals							
Aluminum (Al)-Total	0.035		0.010	mg/L	06-JUL-18	06-JUL-18	R4113997
Antimony (Sb)-Total	0.00012		0.00010	mg/L	06-JUL-18	06-JUL-18	R4113997
Arsenic (As)-Total	0.00230		0.00010	mg/L	06-JUL-18	06-JUL-18	R4113997
Barium (Ba)-Total	0.0188		0.00020	mg/L	06-JUL-18	06-JUL-18	R4113997
Beryllium (Be)-Total	<0.00010		0.00010	mg/L	06-JUL-18	06-JUL-18	R4113997
Bismuth (Bi)-Total	<0.000050		0.000050	mg/L	06-JUL-18	06-JUL-18	R4113997
Boron (B)-Total	0.030		0.010	mg/L	06-JUL-18	06-JUL-18	R4113997

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2124641-2 SW102 Sampled By: CLIENT on 05-JUL-18 @ 13:45 Matrix: WATER							
Total Metals							
Cadmium (Cd)-Total	<0.000010		0.000010	mg/L	06-JUL-18	06-JUL-18	R4113997
Calcium (Ca)-Total	54.2		0.50	mg/L	06-JUL-18	06-JUL-18	R4113997
Cesium (Cs)-Total	<0.000010		0.000010	mg/L	06-JUL-18	06-JUL-18	R4113997
Chromium (Cr)-Total	<0.00050		0.00050	mg/L	06-JUL-18	06-JUL-18	R4113997
Cobalt (Co)-Total	0.00015		0.00010	mg/L	06-JUL-18	06-JUL-18	R4113997
Copper (Cu)-Total	<0.0010		0.0010	mg/L	06-JUL-18	06-JUL-18	R4113997
Iron (Fe)-Total	0.941		0.050	mg/L	06-JUL-18	06-JUL-18	R4113997
Lead (Pb)-Total	<0.00010		0.00010	mg/L	06-JUL-18	06-JUL-18	R4113997
Magnesium (Mg)-Total	13.0		0.050	mg/L	06-JUL-18	06-JUL-18	R4113997
Manganese (Mn)-Total	0.0641		0.00050	mg/L	06-JUL-18	06-JUL-18	R4113997
Molybdenum (Mo)-Total	0.000402		0.000050	mg/L	06-JUL-18	06-JUL-18	R4113997
Nickel (Ni)-Total	0.00057		0.00050	mg/L	06-JUL-18	06-JUL-18	R4113997
Phosphorus (P)-Total	0.059		0.050	mg/L	06-JUL-18	06-JUL-18	R4113997
Potassium (K)-Total	3.93		0.050	mg/L	06-JUL-18	06-JUL-18	R4113997
Rubidium (Rb)-Total	0.00063		0.00020	mg/L	06-JUL-18	06-JUL-18	R4113997
Selenium (Se)-Total	0.000123		0.000050	mg/L	06-JUL-18	06-JUL-18	R4113997
Silicon (Si)-Total	0.60		0.10	mg/L	06-JUL-18	06-JUL-18	R4113997
Silver (Ag)-Total	<0.000050		0.000050	mg/L	06-JUL-18	06-JUL-18	R4113997
Sodium (Na)-Total	17.5		0.50	mg/L	06-JUL-18	06-JUL-18	R4113997
Strontium (Sr)-Total	0.175		0.0010	mg/L	06-JUL-18	06-JUL-18	R4113997
Sulfur (S)-Total	0.86		0.50	mg/L	06-JUL-18	06-JUL-18	R4113997
Tellurium (Te)-Total	<0.00020		0.00020	mg/L	06-JUL-18	06-JUL-18	R4113997
Thallium (Tl)-Total	<0.000010		0.000010	mg/L	06-JUL-18	06-JUL-18	R4113997
Thorium (Th)-Total	<0.00010		0.00010	mg/L	06-JUL-18	06-JUL-18	R4113997
Tin (Sn)-Total	<0.00010		0.00010	mg/L	06-JUL-18	06-JUL-18	R4113997
Titanium (Ti)-Total	<0.0010	DLUI	0.0010	mg/L	06-JUL-18	06-JUL-18	R4113997
Tungsten (W)-Total	<0.00010		0.00010	mg/L	06-JUL-18	06-JUL-18	R4113997
Uranium (U)-Total	0.000482		0.000010	mg/L	06-JUL-18	06-JUL-18	R4113997
Vanadium (V)-Total	<0.00050		0.00050	mg/L	06-JUL-18	06-JUL-18	R4113997
Zinc (Zn)-Total	<0.0030		0.0030	mg/L	06-JUL-18	06-JUL-18	R4113997
Zirconium (Zr)-Total	<0.00030		0.00030	mg/L	06-JUL-18	06-JUL-18	R4113997

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Total	MS-B	L2124641-1, -2
Matrix Spike	Boron (B)-Total	MS-B	L2124641-1, -2
Matrix Spike	Calcium (Ca)-Total	MS-B	L2124641-1, -2
Matrix Spike	Iron (Fe)-Total	MS-B	L2124641-1, -2
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2124641-1, -2
Matrix Spike	Manganese (Mn)-Total	MS-B	L2124641-1, -2
Matrix Spike	Phosphorus (P)-Total	MS-B	L2124641-1, -2
Matrix Spike	Potassium (K)-Total	MS-B	L2124641-1, -2
Matrix Spike	Rubidium (Rb)-Total	MS-B	L2124641-1, -2
Matrix Spike	Silicon (Si)-Total	MS-B	L2124641-1, -2
Matrix Spike	Sodium (Na)-Total	MS-B	L2124641-1, -2
Matrix Spike	Strontium (Sr)-Total	MS-B	L2124641-1, -2
Matrix Spike	Sulfur (S)-Total	MS-B	L2124641-1, -2
Matrix Spike	Zinc (Zn)-Total	MS-B	L2124641-1, -2

Sample Parameter Qualifier key listed:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
DLUI	Detection Limit Raised: Unknown Interference generated an apparent false positive test result.
HTC	Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-WT	Water	Alkalinity, Total (as CaCO3)	EPA 310.2

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.

CL-IC-N-WT	Water	Chloride by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

COLOUR-APPARENT-WT	Water	Colour	APHA 2120

Apparent Colour is measured spectrophotometrically by comparison to platinum-cobalt standards using the single wavelength method after sample decanting. Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

EC-WT	Water	Conductivity	APHA 2510 B

Water samples can be measured directly by immersing the conductivity cell into the sample.

F-IC-N-WT	Water	Fluoride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-WT	Water	Hardness	APHA 2340 B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

MET-T-CCMS-WT	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

NH3-WT	Water	Ammonia, Total as N	EPA 350.1

Sample is measured colorimetrically. When sample is turbid a distillation step is required, sample is distilled into a solution of boric acid and measured colorimetrically.

NO2-IC-WT	Water	Nitrite in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-IC-WT	Water	Nitrate in Water by IC	EPA 300.1 (mod)

Reference Information

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-WT Water pH APHA 4500 H-Electrode
Water samples are analyzed directly by a calibrated pH meter.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011). Holdtime for samples under this regulation is 28 days

PO4-DO-COL-WT Water Diss. Orthophosphate in Water by Colour APHA 4500-P PHOSPHORUS
This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

SO4-IC-N-WT Water Sulfate in Water by IC EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

SOLIDS-TDS-WT Water Total Dissolved Solids APHA 2540C
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

SOLIDS-TSS-WT Water Suspended solids APHA 2540 D-Gravimetric
A well-mixed sample is filtered through a weighed standard glass fibre filter and the residue retained is dried in an oven at 104–1°C for a minimum of four hours or until a constant weight is achieved.

TURBIDITY-WT Water Turbidity APHA 2130 B
Sample result is based on a comparison of the intensity of the light scattered by the sample under defined conditions with the intensity of light scattered by a standard reference suspension under the same conditions. Sample readings are obtained from a Nephelometer.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Chain of Custody Numbers:

17-626141

GLOSSARY OF REPORT TERMS
Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid weight of sample
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: MTE CONSULTANTS INC.
520 BINGEMANS CENTRE DRIVE
KITCHENER ON N2B 3X9
Contact: ANDREW BINGEMAN

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-WT	**Water**							
Batch R4120859								
WG2817578-3 CRM		**WT-ALK-CRM**						
Alkalinity, Total (as CaCO3)			97.2		%		80-120	09-JUL-18
WG2817578-2 LCS								
Alkalinity, Total (as CaCO3)			101.5		%		85-115	09-JUL-18
WG2817578-1 MB								
Alkalinity, Total (as CaCO3)			<10		mg/L		10	09-JUL-18
CL-IC-N-WT	**Water**							
Batch R4120768								
WG2817301-12 LCS								
Chloride (Cl)			102.1		%		90-110	09-JUL-18
WG2817301-11 MB								
Chloride (Cl)			<0.50		mg/L		0.5	09-JUL-18
COLOUR-APPARENT-WT	**Water**							
Batch R4114336								
WG2815428-2 LCS								
Colour, Apparent			106.7		%		85-115	06-JUL-18
WG2815428-1 MB								
Colour, Apparent			<2.0		CU		2	06-JUL-18
EC-WT	**Water**							
Batch R4114791								
WG2815438-6 LCS								
Conductivity			97.4		%		90-110	06-JUL-18
WG2815438-5 MB								
Conductivity			<3.0		umhos/cm		3	06-JUL-18
F-IC-N-WT	**Water**							
Batch R4120768								
WG2817301-12 LCS								
Fluoride (F)			102.0		%		90-110	09-JUL-18
WG2817301-11 MB								
Fluoride (F)			<0.020		mg/L		0.02	09-JUL-18
MET-T-CCMS-WT	**Water**							
Batch R4113997								
WG2815378-2 LCS								
Aluminum (Al)-Total			102.0		%		80-120	06-JUL-18
Antimony (Sb)-Total			100.3		%		80-120	06-JUL-18
Arsenic (As)-Total			99.7		%		80-120	06-JUL-18
Barium (Ba)-Total			102.8		%		80-120	06-JUL-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	**Water**							
Batch R4113997								
WG2815378-2 LCS								
Beryllium (Be)-Total			98.6		%		80-120	06-JUL-18
Bismuth (Bi)-Total			102.0		%		80-120	06-JUL-18
Boron (B)-Total			93.8		%		80-120	06-JUL-18
Cadmium (Cd)-Total			99.5		%		80-120	06-JUL-18
Calcium (Ca)-Total			97.9		%		80-120	06-JUL-18
Chromium (Cr)-Total			96.4		%		80-120	06-JUL-18
Cesium (Cs)-Total			101.9		%		80-120	06-JUL-18
Cobalt (Co)-Total			99.0		%		80-120	06-JUL-18
Copper (Cu)-Total			98.5		%		80-120	06-JUL-18
Iron (Fe)-Total			97.1		%		80-120	06-JUL-18
Lead (Pb)-Total			103.6		%		80-120	06-JUL-18
Magnesium (Mg)-Total			98.4		%		80-120	06-JUL-18
Manganese (Mn)-Total			99.96		%		80-120	06-JUL-18
Molybdenum (Mo)-Total			102.5		%		80-120	06-JUL-18
Nickel (Ni)-Total			99.5		%		80-120	06-JUL-18
Phosphorus (P)-Total			100.0		%		70-130	06-JUL-18
Potassium (K)-Total			97.9		%		80-120	06-JUL-18
Rubidium (Rb)-Total			105.3		%		80-120	06-JUL-18
Selenium (Se)-Total			98.2		%		80-120	06-JUL-18
Silicon (Si)-Total			96.8		%		60-140	06-JUL-18
Silver (Ag)-Total			96.9		%		80-120	06-JUL-18
Sodium (Na)-Total			98.4		%		80-120	06-JUL-18
Strontium (Sr)-Total			102.7		%		80-120	06-JUL-18
Sulfur (S)-Total			92.4		%		80-120	06-JUL-18
Thallium (Tl)-Total			102.4		%		80-120	06-JUL-18
Tellurium (Te)-Total			98.3		%		80-120	06-JUL-18
Thorium (Th)-Total			104.6		%		70-130	06-JUL-18
Tin (Sn)-Total			99.8		%		80-120	06-JUL-18
Titanium (Ti)-Total			95.0		%		80-120	06-JUL-18
Tungsten (W)-Total			101.9		%		80-120	06-JUL-18
Uranium (U)-Total			107.4		%		80-120	06-JUL-18
Vanadium (V)-Total			100.6		%		80-120	06-JUL-18
Zinc (Zn)-Total			93.1		%		80-120	06-JUL-18
Zirconium (Zr)-Total			99.0		%		80-120	06-JUL-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	**Water**							
Batch R4113997								
WG2815378-1 MB								
Aluminum (Al)-Total			<0.0050		mg/L		0.005	06-JUL-18
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	06-JUL-18
Arsenic (As)-Total			<0.00010		mg/L		0.0001	06-JUL-18
Barium (Ba)-Total			<0.00010		mg/L		0.0001	06-JUL-18
Beryllium (Be)-Total			<0.00010		mg/L		0.0001	06-JUL-18
Bismuth (Bi)-Total			<0.000050		mg/L		0.00005	06-JUL-18
Boron (B)-Total			<0.010		mg/L		0.01	06-JUL-18
Cadmium (Cd)-Total			<0.000005C		mg/L		0.000005	06-JUL-18
Calcium (Ca)-Total			<0.050		mg/L		0.05	06-JUL-18
Chromium (Cr)-Total			<0.00050		mg/L		0.0005	06-JUL-18
Cesium (Cs)-Total			<0.000010		mg/L		0.00001	06-JUL-18
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	06-JUL-18
Copper (Cu)-Total			<0.0010		mg/L		0.001	06-JUL-18
Iron (Fe)-Total			<0.010		mg/L		0.01	06-JUL-18
Lead (Pb)-Total			<0.000050		mg/L		0.00005	06-JUL-18
Magnesium (Mg)-Total			<0.0050		mg/L		0.005	06-JUL-18
Manganese (Mn)-Total			<0.00050		mg/L		0.0005	06-JUL-18
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	06-JUL-18
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	06-JUL-18
Phosphorus (P)-Total			<0.050		mg/L		0.05	06-JUL-18
Potassium (K)-Total			<0.050		mg/L		0.05	06-JUL-18
Rubidium (Rb)-Total			<0.00020		mg/L		0.0002	06-JUL-18
Selenium (Se)-Total			<0.000050		mg/L		0.00005	06-JUL-18
Silicon (Si)-Total			<0.10		mg/L		0.1	06-JUL-18
Silver (Ag)-Total			<0.000050		mg/L		0.00005	06-JUL-18
Sodium (Na)-Total			<0.050		mg/L		0.05	06-JUL-18
Strontium (Sr)-Total			<0.0010		mg/L		0.001	06-JUL-18
Sulfur (S)-Total			<0.50		mg/L		0.5	06-JUL-18
Thallium (Tl)-Total			<0.000010		mg/L		0.00001	06-JUL-18
Tellurium (Te)-Total			<0.00020		mg/L		0.0002	06-JUL-18
Thorium (Th)-Total			<0.00010		mg/L		0.0001	06-JUL-18
Tin (Sn)-Total			<0.00010		mg/L		0.0001	06-JUL-18
Titanium (Ti)-Total			<0.00030		mg/L		0.0003	06-JUL-18
Tungsten (W)-Total			<0.00010		mg/L		0.0001	06-JUL-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	**Water**							
Batch R4113997								
WG2815378-1 MB								
Uranium (U)-Total			<0.000010		mg/L		0.00001	06-JUL-18
Vanadium (V)-Total			<0.00050		mg/L		0.0005	06-JUL-18
Zinc (Zn)-Total			<0.0030		mg/L		0.003	06-JUL-18
Zirconium (Zr)-Total			<0.00030		mg/L		0.0003	06-JUL-18
NH3-WT	**Water**							
Batch R4114383								
WG2815492-10 LCS								
Ammonia, Total (as N)			100.2		%		85-115	06-JUL-18
WG2815492-9 MB								
Ammonia, Total (as N)			<0.020		mg/L		0.02	06-JUL-18
NO2-IC-WT	**Water**							
Batch R4120768								
WG2817301-12 LCS								
Nitrite (as N)			101.8		%		70-130	09-JUL-18
WG2817301-11 MB								
Nitrite (as N)			<0.010		mg/L		0.01	09-JUL-18
NO3-IC-WT	**Water**							
Batch R4120768								
WG2817301-12 LCS								
Nitrate (as N)			101.1		%		70-130	09-JUL-18
WG2817301-11 MB								
Nitrate (as N)			<0.020		mg/L		0.02	09-JUL-18
PH-WT	**Water**							
Batch R4114791								
WG2815438-6 LCS								
pH			7.00		pH units		6.9-7.1	06-JUL-18
PO4-DO-COL-WT	**Water**							
Batch R4114407								
WG2815497-6 LCS								
Orthophosphate-Dissolved (as P)			102.9		%		70-130	06-JUL-18
WG2815497-5 MB								
Orthophosphate-Dissolved (as P)			<0.0030		mg/L		0.003	06-JUL-18
SO4-IC-N-WT	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SO4-IC-N-WT	**Water**							
Batch R4120768								
WG2817301-12 LCS								
Sulfate (SO4)			102.8		%		90-110	09-JUL-18
WG2817301-11 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	09-JUL-18
SOLIDS-TDS-WT	**Water**							
Batch R4119430								
WG2817308-2 LCS								
Total Dissolved Solids			97.7		%		85-115	09-JUL-18
WG2817308-1 MB								
Total Dissolved Solids			<10		mg/L		10	09-JUL-18
SOLIDS-TSS-WT	**Water**							
Batch R4122187								
WG2818030-2 LCS								
Total Suspended Solids			102.9		%		85-115	11-JUL-18
WG2818030-1 MB								
Total Suspended Solids			<2.0		mg/L		2	11-JUL-18
TURBIDITY-WT	**Water**							
Batch R4113972								
WG2815502-2 LCS								
Turbidity			107.0		%		85-115	06-JUL-18
WG2815502-1 MB								
Turbidity			<0.10		NTU		0.1	06-JUL-18

Quality Control Report

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

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Canada Toll Free: 1 800 668 9878

L2124641-COFC

COC Number: 17 - 626141

Page 1 of 1

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)
Company:	MTE	Select Report Format: [X] PDF [ ] EXCEL [ ] EDD (DIGITAL)	Regular [R] [X] Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	Andrew Bingeman	Quality Control (QC) Report with Report [X] YES [ ] NO	PRIORITY (Business Days): 4 day [P4-20%] [ ]; 3 day [P3-25%] [ ]; 2 day [P2-50%] [ ]
Phone:	(519) 743-6500	[ ] Compare Results to Criteria on Report - provide details below if box checked	EMERGENCY: 1 Business day [E-100%] [ ]; Same Day, Weekend or Statutory holiday [E2-200%] (Laboratory opening fees may apply) [ ]
	Company address below will appear on the final report	Select Distribution: [X] EMAIL [ ] MAIL [ ] FAX	
Street:	520 Bingemans Centre Dr.	Email 1 or Fax: abingeman@mte85.com	Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm
City/Province:	Kitchener ON	Email 2	For tests that can not be performed according to the service level selected, you will be contacted.
Postal Code:	[redacted]	Email 3	

Invoice To		Invoice Distribution	
	Same as Report To [ ] YES [X] NO	Select Invoice Distribution: [X] EMAIL [ ] MAIL [ ] FAX	
	Copy of Invoice with Report [ ] YES [X] NO	Email 1 or Fax: accounting@mte85.com	
Company:	MTE	Email 2	
Contact:	Accounting		

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:	34280-1.01	Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):	L2124641 OSC	ALS Contact: MM	Sampler:

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total metals	Gen Chem. 1	TSS	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
	SW101	05-Jul-18	13:45	Water	X	X	X			4
	SW102	↓	12:15	↓	X	X	X			4

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? [ ] YES [X] NO	total metals.
Are samples for human consumption/ use? [ ] YES [X] NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	[ ]	SIF Observations	Yes [ ]	No [ ]	
Ice Packs	[ ] Ice Cubes [X]	Custody seal intact	Yes [ ]	No [ ]	
Cooling Initiated	[X]				

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
				20.1			

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
	05-Jul-18	16:27				W	05/7/18	16:25

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

JULY 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

MTE CONSULTANTS INC. (Kitchener)
ATTN: JAKE CARMAN
520 BINGEMANS CENTRE DRIVE
KITCHENER ON N2B 3X9

Date Received: 08-AUG-18
Report Date: 15-AUG-18 12:30 (MT)
Version: FINAL

Client Phone: 519-743-6500

Certificate of Analysis

Lab Work Order #: L2143413

Project P.O. #: NOT SUBMITTED
Job Reference: 34280-101
C of C Numbers: 14-457981
Legal Site Desc:

Mary-Lynn Pike
Client Services Supervisor

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2143413-1 230Q Sampled By: J. CARMAN on 08-AUG-18 @ 10:00 Matrix: WATER							
Physical Tests							
Total Suspended Solids	15.6	DLHC	1.0	mg/L	09-AUG-18	10-AUG-18	R4163154
Anions and Nutrients							
Chloride (Cl)	344		0.50	mg/L		10-AUG-18	R4165753
Nitrate (as N)	0.110		0.020	mg/L		10-AUG-18	R4165753
Phosphorus (P)-Total Dissolved	0.0545		0.0030	mg/L	13-AUG-18	15-AUG-18	R4169433
Phosphorus, Total	0.135		0.0030	mg/L	13-AUG-18	14-AUG-18	R4168437
Total Metals							
Copper (Cu)-Total	0.0025		0.0010	mg/L	09-AUG-18	13-AUG-18	R4162696
Lead (Pb)-Total	0.00069		0.00010	mg/L	09-AUG-18	13-AUG-18	R4162696
Zinc (Zn)-Total	0.0087		0.0030	mg/L	09-AUG-18	13-AUG-18	R4162696
L2143413-2 233Q Sampled By: J. CARMAN on 08-AUG-18 @ 10:00 Matrix: WATER							
Physical Tests							
Total Suspended Solids	273	DLHC	5.0	mg/L	09-AUG-18	10-AUG-18	R4163154
Anions and Nutrients							
Chloride (Cl)	3.11		0.50	mg/L		10-AUG-18	R4165753
Nitrate (as N)	0.066		0.020	mg/L		10-AUG-18	R4165753
Phosphorus (P)-Total Dissolved	0.0766		0.0030	mg/L	13-AUG-18	15-AUG-18	R4169433
Phosphorus, Total	0.815	DLM	0.030	mg/L	13-AUG-18	14-AUG-18	R4168437
Total Metals							
Copper (Cu)-Total	0.036	DLHC	0.010	mg/L	09-AUG-18	13-AUG-18	R4162696
Lead (Pb)-Total	0.0168	DLHC	0.00050	mg/L	09-AUG-18	13-AUG-18	R4162696
Zinc (Zn)-Total	0.109	DLHC	0.030	mg/L	09-AUG-18	13-AUG-18	R4162696
L2143413-3 235Q Sampled By: J. CARMAN on 08-AUG-18 @ 14:00 Matrix: WATER							
Physical Tests							
Total Suspended Solids	15.5	DLHC	1.0	mg/L	09-AUG-18	10-AUG-18	R4163154
Anions and Nutrients							
Chloride (Cl)	293		0.50	mg/L		10-AUG-18	R4165753
Nitrate (as N)	<0.020		0.020	mg/L		10-AUG-18	R4165753
Phosphorus (P)-Total Dissolved	0.0155		0.0030	mg/L	13-AUG-18	15-AUG-18	R4169433
Phosphorus, Total	0.0785		0.0030	mg/L	13-AUG-18	14-AUG-18	R4168437
Total Metals							
Copper (Cu)-Total	0.0021		0.0010	mg/L	09-AUG-18	13-AUG-18	R4162696
Lead (Pb)-Total	0.00088		0.00010	mg/L	09-AUG-18	13-AUG-18	R4162696
Zinc (Zn)-Total	0.0099		0.0030	mg/L	09-AUG-18	13-AUG-18	R4162696

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Chloride (Cl)	MS-B	L2143413-1, -2, -3
Matrix Spike	Phosphorus, Total	MS-B	L2143413-1, -2, -3

Sample Parameter Qualifier key listed:

Qualifier	Description
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
CL-IC-N-WT	Water	Chloride by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

MET-T-CCMS-WT	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

NO3-IC-WT	Water	Nitrate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

P-T-COL-WT	Water	Total P in Water by Colour	APHA 4500-P PHOSPHORUS

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is deteremined colourimetrically after persulphate digestion of the sample.

P-TD-COL-WT	Water	Total Dissolved P in Water by Colour	APHA 4500-P B E

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorus is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

P-TD-COL-WT	Water	Total Dissolved P in Water by Colour	APHA 4500-P PHOSPHORUS

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorus is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

SOLIDS-TSS-LOW-WT	Water	Total Suspended Solids to 0.5 mg/L	APHA 2540 D-Gravimetric

A well-mixed sample is filtered through a weighed standard glass fibre filter and the residue retained is dried in an oven at 104–1°C for a minimum of four hours or until a constant weight is achieved.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Chain of Custody Numbers:

14-457981

Reference Information

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid weight of sample
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: MTE CONSULTANTS INC. (Kitchener)
520 BINGEMANS CENTRE DRIVE
KITCHENER ON N2B 3X9
Contact: JAKE CARMAN

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CL-IC-N-WT	**Water**							
Batch R4165753								
WG2846885-12 LCS								
Chloride (Cl)			100.3		%		90-110	10-AUG-18
WG2846885-17 LCS								
Chloride (Cl)			100.0		%		90-110	10-AUG-18
WG2846885-11 MB								
Chloride (Cl)			<0.50		mg/L		0.5	10-AUG-18
WG2846885-16 MB								
Chloride (Cl)			<0.50		mg/L		0.5	10-AUG-18
MET-T-CCMS-WT	**Water**							
Batch R4162696								
WG2845091-2 LCS								
Copper (Cu)-Total			99.5		%		80-120	10-AUG-18
Lead (Pb)-Total			104.5		%		80-120	10-AUG-18
Zinc (Zn)-Total			95.0		%		80-120	10-AUG-18
WG2845091-1 MB								
Copper (Cu)-Total			<0.0010		mg/L		0.001	10-AUG-18
Lead (Pb)-Total			<0.000050		mg/L		0.00005	10-AUG-18
Zinc (Zn)-Total			<0.0030		mg/L		0.003	10-AUG-18
NO3-IC-WT	**Water**							
Batch R4165753								
WG2846885-12 LCS								
Nitrate (as N)			100.5		%		70-130	10-AUG-18
WG2846885-17 LCS								
Nitrate (as N)			100.1		%		70-130	10-AUG-18
WG2846885-11 MB								
Nitrate (as N)			<0.020		mg/L		0.02	10-AUG-18
WG2846885-16 MB								
Nitrate (as N)			<0.020		mg/L		0.02	10-AUG-18
P-T-COL-WT	**Water**							
Batch R4168437								
WG2847541-2 LCS								
Phosphorus, Total			94.2		%		80-120	14-AUG-18
WG2847541-1 MB								
Phosphorus, Total			<0.0030		mg/L		0.003	14-AUG-18
P-TD-COL-WT	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
P-TD-COL-WT	**Water**							
Batch R4169433								
WG2847948-2 LCS								
Phosphorus (P)-Total	Dissolved		95.1		%		80-120	15-AUG-18
WG2847948-1 MB								
Phosphorus (P)-Total	Dissolved		<0.0030		mg/L		0.003	15-AUG-18
SOLIDS-TSS-LOW-WT	**Water**							
Batch R4163154								
WG2844831-2 LCS								
Total Suspended Solids			98.4		%		85-115	10-AUG-18
WG2844831-1 MB								
Total Suspended Solids			<0.50		mg/L		0.5	10-AUG-18

Quality Control Report

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

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Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

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Canada Toll Free: 1 800 668 9878

L2143413-COFC

COC Number: 14 - 457981

Page 1 of 1

Report To		Report Format / Distribution		Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)*	
Company:	MTE Consultants Inc.	Select Report Format:	[x] PDF [ ] EXCEL [ ] EDD (DIGITAL)	R [x]	Regular (Standard TAT if received by 3pm)
Contact:	Jake Carman	Quality Control (QC) Report with Report	[x] Yes [ ] No	P [ ]	Priority (2-4 business days if received by 3pm)
Address:	520 Bingemans Centre Drive, Kitchener, ON N2B 3X9	[x] Criteria on Report - provide details below if box checked		E [ ]	Emergency (1-2 business days if received by 3pm)
Phone:	519-743-6500 ext. 1273	Select Distribution:	[x] EMAIL [ ] MAIL [ ] FAX	E2 [ ]	Same day or weekend emergency if received by 10am - contact ALS for surcharge.
		Email 1 or Fax	jcarman@mte85.com	Specify Date Required for E2,E or P:	
		Email 2			

Invoice To	Same as Report To	[ ] Yes [x] No	Invoice Distribution		
	Copy of Invoice with Report	[ ] Yes [x] No	Select Invoice Distribution:	[x] EMAIL [ ] MAIL [ ] FAX	
Company:	MTE Consultants Inc.		Email 1 or Fax	accounting@mte85.com	
Contact:	Gail Reddatz		Email 2		

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:		Approver ID:	Cost Center:
Job #:	34280-101	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	
ALS Lab Work Order # (lab use only)	L2143413 COC	ALS Contact:	Sampler: Jake Carman

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	TSS LOW	TURBIDITY	Chloride	Nitrates	Total Phosphorus	Total Dissolved Phosphorus	Lead	Copper	Zinc	Number of Containers
	230Q	8-Aug-18	9am	WATER	X	X		X	X	X	X	X	X	
2	233Q	↓			X	X		X	X	X	X	X	X	
3	235Q	↓	2pm	↓	X	X		X	X	X	X	X	X	

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)
Are samples taken from a Regulated DW System? [ ] Yes [x] No	
Are samples for human drinking water use? [ ] Yes [x] No	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen: [ ]	SIF Observations	Yes [ ]	No [ ]
Ice packs [ ] Yes [ ] No	Custody seal intact	Yes [ ]	No [ ]
Cooling Initiated [ ]			

INITIAL COOLER TEMPERATURES °C		FINAL COOLER TEMPERATURES °C	
		21.0	

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Jake Carman	Date: 8-Aug-18	Time: 3:06	Received by:	Date:	Time:	Received by:	Date: Aug 08/18	Time: 15:00

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

TAB 3

TECHNICAL MEMORANDUM

MTE FILE NO.: C 34280-101
DATE: December 4, 2018
PREPARED BY: Jake Carman, E.I.T.

Re: Surface Water Monitoring
West Waterloo, Westhill District (WW-WD)
North/South Collector Rd (NS-CR)

1.0 INTRODUCTION

The purpose of this memorandum is to describe the local watercourses and surface water monitoring program (established in 2018) for the drainage area associated with the West Waterloo, Westhill District (WW-WD) North/South Collector Rd (NS-CR). The Surface Water Monitoring study area is located southwest of the intersection of Erb Street and Ira Needles Boulevard, encompassed by Erb Street to the north, Region of Waterloo Landfill to the west, Ira Needles Boulevard to the east and The Boardwalk commercial plaza to the south. The drainage area also contains the Westhill Meadows Golf Course and is bisected by a hydro corridor.

The Waterloo Commons wetland is the ultimate downstream receiver of the overall drainage area, receiving drainage from the Region of Waterloo Landfill Stormwater Management (SWM) Facility, Cressman lands, Hydro Corridor, Westhill Meadows Golf Course and the Waterloo Commons commercial development. Surface runoff draining to the Waterloo Commons wetland feature is attenuated by an orifice-controlled outlet into the Erb Street storm sewer. Waterloo Commons wetland feature receives approximately 34.4ha of local surface drainage (refer to Catchment A on **Figure 1.1: Existing Catchment Areas and Monitoring Locations**) as well as approximately 36.6 ha of controlled drainage from the Region of Waterloo Landfill SWM Facility to the west and approximately 5.4 ha of drainage from Ira Needles Boulevard including Westhill Drive to the east. Additionally, local groundwater movements contribute to the Waterloo Commons wetland feature. The rate of contribution will need to be further observed over time to confirm any suspected trends. Based on summer 2018 monitoring the contributions have been slow and small in volume; likely due to clay/silt characteristics of the underlying soils. For further details about local groundwater characteristics refer to the **Hydrogeological Assessment – West Waterloo, Westhill District (WW-WD), North/South Collector Rd (NS-CR)** (MTE, 2018). The surface water monitoring program will continue past 2018 to provide a larger sample size and further populate the data set of the early monitoring observations.

MTE Consultants Inc. www.mte85.com
520 Bingemans Centre Drive
Kitchener, Ontario N2B 3X9
Phone: 519-743-6500
Fax: 519-743-6513

2.0 DRAINAGE AREA CHARACTERIZATION, WATERCOURSES AND CATCHMENT AREAS

The overall catchment area collectively drains to the Waterloo Commons SWM/wetland feature. For the purpose of this study, five sub-catchments have been identified for further detail and analysis of local wetland features and depression storage. These catchment areas are illustrated on **Figure 1.1**.

Sub-Catchment 1 is located at the south-west corner of the drainage area, and represents 6.16 ha of hydro corridor lands which drain into the wetland identified as HEPC South. This catchment is currently, and has historically, been used as agricultural lands and is zoned as OS1/Open Space One. The ultimate overflow of this sub-catchment is north towards the Waterloo Commons SWM/wetland feature and Erb Street.

Sub-Catchment 2 is located along the south-east edge of Catchment Area A and represents 5.39 ha of FD/Future Determination zoned land which is currently being used as portions of the Westhill Meadows Golf Course as well as greenfield lands. This catchment drains into two wetland features on the Cressman property identified as Cressman West and the Former Cressman East. The southern portion of the catchment generally drains into the Cressman West wetland with any overflow volumes flowing into the Former Cressman East. The ultimate overflow of this sub-catchment is north-west from the Former Cressman East wetland feature towards the local topographical draw through the Westhill Meadows Golf Course.

Sub-Catchment 3 is located along the northern portion of the west side of Catchment Area A and represents 1.01 ha of OS1/Open Space 1 zoned land which drains into a wetland identified as HEPC North. This land is currently being used as agricultural and greenfield lands. The ultimate overflow for this catchment is east towards the Waterloo Commons wetland.

Sub-Catchment 4 is located at the north-east corner of Catchment Area A and represents the Waterloo Commons commercial development. This development has an area of 2.87 ha and controls runoff utilizing an outlet at the southwest portion of the sub-catchment directing rainfall into a stormwater management control feature which further directs the runoff into the Waterloo Commons wetland. This sub-catchment is zoned as mixed-use neighbourhood commercial (C2-40) and is comprised of a commercial plaza with associated parking.

Sub-Catchment 5 is located along the north edge of Catchment Area A and represents the 0.78 ha uncontrolled portion of Erb Street which drains to the low point in the road and further into the Waterloo Commons wetland. This uncontrolled runoff from this section of road will contain high concentrations of road salt/chlorides during the winter and spring melt seasons. **Table 2.0** summarizes the zoning, size and identification number of each sub-catchment.

Table 2.0 - Westhill Catchment Areas		
Sub-Catchment	Zoning	Area
1	OS1/Open Space One	6.16
2	FD/Future Determination	5.39
3	OS1/Open Space One	1.01
4	C2-40/Mixed-Use Neighbourhood Commercial	2.87
5	Erb Street	0.78
A *	Varies	34.38

*Includes only local surface runoff within the study area. An additional 36.6 ha of drainage area from the Region of Waterloo Landfill SWMP site and 5.4 ha from the Westhill Road/Ira Needles Boulevard area

3.0 MONITORING STATION INSTALLATION, DEVICES & BENCHMARKING

The monitoring stations generally consist of 7 foot long T-bars buried approximately one metre below the surface, an attached perforated PVC pipe to house the pressure transducer, and a staff gauge (one metre high) to provide a local reference for field observations of water level. The pressure transducer is hung inside of the PVC pipe with a locking well cap such that the sensor located at or just above the local ground elevation.

The monitoring program is conducted through the use of HOBO U20 water level data loggers at monitoring locations 231P, 232P, 233P, 234P and 235P. A HOBO MX2001 BLE level logger is used at monitoring location 230P. Location 230P also served as the local barometric data station. Each unit is programmed to log water level and temperature data in one hour increments.

As a result of using these types of loggers, inconsistencies in the raw data may occur due to the following:

- In order to retrieve the data from the loggers, the loggers must be removed from the water and may take some time to acclimatize/re-settle to actual water temperatures and levels once re-installed. These disruptions are particularly noticeable in locations with small volumes of cooler water; any of these occurrences will be clearly labelled on monitoring analysis figures.
- During the periods where the loggers were unattended, it has been observed that loggers are occasionally tampered with and loggers become displaced. If this occurrence is observed, the erroneous data will removed or clearly labelled in plots and the summaries.

Refer to **Table 3.1** for station specific details, including: start dates, watercourse, location descriptions and coordinates.

Table 3.1: West Hill Monitoring Locations

Station Label	Start Date	Description	Location Coordinates (UTM NAD83 Zone 17)
230 P (SW)	Summer 2018	Waterloo Commons WL Near Outlet HW	534514, 4810353
231 P (SW)	Summer 2018	HEPC North Wetland	534450, 4810151
232 P (SW)	Summer 2018	Cressman West WL	534882, 4809940
233 P (SW)	Summer 2018	SWM Retention Area (Former Cressman East WL)	534957, 4810001
234 P (SW)	Summer 2018	HEPC South Wetland	534590, 4809893
235 P (SW)	Summer 2018	Region Landfill SWMP	534370, 4810199

4.0 DATA ANALYSIS

4.1 Water Level Monitoring Analysis

Water level monitoring graphs have been created for summer 2018 showing the depth logged by the pressure transducer as a function of time. Rainfall data from the GRCA Blair Creek weather station was plotted to help establish the relationship between rainfall and the water level at various locations within the drainage area. Monthly precipitation data over the monitoring period from the GRCA Blair Creek weather station is summarized in **Table 4.0**.

TABLE 4.0: Monthly Precipitation Summary

Precipitation - GRCA Blair Creek Weather Station			
2010-2017 Average		2018	
Month	Rain (mm)	Month	Rain (mm)
Jan	37.3	Jan	79
Feb	29.0	Feb	74
Mar	54.3	Mar	42.6
Apr	86.8	Apr	91.6
May	81.6	May	66
Jun	86.8	Jun	82.8
Jul	85.8	Jul	50.8
Aug	72.4	Aug	118
Sep	93.5	Sep	42.4
Oct	98.8	Oct	111.2
Nov	63.4	Nov	96.6
Dec	40.3	Dec	-
Total	**829.8**	**Total**	**855.0**

Location 230P – Waterloo Commons SWM/Wetland

The Waterloo Commons SWM/wetland feature exists immediately south of Erb Street, east of the Waterloo Regional Landfill and west of the driveway access to the commercial block at the corner of Erb Street and Ira Needles Boulevard. The Waterloo Commons SWM/wetland feature is a pond that has seasonally dependant volumes of standing water. There is an associated GRCA classified wetland area surrounding the pond area. This feature has a defined outlet to the storm sewer within Erb Street, though the outlet has been seen to be frequently clogged with mud and organic debris, causing water levels in the wetland to typically be higher than designed. Debris impeding the outlet is removed during pressure transducer download dates, but has been found to re-clog very quickly since the base level of mud and debris in the wetland is higher than the outlet elevation. Water levels did not appear to noticeably change following any of these download/outlet clearing dates throughout summer 2018.

The monitoring station is located immediately upstream of the orifice controlled storm outlet, within the GRCA categorized wetland. The Waterloo Commons SWM/wetland receives surface water inputs from several local watercourses including local surface runoff from the adjacent portions of agricultural/greenfield lands as well as Erb Street and the Region of Waterloo Landfill SWM Pond. The Waterloo Commons SWM/wetland also functions as a stormwater detention basin for volume control in parallel with the upstream SWM forebay/detention basin which is west of the Waterloo Commons commercial block parking lot.

From late June through November water levels varied from 377.16 to approximately 377.66, responding to rainfall events with spikes in elevation and droughts with gradual declines due to evaporation. The storm serviced outlet of this wetland was surveyed in August 2018 with an elevation of 377.20. Water levels rarely drop to the invert elevation, likely a result of the clogging of the outlet orifice with organic matter causing a higher water level. It appears that the water levels within this wetland decrease at a slower rate than other local wetlands, which suggests contributions from the local groundwater flows and underlying soil conditions with low permeability.

Location 231P – HEPC North

The HEPC North location is located immediately east of the City of Waterloo Landfill SWM facility, south of Erb Street and west of the Waterloo Commons SWM/wetland, in a slight depression which is labelled as a wetland feature by the GRCA.

This monitoring station is located in the centre of the GRCA wetland boundaries and during installation and inspections there was never any sign of surface water being retained for any significant period of time during summer months. This is consistent with the monitoring results which do not show and depth response to any rainfall event during the summer of 2018. Small diurnal fluctuations are seen on the HEPC Water Level graph close to the local ground elevation of 379.68 and are a result of data calibration inconsistencies due to the elevation change and relative distance between the barometer and water level logger location. In late fall saturated soils and increased rainfall caused a small volume of water to collect and stay standing within the wetland, visible from the November 2018 data download/station inspection. During the final logger download of 2018 the standing water near the monitoring station was iced over, making the logger inaccessible for download. The logged data will be downloaded and analysed in spring 2019 after the ice melts.

Location 232P – Cressman West

The Cressman West monitoring station is located east of the hydro corridor, south of the Westhill Meadows golf course, north of the Boardwalk on Ira Needles and approximately 260 metres west of Ira Needles Boulevard. This location is classified by the GRCA as a wetland feature.

This monitoring station is located in a local tree-lined depression in an undeveloped field and during inspections there was never any sign of surface water being retained for any observable period of time within the depression. This is consistent with the monitoring results which do not show and depth response to any rainfall event during 2018. Small diurnal fluctuations are seen on the HEPC Water Level graph close to the local ground elevation of 382.28 and are a result of data calibration inconsistencies due to the elevation change and relative distance between the barometer and water level logger location.

Location 233P – SWM Retention Area (Former Cressman East)

The SWM Retention Area monitoring station is located east of the hydro corridor, south of the Westhill Meadows golf course, north of the Boardwalk on Ira Needles and approximately 160 metres west of the Ira Needles Boulevard. This location is classified by the GRCA as a wetland feature. The Former Cressman East wetland feature was approved to be removed by the GRCA in 2016, and will be referred to herein as the 'SWM Retention Area'; the wetland removal permit can be found appended to the Hydrogeological Assessment for West Waterloo, Westhill District North/South Collector Road (MTE, 2018).

This monitoring station is located in a wetland area which held approximately 20 cm of water during the time of installation, which is consistent with an elevation of 380.15. During the dry period between June 30 and July 17 the wetland dried up to a point where it did not have any standing surface water. During subsequent rainfall events on July 17 and 23 the wetland responded by gaining some standing surface water which then infiltrated/evaporated within the following day. During the final logger download of 2018 the standing water near the monitoring station was iced over, making the logger inaccessible for download. The logged data will be downloaded and analysed in spring 2019 after the ice melts.

Location 234P – HEPC South

The HEPC South location is located east of the City of Waterloo Landfill, south of the HECP North wetland and west of hydro corridor, in a depression which is labelled as a wetland feature by the GRCA.

This monitoring station is located in the centre of the GRCA wetland boundaries and during installation and there were not any signs of surface water being retained for any significant period of time. When monitoring results were analysed it became apparent that this depression held 20-25 cm of water following the June 25 rain event and retained this water level until July 8 when a lack of rainfall and high temperatures caused the water to evaporate and infiltrate. During the remainder of the year storm events on August 25 and October 1 caused approximately 5cm and 10cm of ponding to be detained and eventually infiltrated and evaporated. Starting on October 27 a series of rainfall events resulted in the wetland water level rising to approximately 27cm (elevation of 382.28) and retaining this water level until the final download of 2018 in late November. It appears that this wetland seasonally holds standing water, likely between late October and July, drying up during summer months.

Location 235P – Region of Waterloo Landfill SWMP

This monitoring station was installed adjacent to the outlet of the Region of Waterloo Landfill SWMP. During installation the facility water level was at the permanent pool level of approximately 55cm of depth which corresponds with an elevation of 379.40 as stated in the *Stormwater Management Plan Report on North Area of Waterloo Landfill and ANOWL* (CRA, 1989). This pond is likely outletting at a higher rate than designed due to sediment accumulation. When visiting on-site staff from the Region of Waterloo Landfill mentioned that the pond will likely undergo a sediment removal process in the near future.

This monitoring station observed water elevations ranging from 379.17 to 379.70 in response to local climatic conditions. Observed responses to droughts and rainfall events were well within the expected values for a stormwater management facility.

4.2 Wetland Quality Monitoring Analysis

A quality monitoring program was established in 2018 with the goal of observing water quality characteristics provided within each watercourse feature which is within the drainage area boundaries. Three monitoring locations were observed: 230Q, 233Q and 235Q – each location numerically identifies with each respective monitoring station. During samples with insufficient flow outletting from the SWM facility, the samples were taken from surface water near cooling trench outlet.

Water quality criteria measured are as follows:

- Total suspended solids (TSS)
- Chloride
- Nitrate
- Total Phosphorus
- Dissolved Phosphorus
- Copper
- Lead
- Zinc

Observed results demonstrated elevated chloride levels at 230Q and 235Q relative to typical SWM facility and wetland concentrations within Waterloo Region. This is likely due to road salts being directed into each monitoring location during the spring snow melt. Further quality sample analysis will be deferred until a later reporting date so that a larger sample size can be obtained and used to eliminate any potential outlier sample results.

5.0 CONCLUSIONS

From the above analyses, the following trends are observed during summer 2018:

- Waterloo Commons SWM/wetland is utilized for local stormwater management control and the outlet is not functioning as designed, causing surface water elevations to be higher than intended
- Waterloo Commons wetland (230P) water elevation levels varied from 377.16 to 377.66 (0.21 to 0.71m of ponding)
- HEPC North wetland (231P) did not observe any surface water ponding during summer months, and late fall ponding will be analysed and visualized when climatic conditions allow the data loggers to be accessed and downloaded
- Cressman West wetland (232P) did not observe any surface water ponding
- SWM Retention Area (Former Cressman East wetland 233P) water elevation levels varied from 379.92 to 380.24 (0.0 to 0.32m of ponding)
- HEPC South wetland (234P) water elevation levels varied from 382.01 to 382.35 (0.0 to 0.34m of ponding)
- Region of Waterloo Landfill SWMP water elevation levels varied from 379.18 to 379.70 (0.44 to 0.96m of ponding/storage)
- Chloride water sample results demonstrated elevated concentrations in the Waterloo Commons wetland and the Landfill SWMP likely due to long-term exposure to local road salt runoff in the winter and spring.

It is also important to note the limitations that are associated with the 2018 monitoring season so far:

- Relatively small sample size will likely result in higher variance of data results
- Rainfall was approximately 37% lower than average throughout the summer until August which was approximately 38% higher than average

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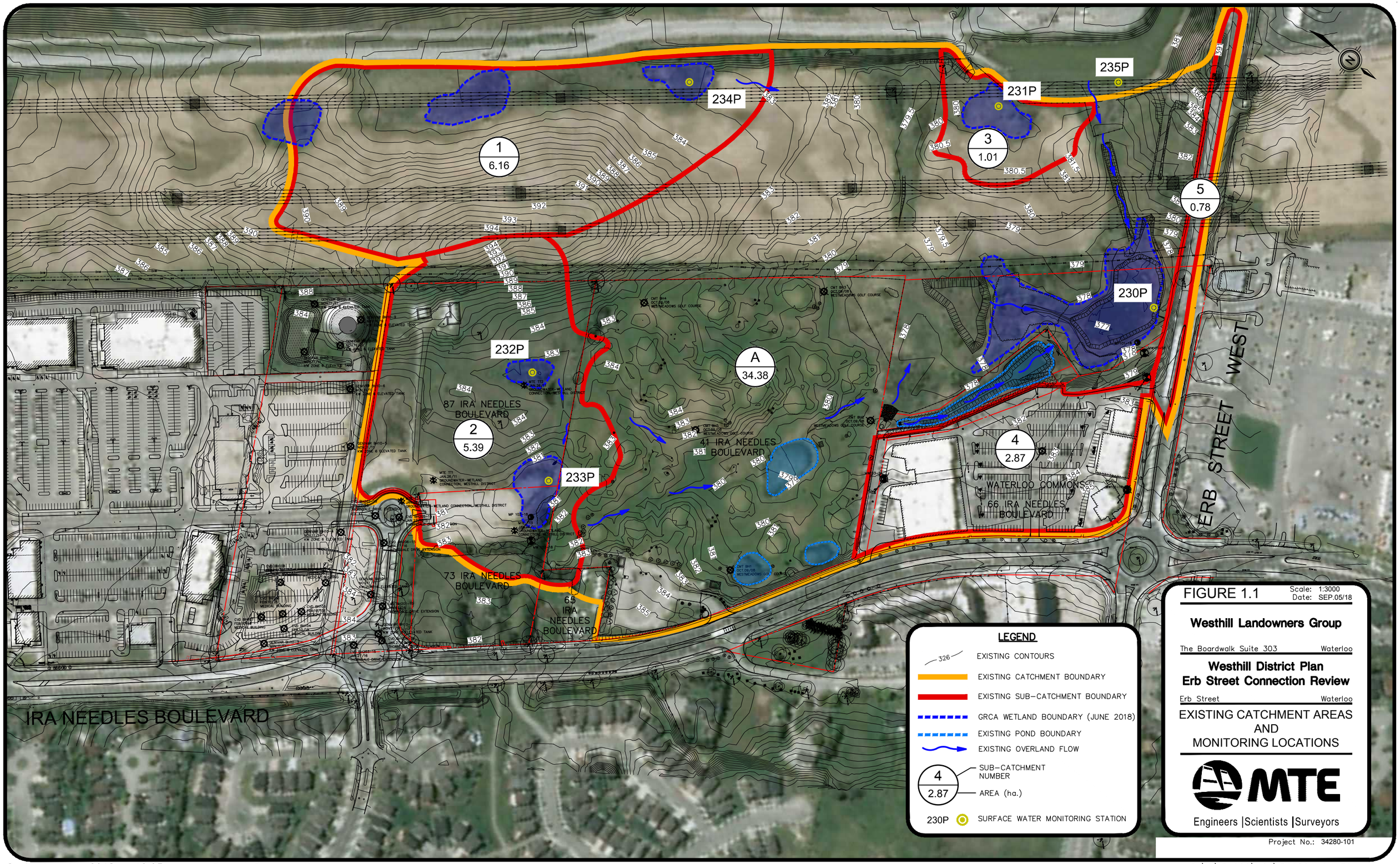


FIGURE 1.1

Scale: 1:3000
Date: SEP.05/18

Westhill Landowners Group

The Boardwalk Suite 303 Waterloo

Westhill District Plan
Erb Street Connection Review

Erb Street Waterloo

EXISTING CATCHMENT AREAS AND MONITORING LOCATIONS

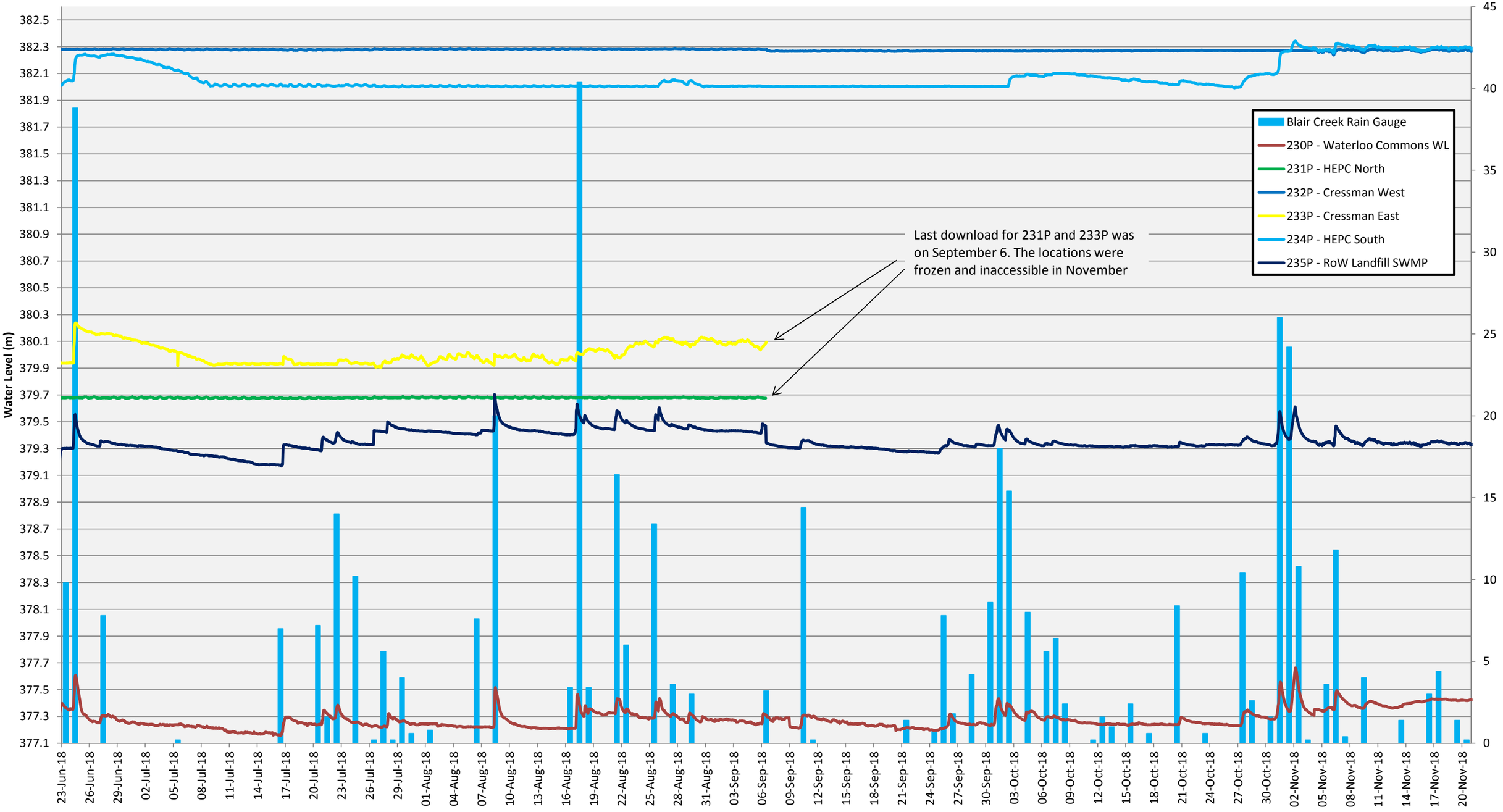
MTE

Engineers | Scientists | Surveyors

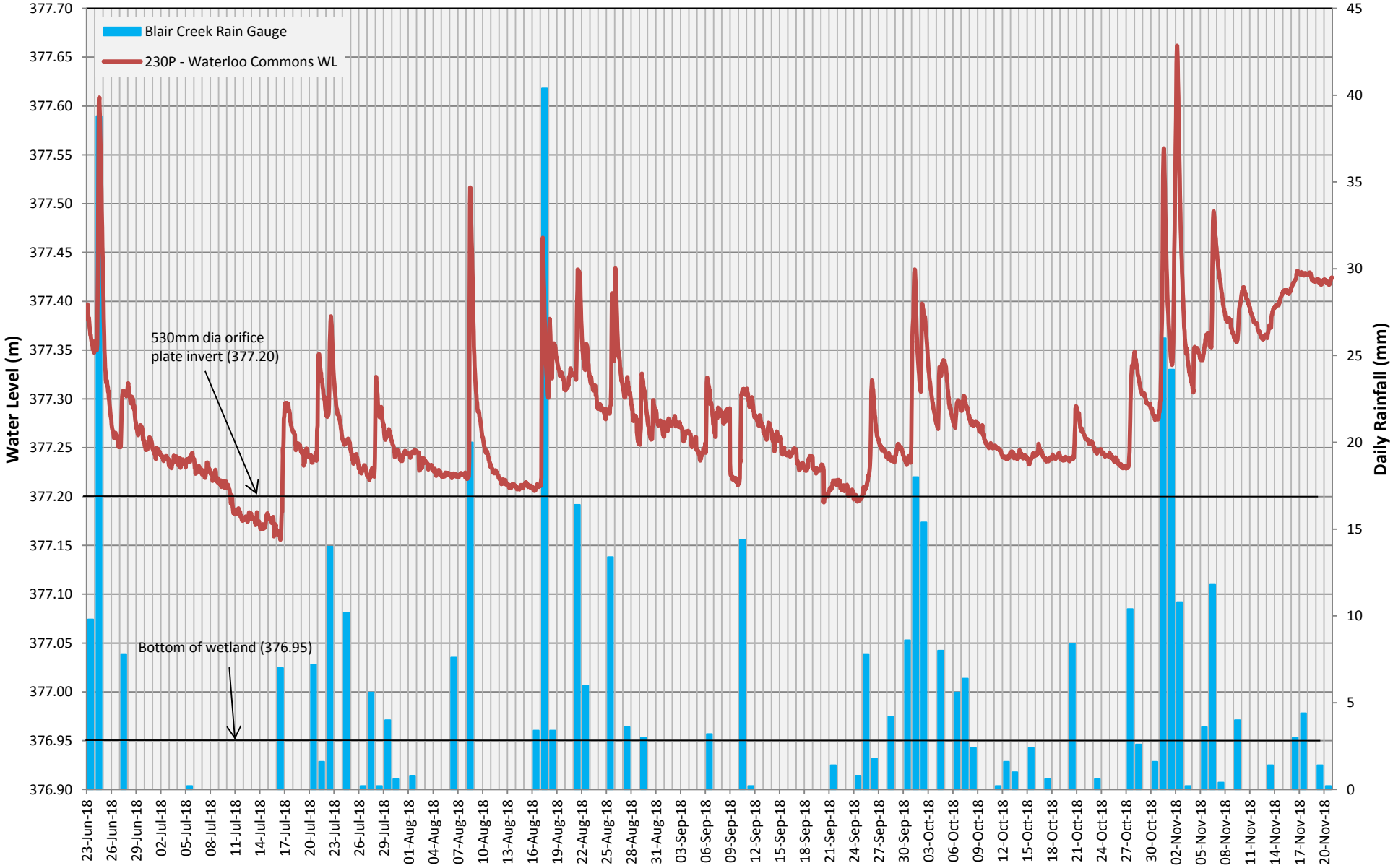
Project No.: 34280-101

Prepared by: JCC

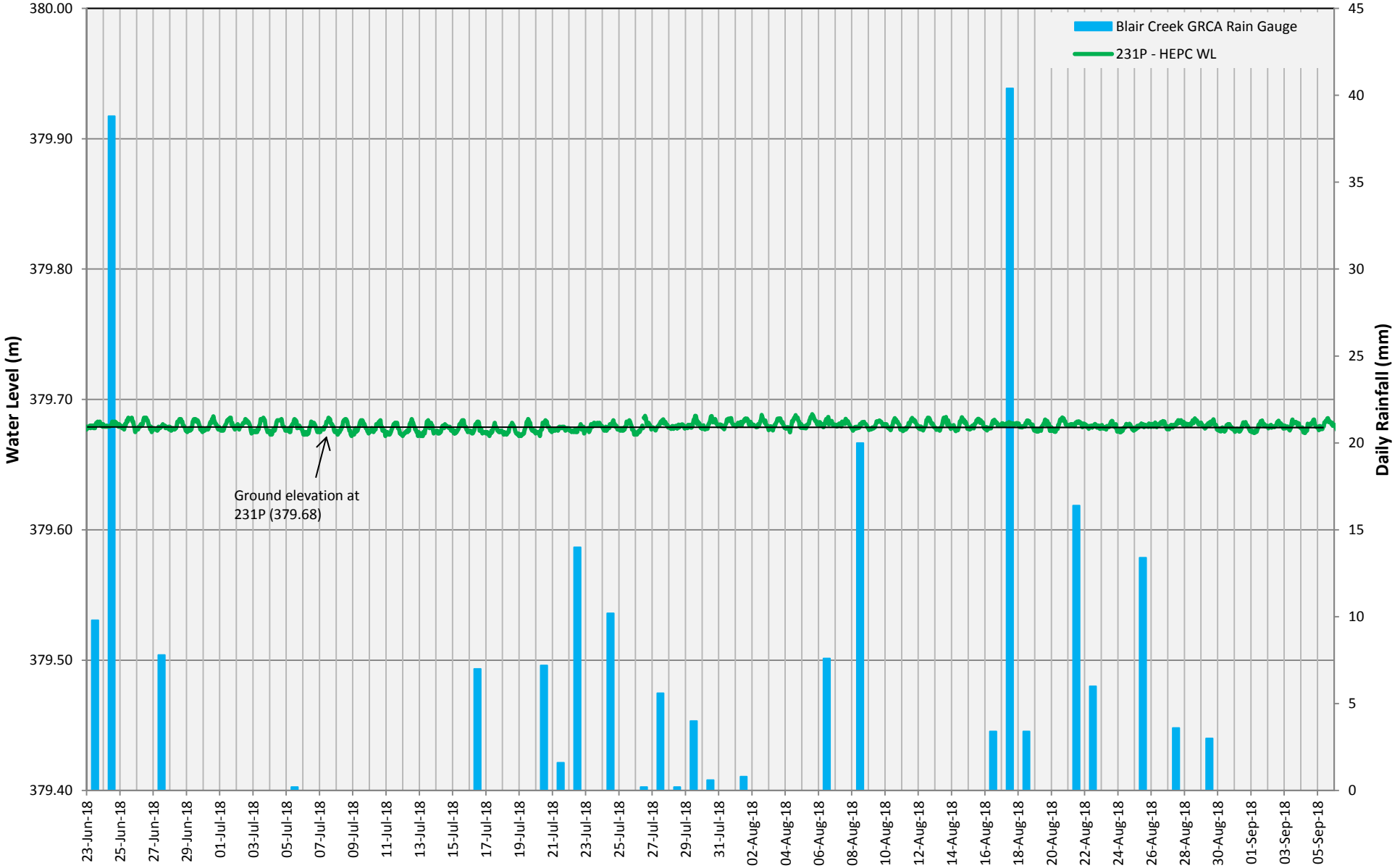
Westhill Monitoring Station Water Levels



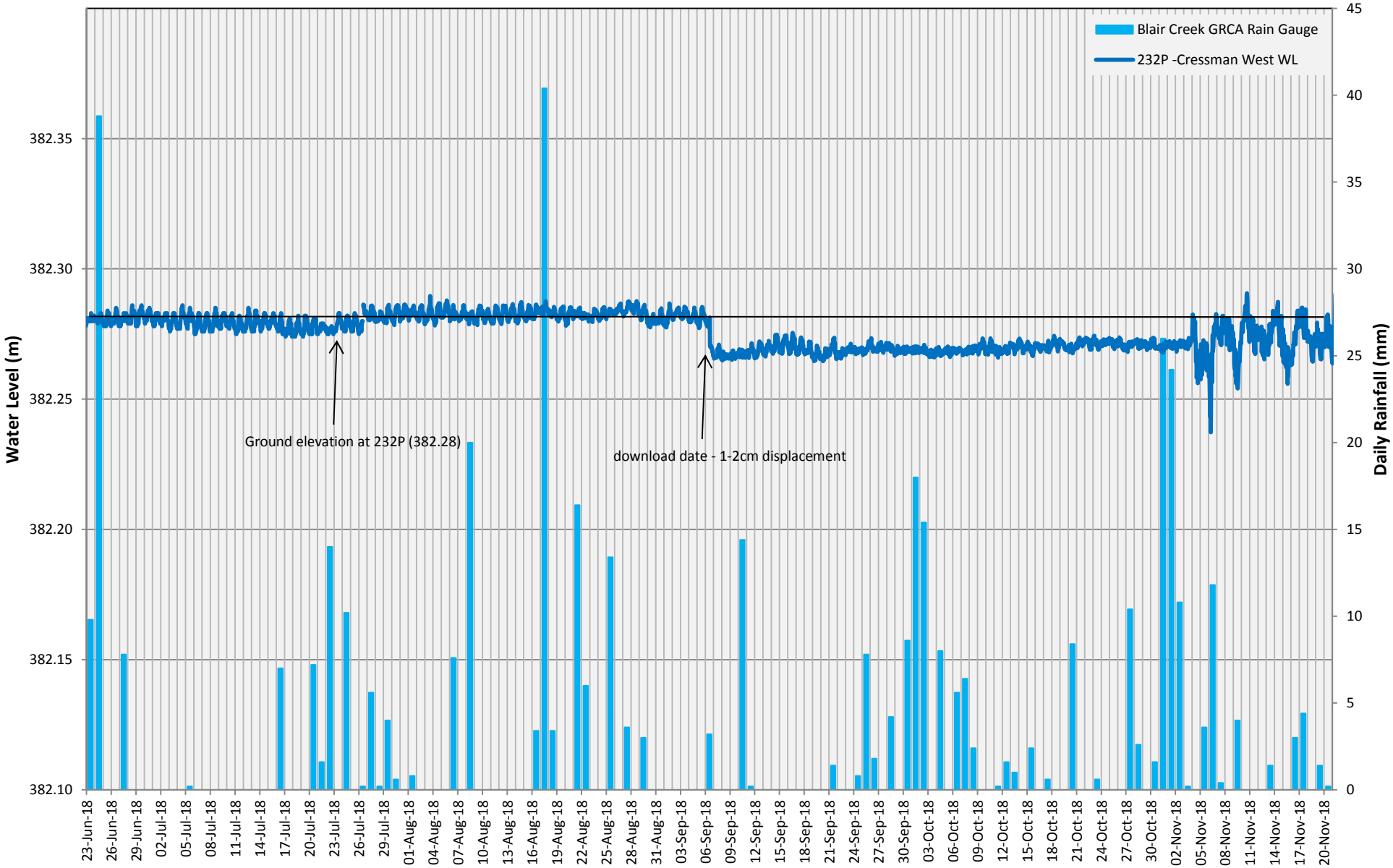
Waterloo Commons WL Water Level



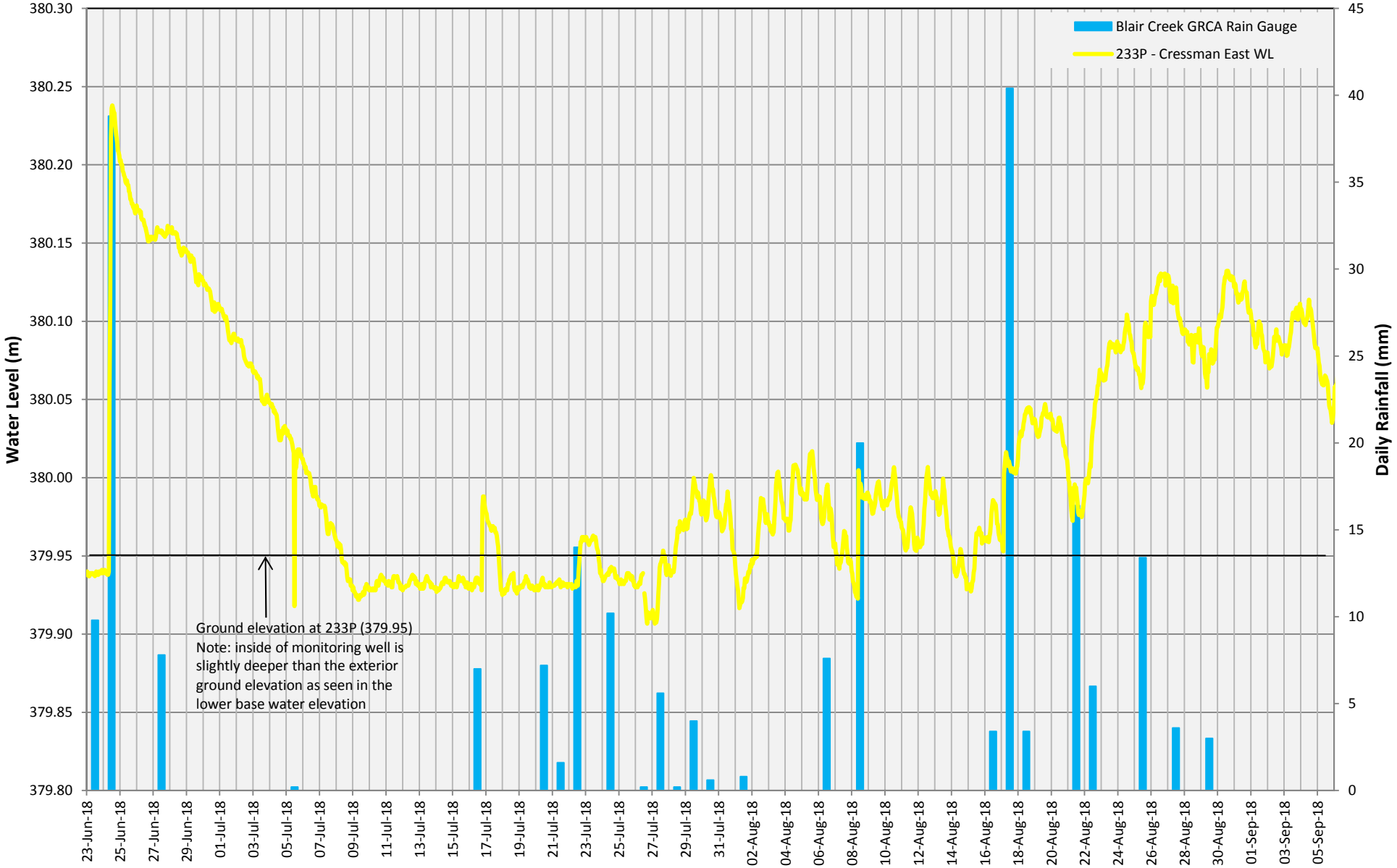
HEPC WL Water Level

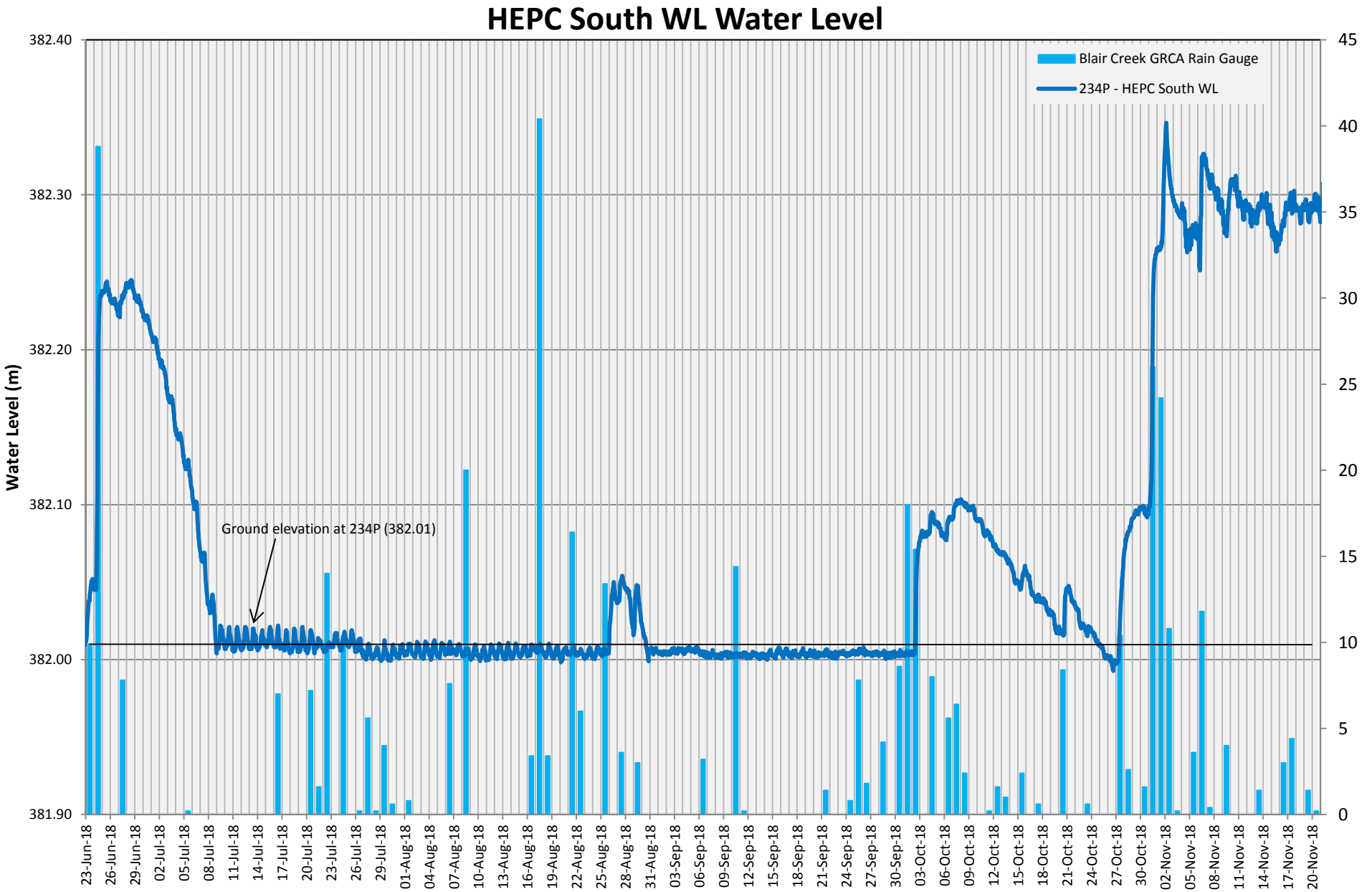


Cressman West WL Water Level

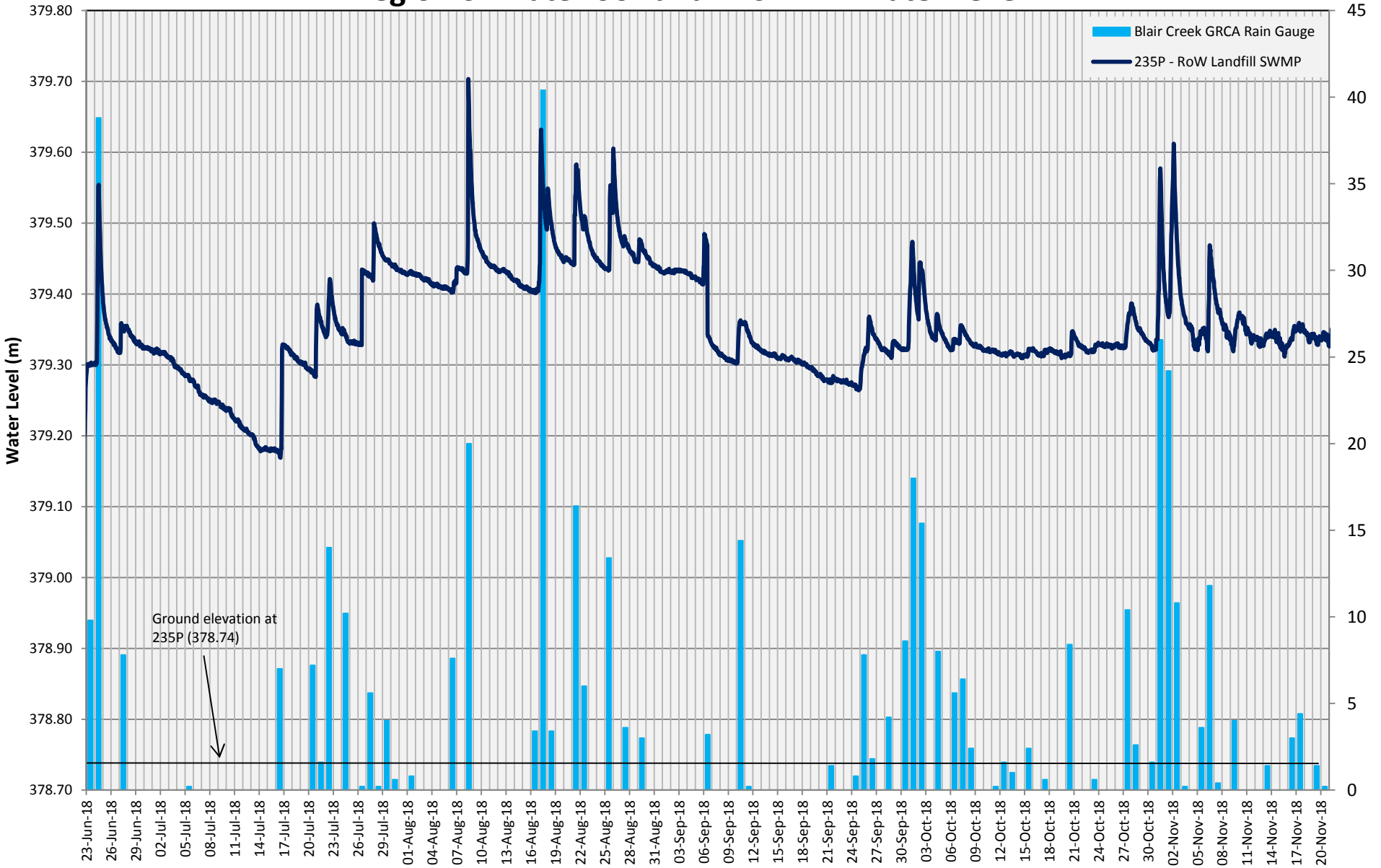


Former Cressman East WL Water Level




HEPC South WL Water Level
Water Level (m)
382.40
382.30
382.20
382.10
382.00
381.90
45
40
35
30
25
20
15
10
5
0
Blair Creek GRCA Rain Gauge
234P - HEPC South WL
Ground elevation at 234P (382.01)
23-Jun-18
26-Jun-18
29-Jun-18
02-Jul-18
05-Jul-18
08-Jul-18
11-Jul-18
14-Jul-18
17-Jul-18
20-Jul-18
23-Jul-18
26-Jul-18
29-Jul-18
01-Aug-18
04-Aug-18
07-Aug-18
10-Aug-18
13-Aug-18
16-Aug-18
19-Aug-18
22-Aug-18
25-Aug-18
28-Aug-18
31-Aug-18
03-Sep-18
06-Sep-18
09-Sep-18
12-Sep-18
15-Sep-18
18-Sep-18
21-Sep-18
24-Sep-18
27-Sep-18
30-Sep-18
03-Oct-18
06-Oct-18
09-Oct-18
12-Oct-18
15-Oct-18
18-Oct-18
21-Oct-18
24-Oct-18
27-Oct-18
30-Oct-18
02-Nov-18
05-Nov-18
08-Nov-18
11-Nov-18
14-Nov-18
17-Nov-18
20-Nov-18

Region of Waterloo Landfill SWMP Water Level



TAB 4

TECHNICAL MEMORANDUM

MTE FILE NO.: C 34280-101
DATE: December 4, 2018
PREPARED BY: Charles Carré, E.I.T.

Re: Technical Design Overview
West Waterloo, Westhill District (WW-WD)
North/South Collector Rd (NS-CR)

1.0 INTRODUCTION

MTE Consultants Inc. (MTE) was retained to complete the existing conditions characterization for the proposed road connection from The Boardwalk extension to the proposed connection between Erb Street West and Ira Needles Boulevard, in the City of Waterloo.

This technical memorandum presents the existing site topography and soil characteristics, the technical design overview of the road geometry and pavement design requirements, and the constructability of the proposed works within the study area for the Erb Street connection. This information is to be considered during the identification, assessment, and determination of an appropriate preferred route alternative for the extension of The Boardwalk from Thorndale Drive to the proposed connection between Erb Street West and Ira Needles Boulevard. This technical memo provides background information for the assessment of the north south collector road alternatives.

This document draws upon the existing information found in several previous reports and studies completed by public agencies and private developers relating to projects undertaken within the study area. The intent is to present the technical design overview for the proposed works and describe any potential conflicts that may need to be considered during the establishment and analysis of road alignment alternatives.

2.0 STUDY AREA

The proposed WW-WD, NS-CR is located west of Ira Needles Boulevard, in the southwestern portion of the City of Waterloo. The internal private road (The Boardwalk) begins at the south end of the box store development, near the entrance to Walmart. The road continues northwest, through the development, to its current terminus at the north end of the Boardwalk commercial development, at the existing roundabout extension of the municipally owned Thorndale Drive.

The study area is located in the upper reach of the Subwatershed 314 – Laurel Creek Watershed and is owned by a variety of landowners, including; the Region of Waterloo, the City of Waterloo, the INCC Corporation, Hydro One, Home Hardware, and the Cressman family. The study area generally includes a small portion of the Region of Waterloo's Waterloo Landfill at 925 Erb Street West, a small portion of the

Hydro One corridor (south of Erb Street West), the residences at 87, 73, and 65 Ira Needles Boulevard, the Westhill Meadows Golf course at 41 Ira Needles Boulevard, and the Waterloo Commons commercial development at 653-659 Erb Street West. These properties will be herein referred to as the 'Subject Lands'.

3.0 EXISTING SITE TOPOGRAPHY AND SOIL CHARACTERISTICS

The Subject Lands are categorized as rolling with scattered topographic low areas. The existing topography is undulating with two significant drainage draws; one through the eastern half of the study area (south to north) which crosses the existing Westhill Meadows Golf Course, and a second along the existing hydro corridor which runs along the east side of the landfill. Drainage is predominantly from south to north, from a high of approximately 394.00m in the hydro corridor to a low of approximately 377.00m at the Erb Street Pond, and is captured by other low lying depressions throughout the Subject Lands. These depressions have been collecting surface water runoff over time and have created multiple semi-permanent surface water features. All this runoff eventually makes its way to the Erb Street Pond, which is the study area's lowest elevation point, and is released via a storm sewer under Erb Street West.

At this time, there has not been a survey and geotechnical investigation done for all the properties in question. However, during the development of some of these properties, some information has been gathered about the existing site topography and soil stratigraphy.

In 1996, MTE completed a detailed topographical survey of the property at 41 Ira Needles Boulevard in correlation with the design and construction of the Westhill Meadows Golf Course. Based on a cut/fill analysis made between this original survey and the existing golf course's topography, it is assumed that approximately 14,000m^3 of fill was used to construct the Westhill Meadows Golf Course. Additionally, MTE completed a detailed topographical survey of the Erb Street Pond and nearby adjacent lands by total station in early 2003. All of this background information has been compiled and combined with Regionally generated topographic contours, provided by the Region of Waterloo, to establish the existing conditions of the study area used for this analysis.

In addition to the surveys described above, MTE completed a Scoped Environmental Impact Study (EIS) in 2004 which outlined some information about the soils in the Erb Street Pond and its associated wetland fringe. Furthermore, a geotechnical investigation was conducted by CMT Engineering Inc. in 2008, whereas the advancement of five boreholes was completed on the Westhill Meadows Golf Course.

Surficial soil inspections were also conducted in a number of the vegetation communities for the purpose of examining the soil moisture characteristics in the wetland fringe surrounding the Erb Street Pond. Surficial soils generally consisted of upper layers dominated by silty loams underlain by loam and silty clay. The lands in the vicinity of the existing Erb Street Pond are rolling with scattered topographic low areas. The combination of low topography and layers of less permeable silty clays appears to create conditions in which wetland communities have been established; fed by the collection of surface water. The existing forebay is located in a deeper area in which water levels are sufficient to create almost permanent ponding, with surrounding sloped areas subject to periodic high soil moisture conditions. The lower slopes are sufficiently wet to sustain wetland vegetation, but these areas grade into drier upland conditions.

The table lands above the low lying areas comprise primarily of silt, clay, and silt till deposits, which can be confirmed by the few geotechnical investigations that have been conducted within the study area. Infiltration practice in this area may not be feasible. This can be confirmed by the relatively recent development of the

adjacent Waterloo Commons and Canadian Tire lands, which could not implement any infiltration facilities due to low soil permeability. However, each site in the catchments upstream of the Erb Street Pond should undergo individual geotechnical investigations prior to development to determine the viability of infiltration on a site-by-site basis, and when feasible, utilize roof runoff infiltration facilities.

Based on the site investigations that were previously completed and the assessment of the study area's existing conditions, it is believed that the majority of the development will require the importation of fill, given the structural support required for the construction of roads, parking lots, and buildings throughout. If that is the case, there is a surplus of soil, or "cheap" fill, available for use on the Region's landfill site that could help reduce the amount of soil required to be imported from elsewhere.

It is anticipated that very little soil will need to be exported offsite with the exception of imported topsoil or onsite peat deposits. Borehole CMT-BH01-08 from the 2008 CMT geotechnical investigation of the Westhill Meadows Golf Course encountered a 0.70m thick layer of peat. It is anticipated that there may be some other areas within the Subject Lands where some layers of organics/peat may be encountered, especially near the existing SWM facilities, wetlands, and surface water features. Further investigations into the extent of unsuitable soils will be required during future development stages.

4.0 ROADWAY GEOMETRY AND PAVEMENT DESIGN REQUIREMENTS

The overall design of the proposed roads through the Subject Lands, like any other new road construction within the city, will have to conform to the design standards of the Transportation Association of Canada (TAC), the City of Waterloo, and the Region of Waterloo. As such, the new roads will need to follow the standards described in Table 7.2.5.1 from Section 7.2.5 of the City of Waterloo Development Engineering Manual 2013. An excerpt of the table is provided below.

Excerpt of Table 7.2.5.1				
Geometric Standards for Road Design				
Drawing Number	W-205	W-204	W-203	W-202
Road Classification	Collector	Collector	Collector	Local
Right-of-Way	26m	22m	20m	18m
Pavement Width	15m	13m	11m	9m
Island/Median Width	-	3m	-	-
Maximum Grade	8%	8%	8%	8%
Total Crossfall	195mm	165mm	155mm	135mm
Sidewalk Width	1.5m	1.5m	1.5m	1.5m
S/W offset from P/L	0.3m	0.3m	0.3m	0.3m
S/W cross slope	2%	2%	2%	2%
Boulevard Width	5.3m	3.3m	4.3m	4.3m
Boulevard Cross Slope	3%	3%	3%	3%
Granular 'A'	150mm	150mm	150mm	150mm
Granular 'B'	500mm	500mm	500mm	300mm
HL3 Asphalt	40mm	40mm	40mm	40mm
HL8 Asphalt	50mm	50mm	50mm	50mm
Min. K Values Crest	8	8	8	8
Min. K Values Sag	5	5	5	5

The existing surrounding roads, which have all been designed to the standards described above, have been individually classified based on their right-of-way size and functionality, and are described as follows:

- Ira Needles Boulevard is classified as a 35m Regional Arterial;
- Erb Street West is classified as a 30m Regional Arterial and is believed to be designed following the City's standards for the 35m Arterial road;
- Thorndale Drive is classified as a 22m Minor Collector; and,
- The Boardwalk is considered a private local road. It has a right-of-way approximately 22m wide on average, and is constructed following similar standards for the City's 22m Collector road.

It is assumed that the newly designed roads through the Subject Lands will be minor collector roads, which will need to follow the standards for the City's minor collector roads, based on their respective right-of-way widths. To achieve the requirements from Table 7.2.5.1, parcels of land will need to be dedicated to include the proposed road corridors, which will divide the existing subject properties into multiple new development blocks. Fill importation, as previously discussed, and area grading works within these new development blocks will need to be suitable to allow for adequate drainage and serviceability. As such, easy access to the existing corridors will need to be maintained. Given the surrounding existing grading near the projected connections points to the existing roads; 383.50m± at the north leg of Thorndale/Boardwalk roundabout, 381.50m± at Erb Street West, and 384.00m± at Ira Needles Boulevard, there does not appear to be any major conflicts with the proposed works. With proper grading designs, adequate drainage should be available to convey stormwater runoff and sanitary flow to the existing outlet locations through Erb Street West. Additionally, there should not be any requirements for any excessively steep slopes or road grades in order to match into the surrounding existing grades. The overall constructability of the proposed road connections should be straightforward.

5.0 CONSTRUCTABILITY

As previously discussed, the overall constructability of the extension of The Boardwalk from Thorndale Drive to the proposed connection between Erb Street West and Ira Needles Boulevard should be relatively simple. As long as every landowner and municipal agency involved is on board, easy access to existing corridors (Erb Street West, Ira Needles Boulevard, The Boardwalk/Thorndale Drive) should be maintained.

There is an ongoing Environmental Study Report (ESR) for the road widening of Erb Street West associated with the construction of a proposed roundabout immediately north of the Erb Street Pond. This proposed roundabout is intended to replace the signalized intersection at the Canadian Tire plaza entrance adjacent to the BMO Bank of Montreal and the Shoppers Drug Mart. If this roundabout is constructed as intended, this provides the most logical connection point to Erb Street West for any newly proposed road alignment through the Subject Lands.

There are no anticipated major conflicts with regards to crossing existing infrastructure within either of the three road connection right-of-ways (i.e. Ira Needles Boulevard, Erb Street West, or The Boardwalk/Thorndale roundabout). The only scenario where conflicts may occur is if one of the proposed road alignment alternatives being assessed crosses or encroaches on the gas easement along the eastern property line of the hydro corridor; which contains a 400mm diameter Union Gas transmission main.

6.0 CONCLUSIONS

Based on the assessment of the technical design overview, the following conclusions are provided:

1. Existing site topographical surveys and geotechnical investigations conclude that the existing topography and soils are suitable for the proposed extension of The Boardwalk from Thorndale Drive to the proposed connection between Erb Street West and Ira Needles Boulevard.

2. The majority of the proposed works will require additional fill to be imported to the sites. Some of this fill could potentially be imported from local sources such as the Region of Waterloo's landfill site, which has an excess of suitable soil.

3. There are some small areas of unsuitable soil/material onsite that may need to be exported. Further investigations will need to be conducted to identify the extent of unsuitable material onsite.

4. New roads are to be constructed in accordance with Section 7.2.5 of the City of Waterloo Development Engineering Manual 2013, which also conform to the standards set forth by the Region of Waterloo and the Transportation Association of Canada.

5. The overall constructability of the project should be relatively straightforward based on the existing conditions information available at this time. The proposed connections to the existing road corridors provide adequate and logical links between the surrounding sites. There are no anticipated major conflicts when it comes to municipal services and utilities crossings.

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TAB 5

TECHNICAL MEMORANDUM

MTE FILE NO.: C 34280-101
DATE: December 4, 2018
PREPARED BY: Charles Carré, E.I.T.

Re: Municipal Services and Utilities
West Waterloo, Westhill District (WW-WD)
North/South Collector Rd (NS-CR)

1.0 INTRODUCTION

MTE Consultants Inc. (MTE) was retained to complete the existing conditions characterization of municipal services and utilities for the proposed road connection from The Boardwalk extension to the proposed connection between Erb Street West and Ira Needles Boulevard, in the City of Waterloo.

This technical memorandum documents the existing conditions information within the study area for the Erb Street connection. This information is to be considered during the identification, assessment, and determination of an appropriate preferred route alternative for the extension of The Boardwalk from Thorndale Drive to the proposed connection between Erb Street West and Ira Needles Boulevard. This technical memo provides background information for the assessment of the north south collector road alternatives.

This document draws upon the existing information found in several previous reports and studies completed by public agencies and private developers relating to projects undertaken within the study area. The intent is to document the existing municipal services and major utilities within the study area and to describe the potential connection points to these services for the proposed development.

2.0 STUDY AREA

The proposed WW-WD, NS-CR is located west of Ira Needles Boulevard, in the southwestern portion of the City of Waterloo. The internal private road (The Boardwalk) begins at the south end of the box store development, near the entrance to Walmart. The road continues northwest, through the development, to its current terminus at the north end of the Boardwalk commercial development, at the existing roundabout extension of the municipally owned Thorndale Drive.

The study area is located in the upper reach of the Subwatershed 314 – Laurel Creek Watershed and is owned by a variety of landowners, including; the Region of Waterloo, the City of Waterloo, the INCC Corporation, Hydro One, Home Hardware, and the Cressman family. The study area generally includes a small portion of the Region of Waterloo's Waterloo Landfill at 925 Erb Street West, a small portion of the Hydro One corridor (south of Erb Street West), the residences at 87, 73, and 65 Ira Needles Boulevard, the

Westhill Meadows Golf course at 41 Ira Needles Boulevard, and the Waterloo Commons commercial development at 653-659 Erb Street West. These properties will be herein referred to as the 'Subject Lands'. Refer to the appended figures for more details.

3.0 MUNICIPAL SERVICES

During the assessment and scoring of various road connection alternatives, the opportunities for connections to, or extensions of, the existing services will play an important role in determining the benefit, or lack thereof, of certain proposed road alignments. Certain factors, such as constructability and/or cost, will govern which alternative provides a more favourable outcome. The servicing limits for the study area extend approximately from the northern limit of the 101 Ira Needles Boulevard property northward. All servicing; sanitary, storm, and water, for the Boardwalk development is conveyed south through the City of Kitchener. The following sections describe the existing servicing infrastructure, surrounding the Subject Lands, and outlines where potential proposed connections could be made for the proposed road alignments and future developments.

3.1 Water Distribution

The Subject Lands within the study area all reside within the City of Waterloo Pressure Zone 6 (Wat Zone 6). Based on information received from the Region of Waterloo, the current hydraulic grade line (HGL) of Wat Zone 6 is approximately 428m, with a serviceability range of approximately 372m to 392m. However, through ongoing discussions with the Region, it is understood that the HGL will vary depending on fluctuating water levels and demands throughout the distribution network.

Wat Zone 6 receives water from the Zone 6 Reservoir elevated water tank, located at the northwestern end of the Boardwalk development, north of the Landmark Cinemas and adjacent to the hydro corridor. Treated water from the Mannheim Water Treatment Plant is combined with groundwater from a series of wells located near the Mannheim Reservoir. This water is then pumped by the Mannheim Zone 6 Pumping Station, located on Ottawa Street South, in the City of Kitchener. The Mannheim PS is used to fill the Zone 6 Reservoir tank, which is then used to service both the Wat Zone 6 and the City of Kitchener Pressure Zone 6 (Kit Zone 6). Twin 450mm diameter watermains exit the water tank and extend to Ira Needles Boulevard. One watermain runs south along Ira Needles Boulevard and eventually connects to the Mannheim PS system, which serves as the principle water source for Kit Zone 6. The second 450mm diameter watermain, which services the Wat Zone 6, crosses Ira Needles Boulevard near the Medical Centre at The Boardwalk and connects to a local 400mm diameter watermain running north-south on the eastern side of Ira Needles Boulevard. This watermain extends north along Ira Needles Boulevard and traverses along West Hill Drive, eventually intersecting with Erb Street West. It also runs south along Ira Needles Boulevard until it reaches University Avenue West where it traverses easterly.

Further to the watermains described above, there are also other local watermains which surround the Subject Lands. There is a 450mm diameter asbestos cement watermain along north side of Erb Street West which serves as a Wat Zone 6 watermain. This watermain currently services the Waterloo Commons and the Canadian Tire developments; among others outside of the study area. There is also a 600mm concrete pressure pipe watermain along the south side of Erb Street West, which conveys water from the Erb Street Reservoir (and pumping station) to the City of Waterloo Pressure Zone 5.

The existing residential dwellings and commercial building at 41, 65, and 73 Ira Needles Boulevard are currently serviced by private onsite wells.

Lastly, there is a 200mm diameter PVC watermain along the newly extended Thorndale Drive, which terminates at the northern leg of the newly constructed roundabout at the intersection of Thorndale Drive and The Boardwalk.

The most reasonable connections points for a newly proposed watermain, which would be part of the proposed works for the road connections in question, would include the existing 200mm diameter watermain at Thorndale Drive and The Boardwalk and the existing 450mm diameter watermain on the north side of Erb Street West. Refer to **Figure 1.0** for more details regarding the exiting water distribution infrastructure.

3.2 Sanitary Servicing

There are not an abundance of sanitary servicing options for the Subject Lands. There are no municipal sanitary sewers running along either Ira Needles Boulevard or Erb Street West in the traditional sense.

The existing residential dwellings and commercial building at 41, 65, and 73 Ira Needles Boulevard are currently serviced by private onsite septic systems. No sanitary outlet currently exists along Ira Needles Boulevard for these properties.

The only sanitary sewer servicing any of the subject properties is a 300mm diameter sanitary sewer which runs south-north along a servicing easement through the western portion of the Canadian Tire development lands. The upper reach of this service starts at the Westhill Apartments lands (which are excluded from the study area) on the southeastern side of the Ira Needles Boulevard and Erb Street West intersection. A 200mm diameter sanitary sewer then crosses Ira Needles Boulevard and runs along the southern property limit of the Waterloo Commons lands. It connects to a 300mm diameter sanitary sewer near the southwestern corner of the property, is combined with the collection system for the onsite commercial buildings, and flows north along the western property limit towards the plaza entrance at Erb Street West. The manhole in the southwestern corner of the property, where the sanitary sewer transitions from a 200mm diameter sewer to a 300mm diameter sewer, also includes a 300mm diameter stub to the south which provides an outlet connection for the remainder of the Subject Lands south of the Waterloo Commons development. This is assumed to be the most convenient outlet location for the development opportunities associated with the extension of The Boardwalk to the connection between Ira Needles Boulevard and Erb Street West.

The municipal manhole in the Waterloo Commons plaza entrance at Erb Street West also serves as a collection point for a 100mm diameter forcemain along the southern side of Erb Street West. This forcemain services lands to the west of the study area. Additionally, there is an abandoned 100mm diameter forcemain immediately east of the aforementioned manhole, along the southern side of Erb Street West. It is assumed that this abandoned portion of the forcemain originally conveyed sewage east along Erb Street West, into the City of Waterloo, before a connection into this new manhole was made.

The sewage collected in the manhole described above outlets through a 300mm diameter sewer which crosses Erb Street West. The sewage is conveyed within a servicing easement through the Canadian Tire plaza lands and is combined with the onsite collection system for the commercial buildings within the development. Ultimately, this flow is conveyed north to the intersection of Bordeaux Place and Paris

Boulevard and continues north through the Clair Meadows Subdivision. Refer to **Figure 2.0** for more details regarding the existing sanitary infrastructure.

3.3 Storm Servicing

Similarly to the sanitary servicing described in Section 3.2, the ultimate terminus of the storm servicing for the majority of the study area is through the servicing easement along the western portion of the Canadian Tire development lands. However, there are some areas fronting the Subject Lands that are not included in this servicing outlet.

A portion of the southeastern corner of the study area, which includes the Thorndale Drive extension and roundabout right-of-way, and a portion of the Ira Needles Boulevard right-of-way, include municipal storm sewers that do not make their way through the Subject Lands. A series of 300mm diameter and 375mm diameter storm sewers collect runoff from the Thorndale Drive extension and roundabout right-of-way and convey it to the municipal storm sewer along Ira Needles Boulevard. This stormwater is combined with the runoff collected by a series of 300mm, 375mm, 450mm, 525mm, and 750mm diameter storm sewers fronting 65, 73, and 101 Ira Needles Boulevard. The combined runoff is conveyed to the road's local low point, in front of 73 Ira Needles Boulevard, and is directed east across the road through a series of 750mm diameter storm sewers. Ultimately, this stormwater makes its way to the Nature's Watch Community subdivision's stormwater management facility, east of Ira Needles Boulevard.

In a similar fashion, a storm sewer system encompassing 300mm, 375mm, 450mm, 600mm, 750mm, and 975mm diameter sewers collects runoff from the Westhill Drive right-of-way and the Ira Needles Boulevard right-of-way from the intersection with Westhill Drive, northward to the roundabout at Erb Street West. Additionally, this storm sewer system also collects runoff from the Westhill Apartments lands on the southeastern side of the Ira Needles Boulevard and Erb Street West intersection roundabout. The total runoff from these aforementioned areas is combined into a 1050mm diameter storm sewer at the southeastern corner of the Waterloo Commons property. This storm sewer conveys the runoff along the southern property limit to the southwestern corner, where it enters a splitter manhole structure. This splitter manhole is designed to convey the runoff from minor storm events to the Regionally owned SWM forebay along the Waterloo Commons western property line. During major storm events, the runoff bypasses the splitter structure and outlets directly to the Erb Street Pond SWM facility. The history and construction details of this forebay and SWM facility will be discussed further in the subsequent section.

It is understood that the onsite stormwater runoff generated within the majority of the subject properties that make up the study area, of which has not been previously discussed, is all directed towards the Erb Street Pond; whether through interactions with groundwater or surface water features existing on these properties. One such example is an additional stormwater management facility within the study area. This SWM pond, known as Pond 4, is located in the northwestern corner of the hydro corridor – south of Erb Street West, and serves as a retention pond for a majority of the landfill site lands. This pond ultimately outlets through a channel in the hydro corridor and the runoff is combined within the Erb Street Pond.

The existing Erb Street Pond outlet is a 900mm diameter sewer located in the southern embankment of the Erb Street West right-of-way. It is approximately lined up with the plaza entrance adjacent to the BMO Bank of Montreal and the Shoppers Drug Mart. Before the outlet crosses Erb Street West, additional storm runoff is collected by a series of 300mm and 375mm diameter sewers installed along Erb Street West, from the Ira Needles Boulevard roundabout to the low point in the road near the pond's outlet. Additionally, 450mm and 525mm diameter CSP culverts collect runoff from a ditch running west along the northern side of Erb Street

West. Finally, all this runoff is combined and conveyed through the previously discussed servicing easement through the Canadian Tire lands, which also contains the study area's sanitary outlet.

The dedicated 900mm storm sewer does not collect any further stormwater runoff as it travels north through the easement, through the intersection of Bordeaux Place and Paris Boulevard, through the Clair Meadows Subdivision, before outletting directly to Clair Creek - north of the Brandenburg Stormwater Management Facility. Refer to **Figure 3.0** for more details regarding the existing storm infrastructure.

3.4 Stormwater Management

In April 2004, MTE prepared a Final Stormwater Management Report and Scoped Environmental Impact Study (2004 MTE Report) for the Erb Street Pond (formally known as Dutton Lake). This was completed in support of a SWM strategy for the Ira Needles Boulevard Zone #6, which includes the Ira Needles Boulevard right-of-way from Westhill Meadows Golf Course to Erb Street. It was determined that the best stormwater management strategy for Zone #6 and the adjacent properties would be to construct a SWM channel and forebay in conjunction with the existing wetland and pond located adjacent to Erb Street and along the westerly limits of the former Wong Property (now the Waterloo Commons development owned by Rock Developments). This constructed storm outlet and forebay is owned by the Region of Waterloo. The previous stormwater management strategy was prepared and reviewed by the agencies. The strategy facilitated the following:

- As part of the Ira Needles Boulevard construction, the forebay was constructed to service the entire lands upstream of the forebay in their ultimate developed conditions. (The splitter, although also intended for the ultimate developed conditions, was not adequately sized or designed for the current grading constraints and wetpond permanent pool option);
- The outlet control of the pond was sized to service the entire lands;
- The strategy proposed some grading (which provided additional storage) and some additional landscaping around the forebay. It demonstrated that with some excavation of the wetland, grading the SWM facility would provide the quantity and quality controls necessary to service the entire upstream developed conditions; and,
- Ultimately, the entire Erb Street Pond would be owned by the City of Waterloo.

The report was revised in 2011 to provide the agencies with an alternative SWM strategy which was less disruptive to the existing wetland vegetation. MTE chaired meetings with the land owners and the agencies (being the City of Waterloo, the Region of Waterloo, and the Grand River Conservation Authority). The City requested that MTE complete an alternate SWM strategy, whereby the previously proposed re-grading within the wetland be eliminated and constructed works on the SWM facility be kept entirely on the municipally owned lands or easements. At that time, the forebay was, and still is, under the Region of Waterloo ownership and the pond/wetland is under private ownership. Less disruption to the wetland was to be favourable to the GRCA as well. Ultimately, the forebay and proposed works within the wetland was completed per the revised report, dated January 25, 2011. These features are currently, to some degree, in the same conditions as previously designed.

The Subject Lands drain towards the Erb Street Pond and form the uppermost reach of the Laurel Creek Subwatershed 314 (known as Area 1 in the Subwatershed 314 Management Plan, Mark L. Dorfman, Planner Inc., October 1996). The Laurel Creek Subwatershed 314 Management Plan outlined design

parameters for sustainable development. The report recognized the Erb Street Pond as a significant feature for storage of surface water runoff from the area south of Erb Street. Furthermore, the report outlined that the previously existing culvert under Erb Street was to be maintained (or enhanced) as a discharge control.

Prior to Erb Street being reconstructed in 2004, the controlled outlet consisted of a 600mm diameter CSP culvert that crossed Erb Street, with its ends projecting out of the sides of the roadway embankments. Flow was then conveyed downstream via an open ditch to Clair Creek. As part of the Ira Needles Boulevard construction project, portions of Erb Street were reconstructed, which included the replacement of the 600mm diameter CSP culvert with the previously mentioned 900mm diameter concrete storm sewer. It also included the construction of a concrete headwall and outlet structure. This outlet crosses Erb Street West through the servicing easement previously described in Section 3.3.

The 2004 MTE Report described SWM facility upgrades to the Erb Street Pond, targeting the immediate need for a SWM solution for Ira Needles Boulevard Zone #6 and Rock Developments (Waterloo Commons). Future improvements to the pond were conceptually discussed and formed the basis for the comprehensive Erb Street SWM strategy presented in the 2011 revised report.

There are currently issues with the Erb Street Pond outlet, which is very frequently clogged with debris and vegetation, which creates an artificial high water level due to perching of the retained stormwater runoff. This issue will need to be addressed in the ultimate preferred road alignment alternative and preferred SWM strategy. The SWM strategy for the Subject Lands will be an outcome of the study. Four alternatives for the management of stormwater are presented in a subsequent technical memo. All the alternatives include the north south collector road passing through the existing pond's location and the construction of one or multiple new SWM facilities within the study area. Each alternative will be assessed to determine if any or all of the existing ponds will be altered.

4.0 UTILITIES

The proposed road connection alternatives will all have to deal with the usual conflicts associated with the construction of new roads and municipal services, which include crossings with utilities such as underground Bell wires, hydro wires, and local gas lines. These conflicts will be present with any of the proposed road alignment options as these utilities are present along the western side of Ira Needles Boulevard and the southern side of Erb Street West. Additionally, a connection point may be available to the existing 100mm diameter high pressure gas main along the north side of Erb Street West, or the 300mm diameter main along the east side of Ira Needles Boulevard.

There may however be additional concerns with some of the road alignment alternatives that are proposed to cross or encroach on the hydro corridor within the study area. There exists a 400mm gasmain, within a gas easement, running parallel to the hydro corridor along its eastern property line. This is a major Union Gas transmission main which crosses Erb Street West into the Union Gas Station near the southwestern corner of the Canadian Tire development lands. It is understood that Union Gas does not allow any work to be performed atop this transmission main, so agreements will need to be made with them in order to entertain any road alignment option that would cross or encroach on the gas easement. Refer to **Figure 4.0** for more details regarding the existing Union Gas infrastructure.

Additionally, there also exist three major high voltage hydro transmission lines and one local hydro line within the hydro corridor. The multiple transmission line towers require a minimum 15m setback from their

base and may create conflicts with some of the proposed road alignment alternatives. Hydro One has already expressed concerns with having a road run longitudinally within the hydro corridor, but may be in favour of a road crossing it perpendicularly. Special considerations and negotiations with Hydro One will be required to receive approval for any work to be done on their land. Refer to **Figure 5.0** for more details regarding the existing hydro infrastructure.

5.0 CONCLUSIONS

Based on the analysis of the existing conditions of the municipal services and utilities within, and in close proximity to, the study area, the following conclusions are provided:

1. Water servicing for the Subject Lands can be made along the extension of The Boardwalk to the road connection between Ira Needles Boulevard and Erb Street west. Connections can be made to the existing 200mm diameter watermain stub at the Thorndale Drive extension roundabout and at the existing 300mm watermain stub within the Waterloo Commons which ultimately connects to the 450mm diameter watermain along Erb Street West.

2. Sanitary servicing for the Subject Lands can be made along the newly proposed road alignments and connected to the existing 300mm diameter sanitary stub at the southwestern corner of the Waterloo Commons lands. This existing sewer would then convey sewage north through the Clair Meadows Subdivision.

3. Storm servicing for the Subject Lands can be made along the newly proposed road alignments and connected to the existing and/or newly proposed stormwater management facilities within the Subject Lands. Ultimately, the area's storm outlet is found at the north end of the study area, wherein an existing 900mm diameter storm sewer would convey storm runoff north through the Clair Meadows Subdivision to be discharged directly to Clair Creek.

4. Special considerations will need to be made while selecting a preferred route alternative in order to minimize the impacts to existing utilities, such as underground Bell lines, hydro lines, and gas lines, throughout the study area. This is especially true for any alternative that may cross or encroach on the gas easement along the eastern property line of the hydro corridor, which contains a 400mm diameter Union Gas transmission main.

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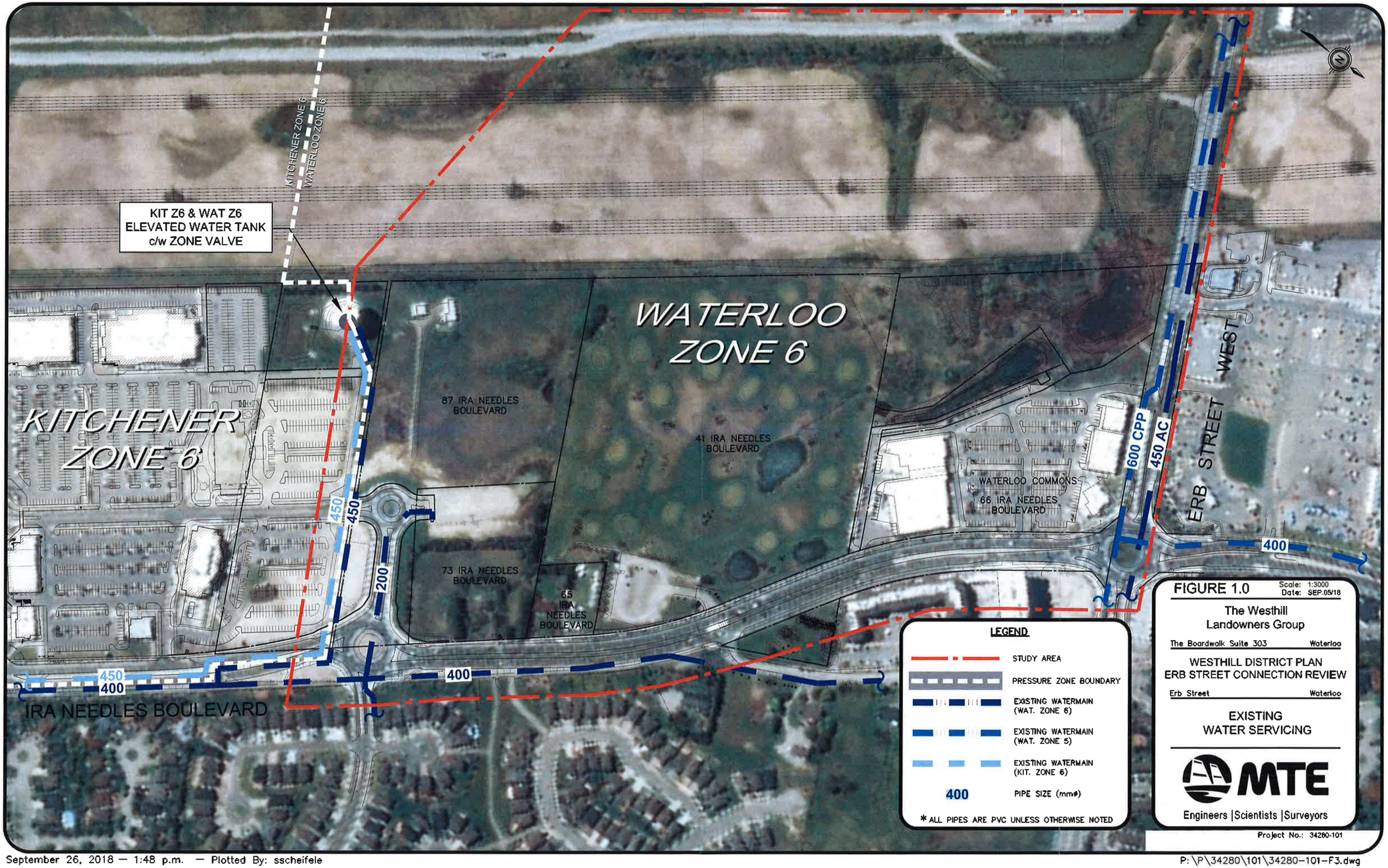


FIGURE 1.0 Scale: 1:3000 Date: SEP.05/18

The Westhill Landowners Group

The Boardwalk Suite 303 Waterloo

WESTHILL DISTRICT PLAN
ERB STREET CONNECTION REVIEW

Erb Street Waterloo

EXISTING WATER SERVICING

MTE

Engineers | Scientists | Surveyors

Project No.: 34280-101

September 26, 2018 — 1:48 p.m. — Plotted By: sscheifele

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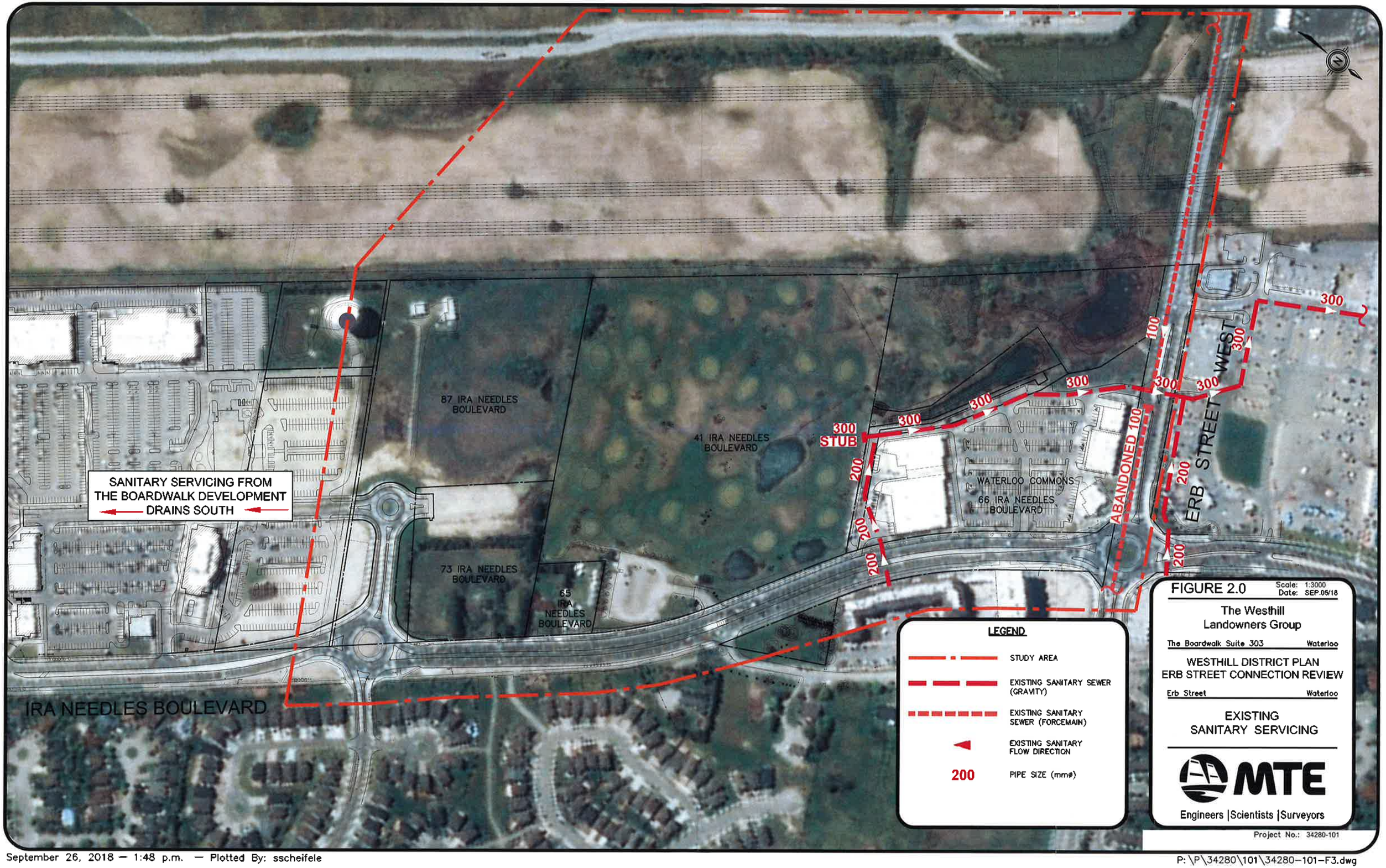


FIGURE 2.0

Scale: 1:3000
Date: SEP.05/18

The Westhill
Landowners Group

The Boardwalk Suite 303 Waterloo

WESTHILL DISTRICT PLAN
ERB STREET CONNECTION REVIEW

Erb Street Waterloo

EXISTING
SANITARY SERVICING

MTE
Engineers | Scientists | Surveyors

Project No.: 34280-101

September 26, 2018 — 1:48 p.m. — Plotted By: sscheifele

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STORM SERVICING FROM
THE BOARDWALK DEVELOPMENT
DRAINS SOUTH

87 IRA NEEDLES BOULEVARD

41 IRA NEEDLES BOULEVARD

73 IRA NEEDLES BOULEVARD

65 IRA NEEDLES BOULEVARD

WATERLOO COMMONS
66 IRA NEEDLES BOULEVARD

ERB STREET POND

IRA NEEDLES BOULEVARD

ERB STREET WEST

ERB STREET

250 250 300 300 375 375 450 300 450 750 450 375 300 450 525 300 600 750

900 300 750 1050 900 375 900 900 900 300 300 975 450 375 375 375 300 300 975 750 600 300 300 600 450 PLUG 600 PLUG 300 300 375 450 450

LEGEND

- STUDY AREA
- EXISTING STORM SEWER
- EXISTING STORM LEAD (300mmø UNLESS NOTED)
- EXISTING STORM FLOW DIRECTION
- 750 PIPE SIZE (mmø)

FIGURE 3.0

Scale: 1:3000
Date: SEP.05/18

The Westhill
Landowners Group

The Boardwalk Suite 303 Waterloo

WESTHILL DISTRICT PLAN
ERB STREET CONNECTION REVIEW

Erb Street Waterloo

EXISTING
STORM SERVICING

MTE
Engineers | Scientists | Surveyors

Project No.: 34280-101

September 26, 2018 — 1:48 p.m. — Plotted By: sscheifele

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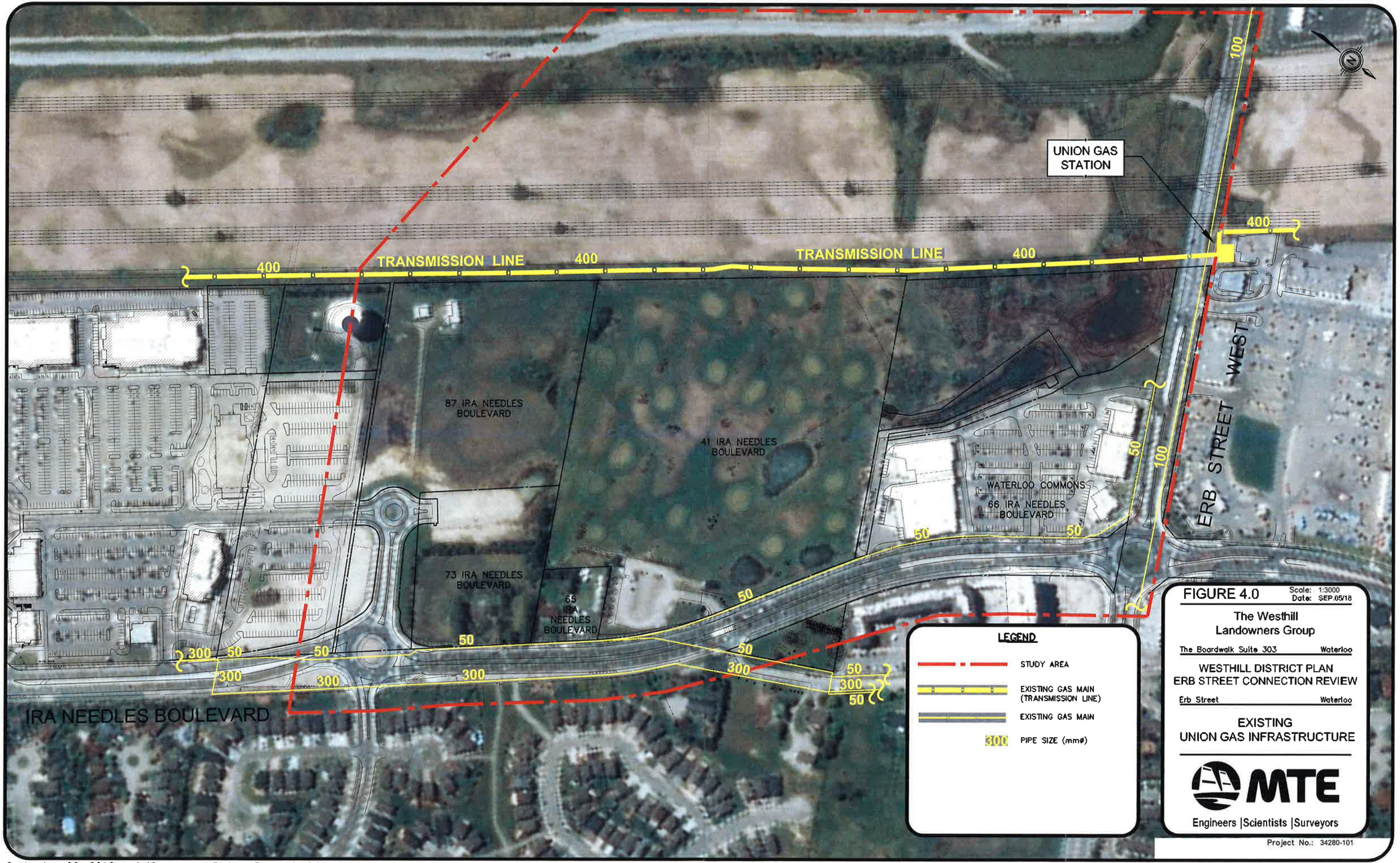


FIGURE 4.0 Scale: 1:3000 Date: SEP.05/18

The Westhill Landowners Group

The Boardwalk Suite 303 Waterloo

WESTHILL DISTRICT PLAN
ERB STREET CONNECTION REVIEW

Erb Street Waterloo

EXISTING
UNION GAS INFRASTRUCTURE

MTE

Engineers | Scientists | Surveyors

Project No.: 34280-101

September 26, 2018 — 1:48 p.m. — Plotted By: sscheifele

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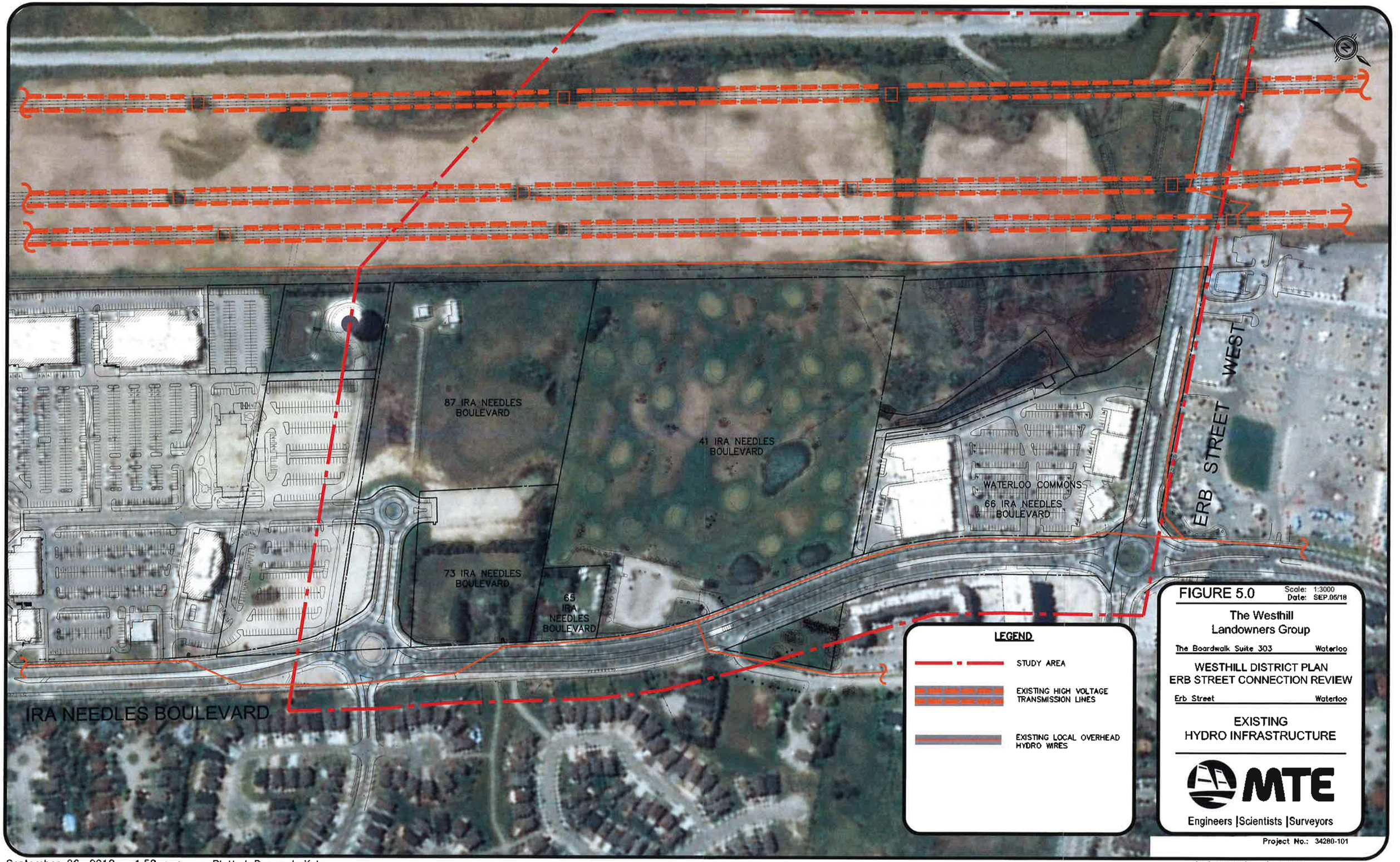


FIGURE 5.0 Scale: 1:3000 Date: SEP.05/18

The Westhill Landowners Group

The Boardwalk Suite 303 Waterloo

WESTHILL DISTRICT PLAN
ERB STREET CONNECTION REVIEW

Erb Street Waterloo

EXISTING HYDRO INFRASTRUCTURE

MTE

Engineers | Scientists | Surveyors

Project No.: 34280-101

September 26, 2018 — 1:58 p.m. — Plotted By: sscheifele

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TAB 6

TECHNICAL MEMORANDUM

TO:	The Westhill Landowners Group	**MTE FILE NO.:**	C 34280-101
			December 4, 2018 May 28, 2020
COMPANY:		**DATE:**	**Revised: July 6, 2020**
		FROM:	Jeff Martens, P.Eng.
			West Waterloo
		PROJECT	Westhill District
		NAME:	North/South Collector Rd

Re: Stormwater Management Alternatives Considered
West Waterloo, Westhill District (WW-WD)
North/South Collector Rd (NS-CR)

1.0 INTRODUCTION

MTE Consultants Inc. (MTE) was retained to complete the existing conditions characterization for the proposed road connection from The Boardwalk extension to the proposed connection between Erb Street West and Ira Needles Boulevard, in the City of Waterloo.

This technical memorandum presents the existing site topography and soil characteristics, the technical design overview of the road geometry and pavement design requirements, and the constructability of the proposed works within the study area for the Erb Street connection. This information is to be considered during the identification, assessment, and determination of an appropriate preferred route alternative for the extension of The Boardwalk from Thorndale Drive to the proposed connection between Erb Street West and Ira Needles Boulevard. This technical memo provides background information for the assessment of the north south collector road alternatives.

This document draws upon the existing information found in several previous reports and studies completed by public agencies and private developers relating to projects undertaken within the study area. The intent is to present the technical design overview for the proposed works and describe any potential conflicts that may need to be considered during the establishment and analysis of road alignment alternatives.

2.0 STUDY AREA

The proposed WW-WD, NS-CR is located west of Ira Needles Boulevard, in the southwestern portion of the City of Waterloo. The internal private road (The Boardwalk) begins at the south end of the box store development, near the entrance to Walmart. The road continues northwest, through the development, to its current terminus at the north end of the Boardwalk commercial development, at the existing roundabout extension of the municipally owned Thorndale Drive.

The study area is located in the upper reach of the Subwatershed 314 – Laurel Creek Watershed and is owned by a variety of landowners, including; the Region of Waterloo, the City of Waterloo, the INCC Corporation, Hydro One, Home Hardware, and the Cressman family. The study area generally includes a small portion of the Region of Waterloo's Waterloo Landfill at 925 Erb Street West, a small portion of the Hydro One corridor (south of Erb Street West), the residences at 87, 73, and 65 Ira Needles Boulevard, the

Westhill Meadows Golf course at 41 Ira Needles Boulevard, and the Waterloo Commons commercial development at 653-659 Erb Street West. These properties will be herein referred to as the 'Subject Lands'.

The Westhill District is within the Grand River Watershed and is located south and west of Laurel Creek. Drainage is generally from south to north and ultimately outletting into Clair Creek. Drainage from the Cressman Lands flows through the dug pond on the golf course and ultimately to the culvert crossing at Erb Street. A large drainage area from the Region's land fill site and the Ontario Hydro Corridor also flows to the Erb Street culvert. The culvert crossing at Erb Street was largely undersized and as a result the impoundment of storm water upstream on Erb Street has occurred for the last 30 years resulting in wetland vegetation in the stormwater attenuation area.

The existing Erb Street Pond outlet is a 900mm diameter sewer located in the southern embankment of the Erb Street West right-of-way. Ultimately, the existing 900mm diameter storm sewer would convey storm runoff north through the Clair Meadows Subdivision to be discharged directly to Clair Creek.

Please refer to the Westhill District Plan Final Stormwater Management Report prepared by MTE Consultants Inc. prepared August 26, 2010, prepared in support of the previously approved Westhill District Plan.

The existing conditions are illustrated in the MTE - Existing Conditions Drawing - **Figure MS11.0**

Outlined below are the various stormwater management alternatives to be considered through the study process:

Alternative 1 - See Figure MS11.1

Do Nothing N/S Collector Roadway bisects the existing SWM/Wetland

- One Open Space SWMF with two Public SWMF and Roadway
- Storm sewer outlets to existing Erb Street SWMF
- No quality control upstream of wetland
- Flooding occurs over roadway

Alternative 2 – See Figure MS11.2

New development serviced by seven private site SWMF plus three public SWMF.
Allowable flow rates established based on prorating available culvert capacity.

- Dual sewer on Municipal ROW
    - Clean water sewer for treated water from private sites
    - Dirty water sewer for road drainage
- Public SWMF downstream of roadway drainage
- Double routings for large storm events

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Kitchener, Ontario N2B 3X9
Phone: 519-743-6500
Fax: 519-743-6513

- Extensive infrastructure with on-site SWMF and public SWMF
- Regional storm flooding will be contained within the SWMFs

Alternative 3 – See Figure MS11.3

New development serviced by six public ownership SWMF, each SWMF having a dedicated storm outlet.

- Developments proceed independently
- Double sewer for Cressman SWMF, Home Hardware SWMF and road drainage.
    - Clean water sewer for treated water from municipal SWMF
    - Dirty water sewer for road drainage
- Regional storm flooding will be contained within the SWMFs

Alternative 4 – See Figure MS11.4

Two public SWMF, and one private SWMF.

- Minimizes infrastructure costs and maintenance
- Minimal number of municipal SWMF
- Regional storm flooding will be contained within the SWMFs

Alternative 5 – See Figure MS11.5

Two public SWMF, and one Hydro Corridor Detention Facility (HCDF).

- Minimizes infrastructure costs and maintenance
- Minimal number of municipal SWMF
- Utilizes existing detention storage on hydro corridor
- Regional storm flooding will be contained within the SWMF1 and SWMF2 and the level of flooding within the HECP Hydro Corridor will be maintained to current conditions

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www.mte85.com

MTE FILE No: 34280-101-MS11.0
PRELIMINARY SWM ALTERNATIVE 3
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EXISTING REGION OF WATERLOO LANDFILL POND

HYDRO CORRIDOR

KW ZONE 6 ELEVATED TANK

87 IRA NEEDLES BOULEVARD

41 IRA NEEDLES BOULEVARD

WATERLOO COMMONS

66 IRA NEEDLES BOULEVARD

THE BOARDWALK

THORNDALE DRIVE

73 IRA NEEDLES BOULEVARD

65 IRA NEEDLES BOULEVARD

IRA NEEDLES BOULEVARD

WESTHILL DRIVE

ERB STREET WEST

750mmø 825mmø 900mmø 900mmø 900mmø

LEGEND

- PROPERTY BOUNDARY
- EASEMENT
- EXISTING SPOT ELEVATIONS/CONTOURS
- EXISTING SANITARY SEWER
- EXISTING WATERMAIN
- EXISTING STORM SEWER
- EXISTING EMBANKMENT (SLOPE AS NOTED)
- LIMIT CONSTRAINT LEVEL 1
- STANDING WATER w/ ECOLOGICAL VEGETATION/FUNCTION
- STANDING WATER

MS11.0 Scale: 1:2500 Date: OCT.16/18

The Westhill Landowners Group

101 IRA NEEDLES BOULEVARD WATERLOO, ON

WESTHILL DISTRICT PLAN
ERB STREET CONNECTION REVIEW

ERB STREET WATERLOO, ON

EXISTING CONDITIONS

MTE Engineers | Scientists | Surveyors

Project No.: 34280-101

October 18, 2018 - 12:39 p.m. - Plotted By: mmiddle

34280-101-MS11.1
PRELIMINARY SWM ALTERNATIVE 3
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HYDRO CORRIDOR

EXISTING
REGION OF WATERLOO
LANDFILL POND

KW ZONE 6
ELEVATED TANK

87 IRA NEEDLES
BOULEVARD

41 IRA NEEDLES
BOULEVARD

WATERLOO
COMMONS

66 IRA NEEDLES
BOULEVARD

THE
BOARDWALK

THORNDALE DRIVE

73 IRA NEEDLES
BOULEVARD

65 IRA
NEEDLES
BOULEVARD

IRA NEEDLES BOULEVARD

WESTHILL DRIVE

ERB STREET WEST

750mmø 825mmø
900mmø 900mmø 900mmø

LEGEND

- EXISTING REGIONAL STORM DETENTION STORAGE AREA
- CONCEPTUAL STORM SEWER COLLECTOR ROAD
- (P) (PRIVATE) SWM POND OWNERSHIP
- (C) (CITY) SWM POND OWNERSHIP
- (R) (REGION) SWM POND OWNERSHIP

MS11.1

Scale: 1:2500
Date: OCT.16/18

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Landowners Group

101 IRA NEEDLES BOULEVARD WATERLOO, ON

WESTHILL DISTRICT PLAN
ERB STREET CONNECTION
REVIEW

ERB STREET WATERLOO, ON

ALTERNATIVE 1
FIGURE

MTE
Engineers | Scientists | Surveyors

Project No: 34280-101

HYDRO CORRIDOR

EXISTING
REGION OF WATERLOO
LANDFILL POND

KW ZONE 6
ELEVATED TANK

87 IRA NEEDLES
BOULEVARD

41 IRA NEEDLES
BOULEVARD

WATERLOO
COMMONS

56 IRA NEEDLES
BOULEVARD

THE
BOARDWALK

THORNDALE DRIVE

73 IRA NEEDLES
BOULEVARD

65 IRA
NEEDLES
BOULEVARD

ERB STREET

IRA NEEDLES BOULEVARD

WESTHILL DRIVE

750mmø 825mmø
900mmø 900mmø 900mmø

P
C
R

LEGEND

- PROPOSED STORM DETENTION STORAGE AREA
- CONCEPTUAL STORM SEWER(UNTREATED)
- STORM SEWER(TREATED)
- COLLECTOR ROAD
- (P) (PRIVATE) SWM POND OWNERSHIP
- (C) (CITY) SWM POND OWNERSHIP
- (R) (REGION) SWM POND OWNERSHIP

MS11.2

Scale: 1:2500
Date: OCT.16/18

The Westhill
Landowners Group
101 IRA NEEDLES BOULEVARD WATERLOO, ON

WESTHILL DISTRICT PLAN
ERB STREET CONNECTION
REVIEW
ERB STREET WATERLOO, ON

ALTERNATIVE 2
FIGURE

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34280-101-MS11.2
PRELIMINARY SWM ALTERNATIVE 3
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PRELIMINARY SWM ALTERNATIVE 3
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HYDRO CORRIDOR

EXISTING
REGION OF WATERLOO
LANDFILL POND

KW ZONE 6
ELEVATED TANK

87 IRA NEEDLES
BOULEVARD

41 IRA NEEDLES
BOULEVARD

66 IRA NEEDLES
BOULEVARD

73 IRA NEEDLES
BOULEVARD

65 IRA
NEEDLES
BOULEVARD

THE
BOARDWALK

THORNDALE DRIVE

ERB STREET WEST

IRA NEEDLES BOULEVARD

WESTHILL DRIVE

WATERLOO
COMMONS

900mmø

750mmø

825mmø

900mmø

900mmø

C

R

LEGEND

- REGIONAL SWM FACILITIES
- CONCEPTUAL STORM SEWER(UNTREATED)
- STORM SEWER(TREATED)
- COLLECTOR ROAD
- (P) (PRIVATE) SWM POND OWNERSHIP
- (C) (CITY) SWM POND OWNERSHIP
- (R) (REGION) SWM POND OWNERSHIP

MS11.3

Scale: 1:2500
Date: OCT.16/16

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Landowners Group
101 IRA NEEDLES BOULEVARD WATERLOO, ON

WESTHILL DISTRICT PLAN
ERB STREET CONNECTION
REVIEW
ERB STREET WATERLOO, ON

ALTERNATIVE 3
FIGURE

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Project No.: 34280-101

October 19, 2016 - 12:29 p.m. - Robert Ilic website

34280-101-MS11.4
PRELIMINARY SWM ALTERNATIVE 3

EXISTING
REGION OF WATERLOO
LANDFILL POND

HYDRO CORRIDOR

KW ZONE 6
ELEVATED TANK

87 IRA NEEDLES
BOULEVARD

41 IRA NEEDLES
BOULEVARD

WATERLOO
COMMONS

66 IRA NEEDLES
BOULEVARD

THE
BOARDWALK

THORNDALE DRIVE

73 IRA NEEDLES
BOULEVARD

65 IRA
NEEDLES
BOULEVARD

ERB STREET

IRA NEEDLES BOULEVARD

WESTHILL DRIVE

750mmø
825mmø
900mmø
900mmø
900mmø

LEGEND

- REGIONAL SWM FACILITIES
- CONCEPTUAL STORM SEWER(UNTREATED)
- STORM SEWER(TREATED)
- COLLECTOR ROAD
- (X) REMOVE SWM POND
- (P) (PRIVATE) SWM POND OWNERSHIP
- (C) (CITY) SWM POND OWNERSHIP
- (R) (REGION) SWM POND OWNERSHIP

MS11.4

Scale: 1:2500
Date: OCT.16/18

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101 IRA NEEDLES BOULEVARD WATERLOO, ON

WESTHILL DISTRICT PLAN
ERB STREET CONNECTION
REVIEW
ERB STREET WATERLOO, ON

ALTERNATIVE 4
FIGURE

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Project No.: 34280-101

SITE FILE No: 34280-101-MS11.5
PRELIMINARY SWM ALTERNATIVE 5
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EXISTING
REGION OF WATERLOO
LANDFILL POND

HYDRO CORRIDOR

SIGNIFICANT WILDLIFE HABITAT (WSP) (TYP.)

SUPPORTING 'B' FEATURES (WSP; PER WATERLOO OP) (TYP.)

KW ZONE 6
ELEVATED TANK

87 IRA NEEDLES BOULEVARD

41 IRA NEEDLES BOULEVARD

OTHER WETLANDS (WSP; PER WATERLOO OP) (TYP.)

SUPPORTING 'A' FEATURES (WSP; PER WATERLOO OP) (TYP.)

WATERLOO COMMONS
851-863 ERB STREET WEST

THE BOARDWALK

73 IRA NEEDLES BOULEVARD

65 IRA NEEDLES BOULEVARD

THORNDALE DRIVE

IRA NEEDLES BOULEVARD

WESTHILL DRIVE

ERB STREET

750mmø 825mmø 900mmø 900mmø 900mmø

W1 W2 W3 W4

1 2 3 4

C C X R

LEGEND

- SWM FACILITIES
- EXISTING REGIONAL STORM DETENTION STORAGE AREA
- CONCEPTUAL STORM SEWER(UNTREATED)
- STORM SEWER(TREATED)
- COLLECTOR ROAD
- X — REMOVE SWM POND
- P — (PRIVATE) SWM POND OWNERSHIP
- C — (CITY) SWM POND OWNERSHIP
- R — (REGION) SWM POND OWNERSHIP
- W1 — STANDING WATER w/ ECOLOGICAL VEGETATION/FUNCTION IDENTIFIER
- 3 — DRAINAGE FEATURE IDENTIFIER
- STANDING WATER

MS11.5

Scale: 1:2500
Date: Feb. 26/20

The Westhill
Landowners Group

101 IRA NEEDLES BOULEVARD WATERLOO, ON

WESTHILL DISTRICT PLAN
ERB STREET CONNECTION
REVIEW

ERB STREET WATERLOO, ON

ALTERNATIVE 5
FIGURE

MTE
Engineers, Scientists, Surveyors

Project No.: 34280-101

May 21, 2020 - 11:49 p.m. - Plotted By: SSchiefele

Appendix L

ERB STREET WEST
& BOARDWALK EXTENSION

WATERLOO, ONTARIO

Intersection Control Study

Prepared for:
Westhill Land Owners

Prepared by:
MTE Consultants Inc.
520 Bingemans Centre Drive
Kitchener, ON N2B 3X9

August 2019

MTE File No.: C34280-101



TABLE OF CONTENTS

1.0 INTRODUCTION 1

1.1 Overview 1
1.2 Purpose of Study 2

2.0 INTERSECTION CONTROL ALTERNATIVES 2

2.1 Analysis Inputs 2
2.2 Signalized Intersection Concept 2
2.3 Roundabout Concept 3

3.0 QUANTITATIVE EVALUATION (COST) 4

3.1 Injury Collision Costs 4
3.1.1 Traffic Signal Injury Collision Prediction 4
3.1.2 Roundabout Injury Collision Prediction 4
3.1.3 Life Cycle Societal Costs 5
3.2 Other Life Cycle Costs 5
3.3 Capital Costs 5
3.4 Results of Quantitative Evaluation 6

4.0 QUALITATIVE EVALULATION 7

4.1 Traffic Operations 7
4.2 Results of Qualitative Evaluation 8

5.0 CONCLUSIONS AND RECOMMENDATIONS 9

APPENDICES

APPENDIX A SAFETY ANALYSIS BACKGROUND
APPENDIX B CAPITAL COST ESTIMATES
APPENDIX C CAPACITY ANALYSIS OUTPUT
APPENDIX D ADDITIONAL SUPPORT DOCUMENTS

FIGURES

FIGURE 1 LOCATION PLAN 1
FIGURE 2 SIGNALIZED INTERSECTION CONCEPT 3
FIGURE 3 ROUNDABOUT CONCEPT 4

TABLES

TABLE 1 COMPARISON OF ANNUAL COLLISION PERFORMANCE 5
TABLE 2 SUMMARY OF CONSTRUCTION AND PROPERTY COSTS 6
TABLE 3 COMPARISON OF CAPITAL AND LIFE CYCLE COSTS 7
TABLE 4 COMPARISON OF 2031 TRAFFIC OPERATIONS 7
TABLE 5 SUMMARY OF QUALITATIVE COMMENTS 8

1.0 INTRODUCTION

1.1 Overview

MTE Consultants Inc. was retained by the Westhill Land Owners Group to perform an Intersection Control Study for the intersection at Erb Street West, the entrance to Westside Market and a road extension from The Boardwalk.

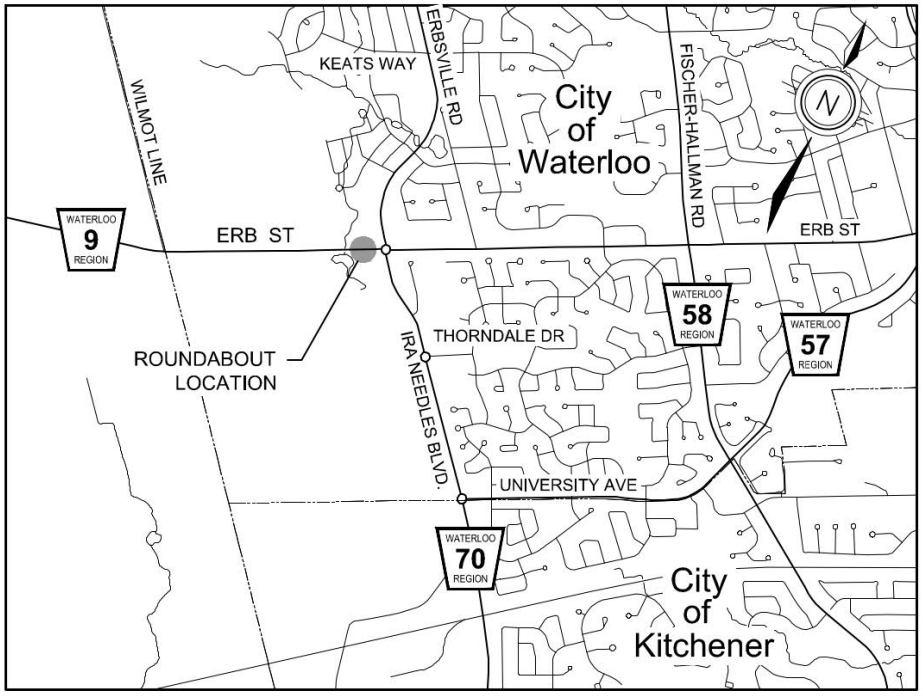
Erb Street West is a two lane east-west arterial road operated by the Region of Waterloo with one lane in each direction and a posted speed limit of 60km/h. In the spring of 2018 the Region of Waterloo filed an EA which specifies upgrading the corridor to four lanes, two lanes in each direction, along with full upgrades to the road. Those upgrades are scheduled to be completed by the fall of 2021.

The study location is currently a three leg signal controlled intersection of Erb Street West and the entrance to the Westside Marketplace to the North. All three legs of the intersection consist of three lanes, with one through lane in each direction along Erb Street West, a westbound left turn lane from the west into the mall, and an eastbound right turn lane into the mall. The mall access consists of one entrance lane and both right and left turn exit lanes.

The proposed Boardwalk Extension is anticipated to be a two lane north/south collector road with one lane in each direction connecting the existing Boardwalk development, Thorndale Blvd and future development to Erb Street West.

The north quadrants are fully developed with a Bank of Montreal (BMO) building to the northwest and Shoppers Drug Mart building to the northeast. The south quadrants are currently undeveloped with a Hydro One corridor to the southwest and an undeveloped portion of Waterloo Commons to the southeast.

Figure 1 - Location Plan



1.2 Purpose of Study

As part of the planning for the Westhill District a new north/south collector road was identified to help facilitate future traffic requirements as well as potentially alleviating congestion experienced at the Erb Street West and Ira Needles Blvd roundabout. The new collector road is proposed to intersect with Erb Street West at an existing signalized intersection approximately 230m west of Ira Needles Boulevard. The purpose of this study is to identify the preferred intersection control for the planned intersection.

This study evaluates both signal and roundabout control alternatives using various criteria including construction costs, societal costs, traffic operations, property impacts, pedestrian and cyclist effects, speed control, fuel consumption and emissions, area land uses, construction staging, maintenance and aesthetics.

2.0 INTERSECTION CONTROL ALTERNATIVES

2.1 Analysis Inputs

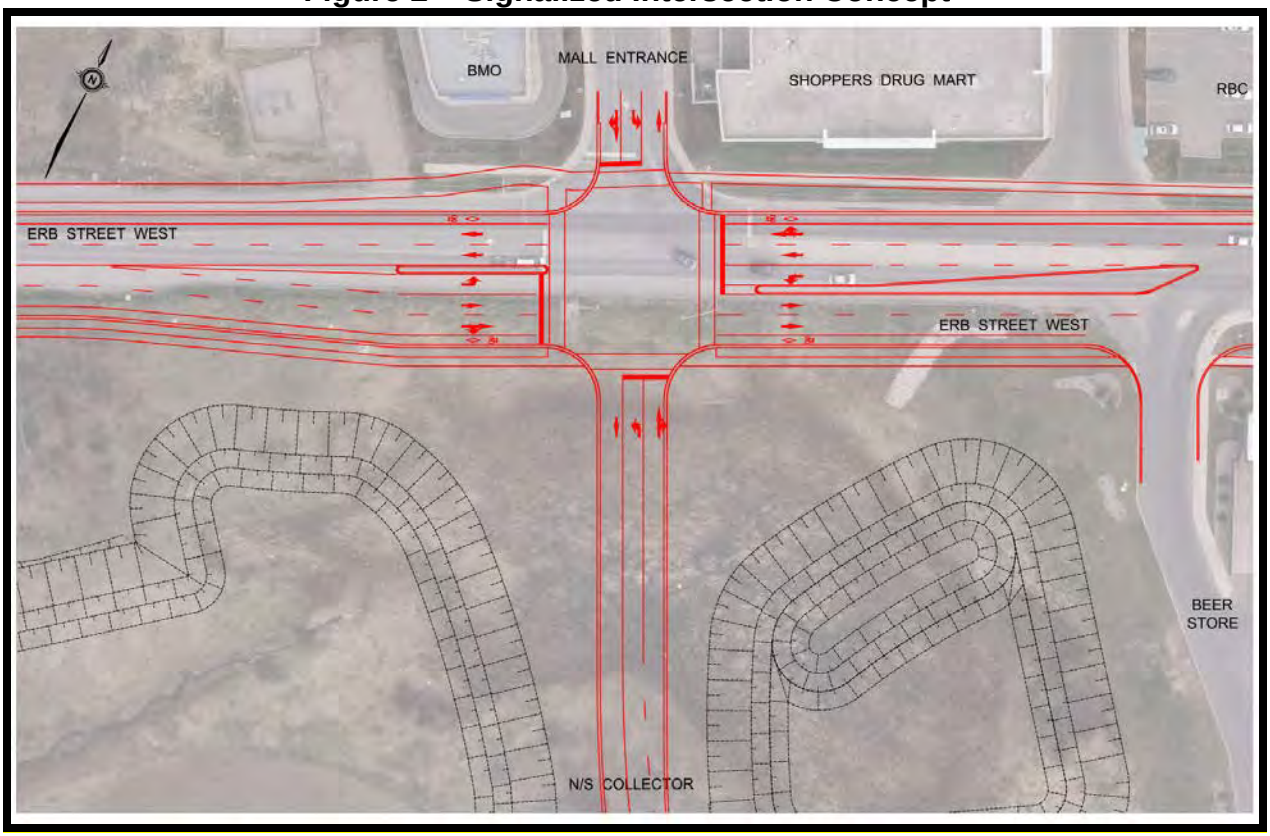
Peak hour and average daily traffic (AADT) forecasts for 2031 were prepared by Paradigm Transportation Solutions from their report dated July 2019. The 2031 data was used to develop signalized and roundabout concept designs to accommodate the proposed 4-lane cross-section from the Erb Street West EA and projected traffic volumes from the Boardwalk extension. Anticipated construction is for 2021, and so a ten year design horizon was determined to be applicable.

The design concepts provided are considered adequate for the evaluation of the intersection functionality, as well as estimating construction costs and property impacts. The designs are considered part of the preliminary design process, and therefore require further refinement as the design process continues.

2.2 Signalized Intersection Concept

The signalized design concept was derived using the forecasted volumes along with consultations with the project design team. The concept drawing of the signalized intersection is shown below in **Figure 2**, and is designed to accommodate the traffic projections for 2031. The design consists of two lanes east/west and one lane north/south with single left turn lanes on all legs. In order to accommodate the signalized intersection, additional property would be required in the southern quadrants.

Figure 2 – Signalized Intersection Concept



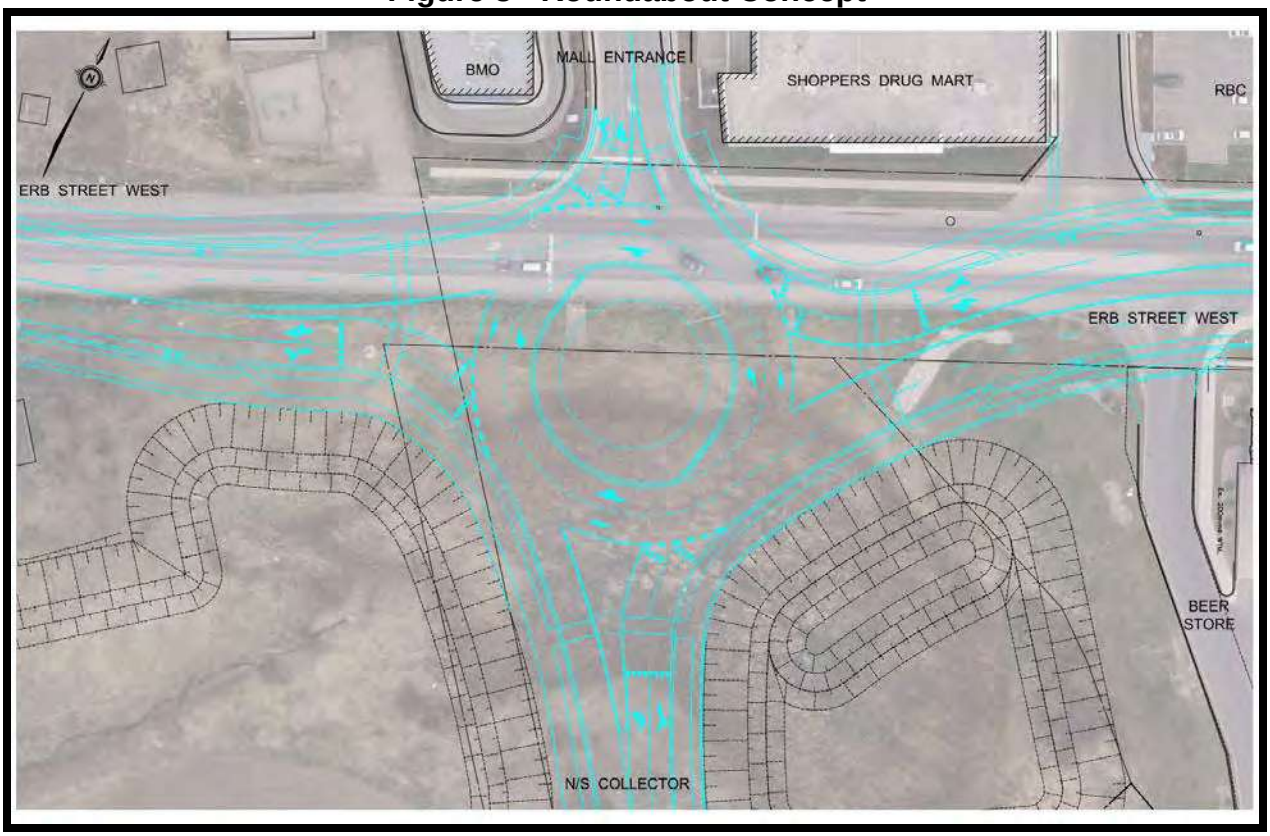
2.3 Roundabout Concept

The roundabout design is based on the forecasted volumes, preliminary modelling in ARCADY and input from the project design team and can be found in **Appendix C** at the end of the report.

The roundabout design is a two lane roundabout with full two lane entry/exits running east/west along Erb Street West and two lane entries for the minor legs with a through-right lane and dedicated left turn lanes. A spiraled central island geometry is utilized for the minor legs to introduce the dedicated left turn lanes and shift left turning traffic from Erb Street West to the outside lane to exit onto the minor legs.

Due to the existing development in the northern quadrants the center of the roundabout is situated 20m± south of the existing Erb Street West alignment. As such, most of the property requirements are on the southern portion of the roundabout on the Waterloo Commons land and Hydro One corridor. Minor property negotiation may be required with the Westside Marketplace development and the Region of Waterloo to encompass the pedestrian crossing on the north leg within the Regional right of way.

Figure 3 - Roundabout Concept



3.0 QUANTITATIVE EVALUATION (COST)

3.1 Injury Collision Costs

3.1.1 *Traffic Signal Injury Collision Prediction*

The data provided by the Region of Waterloo in the form of the Safety Assessment Methodology revised in January 2019 is used to predict the safety performance of an intersection based on the usage. Using the standard spreadsheet that is provided by the Region and the Saturday peak traffic volumes, estimations for future expected collisions on an annual basis were calculated. The signalized intersection is estimated to have 9.23 collisions per year, 5.83 PDO, and 3.39 injury.

3.1.2 *Roundabout Injury Collision Prediction*

The data provided by the Region of Waterloo in the form of the Safety Assessment Methodology revised in January 2019 is used to predict the safety performance of an intersection based on the usage. Using the standard spreadsheet that is provided by the Region and the Saturday peak traffic volumes, estimations for future expected collisions on an annual basis were calculated. The roundabout is estimated to have 15.17 collisions per year, 13.65 PDO, and 1.52 Injury.

3.1.3 *Life Cycle Societal Costs*

The annual societal costs for a signalized intersection and a roundabout were calculated in net present value terms. The 20-Year present value cost used a 6% discount rate. The results are summarized in Table 1 below.

Table 1 – Comparison of Annual Collision Performance

20-Year Present Value Collision Costs (DIRECT CAPITAL COSTS)				
Collisions by Severity	**Total**	**PDO**	**Injury**	**Fatal**
Signalized	**$2,819,771.17**	**$334,348.20**	**$2,352,423.49**	**$132,999.47**
Roundabout	**$1,835,659.41**	**$782,982.69**	**$1,052,676.73**	**$0.00**

The previous table does not include additional costs or any saving that may be associated with property damages. It is difficult to provide an estimate which represents property damage crash savings, and so societal costs are more difficult to obtain. The savings associated with roundabouts are generally societal savings.

3.2 Other Life Cycle Costs

In order to establish life cycle costing a number of assumptions surrounding maintenance costs are required. The present values of maintenance costs through 2031 are presented below:

	Signalized Intersection	Roundabout
Maintenance Item		
Traffic Signals	$2,500 / year	
Street Lighting	$1,000 / year	$1,500 / year
Total Life Cycle Cost	$70,000	$30,000

Present costs are over the 20 year period, and discount rate of 6% is assumed.

3.3 Capital Costs

The estimates that were developed for capital costs included costs for construction and engineering fees. Property acquisitions have not been included as much of the land requirements are encumbered by an easement or will be dedicated by the owner of the Waterloo Commons. Some assumptions made to establish the estimates are as follows:

- The design process has not progressed far enough to properly estimate the full extent of underground construction works. Therefore, while utility costs are provided, they are partial estimates.

- Full road reconstruction regardless of the option selected.
- The roundabout or signalized intersection will be constructed with other Regional Road improvements.
- The roundabout or signalized intersection is an Regional Development Charge eligible expense.
- Similar roundabout and intersection construction projects were used to develop these estimates. Unique features that may arise during design may not be accounted for.
- Construction and property cost estimates include 20% for Engineering Fees, 20% for contingency, and 5% for maintenance.

A summary of the costs is provided below in Table 2. It should be noted that actual construction costs will depend on the timing of construction, contractor availability and scheduling, along with many other factors. At this time, there is minimal property acquisition required, and may not have any cost impact. For this report, property acquisition costs will be considered negligible.

Table 2 – Summary of Construction Costs

Description	Signalized	Roundabout
Site Preparation and Removals	$ 107,500	$ 107,500
Road Works	$ 511,000	$ 728,800
Utilities (Storm)	$ 230,100	$ 248,000
Street lighting and Streetscaping	$ 100,000	$ 120,000
Sub-Total	$ 948,600	$ 1,204,300
Engineering (20%)	$ 189,720	$ 240,860
Contingency (20%)	$ 189,720	$ 240,860
Maintenance (5%)	$ 47,430	$ 60,215
Total	**$ 1,375,470**	**$ 1,746,235**

At the intersection of Erb Street West & Boardwalk Extension, a signalized intersection is estimated to cost approximately $1,375,470 and a roundabout is estimated to cost $1,746,235. There is an approximate $370,765 difference in cost in favour of a signalized intersection.

3.4 Results of Quantitative Evaluation

The table below summarizes the total capital, life cycle and collision cost estimates to establish a direct comparison of total costs associated with a roundabout and signalized intersection. The total overall cost of a signalized intersection is $4,894,270, while the cost of a roundabout is $3,611,935. Therefore there is a $1,282,335 difference in cost between the signalized and roundabout options.

Table 3 – Comparison of Capital and Life Cycle Costs

Cost Item	Signalized	Roundabout
Present Value Collision Costs	$ 2,819,800	$ 1,835,700
Other Life Cycle Costs	$ 70,000	$ 30,000
Capital Cost	$ 1,375,470	$ 1,746,235
Total	$ 4,265,270	$ 3,611,935

4.0 QUALITATIVE EVALULATION

4.1 Traffic Operations

An operational analysis was completed by Paradigm Transportation Solutions using the forecasted 2031 PM peak volumes for both the signalized and roundabout design concepts to determine the level of service. The analysis was done using Synchro for the signalized concept and ARCADY for the roundabout concept. ARCADY Capacity intercept adjustments of 10% and 5% were made as per Region of Waterloo specifications to represent opening capacity and 10+ year capacity respectively. The results are summarized in **Table 4** below with detailed analysis output available in **Appendix C**.

Table 4 – Comparison of 2031 Traffic Operations

	Performance Measure	Signalized Intersection	Roundabout	
			90% Intercept Adjustment	95% Intercept Adjustment
PM Peak	**Avg. Approach Delay**			
	SB Westside Marketplace	≥ 29s	4s	4s
	EB on Erb Street West	≥ 21s	11s	8s
	NB on Boardwalk Extension	≥ 49s	13s	10s
	WB on Erb Street West	≥ 13s	6s	5s
	95th Percentile Queue			
	SB Westside Marketplace	≥ 61m	<15m	<15m
	EB on Erb Street West	≥ 196m	120m	60m
	NB on Boardwalk Extension	≥ 116m	23m	<15m
	WB on Erb Street West	≥ 119m	30m	23m
	Overall LOS	**'C' or lower**	**'A'**	**'A'**

The signalized intersection capacity analysis shows that demand exceeds capacity for at least one turning movement during the PM peak period. As such residual queues would likely cause worse than predicted operations if analyzed over a time period greater than 15 minutes, and the predicted level of service 'C' may be lower.

The roundabout capacity analysis shows an overall level of service 'A' at the 90% intercept, as well as a level of service 'A' at the 95% intercept adjustment.

4.2 Results of Qualitative Evaluation

The following table provides a summary of the qualitative evaluation of signals vs. roundabout, apart from traffic operations.

Table 5 – Summary of Qualitative Comments

Evaluation Criteria	Comments	
	Signalized Intersection	**Roundabout**
Transit	There are no transit routes currently along Erb Street West.	There are no transit routes currently along Erb Street West.
Emergency Services	While emergency vehicle pre-emption would be enabled at this intersection, during peak volumes navigation could become challenging.	With free flow of traffic and the ability to perform u-turns, emergency vehicles should be able to quickly and safely navigate the intersection
Pedestrians and persons with disabilities	Signal will require push button activation per AODA requirements with possible audible signals. Crossing distances are substantial with 5 travel lanes plus cycle lanes.	Crossing distances will be reduced to one vehicle direction at a time with fewer injury crashes and right of way. Consultations may be required if accessibility concerns are raised.
Cyclists	Cycle lanes are proposed for both sides of Erb Street West as well as a multi-use trail along the north side of the right of way. Crossing and left turn movements are not accommodated with actuated signals.	Cycle Lanes are proposed for both sides of Erb Street West with multi-use trail accommodations on proposed for all roundabout legs. Cyclists have the option to take a lane within the roadway or exit onto the MUT.
Speed Control	Traffic speeds will remain high under green light conditions with the exception of peak conditions.	Speeds are reduced with good deflection entering the roundabout.
Compatibility	Excessive queueing could cause access problems.	Lower speeds and less queueing should result in better access.
Noise, Fuel Consumption, Emissions	No change.	Decrease in delay will result in decrease in fuel & emissions. Less stop & starts should decrease noise levels.
Maintenance	No change, lane closures possible.	Work in circulatory roadway may require large vehicles to detour.
Construction Staging	Less complicated.	More complicated, may require temporary roads.
Aesthetics	No change, possible decorative concrete.	Decorative concrete and landscaped central island feature.
Corridor Control	A signal is inconsistent with roundabouts planned	A roundabout is consistent with planned roundabouts, and provides for more effective movements within the corridor.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the cost estimates generated for road reconstruction cost, life cycle costs and collision costs, the roundabout option is $3,611,935, while the signalized option is $4,265,270. Therefore the roundabout is overall $653,335 less than the signalized intersection option presented. There are a few key points to note from this analysis:

- The roundabout option was considered preferable in the 20-year life cycle and safety cost analysis.
- Roundabout option improved the overall level of service to 'A', while the signalized option provided a level of service 'C'.
- Difference in capital cost of intersection was $370,765 or 27% in favour of the signalized intersection option.

When considering all of the capital, life cycle and collision costs, the analysis of the two options represents a preference for the roundabout. Additionally, the roundabout provides a significant level of service improvement at the proposed intersection. Based on the results of this intersection control study, using traffic data for the 2031 design period, the 2 lane roundabout is considered the preferred option.

All of which is respectfully submitted,

MTE CONSULTANTS INC.

Nathan Duimering, C.Tech
Designer

NPD:VPP:zeg

Vince Pugliese, P.Eng. MBA, PMP
Design Engineer



APPENDIX A

SAFETY ANALYSIS BACKGROUND

INTERSECTION CONTROL STUDIES
SAFETY ASSESSMENT METHODOLOGY (HSM)

Region of Waterloo

Last Rev Jan 2019

Scenario: PM Peak - 2031 Planning Horizon

Major Road: Erb Street W

Minor Road: The Boardwalk/Entrance

Major Road Direction:	East / West
Urban or Rural:	Urban
Proposed Control:	Signalized
Proposed Config.	4-Leg Intersection

LT Lanes Proposed (non roundabout):		RT Lanes Proposed (non roundabout):	
Major	2 Approaches	**Major**	No RT Lanes
Minor	2 Approaches	**Minor**	No RT Lanes

Is there going to be any fully protected left-turn phasing?	YES
Number of approaches with FPLTP:	2
Is the proposed intersection "new" or is it existing:	NEW
Does control and number of approaches remain the same:	YES
Will the proposed intersection have illumination:	YES

NOTE: No collision history required

5-Year Total Collisions: N/A

5-Year PDO Collisions: N/A

Proposed Multi-Lane or Single Lane RA? MULTI-LANE ROUNDABOUT

Major Road (mid-block) 10-Year Horizon AADT: 31,110

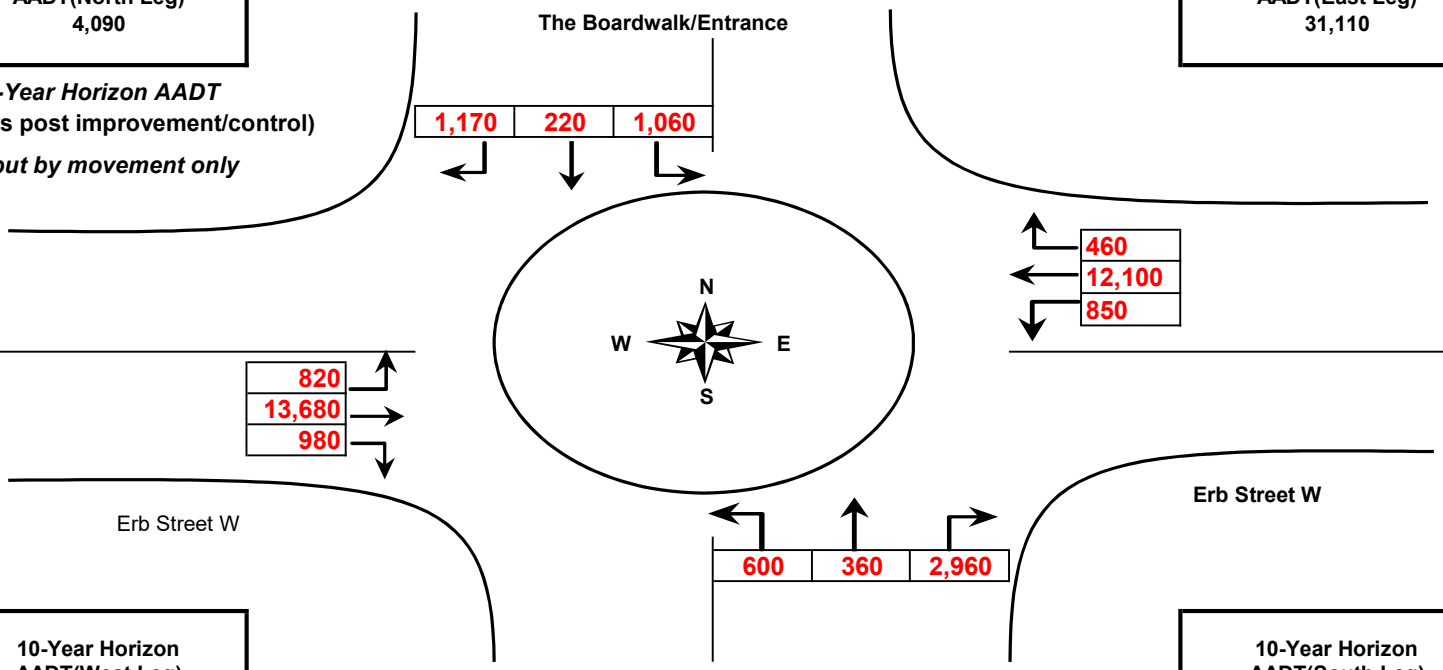
Minor Road (mid-block) 10-Year Horizon AADT: 5,970

10-Year Horizon AADT(North Leg) 4,090

10-Year Horizon AADT(East Leg) 31,110

***10-Year Horizon AADT (10ys post improvement/control)**

***Input by movement only**



10-Year Horizon AADT(West Leg) 29,350

10-Year Horizon AADT(South Leg) 5,970

Direct Capital Costs

Fatal = $1,656,500

Injury = $60,500

PDO = $5,000

Discount Rate = 0.06

20-Year Present Value Collision Costs (DIRECT CAPITAL COSTS)

Collisions by Severity	Total	PDO	Injury	Fatal
Signalized	$2,723,309.13	$321,157.79	$2,269,151.86	$132,999.47
Roundabout	$1,770,502.01	$755,190.43	$1,015,311.58	$0.00

INTERSECTION CONTROL STUDIES
SAFETY ASSESSMENT METHODOLOGY (HSM)

Last Rev Jan 2019

Scenario: PM Peak - 2031 Planning Horizon

Major Road: Erb Street W
Minor Road: The Boardwalk/Entrance

Major Road Direction: East / West

Urban or Rural: Urban

Proposed Control: Signalized

Proposed Config. 4-Leg Intersection

Roundabout Conflicts: 31530

5-Year Total Collisions: N/A

5-Year PDO Collisions: N/A

Estimated **ANNUAL (1-YEAR ONLY)** Collisions				
Future Expected Collisions by Severity	**Total**	**PDO**	**Injury**	**Fatal**
Signalized	**8.88**	**5.60**	**3.27**	**0.01**
Roundabout	**14.63**	**13.17**	**1.46**	**0.00**

TOTAL CRASH COEFFICIENTS USED IN CALCULATION						Fatal/Inj. Ratio	Collision Factor
Control	Intersection Config	Intercept	AADTmaj	AADTmin	Overdispersion		
Signalized	4-Leg Intersection	**-10.99**	**1.07**	**0.23**	**N/A**	**0.002**	**n/a**

PDO CRASH COEFFICIENTS USED IN CALCULATION						Fatal/Inj. Ratio	Collision Factor
Control	Intersection Config	Intercept	AADTmaj	AADTmin	Overdispersion		
Signalized	4-Leg Intersection	**-11.02**	**1.02**	**0.24**	**N/A**	**0.002**	**n/a**

Collision Modification Factors (cmf's)	Left Turn Lane	Right Turn Lane	Calibration Factor	Empirical Bays Weighting	
	0.66		**2.1**	Total **N/A**	PDO **N/A**
	Illumination	Protected LT Phasing			
	0.91	**0.88**			

Comments:

INTERSECTION CONTROL STUDIES
SAFETY ASSESSMENT METHODOLOGY (HSM)

Last Rev Jan 2019

Region of Waterloo

Scenario: PM Peak - 2031 Planning Horizon

Major Road: Erb Street W

Minor Road: The Boardwalk/Entrance

Major Road Direction:	East / West
Urban or Rural:	Urban
Proposed Control:	Signalized
Proposed Config.	4-Leg Intersection

LT Lanes Proposed (non roundabout):		RT Lanes Proposed (non roundabout):	
Major	2 Approaches	**Major**	No RT Lanes
Minor	2 Approaches	**Minor**	No RT Lanes

Is there going to be any fully protected left-turn phasing?	YES
Number of approaches with FPLTP:	2
Is the proposed intersection "new" or is it existing:	NEW
Does control and number of approaches remain the same:	YES
Will the proposed intersection have illumination:	YES

NOTE: No collision history required

5-Year Total Collisions: N/A

5-Year PDO Collisions: N/A

Proposed Multi-Lane or Single Lane RA? MULTI-LANE ROUNDABOUT

Major Road (mid-block) 10-Year Horizon AADT: 31,460

Minor Road (mid-block) 10-Year Horizon AADT: 6,700

10-Year Horizon AADT(North Leg) 4,870

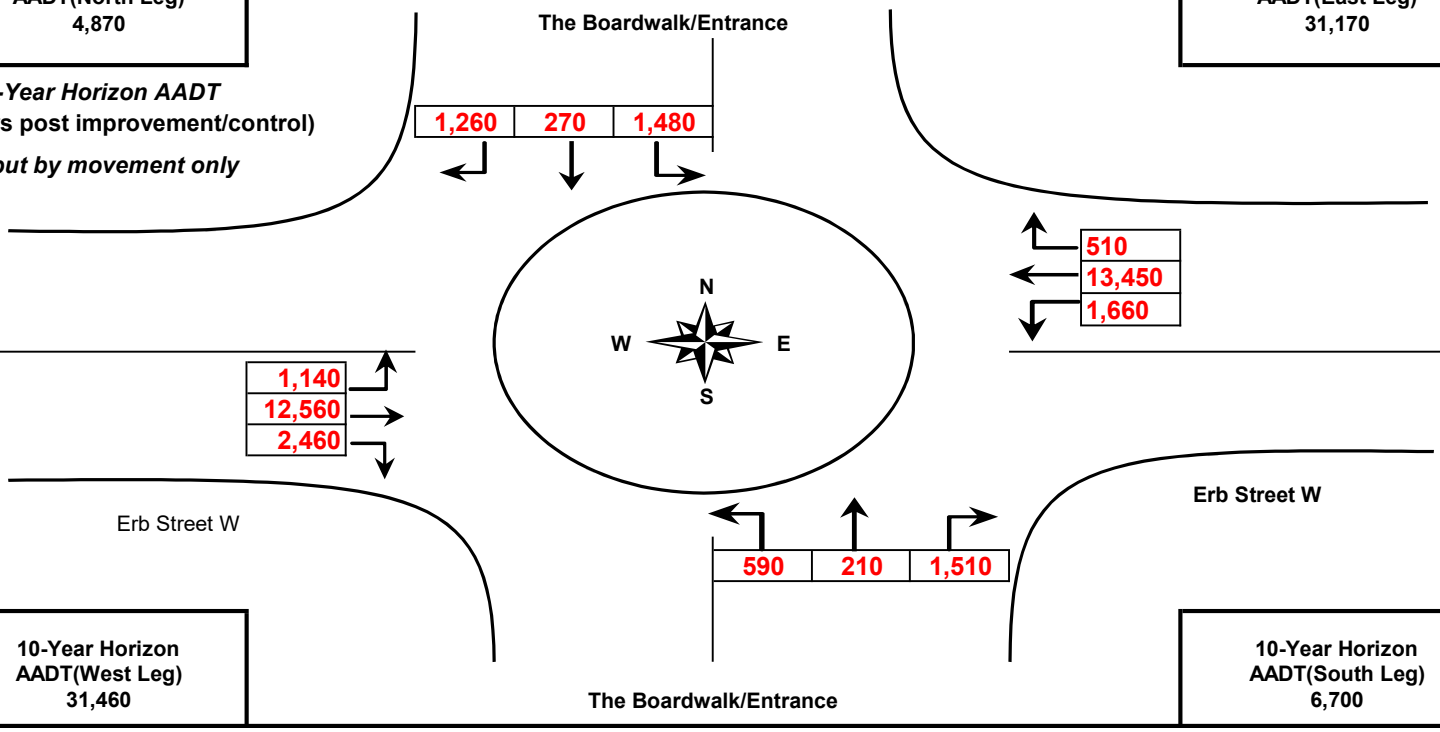
10-Year Horizon AADT(East Leg) 31,170

10-Year Horizon AADT(West Leg) 31,460

10-Year Horizon AADT(South Leg) 6,700

** 10-Year Horizon AADT (10ys post improvement/control)*

** Input by movement only*



Direct Capital Costs

Fatal = $1,656,500

Injury = $60,500

PDO = $5,000

Discount Rate = 0.06

20-Year Present Value Collision Costs (DIRECT CAPITAL COSTS)

Collisions by Severity	Total	PDO	Injury	Fatal
Signalized	$2,819,771.17	$334,348.20	$2,352,423.49	$132,999.47
Roundabout	$1,835,659.41	$782,982.69	$1,052,676.73	$0.00

INTERSECTION CONTROL STUDIES
SAFETY ASSESSMENT METHODOLOGY (HSM)

Region of Waterloo

Last Rev Jan 2019

Scenario: **PM Peak - 2031 Planning Horizon**

Major Road: **Erb Street W**
Minor Road: **The Boardwalk/Entrance**

Major Road Direction:	East / West
Urban or Rural:	Urban
Proposed Control:	Signalized
Proposed Config.	4-Leg Intersection

Roundabout Conflicts:	**32960**
5-Year Total Collisions:	**N/A**
5-Year PDO Collisions:	**N/A**

Estimated **ANNUAL (1-YEAR ONLY)** Collisions				
Future Expected Collisions by Severity	**Total**	**PDO**	**Injury**	**Fatal**
Signalized	**9.23**	**5.83**	**3.39**	**0.01**
Roundabout	**15.17**	**13.65**	**1.52**	**0.00**

TOTAL CRASH COEFFICIENTS USED IN CALCULATION						Fatal/Inj. Ratio	Collision Factor
Control	Intersection Config	Intercept	AADTmaj	AADTmin	Overdispersion		
Signalized	4-Leg Intersection	**-10.99**	**1.07**	**0.23**	**N/A**	**0.002**	**n/a**

PDO CRASH COEFFICIENTS USED IN CALCULATION						Fatal/Inj. Ratio	Collision Factor
Control	Intersection Config	Intercept	AADTmaj	AADTmin	Overdispersion		
Signalized	4-Leg Intersection	**-11.02**	**1.02**	**0.24**	**N/A**	**0.002**	**n/a**

Collision Modification Factors (cmf's)	Left Turn Lane	Right Turn Lane	Calibration Factor	Empirical Bays Weighting	
	0.66		**2.1**	Total **N/A**	PDO **N/A**
	Illumination	Protected LT Phasing			
	0.91	**0.88**			

Comments:

APPENDIX B

CAPITAL COST ESTIMATES

PRELIMINARY CONSTRUCTION COST ESTIMATE - TRAFFIC SIGNAL

Erb Street West & Boardwalk Extension ICS

34280-101 To be read in conjunction with P:\34280\101\34280-101-QU5.dwg July 2019

Item No.	Description	Unit	Unit Cost	Est. Qty	Total Cost
A1 - Site Preparation & Removals					
A1.1	Remove & Dispose of Existing Asphalt	m^2	$5.00	4,000	$20,000.00
A1.2	Remove & Dispose of Existing concrete island	m^2	$8.00	231	$1,848.00
A1.3	Remove & Dispose of Existing Concrete Curbs	L.m.	$11.50	359	$4,128.50
A1.4	Remove & Dispose of Existing Concrete sidewalk	L.m.	$8.00	162	$1,296.00
A1.5	Remove & Dispose of Existing steel guardrail	L.m.	$8.90	140	$1,246.00
A1.6	Remove & Dispose of Existing Traffic Light	each	$800.00	5	$4,000.00
A1.7	Remove & Dispose of existing structures	each	$500.00	0	$0.00
A1.8	Traffic Control & Construction Layout	L.S.	$75,000.00	1	$75,000.00
	Subtotal Section A1 - Site Preparation & Removals				**$107,518.50**
A2 - Road Works					
A2.1	Excavate to Subgrade	m^2	$18.00	7,543	$135,774.00
A2.2	Granular 'B' (450mm)	tonnes	$15.00	6,000	$89,994.38
A2.3	Granular 'A' (150mm)	tonnes	$20.00	2,000	$39,997.50
A2.4	Asphalt (140mm total 100mm base/40mm surface)	tonnes	$90.00	1,800	$162,004.50
A2.5	concrete in island	m^2	$55.00	176	$9,680.00
A2.6	Stamped concrete in island and apron	m^2	$65.00	0	$0.00
A2.7	1.5m wide Sidewalk (both sides)	m^2	$55.00	180	$9,900.00
A2.8	3.0m wide MUT (one side) - Granular 'B' (300mm)	tonnes	$15.00	297	$4,455.00
A2.9	3.0m wide MUT (one side) - Granular 'A' (150mm)	tonnes	$20.00	149	$2,970.00
A2.10	3.0m wide MUT (one side) - Asphalt (100mm)	tonnes	$90.00	99	$8,910.00
A2.11	Curb and Gutter	L.M.	$50.00	724	$36,200.00
A2.12	Boulevards - Topsoil & Sod	m^2	$13.00	856	$11,128.00
	Subtotal Section A2 - Road Works				**$511,013.38**
A3 - Storm Sewers					
A3.1	New Sewer Main (600 mm diameter)	m	$390.00	293	$114,270.00
A3.2	New Sewer Main (300 mm diameter)	m	$240.00	145	$34,800.00
A3.3	Storm Manholes (Including benching)	ea	$7,500.00	8	$60,000.00
A3.4	Storm Catchbasins	ea	$3,500.00	6	$21,000.00
	Subtotal Section A3 - Storm Sewers				**$230,070.00**
A4 - Street Lighting & Streetscaping					
A4.1	Street Lighting	L.S.	$50,000.00	1	$50,000.00
A4.2	Tree Planting	L.S.	$20,000.00	0	$0.00
A4.3	Traffic Light Upgrades	L.S.	$50,000.00	1	$50,000.00
	Subtotal Section A4 - Street Lighting				**$100,000.00**
	Subtotal				**$948,601.88**
	Contingency		**20%**		**$189,720.38**
	Total Project Construction Cost				**$1,138,322.25**

PRELIMINARY CONSTRUCTION COST ESTIMATE - ROUNDABOUT

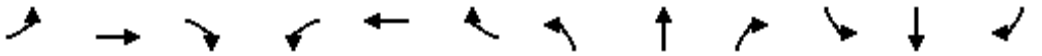
Erb Street West & Boardwalk Extension ICS

34280-101 | To be read in conjunction with P:\34280\101\34280-101-QU4.dwg | July 2019

Item No.	Description	Unit	Unit Cost	Est. Qty	Total Cost
A1 - Site Preparation & Removals					
A1.1	Remove & Dispose of Existing Asphalt	m^2	$5.00	4,000	$20,000.00
A1.2	Remove & Dispose of Existing concrete island	m^2	$8.00	231	$1,848.00
A1.3	Remove & Dispose of Existing Concrete Curbs	L.m.	$11.50	359	$4,128.50
A1.4	Remove & Dispose of Existing Concrete sidewalk	L.m.	$8.00	162	$1,296.00
A1.5	Remove & Dispose of Existing steel guardrail	L.m.	$8.90	140	$1,246.00
A1.6	Remove & Dispose of Existing Traffic Light	each	$800.00	5	$4,000.00
A1.7	Remove & Dispose of existing structures	each	$500.00	0	$0.00
A1.8	Traffic Control & Construction Layout	L.S.	$75,000.00	1	$75,000.00
	Subtotal Section A1 - Site Preparation & Removals				**$107,518.50**
A2 - Road Works					
A2.1	Excavate to Subgrade	m^2	$18.00	9,890	$178,020.00
A2.2	Granular 'B' (450mm)	tonnes	$15.00	9,006	$135,084.38
A2.3	Granular 'A' (150mm)	tonnes	$20.00	3,002	$60,037.50
A2.4	Asphalt (140mm total 100mm base/40mm surface)	tonnes	$90.00	2,058	$185,220.00
A2.5	concrete in island	m^2	$55.00	160	$8,800.00
A2.6	Stamped concrete in island and apron	m^2	$65.00	802	$52,130.00
A2.7	1.5m wide Sidewalk (both sides)	m^2	$55.00	302	$16,610.00
A2.8	3.0m wide MUT (one side) - Granular 'B' (300mm)	tonnes	$15.00	647	$9,708.75
A2.8	3.0m wide MUT (one side) - Granular 'A' (300mm)	tonnes	$15.00	647	$9,708.75
A2.8	3.0m wide MUT (one side) - Asphalt (100mm)	tonnes	$15.00	216	$3,236.25
A2.9	Curb and Gutter	L.M.	$50.00	1,128	$56,400.00
A2.10	Boulevards Central Island- Topsoil & Sod	m^2	$13.00	1,064	$13,832.00
	Subtotal Section A2 - Road Works				**$728,787.63**
A3 - Storm Sewers					
A3.1	New Sewer Main (600 mm diameter)	m	$390.00	280	$109,200.00
A3.2	New Sewer Main (300 mm diameter)	m	$240.00	118	$28,320.00
A3.3	Storm Manholes (Including benching)	ea	$7,500.00	11	$82,500.00
A3.4	Storm Catchbasins	ea	$3,500.00	8	$28,000.00
	Subtotal Section A3 - Storm Sewers				**$248,020.00**
A4 - Street Lighting & Streetscaping					
A4.1	Street Lighting	L.S.	$100,000.00	1	$100,000.00
A4.2	Tree Planting	L.S.	$20,000.00	1	$20,000.00
	Subtotal Section A4 - Street Lighting				**$120,000.00**
	Subtotal				**$1,204,326.13**
	Contingency		**20%**		**$240,865.23**
	Total Project Construction Cost				**$1,445,191.35**

APPENDIX C

OPERATIONAL ANALYSIS OUTPUT

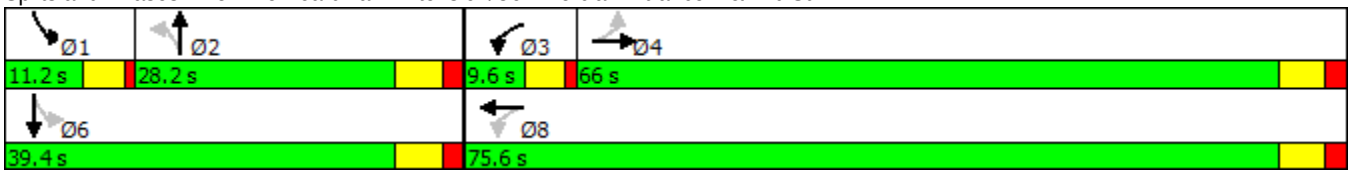


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	82	1368	98	85	1210	46	60	36	296	106	22	117
Future Volume (vph)	82	1368	98	85	1210	46	60	36	296	106	22	117
Ideal Flow (vphpl)	1775	1900	1900	1900	1900	1750	1900	1900	1900	1775	1900	1750
Storage Length (m)	30.0		0.0	60.0		0.0	0.0		0.0	0.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	55.0			0.0			7.5			0.0		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor	1.00				1.00							
Frt		0.990			0.995			0.866			0.874	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1686	3504	0	1770	3488	0	1770	1613	0	1670	1642	0
Flt Permitted	0.185			0.081			0.668			0.173		
Satd. Flow (perm)	328	3504	0	151	3488	0	1244	1613	0	304	1642	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		10			6			134			82	
Link Speed (k/h)		60			60			50			50	
Link Distance (m)		435.4			83.2			94.9			96.6	
Travel Time (s)		26.1			5.0			6.8			7.0	
Confl. Peds. (#/hr)	1					1						
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	2%	2%	2%	3%	0%	2%	2%	2%	1%	2%	1%
Adj. Flow (vph)	82	1368	98	85	1210	46	60	36	296	106	22	117
Shared Lane Traffic (%)												
Lane Group Flow (vph)	82	1466	0	85	1256	0	60	332	0	106	139	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		pm+pt	NA	
Protected Phases		4		3	8			2		1	6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		3	8		2	2		1	6	
Switch Phase												
Minimum Initial (s)	60.0	60.0		5.0	60.0		5.0	5.0		5.0	7.0	
Minimum Split (s)	66.0	66.0		9.5	66.0		24.0	24.0		9.5	13.0	
Total Split (s)	66.0	66.0		9.6	75.6		28.2	28.2		11.2	39.4	
Total Split (%)	57.4%	57.4%		8.3%	65.7%		24.5%	24.5%		9.7%	34.3%	
Maximum Green (s)	60.0	60.0		5.1	69.6		22.2	22.2		6.7	33.4	
Yellow Time (s)	4.0	4.0		3.5	4.0		4.0	4.0		3.5	4.0	
All-Red Time (s)	2.0	2.0		1.0	2.0		2.0	2.0		1.0	2.0	
Lost Time Adjust (s)	-2.0	-2.0		0.0	-2.0		-2.0	0.0		0.0	-2.0	
Total Lost Time (s)	4.0	4.0		4.5	4.0		4.0	6.0		4.5	4.0	
Lead/Lag	Lag	Lag		Lead			Lag	Lag		Lead		
Lead-Lag Optimize?	Yes	Yes		Yes			Yes	Yes		Yes		
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	Max	Max		None	Max		None	None		None	None	
Walk Time (s)	50.0	50.0			50.0		7.0	7.0			7.0	
Flash Dont Walk (s)	10.0	10.0			10.0		11.0	11.0			15.0	
Pedestrian Calls (#/hr)	0	0			0		0	0			0	
Act Effct Green (s)	64.1	64.1		71.2	71.7		20.6	18.6		31.3	31.8	
Actuated g/C Ratio	0.57	0.57		0.64	0.64		0.18	0.17		0.28	0.29	
v/c Ratio	0.44	0.73		0.50	0.56		0.26	0.87		0.63	0.26	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Control Delay	25.1	21.1		18.6	12.7		41.5	50.3		48.9	14.6	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	25.1	21.1		18.6	12.7		41.5	50.3		48.9	14.6	
LOS	C	C		B	B		D	D		D	B	
Approach Delay		21.4			13.1			48.9			29.5	
Approach LOS		C			B			D			C	
Queue Length 50th (m)	11.2	135.1		7.4	83.6		11.9	45.9		18.6	9.7	
Queue Length 95th (m)	28.6	167.6		14.4	104.8		24.6	#91.2		#35.8	25.5	
Internal Link Dist (m)		411.4			59.2			70.9			72.6	
Turn Bay Length (m)	30.0			60.0								
Base Capacity (vph)	188	2019		170	2244		270	428		167	578	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.44	0.73		0.50	0.56		0.22	0.78		0.63	0.24	

Intersection Summary			
Area Type:	Other		
Cycle Length: 115			
Actuated Cycle Length: 111.5			
Natural Cycle: 110			
Control Type: Semi Act-Uncoord			
Maximum v/c Ratio: 0.87			
Intersection Signal Delay: 21.8		Intersection LOS: C	
Intersection Capacity Utilization 111.5%		ICU Level of Service H	
Analysis Period (min) 15			
# 95th percentile volume exceeds capacity, queue may be longer.			
Queue shown is maximum after two cycles.			

Splits and Phases: 5: The Boardwalk Extension/Commercial Entrance 1 & Erb St W



Junctions 8

ARCADY 8 - Roundabout Module

Version: 8.0.6.541 [19821,26/11/2015]
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Filename: Erb Street & Commercial Entrance 1,Boardwalk Extension.arc8
Path: C:\Users\AdamMorrison\Paradigm\Projects - 180136 West Hills Commercial\C5 - Analysis and Evaluation\Arcady\Option A Extension
Report generation date: 2019-07-26 11:39:21 AM

Summary of intersection performance

	PM					
	Queue (PCE)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS
	Option A - Total 2031					
Leg North	0.32	4.30	0.24	A	9.20	A
Leg West	5.24	11.40	0.84	B		
Leg South	1.53	13.03	0.61	B		
Leg East	2.61	6.43	0.72	A		

Values shown are the maximum values over all time segments. Delay is the maximum value of average delay per arriving vehicle. Intersection LOS and Intersection Delay are demand-weighted averages.

"D4 - Total 2031, AM" model duration: 8:00 AM - 9:30 AM
"D5 - Total 2031, PM " model duration: 4:00 PM - 5:30 PM
"D6 - Total 2031, Sat" model duration: 12:00 PM - 1:30 PM

Run using Junctions 8.0.6.541 at 2019-07-26 11:39:20 AM

File summary

Title	(untitled)
Location	
Site Number	
Date	2019-05-24
Version	
Status	(new file)
Identifier	
Client	
Jobnumber	
Analyst	AdamMorrison
Description	

Analysis Options

Vehicle Length (m)	Do Queue Variations	Calculate Residual Capacity	Residual Capacity Criteria Type	V/C Ratio Threshold	Average Delay Threshold (s)	Queue Threshold (PCE)
7.50	✓		N/A	0.85	36.00	20.00

Units

Distance Units	Speed Units	Traffic Units Input	Traffic Units Results	Flow Units	Average Delay Units	Total Delay Units	Rate Of Delay Units
m	kph	PCE	PCE	perHour	s	-Min	perMin

Option A - Total 2031, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Pedestrian Crossing	Leg North - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Leg North - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Leg West - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Leg West - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Leg South - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Leg South - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Leg East - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Leg East - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?

Analysis Set Details

Name	Roundabout Capacity Model	Description	Include In Report	Use Specific Demand Set(s)	Specific Demand Set(s)	Locked	Network Flow Scaling Factor (%)	Network Capacity Scaling Factor (%)	Reason For Scaling Factors
Option A	ARCADY		✓				100.000	100.000	

Demand Set Details

Name	Scenario Name	Time Period Name	Description	Traffic Profile Type	Model Start Time (HH:mm)	Model Finish Time (HH:mm)	Model Time Period Length (min)	Time Segment Length (min)	Results For Central Hour Only	Single Time Segment Only	Locked	Run Automatically	Use Relationship	Relationship
Total 2031, PM	Total 2031	PM		ONE HOUR	16:00	17:30	90	15				✓		

Intersection Network

Intersections

Intersection	Name	Intersection Type	Leg Order	Grade Separated	Large Roundabout	Do Geometric Delay	Intersection Delay (s)	Intersection LOS
1	Erb Street & Commercial Entrance 1/Boardwalk Extension	Roundabout	North,West,South,East				9.20	A

Intersection Network Options

Driving Side	Lighting
Right	Normal/unknown

Legs

Legs

Leg	Leg	Name	Description
North	North	(untitled)	
West	West	(untitled)	
South	South	(untitled)	
East	East	(untitled)	

Capacity Options

Leg	Minimum Capacity (PCE/hr)	Maximum Capacity (PCE/hr)	Assume Flat Start Profile	Initial Queue (PCE)
North	0.00	99999.00		0.00
West	0.00	99999.00		0.00
South	0.00	99999.00		0.00
East	0.00	99999.00		0.00

Roundabout Geometry

Leg	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit Only
North	7.00	8.00	30.00	20.00	55.00	25.00	
West	7.00	8.00	30.00	20.00	55.00	25.00	
South	3.50	8.00	30.00	20.00	55.00	25.00	
East	7.00	8.00	30.00	20.00	55.00	25.00	

Pedestrian Crossings

Leg	Crossing Type
North	Unsignalled Pedestrian Crossing
West	Unsignalled Pedestrian Crossing
South	Unsignalled Pedestrian Crossing
East	Unsignalled Pedestrian Crossing

Unsignalled Pedestrian Crossing Crossings

Leg	Space between crossing and intersection entry (PCE)	Vehicles queueing on exit (PCE)	Central Refuge	Crossing Data Type	Crossing length (m)	Crossing time (s)	Crossing length (entry side) (m)	Crossing time (entry side) (s)	Crossing length (exit side) (m)	Crossing time (exit side) (s)
North	0.00	0.00		Distance	0.00	0.00				
West	0.00	0.00		Distance	0.00	0.00				
South	0.00	0.00		Distance	0.00	0.00				
East	0.00	0.00		Distance	0.00	0.00				

Slope / Intercept / Capacity

Leg Intercept Adjustments

Leg	Type	Reason	Direct Intercept Adjustment (PCE/hr)	Percentage Intercept Adjustment (%)
North	Percentage			90.00
West	Percentage			90.00
South	Percentage			90.00
East	Percentage			90.00

Roundabout Slope and Intercept used in model

Leg	Enter slope and intercept directly	Entered slope	Entered intercept (PCE/hr)	Final Slope	Final Intercept (PCE/hr)
North		(calculated)	(calculated)	0.723	2192.710
West		(calculated)	(calculated)	0.723	2192.710
South		(calculated)	(calculated)	0.647	1814.551
East		(calculated)	(calculated)	0.723	2192.710

The slope and intercept shown above include any corrections and adjustments.

Traffic Flows

Demand Set Data Options

Default Vehicle Mix	Vehicle Mix Varies Over Time	Vehicle Mix Varies Over Turn	Vehicle Mix Varies Over Entry	Vehicle Mix Source	PCE Factor for a Truck (PCE)	Default Turning Proportions	Estimate from entry/exit counts	Turning Proportions Vary Over Time	Turning Proportions Vary Over Turn	Turning Proportions Vary Over Entry
		✓	✓	Truck Percentages	2.00				✓	✓

Entry Flows

General Flows Data

Leg	Profile Type	Use Turning Counts	Average Demand Flow (PCE/hr)	Flow Scaling Factor (%)
North	ONE HOUR	✓	245.00	100.000
West	ONE HOUR	✓	1548.00	100.000
South	ONE HOUR	✓	392.00	100.000
East	ONE HOUR	✓	1341.00	100.000

Pedestrian Flows

General Flows Data

Leg	Profile Type	Average Pedestrian Flow (Ped/hr)
North	ONE HOUR	0.00
West	ONE HOUR	0.00
South	ONE HOUR	0.00
East	ONE HOUR	0.00

Turning Proportions

Turning Counts / Proportions (PCE/hr) - Intersection 1 (for whole period)

		To			
		North	West	South	East
From	North	0.000	117.000	22.000	106.000
	West	82.000	0.000	98.000	1368.000
	South	36.000	60.000	0.000	296.000
	East	46.000	1210.000	85.000	0.000

Turning Proportions (PCE) - Intersection 1 (for whole period)

		To			
		North	West	South	East
From	North	0.00	0.48	0.09	0.43
	West	0.05	0.00	0.06	0.88
	South	0.09	0.15	0.00	0.76
	East	0.03	0.90	0.06	0.00

Vehicle Mix

Average PCE Per Vehicle - Intersection 1 (for whole period)

		To			
		North	West	South	East
From	North	1.000	1.010	1.000	1.010
	West	1.000	1.000	1.000	1.020
	South	1.000	1.000	1.000	1.000
	East	1.000	1.030	1.000	1.000

Truck Percentages - Intersection 1 (for whole period)

		To			
		North	West	South	East
	North	0.0	1.0	0.0	1.0

From	West	0.0	0.0	0.0	2.0
	South	0.0	0.0	0.0	0.0
	East	0.0	3.0	0.0	0.0

Results

Results Summary for whole modelled period

Leg	Max V/C Ratio	Max Delay (s)	Max Queue (PCE)	Max 95th percentile Queue (PCE)	Max LOS	Average Demand (PCE/hr)	Total Intersection Arrivals (PCE)	Total Queueing Delay (PCE-min)	Average Queueing Delay (s)	Rate Of Queueing Delay (PCE-min/min)	Inclusive Total Queueing Delay (PCE-min)	Inclusive Average Queueing Delay (s)
North	0.24	4.30	0.32	~1	A	224.82	337.22	20.00	3.56	0.22	20.01	3.56
West	0.84	11.40	5.24	16.28	B	1420.47	2130.71	249.58	7.03	2.77	249.61	7.03
South	0.61	13.03	1.53	3.00	B	359.71	539.56	74.13	8.24	0.82	74.13	8.24
East	0.72	6.43	2.61	4.11	A	1230.53	1845.79	146.88	4.77	1.63	146.90	4.78

Main Results for each time segment

Main results: (16:00-16:15)

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	V/C Ratio	Start Queue (PCE)	End Queue (PCE)	Delay (s)	LOS
North	184.45	46.11	183.87	122.92	1016.22	0.00	1458.03	717.32	0.127	0.00	0.15	2.849	A
West	1165.42	291.35	1160.26	1040.28	159.81	0.00	2077.17	1828.61	0.561	0.00	1.29	3.973	A
South	295.12	73.78	293.59	153.72	1166.36	0.00	1060.40	506.39	0.278	0.00	0.38	4.685	A
East	1009.58	252.39	1005.79	1326.59	133.36	0.00	2096.30	2033.03	0.482	0.00	0.95	3.380	A

Main results: (16:15-16:30)

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	V/C Ratio	Start Queue (PCE)	End Queue (PCE)	Delay (s)	LOS
North	220.25	55.06	220.02	147.11	1216.20	0.00	1313.46	717.32	0.168	0.15	0.20	3.322	A
West	1391.62	347.91	1388.38	1244.98	191.25	0.00	2054.45	1828.61	0.677	1.29	2.10	5.472	A
South	352.40	88.10	351.44	183.95	1395.68	0.00	912.13	506.39	0.386	0.38	0.62	6.410	A
East	1205.53	301.38	1203.70	1587.51	159.61	0.00	2077.32	2033.03	0.580	0.95	1.40	4.224	A

Main results: (16:30-16:45)

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	V/C Ratio	Start Queue (PCE)	End Queue (PCE)	Delay (s)	LOS
North	269.75	67.44	269.28	179.47	1486.85	0.00	1117.79	717.32	0.241	0.20	0.32	4.280	A
West	1704.38	426.09	1692.54	1522.16	233.98	0.00	2023.56	1828.61	0.842	2.10	5.06	10.701	B
South	431.60	107.90	428.18	224.62	1701.89	0.00	714.14	506.39	0.604	0.62	1.48	12.444	B
East	1476.47	369.12	1471.80	1935.56	194.52	0.00	2052.08	2033.03	0.720	1.40	2.57	6.321	A

Main results: (16:45-17:00)

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	V/C Ratio	Start Queue (PCE)	End Queue (PCE)	Delay (s)	LOS
North	269.75	67.44	269.74	180.51	1491.72	0.00	1114.27	717.32	0.242	0.32	0.32	4.301	A
West	1704.38	426.09	1703.67	1526.96	234.50	0.00	2023.18	1828.61	0.842	5.06	5.24	11.398	B
South	431.60	107.90	431.38	225.65	1712.52	0.00	707.27	506.39	0.610	1.48	1.53	13.027	B
East	1476.47	369.12	1476.33	1948.01	195.89	0.00	2051.09	2033.03	0.720	2.57	2.61	6.428	A

Main results: (17:00-17:15)

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	V/C Ratio	Start Queue (PCE)	End Queue (PCE)	Delay (s)	LOS

North	220.25	55.06	220.71	148.56	1223.17	0.00	1308.42	717.32	0.168	0.32	0.21	3.343	A
West	1391.62	347.91	1403.85	1251.86	192.02	0.00	2053.89	1828.61	0.678	5.24	2.18	5.739	A
South	352.40	88.10	355.93	185.40	1410.47	0.00	902.57	506.39	0.390	1.53	0.65	6.628	A
East	1205.53	301.38	1210.20	1604.87	161.53	0.00	2075.93	2033.03	0.581	2.61	1.44	4.292	A

Main results: (17:15-17:30)

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	V/C Ratio	Start Queue (PCE)	End Queue (PCE)	Delay (s)	LOS
North	184.45	46.11	184.68	123.81	1022.11	0.00	1453.77	717.32	0.127	0.21	0.15	2.862	A
West	1165.42	291.35	1168.87	1046.19	160.60	0.00	2076.60	1828.61	0.561	2.18	1.31	4.050	A
South	295.12	73.78	296.15	154.70	1174.77	0.00	1054.96	506.39	0.280	0.65	0.39	4.752	A
East	1009.58	252.39	1011.48	1336.48	134.44	0.00	2095.52	2033.03	0.482	1.44	0.96	3.418	A

Queueing Delay Results for each time segment

Queueing Delay results: (16:00-16:15)

Leg	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
North	2.15	0.14	2.849	A	A
West	18.65	1.24	3.973	A	A
South	5.58	0.37	4.685	A	A
East	13.82	0.92	3.380	A	A

Queueing Delay results: (16:15-16:30)

Leg	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
North	2.99	0.20	3.322	A	A
West	30.20	2.01	5.472	A	A
South	9.06	0.60	6.410	A	A
East	20.49	1.37	4.224	A	A

Queueing Delay results: (16:30-16:45)

Leg	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
North	4.69	0.31	4.280	A	A
West	68.16	4.54	10.701	B	B
South	20.64	1.38	12.444	B	B
East	36.61	2.44	6.321	A	A

Queueing Delay results: (16:45-17:00)

Leg	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
North	4.81	0.32	4.301	A	A
West	77.48	5.17	11.398	B	B
South	22.67	1.51	13.027	B	B
East	38.88	2.59	6.428	A	A

Queueing Delay results: (17:00-17:15)

Leg	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
North	3.13	0.21	3.343	A	A
West	34.76	2.32	5.739	A	A
South	10.15	0.68	6.628	A	A
East	22.33	1.49	4.292	A	A

Queueing Delay results: (17:15-17:30)

Leg	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
North	2.24	0.15	2.862	A	A
West	20.34	1.36	4.050	A	A
South	6.02	0.40	4.752	A	A

East	14.76	0.98	3.418	A	A

Queue Variation Results for each time segment

Queue Variation results: (16:00-16:15)

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile Message	Marker Message	Probability Of Reaching Or Exceeding Marker	Probability Of Exactly Reaching Marker
North	0.15	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
West	1.29	?	?	?	?	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
South	0.38	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
East	0.95	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A

Queue Variation results: (16:15-16:30)

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile Message	Marker Message	Probability Of Reaching Or Exceeding Marker	Probability Of Exactly Reaching Marker
North	0.20	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
West	2.10	0.00	0.00	4.07	7.12			N/A	N/A
South	0.62	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
East	1.40	0.00	0.00	2.05	4.11			N/A	N/A

Queue Variation results: (16:30-16:45)

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile Message	Marker Message	Probability Of Reaching Or Exceeding Marker	Probability Of Exactly Reaching Marker
North	0.32	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
West	5.06	0.00	0.00	4.07	16.28			N/A	N/A
South	1.48	?	?	?	?	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
East	2.57	?	?	?	?	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A

Queue Variation results: (16:45-17:00)

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile Message	Marker Message	Probability Of Reaching Or Exceeding Marker	Probability Of Exactly Reaching Marker
North	0.32	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
West	5.24	0.00	0.00	0.00	8.14			N/A	N/A
South	1.53	0.00	0.00	0.00	3.00			N/A	N/A
East	2.61	?	?	?	?	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A

Queue Variation results: (17:00-17:15)

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile Message	Marker Message	Probability Of Reaching Or Exceeding Marker	Probability Of Exactly Reaching Marker
North	0.21	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
West	2.18	0.00	0.00	4.07	7.12			N/A	N/A
South	0.65	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
East	1.44	0.00	0.00	2.05	3.08			N/A	N/A

Queue Variation results: (17:15-17:30)

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile Message	Marker Message	Probability Of Reaching Or Exceeding Marker	Probability Of Exactly Reaching Marker
North	0.15	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
West	1.31	0.00	0.00	2.04	4.07			N/A	N/A
South	0.39	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
East	0.96	0.00	0.00	1.03	2.05			N/A	N/A

Junctions 8

ARCADY 8 - Roundabout Module

Version: 8.0.6.541 [19821,26/11/2015]
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Filename: Erb Street & Commercial Entrance 1,Boardwalk Extension - 95%.arc8
Path: C:\Users\AdamMorrison\Paradigm\Projects - 180136 West Hills Commercial\C5 - Analysis and Evaluation\Arcady\Option A Extension
Report generation date: 2019-07-26 11:41:38 AM

Summary of intersection performance

	PM					
	Queue (PCE)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS
	Option A - Total 2031					
Leg North	0.28	3.76	0.22	A	6.98	A
Leg West	3.85	8.29	0.79	A		
Leg South	1.13	9.56	0.53	A		
Leg East	2.16	5.31	0.68	A		

Values shown are the maximum values over all time segments. Delay is the maximum value of average delay per arriving vehicle. Intersection LOS and Intersection Delay are demand-weighted averages.

"D4 - Total 2031, AM" model duration: 8:00 AM - 9:30 AM
"D5 - Total 2031, PM " model duration: 4:00 PM - 5:30 PM
"D6 - Total 2031, Sat" model duration: 12:00 PM - 1:30 PM

Run using Junctions 8.0.6.541 at 2019-07-26 11:41:37 AM

File summary

Title	(untitled)
Location	
Site Number	
Date	2019-05-24
Version	
Status	(new file)
Identifier	
Client	
Jobnumber	
Analyst	AdamMorrison
Description	

Analysis Options

Vehicle Length (m)	Do Queue Variations	Calculate Residual Capacity	Residual Capacity Criteria Type	V/C Ratio Threshold	Average Delay Threshold (s)	Queue Threshold (PCE)
7.50	✓		N/A	0.85	36.00	20.00

Units

Distance Units	Speed Units	Traffic Units Input	Traffic Units Results	Flow Units	Average Delay Units	Total Delay Units	Rate Of Delay Units
m	kph	PCE	PCE	perHour	s	-Min	perMin

Option A - Total 2031, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Pedestrian Crossing	Leg North - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Leg North - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Leg West - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Leg West - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Leg South - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Leg South - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?
Warning	Pedestrian Crossing	Leg East - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default settings only. Is this correct?
Warning	Pedestrian Crossing	Leg East - Unsignalled Pedestrian Crossing Details	Pedestrian crossing uses default flow of 0. Is this correct?

Analysis Set Details

Name	Roundabout Capacity Model	Description	Include In Report	Use Specific Demand Set(s)	Specific Demand Set(s)	Locked	Network Flow Scaling Factor (%)	Network Capacity Scaling Factor (%)	Reason For Scaling Factors
Option A	ARCADY		✓				100.000	100.000	

Demand Set Details

Name	Scenario Name	Time Period Name	Description	Traffic Profile Type	Model Start Time (HH:mm)	Model Finish Time (HH:mm)	Model Time Period Length (min)	Time Segment Length (min)	Results For Central Hour Only	Single Time Segment Only	Locked	Run Automatically	Use Relationship	Relationship
Total 2031, PM	Total 2031	PM		ONE HOUR	16:00	17:30	90	15				✓		

Intersection Network

Intersections

Intersection	Name	Intersection Type	Leg Order	Grade Separated	Large Roundabout	Do Geometric Delay	Intersection Delay (s)	Intersection LOS
1	Erb Street & Commercial Entrance 1/Boardwalk Extension	Roundabout	North,West,South,East				6.98	A

Intersection Network Options

Driving Side	Lighting
Right	Normal/unknown

Legs

Legs

Leg	Leg	Name	Description
North	North	(untitled)	
West	West	(untitled)	
South	South	(untitled)	
East	East	(untitled)	

Capacity Options

Leg	Minimum Capacity (PCE/hr)	Maximum Capacity (PCE/hr)	Assume Flat Start Profile	Initial Queue (PCE)
North	0.00	99999.00		0.00
West	0.00	99999.00		0.00
South	0.00	99999.00		0.00
East	0.00	99999.00		0.00

Roundabout Geometry

Leg	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit Only
North	7.00	8.00	30.00	20.00	55.00	25.00	
West	7.00	8.00	30.00	20.00	55.00	25.00	
South	3.50	8.00	30.00	20.00	55.00	25.00	
East	7.00	8.00	30.00	20.00	55.00	25.00	

Pedestrian Crossings

Leg	Crossing Type
North	Unsignalled Pedestrian Crossing
West	Unsignalled Pedestrian Crossing
South	Unsignalled Pedestrian Crossing
East	Unsignalled Pedestrian Crossing

Unsignalled Pedestrian Crossing Crossings

Leg	Space between crossing and intersection entry (PCE)	Vehicles queueing on exit (PCE)	Central Refuge	Crossing Data Type	Crossing length (m)	Crossing time (s)	Crossing length (entry side) (m)	Crossing time (entry side) (s)	Crossing length (exit side) (m)	Crossing time (exit side) (s)
North	0.00	0.00		Distance	0.00	0.00				
West	0.00	0.00		Distance	0.00	0.00				
South	0.00	0.00		Distance	0.00	0.00				
East	0.00	0.00		Distance	0.00	0.00				

Slope / Intercept / Capacity

Leg Intercept Adjustments

Leg	Type	Reason	Direct Intercept Adjustment (PCE/hr)	Percentage Intercept Adjustment (%)
North	Percentage			95.00
West	Percentage			95.00
South	Percentage			95.00
East	Percentage			95.00

Roundabout Slope and Intercept used in model

Leg	Enter slope and intercept directly	Entered slope	Entered intercept (PCE/hr)	Final Slope	Final Intercept (PCE/hr)
North		(calculated)	(calculated)	0.723	2314.528
West		(calculated)	(calculated)	0.723	2314.528
South		(calculated)	(calculated)	0.647	1915.359
East		(calculated)	(calculated)	0.723	2314.528

The slope and intercept shown above include any corrections and adjustments.

Traffic Flows

Demand Set Data Options

Default Vehicle Mix	Vehicle Mix Varies Over Time	Vehicle Mix Varies Over Turn	Vehicle Mix Varies Over Entry	Vehicle Mix Source	PCE Factor for a Truck (PCE)	Default Turning Proportions	Estimate from entry/exit counts	Turning Proportions Vary Over Time	Turning Proportions Vary Over Turn	Turning Proportions Vary Over Entry
		✓	✓	Truck Percentages	2.00				✓	✓

Entry Flows

General Flows Data

Leg	Profile Type	Use Turning Counts	Average Demand Flow (PCE/hr)	Flow Scaling Factor (%)
North	ONE HOUR	✓	245.00	100.000
West	ONE HOUR	✓	1548.00	100.000
South	ONE HOUR	✓	392.00	100.000
East	ONE HOUR	✓	1341.00	100.000

Pedestrian Flows

General Flows Data

Leg	Profile Type	Average Pedestrian Flow (Ped/hr)
North	ONE HOUR	0.00
West	ONE HOUR	0.00
South	ONE HOUR	0.00
East	ONE HOUR	0.00

Turning Proportions

Turning Counts / Proportions (PCE/hr) - Intersection 1 (for whole period)

		To			
		North	West	South	East
From	North	0.000	117.000	22.000	106.000
	West	82.000	0.000	98.000	1368.000
	South	36.000	60.000	0.000	296.000
	East	46.000	1210.000	85.000	0.000

Turning Proportions (PCE) - Intersection 1 (for whole period)

		To			
		North	West	South	East
From	North	0.00	0.48	0.09	0.43
	West	0.05	0.00	0.06	0.88
	South	0.09	0.15	0.00	0.76
	East	0.03	0.90	0.06	0.00

Vehicle Mix

Average PCE Per Vehicle - Intersection 1 (for whole period)

		To			
		North	West	South	East
From	North	1.000	1.010	1.000	1.010
	West	1.000	1.000	1.000	1.020
	South	1.000	1.000	1.000	1.000
	East	1.000	1.030	1.000	1.000

Truck Percentages - Intersection 1 (for whole period)

		To			
		North	West	South	East
	North	0.0	1.0	0.0	1.0

From	West	0.0	0.0	0.0	2.0
	South	0.0	0.0	0.0	0.0
	East	0.0	3.0	0.0	0.0

Results

Results Summary for whole modelled period

Leg	Max V/C Ratio	Max Delay (s)	Max Queue (PCE)	Max 95th percentile Queue (PCE)	Max LOS	Average Demand (PCE/hr)	Total Intersection Arrivals (PCE)	Total Queueing Delay (PCE-min)	Average Queueing Delay (s)	Rate Of Queueing Delay (PCE-min/min)	Inclusive Total Queueing Delay (PCE-min)	Inclusive Average Queueing Delay (s)
North	0.22	3.76	0.28	~1	A	224.82	337.22	17.83	3.17	0.20	17.83	3.17
West	0.79	8.29	3.85	8.14	A	1420.47	2130.71	198.65	5.59	2.21	198.67	5.59
South	0.53	9.56	1.13	2.00	A	359.71	539.56	59.07	6.57	0.66	59.07	6.57
East	0.68	5.31	2.16	3.08	A	1230.53	1845.79	126.21	4.10	1.40	126.22	4.10

Main Results for each time segment

Main results: (16:00-16:15)

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	V/C Ratio	Start Queue (PCE)	End Queue (PCE)	Delay (s)	LOS
North	184.45	46.11	183.92	122.99	1016.61	0.00	1579.57	757.17	0.117	0.00	0.13	2.603	A
West	1165.42	291.35	1160.86	1040.67	159.86	0.00	2198.95	1930.20	0.530	0.00	1.14	3.513	A
South	295.12	73.78	293.76	153.78	1166.94	0.00	1160.84	534.52	0.254	0.00	0.34	4.146	A
East	1009.58	252.39	1006.16	1327.27	133.43	0.00	2218.06	2145.97	0.455	0.00	0.85	3.041	A

Main results: (16:15-16:30)

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	V/C Ratio	Start Queue (PCE)	End Queue (PCE)	Delay (s)	LOS
North	220.25	55.06	220.05	147.17	1216.52	0.00	1435.04	757.17	0.153	0.13	0.18	2.989	A
West	1391.62	347.91	1389.05	1245.29	191.28	0.00	2176.24	1930.20	0.639	1.14	1.78	4.639	A
South	352.40	88.10	351.64	184.01	1396.32	0.00	1012.53	534.52	0.348	0.34	0.53	5.442	A
East	1205.53	301.38	1204.00	1588.26	159.70	0.00	2199.08	2145.97	0.548	0.85	1.24	3.711	A

Main results: (16:30-16:45)

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	V/C Ratio	Start Queue (PCE)	End Queue (PCE)	Delay (s)	LOS
North	269.75	67.44	269.36	179.81	1488.04	0.00	1238.75	757.17	0.218	0.18	0.28	3.745	A
West	1704.38	426.09	1696.41	1523.32	234.09	0.00	2145.30	1930.20	0.794	1.78	3.77	8.021	A
South	431.60	107.90	429.28	224.94	1705.55	0.00	812.58	534.52	0.531	0.53	1.11	9.336	A
East	1476.47	369.12	1472.86	1939.84	194.99	0.00	2173.56	2145.97	0.679	1.24	2.14	5.249	A

Main results: (16:45-17:00)

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	V/C Ratio	Start Queue (PCE)	End Queue (PCE)	Delay (s)	LOS
North	269.75	67.44	269.74	180.54	1491.79	0.00	1236.04	757.17	0.218	0.28	0.28	3.758	A
West	1704.38	426.09	1704.07	1527.03	234.51	0.00	2144.99	1930.20	0.795	3.77	3.85	8.293	A
South	431.60	107.90	431.51	225.68	1712.89	0.00	807.84	534.52	0.534	1.11	1.13	9.557	A
East	1476.47	369.12	1476.39	1948.46	195.94	0.00	2172.87	2145.97	0.680	2.14	2.16	5.306	A

Main results: (17:00-17:15)

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	V/C Ratio	Start Queue (PCE)	End Queue (PCE)	Delay (s)	LOS

North	220.25	55.06	220.64	148.20	1221.95	0.00	1431.12	757.17	0.154	0.28	0.18	3.003	A
West	1391.62	347.91	1399.70	1250.67	191.91	0.00	2175.78	1930.20	0.640	3.85	1.83	4.768	A
South	352.40	88.10	354.75	185.06	1406.55	0.00	1005.91	534.52	0.350	1.13	0.54	5.549	A
East	1205.53	301.38	1209.13	1600.28	161.02	0.00	2198.12	2145.97	0.548	2.16	1.26	3.753	A

Main results: (17:15-17:30)

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	V/C Ratio	Start Queue (PCE)	End Queue (PCE)	Delay (s)	LOS
North	184.45	46.11	184.65	123.74	1021.76	0.00	1575.84	757.17	0.117	0.18	0.13	2.613	A
West	1165.42	291.35	1168.11	1045.85	160.56	0.00	2198.45	1930.20	0.530	1.83	1.16	3.566	A
South	295.12	73.78	295.92	154.62	1174.05	0.00	1156.24	534.52	0.255	0.54	0.34	4.188	A
East	1009.58	252.39	1011.15	1335.62	134.35	0.00	2217.40	2145.97	0.455	1.26	0.86	3.068	A

Queueing Delay Results for each time segment

Queueing Delay results: (16:00-16:15)

Leg	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
North	1.96	0.13	2.603	A	A
West	16.56	1.10	3.513	A	A
South	4.96	0.33	4.146	A	A
East	12.48	0.83	3.041	A	A

Queueing Delay results: (16:15-16:30)

Leg	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
North	2.70	0.18	2.989	A	A
West	25.81	1.72	4.639	A	A
South	7.73	0.52	5.442	A	A
East	18.09	1.21	3.711	A	A

Queueing Delay results: (16:30-16:45)

Leg	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
North	4.12	0.27	3.745	A	A
West	52.44	3.50	8.021	A	A
South	15.80	1.05	9.336	A	A
East	30.74	2.05	5.249	A	A

Queueing Delay results: (16:45-17:00)

Leg	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
North	4.20	0.28	3.758	A	A
West	57.31	3.82	8.293	A	A
South	16.85	1.12	9.557	A	A
East	32.24	2.15	5.306	A	A

Queueing Delay results: (17:00-17:15)

Leg	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
North	2.81	0.19	3.003	A	A
West	28.71	1.91	4.768	A	A
South	8.44	0.56	5.549	A	A
East	19.44	1.30	3.753	A	A

Queueing Delay results: (17:15-17:30)

Leg	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
North	2.04	0.14	2.613	A	A
West	17.82	1.19	3.566	A	A
South	5.29	0.35	4.188	A	A

East	13.22	0.88	3.068	A	A

Queue Variation Results for each time segment

Queue Variation results: (16:00-16:15)

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile Message	Marker Message	Probability Of Reaching Or Exceeding Marker	Probability Of Exactly Reaching Marker
North	0.13	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
West	1.14	?	?	?	?	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
South	0.34	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
East	0.85	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A

Queue Variation results: (16:15-16:30)

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile Message	Marker Message	Probability Of Reaching Or Exceeding Marker	Probability Of Exactly Reaching Marker
North	0.18	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
West	1.78	0.00	0.00	3.05	6.11			N/A	N/A
South	0.53	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
East	1.24	0.00	0.00	2.05	3.08			N/A	N/A

Queue Variation results: (16:30-16:45)

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile Message	Marker Message	Probability Of Reaching Or Exceeding Marker	Probability Of Exactly Reaching Marker
North	0.28	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
West	3.77	0.00	0.00	0.00	8.14			N/A	N/A
South	1.11	?	?	?	?	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
East	2.14	?	?	?	?	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A

Queue Variation results: (16:45-17:00)

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile Message	Marker Message	Probability Of Reaching Or Exceeding Marker	Probability Of Exactly Reaching Marker
North	0.28	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
West	3.85	?	?	?	?	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
South	1.13	0.00	0.00	0.00	2.00			N/A	N/A
East	2.16	?	?	?	?	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A

Queue Variation results: (17:00-17:15)

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile Message	Marker Message	Probability Of Reaching Or Exceeding Marker	Probability Of Exactly Reaching Marker
North	0.18	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
West	1.83	0.00	0.00	4.07	5.09			N/A	N/A
South	0.54	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
East	1.26	0.00	0.00	1.03	2.05			N/A	N/A

Queue Variation results: (17:15-17:30)

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile Message	Marker Message	Probability Of Reaching Or Exceeding Marker	Probability Of Exactly Reaching Marker
North	0.13	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
West	1.16	0.00	0.00	2.04	3.05			N/A	N/A
South	0.34	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
East	0.86	0.00	0.00	1.03	1.03			N/A	N/A

APPENDIX D

ROUNDABOUT DESIGN CHECKS PACKAGE

MTE FILE No: 34280-101-RG1.0
Roundabout N/S Collector at Erb St W.
P:\P\34280\101\34280-101-RG1.DWG

MTE

ENGINEER

Region of Waterloo

OWNER

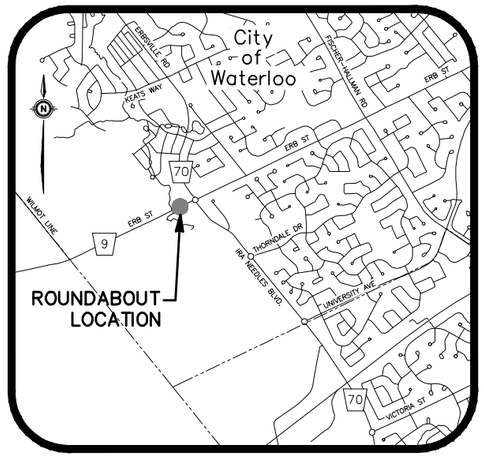
PROJECT

N/S Collector / Erb St W. INTERSECTION

City o□Waterloo, Ontario

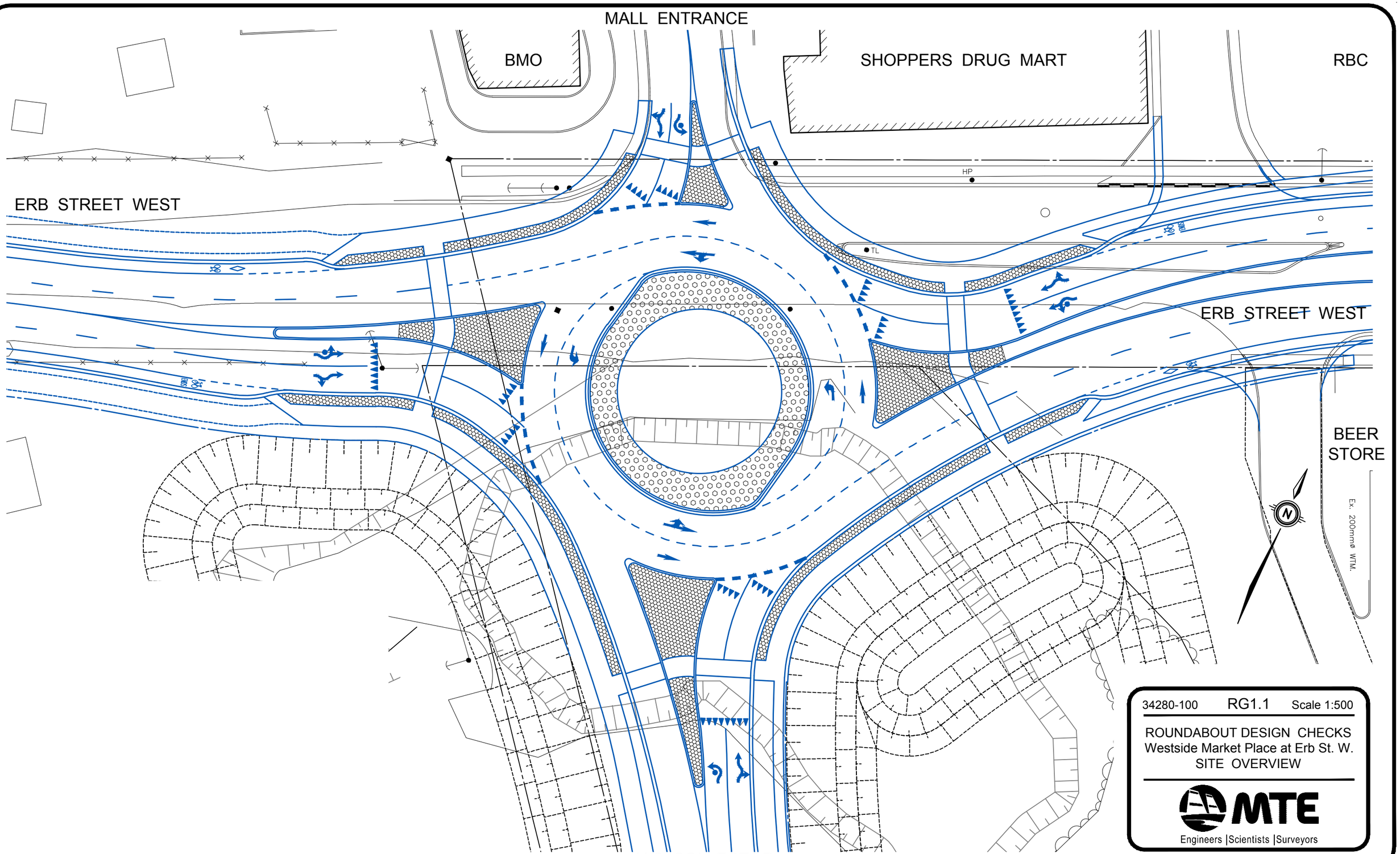
ROUNDABOUT DESIGN CHECKS PACKAGE

Westside Marketplace at Erb Street West (Regional Road □)



LIST OF DRAWINGS

Sheet	MTE Dwg. No.	Description
1.	RG1.1	Site Overview Plan
2.	RG1.2	Hori□ontal Geometry
3.	RG1.3	Design Vehicle - Right Rurns - Truck
4.	RG1.4	Design Vehicle - Le□t Turns - Truck
5.	RG1.5	Design Vehicle - Le□t Turns - Bus
6.	RG1.6	Radii on Fastest Path
7.	RG1.7	Path Overlap Tangents
8.	RG1.8	Entry Angles
□.	RG1.□	Clear View Areas
10.	RG1.10	Pavement Markings



34280-100 RG1.1 Scale 1:500

ROUNDABOUT DESIGN CHECKS
Westside Market Place at Erb St. W.
SITE OVERVIEW

MTE
Engineers | Scientists | Surveyors

DWG PATH:P:\P\34280\101\34280-101-RG1.dwg
July 19, 2019 11:43 a.m. Plotted By: pgaimbault

MALL ENTRANCE

BMO

SHOPPERS DRUG MART

RBC

ERB STREET WEST

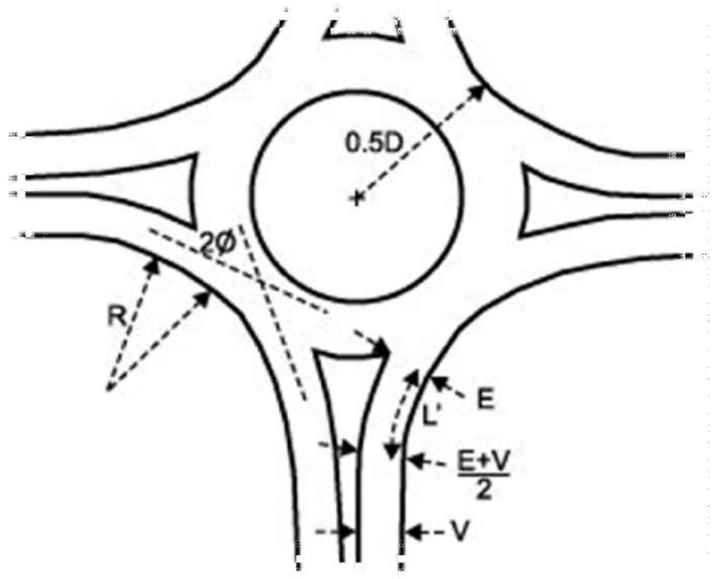
ERB STREET WEST

BEER STORE

N/S COLLECTOR

7.13
3.12
8.25
5.62
ø–56.6
9.65
9.62
6.70
6.70
7.77
ø–52.2
9.65
8.84
30.61
ø–37.2
ø–32.8
ø–32.8
9.65
ø–52.2
8.84
7.77
25.91
9.73
6.70
ø–37.2
ø–56.6
9.65
5.76
8.89
15.63
7.80
6.70

Ex. 200mmø WTM.



34280-100 RG1.2 Scale 1:500

ROUNDABOUT DESIGN CHECKS
Westside Market Place at Erb St. W.
HORIZONTAL GEOMETRY

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DWG PATH: P:\P\34280\101\34280-101-RG1.dwg
July 19, 2019 11:43 a.m. Plotted By: pgaimbault

MALL ENTRANCE

BMO

SHOPPERS DRUG MART

RBC

ERB STREET WEST

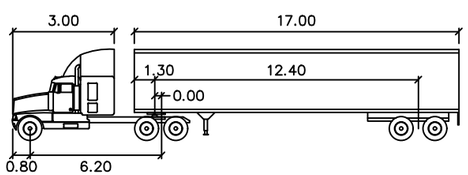
ERB STREET WEST

BEER STORE

Ex. 200mmø WTM.

N/S COLLECTOR

WB-20 TAC-2017 (CA)



WB–20 meters

Tractor Width	: 2.60	Lock to Lock Time	: 6.0
Trailer Width	: 2.60	Steering Angle	: 28.3
Tractor Track	: 2.60	Articulating Angle	: 70.0
Trailer Track	: 2.60		

34280-100 RG1.3 Scale 1:500

ROUNDABOUT DESIGN CHECKS
Westside Market Place at Erb St. W.
DESIGN VEHICLE - RIGHT TURNS

MTE
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DWG PATH: P:\P\34280\101\34280-101-RG1.dwg
July 19, 2019 11:43 a.m. Plotted By: pgaimbault

MALL ENTRANCE

BMO

SHOPPERS DRUG MART

RBC

ERB STREET WEST

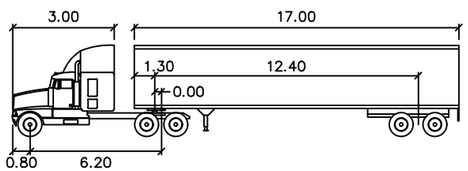
ERB STREET WEST

BEER STORE

Ex. 200mmø WTM.

N/S COLLECTOR

WB-20 TAC-2017 (CA)



WB-20 meters

Tractor Width	: 2.60	Lock to Lock Time	: 6.0
Trailer Width	: 2.60	Steering Angle	: 28.3
Tractor Track	: 2.60	Articulating Angle	: 70.0
Trailer Track	: 2.60		

34280-100 RG1.4 Scale 1:500

ROUNDABOUT DESIGN CHECKS
Westside Market Place at Erb St. W.
DESIGN VEHICLE - LEFT TURNS

MTE
Engineers | Scientists | Surveyors

DWG PATH: P:\P\34280\101\34280-101-RG1.dwg
July 19, 2019 11:43 a.m. Plotted By: praimbault

MALL ENTRANCE

BMO

SHOPPERS DRUG MART

RBC

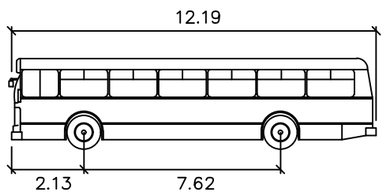
ERB STREET WEST

ERB STREET WEST

BEER STORE

Ex. 200mmø WTM.

N/S COLLECTOR



CITY–BUS Scale 1:200
meters

Width	: 2.59
Track	: 2.59
Lock to Lock Time	: 6.0
Steering Angle	: 41.4

34280-100 RG1.5 Scale 1:500

ROUNDABOUT DESIGN CHECKS
Westside Market Place at Erb St. W.
DESIGN VEHICLE - LEFT TURNS BUS

MTE
Engineers | Scientists | Surveyors

DWG PATH: P:\P\34280\101\34280-101-RG1.dwg
July 19, 2019 11:43 a.m. Plotted By: pgaimbault

MALL ENTRANCE

BMO

SHOPPERS DRUG MART

RBC

ERB STREET WEST

ERB STREET WEST

BEER STORE

N/S COLLECTOR

R-58.9

R-23.4

R-203.0

R-12.1

R-31.6

R-71.6

R-49.3

R-34.1

R-33.1

R-68.2

R-49.4

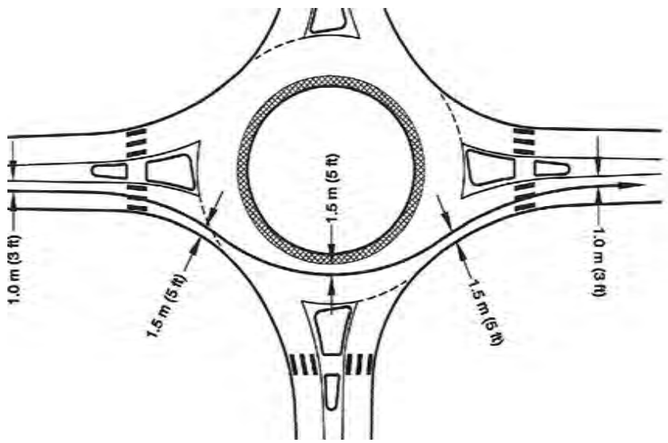
R-71.5

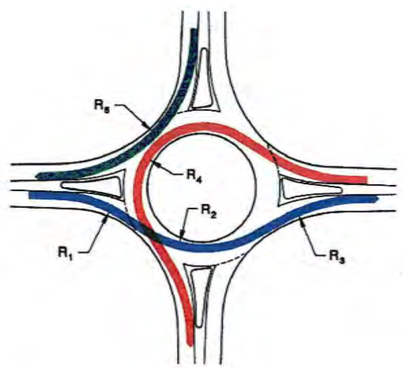
R-41.2

R-92.3

R-100.9

Ex. 200mmø WTM.



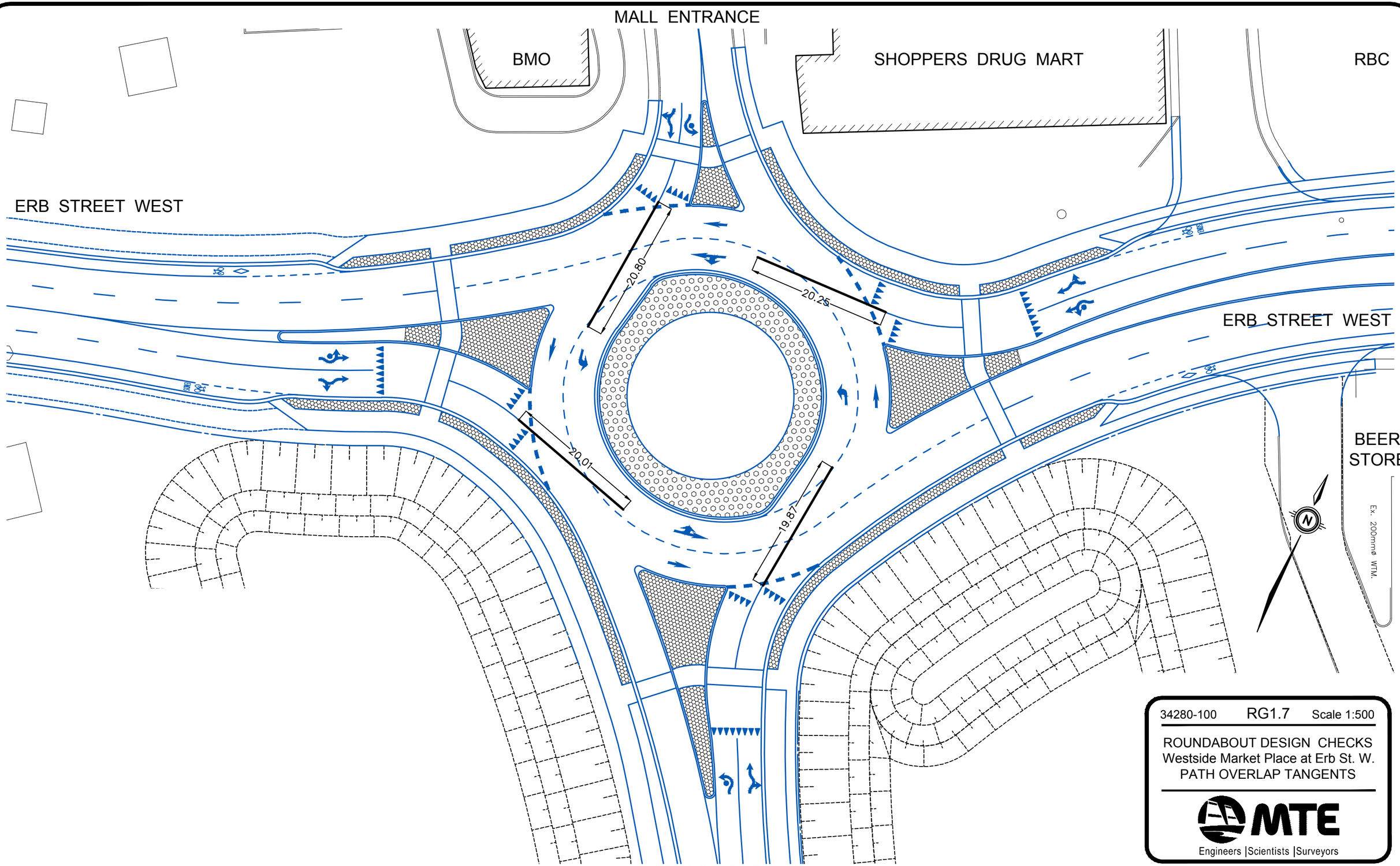


34280-100 RG1.6 Scale 1:500

ROUNDABOUT DESIGN CHECKS
Westside Market Place at Erb St. W.
RADII ON FASTEST PATH

MTE
Engineers | Scientists | Surveyors

DWG PATH:P:\P\34280\101\34280-101-RG1.dwg
July 19, 2019 11:43 a.m. Plotted By: pgaimbault

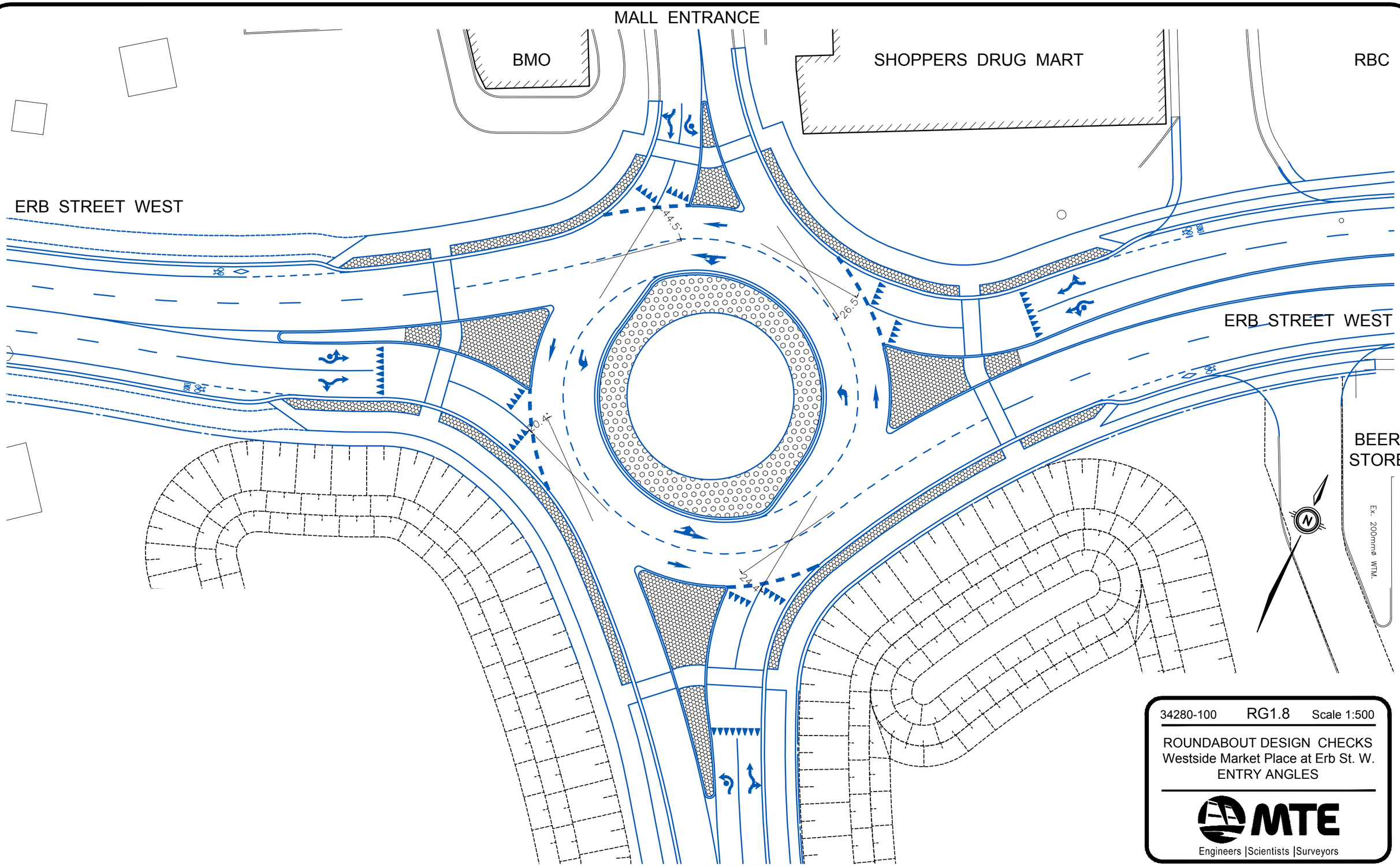


34280-100 RG1.7 Scale 1:500

ROUNDABOUT DESIGN CHECKS
Westside Market Place at Erb St. W.
PATH OVERLAP TANGENTS

MTE
Engineers | Scientists | Surveyors

DWG PATH: P:\P\34280\101\34280-101-RG1.dwg
July 19, 2019 11:43 a.m. Plotted By: pgaimbault



34280-100 RG1.8 Scale 1:500

ROUNDABOUT DESIGN CHECKS
Westside Market Place at Erb St. W.
ENTRY ANGLES

MTE
Engineers | Scientists | Surveyors

DWG PATH:P:\P\34280\101\34280-101-RG1.dwg
July 19, 2019 11:43 a.m. Plotted By: pgaimbault

MALL ENTRANCE

BMO

SHOPPERS DRUG MART

RBC

ERB STREET WEST

ERB STREET WEST

BEER STORE

Ex. 200mmø WTM.

N/S COLLECTOR

LEGEND

STOPPING SIGHT DISTANCE ENVELOPE
DRIVER'S EYE–1.05m AND OBJECT HEIGHT–0.6m

INTERSECTION SIGHT DISTANCE ENVELOPE
DRIVER'S EYE–1.05m AND OBJECT HEIGHT–1.05m

UNRESTRICTED AREA (UNLIMITED HEIGHT)

34280-100 RG1.□ Scale 1:500

ROUNDABOUT DESIGN CHECKS
Westside Market Place at Erb St. W.
CLEAR VIEW AREAS

MTE
Engineers |Scientists |Surveyors

DWG PATH:P:\P\34280\101\34280-101-RG1.dwg
July 19, 2019 11:43 a.m. Plotted By: praimbault

MALL ENTRANCE

BMO

SHOPPERS DRUG MART

RBC

ERB STREET WEST

ERB STREET WEST

BEER STORE

Ex. 200mmø WTM.

N/S COLLECTOR

LEGEND

NOTES

1. 333, 363, 393, DENOTES PAVEMENT MARKING SPACING (IE., 3m LINE, 3m GAP, 3m LINE)
2. (1) DENOTES PAVEMENT MARKING
3. ⟨1⟩ DENOTES PAVEMENT MARKING, DURABLE
4. △1 DENOTES PAVEMENT MARKING, TEMPORARY–REMOVABLE
5. [1] DENOTES PAVEMENT MARKING, TEMPORARY
6. ⟨A⟩ DENOTES CROSSWALK MARKING (SEE DETAIL 'A')

PAVEMENT MARKING LEGEND	
1	SOLID YELLOW, 10cm
5	SOLID WHITE, 10cm
10	111 BROKEN WHITE, 10cm
15	SOLID WHITE, 60cm
16	1–1–1 SOLID WHITE, 45cm
20	SOLID WHITE, SYMBOLS AND ARROWS

34280-100 RG1.10 Scale 1:500

ROUNDABOUT DESIGN CHECKS
Westside Market Place at Erb St. W.
PAVEMENT MARKINGS

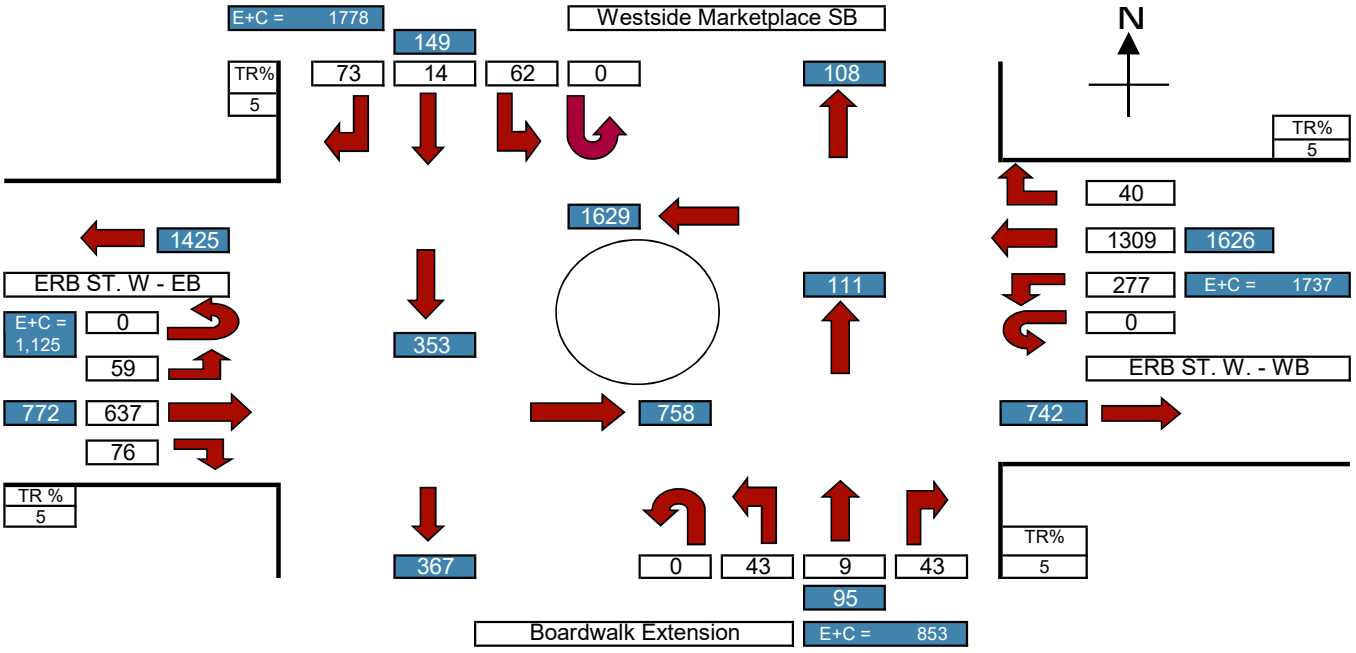
MTE
Engineers | Scientists | Surveyors

DWG PATH:P:\P\34280\101\34280-101-RG1.dwg
July 19, 2019 11:43 a.m. Plotted By: pgaimbault

ROUNDABOUT TRAFFIC FLOW SHEET

Project: Westhill District Plan
Project No.: 34280-101
Intersection: Erb St. W. & Boardwalk Extension
Time Period: **AM PEAK 2031**

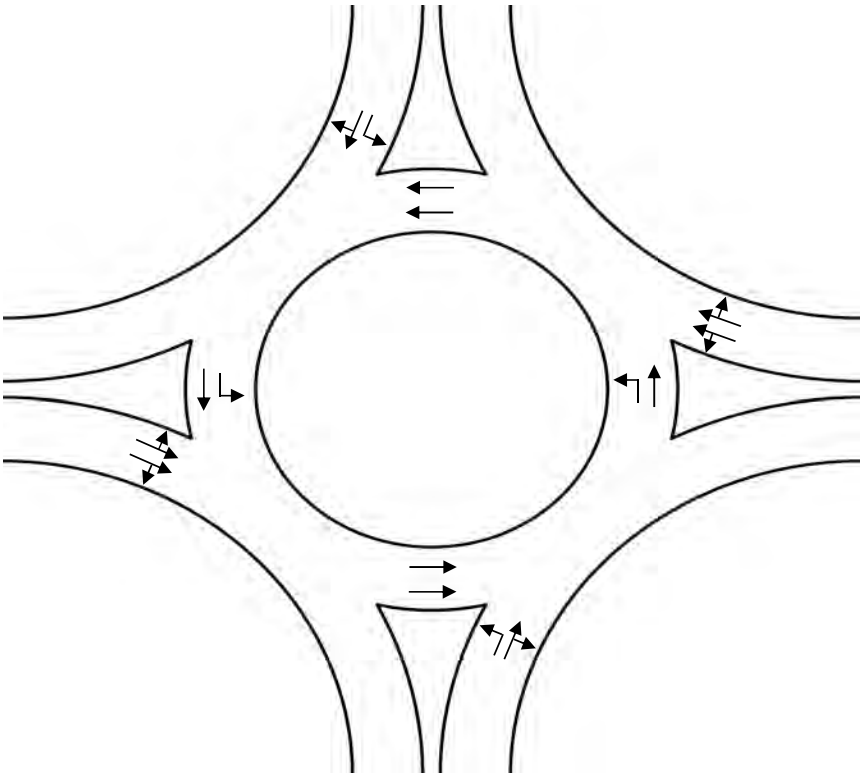
Drawn By: NPD
Sheet: **1 of 3**



Capacity Guidelines

1. Single Lane service volumes < 900vph - 1200 vph
2. Exit flow < 900vph - 1200 vph for single lane exit
3. Entry flow + circulating flow < 1400vph use single lane entry
4. 1400 vph < Entry + Circ. flow < 2200vph use two-lane entry
3. Entry flow + circulating flow > 2200vph use three-lane entry

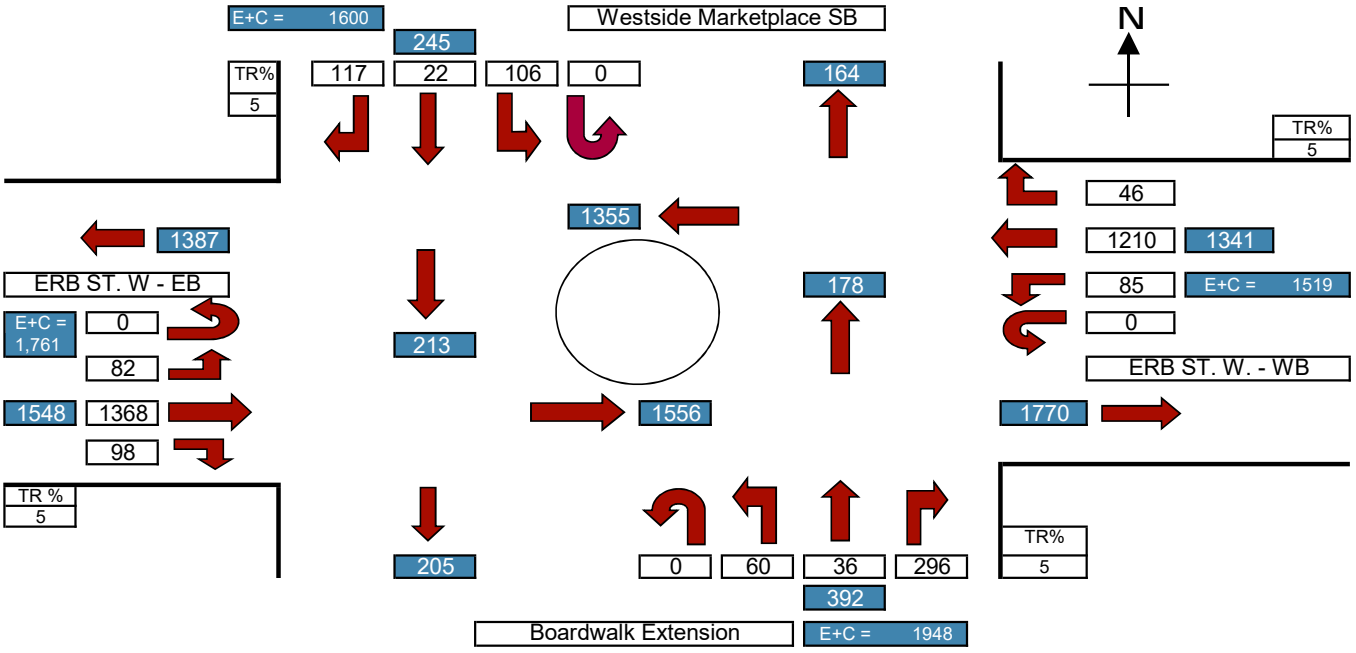
		Model Inputs			
Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
stside Marketplace	1.05	73	14	62	0
ERB ST. W - EB	1.05	76	637	59	0
oardwalk Extensio	1.05	43	9	43	0
ERB ST. W. - WB	1.05	40	1309	277	0



ROUNDABOUT TRAFFIC FLOW SHEET

Project: Westhill District Plan
Project No.: 34280-101
Intersection: Erb St. W. & Boardwalk Extension
Time Period: **PM PEAK 2031**

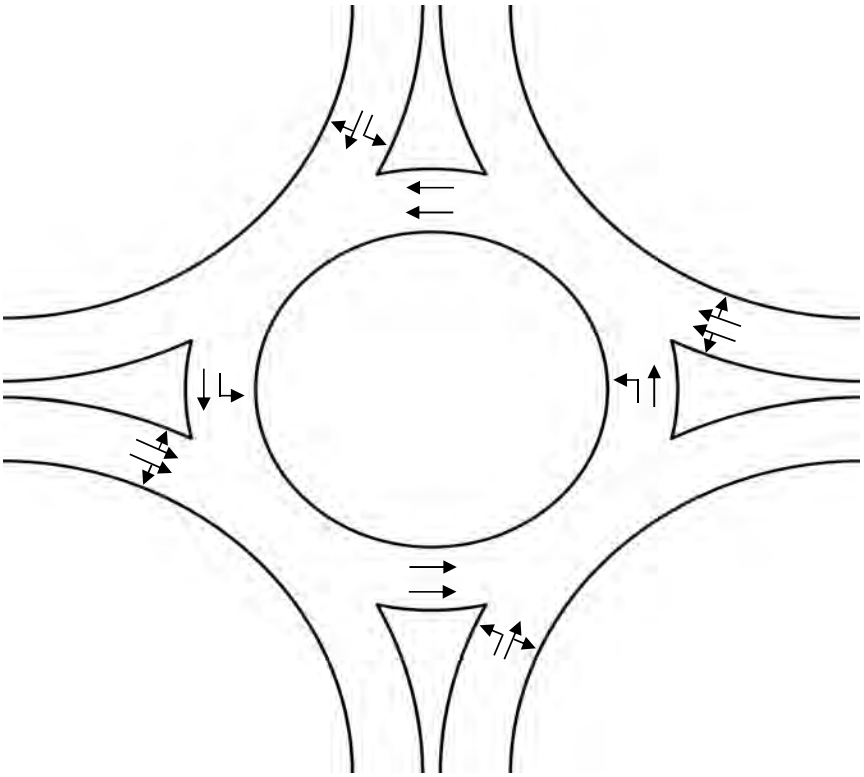
Drawn By: NPD
Sheet: **1 of 3**



Capacity Guidelines

1. Single Lane service volumes < 900vph - 1200 vph
2. Exit flow < 900vph - 1200 vph for single lane exit
3. Entry flow + circulating flow < 1400vph use single lane entry
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3. Entry flow + circulating flow > 2200vph use three-lane entry

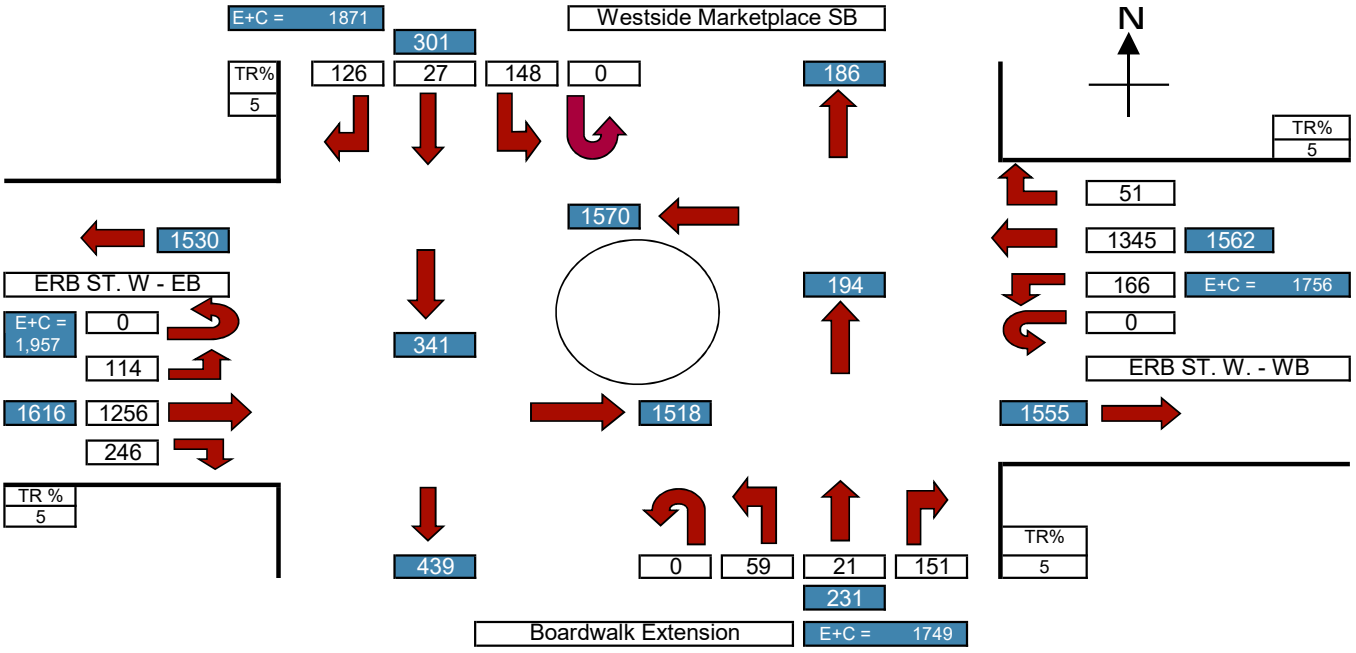
		Model Inputs			
Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
stside Marketplace	1.05	117	22	106	0
ERB ST. W - EB	1.05	98	1368	82	0
oardwalk Extensio	1.05	296	36	60	0
ERB ST. W. - WB	1.05	46	1210	85	0



ROUNDABOUT TRAFFIC FLOW SHEET

Project: Westhill District Plan
Project No.: 34280-101
Intersection: Erb St. W. & Boardwalk Extension
Time Period: **SATURDAY PEAK 2031**

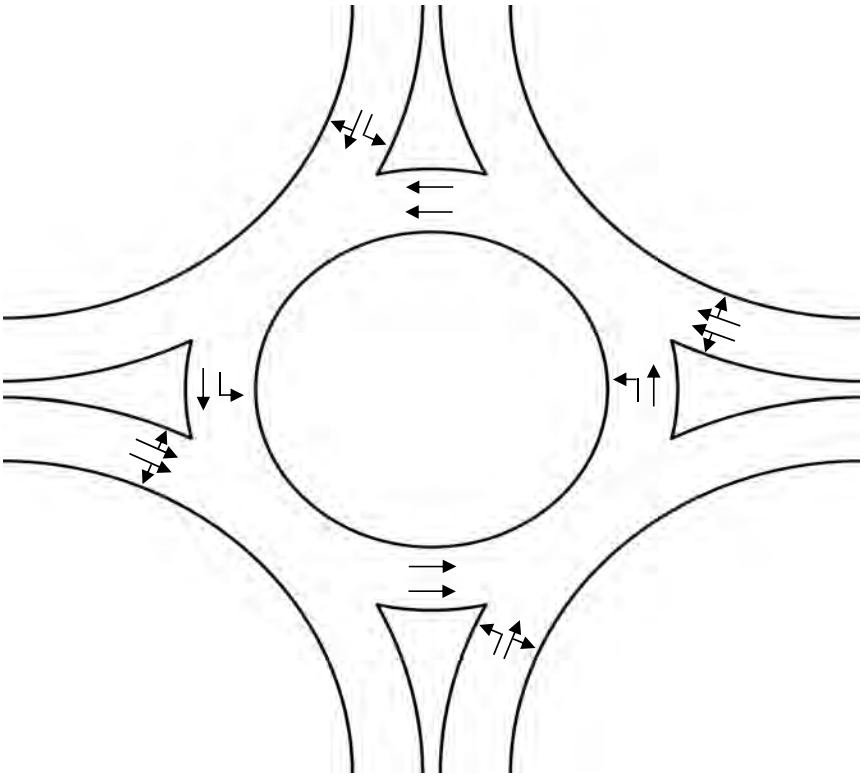
Drawn By: NPD
Sheet: **1 of 3**



Capacity Guidelines

1. Single Lane service volumes < 900vph - 1200 vph
2. Exit flow < 900vph - 1200 vph for single lane exit
3. Entry flow + circulating flow < 1400vph use single lane entry
4. 1400 vph < Entry + Circ. flow < 2200vph use two-lane entry
3. Entry flow + circulating flow > 2200vph use three-lane entry

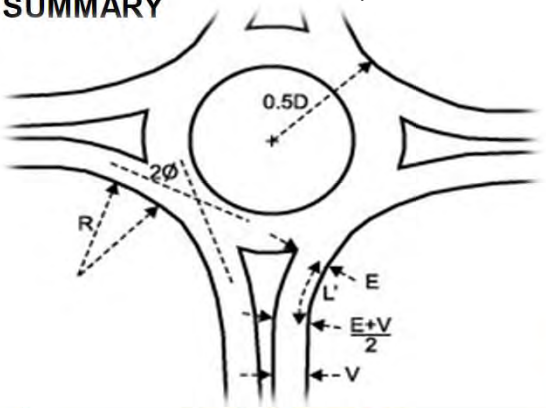
	Model Inputs				
Leg	PCU	1st Exit	2nd Exit	3rd Exit	U-turn
stside Marketplace	1.05	126	27	148	0
ERB ST. W - EB	1.05	246	1256	114	0
oardwalk Extensio	1.05	151	21	59	0
ERB ST. W. - WB	1.05	51	1345	166	0



ROUNDABOUT GEOMETRIC DESIGN SUMMARY

Project: Westhill District Plan
Project No.: 34280-101
Intersection: Erb Street West and N/S Collector
Date: July 2019

Drawn By: NPD
Sheet: 1 of 4



Mall Entrance	Erb Street West	N/S Collector	Erb Street West

Design Parameters	SB	EB	NB	WB
Entry Width, E (m)	8.25	8.84	8.89	8.84
Effective Flare Length, L (m)	3.12	30.61	15.83	25.91
Road Half Width, V (m)	6.00	6.70	6.70	6.70
Entry Radius, R (m)	20.70	39.70	24.70	29.70
Entry Angle, Ø (°)	22.25	10.20	12.20	13.25
Inscribed Circle Diameter, ICD (m)	52.1	52.1	52.1	52.1
Central Island Diameter (m)	32.76	37.11	32.76	37.11
Upstream Circ. Road Width (m)	9.65	9.65	9.65	9.65
Exit Width (m)	5.62	9.62	5.76	9.73
Pedestrian Refuge Width (m)	2.05	3.37	3.87	3.42

Path Radius-Speed Parameters	SB	EB	NB	WB
R1 (km/h)	42	45	50	46
R2 (km/h)	39	34	34	56
R3 (km/h)	52	46	54	68
R4 (km/h)	28	26	28	28
R5 (km/h)	33	30	39	37
Delta V (km/h)	22	24	18	19

Minimum Sight Distance Parameters	SB	EB	NB	WB
Approach Design Speed (km/h)	50	60	60	60
Approach SSD (m)	62.9	84.6	84.6	84.6
Circulating (R2) SSD (m)	43.1	35.1	35.6	70.4
Pedestrian (R5) SSD (m)	34.2	29.4	43.2	39.3
Entering ISD (m)	57.0	52.9	56.0	62.9
Circulating ISD (m)	34.9	34.9	34.9	32.7

Note:

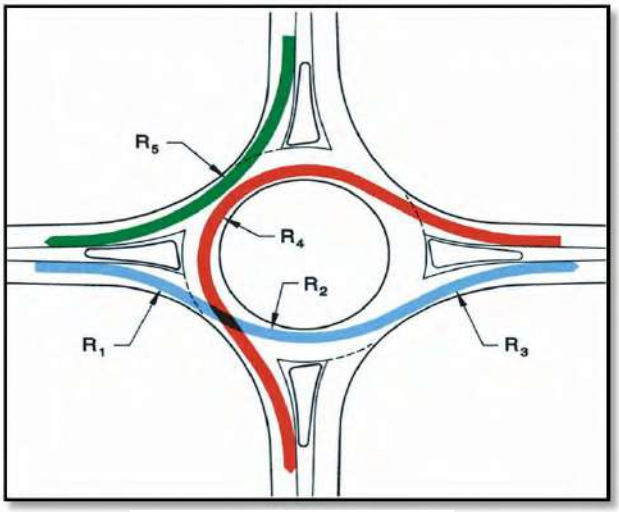
- Intersection sight distance (ISD) calculated based on 4.5s critical gap.

Additional Information	
Design Vehicle:	WB-20 for right turns and I-BUS for left turns (trucks use conc. apron for left turns.)
Circulatory Road:	Dual Lane (9.2m)
Truck Apron:	4.0m wide
Pedestrian Facilities:	3.0m MUT on all legs, crosswalks with signs & zebra crosswalks provided on all legs
Bicycle Facilities:	3.0m Multi-use Trail
Other Comments:	None

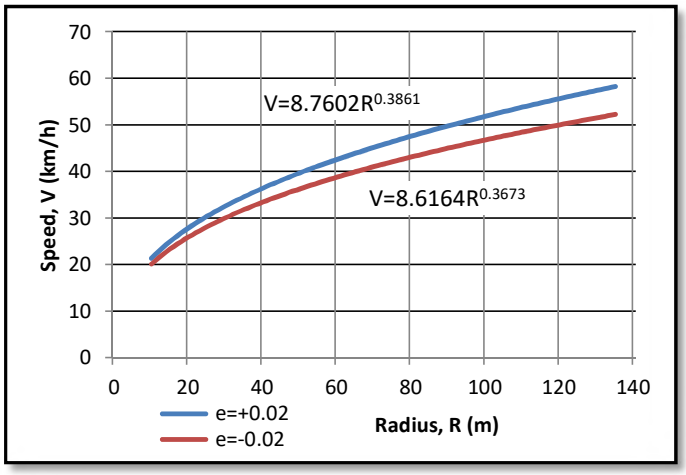
ROUNDABOUT SPEED-RADIUS CALCULATIONS

Project: Westhill District Plan
Project No.: 34280-101
Intersection: Erb Street West and N/S Collector
Date: July 2019

Drawn By: NPD
Sheet: 1 of 1



NCHRP Report 672, Figure 6-46



Speed–Radius Relationship

Mall Entrance SB

Speed - Radius Calculations

	R1	R2	R3	R2+A	R4	R5
Accel. Distance (m)	-	-	-	45.6	-	-
Radius, R (m)	58.9	49.3	100.9	-	20.1	31.6
Speed, V (km/h)	42	39	52	64	28	33

Conflicting Speed Differentials

Max. V	Min. V	Delta V
-	-	-
50	28	22

Erb Street West EB

	R1	R2	R3	R2+A	R4	R5
Accel. Distance	-	-	-	38.4	-	-
Radius, R (m)	68.3	33.1	71.5	-	17.0	23.4
Speed, V (km/h)	45	34	46	57	26	30

Max. V	Min. V	Delta V
-	-	-
50	26	24

N/S Collector NB

	R1	R2	R3	R2+A	R4	R5
Accel. Distance	-	-	-	49.0	-	-
Radius, R (m)	92.3	34.1	112.2	-	20.1	49.4
Speed, V (km/h)	50	34	54	62	28	39

Max. V	Min. V	Delta V
-	-	-
46	28	18

Erb Street West WB

	R1	R2	R3	R2+A	R4	R5
Accel. Distance	-	-	-	47.9	-	-
Radius, R (m)	71.6	121.4	203.0	-	17.0	41.2
Speed, V (km/h)	46	56	68	76	26	37

Max. V	Min. V	Delta V
-	-	-
46	26	19

Notes:

- Speed-Radius values were determined by offsetting from face of curb, not from edge of pavement or painted edge line.
- R2 and R4 values will differ depending on whether the circulatory road is crowned or adverse crossfall.

Appendix M

Westhill District Collector Road – Evaluation of Alternatives Table
Scoring Approach: 1 (least preferred) to 10 (most preferred)

Factor Category Factor Group Factor	Indicator / Measure	South Alternatives (Thorndale Drive to [illegible]) S-1	S-2	S-3	S-4		North Alternatives (Intersection in WHDIP to [illegible]) N-1	N-2	N-3	N-4	Comments
1. NATURAL ENVIRONMENT											
1.A Terrestrial Ecosystems											
Wetlands	Impact on feature and function of PSWs or other wetlands (area; classification/quality, relative extent in relation to entire complex)	9	10	9	1	No PSWs will be directly or indirectly impacted by any alignment Wetland 4 will be removed by S-4	1	7	6	10	No PSWs will be directly or indirectly impacted by any alignment Wetland removals: N-1 will remove a relatively greater area of wetland; N-2 a very small amount; and N-3 a slightly larger amount than N-2 (less than N-1). N-4 will not remove wetland.
Designated areas or areas that meet criteria for designation – natural heritage features per City and Region Official Plans, Environmentally Sensitive Policy Areas, Areas of Natural and Scientific Interest, Significant Woodlands, Significant Wildlife Habitat	Impact on feature and function of designated / potentially designated areas (area; relative extent in relation to entire designated area)	10	9	8	1	No designated / potentially designated areas will be directly or indirectly impacted by alignments S-1, S-2 and S-3 S-4 will remove W4, an Other Wetland (Supporting "B" Natural Feature per the City OP)	1	7	6	10	N-1 will remove a portion of Locally Significant Wetland (Supporting "A" Natural Feature per the City OP) (Wetland 1) and a portion of an area that meets criteria for Significant Wildlife Habitat (but with no net negative impact to SWH per Stage 1 EIS analysis) N-2 and N-3 will remove a small portion of W2, an Other Wetland (Supporting "B" Natural Feature per City OP), but neither alignment will impact SWH N-4 will not remove or impact features which meet criteria for designation.
Vegetation & Flora	Impact on feature and function of vegetation communities and flora (area, type quality, composition, relative extent; and potential for mortality, stress, composition change, Impacts to species of conservation concern [SCC])	9	10	9	1	No provincially significant vegetation communities will be directly or indirectly impacted by any alignment S-4 will remove the greatest amount of vegetation (cultural meadow – Area 1 and golf course) S-1, S-2 and S-3 will potentially remove small amounts of cultural meadow on the golf course - No plant SCC will be directly or indirectly impacted by any alignment	1	7	6	10	No provincially significant vegetation communities or plant species will be directly or indirectly impacted by any alignment N-1 will remove the greatest amount of vegetation (meadow marsh, swamp thicket, treed swamp and cultural meadow). N-2 and N-3 will remove relatively less natural vegetation (cultural meadow / thicket, meadow marsh, swamp thicket). N-4 will not remove any natural vegetation. N-2 and N-3 will potentially remove one regionally significant plant species (Virginia Creeper; recorded in 2016, but not in 2018), but anticipated impacts are minor. No impact to plant SCC with N-1 or N-4
Wildlife Habitat	Impact on feature and function of wildlife habitat (amount, type, composition, quality) Impact on feature and function of and/or reduction of interior habitat (area; fragmentation) Effects on wildlife movement corridors or corridors between critical habitat features (e.g. foraging areas /breeding ponds) (number of crossings)	9	10	9	1	No alignment will directly or indirectly impact interior habitat, specialized wildlife habitat (e.g., amphibian breeding areas, turtle habitat) or known / anticipated wildlife movement corridors No alignment will directly or indirectly impact habitat for wildlife SCC S-4 will remove the greatest amount of wildlife habitat, though it is not significant or sensitive (early successional meadow with a high proportion of disturbance tolerant flora) S-1, S-2 and S-3 will remove small amounts of cultural meadow on the golf course	1	8	7	10	No alignment will directly or indirectly impact interior habitat or known / anticipated wildlife movement corridors N-1 will remove habitat for wildlife SCC (Midland Painted Turtle, Monarch, SAR bats, Terrestrial Crayfish), but with minimal or negligible impact N-1 will remove the greatest amount of wildlife habitat, including herpetofauna breeding / foraging habitat and SWH N-2 and N-3 will remove a small early successional habitat (cultural meadow / thicket, meadow marsh/swamp thicket), but no specialized or sensitive wildlife habitat N-4 will not remove any natural wildlife habitat
	SCORE	9.3	9.8	8.8	1.0		1.0	7.3	6.3	10.0	
1.B Aquatic Ecosystems											
Waterbodies and Watercourses providing fish habitat (including food / shelter)	Number of water bodies and watercourse crossings, sensitivity of fish/fish habitat and thermal regime (warm, cool or cold water) Extent (area) and function of riparian habitat removed Potential impact to aquatic SCC Extent and type of fish habitat (in-stream) altered/displaced at water bodies and watercourse, including importance to aquatic ecosystem (e.g. spawning, nursery areas)	10	10	10	10	No alignment will cross any aquatic features or remove any riparian habitat No alignment will directly or indirectly impact aquatic SCC No alignment will impact fish habitat subject to the Fisheries Act (i.e., downstream of the study area)	1	7	8	10	Each alignment will cross a drainage feature or waterbody that provides direct or indirect warmwater fish habitat, but none is sensitive, none has riparian habitat and all are disconnected from downstream fisheries; as such, none are subject to the prohibitions of the Fisheries Act. N-1 will require partial removal / infilling of Unit 9 Pond (which supports a warmwater fish community) and a crossing of Drainage Feature 4, an intermittent drainage feature that conveys agricultural field flows towards the SWM Facility / Pond 4 N-2 will require the crossing of Drainage Feature 1, an intermittent drainage feature between SWM Facility / Pond 5 and Unit 9 Pond N-3 will require the crossing of Drainage Feature 4
Water Quality, Thermal Regime and Baseflow	Encroachment on headwater areas (1st or 2nd Order Streams) (area) Degree of interference with known groundwater discharge areas that contribute to creek baseflow Effects on surface drainage/floodplain contributions to fish habitat subject to the Fisheries Act (i.e., downstream of the study area),	10	10	10	10	No alignment will encroach on headwater areas No anticipated groundwater discharge effects. No alignment will impact surface drainage contributions to fish habitat subject to the Fisheries Act (i.e., downstream of the study area), with implementation of appropriate stormwater management	9	5	1	10	No alignment will encroach on headwater areas The removal and partial removal of the wetland adjacent to the Landfill Pond in alignments N-3 and N-2 respectively may interfere with the ability of groundwater discharge. The wetland may receive groundwater discharge contributions in order to maintain water levels during dry seasons. No alignment will impact surface drainage contributions to fish habitat subject to the Fisheries Act (i.e., downstream of the study area), with implementation of appropriate stormwater management
	SCORE	10.0	10.0	10.0	10.0		5.0	6.0	4.5	10.0	

Westhill District Collector Road – Evaluation of Alternatives Table
Scoring Approach: 1 (least preferred) to 10 (most preferred)

Factor Category Factor Group Factor	Indicator / Measure	South Alternatives (Thorndale Drive to [illegible]) S-1	S-2	S-3	S-4		North Alternatives (Intersection in WHDIP to [illegible]) N-1	N-2	N-3	N-4	Comments
1.C Groundwater Resources											
Groundwater Recharge Areas	Encroachment on significant groundwater resources (Regional Recharge Area) (removal/disruption of function – area; depth)	10	10	10	10	As per GRCA mapping, no Groundwater recharge areas are within the subject lands	10	10	10	10	As per GRCA mapping, no Groundwater recharge areas are within the subject lands
Groundwater Quality	Potential for impacts to vulnerable areas (area)	10	10	10	10	Scoped on proximity to mapped local Groundwater Protection Areas	10	10	10	10	Scoped on proximity to mapped local Groundwater Protection Areas
Shallow Groundwater Movement	Potential for interference with existing flow patterns (baseflow) relative to proximity to surface water and significant groundwater discharge areas	10	10	10	10	No anticipated interference with local existing flow patterns for any alternatives	10	10	10	10	No anticipated interference with local existing flow patterns for any alternatives
	SCORE	10	10	10	10		10	10	10	10	
1.D Surface Drainage											
Watercourses; Drainage Catchments	Need for diversion/channelization of existing drainage and catchment area impacts (area)	10	10	10	10	No need for diversion for any south alternatives, no existing watercourses or catchment area boundaries within the area	1	5	9	10	N-1 alters the function of the Erb Street pond, needs to be redesigned N-2 bisects the outlet drainage routing from the Landfill SWMP, will need to redesign N-3 and N-4 have little concerns about altering existing drainage or catchment areas
Floodplain Function	Impacts to Regulatory Floodplain	10	10	10	10	Scoped base on proximity to mapped GRCA floodplain (none within subject lands)	10	10	10	10	Scoped base on proximity to mapped GRCA floodplain (none within subject lands)
Stormwater Management	Opportunities to enhance roadway stormwater management measures, including coordination with/use of adjacent development facilities	1	8	10	6	S-1 direct connection to Ira-Needles, introduces additional runoff potential S-2 is close to existing SWM retention area S-3 is adjacent to existing SWM retention Area S-4 creates larger section of impervious roadway, more storm runoff	9	1	5	10	N-1 is adjacent to the Erb Street Pond, easier to coordinate SWM measures N-2 requires more infrastructure to connect with existing facilities N-3 could possibly use Landfill SWMF, although requires coordination with region, longer roadway contributes more runoff N-4 retains function of existing facilities and can tie in directly to the existing forebay
	SCORE	7	9	10	9		7	5	8	10	
1.E Species at Risk (SAR)											
Vegetation Species at Risk	Effects on plant SAR or habitat Requirement for SAR permit under the Endangered Species Act	10	10	10	10	No plant SAR (Endangered, Threatened or Special Concern) or SAR habitat will be directly or indirectly impacted by any alignment No ESA permits will be required for plant SAR	10	10	10	10	No plant SAR (Endangered, Threatened or Special Concern) or SAR habitat will be directly or indirectly impacted by any alignment No ESA permits will be required for plant SAR
Wildlife Species at Risk	Effects on wildlife SAR or habitat Requirement for SAR permit under the Endangered Species Act	5	9	10	1	No confirmed Endangered or Threatened wildlife SAR / habitat will be impacted by any alignment (with implementation of recommended mitigation measures) S-1 will remove one building with low potential for 3 Endangered SAR bat species' roosting habitat and have minimal impact on suitable, but low-quality foraging / breeding habitat for Monarch (Special Concern) and SAR bat foraging habitat S-2 and S-3 will have minimal impact on suitable, but low-quality Monarch foraging / breeding habitat and SAR bat foraging habitat S-4 will remove a relatively greater amount of potential foraging habitat for SAR bats and Monarch foraging/breeding habitat, though it is not significant or sensitive and impacts are minimal No ESA permit requirement is anticipated	1	9	8	10	No confirmed Endangered or Threatened wildlife SAR / habitat will be impacted by any alignment N-1 will potentially remove a very small amount of suitable SAR bat roosting habitat in treed vegetation communities (Unit 5 [SWD4-5] and Unit 8 [SWD4-5]) and wetland foraging habitat, though it is not significant or sensitive (abundant similar or higher quality habitat available in local landscape). Anticipated impacts are minimal. N-1 will remove habitat for two Special Concern wildlife SAR (Monarch and Midland Painted Turtle), but no significant impacts are anticipated N-2 will have minimal impacts on potential Midland Painted Turtle nesting habitat (minor edge removal) N-3 will have minimal impacts on potential SAR bat foraging habitat (wetlands in Unit 2) N-4 will not impact confirmed or potential habitat for SAR No ESA permit requirement is anticipated for wildlife SAR based on analysis presented in the Stage 1 EIS
Aquatic Species at Risk	Effects on aquatic Species at Risk Requirement for an ESA Permit Requirement for a Species At Risk Act (SARA) Permit	10	10	10	10	No aquatic SAR have been recorded or are known from the study area No alignment will directly or indirectly impact aquatic SAR or habitat No ESA permits will be required for aquatic SAR No SARA permits will be required for aquatic SAR	10	10	10	10	No aquatic SAR have been recorded or are known from the study area No alignment will directly or indirectly impact aquatic SAR or habitat, with proper implementation of recommended mitigation and protection measures. No ESA permits will be required for aquatic SAR No SARA permits will be required for aquatic SAR
Species at Risk permits required for construction	Permit requirement (yes, no); probability of obtaining permit(s) (high, medium, low); degree of associated risk to project implementation	10	10	10	10		10	10	10	10	
	SCORE	9	10	10	8		8	10	10	10	
1. NATURAL ENVIRONMENT	**TOTAL SCORE**	45.0	48.8	48.8	37.4		30.4	38.3	38.3	50.0	
	Rank	3	1	2	4		4	2	3	1	
	NORMALIZED	9.0	9.8	9.8	7.5		6.1	7.7	7.7	10.0	
	Rank	3	1	2	4		4	2	3	1	

Westhill District Collector Road – Evaluation of Alternatives Table
Scoring Approach: 1 (least preferred) to 10 (most preferred)

		South Alternatives (Thorndale Drive to [illegible])					North Alternatives (Intersection in WHDIP to [illegible])				
Factor Category Factor Group Factor	**Indicator / Measure**	**S-1**	**S-2**	**S-3**	**S-4**		**N-1**	**N-2**	**N-3**	**N-4**	**Comments**
2. SOCIO-ECONOMIC ENVIRONMENT											
2.A Land Use Policy											
Land use/resource designations and policies	Degree of compatibility with Provincial, Regional and City growth/development goals/objectives policies (high, medium, low)	1	9	10	2		10	5	2	1	
	SCORE	1	9	10	2		10	5	2	1	
2.B Existing and Approved Land Use											
Existing or proposed business operations	Business infrastructure/employees displaced (type; number) Changes (+/-) in business exposure/viability	1	9	10	2		10	5	2	1	N-4 loss of parking in commercial plaza, construction disruptions
Approved or proposed development proposals	Impacts on approved development lands (area; exposure/viability)	2	9	10	1		10	2	5	1	
Planned Land Uses	Impacts on planned land uses	6	10	9	1		10	2	3	1	
	SCORE	3		10			10	3		1	
2.C Communities											
Impacts to individual properties/communities	Encroachment on individual properties (number/area)	2	9	10			10	5	2	1	
Community connectivity (cultural/social linkages)	Physical changes (+/-) to established community connectors (trails/roads) Changes to delivery of community services (emergency; school transportation)	1	9	10	2		10	5	2	1	
Business & Employment opportunities	Changes (+/-) in access to business & employment areas	1	9	10	2		10	2	5	1	Option 1 results in the greatest loss of business areas Option 2 results in the loss of business areas Option 3 has no adverse effect on access to business areas Option 4 increases the possibility for access to business areas Option 5 increases business areas
	SCORE	1	9	10	1		10	4	3	1	

Westhill District Collector Road – Evaluation of Alternatives Table
Scoring Approach: 1 (least preferred) to 10 (most preferred)

Factor Category / Factor Group / Factor	Indicator / Measure	South Alternatives (Thorndale Drive to [illegible]) S-1	S-2	S-3	S-4		North Alternatives (Intersection in WHDIP to [illegible]) N-1	N-2	N-3	N-4	Comments
2.D Noise											
Noise sensitive areas	Noise sensitive receptors experiencing increases (5 dB ranges) in sound levels over pre-existing conditions Noise sensitive receptors experiencing resultant absolute noise levels over 60 bDA	1	7	8	10		10	10	10	10	
	SCORE	1	7	8	10		10	10	10	10	
2.E Response Time for Emergency Services											
Community connectivity	Changes to delivery to emergency services	1	7	10	5		10	9	1	2	
	SCORE	1	7	10	5		10	9	1	2	
2. SOCIO-ECONOMIC	**TOTAL SCORE**	7.3	32.0	47.7	18.3		50.0	31.0	16.0	15.0	
	Rank	4	2	1	3		1	2	3	4	
	NORMALIZED	1.5	6.4	9.5	3.7		10.0	6.2	3.2	3.0	
	Rank	4	2	1	3		1	2	3	4	
3. CULTURAL ENVIRONMENT											
3.A Archaeological Resources											
Known and/or potential archaeological sites	Number/type/significance of direct/indirect impacts to registered archaeological sites - Number/type/significance of direct/indirect impacts to known archaeological resources and/or areas of high archaeological potential	10	7	8	1		9	1	5	10	
3.B Built Heritage											
Built Heritage Features	Number/type/significance of direct/indirect impacts to built heritage resources	10	10	10	10		10	10	10	10	
3.C Cultural Heritage Landscapes											
Cultural Heritage Landscapes	Number/type/significance of direct/indirect impacts to cultural heritage landscapes	10	10	10	10		10	10	10	10	
3. CULTURAL ENVIRONMENT	**TOTAL SCORE**	30.0	27.0	28.0	21.0		29.0	21.0	25.0	30.0	
	Rank	1	3	2	4		2	4	3	1	
	NORMALIZED	10.0	9.0	9.3	7.0		9.7	7.0	8.3	10.0	
	Rank	1	3	2	4		2	4	3	1	

Westhill District Collector Road – Evaluation of Alternatives Table
Scoring Approach: 1 (least preferred) to 10 (most preferred)

Factor Category Factor Group Factor	Indicator / Measure	South Alternatives (Thorndale Drive to [illegible]) S-1	S-2	S-3	S-4		North Alternatives (Intersection in WHDIP to [illegible]) N-1	N-2	N-3	N-4	Comments
4. TRANSPORTATION / MUNICIPAL SERVICES AND UTILITIES											
4.A Transportation Network/Infrastructure											
Transportation network	Relieve future demand on other arterial / collector roads within the community Potential impacts to local roads/intersections	1	8	10	5		10	4	5	1	
Traffic operations	Road safety and accessibility (sight distance; turning movements)	1	6	10	5		10	9	3	1	
Transportation policy initiatives Capacity/capability to accommodate forecast traffic demand. Provides for appropriate access to existing properties	Capability to support municipal policy initiatives (transit, active transportation, roundabouts) Impact on access to existing properties Connectivity to Ira Needles Boulevard and Erb Street	1	7	10	5		10	4	8	1	
	SCORE	1	7	10	5		10	6	5	1	
4.B Municipal Services and Utilities											
Municipal services	Opportunities for connections to or logical extension of existing services - Provision of standard cross-section locations for services - Provision of continuous services	1	10	9	6		10	5	2	1	
SWM Facilities	Ability to coordinate with road construction - Flexibility to implement SWM	1	9	10	6		10	2	5	1	
Utilities	-Degree of exposure of utilities and/or utility conflicts with SWM design	10	10	10	10		10	3	2	1	Option 1 no excavation required and therefore no concern with conflicts due to SWM design Option 2 minimal excavation required through area of utility conflict Option 3 excavation required through buried gas line area and underneath hydro wires and around hydro towers Option 4 requires excavation within Hydro easement under hydro wires and around towers Option 5 some excavation required, utility conflicts not expected to be an issue
	SCORE	4	10	10	7		10	3	3	1	
4. TRANSPORTATION/ MUNICIPAL SERVICES AND UTILITIES	**TOTAL SCORE**	5.0	16.7	19.7	12.3		20.0	9.0	8.3	2.0	
	Rank	4	2	1	3		1	2	3	4	
	NORMALIZED	2.5	8.3	9.8	6.2		10.0	4.5	4.2	1.0	
	Rank	4	2	1	3		1	2	3	4	

Westhill District Collector Road – Evaluation of Alternatives Table
Scoring Approach: 1 (least preferred) to 10 (most preferred)

Factor Category / Factor Group / Factor	Indicator / Measure	South Alternatives (Thorndale Drive to [illegible]) S-1	S-2	S-3	S-4		North Alternatives (Intersection in WHDIP to [illegible]) N-1	N-2	N-3	N-4	Comments
5. FINANCIAL / TECHNICAL											
5.A Financial											
Cost	Estimated capital cost ($) - Road length - Property requirements (number, area) and ease of acquisition - Extraordinary operations and maintenance requirements/costs (e.g., differences in the number of valves and water treatment requirements; collector road maintenance) - Species at Risk mitigation/overall benefit - Cultural heritage mitigation measures	10	8	4	1		10	5	2	1	
	SCORE	10	8	4	1		10	5	2	1	
5.B Technical Complexity											
• Roadway geometric design requirements	-Conformance to TAC and City of Waterloo/RMOW standards	1	10	9	4		10	8	2	1	
Structural/foundation/pavement design requirements	Conformance to TAC and City of Waterloo standards - Requirements for pavement depth and/or foundation footprint, based on soil conditions - Structural requirements relative to capital cost and long term maintenance requirements	7	8	10	1		2	10	8	1	N/A
Topographic; extent of cut/fill	Potential for excessive borrow quantity or excessive off-site disposal of earth material (volume) - Requirements for excessive (steep) grades (length) - Ability to maintain positive drainage, in combination with number of suitable drainage outlets	2	9	10	1		10	2	3	1	
Constructability											
Legal Permissibility/Ability to Implement											
	SCORE	3	9	10	2		7	7	4	1	
5. FINANCIAL / TECHNICAL	**TOTAL SCORE**	13.3	17.0	13.7	3.0		17.3	11.7	6.3	2.0	
	Rank	3	1	2	4		1	2	3	4	
	NORMALIZED	6.67	8.50	6.83	1.50		8.67	5.83	3.17	1.00	
	Rank	3	1	2	4		1	2	3	4	
	GRAND TOTAL	**100.7**	**141.5**	**157.8**	**92.1**		**146.8**	**111.0**	**93.9**	**99.0**	
	RANK	**3**	**2**	**1**	**4**		**1**	**2**	**4**	**3**	
	NORMALIZED	**29.6**	**42.0**	**45.3**	**25.8**		**44.4**	**31.2**	**26.5**	**25.0**	
	RANK	**3**	**2**	**1**	**4**		**1**	**2**	**3**	**4**	

Project Name: Westhill District Plan **MTE File No.:** C34280-101

To: The Westhill Landowners Group **Date:** April 30, 20202

cc: **From:** Jeff Martens

RE: WESTHILL DISTRICT COLLECTOR ROAD – EVALUATION OF ALTERNATIVES

5.0 Financial / Technical

5.A Financial

5.A.1 Cost

Indicator/Measure
Estimated capital cost ($) / Road length
Property requirements (number, area) and ease of acquisition
Extraordinary operations and maintenance requirements/costs (e.g., differences in the number of valves and water treatment requirements; collector road maintenance)
Species at Risk mitigation/overall benefit
Cultural heritage mitigation measures

South Alternatives (Thorndale Drive to Intersection in WHDIP)
Alternative S-1 received a score of 10. Shortest length of roadway. Assumes no connection to Erb Street. Preliminary Cost Estimate -$1.23M

Alternative S-2 received a score of 8. Preliminary Cost Estimate - $1.9M (includes 500k for RAB)

Alternative S-3 received a score of 7 Preliminary Cost Estimate - $ 2.1M (includes 500k for RAB)

Alternative S-4 received a score of 1. It has the longest roadway length.
Preliminary Cost Estimate – $ 3.0M (includes 500k for RAB)

North Alternatives (Intersection in WHDIP to Erb Street W)
Alternative N-1 received a score of 10. It has the shortest distance of roadway, minimal land acquisition needed. Preliminary Cost Estimate - $ 2.9M (includes $1M for RAB)

Alternative N-2 received a score of 5. The land acquisition costs and complexity from Hydro, longer. Preliminary Cost Estimate $ 3.5M (includes $1M for RAB)

Alternative N-3 received a score of 2. Greater land acquisition costs and complexity from Hydro/Region, longest, roadway reconstruction required. Preliminary Cost Estimate $ 5.5M (includes $1M for RAB)

Alternative N-4 received a score of 1. Greater reconstruction costs add to higher cost, however shorter length. Demolition of two buildings and land cost. Preliminary Cost Estimate $ >15M (includes $1M for RAB)

5.B Technical Complexity

5.B.1 Roadway Geometric Design Requirements

Indicator / Measure
Conformance to TAC and City of Waterloo/RMOW standards.

South Alternatives (Thorndale Drive to Intersection in WHDIP)
Alternatives S-2 received scores of 10. Due to the relatively straightforward connection, S-2 scores higher because it is slightly shorter.

Alternatives S-3 received scores of 9 respectively. Due to the relatively straightforward connection similar to S-2. S-3 has good entrance connections to Home Hardware Centre.

Alternatives S-4 received scores of 4 respectively. The connection point is very close to a horizontal curve.

Alternatives S-1 scores of 1. S-1 is a difficult connecting to Ira-Needles on an angle.

North Alternatives (Intersection in WHDIP to Erb Street W)
Alternative N-1 received a score of 10. Due to the relatively straight forward alignment.

Alternative N-2 received a score of 8. It creates a new intersection point on Erb St.

Alternative N-3 received a score of 2. Due to the longest distance of roadway, need to coordinate with heavy truck traffic within Landfill (potentially unsafe traffic operations).

Alternative N-4 received a score of 1. Currently drive lane is not designed to a municipal standard and would need reconstruction and demolition of buildings. Limited possibility for roundabout at Erb due to proximity of Erb/INB roundabout and existing buildings. Grading challenges.

5.B.2 Structural/Foundation/Pavement Design Requirements

Indicator/Measure
Requirements for pavement depth and/or foundation footprint, based on soil conditions.
Structural requirements relative to capital cost and long term maintenance requirements.

South Alternatives (Thorndale Drive to Intersection in WHDIP)
Alternative S-3 received a score of 10. Requires the least structure fill.

Alternative S-2 received a score of 8. Requires minimal structural fill requirements, slightly greater than S-3.

Alternative S-1 received a score of 7. Similar to S-2 with additional fill requirements to cross the westhill pitch and putt parking lot and tying into the elevated grade at Ira Needles.

Alternative S-4 received a score of 1. It requires removal of Wetland 4 and the most structural fill.

North Alternatives (Intersection in WHDIP to Erb Street W)
Alternative N-2 received a score of 10. This alternative has the least requirement for structural fill.

Alternative N-3 received a score of 8. More structural fill than N2 but less than N-1.

Alternative N-1 received a score of 2. It encroaches on Erb Street Pond area where soil conditions are less than favourable for road construction.

Alternative N-4 received a score of 1. Complete reconstruction of road base improvements are required due to reconstruction. May still encroach on Erb Street Pond. Building and foundation removals.

5.B.3 Topographic, Extent of Cut/Fill

Indicator / Measure
Potential for excessive borrow quantity or excessive off-site disposal of earth material (volume)
Requirements for excessive (steep) grades (length)
Ability to maintain positive drainage, in combination with number of suitable drainage outlets

South Alternatives (Thorndale Drive to Intersection in WHDIP)
Alternatives S-2 and S-3 received scores of 9 and 10 respectively. They do not require extensive fill but S-3 will not be as steeply graded. Best to maintain positive drainage, in combination with suitable drainage outlets. Development prefers S3.

Alternative S-1 received a score of 2. Due to the longer roadway distance, need to build up entrance to Ira-Needles. Does not maintain positive drainage or suitable drainage outlets.

Alternative S-4 received a score of 1. It has the longest roadway distance, most grading required.

North Alternatives (Intersection in WHDIP to Erb Street W)
Alternative N-1 received a score of 10. It requires reshaping of Erb Street Pond. Best with respect to maintain positive drainage, in combination with suitable drainage outlets. Smallest area of regrading required.

Alternative N-3 received a score of 3. It require regrading through the existing landfill site and SWMF. Does not maintain positive drainage and suitable drainage outlets.

Alternative N-2 received a score of 2. It requires extensive longitudinal grading of the Hydro corridor which is not support by Hydro. Does not maintain positive drainage and suitable drainage outlets.

Alternative N-4 received a score of 1. It will require regrading of existing commercial site. Does not maintain positive drainage and suitable drainage outlets

5.1.1 5.B.4 Constructability

Indicator / Measure
Physical constructability (adequate access to corridor).
Potential conflicts with existing infrastructure (other than utilities).
Provision of standard horizontal and vertical clearance requirements.
Current staging of development for full implementation of the road network.

South Alternatives (Thorndale Drive to Intersection in WHDIP)
Alternatives S-2 and S-3 received scores of 9 and 10 respectively. They are relatively straightforward with no existing conflicts, S-3 scored higher due to its flatter profile and matches best with the development plans for the Home Hardware site development.

Alternative S-1 received a score of 2. Conflicts with existing infrastructure requirements for sanitary and storm outfalls. Intersection at Ira-Needles is awkward which may be difficult to get regional permission.

Alternative S-4 received a score of 1. It requires largest amount of infrastructure and requires the removal of a small wetland. Conflicts with sanitary servicing strategy and existing sanitary outlet.

North Alternatives (Intersection in WHDIP to Erb Street W)
Alternative N-1 received a score of 10. It is straightforward through client-owned property.

Alternative N-2 received a score of 5. It requires longitudinal access to Hydro Corridor, which is harder to obtain than crossing access. N-2 is not supported by Hydro.

Alternative N-3 received a score of 2. It requires Hydro crossing and access to Regional Landfill lands and is not supported by the Region.

Alternative N-4 received a score of 1. It impacts function of commercial plaza during reconstruction, conflicts with private servicing. This option would require an expropriation and the removal of existing buildings and a complete reorganization of the Waterloo Commons site plan.

5.B.5 Legal Permissibility/Ability to Implement

South Alternatives (Thorndale Drive to Intersection in WHDIP)
Alternatives S-1, S-2, S-3, S-4 all received scores of 10.
All required lands can be acquired through draft plans of subdivisions.

North Alternatives (Intersection in WHDIP to Erb Street W)
Alternative N-1 received a score of 10. It is located upon client-owned lands.

Alternative N-3 received a score of 3. It may not be permitted due to the approvals needed from both the Region and Hydro.

Alternative N-2 received a score of 2. It will not be permitted due to Hydro's unwillingness to allow longitudinal construction within their easements.

Alternative N-4 received a score of 1. It is located on private property, which will not likely be able to be acquired unless an expropriation is considered.

Technical Memorandum

Project Name: Westhill District Plan **MTE File No.:** C34280-101

To: The Westhill Landowners Group **Date:** April 30, 2020

cc: **From:** Jeff Martens

RE: WESTHILL DISTRICT COLLECTOR ROAD – EVALUATION OF ALTERNATIVES

4.0 Transportation / Municipal Services and Utilities

4.A Transportation Network/Infrastructure

4.A.1 Transportation Network

Indicator/Measure
Relieve future demand on other arterial / collector roads within the community.
Potential impacts to local roads/intersections.

South Alternatives (Thorndale Drive to Intersection in WHDIP)
Alternative S-3 received a score of 10. Most direct connection to the WHDIP. Facilitates traffic flow splitting to Ira Needles Boulevard and more importantly Erb Street westerly. Aligns with future entrance of the Home Hardware Centre Development. Good potential to alleviate traffic at Erb/Ira Needles roundabout intersection.

Alternative S-2 received a score of 8. Similar to S3. Does not align with the future entrance of the Home Hardware Center Development.

Alternative S-4 received a score of 5. Good potential to alleviate traffic at Erb/Ira Needles roundabout intersection for traffic moving north and west. Does not service the development traffic adequately. Does not align with the future entrance of the Home Hardware Center Development. Does not align with the previous transportation network outlined in the Westhill District Plan

Alternative S-1 received a score of 1. Does not align with the previous transportation network outlined in the Westhill District Plan. Does not service the development traffic adequately. Does not facilitate traffic flow splitting and will not alleviate traffic congestion at the Erb Street and Ira Needles roundabout intersection.

North Alternatives (Intersection in WHDIP to Erb Street W)

Alternative N-1 received a score of 10. The traffic interface with Erb Street is optimized with the connection at the entrance of the Canadian Tire Site. Adequate distance from other intersections.

Alternative N-4 received a score of 6. The new intersection is closer to Erb and Ira Needles intersection and will limit an efficient diffusion of traffic west and northerly.

Alternative N-3 received a score of 5. The traffic interface with Erb Street is at the existing roundabout at the entrance of Costco. Does not service the Canadian Tire development. Traffic Flow to Clair Hills is not facilitated.

Alternative N-2 received a score of 1. The traffic interface with Erb Street introduces another intersection and is not conducive to flow north and west.

4.B Municipal Services and Utilities

4.B.1 Municipal Services

Indicator / Measure

Opportunities for connections to or logical extension of existing services.
Provision of standard cross-section locations for services.
Provision of continuous services.

South Alternatives (Thorndale Drive to Intersection in WHDIP)

Alternatives S-2 received a score of 10. S-2 is a straightforward connection to WHDIP and North collector roadway, S-2 is the shortest connection.

Alternative S-3 received a score of 9. S-3 is a straightforward connection to North collector roadway, S-3 is slightly longer than S-2.

Alternative S-4 received a score of 6. The longer roadway results in more infrastructure needed.

Alternative S-1 received a score of 1. There is no sanitary sewer connection readily available for this alternative.

North Alternatives (Intersection in WHDIP to Erb Street W)

Alternative N-1 received a score of 10. The score of 10 is due to the available storm outlets at the connection on Erb Street West.

Alternative N-2 received a score of 5. Due to the possible connections on Erb Street West, will require infrastructure expansion/upgrade with increased depth. N2 will not accommodate the sanitary outlet.

Alternative N-3 received a score of 2. It requires coordination with Region for underground works on their land and extensive infrastructure for a storm outlet. N3 will not accommodate the sanitary outlet.

Alternative N-4 received a score of 1. The existing services not in typical location, private services intertwined.

4.B.2 Stormwater Management Facilities (SWMF)

Indicator/Measure
Ability to coordinate with road construction.
Flexibility to implement SWM.

South Alternatives (Thorndale Drive to Intersection in WHDIP)
Alternative S-3 received a scored 10. S-3 aligns with the overall SWM strategy for the developments and the development outlets.

Alternative S-2 received a scored 9. S-2 is similar to S-3 however the developers prefer S-3.

Alternative S-4 received a score of 6. S-4 is similar to S-2 and S-3 from a SWM perspective however does not align with the development fabric preferred by the land owners and more difficult to implement.

Alternative S-1 received a score of 1. It conflicts with SWM Strategy.

North Alternatives (Intersection in WHDIP to Erb Street W)
Alternative N-1 received a score of 10. It is adjacent to the existing pond and can coordinate with existing SWM features and SWM strategy.

Alternative N-2 received a score of 5. Erb Street connection is higher and storm outlets are more challenging than N-1, requires additional storm infrastructure improvements which don't align with the SWM strategy.

Alternative N-3 received a score of 2. It requires coordination with Hydro and Region, largest runoff potential. Does not align with SWM strategy and outlet locations.

Alternative N-4 received a score of 1. N-4 alternative passing through a complete operating commercial site does not provide flexibility to implement SWMFs and does not align with SWM Strategy for separation of private and public drainage.

4.B.3 Utilities

Indicator / Measure
Degree of exposure of utilities and/or utility conflicts with SWM design.

South Alternatives (Thorndale Drive to Intersection in WHDIP)
Alternatives S-1, S-2, S-3, S-4 all received a score of 10.

No conflicts with utilities in the area.

North Alternatives (Intersection in WHDIP to Erb Street W)
Alternative N-1 received a score of 10. It does not interfere with utilities on Hydro or private lands.

Alternatives N-2, N-3 received a score of 3 and 2 respectfully. This is due to potential conflict with gas main through Hydro corridor. Alternative N-3 has additional potential conflict with landfill site utilities.

Alternative N-4 received a score of 1. Conflicts with existing private services and utilities.

Technical Memorandum

Project Name: Westhill District Plan

MTE File No.: C34280-101

To: The Westhill Landowners Group

Date: April 13,2020

cc:

From: Jeff Martens

RE: WESTHILL DISTRICT COLLECTOR ROAD – EVALUATION OF ALTERNATIVES

1.0 Natural Environment

1.B Aquatic Ecosystems

1.B.1 Waterbodies and Watercourses (providing fish habitat, including food/shelter)

Indicator/Measure
Number of water bodies and watercourse crossings.
Sensitivity of fish/fish habitat and thermal regime (warm, cool or cold water).
Extent (area) and function of riparian habitat removed.
Potential impact to aquatic Species of Conservation Concern (SCC).
Extent and type of fish habitat (in-stream) altered/displaced at water bodies and watercourse, including importance to aquatic ecosystem (e.g. spawning, nursery areas).

South Alternatives (Thorndale Drive to Intersection in Westhill District Intersection Point (WHDIP))
South Alternatives S-1 scored 10, S-2 scored 10, S-3 scored 10 , S-4 scored 10.
No south alignment will cross any aquatic features or remove any riparian habitat.
No south alignment will directly or indirectly impact aquatic SCC.
No south alignment will impact fish habitat subject to the Fisheries Act

North Alternatives (Intersection in WHDIP to Erb Street W)
Each alignment will cross a drainage feature or waterbody that provides direct or indirect warm water fish habitat, but none is sensitive, none has riparian habitat and all are disconnected from downstream fisheries; as such, none are subject to the prohibitions of the Fisheries Act. Refer to Figure 5 of the WSP report.

Alternative N-4 received a score of 10. Is mostly within the Waterloo Commons site and does not cross any drainage features.

Alternative N-3 received a score of 8. It will require the crossing of Drainage Feature 4, will not alter the drainage between the Landfill Stormwater Management Facility (SWMF) and the outlet under Erb St. W.

Alternative N-2 received a score of 7. It will require the crossing of Drainage Feature 1, an intermittent drainage feature between SWMF / Pond 5 and Unit 9 Pond which is why it is scored lower than N-3.

Alternative N-1 received a score of 1. It will require partial removal / infilling of Unit 9 Pond and a crossing of Drainage Feature 4, an intermittent drainage feature that conveys agricultural field flows towards the SWMF / Pond 4.

No alignment will directly or indirectly impact aquatic SCC
No alignment will impact fish habitat subject to the Fisheries Act (i.e., downstream of the study area)

1.B.2 Water Quality, Thermal Regime and Baseflow

Indicator/Measure
Encroachment on headwater areas (1st or 2nd Order Streams) (area).
Degree of interference with known groundwater discharge areas that contribute to creek baseflow.
Effects on surface drainage/floodplain contributions to fish habitat subject to the Fisheries Act (i.e., downstream of the study area).

South Alternatives (Thorndale Drive to Intersection in WHDIP)
South Alternatives S-1 scored 10, S-2 scored 10, S-3 scored 10, S-4 scored 10.

No alignment will encroach on headwater areas.
No anticipated groundwater discharge effects.
No alignment will impact surface drainage contributions to fish habitat subject to the Fisheries Act (i.e., downstream of the study area), with implementation of appropriate SWM.

North Alternatives (Intersection in WHDIP to Erb Street W)
No alignment will encroach on headwater areas.
The removal and partial removal of the wetland adjacent to the Landfill Pond in alignments N-3 and N-2 respectively may interfere with the ability of groundwater discharge to the wetlands. The wetland may receive groundwater discharge contributions in order to maintain water levels during dry seasons.
The road provides the conveyance system for the stormwater to the SWMF which provide quality treatment which later outlet to headwater features. Alignment N2 and N3 do not facilitate implementation of the SWM strategies given the location of the outlet sewer.

Alternative N-4 received a score of 10. It will not encroach on wetland areas that may contribute to groundwater discharge. Generally, aligns with SWM strategies that implement water quality for downstream headwater areas.

Alternative N-1 received a score of 9. Aligns with SWM strategies that implement water quality for downstream headwater areas.

Alternative N-2 received a score of 5. Somewhat aligns with SWM strategies that implement water quality for downstream headwater areas. The connection at Erb is higher than N1/N4 and the outlet is located in the vicinity of N1 and N4. This alternative cannot provide quality treatment for the road drainage and its conveyance system.

Alternative N-3 received a score of 1. Does not align with SWM strategies that implement water quality for downstream headwater areas. Similar to N2 the connection to Erb is a higher level further from the outlet.

No alignment will impact surface drainage contributions to fish habitat subject to the Fisheries Act (i.e., downstream of the study area), with implementation of appropriate SWM.

1.D Surface Drainage

1.D.1 Watercourses, Drainage Catchments

Indicator/Measure

Need for diversion/channelization of existing drainage and catchment area impacts (area).

South Alternatives (Thorndale Drive to Intersection in WHDIP)

South Alternatives S-1 scored 10, S-2 scored 10, S-3 scored 10, S-4 scored 10.
No need for diversion for any south alternatives, no existing watercourses or catchment area boundaries within the area.

North Alternatives (Intersection in WHDIP to Erb Street W)

Alternative N-4 scored 10. N4 has virtually no impact on watercourses and drainage catchments. N4 passes through currently developed land and therefore has the least concerns for altering existing drainage.

Alternative N-3 received a score of 9. N3 does not impact any watercourse but does intercept minor surface drainage from the balance of the hydro corridor and landfill site.

Alternative N-2 received a score of 5. It bisects the outlet drainage feature 1 routed from the Landfill SWMF to Erb Street outlet.

Alternative N-1 received a score of 1. It alters the function of the Erb Street pond, needs to be completely redesigned.

1.D.3 Stormwater Management

Indicator / Measure
Opportunities to enhance roadway SWM measures, including coordination with/use of adjacent development facilities.

South Alternatives (Thorndale Drive to Intersection in WHDIP)

Alternative S-3 received a score of 10. It is adjacent to existing SWM retention area, easiest to coordinate with existing feature more so than S-2. Aligns best with SWM strategy.

Alternative S-2 received a score of 8. It is close to existing SWM retention area. Generally, aligns with SWM strategy.

Alternative S-4 received a score of 6. It creates larger section of impervious roadway, more storm runoff, less ability for utilizing the existing SWM retention area and therefore scored lower than S-2.

Alternative S-1 received a score of 1. It needs a direct connection to Ira-Needles, introduces additional runoff potential. Does not align with SWM strategy.

North Alternatives (Intersection in WHDIP to Erb Street W)

Alternative N-4 received a score of 10. It retains function of existing and future SWM facilities.

Alternative N-1 received a score of 9. It is adjacent to the Erb Street Pond, easier to coordinate SWM measures, requires alteration of existing facility and therefore is scored slightly lower than N-4.

Alternative N-3 received a score of 5. It could possibly use the Landfill SWMF, although requires coordination with region, longer roadway contributes more runoff.

Alternative N-2 received a score of 1. It requires more infrastructure to connect with existing facilities, no direct connection with existing features and therefore is scored lowest.

Technical Memorandum

Project Name: Westhill District Plan **MTE File No.:** C34280-101

To: The Westhill Landowners Group **Date:** April 30, 2020

cc: **From:** Jeff Martens

RE: WESTHILL DISTRICT COLLECTOR ROAD – EVALUATION OF ALTERNATIVES

4.0 Transportation / Municipal Services and Utilities

4.A Transportation Network/Infrastructure

4.A.1 Transportation Network

Indicator/Measure
Relieve future demand on other arterial / collector roads within the community.
Potential impacts to local roads/intersections.

South Alternatives (Thorndale Drive to Intersection in WHDIP)
Alternative S-3 received a score of 10. Most direct connection to the WHDIP. Facilitates traffic flow splitting to Ira Needles Boulevard and more importantly Erb Street westerly. Aligns with future entrance of the Home Hardware Centre Development. Good potential to alleviate traffic at Erb/Ira Needles roundabout intersection.

Alternative S-2 received a score of 8. Similar to S3. Does not align with the future entrance of the Home Hardware Center Development.

Alternative S-4 received a score of 5. Good potential to alleviate traffic at Erb/Ira Needles roundabout intersection for traffic moving north and west. Does not service the development traffic adequately. Does not align with the future entrance of the Home Hardware Center Development. Does not align with the previous transportation network outlined in the Westhill District Plan

Alternative S-1 received a score of 1. Does not align with the previous transportation network outlined in the Westhill District Plan. Does not service the development traffic adequately. Does not facilitate traffic flow splitting and will not alleviate traffic congestion at the Erb Street and Ira Needles roundabout intersection.

North Alternatives (Intersection in WHDIP to Erb Street W)

Alternative N-1 received a score of 10. The traffic interface with Erb Street is optimized with the connection at the entrance of the Canadian Tire Site. Adequate distance from other intersections.

Alternative N-4 received a score of 6. The new intersection is closer to Erb and Ira Needles intersection and will limit an efficient diffusion of traffic west and northerly.

Alternative N-3 received a score of 5. The traffic interface with Erb Street is at the existing roundabout at the entrance of Costco. Does not service the Canadian Tire development. Traffic Flow to Clair Hills is not facilitated.

Alternative N-2 received a score of 1. The traffic interface with Erb Street introduces another intersection and is not conducive to flow north and west.

4.B Municipal Services and Utilities

4.B.1 Municipal Services

Indicator / Measure

Opportunities for connections to or logical extension of existing services.
Provision of standard cross-section locations for services.
Provision of continuous services.

South Alternatives (Thorndale Drive to Intersection in WHDIP)

Alternatives S-2 received a score of 10. S-2 is a straightforward connection to WHDIP and North collector roadway, S-2 is the shortest connection.

Alternative S-3 received a score of 9. S-3 is a straightforward connection to North collector roadway, S-3 is slightly longer than S-2.

Alternative S-4 received a score of 6. The longer roadway results in more infrastructure needed.

Alternative S-1 received a score of 1. There is no sanitary sewer connection readily available for this alternative.

North Alternatives (Intersection in WHDIP to Erb Street W)

Alternative N-1 received a score of 10. The score of 10 is due to the available storm outlets at the connection on Erb Street West.

Alternative N-2 received a score of 5. Due to the possible connections on Erb Street West, will require infrastructure expansion/upgrade with increased depth. N2 will not accommodate the sanitary outlet.

Alternative N-3 received a score of 2. It requires coordination with Region for underground works on their land and extensive infrastructure for a storm outlet. N3 will not accommodate the sanitary outlet.

Alternative N-4 received a score of 1. The existing services not in typical location, private services intertwined.

4.B.2 Stormwater Management Facilities (SWMF)

Indicator/Measure
Ability to coordinate with road construction.
Flexibility to implement SWM.

South Alternatives (Thorndale Drive to Intersection in WHDIP)
Alternative S-3 received a scored 10. S-3 aligns with the overall SWM strategy for the developments and the development outlets.

Alternative S-2 received a scored 9. S-2 is similar to S-3 however the developers prefer S-3.

Alternative S-4 received a score of 6. S-4 is similar to S-2 and S-3 from a SWM perspective however does not align with the development fabric preferred by the land owners and more difficult to implement.

Alternative S-1 received a score of 1. It conflicts with SWM Strategy.

North Alternatives (Intersection in WHDIP to Erb Street W)
Alternative N-1 received a score of 10. It is adjacent to the existing pond and can coordinate with existing SWM features and SWM strategy.

Alternative N-2 received a score of 5. Erb Street connection is higher and storm outlets are more challenging than N-1, requires additional storm infrastructure improvements which don't align with the SWM strategy.

Alternative N-3 received a score of 2. It requires coordination with Hydro and Region, largest runoff potential. Does not align with SWM strategy and outlet locations.

Alternative N-4 received a score of 1. N-4 alternative passing through a complete operating commercial site does not provide flexibility to implement SWMFs and does not align with SWM Strategy for separation of private and public drainage.

4.B.3 Utilities

Indicator / Measure
Degree of exposure of utilities and/or utility conflicts with SWM design.

South Alternatives (Thorndale Drive to Intersection in WHDIP)
Alternatives S-1, S-2, S-3, S-4 all received a score of 10.

No conflicts with utilities in the area.

North Alternatives (Intersection in WHDIP to Erb Street W)
Alternative N-1 received a score of 10. It does not interfere with utilities on Hydro or private lands.

Alternatives N-2, N-3 received a score of 3 and 2 respectfully. This is due to potential conflict with gas main through Hydro corridor. Alternative N-3 has additional potential conflict with landfill site utilities.

Alternative N-4 received a score of 1. Conflicts with existing private services and utilities.

Project Name: Westhill District Plan **MTE File No.:** C34280-101

To: The Westhill Landowners Group **Date:** April 30, 20202

cc: **From:** Jeff Martens

RE: WESTHILL DISTRICT COLLECTOR ROAD – EVALUATION OF ALTERNATIVES

5.0 Financial / Technical

5.A Financial

5.A.1 Cost

Indicator/Measure
Estimated capital cost ($) / Road length
Property requirements (number, area) and ease of acquisition
Extraordinary operations and maintenance requirements/costs (e.g., differences in the number of valves and water treatment requirements; collector road maintenance)
Species at Risk mitigation/overall benefit
Cultural heritage mitigation measures

South Alternatives (Thorndale Drive to Intersection in WHDIP)
Alternative S-1 received a score of 10. Shortest length of roadway. Assumes no connection to Erb Street. Preliminary Cost Estimate -$1.23M

Alternative S-2 received a score of 8. Preliminary Cost Estimate - $1.9M (includes 500k for RAB)

Alternative S-3 received a score of 7 Preliminary Cost Estimate - $ 2.1M (includes 500k for RAB)

Alternative S-4 received a score of 1. It has the longest roadway length.
Preliminary Cost Estimate – $ 3.0M (includes 500k for RAB)

North Alternatives (Intersection in WHDIP to Erb Street W)
Alternative N-1 received a score of 10. It has the shortest distance of roadway, minimal land acquisition needed. Preliminary Cost Estimate - $ 2.9M (includes $1M for RAB)

Alternative N-2 received a score of 5. The land acquisition costs and complexity from Hydro, longer. Preliminary Cost Estimate $ 3.5M (includes $1M for RAB)

Alternative N-3 received a score of 2. Greater land acquisition costs and complexity from Hydro/Region, longest, roadway reconstruction required. Preliminary Cost Estimate $ 5.5M (includes $1M for RAB)

Alternative N-4 received a score of 1. Greater reconstruction costs add to higher cost, however shorter length. Demolition of two buildings and land cost. Preliminary Cost Estimate $ >15M (includes $1M for RAB)

5.B Technical Complexity

5.B.1 Roadway Geometric Design Requirements

Indicator / Measure
Conformance to TAC and City of Waterloo/RMOW standards.

South Alternatives (Thorndale Drive to Intersection in WHDIP)
Alternatives S-2 received scores of 10. Due to the relatively straightforward connection, S-2 scores higher because it is slightly shorter.

Alternatives S-3 received scores of 9 respectively. Due to the relatively straightforward connection similar to S-2. S-3 has good entrance connections to Home Hardware Centre.

Alternatives S-4 received scores of 4 respectively. The connection point is very close to a horizontal curve.

Alternatives S-1 scores of 1. S-1 is a difficult connecting to Ira-Needles on an angle.

North Alternatives (Intersection in WHDIP to Erb Street W)
Alternative N-1 received a score of 10. Due to the relatively straight forward alignment.

Alternative N-2 received a score of 8. It creates a new intersection point on Erb St.

Alternative N-3 received a score of 2. Due to the longest distance of roadway, need to coordinate with heavy truck traffic within Landfill (potentially unsafe traffic operations).

Alternative N-4 received a score of 1. Currently drive lane is not designed to a municipal standard and would need reconstruction and demolition of buildings. Limited possibility for roundabout at Erb due to proximity of Erb/INB roundabout and existing buildings. Grading challenges.

5.B.2 Structural/Foundation/Pavement Design Requirements

Indicator/Measure
Requirements for pavement depth and/or foundation footprint, based on soil conditions.
Structural requirements relative to capital cost and long term maintenance requirements.

South Alternatives (Thorndale Drive to Intersection in WHDIP)
Alternative S-3 received a score of 10. Requires the least structure fill.

Alternative S-2 received a score of 8. Requires minimal structural fill requirements, slightly greater than S-3.

Alternative S-1 received a score of 7. Similar to S-2 with additional fill requirements to cross the westhill pitch and putt parking lot and tying into the elevated grade at Ira Needles.

Alternative S-4 received a score of 1. It requires removal of Wetland 4 and the most structural fill.

North Alternatives (Intersection in WHDIP to Erb Street W)
Alternative N-2 received a score of 10. This alternative has the least requirement for structural fill.

Alternative N-3 received a score of 8. More structural fill than N2 but less than N-1.

Alternative N-1 received a score of 2. It encroaches on Erb Street Pond area where soil conditions are less than favourable for road construction.

Alternative N-4 received a score of 1. Complete reconstruction of road base improvements are required due to reconstruction. May still encroach on Erb Street Pond. Building and foundation removals.

5.B.3 Topographic, Extent of Cut/Fill

Indicator / Measure
Potential for excessive borrow quantity or excessive off-site disposal of earth material (volume)
Requirements for excessive (steep) grades (length)
Ability to maintain positive drainage, in combination with number of suitable drainage outlets

South Alternatives (Thorndale Drive to Intersection in WHDIP)
Alternatives S-2 and S-3 received scores of 9 and 10 respectively. They do not require extensive fill but S-3 will not be as steeply graded. Best to maintain positive drainage, in combination with suitable drainage outlets. Development prefers S3.

Alternative S-1 received a score of 2. Due to the longer roadway distance, need to build up entrance to Ira-Needles. Does not maintain positive drainage or suitable drainage outlets.

Alternative S-4 received a score of 1. It has the longest roadway distance, most grading required.

North Alternatives (Intersection in WHDIP to Erb Street W)
Alternative N-1 received a score of 10. It requires reshaping of Erb Street Pond. Best with respect to maintain positive drainage, in combination with suitable drainage outlets. Smallest area of regrading required.

Alternative N-3 received a score of 3. It require regrading through the existing landfill site and SWMF. Does not maintain positive drainage and suitable drainage outlets.

Alternative N-2 received a score of 2. It requires extensive longitudinal grading of the Hydro corridor which is not support by Hydro. Does not maintain positive drainage and suitable drainage outlets.

Alternative N-4 received a score of 1. It will require regrading of existing commercial site. Does not maintain positive drainage and suitable drainage outlets

5.1.1 5.B.4 Constructability

Indicator / Measure
Physical constructability (adequate access to corridor).
Potential conflicts with existing infrastructure (other than utilities).
Provision of standard horizontal and vertical clearance requirements.
Current staging of development for full implementation of the road network.

South Alternatives (Thorndale Drive to Intersection in WHDIP)
Alternatives S-2 and S-3 received scores of 9 and 10 respectively. They are relatively straightforward with no existing conflicts, S-3 scored higher due to its flatter profile and matches best with the development plans for the Home Hardware site development.

Alternative S-1 received a score of 2. Conflicts with existing infrastructure requirements for sanitary and storm outfalls. Intersection at Ira-Needles is awkward which may be difficult to get regional permission.

Alternative S-4 received a score of 1. It requires largest amount of infrastructure and requires the removal of a small wetland. Conflicts with sanitary servicing strategy and existing sanitary outlet.

North Alternatives (Intersection in WHDIP to Erb Street W)
Alternative N-1 received a score of 10. It is straightforward through client-owned property.

Alternative N-2 received a score of 5. It requires longitudinal access to Hydro Corridor, which is harder to obtain than crossing access. N-2 is not supported by Hydro.

Alternative N-3 received a score of 2. It requires Hydro crossing and access to Regional Landfill lands and is not supported by the Region.

Alternative N-4 received a score of 1. It impacts function of commercial plaza during reconstruction, conflicts with private servicing. This option would require an expropriation and the removal of existing buildings and a complete reorganization of the Waterloo Commons site plan.

5.B.5 Legal Permissibility/Ability to Implement

South Alternatives (Thorndale Drive to Intersection in WHDIP)
Alternatives S-1, S-2, S-3, S-4 all received scores of 10.
All required lands can be acquired through draft plans of subdivisions.

North Alternatives (Intersection in WHDIP to Erb Street W)
Alternative N-1 received a score of 10. It is located upon client-owned lands.

Alternative N-3 received a score of 3. It may not be permitted due to the approvals needed from both the Region and Hydro.

Alternative N-2 received a score of 2. It will not be permitted due to Hydro's unwillingness to allow longitudinal construction within their easements.

Alternative N-4 received a score of 1. It is located on private property, which will not likely be able to be acquired unless an expropriation is considered.

Appendix N

Westhill District SWM – Evaluation of Alternatives Table
Scoring Approach: 1 (least preferred) to 10 (most preferred)

Factor Category Factor Group Factor	Indicator / Measure	SWM Alternatives SWM - 1	SWM - 2	SWM - 3	SWM - 4	SWM - 5	Comments
1. NATURAL ENVIRONMENT							
1.A Terrestrial Ecosystems							
Wetlands	Impact on feature and function of PSWs or other wetlands (area; classification/quality, relative extent in relation to entire complex)	8	10	2	1	7	• No PSWs directly or indirectly impacted by any Option. • No options directly impact W4 • Option 1. No direct impacts to any wetland. Relatively greatest indirect impact to W1 (entire area) and W2 (entire area), due to lack of quantity control and resulting larger flooding / detention area and lack of additional quality control. • Option 2. Relatively greater direct impact to W1 (removal of 7,865 m2), with installation of 3 new SWM facilities (2 Private; 1 City). Direct impact to W3 (removal of 2,273 m2), with installation of 2 new private SWM facilities. No direct impact to W2 or W4. Relatively greater indirect impact to W1 and W2 with larger ponded area (over most of W1 and most of W2), mitigated by improved quality in W1 through additional SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (relatively less effective than Options 3 and 4). • Option 3. Relatively greater direct impact to W1 (removal of 8,176 m2), with installation of 3 new City SWM facilities. Greatest direct impact to other wetlands (W2 and W3), with installation of 1 new City SWM facility and maintenance access through the Hydro corridor (removal of 9,983 m2). No direct impact to W4. No indirect impact to wetlands due to increased ponding (detention is within formal SWM ponds); improved quality in W1 through additional SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (most effective, greater than Options 2 and 5). • Option 4. Greatest direct impact to W1 (removal of 8,944 m2), with installation of 3 new SWM facilities (2 City and 1 Regional). Relatively greater direct impact to other wetlands (W2), with installation of 1 new Regional SWM facility and maintenance of access through the Hydro corridor (removal of 9,673 m2). No direct impact to W3 or W4. No indirect impact to wetlands due to increased ponding (detention is within formal SWM ponds); improved quality in W1 through additional SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (most effective, greater than Options 2 and 5). Provides a very large area for naturalization in the SWM • Option 5. Relatively less direct impact to W1 (5,995 m2), with installation of 2 new City SWM facilities. No direct impact to W2, W3 or W4. Relatively larger indirect impact to W2 (entire area); improved quality in W1 through additional SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (relatively less effective than Options 3 and 4).
Designated areas or areas that meet criteria for designation – natural heritage features per City and Region Official Plans, Environmentally Sensitive Policy Areas, Areas of Natural and Scientific Interest, Significant Woodlands, Significant Wildlife Habitat	Impact on feature and function of designated / potentially designated areas (area; relative extent in relation to entire designated area)	10	7	2	1	8	• All options, except Option 1, include grading / disturbance in GRCA Regulated areas. • Options 3, 4 and 5 (and associated requirements for access through the Hydro Corridor) would remove Significant Wildlife Habitat (SWH). However, none of these options would result in negative impact to SWH with maintenance of suitable habitat in the local landscape and/or habitat enhancements. • No options impact ESPAs or Significant Woodlands • Option 1. No direct impacts to designated areas. No grading within GRCA Regulated areas. Relatively greatest indirect impact to Supporting 'A' features (Locally Significant Wetland; W1 – entire area) and Supporting 'B' features ('Other Wetlands'; W2 – entire area), due to lack of quantity control and resulting larger flooding / detention area and lack of additional quality control. • Option 2. Relatively greater direct impact to Supporting 'A' features (Locally Significant Wetland; W1) (removal of 7,865 m2), with installation of 3 new SWM facilities (2 Private; 1 City). Direct impact to Supporting 'B' features ('Other Wetlands'; W3) with installation of 2 new private SWM facilities (removal of 2,273 m2). No direct impact to W2 or W4. Relatively greater indirect impact to Supporting 'A' features (W1) and Supporting 'B' features (W2) with larger ponded area (over most of W1 and most of W2),mitigated by improved quality in W1 through additional SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (relatively less effective than Options 3 and 4). • Option 3. Relatively greater direct impact to Supporting 'A' features (Locally Significant Wetland; W1) (removal of 8,176 m2), with installation of 3 new City SWM facilities. Greatest direct impact to Supporting 'B' features (W2 and W3), with installation of 1 new City SWM facility and maintenance access through the Hydro corridor (removal of 9,983 m2). No direct impact to W4. No indirect impact to wetlands due to increased ponding (detention is within formal SWM ponds); improved quality in W1 through additional SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (most effective, greater than Options 2 and 5). • Option 4. Greatest direct impact to Supporting 'A' features (Locally Significant Wetland; W1) (removal of 8,944 m2), with installation of 3 new SWM facilities. Relatively greater direct impact to Supporting 'B' features (W2), with installation of 1 new Regional SWM facility and maintenance of access through the Hydro corridor (removal of 9,983 m2). No direct impact to W3 or W4. No indirect impact to wetlands due to increased ponding (detention is within formal SWM ponds); improved quality in W1 through additional SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (most effective, greater than Options 2 and 5). Provides a very large area for naturalization in the SWM • Option 5. Relatively less direct impact to Supporting 'A' features (Locally Significant Wetland; W1) (removal of 5,995 m2), with installation of 2 new SWM facilities. No direct impact to 'Other Wetlands' (for SWM facility installation or Hydro Corridor access). Relatively larger indirect impact to W2 (entire area); improved quality in W1 through additional SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (relatively less effective than Options 3 and 4).
Vegetation & Flora	Impact on feature and function of vegetation communities and flora (area, type quality, composition, relative extent; and potential for mortality, stress, composition change, Impacts to species of conservation concern [SCC])	10	6	3	1	7	• No provincially significant vegetation communities or plant species of conservation concern (nationally, provincially or regionally rare species, SAR, species with high 'Coefficient of Conservatism' values) will be directly or indirectly impacted by any SWM Option. • Vegetation is culturally influenced, with moderate to high levels of anthropogenic disturbance in most communities. The relatively least disturbed vegetation is the SWT/SWD communities in W1 • Option 1. No direct vegetation removal, but resulting higher post-construction water levels can alter vegetation composition in W1 (meadow marsh [MAM], thicket swamp [SWT], treed swamp [SWD] and open water [SAS] vegetation types), W2 (cultural meadow [CUM], cultural thicket [CUT], MAM and shallow marsh [MAS]) and Unit 6 (CUM). • Option 2. Relatively greater direct impact to vegetation in W1 (removal of 7,865 m2 of MAM, SWT and SAS) and W3 (removal of 2,273 m2 of MAM and MAS), with installation of SWM facilities. No direct impact to vegetation in W2 or W4. Relatively greater indirect impact vegetation in W1 and W2 (hydrologic changes, mitigated by improved quality in W1 through additional SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (relatively less effective than Options 3 and 4). • Option 3. Relatively greater direct impact to vegetation in W1, W2, W3 and Unit 6 (removal of CUM, CUT, MAM, MAS, SWT, SWD, SAS), with installation of new City SWM facilities and maintenance of access through the Hydro corridor. No indirect impact to vegetation due to increased ponding (detention is within formal SWM ponds); improved quality in W1 through additional SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (most effective, greater than Options 2 and 5). • Option 4. Greatest direct impact to vegetation in W1, W2 and Unit 6 (removal of CUM, CUT, SWT, MAM, SAS, MAS), with installation of new SWM facilities and maintenance of access through the Hydro corridor. No indirect impact to vegetation due to increased ponding (detention is within formal SWM ponds); improved quality in W1 through additional SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (most effective, greater than Options 2 and 5). Provides a very large area for naturalization in the SWM. • Option 5. Relatively less direct impact to vegetation in W1 (removal of MAM, SWT, SWD and SAS), with installation of 2 new SWM facilities. No direct impact to other vegetation. Relatively larger indirect impact to W2 and Unti 6 (removal of CUM, CUT, SWT, MAM, MAS); improved quality in W1 through additional SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (relatively less effective than Options 3 and 4).
Wildlife Habitat	Impact on feature and function of wildlife habitat (amount, type, composition, quality) Impact on feature and function of and/or reduction of interior habitat (area; fragmentation) Effects on wildlife movement corridors or corridors between critical habitat features (e.g. foraging areas /breeding ponds) (number of crossings)	7	10	1	2	5	• No option will directly or indirectly impact interior habitat or known / anticipated wildlife movement corridors • Wildlife habitat is culturally influenced, with moderate to high levels of anthropogenic disturbance in most communities. The relatively most 'specialized' habitat is open water features (including the existing SWM ponds) which support herpetofauna use • For all options, impacts to wildlife (individuals) can be mitigated through Best Management Practices during construction, appropriate timing for activities and other measures, as required (e.g., exclusion, awareness / encounter protocols) • Option 1. No direct wildlife habitat removal, but indirect impacts to W1, W2 and Unit 6 (i.e., higher water levels which can alter vegetation and wildlife habitat) including habitat for wildlife SCC (Midland Painted Turtle, Monarch, SAR bats, Terrestrial Crayfish). No opportunity for establishing naturalized habitat in new SWM facilities (none is proposed). • Option 2. Relatively greater direct impact to W1 with installation of 3 new SWM facilities (removal of marsh, swamp thicket and pond vegetation), which is habitat for wildlife SCC (Midland Painted Turtle, Monarch, SAR bats, Terrestrial Crayfish). Direct impact to W3 with installation of 2 new private SWM facilities (removal of marsh; no wildlife SCC). Relatively greater indirect impact to habitat in W1 and W2 (marsh, pond, thicket and swamp vegetation), mitigated by improved quality in W1 through additional SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (relatively less effective than Options 3 and 4). Existing SWM ponds retained and some opportunity for creating additional naturalized habitat in new SWM facilities. • Option 3. Relatively greater direct impact to W1, W2 and Veg. Unit 6 with installation of 3 new SWM facilities and maintenance access through the Hydro corridor (removal of cultural meadow, marsh, swamp thicket and pond vegetation), which is habitat for wildlife SCC (Midland Painted Turtle, Monarch, SAR bats, Terrestrial Crayfish). Direct impact to W3 with installation of 1 new City SWM facility (removal of marsh; no wildlife SCC). No indirect impact to wetlands due to increased ponding (detention is within formal SWM ponds); improved quality in W1 through additional SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (most effective, greater than Options 2 and 5). Existing SWM ponds retained and opportunity for creating substantial additional naturalized habitat in large new SWM facilities. • Option 4. Greatest direct impact to W1, W2 and Unit 6, with installation of new SWM facilities and maintenance of access through the Hydro corridor (removal of CUM, CUT, SWT, MAM, SAS, MAS) which is habitat for wildlife SCC (Midland Painted Turtle, Monarch, SAR bats, Terrestrial Crayfish). Direct impact to anthropogenic habitat, with removal of two existing Regional SWM facilities (habitat for anurans and Midland Painted Turtle); however, this is a short-term effect, as similar habitat would be created in the new SWM facilities. No direct impact to wildlife habitat in W3 and W4. No indirect impact to vegetation due to increased ponding (detention is within formal SWM ponds); improved quality in W1 through additional SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (most effective, greater than Options 2 and 5). Provides a very large area for naturalization in the new SWM ponds. • Option 5. Relatively less direct impact to vegetation in W1, with installation of 2 new SWM facilities (removal of MAM, SWT, SWD and SAS), which is habitat for wildlife SCC (Midland Painted Turtle, Monarch, SAR bats, Terrestrial Crayfish). Direct impact to anthropogenic habitat, with removal of one existing Regional SWM facility (habitat for anurans and Midland Painted Turtle); however, this is a short-term effect, as similar habitat would be created in the new SWM facilities. No direct impact to wildlife habitat in W2, W3 and W4. Relatively greater indirect impact to W2 and Unit 6 (removal of CUM, CUT, SWT, MAM, MAS); improved quality in W1 through additional SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (relatively less effective than Options 3 and 4). Opportunity for creating additional naturalized habitat in new SWM facilities.
	SCORE	8.8	8.3	2.0	1.3	6.8	
1.B Aquatic Ecosystems							
Waterbodies and Watercourses providing fish habitat (including food / shelter)	Number of water bodies and watercourse crossings, sensitivity of fish/fish habitat and thermal regime (warm, cool or cold water) Extent (area) and function of riparian habitat removed Potential impact to aquatic SCC Extent and type of fish habitat (in-stream) altered/displaced at water bodies and watercourse, including importance to aquatic ecosystem (e.g. spawning, nursery areas)	1	5	10	9	4	• Under current conditions, there are several dug ponds, two SWM facility ponds and several drainage features (i.e., swales, diffuse flow areas). Some of these features provide direct or indirect warmwater fish habitat, but none is sensitive, none has riparian habitat and all are disconnected from downstream fisheries • No option will directly or indirectly impact aquatic SCC, including SAR • No option will negatively impact fish habitat subject to the Fisheries Act (i.e., habitat that is downstream of the study area [Clair Creek and Clair Lake] and isolated by a 750m+ long enclosed section of watercourse) • Option 1. No direct impact to ponds or drainage features. Greatest indirect impact to downstream aquatic habitat due to increased development runoff and lack of upstream quality and quantity controls. • Option 2. Direct impact to a reach of Drainage Feature 1 and Unit 9 pond (removal), with installation of 3 new SWM facilities. Net improvement to downstream / offsite water quality with improved SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (relatively less effective than Options 3 and 4). • Option 3. Direct impact to a reach of Drainage Feature 1 and Unit 9 pond (removal), with installation of 3 new SWM facilities. Net improvement to downstream / offsite water quality with improved SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (most effective, greater than Options 2 and 5). • Option 4. Direct impact to reaches of Drainage Features 1 / 2 / 4, Unit 9 pond and Regional SWM Ponds 4 / 5 (removal), with installation of 3 new SWM facilities. Net improvement to downstream / offsite water quality with improved SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (most effective, greater than Options 2 and 5). • Option 5. Direct impact to a reach of Drainage Feature 2, Unit 9 pond and Regional SWM Ponds 4 / 5 (removal), with installation of a new SWM facility. Net improvement to downstream / offsite water quality with improved SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (relatively less effective than Options 3 and 4).

Westhill District SWM – Evaluation of Alternatives Table
Scoring Approach: 1 (least preferred) to 10 (most preferred)

		SWM Alternatives					
Factor Category Factor Group Factor	**Indicator / Measure**	**SWM - 1**	**SWM - 2**	**SWM - 3**	**SWM - 4**	**SWM - 5**	**Comments**
Water Quality, Thermal Regime and Baseflow	Encroachment on headwater areas (1st or 2nd Order Streams) (area) Degree of interference with known groundwater discharge areas that contribute to creek baseflow Effects on surface drainage/floodplain contributions to fish habitat subject to the Fisheries Act (i.e., downstream of the study area),	1	5	10	9	4	• No option will encroach on headwater areas • No option will interfere with known groundwater discharge areas that contribute to creek baseflow , though options differ in potential warming of downstream aquatic habitat • No option will impact surface drainage contributions to fish habitat subject to the Fisheries Act (i.e., downstream of the study area [Clair Creek and Clair Lake] and isolated by a 750m+ long enclosed section of watercourse) • Option 1. Greatest indirect impact to downstream aquatic habitat due to increased development runoff and lack of upstream quality and quantity controls. • Option 2. Net improvement to downstream / offsite water quality with improved SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (relatively less effective than Options 3 and 4). • Option 3. Net improvement to downstream / offsite water quality with improved SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (most effective, greater than Options 2 and 5). • Option 4. Net improvement to downstream / offsite water quality with improved SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (most effective, greater than Options 2 and 5). • Option 5. Net improvement to downstream / offsite water quality with improved SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (relatively less effective than Options 3 and 4).
	SCORE	1.0	5.0	10.0	9.0	4.0	

Westhill District SWM – Evaluation of Alternatives Table
Scoring Approach: 1 (least preferred) to 10 (most preferred)

		SWM Alternatives					
Factor Category Factor Group Factor	**Indicator / Measure**	**SWM - 1**	**SWM - 2**	**SWM - 3**	**SWM - 4**	**SWM - 5**	**Comments**
1.C Groundwater Resources							
Groundwater Recharge Areas	Encroachment on significant groundwater resources (Regional Recharge Area) (removal/disruption of function – area; depth)	10	10	10	10	10	No encroachment on significant groundwater resources. No significant GRCA or MNRF regional recharge areas within subject lands Not within a Regional Recharge Area (per Map 6g of the Regional Official Plan 2015)
Groundwater Quality	Potential for impacts to vulnerable areas (area)	10	10	10	10	10	No SGRA vulnerable (GRCA) areas within subject lands
Shallow Groundwater Movement	Potential for interference with existing flow patterns (baseflow) relative to proximity to surface water and significant groundwater discharge areas	10	10	10	10	10	No potential for interference with existing baseflow patterns
	SCORE	10	10	10	10	10	
1.D Surface Drainage							
Watercourses; Drainage Catchments	Need for diversion/channelization of existing drainage and catchment area impacts (area)	10	8	1	6	7	• None of the options directly impacts defined watercourses Option 1 no alteration to existing drainage system Option 2 minor alteration to existing drainage, routing of landfill pond outflow needed Option 3 is most difficult to design while considering existing site drainage, need to route landfill pond and regional pond outflow Option 4 removes landfill and regional ponds entirely, may require coordination with Region for new drainage strategy Option 5 some alterations required, landfill pond and flow route retained
Floodplain Function	Impacts to Regulatory Floodplain	10	10	10	10	10	No regulated floodplains within subject lands
Stormwater Management	Opportunities to enhance roadway stormwater management measures, including coordination with/use of adjacent development facilities	1	2	8	9	10	• All options except Option 1 will provide an enhancement to existing roadway SWM measures, with implementation of various SWM strategies, with resulting improvements to existing natural feature receiving areas (i.e., W1 and downstream / offsite aquatic habitat) • Option 1. No enhancement to roadway SWM measures, with resulting impact to receiving natural areas. • Option 2. Limited enhancement to roadway SWM measures as this option provides only upstream controls at property level, with roadway runoff not treated at the source – potential impact to receiving natural areas • Option 3. Relatively greater enhancement to roadway SWM measures - provides opportunity for spill containment from landfill, plus multi-step treatment approach on a developer level • Option 4. Relatively greater enhancement to roadway SWM measures - provides more treatment for Ira Needles as the current Regional forebay is not adequately designed for the flows it is receiving. Also develops an updated SWM plan for the landfill as the existing Regional landfill SWM pond may not be functioning at current design standards. Does not give protection against landfill spills, may result in contaminants entering receiving watercourse. • Option 5. Greatest enhancement to roadway SWM measures. Provides quality and quantity control for entire subject lands & landfill, hydro and Ira Needles areas; designed to improve quality of effluent downstream and maintains flow allocations to avoid erosion and sediment control issues in the receiving watercourse. Larger storm retention is contained within the hydro corridor. improvement to downstream / offsite water quality with improved SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (relatively less effective than Options 3 and 4). Option 1 has greatest ponding area which introduces more likelihood of warming, plus no quality controls resulting in poor downstream water quality • Option 2 large ponding area results in high potential warming, effects downstream thermal regime • Option 3 introduces quality and quantity controls without large ponding areas to maintain downstream water quality • Option 4 enhanced condition, separates public and private stormwater while utilizing quality and quantity controls to maintain downstream water quality • Option 5 ability to adequately control and manage up to the regional storm event, utilizes quality controls management system which minimizes sediment loading to receiving watercourses.
	SCORE	7	7	6	8	9	
1.E Species at Risk (SAR)							
Vegetation Species at Risk	Effects on plant SAR or habitat Requirement for SAR permit under the Endangered Species Act	10	10	10	10	10	• No confirmed plant SAR (Endangered [END], Threatened [THR] or Special Concern [SC]) or SAR habitat will be directly or indirectly impacted by any option • No ESA permits will be required for plant SAR
Wildlife Species at Risk	Effects on wildlife SAR or habitat Requirement for SAR permit under the Endangered Species Act	7	10	3	4	1	• No confirmed END/THR wildlife SAR or confirmed END/THR wildlife SAR habitat will be directly or indirectly impacted by any option • No impact to wildlife SAR (END/THR/SC individuals) for any option, with implementation of appropriate protection and mitigation measures • No ESA or SARA permits will be required for wildlife SAR for any option • Option 1. No direct impact to any wildlife SAR habitat. Potential indirect impact to habitat for Midland Painted Turtle (SC), bats (END) and Monarch (SC) in W1 resulting from hydrologic changes (higher water levels) and increase in untreated runoff which can alter vegetation composition and wildlife habitat. • Option 2. Limited direct impact to SAR wildlife habitat in W1 with installation of new SWM facilities (removal of marsh, swamp thicket and pond vegetation). Relatively greater indirect impact (hydrologic / vegetation changes) to SAR wildlife habitat in W1, mitigated by improvements to water quality of surface runoff via SWM treatment. • Option 3. Relatively greater direct impact to SAR wildlife habitat in W1 with installation of 3 new SWM facilities (removal of marsh, swamp thicket and pond vegetation). No indirect impact to SAR wildlife habitat (detention is within formal SWM ponds); improved quality in W1 through additional SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (most effective, greater than Options 2 and 5). • Option 4. Greatest direct impact to SAR wildlife habitat in W1 with installation of 3 new SWM facilities (removal of marsh, swamp thicket and pond vegetation). No indirect impact to SAR wildlife habitat (detention is within formal SWM ponds); improved quality in W1 through additional SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (most effective, greater than Options 2 and 5). Option 5. Relatively less direct impact to SAR wildlife habitat in W1 with installation of 3 new SWM facilities (removal of marsh, swamp thicket and pond vegetation. Relatively greater indirect impact to W2 and Unit 6 (removal of CUM, CUT, SWT, MAM, MAS); improved quality in W1 through additional SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (relatively less effective than Options 3 and 4). Opportunity for creating additional naturalized habitat in new SWM facilities.
Aquatic Species at Risk	Effects on aquatic Species at Risk Requirement for an ESA Permit Requirement for a Species At Risk Act (SARA) Permit	10	10	10	10	10	• No aquatic SAR have been recorded or are known from the study area • No alignment will directly or indirectly impact aquatic SAR or habitat, with proper implementation of recommended mitigation and protection measures. • No ESA permits will be required for aquatic SAR • No SARA permits will be required for aquatic SAR
Species at Risk permits required for construction	Permit requirement (yes, no); probability of obtaining permit(s) (high, medium, low); degree of associated risk to project implementation	10	10	10	10	10	No permits anticipated for development
	SCORE	9	10	8	9	8	
1. NATURAL ENVIRONMENT	**TOTAL SCORE**	36.0	39.9	36.6	37.1	37.5	
	Rank	5	1	4	3	2	
	NORMALIZED	7.2	8.0	7.3	7.4	7.5	
	Rank	5	1	4	3	2	

Westhill District SWM – Evaluation of Alternatives Table
Scoring Approach: 1 (least preferred) to 10 (most preferred)

		SWM Alternatives					
Factor Category Factor Group Factor	**Indicator / Measure**	**SWM - 1**	**SWM - 2**	**SWM - 3**	**SWM - 4**	**SWM - 5**	**Comments**
2. SOCIO-ECONOMIC ENVIRONMENT							
2.A Land Use Policy							
Land use/resource designations and policies	Degree of compatibility with Provincial, Regional and City growth/development goals/objectives policies (high, medium, low)	1	3	5	9	10	Option 1 large ponding area reduces the allowance for development Option 2 too many swm facilities, not efficient use of land Option 3 does not maintain required 1/3 ROW width across the Hydro easement, may be difficult to implement Option 4 best implements development land and SWM area, creates the most developable land while maintaining Hydro access Option 5 best use of area, hydro land not altered
	SCORE	1	3	5	9	10	
2.B Existing and Approved Land Use							
Existing or proposed business operations	Business infrastructure/employees displaced (type; number) Changes (+/-) in business exposure/viability	1	2	4	9	10	Option 1 loss of development lands due to increased ponding area Option 2 SWM facility for the Regions landfill swm pond is maintained, loss of development lands due to large ponding area Option 3 requires coordination between property owners and developers for SWM pond ownership and maintenance Option 4 adds land use where current regional forebay is, creates jobs and business viability Option 5 increases business development opportunities
Approved or proposed development proposals	Impacts on approved development lands (area; exposure/viability)	1	2	5	9	10	Option 1 greatly reduces approved development land area Option 2 reduces approved development land area Option 3 needs greater area approval from Hydro Option 4 fits best with development proposals, increases availability of development lands
Planned Land Uses	Impacts on planned land uses	1	2	5	10	8	Option 1 greatly reduces planned land use area Option 2 reduces planned land use area Option 3 follows land use plan Option 4 enhances land use area
	SCORE	1	2	5	9	9	
2.C Communities							
Impacts to individual properties/communities	Encroachment on individual properties (number/area)	10	8	1	5	9	Option 1 does not impact or encroach on surrounding properties Option 2 does not encroach on surrounding properties, may effect landfill SWM pond outflow path Option 3 encroaches on Hydro ROW and does not provide required 1/3 width access Option 4 encroaches on Hydro ROW, however maintains 1/3 width access Option 5 does not encroach on surrounding properties
Community connectivity (cultural/social linkages)	Physical changes (+/-) to established community connectors (trails/roads) Changes to delivery of community services (emergency; school transportation)	1	3	5	10	6	Option 1 does not provide any opportunity for new community connectors Option 2 does not provide any opportunity for new community connectors Option 3 provides some opportunity for new community trails, however lack of Hydro ROW may limit this Option 4 provides the most opportunity for new community trails surrounding SWM facilities Option 5 provides some opportunity for new community connections
Business & Employment opportunities	Changes (+/-) in access to business & employment areas	1	2	5	9	10	Option 1 results in the greatest loss of business areas Option 2 results in the loss of business areas Option 3 has no adverse effect on access to business areas Option 4 increases the possibility for access to business areas Option 5 increases business areas
	SCORE	4	4	4	8	8	

Westhill District SWM – Evaluation of Alternatives Table
Scoring Approach: 1 (least preferred) to 10 (most preferred)

		SWM Alternatives					
Factor Category Factor Group Factor	**Indicator / Measure**	**SWM - 1**	**SWM - 2**	**SWM - 3**	**SWM - 4**	**SWM - 5**	**Comments**
2.D Noise							
Noise sensitive areas	Noise sensitive receptors experiencing increases (5 dB ranges) in sound levels over pre-existing conditions Noise sensitive receptors experiencing resultant absolute noise levels over 60 bDA	10	10	10	10	10	No noise sensitive receptors within the subject lands
	SCORE	10	10	10	10	10	
2.E Response Time for Emergency Services							
Community connectivity	Changes to delivery to emergency services	10	10	10	10	10	SWM options do not effect the function or layout of the roadway network
2. SOCIO-ECONOMIC	**TOTAL SCORE**	26.0	29.3	33.3	46.3	47.7	
	Rank	5	4	3	2	1	
	NORMALIZED	5.2	5.9	6.7	9.3	9.5	
	Rank	5	4	3	2	1	
3. CULTURAL ENVIRONMENT							
3.A Archaeological Resources							
Known and/or potential archaeological sites	Number/type/significance of direct/indirect impacts to registered archaeological sites - Number/type/significance of direct/indirect impacts to known archaeological resources and/or areas of high archaeological potential	10	8	3	1	5	Option 1 no disturbance to areas of archaeological potential Option 2 minimal disturbance to areas of archaeological potential Option 3 regrading for SWM facilities could effect areas of archaeological potential Option 4 regrading and excavation for SWM facilities may effect areas of archaeological potential Option 5 some regrading for SWM facilities
3.B Built Heritage							
Built Heritage Features	Number/type/significance of direct/indirect impacts to built heritage resources	10	10	10	10	10	No heritage features within subject lands
3.C Cultural Heritage Landscapes							
Cultural Heritage Landscapes	Number/type/significance of direct/indirect impacts to cultural heritage landscapes	10	10	10	10	10	No cultural heritage landscapes within subject lands
3. CULTURAL ENVIRONMENT	**TOTAL SCORE**	30.0	28.0	23.0	21.0	25.0	
	Rank	1	2	4	5	3	
	NORMALIZED	10.0	9.3	7.7	7.0	8.3	
	Rank	1	2	4	5	3	

Westhill District SWM – Evaluation of Alternatives Table
Scoring Approach: 1 (least preferred) to 10 (most preferred)

		SWM Alternatives					
Factor Category Factor Group Factor	**Indicator / Measure**	**SWM - 1**	**SWM - 2**	**SWM - 3**	**SWM - 4**	**SWM - 5**	**Comments**
4. TRANSPORTATION / MUNICIPAL SERVICES AND UTILITIES							
4.A Transportation Network/Infrastructure							
Transportation network	Relieve future demand on other arterial / collector roads within the community Potential impacts to local roads/intersections	10	10	10	10	10	SWM alternatives do not effect road network layouts
Traffic operations	Road safety and accessibility (sight distance; turning movements)	10	10	10	10	10	SWM alternatives do not effect traffic operations
Transportation policy initiatives Capacity/capability to accommodate forecast traffic demand. Provides for appropriate access to existing properties	Capability to support municipal policy initiatives (transit, active transportation, roundabouts) Impact on access to existing properties Connectivity to Ira Needles Boulevard and Erb Street	1	3	5	10	4	Option 1 large ponding area makes implementation of trail system difficult to promote active transportation Option 2 large ponding area makes implementation of trail system difficult to promote active transportation Option 3 does not provide appropriate access for Hydro Easement Option 4 provides opportunity to construct multi use trail system for active transportation potential, also maintains access for Hydro easement Option 5 large detention area makes trail systems difficult
	SCORE	7	8	8	10	8	
4.B Municipal Services and Utilities							
Municipal services	Opportunities for connections to or logical extension of existing services - Provision of standard cross-section locations for services - Provision of continuous services	1	4	5	9	10	Option 1 has no road conveyance network Option 2 more upstream private ponds requires a larger treated sewer network Option 3 requires a large amount of infrastructure for conveyance between developments and existing landfill/regional ponds Option 4 minimizes required infrastructure while providing adequate servicing for both the private development and the city/region Option 5 less infrastructure, ability to convey flows with adequate allocation
SWM Facilities	Ability to coordinate with road construction - Flexibility to implement SWM	1	2	5	9	10	Option 1 is a purely quantity based approach, no flexibility in implementing quality measures Option 2 requires each property owner to operate and maintain their own SWM facility, larger cost for individuals and greater monitoring of SWMP function required Option 3 needs coordination with City, Region and Hydro to implement SWM strategy Option 4 eliminates difficult ownership system and replaces with centralized city and private owned ponds, greater ability to implement SWM strategy from each adequately designed facility Option 5 centralized city owned facilities, no coordination with hydro
Utilities	-Degree of exposure of utilities and/or utility conflicts with SWM design	10	8	1	3	6	Option 1 no excavation required and therefore no concern with conflicts due to SWM design Option 2 minimal excavation required through area of utility conflict Option 3 excavation required through buried gas line area and underneath hydro wires and around hydro towers Option 4 requires excavation within Hydro easement under hydro wires and around towers Option 5 some excavation required, utility conflicts not expected to be an issue
	SCORE	4	5	4	7	9	
4. TRANSPORTATION/	**TOTAL SCORE**	11.0	12.3	12.0	17.0	16.7	
	Rank	5	3	4	1	2	
	NORMALIZED	5.5	6.2	6.0	8.5	8.3	
MUNICIPAL SERVICES AND UTILITIES	**Rank**	5	3	4	1	2	

Westhill District SWM – Evaluation of Alternatives Table
Scoring Approach: 1 (least preferred) to 10 (most preferred)

Factor Category / Factor Group / Factor	Indicator / Measure	SWM Alternatives SWM - 1	SWM - 2	SWM - 3	SWM - 4	SWM - 5	Comments
5. FINANCIAL / TECHNICAL							
5.A Financial							
Cost	Estimated capital cost ($) - Road length - Property requirements (number, area) and ease of acquisition - Extraordinary operations and maintenance requirements/costs (e.g., differences in the number of valves and water treatment requirements; collector road maintenance) - Species at Risk mitigation/overall benefit - Cultural heritage mitigation measures	1	3	8	9	10	Option 1 greatest area of land to be acquired Option 2 requires land to be acquired, multiple private facilities needed Option 3 SWM facilities are streamlined to a developer level Option 4 SWM facilities are centralized and construction costs from amount of infrastructure needed are minimized Option 5 centralized facility, no land to be acquired
	SCORE	1	3	8	9	10	
5.B Technical							
• SWM function design requirements	-Conformance to City of Waterloo/RMOW standards	1	3	7	9	10	Option 1 does not provide adequate design according to City/Region standards Option 2 will likely not conform to downstream quality control standards as per the City/Region guidelines Option 3 will conform to regional/city guidelines Option 4 will likely perform to an enhanced function of SWM design requirements Option 5 likely to surpass SWM requirements
~~Structural/foundation/pavement design requirements~~	Conformance to TAC and City of Waterloo standards - Requirements for pavement depth and/or foundation footprint, based on soil conditions - Structural requirements relative to capital cost and long term maintenance requirements						N/A
Topographic; extent of cut/fill	Potential for excessive borrow quantity or excessive off-site disposal of earth material (volume) - Requirements for excessive (steep) grades (length) - Ability to maintain positive drainage, in combination with number of suitable drainage outlets	10	4	2	1	6	Option 1 no cut/fill needed Option 2 lots of small private ponds, some volume of cut/fill will be required Option 3 requires extensive grading of private and city owned lands to ensure proper design of SWM facilities and drainage paths Option 4 will require the most grading and cut/fill to ensure overland flow routes drain correctly to the properly graded SWM facilities Option 5 moderate amount of cut/fill for Pond 1/2
Constructability		1	3	5	9	10	Option 1 requirement for land acquisition limits constructability Option 2 requirement for land acquisition limits constructability Option 3 large infrastructure requirements makes construction complex Option 4 straightforward design and standardized SWM strategy creates favourable construction conditions for contractors that are familiar with similar designs Option 5 relatively simple design
Legal Permissibility/Ability to Implement		1	2	5	9	10	Option 1 can't implement without acquiring land Option 2 can't implement without acquiring land Option 3 can't implement without permissions from Hydro Option 4 likely to g6et approvals and permission to implement from Hydro and regulating authorities Option 5 most likely to get approved
	SCORE	3	3	5	7	9	
5. FINANCIAL / TECHNICAL	**TOTAL SCORE**	4.3	6.0	12.8	16.0	19.0	
	Rank	5	4	3	2	1	
	NORMALIZED	2.13	3.00	6.38	8.00	9.50	
	Rank	5	4	3	2	1	
	GRAND TOTAL	**107.3**	**115.6**	**117.7**	**137.4**	**145.8**	
	RANK	**5**	**4**	**3**	**2**	**1**	
	NORMALIZED	**30.0**	**32.4**	**34.0**	**40.2**	**43.2**	
	RANK	**5**	**4**	**3**	**2**	**1**	

Technical Memorandum

Project Name: Westhill District Plan

MTE File No.: C34280-101

To: The Westhill Landowners Group

Date: April 13, 2020

cc:

From: Jeff Martens

RE: WESTHILL DISTRICT SWM – EVALUATION OF ALTERNATIVES

5.0 Financial / Technical

5.A Financial

5.A.1 Cost

Indicator / Measure
Estimated capital cost ($)
Property requirements (number, area) and ease of acquisition
Extraordinary operations and maintenance requirements/costs (e.g., differences in the number of valves and water treatment requirements; collector road maintenance)
Species at Risk mitigation/overall benefit
Cultural heritage mitigation measures

Alternative SWM-5 received a score of 10. The Stormwater Management Facilities (SWMFs) are centralized, no land to be acquired from Hydro. Supported by developers with a willingness to convey lands for SWMFs. Less infrastructure than SWM-4. No proposed SWMF within the hydro lands. Preliminary Cost Estimate – $1.5M

Alternative SWM-4 received a score of 9. The SWMFs are centralized and construction costs from amount of infrastructure needed are minimized. Preliminary Cost Estimate – $3.5M

Alternative SWM-3 received a score of 8. The SWMFs are streamlined to a developer level, however there is still extensive infrastructure needed (more than SWM - 4 or 5). Preliminary Cost Estimate – $4.0M

Alternative SWM-2 received a score of 3. It requires some land to be acquired, multiple (7) private facilities needed, 2 existing municipal facilities and 1 new. Preliminary Cost Estimate – $4.5M. Sterilizes a significant amount of potential development land.

Alternative SWM-1 received a score of 1. It has the greatest area of land to be sterilized by detention storage. It may have the lowest capital construction cost. SWM-1 has the largest overall cost due to the loss of development potential for commercial lands.

5.B Technical

5.B.1 SWM Function Design Requirements

Indicator / Measure
Conformance to City of Waterloo/RMOW standards.

Alternative SWM-5 received a score of 10. Enhanced treatment function of SWM design requirements while consolidating pond ownership for ease of maintenance. Current treatment and contaminant management for landfill site is maintained.

Alternative SWM-4 received a score of 9. Enhanced treatment function of SWM design. Required to replicate SWM measures for landfill site in SWM design.

Alternative SWM-3 received a scored of 7. It will conform to Regional/City standards. Too many SWMFs under municipal ownership.

Alternative SWM-2 received a score of 3. It will conform to downstream quality control standards as per the City/Region guidelines and relies heavily on SWM measures to be maintained on private property.

Alternative SWM-1 received a score of 1. It does not provide adequate SWM design according to City/Region standards. No quality control measures being implemented.

5.B.2 Topographic Extent of Cut/Fill

Indicator / Measure
Potential for excessive borrow quantity or excessive off-site disposal of earth material (volume).
Requirements for excessive (steep) grades (length).
Ability to maintain positive drainage, in combination with number of suitable drainage outlets.

Alternative SWM-1 received a score of 10. There is no cut/fill needed, existing condition

Alternative SWM-5 received a score of 6. There will be a moderate amount of cut/fill for SWMF1 and SWMF2, however no earthworks are required within the hydro corridor.

Alternative SWM-2 received a score of 4. There are lots of small private ponds, significant volume of cut/fill will be required as a result of multitude of facilities of small scale.

Alternative SWM-3 received a score of 2. It requires extensive grading of private, hydro and city owned facilities to ensure proper design of SWMFs and drainage paths.

Alternative SWM-4 received a score of 1. It will require the most grading (specifically HEPC lands) and cut/fill to ensure overland flow routes drain correctly to the properly graded SWMFs.

5.B.3 Constructability

Indicator / Measure

Alternative SWM-5 received a score of 10. Due to the relatively simple design, only 2 formal SWMFs which will require minimal amounts of earthworks to complete, less infrastructure than SWM-4.

Alternative SWM-4 received a score of 9. The straightforward design and standardized SWM strategy creates favourable construction conditions for contractors that are familiar with similar designs.

Alternative SWM-3 received a score of 5. Large infrastructure requirements (additional dedicated storm sewer) will make constructability more complex; however, it can be constructed more easily than SWM - 1 or 2.

Alternative SWM-2 received a score of 3. Large infrastructure requirements (additional dedicated storm sewer) will make constructability more complex. All private SWMFs will be completed through a Site development application. SWMFs constructed under private developments may lack adequate quality control for construction.

Alternative SWM-1 received a score of 1. The construction of a system that meets the requirements for development of the Westhill District is not possible with this option.

5.B.4 Legal Permissibility/Ability to Implement

Indicator / Measure

Alternative SWM-5 received a score of 10. It is most likely to get approved, does not need formal approval from Hydro since it maintains current conditions on the Hydro Lands.

Alternative SWM-4 received a score of 9. It is likely to get approvals and permission to implement from Hydro and regulating authorities. This alternative provides Hydro with their required access of 1/3 of the Hydro right of way.

Alternative SWM-3 received a score of 5. Not likely to receive Hydro approval because of access requirements.

Alternative SWM-2 received a score of 2. Difficult to implement for the multitudes of private SWMFs and not supported by the City of Waterloo.

Alternative SWM-1 received a score of 1. It can't be implemented to meet the SWM treatment requirements for development.

Technical Memorandum

Project Name: Westhill District Plan **MTE File No.:** C34280-101

To: The Westhill Landowners Group **Date:** April 13, 2020

cc: **From:** Jeff Martens

RE: WESTHILL DISTRICT SWM – EVALUATION OF ALTERNATIVES

4.0 Transportation Network / Municipal Services and Utilities

4.A Transportation Network/Infrastructure

4.A.3 Transportation Policy Initiatives

Indicator / Measure
Capacity/capability to accommodate forecast traffic demand.
Provides for appropriate access to existing properties.
Capability to support municipal policy initiatives (transit, active transportation, roundabouts)
Impact on access to existing properties.
Connectivity to Ira Needles Boulevard and Erb Street.

Commentary
No Stormwater Management (SWM) alternative relates to capacity/capability to accommodate forecast traffic demand.
All SWM alternatives were reviewed assuming Road N1 and S3 as the preliminary preferred road alternatives.
All SWM alternatives provide connectivity to Ira Needles Boulevard and Erb Street

Alternatives were primarily assessed based on:
Capability to support municipal policy initiatives active transportation, specifically trails.
Provides for appropriate access to existing properties.
Impact on access to existing properties.

Alternative SWM-4 received a score of 10. It provides opportunity to construct multi use trail system for active transportation potential, also maintains access for Hydro easement. Creating a Stormwater Management Facility (SWMF) within the Hydro corridor would present an opportunity to incorporate a trail along the perimeter of the SWMF. Provides for appropriate access or enhanced to existing properties.

Alternative SWM-3 received a score of 5. Provides limited appropriate access for Hydro Easement, although the rest of the subject lands would be adequately designed from a SWM perspective to accommodate active transportation through the site. Provides for appropriate access or enhanced to existing properties.

Alternative SWM-5 received a score of 4. Although the Hydro access it maintained, the trail systems would not exist because no formal easement or land acquisition will be acquired from Hydro. A small trail connection could be incorporated into the SWMF east of road alternative N1. Provides for appropriate access or enhanced to existing properties.

Alternative SWM-2 received a score of 3. Similar to SWM-5 a small trail connection could be incorporated into the SWMF west of road alternative N1.

Alternative SWM-1 received a score of 1. The large ponding area and no proposed SWMFs limits opportunities to implement a quality trail system to promote active transportation.

4.B Municipal Services and Utilities

4.B.1 Municipal Services

Indicator / Measure
Opportunities for connections to or logical extension of existing services.
Provision of standard cross-section locations for services.
Provision of continuous services.

Alternative SWM-5 received a score of 10. It has simple SWM control structures, while still having the ability to manage and convey flows with adequate flow detention. Aligns with servicing strategy for sanitary and storm outlets.

Alternative SWM-4 received a score of 9. The removal of the regional landfill pond replaced with the proposed SWMF on the hydro corridor requires additional SWM control structures (forebay, inlet and outlet structures). The Hydro corridor has formal pond which increases amount of infrastructure compared to SWM-5.

Alternative SWM-3 received a score of 5. It requires a large amount of SWM control structures with the associated six SWMFs. Additional clean water storm system is required for the SWMF located on the Cressman lands to the Erb Street outlet.

Alternative SWM-2 received a score of 4. Additional clean water storm system is required for the six upstream private SWMFs to the Erb Street outlet.

Alternative SWM-1 received a score of 1. It has no road conveyance network which would cause flooding during rain events.

4.B.2 SWM Facilities

Indicator / Measure
Ability to coordinate with road construction.
Flexibility to implement SWM (assuming N1 and S3).

Alternative SWM-5 received a score of 10. Eliminates difficult ownership issues and replaces with centralized city and private owned ponds. Includes all the SWM quality and quantity controls as SWM - 4 along with centralized city owned facilities and no land or easement required from hydro.

Alternative SWM-4 received a score of 9. Requires land from Hydro and removal of the Region of Waterloo landfill SWMF.

Alternative SWM-3 received a score of 5. Requires land from Hydro, however does not provide access for hydro (1/3 hydro easement). Additional infrastructure (clean water storm sewer) to be incorporated in typical road cross sections.

Alternative SWM-2 received a score of 2. Additional infrastructure (clean water storm sewer) to be incorporated in typical road cross sections. Private SWMFs not fully functioning until all development is complete.

Alternative SWM-1 received a score of 1. SWM-1 is not flexible because it doesn't meet the SWM standards.

4.B.3 Utilities

Indicator / Measure
Degree of exposure of utilities and/or utility conflicts with SWM design.

Alternative SWM-1 received a score of 10. There is no excavation required and therefore no concern with conflicts due to SWM design, existing conditions.

Alternative SWM-2 received a score of 8. There is minimal excavation required through area of utility conflict (Waterloo commons, Hydro corridor).

Alternative SWM-5 received a score of 6. There is some excavation required within the Erb Street Pond area, utility conflicts not expected to be an issue within the Hydro corridor as there is no active earthworks.

Alternative SWM-4 received a score of 3. It requires excavation within Hydro easement under hydro wires and around towers, although it is not anticipated that the gas line will be an issue.

Alternative SWM-3 received a score of 1. SWM-3 does not provide sufficient access through the HEPC right-of-way (1/3 hydro easement width). There is excavation required through buried gas line area and underneath hydro wires and around hydro towers which may require additional permits and fees.

Technical Memorandum

Project Name: Westhill District Plan **MTE File No.:** C34280-101

To: The Westhill Landowners Group **Date:** April 13, 2020

cc: **From:** Jeff Martens

RE: WESTHILL DISTRICT SWM – EVALUATION OF ALTERNATIVES

1.0 Natural Environment

1.B Aquatic Ecosystems

1.B.2 Waterbodies and Watercourses (providing fish habitat, including food/shelter)

Indicator/Measure
Extent (area) and function of riparian habitat removed.
Potential impact to aquatic Species of Conservation Concern (SCC).
Extent and type of fish habitat (in-stream) altered/displaced at water bodies and watercourse, including importance to aquatic ecosystem (e.g. spawning, nursery areas).

Context provided by WSP
Under current conditions, there are several dug ponds, two Stormwater Management Facilities (SWMFs) and several drainage features (i.e., swales, diffuse flow areas). Some of these features provide direct or indirect warmwater fish habitat, but none is sensitive, none has riparian habitat and all are disconnected from downstream fisheries.

No alternative will directly or indirectly impact aquatic SCC, including Species at Risk (SAR).
No alternative will negatively impact fish habitat subject to the Fisheries Act (i.e., habitat that is downstream of the study area [Clair Creek and Clair Lake] and isolated by a 750m+ long enclosed section of watercourse).

This tech memo to be read in conjunction with WSP memos and reports.

Alternative SWM-3 received a score of 10. Direct impact to a reach of Drainage Feature 1 and Unit 9 pond (removal), with installation of 4 new municipally owned SWMFs providing an enhanced level of treatment. Net improvement to downstream / offsite water quality with improved SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (most effective, greater than Alternatives 1, 2 and 5).

Alternative SWM-4 received a score of 9. Direct impact to reaches of Drainage Features 1 / 2 / 4, Unit 9 pond and Regional SWM Ponds 4 / 5 (removal), with installation of 3 new municipally owned SWMFs. Net improvement to downstream / offsite water quality with improved SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (most effective, greater than Alternatives 2 and 5). The Regional Landfill SWMF is being removed and any contamination from the landfill is not isolated or managed independently.

Alternative SWM–2 received a score of 5. Direct impact to a reach of Drainage Feature 1 and Unit 9 pond (removal), with installation of 7 private, 1 City owned new SWMF and the retention of 2 Regional SWMFs. Net improvement to downstream / offsite water quality with improved SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (relatively less effective than Alternatives 3 and 4). The long term maintenance of private facilities may be of concern with respect to downstream fish habitat.

Alternative SWM–5 received a score of 4. Direct impact to a reach of Drainage Feature 2, Unit 9 pond and Regional SWMF forebay (removal), with installation of a new SWMF. Net improvement to downstream / offsite water quality with improved SWM treatment of runoff from development lands (including internal roadways, Ira Needles Boulevard and Westhill Drive development) within the Westhill District Plan.

Alternative SWM–1 received a score of 1. No direct impact to ponds or drainage features. Greatest indirect impact to downstream aquatic habitat due to increased development runoff and lack of upstream quality and quantity controls.

1.B.3 Water Quality, Thermal Regime and Baseflow

Indicator/Measure
Encroachment on headwater areas (1st or 2nd Order Streams) (area).
Degree of interference with known groundwater discharge areas that contribute to creek baseflow.
Effects on surface drainage/floodplain contributions to fish habitat subject to the Fisheries Act (i.e., downstream of the study area).

Comments
No alternative will encroach on headwater areas.
No alternative will interfere with known groundwater discharge areas that contribute to creek baseflow. though alternatives differ in potential warming of downstream aquatic habitat.
No alternatives will impact surface drainage contributions to fish habitat subject to the Fisheries Act (i.e., downstream of the study area [Clair Creek and Clair Lake] and isolated by a 750m+ long enclosed section of watercourse).

Alternative SWM–3 received a score of 10. Net improvement to downstream / offsite water quality with improved SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (most effective, greater than Alternatives 1, 2 and 5).

Alternative SWM–4 received a score of 9. Net improvement to downstream / offsite water quality with improved SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (most effective, greater than Alternatives 1, 2 and 5).

Alternative SWM–2 received a score of 5. Net improvement to downstream / offsite water quality with improved SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition.

Alternative SWM–5 received a score of 4. Net improvement to downstream / offsite water quality with improved SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition.

Alternative SWM–1 received a score of 1. Greatest indirect impact to downstream aquatic habitat due to increased development runoff and lack of upstream quality and quantity controls.

1.D Surface Drainage

1.D.1 Watercourses, Drainage Catchments

Indicator/Measure
Need for diversion/channelization of existing drainage and catchment area impacts (area).

None of the alternatives directly impacts defined regulated watercourses. The only quasi watercourse (Drainage feature 1) exists between the regional landfill SWMF and the Erb Street pond.

Alternative SWM-1 received a score of 10. There will be no alteration to existing drainage system.

Alternative SWM-2 received a score of 8. There will be minor alteration to existing drainage, routing of Drainage feature 1 from the landfill pond needs to be routed around the City SWMF.

Alternative SWM-5 received a score of 7. This alternative is similar to SWM-2, and requires more construction of municipal facilities east of N1road alternative (preliminary preferred road). SWM–5 proposes the removal of the Ira Needles Boulevard regional forebay, altering the drainage catchments.

Alternative SWM-4 received a score of 6. This alternative removes landfill and regional ponds entirely, may require coordination with Region for new drainage strategy, more physical changes than Alternatives 2 or 5. SWM-4 requires the removal of drainage feature 1.

Alternative SWM-3 received a score of 1. This alternative impacts the existing site drainage features. The Westhill and Ira Needles catchment is routed through the regional forebay without flows being directed to a City owned facility having a unique catchment. The double routing of flows from the regional forebay is complex and as a result the alternative scored a 1.

1.D.3 Stormwater Management

Indicator / Measure
Opportunities to enhance roadway stormwater management measures, including coordination with/use of adjacent development facilities.

All options except Alternative 1 will provide an enhancement to existing roadway SWM measures, with implementation of various SWM strategies, with resulting improvements to existing natural feature receiving areas (i.e., W1 and downstream / offsite aquatic habitat).

Alternative SWM-5 received a score of 10. It has the greatest enhancement to roadway SWM measures. Provides quality and quantity control for entire developable portion of the subject lands and Ira Needles Boulevard and Westhill Drive development areas. Quantity control for the landfill, hydro lands. Designed to improve quality of effluent downstream and maintains flow allocations to avoid erosion and sediment control issues in the receiving watercourse. Larger storm retention is contained within the hydro corridor, and two City owned facilities. This option retains the Region of Waterloo landfill SWMF and is preferred by Waste Management staff at the Region of Waterloo.

SWM-5 has the ability to adequately control and manage up to the regional storm event, utilizes quality controls management system which minimizes sediment loading to receiving watercourses.

Alternative SWM-4 received a score of 9. SWM-4 creates the engineered SWMF on the Hydro lands providing quantity and quality control in a constructed wetland receiving drainage directly from the landfill Hydro lands. Does not give protection against landfill contaminants, may result in contaminants entering receiving watercourse which is why it is not scored as the 10. The proposed SWMF on the Hydro lands is not supported by the City of Waterloo, Region of Waterloo and Hydro.

Alternative SWM-3 received a score of 8. Similarly, to SWM-4 the construction of the proposed SWMF on the Hydro lands is not supported. Four City SWMFs and two Regional SWMFs are deemed to be too many municipally owned facilities be constructed and maintained for the Westhill District area.

Alternative SWM-2 received a score of 2. Water quality and quantity controls for the development lands will be provided by the private SWMFs (potentially a higher risk than a municipal facility).

Alternative SWM-1 received a score of 1. There will be no enhancement to roadway SWM measures, with resulting impact to receiving natural areas.

SWM-1 has greatest ponding area, plus no quality controls resulting in poor downstream water quality.

Technical Memorandum

Project Name: Westhill District Plan **MTE File No.:** C34280-101

To: The Westhill Landowners Group **Date:** April 13, 2020

cc: **From:** Jeff Martens

RE: WESTHILL DISTRICT SWM – EVALUATION OF ALTERNATIVES

1.0 Natural Environment

1.B Aquatic Ecosystems

1.B.2 Waterbodies and Watercourses (providing fish habitat, including food/shelter)

Indicator/Measure
Extent (area) and function of riparian habitat removed.
Potential impact to aquatic Species of Conservation Concern (SCC).
Extent and type of fish habitat (in-stream) altered/displaced at water bodies and watercourse, including importance to aquatic ecosystem (e.g. spawning, nursery areas).

Context provided by WSP
Under current conditions, there are several dug ponds, two Stormwater Management Facilities (SWMFs) and several drainage features (i.e., swales, diffuse flow areas). Some of these features provide direct or indirect warmwater fish habitat, but none is sensitive, none has riparian habitat and all are disconnected from downstream fisheries.

No alternative will directly or indirectly impact aquatic SCC, including Species at Risk (SAR).
No alternative will negatively impact fish habitat subject to the Fisheries Act (i.e., habitat that is downstream of the study area [Clair Creek and Clair Lake] and isolated by a 750m+ long enclosed section of watercourse).

This tech memo to be read in conjunction with WSP memos and reports.

Alternative SWM-3 received a score of 10. Direct impact to a reach of Drainage Feature 1 and Unit 9 pond (removal), with installation of 4 new municipally owned SWMFs providing an enhanced level of treatment. Net improvement to downstream / offsite water quality with improved SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (most effective, greater than Alternatives 1, 2 and 5).

Alternative SWM-4 received a score of 9. Direct impact to reaches of Drainage Features 1 / 2 / 4, Unit 9 pond and Regional SWM Ponds 4 / 5 (removal), with installation of 3 new municipally owned SWMFs. Net improvement to downstream / offsite water quality with improved SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (most effective, greater than Alternatives 2 and 5). The Regional Landfill SWMF is being removed and any contamination from the landfill is not isolated or managed independently.

Alternative SWM–2 received a score of 5. Direct impact to a reach of Drainage Feature 1 and Unit 9 pond (removal), with installation of 7 private, 1 City owned new SWMF and the retention of 2 Regional SWMFs. Net improvement to downstream / offsite water quality with improved SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (relatively less effective than Alternatives 3 and 4). The long term maintenance of private facilities may be of concern with respect to downstream fish habitat.

Alternative SWM–5 received a score of 4. Direct impact to a reach of Drainage Feature 2, Unit 9 pond and Regional SWMF forebay (removal), with installation of a new SWMF. Net improvement to downstream / offsite water quality with improved SWM treatment of runoff from development lands (including internal roadways, Ira Needles Boulevard and Westhill Drive development) within the Westhill District Plan.

Alternative SWM–1 received a score of 1. No direct impact to ponds or drainage features. Greatest indirect impact to downstream aquatic habitat due to increased development runoff and lack of upstream quality and quantity controls.

1.B.3 Water Quality, Thermal Regime and Baseflow

Indicator/Measure
Encroachment on headwater areas (1st or 2nd Order Streams) (area).
Degree of interference with known groundwater discharge areas that contribute to creek baseflow.
Effects on surface drainage/floodplain contributions to fish habitat subject to the Fisheries Act (i.e., downstream of the study area).

Comments
No alternative will encroach on headwater areas.
No alternative will interfere with known groundwater discharge areas that contribute to creek baseflow. though alternatives differ in potential warming of downstream aquatic habitat.
No alternatives will impact surface drainage contributions to fish habitat subject to the Fisheries Act (i.e., downstream of the study area [Clair Creek and Clair Lake] and isolated by a 750m+ long enclosed section of watercourse).

Alternative SWM–3 received a score of 10. Net improvement to downstream / offsite water quality with improved SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (most effective, greater than Alternatives 1, 2 and 5).

Alternative SWM–4 received a score of 9. Net improvement to downstream / offsite water quality with improved SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition (most effective, greater than Alternatives 1, 2 and 5).

Alternative SWM–2 received a score of 5. Net improvement to downstream / offsite water quality with improved SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition.

Alternative SWM–5 received a score of 4. Net improvement to downstream / offsite water quality with improved SWM treatment of runoff from HEPC/landfill lands to the west relative to the existing condition.

Alternative SWM–1 received a score of 1. Greatest indirect impact to downstream aquatic habitat due to increased development runoff and lack of upstream quality and quantity controls.

1.D Surface Drainage

1.D.1 Watercourses, Drainage Catchments

Indicator/Measure
Need for diversion/channelization of existing drainage and catchment area impacts (area).

None of the alternatives directly impacts defined regulated watercourses. The only quasi watercourse (Drainage feature 1) exists between the regional landfill SWMF and the Erb Street pond.

Alternative SWM-1 received a score of 10. There will be no alteration to existing drainage system.

Alternative SWM-2 received a score of 8. There will be minor alteration to existing drainage, routing of Drainage feature 1 from the landfill pond needs to be routed around the City SWMF.

Alternative SWM-5 received a score of 7. This alternative is similar to SWM-2, and requires more construction of municipal facilities east of N1road alternative (preliminary preferred road). SWM–5 proposes the removal of the Ira Needles Boulevard regional forebay, altering the drainage catchments.

Alternative SWM-4 received a score of 6. This alternative removes landfill and regional ponds entirely, may require coordination with Region for new drainage strategy, more physical changes than Alternatives 2 or 5. SWM-4 requires the removal of drainage feature 1.

Alternative SWM-3 received a score of 1. This alternative impacts the existing site drainage features. The Westhill and Ira Needles catchment is routed through the regional forebay without flows being directed to a City owned facility having a unique catchment. The double routing of flows from the regional forebay is complex and as a result the alternative scored a 1.

1.D.3 Stormwater Management

Indicator / Measure
Opportunities to enhance roadway stormwater management measures, including coordination with/use of adjacent development facilities.

All options except Alternative 1 will provide an enhancement to existing roadway SWM measures, with implementation of various SWM strategies, with resulting improvements to existing natural feature receiving areas (i.e., W1 and downstream / offsite aquatic habitat).

Alternative SWM-5 received a score of 10. It has the greatest enhancement to roadway SWM measures. Provides quality and quantity control for entire developable portion of the subject lands and Ira Needles Boulevard and Westhill Drive development areas. Quantity control for the landfill, hydro lands. Designed to improve quality of effluent downstream and maintains flow allocations to avoid erosion and sediment control issues in the receiving watercourse. Larger storm retention is contained within the hydro corridor, and two City owned facilities. This option retains the Region of Waterloo landfill SWMF and is preferred by Waste Management staff at the Region of Waterloo.

SWM-5 has the ability to adequately control and manage up to the regional storm event, utilizes quality controls management system which minimizes sediment loading to receiving watercourses.

Alternative SWM-4 received a score of 9. SWM-4 creates the engineered SWMF on the Hydro lands providing quantity and quality control in a constructed wetland receiving drainage directly from the landfill Hydro lands. Does not give protection against landfill contaminants, may result in contaminants entering receiving watercourse which is why it is not scored as the 10. The proposed SWMF on the Hydro lands is not supported by the City of Waterloo, Region of Waterloo and Hydro.

Alternative SWM-3 received a score of 8. Similarly, to SWM-4 the construction of the proposed SWMF on the Hydro lands is not supported. Four City SWMFs and two Regional SWMFs are deemed to be too many municipally owned facilities be constructed and maintained for the Westhill District area.

Alternative SWM-2 received a score of 2. Water quality and quantity controls for the development lands will be provided by the private SWMFs (potentially a higher risk than a municipal facility).

Alternative SWM-1 received a score of 1. There will be no enhancement to roadway SWM measures, with resulting impact to receiving natural areas.

SWM-1 has greatest ponding area, plus no quality controls resulting in poor downstream water quality.

Technical Memorandum

Project Name: Westhill District Plan

MTE File No.: C34280-101

To: The Westhill Landowners Group

Date: April 13, 2020

cc:

From: Jeff Martens

RE: WESTHILL DISTRICT SWM – EVALUATION OF ALTERNATIVES

5.0 Financial / Technical

5.A Financial

5.A.1 Cost

Indicator / Measure
Estimated capital cost ($)
Property requirements (number, area) and ease of acquisition
Extraordinary operations and maintenance requirements/costs (e.g., differences in the number of valves and water treatment requirements; collector road maintenance)
Species at Risk mitigation/overall benefit
Cultural heritage mitigation measures

Alternative SWM-5 received a score of 10. The Stormwater Management Facilities (SWMFs) are centralized, no land to be acquired from Hydro. Supported by developers with a willingness to convey lands for SWMFs. Less infrastructure than SWM-4. No proposed SWMF within the hydro lands. Preliminary Cost Estimate – $1.5M

Alternative SWM-4 received a score of 9. The SWMFs are centralized and construction costs from amount of infrastructure needed are minimized. Preliminary Cost Estimate – $3.5M

Alternative SWM-3 received a score of 8. The SWMFs are streamlined to a developer level, however there is still extensive infrastructure needed (more than SWM - 4 or 5). Preliminary Cost Estimate – $4.0M

Alternative SWM-2 received a score of 3. It requires some land to be acquired, multiple (7) private facilities needed, 2 existing municipal facilities and 1 new. Preliminary Cost Estimate – $4.5M. Sterilizes a significant amount of potential development land.

Alternative SWM-1 received a score of 1. It has the greatest area of land to be sterilized by detention storage. It may have the lowest capital construction cost. SWM-1 has the largest overall cost due to the loss of development potential for commercial lands.

5.B Technical

5.B.1 SWM Function Design Requirements

Indicator / Measure
Conformance to City of Waterloo/RMOW standards.

Alternative SWM-5 received a score of 10. Enhanced treatment function of SWM design requirements while consolidating pond ownership for ease of maintenance. Current treatment and contaminant management for landfill site is maintained.

Alternative SWM-4 received a score of 9. Enhanced treatment function of SWM design. Required to replicate SWM measures for landfill site in SWM design.

Alternative SWM-3 received a scored of 7. It will conform to Regional/City standards. Too many SWMFs under municipal ownership.

Alternative SWM-2 received a score of 3. It will conform to downstream quality control standards as per the City/Region guidelines and relies heavily on SWM measures to be maintained on private property.

Alternative SWM-1 received a score of 1. It does not provide adequate SWM design according to City/Region standards. No quality control measures being implemented.

5.B.2 Topographic Extent of Cut/Fill

Indicator / Measure
Potential for excessive borrow quantity or excessive off-site disposal of earth material (volume).
Requirements for excessive (steep) grades (length).
Ability to maintain positive drainage, in combination with number of suitable drainage outlets.

Alternative SWM-1 received a score of 10. There is no cut/fill needed, existing condition

Alternative SWM-5 received a score of 6. There will be a moderate amount of cut/fill for SWMF1 and SWMF2, however no earthworks are required within the hydro corridor.

Alternative SWM-2 received a score of 4. There are lots of small private ponds, significant volume of cut/fill will be required as a result of multitude of facilities of small scale.

Alternative SWM-3 received a score of 2. It requires extensive grading of private, hydro and city owned facilities to ensure proper design of SWMFs and drainage paths.

Alternative SWM-4 received a score of 1. It will require the most grading (specifically HEPC lands) and cut/fill to ensure overland flow routes drain correctly to the properly graded SWMFs.

5.B.3 Constructability

Indicator / Measure

Alternative SWM-5 received a score of 10. Due to the relatively simple design, only 2 formal SWMFs which will require minimal amounts of earthworks to complete, less infrastructure than SWM-4.

Alternative SWM-4 received a score of 9. The straightforward design and standardized SWM strategy creates favourable construction conditions for contractors that are familiar with similar designs.

Alternative SWM-3 received a score of 5. Large infrastructure requirements (additional dedicated storm sewer) will make constructability more complex; however, it can be constructed more easily than SWM - 1 or 2.

Alternative SWM-2 received a score of 3. Large infrastructure requirements (additional dedicated storm sewer) will make constructability more complex. All private SWMFs will be completed through a Site development application. SWMFs constructed under private developments may lack adequate quality control for construction.

Alternative SWM-1 received a score of 1. The construction of a system that meets the requirements for development of the Westhill District is not possible with this option.

5.B.4 Legal Permissibility/Ability to Implement

Indicator / Measure

Alternative SWM-5 received a score of 10. It is most likely to get approved, does not need formal approval from Hydro since it maintains current conditions on the Hydro Lands.

Alternative SWM-4 received a score of 9. It is likely to get approvals and permission to implement from Hydro and regulating authorities. This alternative provides Hydro with their required access of 1/3 of the Hydro right of way.

Alternative SWM-3 received a score of 5. Not likely to receive Hydro approval because of access requirements.

Alternative SWM-2 received a score of 2. Difficult to implement for the multitudes of private SWMFs and not supported by the City of Waterloo.

Alternative SWM-1 received a score of 1. It can't be implemented to meet the SWM treatment requirements for development.

Technical Memorandum

Project Name: Westhill District Plan **MTE File No.:** C34280-101

To: The Westhill Landowners Group **Date:** April 13, 2020

cc: **From:** Jeff Martens

RE: WESTHILL DISTRICT SWM – EVALUATION OF ALTERNATIVES

4.0 Transportation Network / Municipal Services and Utilities

4.A Transportation Network/Infrastructure

4.A.3 Transportation Policy Initiatives

Indicator / Measure
Capacity/capability to accommodate forecast traffic demand.
Provides for appropriate access to existing properties.
Capability to support municipal policy initiatives (transit, active transportation, roundabouts)
Impact on access to existing properties.
Connectivity to Ira Needles Boulevard and Erb Street.

Commentary
No Stormwater Management (SWM) alternative relates to capacity/capability to accommodate forecast traffic demand.
All SWM alternatives were reviewed assuming Road N1 and S3 as the preliminary preferred road alternatives.
All SWM alternatives provide connectivity to Ira Needles Boulevard and Erb Street

Alternatives were primarily assessed based on:
Capability to support municipal policy initiatives active transportation, specifically trails.
Provides for appropriate access to existing properties.
Impact on access to existing properties.

Alternative SWM-4 received a score of 10. It provides opportunity to construct multi use trail system for active transportation potential, also maintains access for Hydro easement. Creating a Stormwater Management Facility (SWMF) within the Hydro corridor would present an opportunity to incorporate a trail along the perimeter of the SWMF. Provides for appropriate access or enhanced to existing properties.

Alternative SWM-3 received a score of 5. Provides limited appropriate access for Hydro Easement, although the rest of the subject lands would be adequately designed from a SWM perspective to accommodate active transportation through the site. Provides for appropriate access or enhanced to existing properties.

Alternative SWM-5 received a score of 4. Although the Hydro access it maintained, the trail systems would not exist because no formal easement or land acquisition will be acquired from Hydro. A small trail connection could be incorporated into the SWMF east of road alternative N1. Provides for appropriate access or enhanced to existing properties.

Alternative SWM-2 received a score of 3. Similar to SWM-5 a small trail connection could be incorporated into the SWMF west of road alternative N1.

Alternative SWM-1 received a score of 1. The large ponding area and no proposed SWMFs limits opportunities to implement a quality trail system to promote active transportation.

4.B Municipal Services and Utilities

4.B.1 Municipal Services

Indicator / Measure
Opportunities for connections to or logical extension of existing services.
Provision of standard cross-section locations for services.
Provision of continuous services.

Alternative SWM-5 received a score of 10. It has simple SWM control structures, while still having the ability to manage and convey flows with adequate flow detention. Aligns with servicing strategy for sanitary and storm outlets.

Alternative SWM-4 received a score of 9. The removal of the regional landfill pond replaced with the proposed SWMF on the hydro corridor requires additional SWM control structures (forebay, inlet and outlet structures). The Hydro corridor has formal pond which increases amount of infrastructure compared to SWM-5.

Alternative SWM-3 received a score of 5. It requires a large amount of SWM control structures with the associated six SWMFs. Additional clean water storm system is required for the SWMF located on the Cressman lands to the Erb Street outlet.

Alternative SWM-2 received a score of 4. Additional clean water storm system is required for the six upstream private SWMFs to the Erb Street outlet.

Alternative SWM-1 received a score of 1. It has no road conveyance network which would cause flooding during rain events.

4.B.2 SWM Facilities

Indicator / Measure
Ability to coordinate with road construction.
Flexibility to implement SWM (assuming N1 and S3).

Alternative SWM-5 received a score of 10. Eliminates difficult ownership issues and replaces with centralized city and private owned ponds. Includes all the SWM quality and quantity controls as SWM - 4 along with centralized city owned facilities and no land or easement required from hydro.

Alternative SWM-4 received a score of 9. Requires land from Hydro and removal of the Region of Waterloo landfill SWMF.

Alternative SWM-3 received a score of 5. Requires land from Hydro, however does not provide access for hydro (1/3 hydro easement). Additional infrastructure (clean water storm sewer) to be incorporated in typical road cross sections.

Alternative SWM-2 received a score of 2. Additional infrastructure (clean water storm sewer) to be incorporated in typical road cross sections. Private SWMFs not fully functioning until all development is complete.

Alternative SWM-1 received a score of 1. SWM-1 is not flexible because it doesn't meet the SWM standards.

4.B.3 Utilities

Indicator / Measure
Degree of exposure of utilities and/or utility conflicts with SWM design.

Alternative SWM-1 received a score of 10. There is no excavation required and therefore no concern with conflicts due to SWM design, existing conditions.

Alternative SWM-2 received a score of 8. There is minimal excavation required through area of utility conflict (Waterloo commons, Hydro corridor).

Alternative SWM-5 received a score of 6. There is some excavation required within the Erb Street Pond area, utility conflicts not expected to be an issue within the Hydro corridor as there is no active earthworks.

Alternative SWM-4 received a score of 3. It requires excavation within Hydro easement under hydro wires and around towers, although it is not anticipated that the gas line will be an issue.

Alternative SWM-3 received a score of 1. SWM-3 does not provide sufficient access through the HEPC right-of-way (1/3 hydro easement width). There is excavation required through buried gas line area and underneath hydro wires and around hydro towers which may require additional permits and fees.

Technical Memorandum

Project Name: Westhill District Plan

MTE File No.: C34280-101

To: The Westhill Landowners Group

Date: April 13, 2020

cc:

From: Jeff Martens

RE: WESTHILL DISTRICT SWM – EVALUATION OF ALTERNATIVES

5.0 Financial / Technical

5.A Financial

5.A.1 Cost

Indicator / Measure
Estimated capital cost ($)
Property requirements (number, area) and ease of acquisition
Extraordinary operations and maintenance requirements/costs (e.g., differences in the number of valves and water treatment requirements; collector road maintenance)
Species at Risk mitigation/overall benefit
Cultural heritage mitigation measures

Alternative SWM-5 received a score of 10. The Stormwater Management Facilities (SWMFs) are centralized, no land to be acquired from Hydro. Supported by developers with a willingness to convey lands for SWMFs. Less infrastructure than SWM-4. No proposed SWMF within the hydro lands. Preliminary Cost Estimate – $1.5M

Alternative SWM-4 received a score of 9. The SWMFs are centralized and construction costs from amount of infrastructure needed are minimized. Preliminary Cost Estimate – $3.5M

Alternative SWM-3 received a score of 8. The SWMFs are streamlined to a developer level, however there is still extensive infrastructure needed (more than SWM - 4 or 5). Preliminary Cost Estimate – $4.0M

Alternative SWM-2 received a score of 3. It requires some land to be acquired, multiple (7) private facilities needed, 2 existing municipal facilities and 1 new. Preliminary Cost Estimate – $4.5M. Sterilizes a significant amount of potential development land.

Alternative SWM-1 received a score of 1. It has the greatest area of land to be sterilized by detention storage. It may have the lowest capital construction cost. SWM-1 has the largest overall cost due to the loss of development potential for commercial lands.

5.B Technical

5.B.1 SWM Function Design Requirements

Indicator / Measure
Conformance to City of Waterloo/RMOW standards.

Alternative SWM-5 received a score of 10. Enhanced treatment function of SWM design requirements while consolidating pond ownership for ease of maintenance. Current treatment and contaminant management for landfill site is maintained.

Alternative SWM-4 received a score of 9. Enhanced treatment function of SWM design. Required to replicate SWM measures for landfill site in SWM design.

Alternative SWM-3 received a scored of 7. It will conform to Regional/City standards. Too many SWMFs under municipal ownership.

Alternative SWM-2 received a score of 3. It will conform to downstream quality control standards as per the City/Region guidelines and relies heavily on SWM measures to be maintained on private property.

Alternative SWM-1 received a score of 1. It does not provide adequate SWM design according to City/Region standards. No quality control measures being implemented.

5.B.2 Topographic Extent of Cut/Fill

Indicator / Measure
Potential for excessive borrow quantity or excessive off-site disposal of earth material (volume).
Requirements for excessive (steep) grades (length).
Ability to maintain positive drainage, in combination with number of suitable drainage outlets.

Alternative SWM-1 received a score of 10. There is no cut/fill needed, existing condition

Alternative SWM-5 received a score of 6. There will be a moderate amount of cut/fill for SWMF1 and SWMF2, however no earthworks are required within the hydro corridor.

Alternative SWM-2 received a score of 4. There are lots of small private ponds, significant volume of cut/fill will be required as a result of multitude of facilities of small scale.

Alternative SWM-3 received a score of 2. It requires extensive grading of private, hydro and city owned facilities to ensure proper design of SWMFs and drainage paths.

Alternative SWM-4 received a score of 1. It will require the most grading (specifically HEPC lands) and cut/fill to ensure overland flow routes drain correctly to the properly graded SWMFs.

5.B.3 Constructability

Indicator / Measure

Alternative SWM-5 received a score of 10. Due to the relatively simple design, only 2 formal SWMFs which will require minimal amounts of earthworks to complete, less infrastructure than SWM-4.

Alternative SWM-4 received a score of 9. The straightforward design and standardized SWM strategy creates favourable construction conditions for contractors that are familiar with similar designs.

Alternative SWM-3 received a score of 5. Large infrastructure requirements (additional dedicated storm sewer) will make constructability more complex; however, it can be constructed more easily than SWM - 1 or 2.

Alternative SWM-2 received a score of 3. Large infrastructure requirements (additional dedicated storm sewer) will make constructability more complex. All private SWMFs will be completed through a Site development application. SWMFs constructed under private developments may lack adequate quality control for construction.

Alternative SWM-1 received a score of 1. The construction of a system that meets the requirements for development of the Westhill District is not possible with this option.

5.B.4 Legal Permissibility/Ability to Implement

Indicator / Measure

Alternative SWM-5 received a score of 10. It is most likely to get approved, does not need formal approval from Hydro since it maintains current conditions on the Hydro Lands.

Alternative SWM-4 received a score of 9. It is likely to get approvals and permission to implement from Hydro and regulating authorities. This alternative provides Hydro with their required access of 1/3 of the Hydro right of way.

Alternative SWM-3 received a score of 5. Not likely to receive Hydro approval because of access requirements.

Alternative SWM-2 received a score of 2. Difficult to implement for the multitudes of private SWMFs and not supported by the City of Waterloo.

Alternative SWM-1 received a score of 1. It can't be implemented to meet the SWM treatment requirements for development.

Appendix O

Westhill District Plan

Preliminary Stormwater Management Report

Project Location:
Ira Needles Boulevard & Erb Street, Waterloo, ON

Prepared for:
Westhill Land Owners Group

Prepared by:
MTE Consultants
520 Bingemans Centre Drive
Kitchener, ON N2B 3X9

June 5, 2020

MTE File No.: 34280-101

Engineers, Scientists, Surveyors.

Table of Contents

Page

1.0 Introduction 1
1.1 The Study Area 2
1.2 Purpose of Study 3
1.3 Previous Studies 3
1.4 Stormwater Management Objectives 5
2.0 Existing Conditions and Background Information 5
2.1 Topographical Information and Outlet 5
2.2 Pre-Development Conditions 7
2.3 Geotechnical Information 10
2.4 Erb Street Detention Facility (ESDF) 10
2.5 ESDF Outlet 11
3.0 Stormwater Management Design Criteria 12
3.1 Water Quality & Erosion Control 12
3.2 Quantity Control 12
3.3 Runoff Volumes 12
3.4 Temperature Mitigation of Stormwater Runoff 13
4.0 Proposed Development and SWM Strategy 13
4.1 Post-Development Conditions 15
5.0 Stormwater Management Design 18
5.1 Hydrologic Modelling 18
5.2 SWMF1, SWMF2 and HCDF 18
5.3 Stormwater Quality Control 18
5.4 Stormwater Quantity Control 22
5.5 Wetland Habitat Restoration 25
6.0 Erosion and Sediment Control Measures 29
7.0 Operation and Maintenance 30
8.0 Conclusions and Recommendations 31

Figures

Figure 1.0 – Project Study Area (PSA) 4
Figure 2.0 – Existing Conditions 6
Figure 3.1 – Internal Pre Development Catchment Areas 8
Figure 3.2 – External Pre Development Catchment Areas 9
Figure 4.0 – Proposed Development Plan 14
Figure 5.0 – Post Development Catchment Areas 17
Figure 6.0 – Preliminary SWM Facility #1 26
Figure 7.0 – Preliminary SWM Facility #2 27
Figure 8.0 – HCDF General Arrangement 28

Tables

Table 4.1 – Post-Development Catchment Parameters 16
Table 5.3.1 – Water Quality Control Details (SWMF1) 20
Table 5.3.2 – Water Quality Control Details (SWMF2) 21
Table 5.4.1 – Stage-Storage-Discharge Information (SWMF1) 22
Table 5.4.2 – Stage-Storage-Discharge Information (SWMF2) 23
Table 5.4.3 – Stage-Storage-Discharge Information (hcDF) 23
Table 5.4.4 – Peak Flow Summary (in m^3/s) 24
Table 5.4.5 – Runoff Volumes (in m^3) 24
Table 5.4.6 – Summary of Maximum SWM Facility Ponding Elevations 24

Appendices

Appendix A Westhill Culvert Capacity
Appendix B Hydrologic Modelling Output

1.0 Introduction

On behalf of the Westhill Landowners Group, MHBC, WSP and MTE are updating the Westhill District Plan for lands south of Erb Street West (Regional Road 9) and west of Ira Needles Boulevard (Regional Road 70), in the City of Waterloo. The updating of the Westhill District Plan requires the completion of two studies, the Westhill Collector Road Study (WHCRS) and the Westhill District Functional Servicing Report (WHFSR). The project team have completed an evaluation of collector road network and stormwater management alternatives. The updated Westhill District Plan is required for development lands to proceed to draft plans of subdivision. MTE was also retained by the Westhill Land Owners Group to prepare a Preliminary Stormwater Management Report (PSWMR) which will outline details relating to the preferred stormwater management strategy which includes replacing the existing Erb Street Detention Facility (ESDF) formally known as the Dutton Pond with alternative SWM measures.

In April 2004, MTE Consultants Inc. prepared a Final Stormwater Management Report and Scoped Environmental Impact Study (2004 MTE Report) for the ESDF. This report was prepared in support of a SWM strategy for Ira Needles Boulevard (INB) Zone #6, which includes the INB right-of-way from Westhill Meadows Golf Course to Erb Street including lands east of INB formerly known as the Wong Lands.

The SWM strategy at that time, proposed some grading removing existing wetland vegetation and providing additional storage demonstrating that with some excavation, quantity control was provided as necessary to accommodate the entire upstream developed condition. The outlet control of the ESDF was intended to be sized to service the entire drainage area.

The INB construction included the forebay to service upstream lands in their ultimate developed condition (Ira Needles Boulevard and the Westhill Drive Area). It was determined that the best stormwater management strategy for Zone #6 and the adjacent properties would be to construct a SWM channel and forebay within the ESDF located adjacent to Erb Street and along the westerly limits of Waterloo Commons (formerly the Wong Property and later the Rock Developments). The constructed storm outlet and forebay is owned by the Region of Waterloo.

The splitter structure, although intended for the ultimate developed conditions, was not adequately sized for the entire fully developed Westhill District drainage area. The outlet also had grading constraints associated with the forebay, and permanent pool within the ESDF.

The 2004 report was revised in 2011 to advance an alternative SWM strategy which was less disruptive to the existing wetland vegetation within the ESDF. MTE chaired meetings with land owners and agencies including the City of Waterloo, the Region of Waterloo (ROW), and Grand River Conservation Authority (GRCA).

The forebay and proposed works within the ESDF wetland vegetation was completed per the revised report, dated January 25, 2011. These SWM measures are generally in the same condition as previously designed and constructed in 2011. Infrequent maintenance of the forebay and channel has resulted in sediment accumulation in the channel, forebay and permanent pool.

A new collector road network, the resolution of access and transportation issues and the preparation of a master stormwater management plan and updated functional servicing plan are required to give direction to the development of the Westhill District.

1.1 The Study Area

The Project Study Area (PSA) is illustrated on the attached **Figure 1.0**. The subject area is located in the upper reach of the Subwatershed 314 - Laurel Creek Watershed and is owned by a variety of land holders, including; the Region of Waterloo, the City of Waterloo, the INCC Corporation, Hydro One, Home Hardware, and Ms. Cressman.

The project drainage area and subject lands is generally located in the southwest quadrant near the intersection of Ira Needles Boulevard and Erb Street. The PSA (82.29 ha) is bounded by Erb Street West to the north, Ira Needles Boulevard and the existing residential/commercial properties on Westhill Drive to the east, the Boardwalk Commercial Development to the south, and the ROW Landfill and Hydro One's hydro corridor to the west.

The catchment area drains towards the ESDF and forms the uppermost reach of the Laurel Creek Subwatershed 314 (known as Area 1 in the *Subwatershed 314 Management Plan*, Mark L. Dorfman, Planner Inc., October 1996). The area draining towards the ESDF is 82.29 ha of which 20.5 ha is contemplated for commercial/employment development in the Westhill District Plan and located entirely within the City of Waterloo.

The entire catchment consists of a mix of land uses being: 2.3 ha of ROW lands, 3.7 ha of developed commercial property, 20.5 ha of undeveloped employment lands, 52.5 ha of combined HEPC corridor and ROW landfill lands, 2.4 ha of SWMF owned in part by the Region of Waterloo and Waterloo Commons and 1.0 ha of existing residential development.

The Laurel Creek (Clair Creek Tributary) *Subwatershed 314 Management Plan* outlined design parameters for sustainable development. The report recognized the ESDF as a significant feature for storage of surface water runoff from the area south of Erb Street. Furthermore, the report outlined that the previously existing culvert under Erb Street was to be maintained as a discharge control, limiting flow to its original capacity under pressure and under regional storm flood level conditions.

The 2004 MTE Report described SWMF upgrades to the ESDF, targeting the immediate need for a SWM solution for INB Zone #6 and Waterloo Commons (formerly the Wong lands and later the Rock Developments). Future improvements to the ESDF were conceptually discussed and formed the basis for the overall ESDF SWM strategy presented in the 2011 revised report.

1.2 Purpose of Study

The purpose of this study is to update the SWM strategy outlined above to implement the preferred Alternative 5 as detailed in the Evaluation Report dated June 5, 2020. Alternative 5 proposes to replace the ESDF with 2 municipal SWMFs (SWMF1 and SWMF2) and maintain the balance of the ESDF in the form of a detention storage located on the Hydro Electric Power Commission (HEPC) corridor referenced as the Hydro Corridor Detention Facility (HCDF).

SWMF1 will be located on the Home Hardware lands and SWMF2 will be located on the Waterloo Common lands. Both SWMFs will be designed as constructed wetland type facilities with Regional Storm controls and detention storage. HCDF will maintain current storage and flood levels under post development conditions on the HEPC lands.

1.3 Previous Studies

Several reports have previously been prepared, which contain relevant information regarding the upper reach of the Laurel Creek Subwatershed 314, all of which have been incorporated into this document. These reports include:

- *Subwatershed 314 Management Plan*, Mark L. Dorfman Planner Inc., October 1996;
- *Clair Meadows Subdivision Final Stormwater Management Report*, Stantec Consulting Ltd., October 2000;
- *Clair Meadows Subdivision Final Stormwater Management Report Addendum*, Stantec Consulting Ltd., October 2002;
- *Technical Design Brief (SWM) and Scoped Environmental Impact Study: Erb Street Pond*, MTE Consultants Inc., 2003; and,
- *MOE Stormwater Management Planning and Design Manual,* Ministry of the Environment 20003
- *Final SWM Report and Scoped Environmental Impact Study: Erb Street Pond*, MTE Consultants Inc., April 2004.
- Stormwater Management Master Plan (SWM-MP) Municipal Class Environmental Assessment – City of Waterloo
  Aquafor Beech Ltd., December 2019

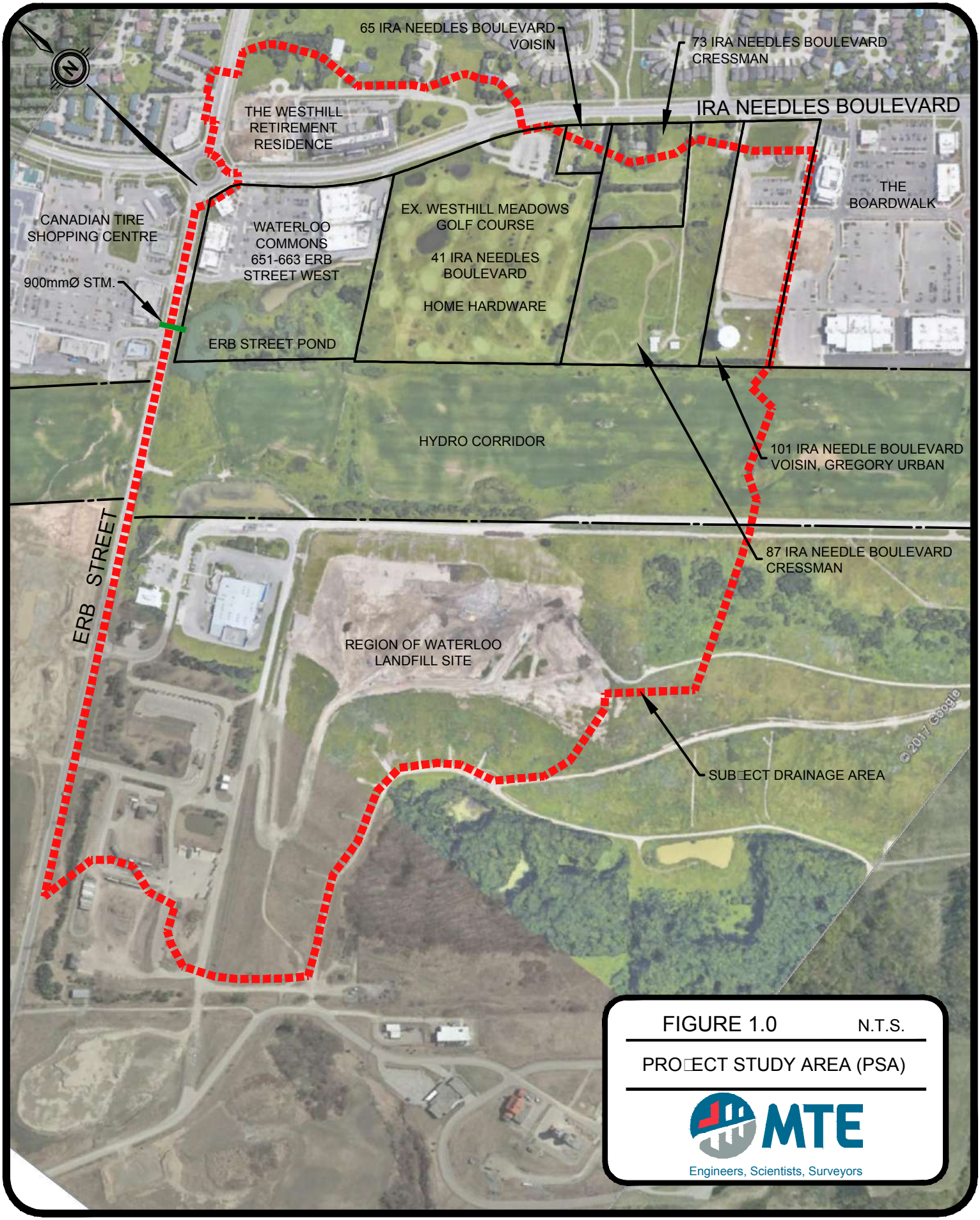


FIGURE 1.0 N.T.S.

PROJECT STUDY AREA (PSA)

MTE
Engineers, Scientists, Surveyors

DWG PATH: P:\P\34280\101\34280-101-ALT5-F1.dwg

May 29, 2020 – 4:27:58 PM – Plotted By: Scott Scheifele

1.4 Stormwater Management Objectives

Stormwater Management objectives are based on current MOE SWM Planning and Design Manual 2003 and pertinent published objectives of previous studies.

The primary objectives are established as follows:

- Replace the ESDF with SWMF1, SWMF2 and the HCDF;
- Provide water quality to a “Normal” level 2 protection as required in previous studies for Clair Creek and Laurel Creek;
- Provide 24 to 48 hours of extended detention volume for the 25mm – 4-hour storm event for erosion protection of downstream receiving watercourses
- Attenuate post-development peak flows to pre-development levels for the 2 year to 100 Year storm events;
- Control the regional storm to the allowable flowrate of the original 24” (610mm) Erb Street Culvert under 3.3m of head/pressure conditions which occurred during the regional storm flood elevation of the predevelopment condition.
- Satisfy surface water quality parameters as outlined in the *Subwatershed 314 Management Plan*;

2.0 Existing Conditions and Background Information

2.1 Topographical Information and Outlet

Figure 2.0 – Existing Conditions, illustrates features and contours within the PSA.

The subject lands are rolling with scattered topographic low areas. This drainage area includes a portion of the ROW Landfill facility. The existing topography is undulating with two significant drainage draws; one through the eastern half of the area which crosses the existing Westhill Meadows Golf Course, and a second along the existing hydro corridor which runs along the east side of the landfill. Drainage is predominantly from south to north, being captured in the ESDF and outletting via culvert/storm sewer under Erb Street.

In 1971 the chronology and photo history documents the agricultural land use of the area currently described as wetland upstream of Erb Street. Between 1972 and 1975 improvements to Erb Street and the creation/expansion of the ROW Landfill site resulted in detention storage upstream of Erb Street and the 24” (610mm) diameter culvert on Erb Street.

The perched 24” (610 mm) culvert and the disruption of the private drain upstream of Erb Street had the effect of maintaining the detention storage function in priority to the anthropogenic wetland (with its genesis in 1975 to its growth in its current state) located adjacent to Erb Street.

The ESDF outlet was originally a 24” (610 mm) diameter culvert and was replaced with a 900 mm diameter storm sewer complete with a 550 mm diameter orifice plate mounted on a headwall as part of the Ira Needles Boulevard Zone #6 construction. MTE completed a detailed topographical survey of the ESDF and adjacent lands by total station in early 2003 and has since updated this topographical information with changes to the ESDF outlet structure.

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EXISTING
REGION OF WATERLOO
LANDFILL POND

HYDRO CORRIDOR

W2

W1

W3

W4

REGIONAL PONDING LIMIT
381.56m

KW ZONE 6
ELEVATED TANK

87 IRA NEEDLES
BOULEVARD

41 IRA NEEDLES
BOULEVARD

73 IRA NEEDLES
BOULEVARD

65 IRA
NEEDLES
BOULEVARD

THE
BOARDWALK

WATERLOO
COMMONS
651-663 ERB STREET
WEST

ERB STREET WEST

IRA NEEDLES BOULEVARD

ERBSVILLE ROAD

WESTHILL DRIVE

THORNDALE DRIVE

750mmø
825mmø
900mmø
900mmø
900mmø

1
2
3
4

LEGEND

- PROPERTY BOUNDARY
- EXISTING REGIONAL STORM DETENTION STORAGE AREA (381.56m)
- EASEMENT
- EXISTING SPOT ELEVATIONS/CONTOURS
- EXISTING SANITARY SEWER
- EXISTING WATERMAIN
- EXISTING STORM SEWER
- EXISTING EMBANKMENT (SLOPE AS NOTED)
- W1 — STANDING WATER w/ ECOLOGICAL VEGETATION/FUNCTION IDENTIFIER
- 3 — DRAINAGE FEATURE IDENTIFIER
- STANDING WATER

Scale: 1:2500
Date: JUN.16/20

The Westhill
Landowners Group
101 IRA NEEDLES BOULEVARD WATERLOO, ON

WESTHILL DISTRICT PLAN
ERB STREET CONNECTION
REVIEW
ERB STREET WATERLOO, ON

EXISTING CONDITIONS

MTE
Engineers, Scientists, Surveyors

Project No.: 34280-101

2.2 Pre-Development Conditions

Figure 3.1 - Internal Pre-Development Catchment Areas and **Figure 3.2** – External Pre-Development Catchment Areas, illustrates the subcatchment delineation for the PSA.

For the purpose of this report, runoff from the landfill site is assumed to be un-attenuated and has been incorporated into the hydrologic modelling accordingly. This is a conservative approach as the ROW landfill site has its own SWMF which provides quality control, spill containment and some quantity control.

Table 2.2 outlines the catchment parameters utilized in the preparation of the pre-development conditions modelling.

Table 2.2 – Pre-Development Catchment Parameters

Catch#	Description	Area (ha)	% IMP	Flow Length (m)	Slope (%)	Pervious CN
101	Ira Needles Commercial Property	1.92	10.0	60	2.0	75
102	101 Ira Needles Blvd.	2.88	10.0	100	2.0	75
103	87 Ira Needles Blvd.	4.13	10.0	100	2.0	75
104	73 Ira Needles Blvd.	1.14	10.0	80	2.0	75
105	65 Ira Needles Blvd.	0.25	40.0	60	2.0	75
106	Westhill Meadows Golf Club (Home Hardware)	7.94	5.0	150	2.0	75
107	Undeveloped Westhill Drive Commercial Property (East of WHD)	0.31	10.0	40	2.0	75
108	Undeveloped Westhill Drive Commercial Property (West of WHD)	0.28	0.0	45	4.0	75
109	West Hill Drive R.O.W.	0.55	45.0	10	2.0	75
110	External Area (North of WHD)	0.69	10.0	45	5.0	75
111	Westhill Retirement Residence, East of Ira Needles	1.89	0.0	100	5.0	75
112	Ira Needles Blvd. R.O.W.	1.76	10.0	40	5.0	75
113	Waterloo Commons West of Ira Needles	3.65	10.0	100	5.0	75
114	Hydro Lands and RoW Landfill	52.51	20.0	100	4.0	75
115	ESDF Lands	2.39	25.0	50	2.0	75
	Total:	**82.29**	**16.4**			

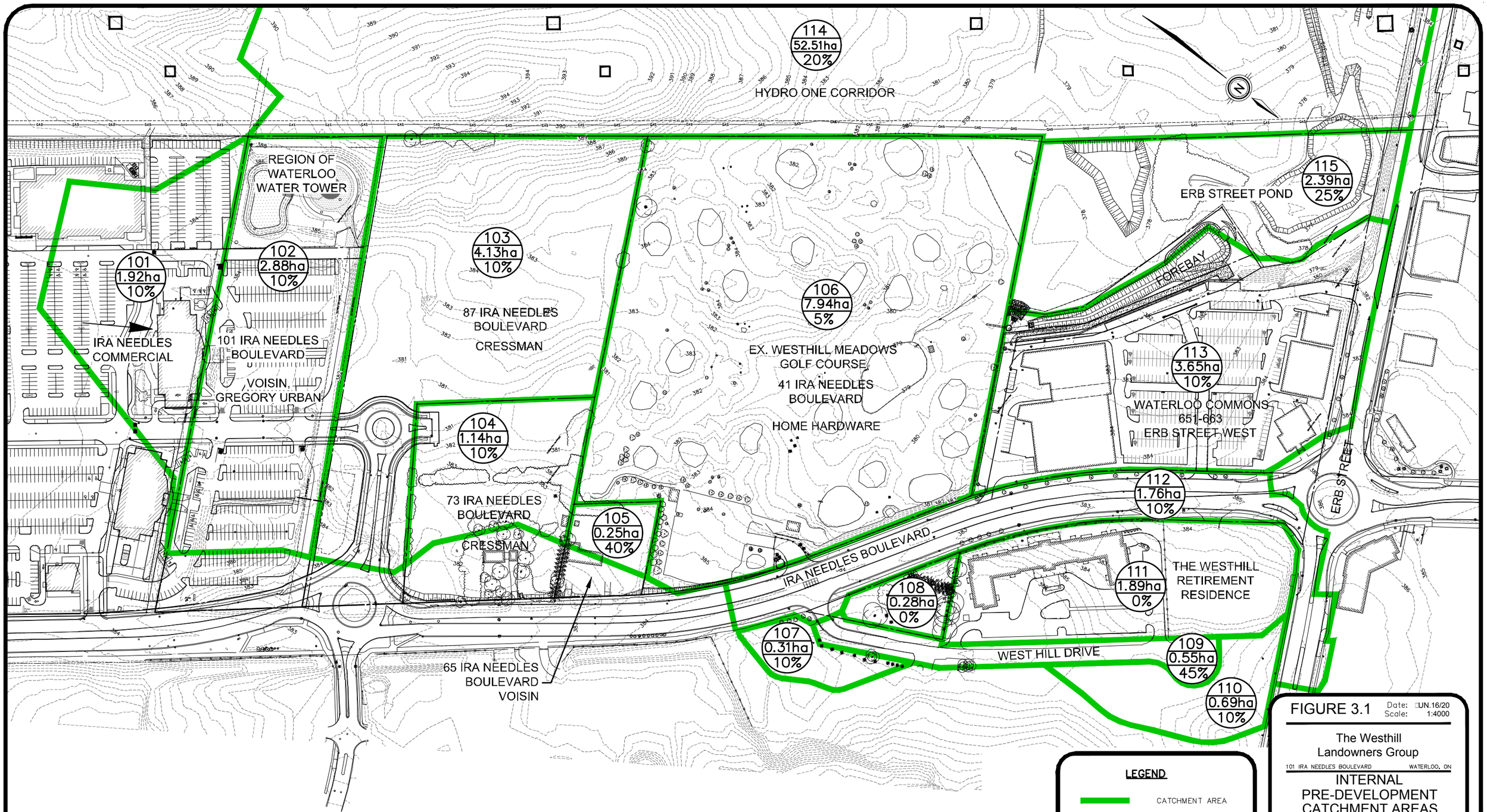


FIGURE 3.1 Date: JUN.16/20 Scale: 1:4000

The Westhill Landowners Group

101 IRA NEEDLES BOULEVARD WATERLOO, ON

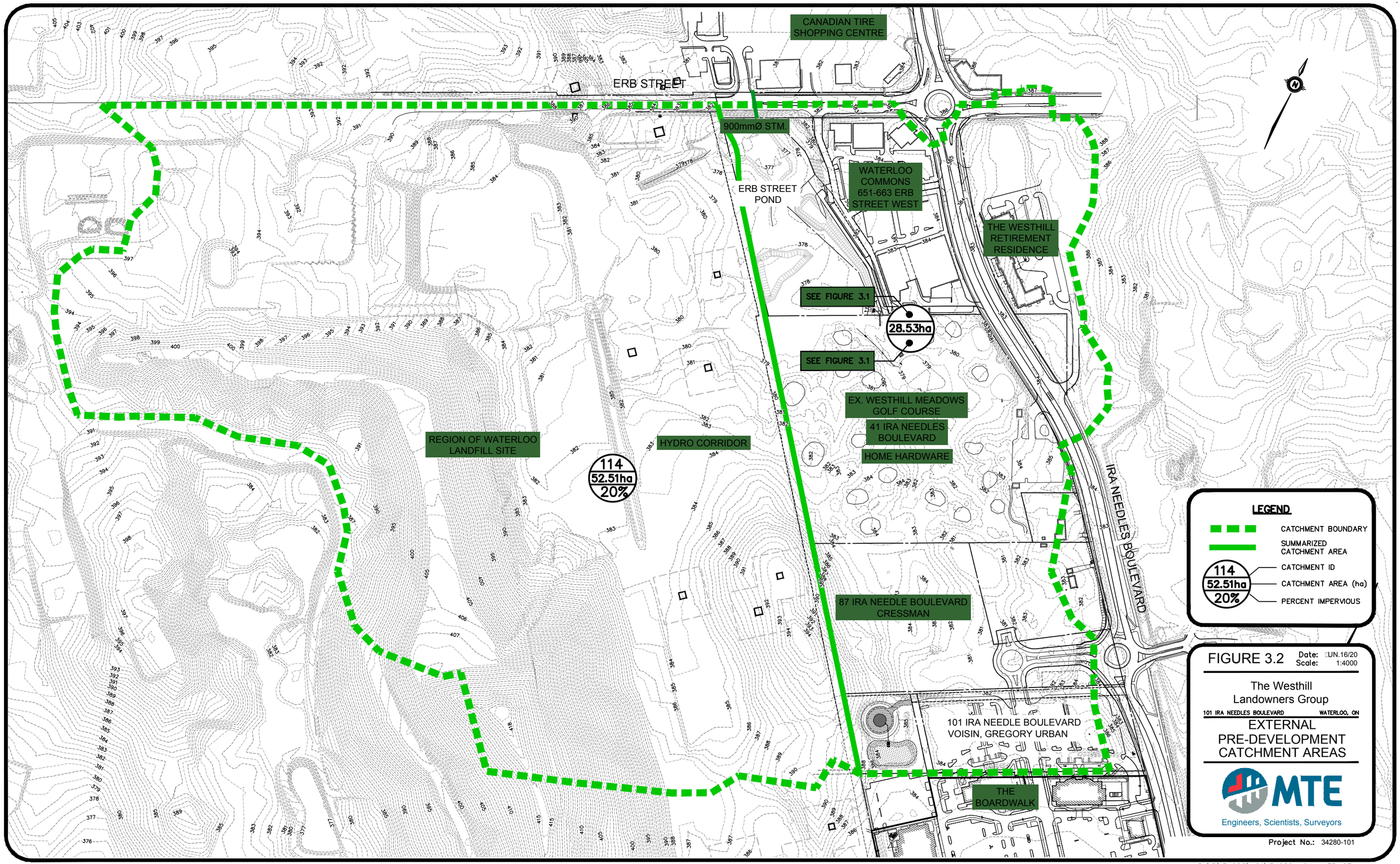
INTERNAL PRE-DEVELOPMENT CATCHMENT AREAS

MTE Engineers, Scientists, Surveyors

Project No.: 34280-101

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2.3 Geotechnical Information

Surficial soils generally consisted of upper layers dominated by silty loams underlain by loam, silty clay and clay. The lands in the vicinity of the existing ESDF are rolling with scattered topographic low areas. The combination of low topography and layers of less permeable silty clays appears to create conditions in which pockets of wetland vegetation have been established; fed by the collection and conveyance of surface water discharge.

The table lands above the low lying areas comprise primarily of silt, clay, and silt till deposits. Infiltration practice in this area are not be feasible due to impermeable soil conditions. The recent development of the adjacent Waterloo Commons (formerly Rock Development) and Canadian Tire lands could not implement any infiltration facilities due to low soil permeability and perched groundwater conditions.

Each site in the catchments upstream of the ESDF should undergo individual geotechnical investigations prior to development to determine the viability of infiltration on a site-by-site basis, and when feasible, utilize roof infiltration facilities as appropriate.

2.4 Erb Street Detention Facility (ESDF)

The ESDF (formerly known as Dutton Pond in the Laurel Creek Watershed Study) and its associated wetland vegetation fringe is an anthropogenic feature established in a topographic low by the impoundment of water and backwater effect originally imposed by the raised Erb Street culvert. The wetland vegetation has developed to a significant degree as a result of this human-induced impoundment of water that occurred in and around 1970. Please refer to MTE's Technical Memos dated December 4, 2018, which includes a chronology and photo inventory for the area from 1930 to 2017. This wetland vegetation has been the subject of field work that was conducted as part of the October 1996 *Subwatershed 314 Management Plan*, prepared by Mark L. Dorfman Planner Inc.

The detailed Ecological Land Categories (ELCs) were inventoried by WSP and are documented in the Stage 1 Environment Impact Study prepared by WSP and dated December 2018.

As per the recommendations of the FSWMR for ESDF by MTE in 2004 and subsequently updated in 2011, a channel and forebay were constructed in conjunction with the Ira Needles Boulevard - Stage 1 construction. The grassed channel feature runs adjacent to the wetland vegetation, parallel to the southern property boundary of the Waterloo Commons to approximately half way up the east side of the wetland. The channel was designed with a trapezoidal cross section which includes sloped sides that are suitable for landscape plantings with the objective of integrating the drainage feature into the adjacent wetland areas. The grassed channel leads to a sediment forebay that is located within an upland field area with perimeter berms located outside the wetland vegetation.

Since construction, the channel and forebay have filled in considerably with sediment and no longer have a trapezoidal cross-section. The outlet of the forebay is a cable concrete weir that is submerged due to sedimentation and a higher grade on the downstream side of the weir.

The ESDF regional storm flood level is 380.56 mASL and the detention area is 4m deep at its lowest point.

2.5 ESDF Outlet

Prior to the reconstruction of Erb Street in 2011, the controlled outlet for the ESDF was a 24" (610 mm) diameter CSP culvert that crossed Erb Street, with its ends projecting out of the sides of the roadway embankments. The invert of the culvert was around 376.99 similar to the orifice elevation of today. Flow was conveyed downstream via an open ditch to Clair Creek. As part of the Ira Needles Boulevard construction project, portions of Erb Street were reconstructed, which included the replacement of the 24" (610 mm) diameter CSP culvert with a 900 mm diameter concrete storm sewer. The inlet of the storm sewer included the construction of a concrete headwall and outlet structure with a 550 mm diameter orifice plate. Immediately and downstream of Erb Street, the Canadian Tire development project at that time included the construction of a 900 mm diameter storm sewer crossing the site to convey flows from the ESDF to the Clair Meadows Subdivision and ultimately Clair Creek and Laurel Creek.

The regional storm flow capacity from the 24" (610 mm) CSP culvert under the regional storm is documented as being between 1.871 and 2.222 m^3/s. See **Appendix A** for detailed calculations.

3.0 Stormwater Management Design Criteria

New developments are required to provide stormwater management in accordance with provincial and municipal policies. Based on a review of background reports and documents, and site specific considerations, the following SWM criteria are recommended for agency approval.

3.1 Water Quality & Erosion Control

The water quality targets were established in the *Subwatershed 314 Management Plan* and are described as follows:

- Lands upstream of ESDF to provide Normal (Level 2) level of water quality protection as established by the MOE Stormwater Management Planning and Design Manual - 2003.

- Erosion control criteria outlined that the distribution of impulse and flow frequency distributions are not to be increased in the receiving watercourse. For erosion control, discharge from the 25 mm 4-hour storm should have a drawdown time between 24 and 48 hours.

- SWMFs should be extended detention wetland facilities to mitigate impact associated with phosphorus, suspended solids, thermal mitigation and bacteria levels.

3.2 Quantity Control

The *Subwatershed 314 Management Plan* required major storm flows be reduced to the pre-condition that existed in 1970, where a 24” (610 mm) diameter culvert crossed Erb Street as the outlet for the ESDF.

The criteria for SWM quantity control is as follows:

- Control post-development peak flows to pre-development levels for the 2, 5, 25, and 100-year storm events.

- Control the post development peak flows for the regional storm event to less than the original flowrate of the 24” (610mm) CSP culvert (being in the range of 1.871 and 2.222 m^3/s).

3.3 Runoff Volumes

Based on the *Subwatershed 314 Management Plan*, it was recommended that runoff volumes should be targeted to be within 10% of the existing volumes particularly for larger storm events associated with downstream flooding.

3.4 Temperature Mitigation of Stormwater Runoff

The following temperature mitigation criteria were developed in the *Subwatershed 314 Management Plan*, and are listed as follows:

- Stormwater discharged to the receiving stream is not to exceed 26° C from June 1 to August 1; and,

- Stormwater discharged to the receiving stream is not to exceed 29° C from August 1 to October 1.

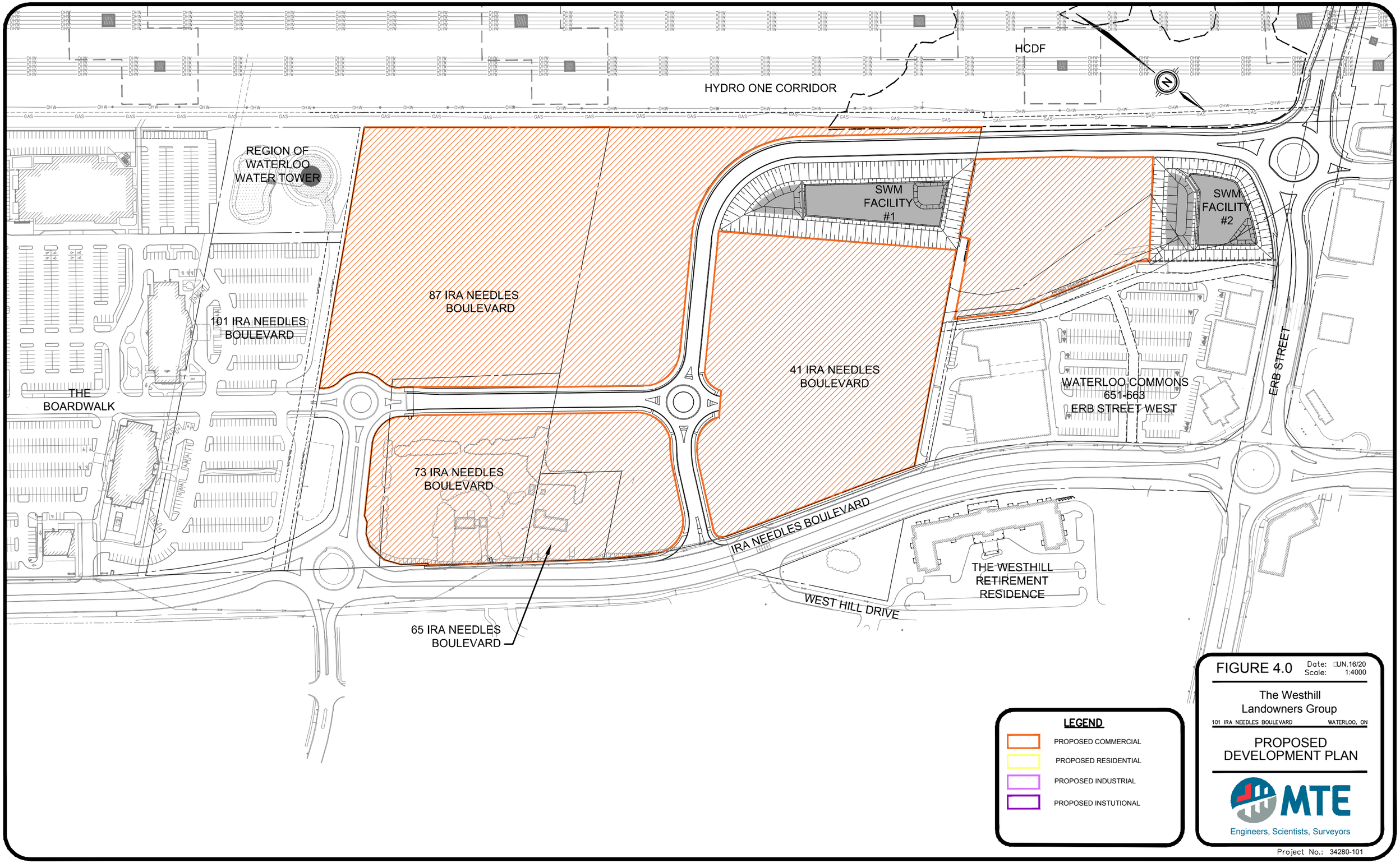
Prior to development in this area, the outflows from the ESDF were directed to an open channel that traversed approximately 1 km prior to entering Clair Creek. Since development has occurred on the north side of Erb Street, the flows from the ESDF are directed subsurface into a sewer, which has a length of more than 1 km below grade. With more than 1.5 m of cover. During spring and summer, subsurface ground temperatures greater than 1.5 m below the surface are generally 13 to 15° C. Since the storm flows are significantly attenuated for storm events less than the 25 mm storm and these flows are being directed through the 1,000+ metres of sewer, it is MTE's opinion that the post-development condition represents an enhanced condition with respect to water temperature and dissolved oxygen, when compared to the pre-development condition.

4.0 Proposed Development and SWM Strategy

Figure 4.0 – Proposed Development Plan, illustrates the development plan for the Westhill District.

The proposed development plans for the Westhill District include a collector road system providing connectivity from INB and the Boardwalk to Erb Street. The primary collector road runs south-north and extends from the existing Thorndale Drive extension roundabout to Erb Street West near the existing outlet location of the ESDF. A second internal roundabout is proposed at the intersection of the proposed Boardwalk extension and the north-south collector road. Following the approval of the Westhill District Plan, development of the employment lands will be subject to draft plans of subdivision and/or site plan applications.

The grading design will be controlled by many factors, which include matching existing grades at adjacent property lines, environmental features, hydro towers, as well as optimizing a cut/fill balance on sites. It is anticipated that for visibility and marketing purposes; future development blocks may require filling such that lot grades are near the level defined by the centerline road grades of Ira Needles Boulevard and the proposed north-south collector road and Boardwalk extensions. These centerline grades vary from 379.8 mASL to 384.8 mASL.



LEGEND

- PROPOSED COMMERCIAL
- PROPOSED RESIDENTIAL
- PROPOSED INDUSTRIAL
- PROPOSED INSTUTIONAL

FIGURE 4.0

Date: JUN.16/20
Scale: 1:4000

The Westhill Landowners Group

101 IRA NEEDLES BOULEVARD WATERLOO, ON

PROPOSED DEVELOPMENT PLAN

MTE

Engineers, Scientists, Surveyors

Project No.: 34280-101

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4.1 Post-Development Conditions

Figure 5.0 – Post Development Catchment Areas, illustrates the catchment delineation modelled for the post-development conditions.

Development of the INB commercial development to the south, catchment areas 101 and 102 have been redirected away from the ESDF. Drainage from these catchments is being directed to the neighbouring subdivision to the southeast. The total post-development drainage area has then been reduced to 75.98 ha. The future development area includes the 17.91 ha of commercially zoned property north of the existing Boardwalk commercial area and south of the ESDF.

The new collector road system is proposed to bisect through the existing ESDF which required a new SWM strategy to be developed in order to adequately manage the volume of stormwater runoff that the ESDF was originally designed to collect and control. This new strategy entails constructing two new SWMFs. The first, referenced as SWMF1, is to be constructed on the Home Hardware lands within the existing Westhill Meadows Golf Course lands. The second, SWMF2 is proposed within the Waterloo Commons lands east of the future collector road connection with Erb Street.

Under post-development conditions, the catchment area was delineated into 7 sub-catchments. **Table 4.1** provides a brief description of each sub-catchment area as well as the design parameters used in the hydrologic modelling. SWMF1 receives runoff from the southern development lands and the external Westhill Drive and Ira-Needles Boulevard area. SWMF2 receives runoff generated from the existing Waterloo Commons property and the northern portion of the N-S collector road. The external Westhill Drive and Ira Needles Boulevard area was modeled flowing to SWMF1 however, the external Westhill Drive lands (sub-catchments #107, 108, 109, 110, 111 & 112) could be directed to either SWMF1 or SWMF2. The final configuration of the SWMFs and the determination of the outflows from the external Westhill Drive area will be finalized through future development review processes. The area of stormwater retention within the HEPC corridor is maintained and floods to the same elevation as current conditions (380.56 mASL). The HCDF detains runoff from the Hydro One Lands and the Region of Waterloo landfill lands only.

Table 4.1 – Post-Development Catchment Parameters

Sub-Catchment	Description	Area (ha)	% Impervious	Flow Length (m)	Slope (%)	Pervious CN
101	RoW Landfill	52.51	20.0	100.0	4.0	75
201	Ira Needles External	5.48	81.4	250.0	2.0	74
202	South Development Lands	7.68	85.0	300.0	2.0	74
203	South Collector R.O.W	1.52	72.0	250.0	2.0	74
204	Home Hardware	3.23	85.0	100.0	2.0	74
301	North Collector R.O.W	0.50	72.0	100.0	1.0	74
302	Waterloo Commons	5.06	86.1	250.0	2.0	74
	Total:	**75.98**	**39.5**			

3-1
52.51

HYDRO ONE CORRIDOR

HCDF
(380.55m)

REGION OF
WATERLOO
WATER TOWER

SWM
FACILITY
#1

SWM
FACILITY
#2

2-1
5.561

1-1
17.□1

87 IRA NEEDLES
BOULEVARD

101 IRA NEEDLES
BOULEVARD

41 IRA NEEDLES
BOULEVARD

THE
BOARDWALK

WATERLOO COMMONS
651-663
ERB STREET WEST

ERB STREET

73 IRA NEEDLES
BOULEVARD

IRA NEEDLES BOULEVARD

THE WESTHILL
RETIREMENT
RESIDENCE

WEST HILL DRIVE

65 IRA NEEDLES
BOULEVARD

LEGEND

- CATCHMENT AREA
- 1-1 / 19.00 — CATCHMENT ID / CATCHMENT AREA (ha)
- EXTERNAL LANDS FLOW DIRECTION

FIGURE 5.0 Date: □UN.16/20 Scale: 1:4000

The Westhill
Landowners Group

101 IRA NEEDLES BOULEVARD WATERLOO, ON

POST-DEVELOPMENT
CATCHMENT AREAS

MTE
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5.0 Stormwater Management Design

5.1 Hydrologic Modelling

A hydrologic model was developed to simulate drainage conditions for the study area, to predict flows for the proposed development conditions, and design an outlet control that restricts flows to pre-development conditions. The MIDUSS hydrologic modelling program was utilized for the storm event simulations in order to maintain pre-development peak flow conditions. Proposed development conditions were modelled for the:

- 2, 5, 25, 100 year, and Regional return-period rainfall events (3 hour Chicago Storm distribution derived from the City of Waterloo's Intensity-Duration-Frequency parameters).

The hydrologic parameters of the areas directed to the two new SWMFs and HCDF are summarized in **Table 4.1**. The MIDUSS modelling output is provided in **Appendix B**.

5.2 SWMF1, SWMF2 and HCDF

Figure 6.0 – SWMF1, illustrates the preliminary design and general arrangement of SWMF1.
Figure 7.0 – SWMF2, illustrates the preliminary design and general arrangement of SWMF2.
Figure 8.0 – HCDF, illustrates the general arrangement of HCDF.

5.3 Stormwater Quality Control

Quality control for the developed portion of the study area will be provided by the proposed SWMFs, which have been designed as wetland types for both SWMF1 and SWMF2. The proposed SWMFs contain a forebay and wetland cell.

Larger storm events will have greater peak flows and velocities with the potential for re-suspension (scouring) of accumulated sediment. A flow splitter structure should be implemented upstream of the forebay whereby smaller flows are directed into the forebay and larger flows are directed to the main wetland cell. The forebay is designed to allow the majority of suspended solid particulate to settle out before it reaches the second wetland cell.

Sizing of a splitter structure by simply sizing the outlet pipes based on free flow (Manning's) capacities often results in 'washout' of the forebay (and costly remediation) due to larger flows that result from surcharging of the splitter structure. The design of the proposed splitter structure should incorporate both free flowing pipe capacities (i.e. assuming no surcharge and using Manning's equation), as well as the effects of head buildup within the splitter structure and associated discharge pipes.

The permanent pool depth for the forebays of SWMF1 and SWMF2 is 1.5 m. The wetland cells for both SWMF1 and SWMF have a permanent pool depth of 0.3 m.

The 2003 MOE document suggests that the clean-out frequency for the SWMF be based on the sediment loading within the entire SWMF, however, it is MTEs recommendation that the clean-out frequency be based on the loadings within the forebay only. While this typically results in more frequent clean-out, it is restricted to the forebay area only and avoids disturbance of the main wetland cell.

Although the criteria in Section 3.1 only specifies that a Normal (Level 2) water quality control is required, per the *Subwatershed 314 Management Plan*, both SWMFs have been conservatively designed to provide an Enhanced (Level 1) level of quality control.

The preferred collector road alignment is deemed essential community infrastructure and its location has been established through the evaluation of alternatives with no other alternative being deemed feasible. The preferred road alignment will move into final design where appropriate mitigation and/or restoration can be implemented.

The post development drainage area upstream of SWMF1 and SWMF2 has an imperviousness of 82.8% and 84.8% respectively. An Enhanced (Level 1) of water quality control requires a storage volume of 137m^3/ha and 140m^3/ha for 83% and 85% imperviousness respectively. All but 40 m^3/ha represents the permanent pool requirement. Considering the drainage areas for each SWMF being 17.91 ha (SWMF1) and 5.54 ha (SWMF2) the required permanent pool volumes are 1,737m^3 (SWMF1) and 554m^3 (SWMF2) and the required extended detention volume of 716 m^3 (SWMF1) and 222 m^3 (SWMF2) respectively.

The RoW SWMF upstream of the HCDF provides quality control for the RoW landfill lands.

Tables 5.3.1 and **5.3.2** outline the designs of the proposed SWMFs.

Table 5.3.1 – Water Quality Control Details (SWMF1)

General	Pond Characteristics
Wetland Stormwater Management Facility Required	Normal (Level 2) Quality
Wetland Stormwater Management Facility Provided	Enhanced (Level 1) Quality
Total Contributing Area	17.91 ha
Imperviousness (of whole drainage area)	82.8 %
Bottom Elevation of Forebay	376.50 mASL
Bottom Elevation of Wetland Cell	377.70 mASL
Storage	
* Unit Area Storage Volume Requirements as per SWMMP (MOECC Guideline 2003)	88 m^3/ha (Normal) 137m3/ha (Enhanced)
Required Total Volume (MOE 2003)	2,453 m^3
Provided Total Volume	2,500 m^3
Permanent Pool (forebay and wetland cell)	
Required Permanent Pool Volume (MOE 2003)	1,737 m^3
Permanent Pool Volume Provided	1,750 m^3
Permanent Pool Elevation	378.00 mASL
Extended Detention (based on 40 m^3/ha.)	
Minimum Required Volume	716 m^3
Volume Provided	750 m^3
Extended Detention Elevation	378.32 mASL
Approximate Drawdown Time	25.6 hr
Forebay	
Required Forebay Length	29 m
Actual Forebay Length Provided	35 m
Bottom Elevation	376.50 mASL
Permanent Pool Elevation	378.00 mASL

Note: * of this storage volume 40m^3/ha is extended detention

Table 5.3.2 – Water Quality Control Details (SWMF2)

General	Pond Characteristics
Wetland Stormwater Management Facility Required	Normal (Level 2) Quality
Wetland Stormwater Management Facility Provided	Enhanced (Level 1) Quality
Total Contributing Area	5.54 ha
Imperviousness (of whole drainage area)	84.8 %
Bottom Elevation of Forebay	376.50 mASL
Bottom Elevation of Wetland Cell	377.70 mASL
Storage	
* Unit Area Storage Volume Requirements as per SWMMP (MOECC Guideline 2003)	90 m^3/ha (Normal) 140m3/ha (Enhanced)
Required Total Volume (MOE 2003)	776 m^3
Provided Total Volume	1,808 m^3
Permanent Pool (forebay and wetland cell)	
Required Permanent Pool Volume (MOE 2003)	554 m^3
Permanent Pool Volume Provided	1,558 m^3
Permanent Pool Elevation	378.00 mASL
Extended Detention (based on 40 m^3/ha.)	
Minimum Required Volume	222 m^3
Volume Provided	250 m^3
Extended Detention Elevation	378.09 mASL
Approximate Drawdown Time	45.2 hr
Forebay	
Required Forebay Length	15 m
Actual Forebay Length Provided	40 m
Bottom Elevation	376.50 mASL
Permanent Pool Elevation	378.00 mASL

Note: * of this storage volume 40m^3/ha is extended detention

5.4 Stormwater Quantity Control

All minor storm event flows (5-year and less) will be conveyed to their respective SWMF via the combination of on-site and municipal storm sewer systems. Major storm flows will be directed to the ponds by a combination of storm sewers and overland flow routes (i.e. right-of-ways and spillways).

Summary stage-storage-discharge relationships for the proposed SWMFs are shown below in **Tables 5.4.1, 5.4.2 and 5.4.3**. Detailed stage-storage-discharge relationships for the SWMFs are provided with the MIDUSS modelling in **Appendix B**.

Table 5.4.1 – Stage-Storage-Discharge Information (SWMF1)

Elevation (m)	Discharge (m^3/s)	Active Volume (m^3)	Remarks
378.00	0.000	0	Permanent Pool Elevation - 100 mm orifice invert @ 377.75 Extended Detention @ 378.32
378.40	0.039	1607	Ditch Inlet #1 150mm Orifice Invert @ 377.75
378.91	0.051	4009	2-yr Storm
379.15	0.057	5292	5-yr Storm
379.30	0.085	6095	Ditch Inlet #2 Lip Elevation, 100x250mm Orifice Invert @ 377.75
379.82	0.099	9080	25-yr Storm
379.90	0.121	11501	Ditch Inlet #3 Lip Elevation, 100x300mm Orifice Invert @ 377.75
380.28	0.132	11994	100-yr Storm
380.90	0.147	16364	Ditch Inlet #4 Lip Elevation, 100x400mm Orifice Invert @ 377.75
382.49	0.242	29695	Regional Storm Ponding Elevation

Note: Storage volumes and flood levels may be reduced should the external lands for Westhill Drive (sub-catchments 107 to 112) be directed to SWMF2.

Table 5.4.2 – Stage-Storage-Discharge Information (SWMF2)

Elevation (m)	Discharge (m^3/s)	Active Volume (m^3)	Remarks
378.00	0.000	0	Permanent Pool Elevation - 65 mm Orifice Invert @ 377.00 Extended Detention @ 378.09
378.10	0.017	620	Ditch Inlet #1 Elevation 85mm Orifice Invert @ 377.00
378.39	0.018	1257	2-yr Storm
378.50	0.019	1664	5-yr Storm
378.60	0.035	2432	Ditch Inlet #2 Lip Elevation, 100x100mm Orifice Invert @ 377.00
378.80	0.037	2846	25-yr Storm
379.03	0.039	3789	100-yr Storm
379.20	0.081	4518	Ditch Inlet #3 Lip Elevation, 100x200mm Orifice Invert @ 377.00
380.16	0.098	9054	Regional Storm Ponding Elevation

Note: Storage volumes and flood levels may be increased should the external lands for Westhill Drive (sub-catchments 107 to 112) be directed to SWMF2.

Table 5.4.3 – Stage-Storage-Discharge Information (HCDF)

Elevation (m)	Discharge (m^3/s)	Volume (m^3)	Remarks
377.00	0.00	6	Ditch Inlet #1 Lip Elevation, 600x200mmOrifice Invert
378.48	0.39	2274	2-yr Storm
378.50	0.40	2375	Ditch Inlet #2 Lip Elevation, 850x200mm Orifice Invert @ 377.00
378.79	0.62	4985	5-yr Storm
378.80	0.69	5044	Ditch Inlet #3 Lip Elevation, 900x200mm Orifice Invert @ 377.00
379.23	0.77	10897	25-yr Storm
379.30	0.85	12114	Ditch Inlet #4 Lip Elevation, 1000x200mm Orifice Invert @ 377.00
379.56	0.88	17380	100-yr Storm
379.60	1.26	18103	Ditch Inlet #5 Lip Elevation, 1400x200mm Orifice Invert @ 377.00
380.56	1.45	50615	Maximum Ponding, Regional Storm

A summary of the peak flows for the pre and post-development is tabulated in **Table 5.4.4**.

Table 5.4.4 – Peak Flow Summary (in m^3/s)

	2 Year	5 Year	25 Year	100 Year	Regional
Pre-Development	0.479	0.756	0.971	1.124	2.222 max 1.871
Post Development	0.461	0.675	0.908	1.047	1.794

As illustrated in **Table 5.4.4**, the post-development peak flows can be attenuated to the SWM criteria as outlined in Section 3.0 to within predevelopment conditions up to the 100 year storm. The post development regional storm peak flow has been attenuated to a level less than the allowable rate range of 1.87 to 2.22 m^3/s.

The MIDUSS output for the quantity control can be found in **Appendix B**.

The runoff volumes are summarized in **Table 5.4.5**.

Table 5.4.5 – Runoff Volumes (in m^3)

	25 Yr	% Increase	100 Yr	% Increase	Regional	% Increase
Pre-Development	25290	--	37779	--	147130	--
Post-Development	29742	18%	41109	9%	121860	-17%

Although it indicates an increase in runoff volumes for the 25 year and the 100-year storm of 18% and 9%, respectively, the Regional runoff volume has been decreased by 17%. This is representative of the combination of the developed conditions and the diversion of catchments 101 and 102 to the south. The increase in runoff volume for the 25 and 100 year storms is not a concern, as the peak flows from these storms have been controlled to within the pre-development conditions.

The final ponding elevations are summarized in **Table 5.4.6**.

Table 5.4.6 – Summary of Maximum SWM Facility Ponding Elevations

Storm Event	SWMF1		SWMF2		HCDF	
	Max. Ponding Elevation (m)	Depth (m)	Max. Ponding Elevation (m)	Depth (m)	Max. Ponding Elevation (m)	Depth (m)
Permanent Pool	378.00	0.00	378.00	0.00	377.00	0.00
2 Year	378.91	0.91	378.39	0.39	378.48	1.48
5 Year	379.15	1.15	378.50	0.50	378.78	1.78
25 Year	379.82	1.82	378.80	0.80	379.23	2.23
100 Year	380.28	2.28	379.03	1.03	379.57	2.57
Regional	382.49	4.49	380.16	2.16	380.56	3.56

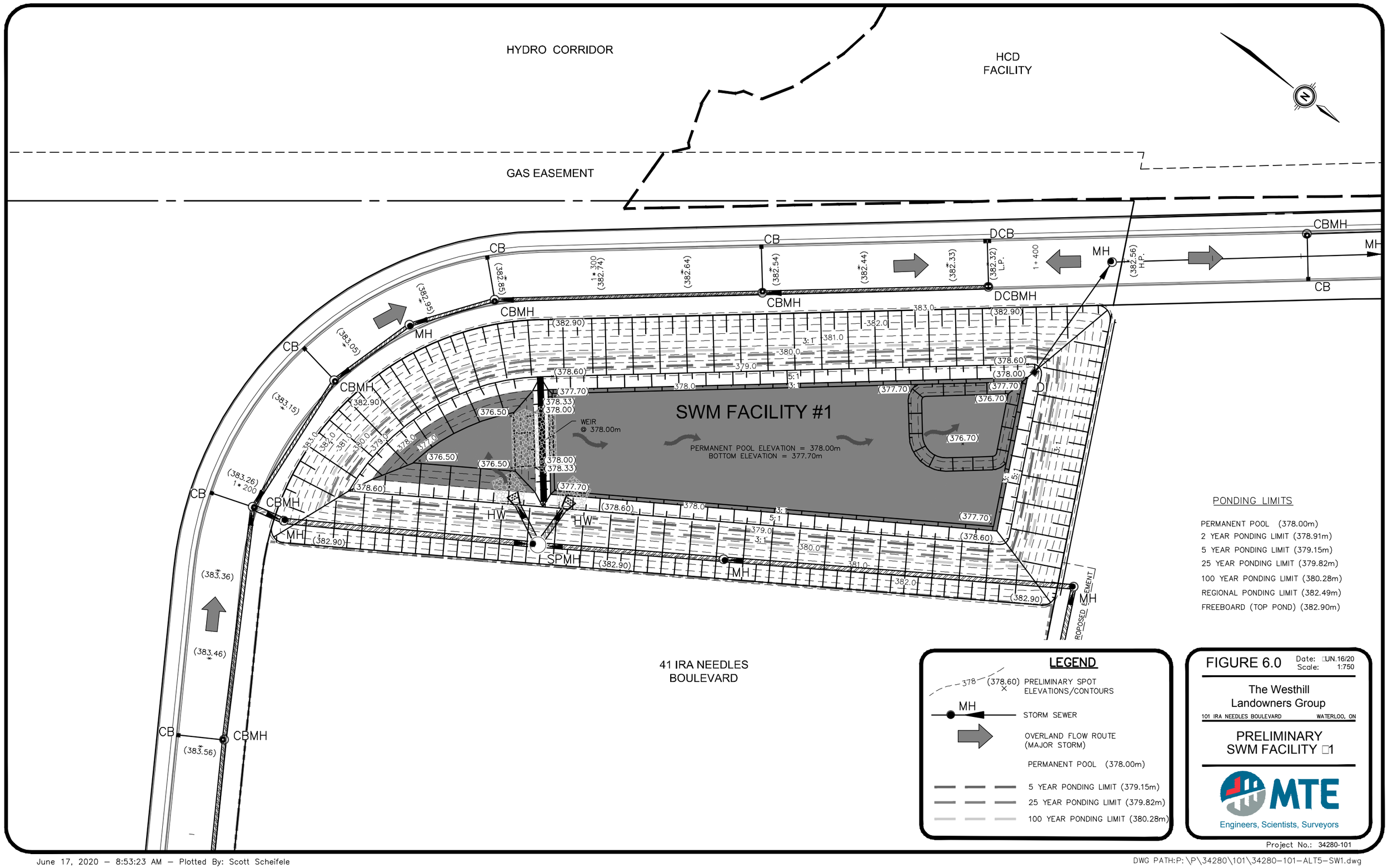
Note: Generally, flood elevations outlined in the table above will be maintained regardless whether the Westhill external lands (sub-catchments 107 to 112) is directed to either SWMF1 or SWMF2, however, size and storage volumes will be increased (SWMF2) or reduced (SWMF1) accordingly.

A third stormwater detention area was modelled being the HCDF within the hydro corridor. The maximum ponding levels within the HCDF has been maintained to pre-development conditions. No earthworks are proposed to occur within the area and the proposed ponding level is 380.56 mASL (post to pre). In order to generally maintain the pre-development water level in post development conditions, an optimized outlet structure has been proposed. The retention area has been designed to minimize increases on post development flooding elevations for the 2, 5, 25, 100 year storms. The Regional storm elevation mimics current conditions.

5.5 Wetland Habitat Restoration

A detail planting design for the SWMFs will be completed at final design. The landscaping of the facilities is for aesthetics, temperature mitigation, erosion protection, restoration of wetland habitat, long term stability of the banks, and to limit pedestrian access into its permanent pool components. Where suitable vegetation is present, efforts should be made to harvest the existing substrate and root mass which contains wetland bio matter for re-use in wetland cells proposed for SWMF1 and SWMF2. Open-water areas are dominated by European Reed (*Phragmites*), an invasive non-native species; in those areas, seedbank and/or rootwad salvage is not recommended. Rather, it is proposed that Phragmites be removed and disposed of per current best practices. Seedbank salvage will be considered in other areas, where appropriate.

Along the permanent water line, large emergent root masses are proposed to expedite the establishment of waterline vegetation to add to the cooling process, and form barriers to deter waterfowl. Recommended plant species will be selected from those included in the Region of Waterloo's list of Native Shrubs and Trees. Mature deciduous trees and coniferous trees will be specified along the southern top of bank areas to provide immediate shade protection to cool water before it exits the SWMFs. Additional native species plantings and/or seeding will be specified in remaining SWM areas.



PONDING LIMITS

PERMANENT POOL (378.00m)
2 YEAR PONDING LIMIT (378.91m)
5 YEAR PONDING LIMIT (379.15m)
25 YEAR PONDING LIMIT (379.82m)
100 YEAR PONDING LIMIT (380.28m)
REGIONAL PONDING LIMIT (382.49m)
FREEBOARD (TOP POND) (382.90m)

LEGEND

- (378.60) PRELIMINARY SPOT ELEVATIONS/CONTOURS
- MH — STORM SEWER
- OVERLAND FLOW ROUTE (MAJOR STORM)
- PERMANENT POOL (378.00m)
- 5 YEAR PONDING LIMIT (379.15m)
- 25 YEAR PONDING LIMIT (379.82m)
- 100 YEAR PONDING LIMIT (380.28m)

FIGURE 6.0

Date: JUN.16/20
Scale: 1:750

The Westhill Landowners Group

101 IRA NEEDLES BOULEVARD WATERLOO, ON

PRELIMINARY SWM FACILITY #1

MTE Engineers, Scientists, Surveyors

Project No.: 34280-101

June 17, 2020 – 8:53:23 AM – Plotted By: Scott Scheifele

DWG PATH:P:\P\34280\101\34280-101-ALT5-SW1.dwg

HYDRO CORRIDOR

HCD
FACILITY

GAS EASEMENT

MH (382.03) 1.5% 500 (381.83) CBMH CB (381.63) (381.43) CBMH (381.23) MH (381.03) 1.5% 600 (380.83) MH DCBMH (380.68) L.P. (381.02) MH DCB (381.52) MH MH 1.5% 780

(381.30) (381.30) 381.0 380.0 379.0 378.0 (378.60) (378.60) (377.70) (376.50) WEIR @ 378.00m (377.70)

PERMANENT POOL ELEVATION = 378.00m
BOTTOM ELEVATION = 377.70m

(381.30) (376.50) 377.0 378.0 378.0 (377.70) (377.70) (377.70) 376.70 D 377.0 (377.69) 378.0 (378.60) (378.60) 379.0 380.0 (381.30) 381.0 (381.30)

MH MH SPMH HW HW

MH

PROPOSED DEVELOPMENT
EXISTING DEVELOPMENT

PONDING LIMITS

PERMANENT POOL (378.00m)
2 YEAR PONDING LIMIT (378.39m)
5 YEAR PONDING LIMIT (378.50m)
25 YEAR PONDING LIMIT (378.80m)
100 YEAR PONDING LIMIT (379.03m)
REGIONAL PONDING LIMIT (380.16m)
FREEBOARD (TOP POND) (381.30m)

LEGEND

378 (378.60) PRELIMINARY SPOT ELEVATIONS/CONTOURS
MH STORM SEWER
OVERLAND FLOW ROUTE (MAJOR STORM)
PERMANENT POOL (378.00m)
5 YEAR PONDING LIMIT (378.50m)
25 YEAR PONDING LIMIT (378.80m)
100 YEAR PONDING LIMIT (379.03m)

WATERLOO COMMONS
651-663
ERB STREET WEST

FIGURE 7.0 Date: JUN.16/20 Scale: 1:750

The Westhill
Landowners Group
101 IRA NEEDLES BOULEVARD WATERLOO, ON

PRELIMINARY
SWM FACILITY 2

MTE
Engineers, Scientists, Surveyors

Project No.: 34280-101

June 17, 2020 – 8:56:02 AM – Plotted By: Scott Scheifele

DWG PATH:P:\P\34280\101\34280-101-ALT5-SW1.dwg

W2

HYDRO CORRIDOR

HCD FACILITY
POST DEVELOPMENT
REGIONAL PONDING LIMIT
(381.56m)
PERMANENT POOL ELEVATION = 377.00m

W1

W1

W1

GAS EASEMENT

SWM FACILITY #1
POST DEVELOPMENT
REGIONAL PONDING LIMIT (382.4□m)

SWM FACILITY #2
POST DEVELOPMENT
REGIONAL PONDING LIMIT (380.16m)

PONDING LIMITS

PERMANENT POOL (377.00m)
2 YEAR PONDING LIMIT (378.48m)
5 YEAR PONDING LIMIT (378.78m)
25 YEAR PONDING LIMIT (379.23m)
100 YEAR PONDING LIMIT (379.57m)
REGIONAL PONDING LIMIT (380.56m)

LEGEND

- HYDRO CORRIDOR DETENTION (HCD) FACILITY LIMIT
- (378.60) × 378 — PRELIMINARY SPOT ELEVATIONS/CONTOURS
- MH — STORM SEWER
- OVERLAND FLOW ROUTE (MAJOR STORM)
- W1 — STANDING WATER w/ ECOLOGICAL VEGETATION/FUNCTION IDENTIFIER
- 1 — DRAINAGE FEATURE IDENTIFIER

FIGURE 8.0 Date: □UN.16/20 Scale: 1:1000

The Westhill
Landowners Group
101 IRA NEEDLES BOULEVARD WATERLOO, ON

HYDRO CORRIDOR
DETENTION FACILITY

MTE
Engineers, Scientists, Surveyors

Project No.: 34280-101

June 17, 2020 – 9:03:06 AM – Plotted By: Scott Scheifele

DWG PATH:P:\P\34280\101\34280-101-ALT5-SW1.dwg

6.0 Erosion and Sediment Control Measures

Available soils information indicates that silt and clay is the predominant surficial soil underlying the subject lands. Precautions will be taken during construction to limit erosion and sedimentation. Erosion and sediment control plans will be prepared for the subject lands during final design. The plans will illustrate the erosion and sediment control measures to be implemented during construction, which will limit the impacts associated with site development.

Typically, the recommended construction sequence for erosion and sediment control measures of upstream development is as follows:

- Placement of all sediment control fencing where required;
- Construction of permanent and temporary stormwater management ponds which will serve as sedimentation basins for the site during construction;
- Construction of temporary swales to direct runoff to sedimentation basins, with rock check dams as required to control velocities;
- Stripping and strategic placement of topsoil stockpiles; including placement of sediment control fencing around all stockpile areas; and,
- Re-vegetation of completed areas as soon as possible after construction, including those areas not slated for construction within 60 days.

Reporting of the inspection and monitoring results should be distributed to the Grand River Conservation Authority and the City of Waterloo.

7.0 Operation and Maintenance

It is recommended that during construction of the SWM facility inlets and outlets, monitoring and inspection of the erosion and sediment controls be conducted to ensure the satisfactory performance of these measures.

As noted in Section 6.0, during build out, the upstream lands of any proposed SWM facility should manage their own sediment. It is recommended that the owners initiate a post-construction monitoring program to ensure the long term effectiveness of the SWMFs. The post-construction monitoring program should include:

- Periodic inspection of the SWMFs and other erosion control works;
- Inspection of the SWMF and its outlet after significant rainfall events (generally in excess of 10 mm of rainfall);
- Removal of debris that may accumulate and hinder functioning of the SWMF; and,
- Implementation of remedial measures including erosion stabilization, repair of damaged vegetation, and sediment removal, as required.

The monitoring program will be provided in the Final SWM Report.

8.0 Conclusions and Recommendations

Based on the foregoing analysis, it is concluded that:

- The water quality targets established in the *Subwatershed 314 Management Plan* required a normal (Level 2) of water quality has been improved by providing an enhanced (Level 1) quality control protection;
- Adequate storage and discharge control can be established in the SWMFs and HCDF to reduce the 2 year, 5 year, 25 year, 100-year post-development peak flows to pre-development levels;
- The regional storm has been controlled to the allowable rate established by *Subcatchment 314 Management Plan* being the capacity of the original 24" (610mm) CSP culvert;
- The final preferred SWM strategy will incorporate two municipal SWMFs on the development lands while maintaining existing detention storage on the HCDF. The outlet location (SWMF1 or SWMF2) for the Westhill external drainage area (sub-catchments 107 to 112) will be finalized through the development review process;
- Erosion and sediment controls will minimize negative impacts of construction activities on the receiving watercourse; and
- Wetland habitat restoration plans will be prepared for SWMF1 and SWMF2 in an effort to provide for the loss of wetland through the introduction of a SWMF.

It is recommended that the City of Waterloo approve the updated SWM strategy outlined in this report.

All of which is respectfully submitted,

MTE Consultants Inc.





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Appendix A

Westhill Culvert Capacity

WESTHILL DISTRICT PLAN
CULVERT CAPACITY DESIGN
Waterloo, Ontario

Project Number:	34280-101
Date:	May 20, 2020
Design By:	JEM
File:	M:\34280\101\Reports\SWM\APP A\Culvert Capacity.xlsx

CAPACITY OF 610mm CULVERT OPERATING UNDER REGIONAL STORM FLOOD HEAD

$$Q = CA\sqrt{2gH}$$ Orifice Plate Equation

where

Q = discharge (m^3/s)
H = head (m)

C =		orifice "C"
d =	*mm*	diameter of the orifice
A =	m^2	cross-sectional area of the orifice
g =	m/s^2	gravitational acceleration constant
	m	orifice invert elevation
	m	orifice centre elevation

	Orifice C=0.80	Orifice C=0.95	
G	9.810	9.810	= G
Diameter	0.610	0.610	
Area	0.292	0.292	= A
Orifice Coefficient	0.800	0.950	= Range of C
900mm Storm Outlet	376.820	376.820	
Orifice Invert	376.990	376.990	Invert of 610mm Culvert
Orifice Centre	377.295	377.295	Centre of 610mm Culvert
Max water level	380.560	380.560	Max Elevation of Backwater of Regional Storm Event
H	3.265	3.265	Head in m above the Centre of the 610mm Culvert
Flow	1.871	2.222	Q - Flow in m^3/s through the 610 mm Orifice based on the Orifice Equation

Appendix B

Hydrologic Modelling Output

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 7, 2010"
"           10   Units used:                                        ie METRIC"
"                Job folder:                                 Q:\34280\101\SWM\"
"                                                 SWM Options_February 18 2020"
"                Output filename:                                 Combined2.out"
"                Licensee name:                                               A"
"                Company                                                      "
"                Date & Time last used:               4/30/2020 at 3:15:48 PM"
" 31          TIME PARAMETERS"
"         5.000   Time Step"
"       180.000   Max. Storm length"
"      3000.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"             1   Chicago storm"
"       743.000   Coefficient A"
"         6.000   Constant B"
"         0.799   Exponent C"
"         0.400   Fraction R"
"       180.000   Duration"
"         1.000   Time step multiplier"
"              Maximum intensity          109.374    mm/hr"
"              Total depth                 34.259    mm"
"             6   002hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"             1   Triangular SCS"
"             1   Equal length"
"             1   SCS method"
"           101   Landfill"
"        20.000   % Impervious"
"        52.510   Total Area"
"       100.000   Flow length"
"         4.000   Overland Slope"
"        42.008   Pervious Area"
"       100.000   Pervious length"
"         4.000   Pervious slope"
"        10.502   Impervious Area"
"       100.000   Impervious length"
"         4.000   Impervious slope"
"         0.250   Pervious Manning 'n'"
"        75.000   Pervious SCS Curve No."
"         0.176   Pervious Runoff coefficient"
"         0.100   Pervious Ia/S coefficient"
"         8.467   Pervious Initial abstraction"
"         0.015   Impervious Manning 'n'"
"        98.000   Impervious SCS Curve No."
"         0.836   Impervious Runoff coefficient"
"         0.100   Impervious Ia/S coefficient"
"         0.518   Impervious Initial abstraction"
```

```
"                    2.206     0.000     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           42.008     10.502     52.510     hectare"
"             Time of concentration  43.981     3.696      22.102     minutes"
"             Time to Centroid       156.859    93.661     122.537    minutes"
"             Rainfall depth         34.259     34.259     34.259     mm"
"             Rainfall volume        1.4391     0.3598     1.7989     ha-m"
"             Rainfall losses        28.238     5.636      23.718     mm"
"             Runoff depth           6.020      28.623     10.541     mm"
"             Runoff volume          2528.95    3005.99    5534.94    c.m"
"             Runoff coefficient     0.176      0.836      0.308      "
"             Maximum flow           0.444      2.138      2.206      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    2.206     2.206     0.000     0.000"
" 54          POND DESIGN"
"        2.206   Current peak flow    c.m/sec"
"        3.548   Target outflow    c.m/sec"
"       5534.9   Hydrograph volume    c.m"
"          37.   Number of stages"
"      377.000   Minimum water level    metre"
"      380.600   Maximum water level    metre"
"      377.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                377.000     0.000     6.000"
"                377.100   0.03740    13.200"
"                377.200    0.1059    20.400"
"                377.300    0.1498    49.600"
"                377.400    0.1834   100.800"
"                377.500    0.2118   152.000"
"                377.600    0.2368   261.600"
"                377.700    0.2594   371.200"
"                377.800    0.2802   499.200"
"                377.900    0.2995   645.600"
"                378.000    0.3177   792.000"
"                378.100    0.3349   981.200"
"                378.200    0.3512  1170.400"
"                378.300    0.3668  1487.200"
"                378.400    0.3818  1931.600"
"                378.500    0.3962  2376.000"
"                378.600    0.4101  3212.800"
"                378.700    0.6001  4049.600"
"                378.800    0.6185  5044.200"
"                378.900    0.7113  6196.600"
"                379.000    0.7308  7349.000"
"                379.100    0.7498  8876.200"
"                379.200    0.7683  10403.40"
"                379.300    0.7864  12114.60"
"                379.400    0.8041  14009.80"
```

```
"                379.500    0.8646  15905.00"
"                379.600    0.8824  18103.40"
"                379.700    0.8999  20301.80"
"                379.800     1.284  22798.80"
"                379.900     1.308  25594.40"
"                380.000     1.331  28390.00"
"                380.100     1.353  31896.00"
"                380.200     1.376  35402.00"
"                380.300     1.398  39224.20"
"                380.400     1.419  43362.60"
"                380.500     1.441  47501.00"
"                380.600     1.462  52352.20"
"             Peak outflow                  0.393    c.m/sec"
"             Maximum level               378.476    metre"
"             Maximum storage            2270.591    c.m"
"             Centroidal lag                3.146   hours"
"                  2.206     2.206     0.393     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                "
"             Maximum flow                  0.393    c.m/sec"
"             Hydrograph volume          5531.697    c.m"
"                     2.206     2.206     0.393     0.393"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     2.206     0.000     0.393     0.393"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          201   Ira Needles"
"        81.400   % Impervious"
"         5.480   Total Area"
"       250.000   Flow length"
"         2.000   Overland Slope"
"         1.019   Pervious Area"
"       250.000   Pervious length"
"         2.000   Pervious slope"
"         4.461   Impervious Area"
"       250.000   Impervious length"
"         2.000   Impervious slope"
"         0.250   Pervious Manning 'n'"
"        74.000   Pervious SCS Curve No."
"         0.164   Pervious Runoff coefficient"
"         0.100   Pervious Ia/S coefficient"
"         8.924   Pervious Initial abstraction"
"         0.015   Impervious Manning 'n'"
"        98.000   Impervious SCS Curve No."
"         0.852   Impervious Runoff coefficient"
```

```
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.911     0.000     0.393     0.393 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           1.019      4.461      5.480      hectare"
"             Time of concentration  98.384     7.885      11.687     minutes"
"             Time to Centroid       221.598    99.893     105.006    minutes"
"             Rainfall depth         34.259     34.259     34.259     mm"
"             Rainfall volume        349.19     1528.18    1877.37    c.m"
"             Rainfall losses        28.657     5.072      9.459      mm"
"             Runoff depth           5.601      29.187     24.800     mm"
"             Runoff volume          57.09      1301.93    1359.03    c.m"
"             Runoff coefficient     0.164      0.852      0.724      "
"             Maximum flow           0.005      0.911      0.911      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.911     0.911     0.393     0.393"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.911     0.911     0.911     0.393"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                "
"             Maximum flow                  0.911    c.m/sec"
"             Hydrograph volume          1359.026    c.m"
"                     0.911     0.911     0.911     0.911"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.911     0.000     0.911     0.911"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          202   South Development Lands"
"       85.000   % Impervious"
"        7.680   Total Area"
"      300.000   Flow length"
"        2.000   Overland Slope"
"        1.152   Pervious Area"
"      300.000   Pervious length"
"        2.000   Pervious slope"
"        6.528   Impervious Area"
"      300.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       74.000   Pervious SCS Curve No."
"        0.163   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.924   Pervious Initial abstraction"
```

```
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.852   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     1.152     0.000     0.911     0.911 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           1.152      6.528      7.680      hectare"
"             Time of concentration  109.757    8.796      12.105     minutes"
"             Time to Centroid       235.201    101.169    105.561    minutes"
"             Rainfall depth         34.259     34.259     34.259     mm"
"             Rainfall volume        394.66     2236.40    2631.06    c.m"
"             Rainfall losses        28.657     5.085      8.621      mm"
"             Runoff depth           5.601      29.174     25.638     mm"
"             Runoff volume          64.53      1904.46    1968.99    c.m"
"             Runoff coefficient     0.163      0.852      0.748      "
"             Maximum flow           0.006      1.151      1.152      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     1.152     1.152     0.911     0.911"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     1.152     1.152     1.152     0.911"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                "
"             Maximum flow                  2.063    c.m/sec"
"             Hydrograph volume          3328.010    c.m"
"                     1.152     1.152     1.152     2.063"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     1.152     0.000     1.152     2.063"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          203   South ROW"
"       72.000   % Impervious"
"        1.521   Total Area"
"      250.000   Flow length"
"        2.000   Overland Slope"
"        0.426   Pervious Area"
"      250.000   Pervious length"
"        2.000   Pervious slope"
"        1.095   Impervious Area"
"      250.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       74.000   Pervious SCS Curve No."
```

```
"        0.164   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.924   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.852   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.224     0.000     1.152     2.063 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           0.426      1.095      1.521      hectare"
"             Time of concentration  98.384     7.885      14.170     minutes"
"             Time to Centroid       221.598    99.893     108.346    minutes"
"             Rainfall depth         34.259     34.259     34.259     mm"
"             Rainfall volume        145.90     375.17     521.07     c.m"
"             Rainfall losses        28.657     5.072      11.676     mm"
"             Runoff depth           5.601      29.187     22.583     mm"
"             Runoff volume          23.86      319.63     343.48     c.m"
"             Runoff coefficient     0.164      0.852      0.659      "
"             Maximum flow           0.002      0.224      0.224      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.224     0.224     1.152     2.063"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.224     0.224     0.224     2.063"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                "
"             Maximum flow                  2.286    c.m/sec"
"             Hydrograph volume          3671.494    c.m"
"                     0.224     0.224     0.224     2.286"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.224     0.000     0.224     2.286"
" 33          CATCHMENT 204"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          204   Home Hardware"
"       85.000   % Impervious"
"        3.231   Total Area"
"      100.000   Flow length"
"        2.000   Overland Slope"
"        0.485   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        2.746   Impervious Area"
"      100.000   Impervious length"
```

```
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       74.000   Pervious SCS Curve No."
"        0.163   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.924   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.846   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    0.574     0.000     0.224     2.286 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           0.485      2.746      3.231      hectare"
"             Time of concentration  56.775     4.550      6.273      minutes"
"             Time to Centroid       171.820    94.883     97.420     minutes"
"             Rainfall depth         34.259     34.259     34.259     mm"
"             Rainfall volume        166.03     940.86     1106.89    c.m"
"             Rainfall losses        28.658     5.281      8.787      mm"
"             Runoff depth           5.600      28.978     25.471     mm"
"             Runoff volume          27.14      795.83     822.97     c.m"
"             Runoff coefficient     0.163      0.846      0.743      "
"             Maximum flow           0.004      0.574      0.574      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.574     0.574     0.224     2.286"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.574     0.574     0.574     2.286"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                "
"             Maximum flow                  2.860    c.m/sec"
"             Hydrograph volume          4494.466    c.m"
"                    0.574     0.574     0.574     2.860"
" 40          HYDROGRAPH   Confluence    2"
"            7   Confluence "
"            2   Node #"
"                "
"             Maximum flow                  2.860    c.m/sec"
"             Hydrograph volume          4494.466    c.m"
"                    0.574     2.860     0.574     0.000"
" 54          POND DESIGN"
"        2.860   Current peak flow    c.m/sec"
"        3.548   Target outflow    c.m/sec"
"       4494.5   Hydrograph volume    c.m"
"          47.   Number of stages"
"      378.000   Minimum water level    metre"
"      382.600   Maximum water level    metre"
```

```
"      378.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                378.000   0.01000     0.000"
"                378.100   0.01200   374.900"
"                378.200   0.01400   767.600"
"                378.300   0.01500  1178.330"
"                378.400   0.01700  1607.130"
"                378.500   0.04100  2053.520"
"                378.600   0.04300  2517.640"
"                378.700   0.04600  2996.080"
"                378.800   0.04900  3485.290"
"                378.900   0.05110  3985.310"
"                379.000   0.05350  4496.230"
"                379.100   0.05570  5018.110"
"                379.200   0.05780  5551.010"
"                379.300   0.05990  6095.000"
"                379.400   0.08820  6650.140"
"                379.500   0.09100  7216.500"
"                379.600   0.09360  7794.140"
"                379.700   0.09620  8383.150"
"                379.800   0.09870  8983.590"
"                379.900    0.1011  9595.530"
"                380.000    0.1240  10219.06"
"                380.100    0.1270  10854.25"
"                380.200    0.1300  11501.17"
"                380.300    0.1324  12159.89"
"                380.400    0.1800  12830.50"
"                380.500    0.1830  13513.07"
"                380.600    0.1870  14207.68"
"                380.700    0.1900  14914.40"
"                380.800    0.1930  15633.32"
"                380.900    0.1970  16364.51"
"                381.000    0.1997  17108.05"
"                381.100    0.2028  17864.03"
"                381.200    0.2058  18632.52"
"                381.300    0.2088  19413.61"
"                381.400    0.2118  20207.37"
"                381.500    0.2147  21013.90"
"                381.600    0.2176  21833.28"
"                381.700    0.2204  22665.60"
"                381.800    0.2232  23510.94"
"                381.900    0.2260  24369.39"
"                382.000    0.2288  25241.05"
"                382.100    0.2315  26126.01"
"                382.200    0.2341  27024.37"
"                382.300    0.2368  27936.23"
"                382.400    0.2394  28861.70"
"                382.500    0.2420  29800.88"
"                382.600    0.2446  30753.91"
```

```
"             Peak outflow                  0.051    c.m/sec"
"             Maximum level               378.905    metre"
"             Maximum storage            4008.834    c.m"
"             Centroidal lag               19.266   hours"
"                  0.574     2.860     0.051     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                "
"             Maximum flow                  0.443    c.m/sec"
"             Hydrograph volume          9835.936    c.m"
"                     0.574     2.860     0.051     0.443"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.574     0.000     0.051     0.443"
" 33          CATCHMENT 301"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          301   North ROW"
"       72.000   % Impervious"
"        0.504   Total Area"
"      100.000   Flow length"
"        1.000   Overland Slope"
"        0.141   Pervious Area"
"      100.000   Pervious length"
"        1.000   Pervious slope"
"        0.363   Impervious Area"
"      100.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       74.000   Pervious SCS Curve No."
"        0.163   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.924   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.851   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.075     0.000     0.051     0.443 c.m/sec"
"             Catchment 301          Pervious   Impervious Total Area "
"             Surface Area           0.141      0.363      0.504      hectare"
"             Time of concentration  69.899     5.602      10.074     minutes"
"             Time to Centroid       187.521    96.413     102.749    minutes"
"             Rainfall depth         34.259     34.259     34.259     mm"
"             Rainfall volume        48.35      124.32     172.66     c.m"
"             Rainfall losses        28.658     5.120      11.710     mm"
"             Runoff depth           5.601      29.139     22.548     mm"
"             Runoff volume          7.90       105.74     113.64     c.m"
```

```
"             Runoff coefficient     0.163      0.851      0.658      "
"             Maximum flow           0.001      0.075      0.075      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.075     0.075     0.051     0.443"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.075     0.075     0.075     0.443"
" 40          HYDROGRAPH   Combine    3"
"            6   Combine "
"            3   Node #"
"                "
"             Maximum flow                  0.075    c.m/sec"
"             Hydrograph volume           113.642    c.m"
"                    0.075     0.075     0.075     0.075"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.075     0.000     0.075     0.075"
" 33          CATCHMENT 302"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          302   Waterloo Commons"
"       86.100   % Impervious"
"        5.057   Total Area"
"      250.000   Flow length"
"        2.000   Overland Slope"
"        0.703   Pervious Area"
"      250.000   Pervious length"
"        2.000   Pervious slope"
"        4.354   Impervious Area"
"      250.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       74.000   Pervious SCS Curve No."
"        0.164   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.924   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.852   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    0.889     0.000     0.075     0.075 c.m/sec"
"             Catchment 302          Pervious   Impervious Total Area "
"             Surface Area           0.703      4.354      5.057      hectare"
"             Time of concentration  98.384     7.885      10.605     minutes"
"             Time to Centroid       221.598    99.893     103.551    minutes"
"             Rainfall depth         34.259     34.259     34.259     mm"
"             Rainfall volume        240.81     1491.64    1732.46    c.m"
```

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"             Rainfall losses        28.657     5.072      8.350      mm"
"             Runoff depth           5.601      29.187     25.908     mm"
"             Runoff volume          39.37      1270.81    1310.18    c.m"
"             Runoff coefficient     0.164      0.852      0.756      "
"             Maximum flow           0.004      0.889      0.889      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.889     0.889     0.075     0.075"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.889     0.889     0.889     0.075"
" 40          HYDROGRAPH   Combine    3"
"            6   Combine "
"            3   Node #"
"                "
"             Maximum flow                  0.965    c.m/sec"
"             Hydrograph volume          1423.821    c.m"
"                    0.889     0.889     0.889     0.965"
" 40          HYDROGRAPH   Confluence    3"
"            7   Confluence "
"            3   Node #"
"                "
"             Maximum flow                  0.965    c.m/sec"
"             Hydrograph volume          1423.821    c.m"
"                    0.889     0.965     0.889     0.000"
" 54          POND DESIGN"
"         0.965   Current peak flow    c.m/sec"
"         3.548   Target outflow    c.m/sec"
"        1423.8   Hydrograph volume    c.m"
"           31.   Number of stages"
"       378.000   Minimum water level    metre"
"       381.000   Maximum water level    metre"
"       378.000   Starting water level    metre"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                 378.000     0.000     0.000"
"                 378.100  9.00E-05   302.890"
"                 378.200   0.01700   619.920"
"                 378.300   0.01780   951.440"
"                 378.400   0.01840  1297.850"
"                 378.500   0.01910  1659.560"
"                 378.600   0.01980  2037.050"
"                 378.700   0.03600  2431.620"
"                 378.800   0.03690  2833.700"
"                 378.900   0.03800  3243.320"
"                 379.000   0.03900  3660.550"
"                 379.100   0.05990  4085.430"
"                 379.200   0.06140  4518.010"
"                 379.300   0.06280  4958.340"
"                 379.400   0.06420  5406.490"
```

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"               379.500    0.1100  5862.560"
"               379.600    0.1120  6326.620"
"               379.700    0.1140  6798.770"
"               379.800    0.1160  7279.080"
"               379.900    0.1178  7767.640"
"               380.000    0.1198  8264.530"
"               380.100    0.1218  8769.840"
"               380.200    0.1238  9283.640"
"               380.300    0.1258  9806.040"
"               380.400    0.1277  10337.10"
"               380.500    0.1296  10876.91"
"               380.600    0.1314  11425.57"
"               380.700    0.1333  11983.14"
"               380.800    0.1351  12549.72"
"               380.900    0.1369  13125.39"
"               381.000    0.1387  13710.23"
"            Peak outflow                  0.018    c.m/sec"
"            Maximum level               378.388    metre"
"            Maximum storage            1257.057    c.m"
"            Centroidal lag               10.889   hours"
"                 0.889     0.965     0.018     0.000 c.m/sec"
" 40         HYDROGRAPH   Combine    1"
"           6   Combine "
"           1   Node #"
"               "
"            Maximum flow                  0.461    c.m/sec"
"            Hydrograph volume         10959.762    c.m"
"                    0.889     0.965     0.018     0.461"
" 40         HYDROGRAPH   Confluence    1"
"           7   Confluence "
"           1   Node #"
"               "
"            Maximum flow                  0.461    c.m/sec"
"            Hydrograph volume         10959.761    c.m"
"                    0.889     0.461     0.018     0.000"
" 51         PIPE DESIGN"
"       0.461   Current peak flow    c.m/sec"
"       0.013   Manning 'n'"
"       0.914   Diameter    metre"
"       0.500   Gradient   %"
"            Depth of flow                 0.371    metre"
"            Velocity                      1.847    m/sec"
"            Pipe capacity                 1.334    c.m/sec"
"            Critical depth                0.393    metre"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 7, 2010"
"           10   Units used:                                        ie METRIC"
"                Job folder:                                Q:\34280\101\SWM\"
"                                                 SWM Options_February 18 2020"
"                Output filename:                                Combined5.out"
"                Licensee name:                                              A"
"                Company                                                      "
"                Date & Time last used:              4/30/2020 at 3:24:51 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     3000.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1593.000   Coefficient A"
"       11.000   Constant B"
"        0.898   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          132.141    mm/hr"
"             Total depth                 42.776    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          101   Landfill"
"       20.000   % Impervious"
"       52.510   Total Area"
"      100.000   Flow length"
"        4.000   Overland Slope"
"       42.008   Pervious Area"
"      100.000   Pervious length"
"        4.000   Pervious slope"
"       10.502   Impervious Area"
"      100.000   Impervious length"
"        4.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.231   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.863   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
```

```
"                    2.914     0.000     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           42.008     10.502     52.510     hectare"
"             Time of concentration  34.665     3.394      19.571     minutes"
"             Time to Centroid       140.159    90.655     116.264    minutes"
"             Rainfall depth         42.776     42.776     42.776     mm"
"             Rainfall volume        1.7969     0.4492     2.2462     ha-m"
"             Rainfall losses        32.889     5.875      27.486     mm"
"             Runoff depth           9.887      36.901     15.289     mm"
"             Runoff volume          4153.17    3875.33    8028.50    c.m"
"             Runoff coefficient     0.231      0.863      0.357      "
"             Maximum flow           0.981      2.719      2.914      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    2.914     2.914     0.000     0.000"
" 54          POND DESIGN"
"        2.914   Current peak flow    c.m/sec"
"        3.548   Target outflow    c.m/sec"
"       8028.5   Hydrograph volume    c.m"
"          37.   Number of stages"
"      377.000   Minimum water level    metre"
"      380.600   Maximum water level    metre"
"      377.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                377.000     0.000     6.000"
"                377.100   0.03740    13.200"
"                377.200    0.1059    20.400"
"                377.300    0.1498    49.600"
"                377.400    0.1834   100.800"
"                377.500    0.2118   152.000"
"                377.600    0.2368   261.600"
"                377.700    0.2594   371.200"
"                377.800    0.2802   499.200"
"                377.900    0.2995   645.600"
"                378.000    0.3177   792.000"
"                378.100    0.3349   981.200"
"                378.200    0.3512  1170.400"
"                378.300    0.3668  1487.200"
"                378.400    0.3818  1931.600"
"                378.500    0.3962  2376.000"
"                378.600    0.4101  3212.800"
"                378.700    0.6001  4049.600"
"                378.800    0.6185  5044.200"
"                378.900    0.7113  6196.600"
"                379.000    0.7308  7349.000"
"                379.100    0.7498  8876.200"
"                379.200    0.7683  10403.40"
"                379.300    0.7864  12114.60"
"                379.400    0.8041  14009.80"
```

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"               379.500    0.8646  15905.00"
"               379.600    0.8824  18103.40"
"               379.700    0.8999  20301.80"
"               379.800     1.284  22798.80"
"               379.900     1.308  25594.40"
"               380.000     1.331  28390.00"
"               380.100     1.353  31896.00"
"               380.200     1.376  35402.00"
"               380.300     1.398  39224.20"
"               380.400     1.419  43362.60"
"               380.500     1.441  47501.00"
"               380.600     1.462  52352.20"
"            Peak outflow                 0.601    c.m/sec"
"            Maximum level              378.706    metre"
"            Maximum storage           4111.572    c.m"
"            Centroidal lag               3.491   hours"
"                 2.914     2.914     0.601     0.000 c.m/sec"
" 40         HYDROGRAPH   Combine    1"
"           6   Combine "
"           1   Node #"
"               "
"            Maximum flow                 0.601    c.m/sec"
"            Hydrograph volume         8030.748    c.m"
"                    2.914     2.914     0.601     0.601"
" 40         HYDROGRAPH Start - New Tributary"
"           2   Start - New Tributary"
"                    2.914     0.000     0.601     0.601"
" 33         CATCHMENT 201"
"           1   Triangular SCS"
"           1   Equal length"
"           1   SCS method"
"         201   Ira Needles"
"       81.400   % Impervious"
"        5.480   Total Area"
"      250.000   Flow length"
"        2.000   Overland Slope"
"        1.019   Pervious Area"
"      250.000   Pervious length"
"        2.000   Pervious slope"
"        4.461   Impervious Area"
"      250.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       74.000   Pervious SCS Curve No."
"        0.218   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.924   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.873   Impervious Runoff coefficient"
```

```
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     1.218     0.000     0.601     0.601 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           1.019      4.461      5.480      hectare"
"             Time of concentration  76.555     7.242      10.975     minutes"
"             Time to Centroid       191.053    96.178     101.288    minutes"
"             Rainfall depth         42.776     42.776     42.776     mm"
"             Rainfall volume        436.00     1908.10    2344.11    c.m"
"             Rainfall losses        33.468     5.415      10.633     mm"
"             Runoff depth           9.308      37.361     32.143     mm"
"             Runoff volume          94.87      1666.55    1761.43    c.m"
"             Runoff coefficient     0.218      0.873      0.751      "
"             Maximum flow           0.012      1.217      1.218      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     1.218     1.218     0.601     0.601"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     1.218     1.218     1.218     0.601"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                "
"             Maximum flow                  1.218    c.m/sec"
"             Hydrograph volume          1761.425    c.m"
"                     1.218     1.218     1.218     1.218"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     1.218     0.000     1.218     1.218"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          202   South Development Lands"
"       85.000   % Impervious"
"        7.680   Total Area"
"      300.000   Flow length"
"        2.000   Overland Slope"
"        1.152   Pervious Area"
"      300.000   Pervious length"
"        2.000   Pervious slope"
"        6.528   Impervious Area"
"      300.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       74.000   Pervious SCS Curve No."
"        0.218   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.924   Pervious Initial abstraction"
```

```
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.878   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     1.738     0.000     1.218     1.218 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           1.152      6.528      7.680      hectare"
"             Time of concentration  85.404     8.079      11.320     minutes"
"             Time to Centroid       201.796    97.372     101.749    minutes"
"             Rainfall depth         42.776     42.776     42.776     mm"
"             Rainfall volume        492.78     2792.40    3285.17    c.m"
"             Rainfall losses        33.468     5.232      9.467      mm"
"             Runoff depth           9.308      37.544     33.309     mm"
"             Runoff volume          107.23     2450.87    2558.10    c.m"
"             Runoff coefficient     0.218      0.878      0.779      "
"             Maximum flow           0.013      1.737      1.738      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     1.738     1.738     1.218     1.218"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     1.738     1.738     1.738     1.218"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                "
"             Maximum flow                  2.956    c.m/sec"
"             Hydrograph volume          4319.525    c.m"
"                     1.738     1.738     1.738     2.956"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     1.738     0.000     1.738     2.956"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          203   South ROW"
"       72.000   % Impervious"
"        1.521   Total Area"
"      250.000   Flow length"
"        2.000   Overland Slope"
"        0.426   Pervious Area"
"      250.000   Pervious length"
"        2.000   Pervious slope"
"        1.095   Impervious Area"
"      250.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       74.000   Pervious SCS Curve No."
```

```
"        0.218   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.924   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.873   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.299     0.000     1.738     2.956 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           0.426      1.095      1.521      hectare"
"             Time of concentration  76.555     7.242      13.364     minutes"
"             Time to Centroid       191.053    96.178     104.558    minutes"
"             Rainfall depth         42.776     42.776     42.776     mm"
"             Rainfall volume        182.17     468.45     650.62     c.m"
"             Rainfall losses        33.468     5.415      13.270     mm"
"             Runoff depth           9.308      37.361     29.506     mm"
"             Runoff volume          39.64      409.14     448.78     c.m"
"             Runoff coefficient     0.218      0.873      0.690      "
"             Maximum flow           0.005      0.299      0.299      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.299     0.299     1.738     2.956"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.299     0.299     0.299     2.956"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                "
"             Maximum flow                  3.255    c.m/sec"
"             Hydrograph volume          4768.311    c.m"
"                     0.299     0.299     0.299     3.255"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.299     0.000     0.299     3.255"
" 33          CATCHMENT 204"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          204   Home Hardware"
"       85.000   % Impervious"
"        3.231   Total Area"
"      100.000   Flow length"
"        2.000   Overland Slope"
"        0.485   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        2.746   Impervious Area"
"      100.000   Impervious length"
```

```
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       74.000   Pervious SCS Curve No."
"        0.217   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.924   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.870   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    0.743     0.000     0.299     3.255 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           0.485      2.746      3.231      hectare"
"             Time of concentration  44.178     4.179      5.869      minutes"
"             Time to Centroid       151.751    91.788     94.321     minutes"
"             Rainfall depth         42.776     42.776     42.776     mm"
"             Rainfall volume        207.31     1174.77    1382.08    c.m"
"             Rainfall losses        33.472     5.562      9.749      mm"
"             Runoff depth           9.303      37.214     33.027     mm"
"             Runoff volume          45.09      1022.02    1067.10    c.m"
"             Runoff coefficient     0.217      0.870      0.772      "
"             Maximum flow           0.009      0.742      0.743      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.743     0.743     0.299     3.255"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.743     0.743     0.743     3.255"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                "
"             Maximum flow                  3.998    c.m/sec"
"             Hydrograph volume          5835.416    c.m"
"                    0.743     0.743     0.743     3.998"
" 40          HYDROGRAPH   Confluence    2"
"            7   Confluence "
"            2   Node #"
"                "
"             Maximum flow                  3.998    c.m/sec"
"             Hydrograph volume          5835.415    c.m"
"                    0.743     3.998     0.743     0.000"
" 54          POND DESIGN"
"        3.998   Current peak flow    c.m/sec"
"        3.548   Target outflow    c.m/sec"
"       5835.4   Hydrograph volume    c.m"
"          47.   Number of stages"
"      378.000   Minimum water level    metre"
"      382.600   Maximum water level    metre"
```

```
"      378.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                378.000   0.01000     0.000"
"                378.100   0.01200   374.900"
"                378.200   0.01400   767.600"
"                378.300   0.01500  1178.330"
"                378.400   0.01700  1607.130"
"                378.500   0.04100  2053.520"
"                378.600   0.04300  2517.640"
"                378.700   0.04600  2996.080"
"                378.800   0.04900  3485.290"
"                378.900   0.05110  3985.310"
"                379.000   0.05350  4496.230"
"                379.100   0.05570  5018.110"
"                379.200   0.05780  5551.010"
"                379.300   0.05990  6095.000"
"                379.400   0.08820  6650.140"
"                379.500   0.09100  7216.500"
"                379.600   0.09360  7794.140"
"                379.700   0.09620  8383.150"
"                379.800   0.09870  8983.590"
"                379.900    0.1011  9595.530"
"                380.000    0.1240  10219.06"
"                380.100    0.1270  10854.25"
"                380.200    0.1300  11501.17"
"                380.300    0.1324  12159.89"
"                380.400    0.1800  12830.50"
"                380.500    0.1830  13513.07"
"                380.600    0.1870  14207.68"
"                380.700    0.1900  14914.40"
"                380.800    0.1930  15633.32"
"                380.900    0.1970  16364.51"
"                381.000    0.1997  17108.05"
"                381.100    0.2028  17864.03"
"                381.200    0.2058  18632.52"
"                381.300    0.2088  19413.61"
"                381.400    0.2118  20207.37"
"                381.500    0.2147  21013.90"
"                381.600    0.2176  21833.28"
"                381.700    0.2204  22665.60"
"                381.800    0.2232  23510.94"
"                381.900    0.2260  24369.39"
"                382.000    0.2288  25241.05"
"                382.100    0.2315  26126.01"
"                382.200    0.2341  27024.37"
"                382.300    0.2368  27936.23"
"                382.400    0.2394  28861.70"
"                382.500    0.2420  29800.88"
"                382.600    0.2446  30753.91"
```

```
"             Peak outflow                  0.057    c.m/sec"
"             Maximum level               379.151    metre"
"             Maximum storage            5292.047    c.m"
"             Centroidal lag               20.928   hours"
"                  0.743     3.998     0.057     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                "
"             Maximum flow                  0.657    c.m/sec"
"             Hydrograph volume         13458.757    c.m"
"                     0.743     3.998     0.057     0.657"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.743     0.000     0.057     0.657"
" 33          CATCHMENT 301"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          301   North ROW"
"       72.000   % Impervious"
"        0.504   Total Area"
"      100.000   Flow length"
"        1.000   Overland Slope"
"        0.141   Pervious Area"
"      100.000   Pervious length"
"        1.000   Pervious slope"
"        0.363   Impervious Area"
"      100.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       74.000   Pervious SCS Curve No."
"        0.218   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.924   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.873   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.100     0.000     0.057     0.657 c.m/sec"
"             Catchment 301          Pervious   Impervious Total Area "
"             Surface Area           0.141      0.363      0.504      hectare"
"             Time of concentration  54.390     5.145      9.496      minutes"
"             Time to Centroid       164.150    93.149     99.422     minutes"
"             Rainfall depth         42.776     42.776     42.776     mm"
"             Rainfall volume        60.37      155.22     215.59     c.m"
"             Rainfall losses        33.468     5.424      13.276     mm"
"             Runoff depth           9.308      37.352     29.499     mm"
"             Runoff volume          13.14      135.54     148.68     c.m"
```

```
"             Runoff coefficient     0.218      0.873      0.690      "
"             Maximum flow           0.002      0.100      0.100      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.100     0.100     0.057     0.657"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.100     0.100     0.100     0.657"
" 40          HYDROGRAPH   Combine    3"
"            6   Combine "
"            3   Node #"
"                "
"             Maximum flow                  0.100    c.m/sec"
"             Hydrograph volume           148.677    c.m"
"                    0.100     0.100     0.100     0.100"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.100     0.000     0.100     0.100"
" 33          CATCHMENT 302"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          302   Waterloo Commons"
"       86.100   % Impervious"
"        5.057   Total Area"
"      250.000   Flow length"
"        2.000   Overland Slope"
"        0.703   Pervious Area"
"      250.000   Pervious length"
"        2.000   Pervious slope"
"        4.354   Impervious Area"
"      250.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       74.000   Pervious SCS Curve No."
"        0.218   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.924   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.873   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    1.189     0.000     0.100     0.100 c.m/sec"
"             Catchment 302          Pervious   Impervious Total Area "
"             Surface Area           0.703      4.354      5.057      hectare"
"             Time of concentration  76.555     7.242      9.922      minutes"
"             Time to Centroid       191.053    96.178     99.846     minutes"
"             Rainfall depth         42.776     42.776     42.776     mm"
"             Rainfall volume        300.68     1862.49    2163.17    c.m"
```

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"             Rainfall losses        33.468     5.415      9.314      mm"
"             Runoff depth           9.308      37.361     33.461     mm"
"             Runoff volume          65.43      1626.71    1692.14    c.m"
"             Runoff coefficient     0.218      0.873      0.782      "
"             Maximum flow           0.008      1.188      1.189      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    1.189     1.189     0.100     0.100"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    1.189     1.189     1.189     0.100"
" 40          HYDROGRAPH   Combine    3"
"            6   Combine "
"            3   Node #"
"                "
"             Maximum flow                  1.289    c.m/sec"
"             Hydrograph volume          1840.813    c.m"
"                    1.189     1.189     1.189     1.289"
" 40          HYDROGRAPH   Confluence    3"
"            7   Confluence "
"            3   Node #"
"                "
"             Maximum flow                  1.289    c.m/sec"
"             Hydrograph volume          1840.813    c.m"
"                    1.189     1.289     1.189     0.000"
" 54          POND DESIGN"
"         1.289   Current peak flow    c.m/sec"
"         3.548   Target outflow    c.m/sec"
"        1840.8   Hydrograph volume    c.m"
"           31.   Number of stages"
"       378.000   Minimum water level    metre"
"       381.000   Maximum water level    metre"
"       378.000   Starting water level    metre"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                 378.000     0.000     0.000"
"                 378.100  9.00E-05   302.890"
"                 378.200   0.01700   619.920"
"                 378.300   0.01780   951.440"
"                 378.400   0.01840  1297.850"
"                 378.500   0.01910  1659.560"
"                 378.600   0.01980  2037.050"
"                 378.700   0.03600  2431.620"
"                 378.800   0.03690  2833.700"
"                 378.900   0.03800  3243.320"
"                 379.000   0.03900  3660.550"
"                 379.100   0.05990  4085.430"
"                 379.200   0.06140  4518.010"
"                 379.300   0.06280  4958.340"
"                 379.400   0.06420  5406.490"
```

```
"               379.500    0.1100  5862.560"
"               379.600    0.1120  6326.620"
"               379.700    0.1140  6798.770"
"               379.800    0.1160  7279.080"
"               379.900    0.1178  7767.640"
"               380.000    0.1198  8264.530"
"               380.100    0.1218  8769.840"
"               380.200    0.1238  9283.640"
"               380.300    0.1258  9806.040"
"               380.400    0.1277  10337.10"
"               380.500    0.1296  10876.91"
"               380.600    0.1314  11425.57"
"               380.700    0.1333  11983.14"
"               380.800    0.1351  12549.72"
"               380.900    0.1369  13125.39"
"               381.000    0.1387  13710.23"
"            Peak outflow                  0.019    c.m/sec"
"            Maximum level               378.501    metre"
"            Maximum storage            1663.526    c.m"
"            Centroidal lag               13.496   hours"
"                 1.189     1.289     0.019     0.000 c.m/sec"
" 40         HYDROGRAPH   Combine    1"
"           6   Combine "
"           1   Node #"
"               "
"            Maximum flow                  0.675    c.m/sec"
"            Hydrograph volume         14997.650    c.m"
"                    1.189     1.289     0.019     0.675"
" 40         HYDROGRAPH   Confluence    1"
"           7   Confluence "
"           1   Node #"
"               "
"            Maximum flow                  0.675    c.m/sec"
"            Hydrograph volume         14997.650    c.m"
"                    1.189     0.675     0.019     0.000"
" 51         PIPE DESIGN"
"       0.675   Current peak flow    c.m/sec"
"       0.013   Manning 'n'"
"       0.914   Diameter    metre"
"       0.500   Gradient   %"
"            Depth of flow                 0.460    metre"
"            Velocity                      2.039    m/sec"
"            Pipe capacity                 1.334    c.m/sec"
"            Critical depth                0.480    metre"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 7, 2010"
"           10   Units used:                                        ie METRIC"
"                Job folder:                                Q:\34280\101\SWM\"
"                                                 SWM Options_February 18 2020"
"                Output filename:                                Combined25.out"
"                Licensee name:                                              A"
"                Company                                                      "
"                Date & Time last used:              4/30/2020 at 3:30:34 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     3000.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     3158.000   Coefficient A"
"       15.000   Constant B"
"        0.936   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          191.557    mm/hr"
"             Total depth                 68.266    mm"
"            6   025hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          101   Landfill"
"       20.000   % Impervious"
"       52.510   Total Area"
"      100.000   Flow length"
"        4.000   Overland Slope"
"       42.008   Pervious Area"
"      100.000   Pervious length"
"        4.000   Pervious slope"
"       10.502   Impervious Area"
"      100.000   Impervious length"
"        4.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.362   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.901   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
```

```
"                    5.072     0.000     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           42.008     10.502     52.510     hectare"
"             Time of concentration  23.624     2.891      15.678     minutes"
"             Time to Centroid       124.055    88.683     110.500    minutes"
"             Rainfall depth         68.266     68.266     68.266     mm"
"             Rainfall volume        2.8677     0.7169     3.5847     ha-m"
"             Rainfall losses        43.529     6.786      36.181     mm"
"             Runoff depth           24.737     61.480     32.086     mm"
"             Runoff volume          1.0392     0.6457     1.6848     ha-m"
"             Runoff coefficient     0.362      0.901      0.470      "
"             Maximum flow           3.345      4.297      5.072      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    5.072     5.072     0.000     0.000"
" 54          POND DESIGN"
"        5.072   Current peak flow    c.m/sec"
"        3.548   Target outflow    c.m/sec"
"      16848.2   Hydrograph volume    c.m"
"          37.   Number of stages"
"      377.000   Minimum water level    metre"
"      380.600   Maximum water level    metre"
"      377.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                377.000     0.000     6.000"
"                377.100   0.03740    13.200"
"                377.200    0.1059    20.400"
"                377.300    0.1498    49.600"
"                377.400    0.1834   100.800"
"                377.500    0.2118   152.000"
"                377.600    0.2368   261.600"
"                377.700    0.2594   371.200"
"                377.800    0.2802   499.200"
"                377.900    0.2995   645.600"
"                378.000    0.3177   792.000"
"                378.100    0.3349   981.200"
"                378.200    0.3512  1170.400"
"                378.300    0.3668  1487.200"
"                378.400    0.3818  1931.600"
"                378.500    0.3962  2376.000"
"                378.600    0.4101  3212.800"
"                378.700    0.6001  4049.600"
"                378.800    0.6185  5044.200"
"                378.900    0.7113  6196.600"
"                379.000    0.7308  7349.000"
"                379.100    0.7498  8876.200"
"                379.200    0.7683  10403.40"
"                379.300    0.7864  12114.60"
"                379.400    0.8041  14009.80"
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"                379.500    0.8646  15905.00"
"                379.600    0.8824  18103.40"
"                379.700    0.8999  20301.80"
"                379.800     1.284  22798.80"
"                379.900     1.308  25594.40"
"                380.000     1.331  28390.00"
"                380.100     1.353  31896.00"
"                380.200     1.376  35402.00"
"                380.300     1.398  39224.20"
"                380.400     1.419  43362.60"
"                380.500     1.441  47501.00"
"                380.600     1.462  52352.20"
"             Peak outflow                  0.774    c.m/sec"
"             Maximum level               379.229    metre"
"             Maximum storage           10896.726    c.m"
"             Centroidal lag                4.473   hours"
"                  5.072     5.072     0.774     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                "
"             Maximum flow                  0.774    c.m/sec"
"             Hydrograph volume         16852.020    c.m"
"                     5.072     5.072     0.774     0.774"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     5.072     0.000     0.774     0.774"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          201   Ira Needles"
"       81.400   % Impervious"
"        5.480   Total Area"
"      250.000   Flow length"
"        2.000   Overland Slope"
"        1.019   Pervious Area"
"      250.000   Pervious length"
"        2.000   Pervious slope"
"        4.461   Impervious Area"
"      250.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       74.000   Pervious SCS Curve No."
"        0.347   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.924   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.916   Impervious Runoff coefficient"
```

```
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     1.892     0.000     0.774     0.774 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           1.019      4.461      5.480      hectare"
"             Time of concentration  51.517     6.167      9.779      minutes"
"             Time to Centroid       158.815    93.313     98.532     minutes"
"             Rainfall depth         68.266     68.266     68.266     mm"
"             Rainfall volume        695.82     3045.17    3740.99    c.m"
"             Rainfall losses        44.573     5.714      12.942     mm"
"             Runoff depth           23.694     62.552     55.325     mm"
"             Runoff volume          241.50     2790.28    3031.77    c.m"
"             Runoff coefficient     0.347      0.916      0.810      "
"             Maximum flow           0.044      1.886      1.892      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     1.892     1.892     0.774     0.774"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     1.892     1.892     1.892     0.774"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                "
"             Maximum flow                  1.892    c.m/sec"
"             Hydrograph volume          3031.771    c.m"
"                     1.892     1.892     1.892     1.892"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     1.892     0.000     1.892     1.892"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          202   South Development Lands"
"       85.000   % Impervious"
"        7.680   Total Area"
"      300.000   Flow length"
"        2.000   Overland Slope"
"        1.152   Pervious Area"
"      300.000   Pervious length"
"        2.000   Pervious slope"
"        6.528   Impervious Area"
"      300.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       74.000   Pervious SCS Curve No."
"        0.347   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.924   Pervious Initial abstraction"
```

```
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.913   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     2.852     0.000     1.892     1.892 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           1.152      6.528      7.680      hectare"
"             Time of concentration  57.472     6.880      10.062     minutes"
"             Time to Centroid       166.212    94.278     98.803     minutes"
"             Rainfall depth         68.266     68.266     68.266     mm"
"             Rainfall volume        786.43     4456.42    5242.85    c.m"
"             Rainfall losses        44.572     5.971      11.761     mm"
"             Runoff depth           23.695     62.296     56.505     mm"
"             Runoff volume          272.96     4066.65    4339.60    c.m"
"             Runoff coefficient     0.347      0.913      0.828      "
"             Maximum flow           0.045      2.846      2.852      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     2.852     2.852     1.892     1.892"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     2.852     2.852     2.852     1.892"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                "
"             Maximum flow                  4.743    c.m/sec"
"             Hydrograph volume          7371.368    c.m"
"                     2.852     2.852     2.852     4.743"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     2.852     0.000     2.852     4.743"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          203   South ROW"
"       72.000   % Impervious"
"        1.521   Total Area"
"      250.000   Flow length"
"        2.000   Overland Slope"
"        0.426   Pervious Area"
"      250.000   Pervious length"
"        2.000   Pervious slope"
"        1.095   Impervious Area"
"      250.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       74.000   Pervious SCS Curve No."
```

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"        0.347   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.924   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.916   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.465     0.000     2.852     4.743 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           0.426      1.095      1.521      hectare"
"             Time of concentration  51.517     6.167      11.989     minutes"
"             Time to Centroid       158.815    93.313     101.723    minutes"
"             Rainfall depth         68.266     68.266     68.266     mm"
"             Rainfall volume        290.73     747.60     1038.33    c.m"
"             Rainfall losses        44.573     5.714      16.594     mm"
"             Runoff depth           23.694     62.552     51.672     mm"
"             Runoff volume          100.91     685.02     785.93     c.m"
"             Runoff coefficient     0.347      0.916      0.757      "
"             Maximum flow           0.018      0.463      0.465      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.465     0.465     2.852     4.743"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.465     0.465     0.465     4.743"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                "
"             Maximum flow                  5.209    c.m/sec"
"             Hydrograph volume          8157.292    c.m"
"                     0.465     0.465     0.465     5.209"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.465     0.000     0.465     5.209"
" 33          CATCHMENT 204"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          204   Home Hardware"
"       85.000   % Impervious"
"        3.231   Total Area"
"      100.000   Flow length"
"        2.000   Overland Slope"
"        0.485   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        2.746   Impervious Area"
"      100.000   Impervious length"
```

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"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       74.000   Pervious SCS Curve No."
"        0.347   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.924   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.903   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    1.108     0.000     0.465     5.209 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           0.485      2.746      3.231      hectare"
"             Time of concentration  29.729     3.559      5.222      minutes"
"             Time to Centroid       131.780    89.678     92.353     minutes"
"             Rainfall depth         68.266     68.266     68.266     mm"
"             Rainfall volume        330.85     1874.83    2205.68    c.m"
"             Rainfall losses        44.573     6.654      12.342     mm"
"             Runoff depth           23.693     61.613     55.925     mm"
"             Runoff volume          114.83     1692.10    1806.92    c.m"
"             Runoff coefficient     0.347      0.903      0.819      "
"             Maximum flow           0.032      1.100      1.108      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    1.108     1.108     0.465     5.209"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    1.108     1.108     1.108     5.209"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                "
"             Maximum flow                 6.317    c.m/sec"
"             Hydrograph volume          9964.197    c.m"
"                    1.108     1.108     1.108     6.317"
" 40          HYDROGRAPH   Confluence    2"
"            7   Confluence "
"            2   Node #"
"                "
"             Maximum flow                 6.317    c.m/sec"
"             Hydrograph volume          9964.197    c.m"
"                    1.108     6.317     1.108     0.000"
" 54          POND DESIGN"
"        6.317   Current peak flow    c.m/sec"
"        3.548   Target outflow    c.m/sec"
"       9964.2   Hydrograph volume    c.m"
"          47.   Number of stages"
"      378.000   Minimum water level    metre"
"      382.600   Maximum water level    metre"
```

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"      378.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                378.000   0.01000     0.000"
"                378.100   0.01200   374.900"
"                378.200   0.01400   767.600"
"                378.300   0.01500  1178.330"
"                378.400   0.01700  1607.130"
"                378.500   0.04100  2053.520"
"                378.600   0.04300  2517.640"
"                378.700   0.04600  2996.080"
"                378.800   0.04900  3485.290"
"                378.900   0.05110  3985.310"
"                379.000   0.05350  4496.230"
"                379.100   0.05570  5018.110"
"                379.200   0.05780  5551.010"
"                379.300   0.05990  6095.000"
"                379.400   0.08820  6650.140"
"                379.500   0.09100  7216.500"
"                379.600   0.09360  7794.140"
"                379.700   0.09620  8383.150"
"                379.800   0.09870  8983.590"
"                379.900    0.1011  9595.530"
"                380.000    0.1240  10219.06"
"                380.100    0.1270  10854.25"
"                380.200    0.1300  11501.17"
"                380.300    0.1324  12159.89"
"                380.400    0.1800  12830.50"
"                380.500    0.1830  13513.07"
"                380.600    0.1870  14207.68"
"                380.700    0.1900  14914.40"
"                380.800    0.1930  15633.32"
"                380.900    0.1970  16364.51"
"                381.000    0.1997  17108.05"
"                381.100    0.2028  17864.03"
"                381.200    0.2058  18632.52"
"                381.300    0.2088  19413.61"
"                381.400    0.2118  20207.37"
"                381.500    0.2147  21013.90"
"                381.600    0.2176  21833.28"
"                381.700    0.2204  22665.60"
"                381.800    0.2232  23510.94"
"                381.900    0.2260  24369.39"
"                382.000    0.2288  25241.05"
"                382.100    0.2315  26126.01"
"                382.200    0.2341  27024.37"
"                382.300    0.2368  27936.23"
"                382.400    0.2394  28861.70"
"                382.500    0.2420  29800.88"
"                382.600    0.2446  30753.91"
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"             Peak outflow                  0.099    c.m/sec"
"             Maximum level               379.816    metre"
"             Maximum storage            9080.138    c.m"
"             Centroidal lag               23.119   hours"
"                  1.108     6.317     0.099     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                "
"             Maximum flow                  0.871    c.m/sec"
"             Hydrograph volume         25775.488    c.m"
"                     1.108     6.317     0.099     0.871"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     1.108     0.000     0.099     0.871"
" 33          CATCHMENT 301"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          301   North ROW"
"       72.000   % Impervious"
"        0.504   Total Area"
"      100.000   Flow length"
"        1.000   Overland Slope"
"        0.141   Pervious Area"
"      100.000   Pervious length"
"        1.000   Pervious slope"
"        0.363   Impervious Area"
"      100.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       74.000   Pervious SCS Curve No."
"        0.347   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.924   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.914   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.153     0.000     0.099     0.871 c.m/sec"
"             Catchment 301          Pervious   Impervious Total Area "
"             Surface Area           0.141      0.363      0.504      hectare"
"             Time of concentration  36.601     4.381      8.528      minutes"
"             Time to Centroid       140.304    90.806     97.176     minutes"
"             Rainfall depth         68.266     68.266     68.266     mm"
"             Rainfall volume        96.34      247.72     344.06     c.m"
"             Rainfall losses        44.573     5.886      16.718     mm"
"             Runoff depth           23.694     62.380     51.548     mm"
"             Runoff volume          33.44      226.36     259.80     c.m"
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"             Runoff coefficient     0.347      0.914      0.755      "
"             Maximum flow           0.008      0.151      0.153      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.153     0.153     0.099     0.871"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.153     0.153     0.153     0.871"
" 40          HYDROGRAPH   Combine    3"
"            6   Combine "
"            3   Node #"
"                "
"             Maximum flow                  0.153    c.m/sec"
"             Hydrograph volume           259.801    c.m"
"                    0.153     0.153     0.153     0.153"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.153     0.000     0.153     0.153"
" 33          CATCHMENT 302"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          302   Waterloo Commons"
"       86.100   % Impervious"
"        5.057   Total Area"
"      250.000   Flow length"
"        2.000   Overland Slope"
"        0.703   Pervious Area"
"      250.000   Pervious length"
"        2.000   Pervious slope"
"        4.354   Impervious Area"
"      250.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       74.000   Pervious SCS Curve No."
"        0.347   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.924   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.916   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    1.845     0.000     0.153     0.153 c.m/sec"
"             Catchment 302          Pervious   Impervious Total Area "
"             Surface Area           0.703      4.354      5.057      hectare"
"             Time of concentration  51.517     6.167      8.780      minutes"
"             Time to Centroid       158.815    93.313     97.089     minutes"
"             Rainfall depth         68.266     68.266     68.266     mm"
"             Rainfall volume        479.86     2972.36    3452.22    c.m"
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"             Rainfall losses        44.573     5.714      11.115     mm"
"             Runoff depth           23.694     62.552     57.151     mm"
"             Runoff volume          166.55     2723.57    2890.11    c.m"
"             Runoff coefficient     0.347      0.916      0.837      "
"             Maximum flow           0.030      1.841      1.845      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    1.845     1.845     0.153     0.153"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    1.845     1.845     1.845     0.153"
" 40          HYDROGRAPH   Combine    3"
"            6   Combine "
"            3   Node #"
"                "
"             Maximum flow                  1.998    c.m/sec"
"             Hydrograph volume          3149.909    c.m"
"                    1.845     1.845     1.845     1.998"
" 40          HYDROGRAPH   Confluence    3"
"            7   Confluence "
"            3   Node #"
"                "
"             Maximum flow                  1.998    c.m/sec"
"             Hydrograph volume          3149.909    c.m"
"                    1.845     1.998     1.845     0.000"
" 54          POND DESIGN"
"         1.998   Current peak flow    c.m/sec"
"         3.548   Target outflow    c.m/sec"
"        3149.9   Hydrograph volume    c.m"
"           31.   Number of stages"
"       378.000   Minimum water level    metre"
"       381.000   Maximum water level    metre"
"       378.000   Starting water level    metre"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                 378.000     0.000     0.000"
"                 378.100  9.00E-05   302.890"
"                 378.200   0.01700   619.920"
"                 378.300   0.01780   951.440"
"                 378.400   0.01840  1297.850"
"                 378.500   0.01910  1659.560"
"                 378.600   0.01980  2037.050"
"                 378.700   0.03600  2431.620"
"                 378.800   0.03690  2833.700"
"                 378.900   0.03800  3243.320"
"                 379.000   0.03900  3660.550"
"                 379.100   0.05990  4085.430"
"                 379.200   0.06140  4518.010"
"                 379.300   0.06280  4958.340"
"                 379.400   0.06420  5406.490"
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"               379.500    0.1100  5862.560"
"               379.600    0.1120  6326.620"
"               379.700    0.1140  6798.770"
"               379.800    0.1160  7279.080"
"               379.900    0.1178  7767.640"
"               380.000    0.1198  8264.530"
"               380.100    0.1218  8769.840"
"               380.200    0.1238  9283.640"
"               380.300    0.1258  9806.040"
"               380.400    0.1277  10337.10"
"               380.500    0.1296  10876.91"
"               380.600    0.1314  11425.57"
"               380.700    0.1333  11983.14"
"               380.800    0.1351  12549.72"
"               380.900    0.1369  13125.39"
"               381.000    0.1387  13710.23"
"             Peak outflow                  0.037    c.m/sec"
"             Maximum level               378.803    metre"
"             Maximum storage            2846.054    c.m"
"             Centroidal lag               16.948   hours"
"                  1.845     1.998     0.037     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                "
"             Maximum flow                  0.908    c.m/sec"
"             Hydrograph volume         28613.855    c.m"
"                     1.845     1.998     0.037     0.908"
" 40          HYDROGRAPH   Confluence    1"
"            7   Confluence "
"            1   Node #"
"                "
"             Maximum flow                  0.908    c.m/sec"
"             Hydrograph volume         28613.855    c.m"
"                     1.845     0.908     0.037     0.000"
" 51          PIPE DESIGN"
"         0.908   Current peak flow    c.m/sec"
"         0.013   Manning 'n'"
"         0.914   Diameter    metre"
"         0.500   Gradient   %"
"              Depth of flow                0.553    metre"
"              Velocity                     2.187    m/sec"
"              Pipe capacity                1.334    c.m/sec"
"              Critical depth               0.560    metre"
```

```
"                MIDUSS Output ------------------------------------------------>"
"                MIDUSS version                            Version 2.25  rev. 473"
"                MIDUSS created                          Sunday, February 7, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:                                  Q:\34280\101\SWM\"
"                                                  SWM Options_February 18 2020"
"                Output filename:                               Combined100.out"
"                Licensee name:                                               A"
"                Company                                                       "
"                Date & Time last used:                  4/30/2020 at 3:49:54 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     3000.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     4688.000   Coefficient A"
"       17.000   Constant B"
"        0.962   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           239.354    mm/hr"
"             Total depth                  87.079    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          101   Landfill"
"       20.000   % Impervious"
"       52.510   Total Area"
"      100.000   Flow length"
"        4.000   Overland Slope"
"       42.008   Pervious Area"
"      100.000   Pervious length"
"        4.000   Pervious slope"
"       10.502   Impervious Area"
"      100.000   Impervious length"
"        4.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.434   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.919   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
```

```
"                    7.410     0.000     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           42.008     10.502     52.510     hectare"
"             Time of concentration  19.759     2.635      13.831     minutes"
"             Time to Centroid       117.598    87.570     107.204    minutes"
"             Rainfall depth         87.079     87.079     87.079     mm"
"             Rainfall volume        3.6580     0.9145     4.5725     ha-m"
"             Rainfall losses        49.299     7.077      40.855     mm"
"             Runoff depth           37.780     80.002     46.224     mm"
"             Runoff volume          1.5871     0.8402     2.4272     ha-m"
"             Runoff coefficient     0.434      0.919      0.531      "
"             Maximum flow           5.832      5.599      7.410      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    7.410     7.410     0.000     0.000"
" 54          POND DESIGN"
"        7.410   Current peak flow    c.m/sec"
"        3.548   Target outflow    c.m/sec"
"      24272.4   Hydrograph volume    c.m"
"           37.  Number of stages"
"      377.000   Minimum water level    metre"
"      380.600   Maximum water level    metre"
"      377.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                377.000     0.000     6.000"
"                377.100   0.03740    13.200"
"                377.200    0.1059    20.400"
"                377.300    0.1498    49.600"
"                377.400    0.1834   100.800"
"                377.500    0.2118   152.000"
"                377.600    0.2368   261.600"
"                377.700    0.2594   371.200"
"                377.800    0.2802   499.200"
"                377.900    0.2995   645.600"
"                378.000    0.3177   792.000"
"                378.100    0.3349   981.200"
"                378.200    0.3512  1170.400"
"                378.300    0.3668  1487.200"
"                378.400    0.3818  1931.600"
"                378.500    0.3962  2376.000"
"                378.600    0.4101  3212.800"
"                378.700    0.6001  4049.600"
"                378.800    0.6185  5044.200"
"                378.900    0.7113  6196.600"
"                379.000    0.7308  7349.000"
"                379.100    0.7498  8876.200"
"                379.200    0.7683  10403.40"
"                379.300    0.7864  12114.60"
"                379.400    0.8041  14009.80"
```

```
"               379.500    0.8646  15905.00"
"               379.600    0.8824  18103.40"
"               379.700    0.8999  20301.80"
"               379.800     1.284  22798.80"
"               379.900     1.308  25594.40"
"               380.000     1.331  28390.00"
"               380.100     1.353  31896.00"
"               380.200     1.376  35402.00"
"               380.300     1.398  39224.20"
"               380.400     1.419  43362.60"
"               380.500     1.441  47501.00"
"               380.600     1.462  52352.20"
"            Peak outflow                 0.877    c.m/sec"
"            Maximum level              379.567    metre"
"            Maximum storage          17380.254    c.m"
"            Centroidal lag               5.398   hours"
"                 7.410     7.410     0.877     0.000 c.m/sec"
" 40         HYDROGRAPH   Combine    1"
"           6   Combine "
"           1   Node #"
"               "
"            Maximum flow                 0.877    c.m/sec"
"            Hydrograph volume        24290.602    c.m"
"                    7.410     7.410     0.877     0.877"
" 40         HYDROGRAPH Start - New Tributary"
"           2   Start - New Tributary"
"                    7.410     0.000     0.877     0.877"
" 33         CATCHMENT 201"
"           1   Triangular SCS"
"           1   Equal length"
"           1   SCS method"
"         201   Ira Needles"
"       81.400   % Impervious"
"        5.480   Total Area"
"      250.000   Flow length"
"        2.000   Overland Slope"
"        1.019   Pervious Area"
"      250.000   Pervious length"
"        2.000   Pervious slope"
"        4.461   Impervious Area"
"      250.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       74.000   Pervious SCS Curve No."
"        0.419   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.924   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.931   Impervious Runoff coefficient"
```

```
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     2.437     0.000     0.877     0.877 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           1.019      4.461      5.480      hectare"
"             Time of concentration  42.917     5.621      9.099      minutes"
"             Time to Centroid       146.696    91.755     96.879     minutes"
"             Rainfall depth         87.079     87.079     87.079     mm"
"             Rainfall volume        887.58     3884.36    4771.94    c.m"
"             Rainfall losses        50.600     6.029      14.319     mm"
"             Runoff depth           36.479     81.050     72.760     mm"
"             Runoff volume          371.82     3615.44    3987.26    c.m"
"             Runoff coefficient     0.419      0.931      0.836      "
"             Maximum flow           0.080      2.423      2.437      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     2.437     2.437     0.877     0.877"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     2.437     2.437     2.437     0.877"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                "
"             Maximum flow                  2.437    c.m/sec"
"             Hydrograph volume          3987.260    c.m"
"                     2.437     2.437     2.437     2.437"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     2.437     0.000     2.437     2.437"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          202   South Development Lands"
"       85.000   % Impervious"
"        7.680   Total Area"
"      300.000   Flow length"
"        2.000   Overland Slope"
"        1.152   Pervious Area"
"      300.000   Pervious length"
"        2.000   Pervious slope"
"        6.528   Impervious Area"
"      300.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       74.000   Pervious SCS Curve No."
"        0.419   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.924   Pervious Initial abstraction"
```

```
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.932   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     3.540     0.000     2.437     2.437 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           1.152      6.528      7.680      hectare"
"             Time of concentration  47.879     6.271      9.329      minutes"
"             Time to Centroid       152.896    92.684     97.110     minutes"
"             Rainfall depth         87.079     87.079     87.079     mm"
"             Rainfall volume        1003.15    5684.53    6687.68    c.m"
"             Rainfall losses        50.605     5.957      12.654     mm"
"             Runoff depth           36.475     81.122     74.425     mm"
"             Runoff volume          420.19     5295.66    5715.84    c.m"
"             Runoff coefficient     0.419      0.932      0.855      "
"             Maximum flow           0.083      3.527      3.540      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     3.540     3.540     2.437     2.437"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     3.540     3.540     3.540     2.437"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                "
"             Maximum flow                  5.976    c.m/sec"
"             Hydrograph volume          9703.104    c.m"
"                     3.540     3.540     3.540     5.976"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     3.540     0.000     3.540     5.976"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          203   South ROW"
"       72.000   % Impervious"
"        1.521   Total Area"
"      250.000   Flow length"
"        2.000   Overland Slope"
"        0.426   Pervious Area"
"      250.000   Pervious length"
"        2.000   Pervious slope"
"        1.095   Impervious Area"
"      250.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       74.000   Pervious SCS Curve No."
```

```
"        0.419   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.924   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.931   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.601     0.000     3.540     5.976 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           0.426      1.095      1.521      hectare"
"             Time of concentration  42.917     5.621      11.177     minutes"
"             Time to Centroid       146.696    91.755     99.939     minutes"
"             Rainfall depth         87.079     87.079     87.079     mm"
"             Rainfall volume        370.85     953.62     1324.47    c.m"
"             Rainfall losses        50.600     6.029      18.509     mm"
"             Runoff depth           36.479     81.050     68.571     mm"
"             Runoff volume          155.36     887.60     1042.96    c.m"
"             Runoff coefficient     0.419      0.931      0.787      "
"             Maximum flow           0.034      0.595      0.601      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.601     0.601     3.540     5.976"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.601     0.601     0.601     5.976"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                "
"             Maximum flow                  6.577    c.m/sec"
"             Hydrograph volume         10746.065    c.m"
"                     0.601     0.601     0.601     6.577"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.601     0.000     0.601     6.577"
" 33          CATCHMENT 204"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          204   Home Hardware"
"       85.000   % Impervious"
"        3.231   Total Area"
"      100.000   Flow length"
"        2.000   Overland Slope"
"        0.485   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        2.746   Impervious Area"
"      100.000   Impervious length"
```

```
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       74.000   Pervious SCS Curve No."
"        0.419   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.924   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.919   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    1.410     0.000     0.601     6.577 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           0.485      2.746      3.231      hectare"
"             Time of concentration  24.767     3.244      4.845      minutes"
"             Time to Centroid       124.025    88.462     91.108     minutes"
"             Rainfall depth         87.079     87.079     87.079     mm"
"             Rainfall volume        422.03     2391.50    2813.53    c.m"
"             Rainfall losses        50.617     7.030      13.568     mm"
"             Runoff depth           36.463     80.049     73.511     mm"
"             Runoff volume          176.72     2198.43    2375.15    c.m"
"             Runoff coefficient     0.419      0.919      0.844      "
"             Maximum flow           0.056      1.404      1.410      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    1.410     1.410     0.601     6.577"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    1.410     1.410     1.410     6.577"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                "
"             Maximum flow                  7.968    c.m/sec"
"             Hydrograph volume         13121.212    c.m"
"                    1.410     1.410     1.410     7.968"
" 40          HYDROGRAPH   Confluence    2"
"            7   Confluence "
"            2   Node #"
"                "
"             Maximum flow                  7.968    c.m/sec"
"             Hydrograph volume         13121.212    c.m"
"                    1.410     7.968     1.410     0.000"
" 54          POND DESIGN"
"        7.968   Current peak flow    c.m/sec"
"        3.548   Target outflow    c.m/sec"
"      13121.2   Hydrograph volume    c.m"
"         47.    Number of stages"
"      378.000   Minimum water level    metre"
"      382.600   Maximum water level    metre"
```

```
"      378.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                378.000   0.01000     0.000"
"                378.100   0.01200   374.900"
"                378.200   0.01400   767.600"
"                378.300   0.01500  1178.330"
"                378.400   0.01700  1607.130"
"                378.500   0.04100  2053.520"
"                378.600   0.04300  2517.640"
"                378.700   0.04600  2996.080"
"                378.800   0.04900  3485.290"
"                378.900   0.05110  3985.310"
"                379.000   0.05350  4496.230"
"                379.100   0.05570  5018.110"
"                379.200   0.05780  5551.010"
"                379.300   0.05990  6095.000"
"                379.400   0.08820  6650.140"
"                379.500   0.09100  7216.500"
"                379.600   0.09360  7794.140"
"                379.700   0.09620  8383.150"
"                379.800   0.09870  8983.590"
"                379.900    0.1011  9595.530"
"                380.000    0.1240  10219.06"
"                380.100    0.1270  10854.25"
"                380.200    0.1300  11501.17"
"                380.300    0.1324  12159.89"
"                380.400    0.1800  12830.50"
"                380.500    0.1830  13513.07"
"                380.600    0.1870  14207.68"
"                380.700    0.1900  14914.40"
"                380.800    0.1930  15633.32"
"                380.900    0.1970  16364.51"
"                381.000    0.1997  17108.05"
"                381.100    0.2028  17864.03"
"                381.200    0.2058  18632.52"
"                381.300    0.2088  19413.61"
"                381.400    0.2118  20207.37"
"                381.500    0.2147  21013.90"
"                381.600    0.2176  21833.28"
"                381.700    0.2204  22665.60"
"                381.800    0.2232  23510.94"
"                381.900    0.2260  24369.39"
"                382.000    0.2288  25241.05"
"                382.100    0.2315  26126.01"
"                382.200    0.2341  27024.37"
"                382.300    0.2368  27936.23"
"                382.400    0.2394  28861.70"
"                382.500    0.2420  29800.88"
"                382.600    0.2446  30753.91"
```

```
"             Peak outflow                  0.132    c.m/sec"
"             Maximum level               380.275    metre"
"             Maximum storage           11994.461    c.m"
"             Centroidal lag               23.874   hours"
"                  1.410     7.968     0.132     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                "
"             Maximum flow                  1.008    c.m/sec"
"             Hydrograph volume         36005.012    c.m"
"                     1.410     7.968     0.132     1.008"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     1.410     0.000     0.132     1.008"
" 33          CATCHMENT 301"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          301   North ROW"
"       72.000   % Impervious"
"        0.504   Total Area"
"      100.000   Flow length"
"        1.000   Overland Slope"
"        0.141   Pervious Area"
"      100.000   Pervious length"
"        1.000   Pervious slope"
"        0.363   Impervious Area"
"      100.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       74.000   Pervious SCS Curve No."
"        0.419   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.924   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.926   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.193     0.000     0.132     1.008 c.m/sec"
"             Catchment 301          Pervious   Impervious Total Area "
"             Surface Area           0.141      0.363      0.504      hectare"
"             Time of concentration  30.491     3.994      7.958      minutes"
"             Time to Centroid       131.166    89.533     95.762     minutes"
"             Rainfall depth         87.079     87.079     87.079     mm"
"             Rainfall volume        122.89     315.99     438.88     c.m"
"             Rainfall losses        50.605     6.452      18.815     mm"
"             Runoff depth           36.474     80.627     68.264     mm"
"             Runoff volume          51.47      292.58     344.05     c.m"
```

```
"             Runoff coefficient     0.419      0.926      0.784      "
"             Maximum flow           0.014      0.189      0.193      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.193     0.193     0.132     1.008"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.193     0.193     0.193     1.008"
" 40          HYDROGRAPH   Combine    3"
"            6   Combine "
"            3   Node #"
"                "
"             Maximum flow                  0.193    c.m/sec"
"             Hydrograph volume           344.051    c.m"
"                    0.193     0.193     0.193     0.193"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.193     0.000     0.193     0.193"
" 33          CATCHMENT 302"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          302   Waterloo Commons"
"       86.100   % Impervious"
"        5.057   Total Area"
"      250.000   Flow length"
"        2.000   Overland Slope"
"        0.703   Pervious Area"
"      250.000   Pervious length"
"        2.000   Pervious slope"
"        4.354   Impervious Area"
"      250.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       74.000   Pervious SCS Curve No."
"        0.419   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.924   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.931   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    2.374     0.000     0.193     0.193 c.m/sec"
"             Catchment 302          Pervious   Impervious Total Area "
"             Surface Area           0.703      4.354      5.057      hectare"
"             Time of concentration  42.917     5.621      8.147      minutes"
"             Time to Centroid       146.696    91.755     95.477     minutes"
"             Rainfall depth         87.079     87.079     87.079     mm"
"             Rainfall volume        612.10     3791.50    4403.60    c.m"
```

```
"             Rainfall losses        50.600     6.029      12.224     mm"
"             Runoff depth           36.479     81.050     74.855     mm"
"             Runoff volume          256.42     3529.00    3785.42    c.m"
"             Runoff coefficient     0.419      0.931      0.860      "
"             Maximum flow           0.055      2.365      2.374      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    2.374     2.374     0.193     0.193"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    2.374     2.374     2.374     0.193"
" 40          HYDROGRAPH   Combine    3"
"            6   Combine "
"            3   Node #"
"                "
"             Maximum flow                  2.567    c.m/sec"
"             Hydrograph volume          4129.471    c.m"
"                    2.374     2.374     2.374     2.567"
" 40          HYDROGRAPH   Confluence    3"
"            7   Confluence "
"            3   Node #"
"                "
"             Maximum flow                  2.567    c.m/sec"
"             Hydrograph volume          4129.471    c.m"
"                    2.374     2.567     2.374     0.000"
" 54          POND DESIGN"
"         2.567   Current peak flow    c.m/sec"
"         3.548   Target outflow    c.m/sec"
"        4129.5   Hydrograph volume    c.m"
"           31.   Number of stages"
"       378.000   Minimum water level    metre"
"       381.000   Maximum water level    metre"
"       378.000   Starting water level    metre"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                 378.000     0.000     0.000"
"                 378.100  9.00E-05   302.890"
"                 378.200   0.01700   619.920"
"                 378.300   0.01780   951.440"
"                 378.400   0.01840  1297.850"
"                 378.500   0.01910  1659.560"
"                 378.600   0.01980  2037.050"
"                 378.700   0.03600  2431.620"
"                 378.800   0.03690  2833.700"
"                 378.900   0.03800  3243.320"
"                 379.000   0.03900  3660.550"
"                 379.100   0.04000  4085.430"
"                 379.200   0.08100  4518.010"
"                 379.300   0.08300  4958.340"
"                 379.400   0.08500  5406.490"
```

```
"               379.500   0.08600  5862.560"
"               379.600   0.08800  6326.620"
"               379.700   0.09000  6798.770"
"               379.800   0.09200  7279.080"
"               379.900   0.09300  7767.640"
"               380.000   0.09500  8264.530"
"               380.100   0.09700  8769.840"
"               380.200   0.09800  9283.640"
"               380.300    0.1000  9806.040"
"               380.400    0.1010  10337.10"
"               380.500    0.1030  10876.91"
"               380.600    0.1040  11425.57"
"               380.700    0.1060  11983.14"
"               380.800    0.1070  12549.72"
"               380.900    0.1090  13125.39"
"               381.000    0.1100  13710.23"
"            Peak outflow                  0.039    c.m/sec"
"            Maximum level               379.030    metre"
"            Maximum storage            3789.037    c.m"
"            Centroidal lag               18.701   hours"
"                 2.374     2.567     0.039     0.000 c.m/sec"
" 40         HYDROGRAPH   Combine    1"
"           6   Combine "
"           1   Node #"
"               "
"            Maximum flow                  1.047    c.m/sec"
"            Hydrograph volume         39793.297    c.m"
"                    2.374     2.567     0.039     1.047"
" 40         HYDROGRAPH   Confluence    1"
"           7   Confluence "
"           1   Node #"
"               "
"            Maximum flow                  1.047    c.m/sec"
"            Hydrograph volume         39793.297    c.m"
"                    2.374     1.047     0.039     0.000"
" 51         PIPE DESIGN"
"       1.047   Current peak flow    c.m/sec"
"       0.013   Manning 'n'"
"       0.914   Diameter    metre"
"       0.500   Gradient   %"
"            Depth of flow                 0.610    metre"
"            Velocity                      2.251    m/sec"
"            Pipe capacity                 1.334    c.m/sec"
"            Critical depth                0.603    metre"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                            Version 2.25  rev. 473"
"                MIDUSS created                          Sunday, February 7, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:                                  Q:\34280\101\SWM\"
"                                                  SWM Options_February 18 2020"
"                Output filename:                         CombinedRegional.out"
"                Licensee name:                                              A"
"                Company                                                      "
"                Date & Time last used:                  4/30/2020 at 3:52:47 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      720.000   Max. Storm length"
"     3000.000   Max. Hydrograph"
" 32          STORM Mass Curve"
"             3   Mass Curve"
"      212.000   Rainfall depth"
"      720.000   Duration"
"            41   C:\Program Files (x86)\MIDUSS\Hazel12.mrd   Hurricane Hazel (last
12 h)"
"             Maximum intensity            53.000    mm/hr"
"             Total depth                 212.000    mm"
"            6   200hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          101   Landfill"
"       20.000   % Impervious"
"       52.510   Total Area"
"      100.000   Flow length"
"        4.000   Overland Slope"
"       42.008   Pervious Area"
"      100.000   Pervious length"
"        4.000   Pervious slope"
"       10.502   Impervious Area"
"      100.000   Impervious length"
"        4.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.678   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.969   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    7.096     0.000     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
```

```
"             Surface Area           42.008     10.502     52.510     hectare"
"             Time of concentration  27.352     4.785      21.409     minutes"
"             Time to Centroid       556.114    477.235    535.343    minutes"
"             Rainfall depth         212.000    212.000    212.000    mm"
"             Rainfall volume        8.9057     2.2264     11.1321    ha-m"
"             Rainfall losses        68.364     6.621      56.015     mm"
"             Runoff depth           143.636    205.379    155.985    mm"
"             Runoff volume          6.0339     2.1569     8.1908     ha-m"
"             Runoff coefficient     0.678      0.969      0.736      "
"             Maximum flow           5.557      1.577      7.096      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     7.096     7.096     0.000     0.000"
" 54          POND DESIGN"
"         7.096   Current peak flow    c.m/sec"
"         3.548   Target outflow    c.m/sec"
"       81907.5   Hydrograph volume    c.m"
"           37.   Number of stages"
"       377.000   Minimum water level    metre"
"       380.600   Maximum water level    metre"
"       377.000   Starting water level    metre"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                 377.000     0.000     6.000"
"                 377.100   0.03740    13.200"
"                 377.200    0.1059    20.400"
"                 377.300    0.1498    49.600"
"                 377.400    0.1834   100.800"
"                 377.500    0.2118   152.000"
"                 377.600    0.2368   261.600"
"                 377.700    0.2594   371.200"
"                 377.800    0.2802   499.200"
"                 377.900    0.2995   645.600"
"                 378.000    0.3177   792.000"
"                 378.100    0.3349   981.200"
"                 378.200    0.3512  1170.400"
"                 378.300    0.3668  1487.200"
"                 378.400    0.3818  1931.600"
"                 378.500    0.3962  2376.000"
"                 378.600    0.4101  3212.800"
"                 378.700    0.6001  4049.600"
"                 378.800    0.6185  5044.200"
"                 378.900    0.7113  6196.600"
"                 379.000    0.7308  7349.000"
"                 379.100    0.7498  8876.200"
"                 379.200    0.7683  10403.40"
"                 379.300    0.7864  12114.60"
"                 379.400    0.8041  14009.80"
"                 379.500    0.8646  15905.00"
"                 379.600    0.8824  18103.40"
```

```
"                379.700    0.8999  20301.80"
"                379.800     1.284  22798.80"
"                379.900     1.308  25594.40"
"                380.000     1.331  28390.00"
"                380.100     1.353  31896.00"
"                380.200     1.376  35402.00"
"                380.300     1.398  39224.20"
"                380.400     1.419  43362.60"
"                380.500     1.441  47501.00"
"                380.600     1.462  52352.20"
"             Peak outflow                  1.454    c.m/sec"
"             Maximum level               380.564    metre"
"             Maximum storage           50613.949    c.m"
"             Centroidal lag               14.723   hours"
"                  7.096     7.096     1.454     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                "
"             Maximum flow                  1.454    c.m/sec"
"             Hydrograph volume         81904.438    c.m"
"                     7.096     7.096     1.454     1.454"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     7.096     0.000     1.454     1.454"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          201   Ira Needles"
"       81.400   % Impervious"
"        5.480   Total Area"
"      250.000   Flow length"
"        2.000   Overland Slope"
"        1.019   Pervious Area"
"      250.000   Pervious length"
"        2.000   Pervious slope"
"        4.461   Impervious Area"
"      250.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       74.000   Pervious SCS Curve No."
"        0.665   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.924   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.970   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
```

```
"                    0.757     0.000     1.454     1.454 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           1.019      4.461      5.480      hectare"
"             Time of concentration  58.608     10.209     16.769     minutes"
"             Time to Centroid       591.015    482.532    497.234    minutes"
"             Rainfall depth         212.000    212.000    212.000    mm"
"             Rainfall volume        0.2161     0.9457     1.1618     ha-m"
"             Rainfall losses        70.962     6.435      18.437     mm"
"             Runoff depth           141.038    205.565    193.563    mm"
"             Runoff volume          0.1438     0.9170     1.0607     ha-m"
"             Runoff coefficient     0.665      0.970      0.913      "
"             Maximum flow           0.125      0.686      0.757      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.757     0.757     1.454     1.454"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.757     0.757     0.757     1.454"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                "
"             Maximum flow                  0.757    c.m/sec"
"             Hydrograph volume         10607.233    c.m"
"                    0.757     0.757     0.757     0.757"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.757     0.000     0.757     0.757"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          202   South Development Lands"
"       85.000   % Impervious"
"        7.680   Total Area"
"      300.000   Flow length"
"        2.000   Overland Slope"
"        1.152   Pervious Area"
"      300.000   Pervious length"
"        2.000   Pervious slope"
"        6.528   Impervious Area"
"      300.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       74.000   Pervious SCS Curve No."
"        0.665   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.924   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
```

```
"        0.970   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     1.073     0.000     0.757     0.757 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           1.152      6.528      7.680      hectare"
"             Time of concentration  65.383     11.389     17.218     minutes"
"             Time to Centroid       598.233    483.617    495.989    minutes"
"             Rainfall depth         212.000    212.000    212.000    mm"
"             Rainfall volume        0.2442     1.3839     1.6282     ha-m"
"             Rainfall losses        70.943     6.287      15.986     mm"
"             Runoff depth           141.057    205.713    196.014    mm"
"             Runoff volume          0.1625     1.3429     1.5054     ha-m"
"             Runoff coefficient     0.665      0.970      0.925      "
"             Maximum flow           0.138      1.006      1.073      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     1.073     1.073     0.757     0.757"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     1.073     1.073     1.073     0.757"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                "
"             Maximum flow                  1.830    c.m/sec"
"             Hydrograph volume         25661.111    c.m"
"                     1.073     1.073     1.073     1.830"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     1.073     0.000     1.073     1.830"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          203   South ROW"
"       72.000   % Impervious"
"        1.521   Total Area"
"      250.000   Flow length"
"        2.000   Overland Slope"
"        0.426   Pervious Area"
"      250.000   Pervious length"
"        2.000   Pervious slope"
"        1.095   Impervious Area"
"      250.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       74.000   Pervious SCS Curve No."
"        0.665   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
```

```
"        8.924   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.970   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.205     0.000     1.073     1.830 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           0.426      1.095      1.521      hectare"
"             Time of concentration  58.608     10.209     20.403     minutes"
"             Time to Centroid       591.019    482.531    505.381    minutes"
"             Rainfall depth         212.000    212.000    212.000    mm"
"             Rainfall volume        902.87     2321.65    3224.52    c.m"
"             Rainfall losses        70.962     6.435      24.503     mm"
"             Runoff depth           141.038    205.565    187.497    mm"
"             Runoff volume          600.65     2251.18    2851.83    c.m"
"             Runoff coefficient     0.665      0.970      0.884      "
"             Maximum flow           0.052      0.168      0.205      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.205     0.205     1.073     1.830"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.205     0.205     0.205     1.830"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                "
"             Maximum flow                  2.035    c.m/sec"
"             Hydrograph volume         28512.939    c.m"
"                     0.205     0.205     0.205     2.035"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.205     0.000     0.205     2.035"
" 33          CATCHMENT 204"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          204   Home Hardware"
"       85.000   % Impervious"
"        3.231   Total Area"
"      100.000   Flow length"
"        2.000   Overland Slope"
"        0.485   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        2.746   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
```

```
"       74.000   Pervious SCS Curve No."
"        0.665   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.924   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.963   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.465     0.000     0.205     2.035 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           0.485      2.746      3.231      hectare"
"             Time of concentration  33.822     5.891      8.924      minutes"
"             Time to Centroid       564.623    477.183    486.677    minutes"
"             Rainfall depth         212.000    212.000    212.000    mm"
"             Rainfall volume        1027.46    5822.26    6849.72    c.m"
"             Rainfall losses        71.048     7.783      17.273     mm"
"             Runoff depth           140.952    204.217    194.727    mm"
"             Runoff volume          683.12     5608.52    6291.64    c.m"
"             Runoff coefficient     0.665      0.963      0.919      "
"             Maximum flow           0.064      0.420      0.465      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.465     0.465     0.205     2.035"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.465     0.465     0.465     2.035"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                "
"             Maximum flow                  2.500    c.m/sec"
"             Hydrograph volume         34804.574    c.m"
"                     0.465     0.465     0.465     2.500"
" 40          HYDROGRAPH   Confluence    2"
"            7   Confluence "
"            2   Node #"
"                "
"             Maximum flow                  2.500    c.m/sec"
"             Hydrograph volume         34804.574    c.m"
"                     0.465     2.500     0.465     0.000"
" 54          POND DESIGN"
"        2.500   Current peak flow    c.m/sec"
"        3.548   Target outflow    c.m/sec"
"      34804.6   Hydrograph volume    c.m"
"          47.   Number of stages"
"      378.000   Minimum water level    metre"
"      382.600   Maximum water level    metre"
"      378.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
```

Level	Discharge	Volume
378.000	0.01000	0.000
378.100	0.01200	374.900
378.200	0.01400	767.600
378.300	0.01500	1178.330
378.400	0.01700	1607.130
378.500	0.04100	2053.520
378.600	0.04300	2517.640
378.700	0.04600	2996.080
378.800	0.04900	3485.290
378.900	0.05110	3985.310
379.000	0.05350	4496.230
379.100	0.05570	5018.110
379.200	0.05780	5551.010
379.300	0.05990	6095.000
379.400	0.08820	6650.140
379.500	0.09100	7216.500
379.600	0.09360	7794.140
379.700	0.09620	8383.150
379.800	0.09870	8983.590
379.900	0.1011	9595.530
380.000	0.1240	10219.06
380.100	0.1270	10854.25
380.200	0.1300	11501.17
380.300	0.1324	12159.89
380.400	0.1800	12830.50
380.500	0.1830	13513.07
380.600	0.1870	14207.68
380.700	0.1900	14914.40
380.800	0.1930	15633.32
380.900	0.1970	16364.51
381.000	0.1997	17108.05
381.100	0.2028	17864.03
381.200	0.2058	18632.52
381.300	0.2088	19413.61
381.400	0.2118	20207.37
381.500	0.2147	21013.90
381.600	0.2176	21833.28
381.700	0.2204	22665.60
381.800	0.2232	23510.94
381.900	0.2260	24369.39
382.000	0.2288	25241.05
382.100	0.2315	26126.01
382.200	0.2341	27024.37
382.300	0.2368	27936.23
382.400	0.2394	28861.70
382.500	0.2420	29800.88
382.600	0.2446	30753.91

Peak outflow	0.242	c.m/sec
Maximum level	382.489	metre

```
"             Maximum storage           29694.535    c.m"
"             Centroidal lag               32.297   hours"
"                  0.465     2.500     0.242     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                "
"             Maximum flow                  1.696    c.m/sec"
"             Hydrograph volume        109963.633    c.m"
"                     0.465     2.500     0.242     1.696"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.465     0.000     0.242     1.696"
" 33          CATCHMENT 301"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          301   North ROW"
"       72.000   % Impervious"
"        0.504   Total Area"
"      100.000   Flow length"
"        1.000   Overland Slope"
"        0.141   Pervious Area"
"      100.000   Pervious length"
"        1.000   Pervious slope"
"        0.363   Impervious Area"
"      100.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       74.000   Pervious SCS Curve No."
"        0.665   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.924   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.965   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.071     0.000     0.242     1.696 c.m/sec"
"             Catchment 301          Pervious   Impervious Total Area "
"             Surface Area           0.141      0.363      0.504      hectare"
"             Time of concentration  41.639     7.253      14.521     minutes"
"             Time to Centroid       572.964    479.486    499.244    minutes"
"             Rainfall depth         212.000    212.000    212.000    mm"
"             Rainfall volume        299.17     769.31     1068.48    c.m"
"             Rainfall losses        70.983     7.387      25.194     mm"
"             Runoff depth           141.017    204.613    186.806    mm"
"             Runoff volume          199.00     742.50     941.50     c.m"
"             Runoff coefficient     0.665      0.965      0.881      "
"             Maximum flow           0.018      0.055      0.071      c.m/sec"
```

```
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.071     0.071     0.242     1.696"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.071     0.071     0.071     1.696"
" 40          HYDROGRAPH   Combine    3"
"            6   Combine "
"            3   Node #"
"                "
"             Maximum flow                  0.071    c.m/sec"
"             Hydrograph volume           941.502    c.m"
"                     0.071     0.071     0.071     0.071"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.071     0.000     0.071     0.071"
" 33          CATCHMENT 302"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          302   Waterloo Commons"
"       86.100   % Impervious"
"        5.057   Total Area"
"      250.000   Flow length"
"        2.000   Overland Slope"
"        0.703   Pervious Area"
"      250.000   Pervious length"
"        2.000   Pervious slope"
"        4.354   Impervious Area"
"      250.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       74.000   Pervious SCS Curve No."
"        0.665   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.924   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.970   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.708     0.000     0.071     0.071 c.m/sec"
"             Catchment 302          Pervious   Impervious Total Area "
"             Surface Area           0.703      4.354      5.057      hectare"
"             Time of concentration  58.608     10.209     15.035     minutes"
"             Time to Centroid       591.015    482.532    493.350    minutes"
"             Rainfall depth         212.000    212.000    212.000    mm"
"             Rainfall volume        0.1490     0.9231     1.0721     ha-m"
"             Rainfall losses        70.962     6.435      15.404     mm"
"             Runoff depth           141.038    205.565    196.596    mm"
```

```
"             Runoff volume          991.39     8950.45    9941.83    c.m"
"             Runoff coefficient     0.665      0.970      0.927      "
"             Maximum flow           0.087      0.669      0.708      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.708     0.708     0.071     0.071"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.708     0.708     0.708     0.071"
" 40          HYDROGRAPH   Combine    3"
"            6   Combine "
"            3   Node #"
"                "
"             Maximum flow                  0.779    c.m/sec"
"             Hydrograph volume         10883.329    c.m"
"                    0.708     0.708     0.708     0.779"
" 40          HYDROGRAPH   Confluence    3"
"            7   Confluence "
"            3   Node #"
"                "
"             Maximum flow                  0.779    c.m/sec"
"             Hydrograph volume         10883.329    c.m"
"                    0.708     0.779     0.708     0.000"
" 54          POND DESIGN"
"        0.779   Current peak flow    c.m/sec"
"        3.548   Target outflow    c.m/sec"
"      10883.3   Hydrograph volume    c.m"
"         31.    Number of stages"
"      378.000   Minimum water level    metre"
"      381.000   Maximum water level    metre"
"      378.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                378.000     0.000     0.000"
"                378.100  9.00E-05   302.890"
"                378.200   0.01700   619.920"
"                378.300   0.01780   951.440"
"                378.400   0.01840  1297.850"
"                378.500   0.01910  1659.560"
"                378.600   0.01980  2037.050"
"                378.700   0.03600  2431.620"
"                378.800   0.03690  2833.700"
"                378.900   0.03800  3243.320"
"                379.000   0.03900  3660.550"
"                379.100   0.04000  4085.430"
"                379.200   0.08100  4518.010"
"                379.300   0.08300  4958.340"
"                379.400   0.08500  5406.490"
"                379.500   0.08600  5862.560"
"                379.600   0.08800  6326.620"
```

```
"               379.700   0.09000  6798.770"
"               379.800   0.09200  7279.080"
"               379.900   0.09300  7767.640"
"               380.000   0.09500  8264.530"
"               380.100   0.09700  8769.840"
"               380.200   0.09800  9283.640"
"               380.300    0.1000  9806.040"
"               380.400    0.1010  10337.10"
"               380.500    0.1030  10876.91"
"               380.600    0.1040  11425.57"
"               380.700    0.1060  11983.14"
"               380.800    0.1070  12549.72"
"               380.900    0.1090  13125.39"
"               381.000    0.1100  13710.23"
"            Peak outflow                  0.098    c.m/sec"
"            Maximum level               380.155    metre"
"            Maximum storage            9053.520    c.m"
"            Centroidal lag               29.345   hours"
"                 0.708     0.779     0.098     0.000 c.m/sec"
" 40         HYDROGRAPH   Combine    1"
"           6   Combine "
"           1   Node #"
"               "
"            Maximum flow                  1.794    c.m/sec"
"            Hydrograph volume        119171.492    c.m"
"                    0.708     0.779     0.098     1.794"
" 40         HYDROGRAPH   Confluence    1"
"           7   Confluence "
"           1   Node #"
"               "
"            Maximum flow                  1.794    c.m/sec"
"            Hydrograph volume        119171.477    c.m"
"                    0.708     1.794     0.098     0.000"
" 51         PIPE DESIGN"
"       1.794   Current peak flow    c.m/sec"
"       0.013   Manning 'n'"
"       0.914   Diameter    metre"
"       0.500   Gradient   %"
"            Surcharged HGL                0.904    %"
"            Velocity                      2.734    m/sec"
"            Pipe capacity                 1.334    c.m/sec"
"            Critical depth                0.000    metre"
```

Appendix P

WESTHILL DISTRICT
NORTH-SOUTH COLLECTOR ROAD STUDY
WATERLOO, ONTARIO

NATURAL ENVIRONMENT STAGE 2 REPORT
EVALUATION OF ALTERNATIVES & IMPACT ASSESSMENT




Prepared By:

WSP Canada Group Ltd.

July 2020

TABLE OF CONTENTS

1.0 INTRODUCTION 1

1.1 Background & Project Overview 1

1.2 Project Need 2

2.0 STUDY APPROACH 3

3.0 EXISTING CONDITIONS 4

3.1 Past and Present Land Use 4

3.2 Natural Heritage Features & Designations 5

3.3 Vegetation & Flora 6

3.3.1 Floristics 6

3.3.1 Vegetation 7

3.4 Wildlife 8

3.5 Aquatic Resources 10

3.6 Hydrogeology 11

4.0 EVALUATION OF ROAD ALIGNMENT ALTERNATIVES 14

4.1 South Alternatives 14

4.1.1 Natural Environment 14

4.1.1 Overall Evaluation 15

4.2 North Alternatives 15

4.2.1 Natural Environment 15

4.2.2 Overall Evaluation 16

4.3 Conclusion 17

5.0 EVALUATION OF SWM ALTERNATIVES 18

5.1 Approach 18

5.2 Natural Environment 20

5.2 Overall Evaluation 21

6.0 PROJECT DESCRIPTION 22

6.1 Road 22

6.2 SWM Strategy 22

7.0 MITIGATION & RESTORATION 24

7.1 Mitigation Measures 24

7.2 Wetland Restoration 26

7.2.1 Features and Functions 26

7.2.2 Conceptual Restoration Strategy 27

8.0 IMPACT ASSESSENT 29

8.1 Direct Impacts 29

8.2 Indirect Impacts 29

9.0 POLICY COMPLIANCE 32

9.1 Fisheries Act 32

9.1.1 Overview of Key Policies 32

9.1.2 Study Assessment 33

9.2 Species at Risk Act (2002) 34

9.2.1 Overview of Key Policies 34

9.2.2 Study Assessment 34

9.2.2.1 Applicability 34

9.2.2.2 Assessment & Conclusions 34

9.3 Endangered Species Act (2007) 35

9.3.1 Overview of Key Polices 35

9.3.2 Assessment 35

9.3.2.1 Applicability 35

9.3.2.2 Habitat Assessment / Screening 35

9.3.2.3 Results and Conclusions 35

9.4 Provincial Policy Statement (2020) 36
9.4.1 Overview of Key Policies 36
9.4.2 Study Assessment & Conclusions 36

9.5 Waterloo Regional Official Plan (2015) 38
9.5.1 Overview of Key Policies 38
9.5.2 Study Assessment 38
9.5.3 Conclusion 39

9.6 City of Waterloo Official Plan (2016) 40
9.6.1 Overview of Key Policies 40
9.6.2 Study Assessment 40
9.6.2.1 Supporting “A” Natural Features 40
9.6.2.1 Supporting “B” Natural Features 41
9.6.2 Compliance 43

9.7 Grand River Conservation Authority 44
9.7.1 Overview of Key Policies 44
9.7.3 Study Assessment 44

10.0 FUTURE WORK 45

REFERENCES 46

LIST OF FIGURES (end of report)

Figures 1-5 (from Stage 1 EIS)

Figure 1: Study Area

Figure 2: Natural Heritage Features

Figure 3: Vegetation Communities

Figure 4: Wildlife Survey Locations and Results

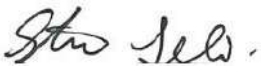
Figure 5: Aquatic Survey Locations and Results

Figure 6: Collector Road Alignment Alternatives (MHBC)

Figure 7: Natural Environment Impact Areas

Signatures

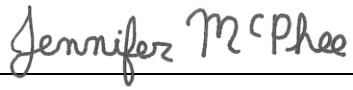
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1.0 INTRODUCTION

1.1 Background & Project Overview

WSP Canada Group Limited (WSP), was retained in 2016 on behalf of major landowners within the Westhill District to undertake an ecological study as input to an Official Plan Amendment application whose purpose is to identify a new collector road (The Ira Needles Boulevard By-pass that would connect Erb Street to Ira Needles Boulevard). WSP is part of an integrated team than includes MHBC, MTE and Paradigm.

The Westhill District study area, shown on Figure 1, is located in the upper reach of the Subwatershed 314 – Laurel Creek Watershed and is owned by a variety of landowners: the Region of Waterloo; the City of Waterloo; Waterloo Commons JV Inc.; the INCC Corporation; Hydro One; Home Hardware; and 1130814 Ontario Inc. The study area generally includes a small portion of the Region of Waterloo's Waterloo Landfill at 925 Erb Street West, a small portion of the Hydro One corridor (south of Erb Street West), the residences at 87, 73, and 65 Ira Needles Boulevard, the Westhill Meadows Golf course at 41 Ira Needles Boulevard, and the Waterloo Commons commercial development at 653-659 Erb Street West. These properties are herein referred to as the 'study area'.

The study area includes a mix of: developed lands (retail stores, rural residential property / landscaping); agricultural fields; a golf course; two active Stormwater Management (SWM) ponds near Erb Street; regenerating vegetation, including anthropogenically derived wetland in the vicinity of the SWM ponds; and a mosaic of old field / manicured grass and remnant wetlands on lands owned by 1130814 Ontario Inc. The easterly SWM pond near Erb Street, installed prior to 2004, is owned and operated by the Region of Waterloo, and treats runoff from Ira Needles Boulevard, Waterloo Commons and lands east of Ira Needles Boulevard. The westerly SWM pond in the hydro corridor, installed in the early/mid 1990s, is owned and operated by the Region of Waterloo, and treats runoff from the Regional landfill site.

Surrounding lands include: urban residential / commercial lands to the south, east and north; and a hydro-electric power corridor (HEPC) and Regional Landfill site to the west / southwest.

This area has been subject to considerable study since the mid-1990s, with key studies referenced, considered and summarized herein.

Significant public infrastructure, including the Region of Waterloo landfill, the Hydro Corridor / Hydro Substation, has limited the ability to provide north / south road network capacity / alternatives west of Ira Needles Boulevard. As a result, much of the north / south traffic associated with the West Side of Waterloo is supported by Ira Needles Boulevard and significant traffic volumes travel through the Ira Needles Boulevard / Erb Street roundabout. There are a limited number of accesses connecting The Boardwalk to Ira Needles Boulevard. This was intentional given the objective of internalizing traffic movements within The Boardwalk development. The Thorndale Drive roundabout, as constructed, provides for the northerly extension of The Boardwalk Avenue.

1.2 Project Need

The Boardwalk Avenue currently terminates at the Thorndale roundabout. The roundabout design provides for the northerly extension of The Boardwalk Avenue. The need for the extension of The Boardwalk Avenue to Erb Street West has been identified in the City of Waterloo's Integrated Multi-Modal Transportation Study (IMMTS). The IMMTS identifies the inclusion of a new road (The Boardwalk) from Thorndale Drive, northerly to intersect with Erb Street and a controlled intersection (roundabout) at the intersection of The Boardwalk Avenue and Erb Street West. IMMTS Active Transportation and Traffic Demand Management measures include cycling and pedestrian facilities, are to be included.

Specific Provision (SPA 41) of the Waterloo Official Plan applies to part of the Westhill District. This provision reports that a planned road network is to be addressed prior to, or in conjunction with any plan of subdivision or site plan application and may necessitate an amendment to the Westhill District Implementation Plan (WDIP). The WDIP recommends the development of a new collector road to facilitate The Boardwalk Avenue extension to the north. The 'Ira Needles Boulevard By-Pass" is included in the City of Waterloo's Development Charges Background Study (2018) and includes sanitary sewers, water main and storm sewers, a new collector road and related sidewalks, bike lanes, culvert crossing, pond restoration/relocations and a roundabout at Erb Street West.

2.0 STUDY APPROACH

This study is informed by a Terms of Reference (TOR; included as Appendix A of the Stage 1 EIS) based on input from City of Waterloo, Region of Waterloo and Grand River Conservation Authority (GRCA) staff. Per agency direction, the natural environment study will be completed in three stages, with each stage reviewed and accepted prior to moving to the next stage:

- Stage 1: Existing conditions characterization for ecological and hydrological features and functions of wetlands and watercourse within the study area.
- Stage 2 (current report): evaluation of alternatives, identification of the preferred alternative, and recommended mitigation
- Stage 3: property-specific, focused evaluation

A Stage 1 EIS was submitted for agency review in December 2018, as part of a larger submission which included other technical studies (e.g., planning, engineering). The current report addresses Stage 2, as input to a consolidated Evaluation Study Report, Westhill District, City of Waterloo, which incorporates technical information from all disciplines. The current study builds on the Stage 1 EIS and agency comments / inputs received following the December 2018 submission, including:

- October 15, 2019. Pre-consultation meeting
- November 14, 2019. OPA 27 and Westhill DP Amendment comments (GRCA)
- February 4, 2020. Post-circulation comment (City of Waterloo)

This report includes the following components:

- Overview of existing conditions (as presented in the Stage 1 report)
- Review and integration of other technical information, as relevant
- Natural heritage input to the evaluation of road alternatives (part of the consolidated evaluation of alternatives)
- Natural heritage input to the evaluation of Stormwater Management (SWM) alternative strategies (part of the consolidated evaluation of alternatives)
- Natural heritage impact analysis for the preferred road alignment and SWM strategy
- Recommended mitigation measures, including a conceptual wetland restoration strategy
- Policy compliance discussion
- Identification of future work requirements

3.0 EXISTING CONDITIONS

3.1 Past and Present Land Use

The study area is a mosaic of habitats that reflect the long anthropogenic land use history in the area. A comprehensive overview of that land use history, with air photos from 1930 to present, was included in the Stage 1 EIS. Study area attributes and key results / conclusions are as follows:

- The study area was a rural agricultural landscape until the early 1980s when urban development began approaching from the east. Development within the study area includes:
    - Conversion of agricultural lands in the central portion to a golf course (1996)
    - Installation of a SWM pond near Erb Street in 2004 (in accordance with recommendations from the 1996 Subwatershed Management Plan) and subsequent development of wetland habitat following the SWM installation / establishment of the water storage / detention function
    - Installation of a SWM facility and other infrastructure associated with the Region Landfill in the northwest area (Circa 1989)
    - Development of the Waterloo Commons commercial block in the northeast (2009/2010)
    - Installation of the roundabout at the south end, with extensions of the Boardwalk and Thorndale Drive and pre-grading / fill of the road alignment ~ 85 m north of the roundabout (2016). This included removal of the majority of W3 in accordance with GRCA Permit No. 755/15.
- With respect to natural heritage features, the study area was comprised of agricultural fields until 1971. Prior to development, there were low lying depressions where water pooled, then infiltrated. Landowners installed clay tiles to drain these areas north to Clair Creek in the 1930s and 1950s.
    - The existing wetland features, as described in the Stage 1 EIS (W1 and W3) have been created through alterations of drainage patterns during construction / of the landfill, golf course and Erb Street.

- Major development / land use changes in the local landscape include: the Region Landfill construction beginning in the early 1970s; Erb Street reconstruction in the early 1980s; residential / commercial development on lands to the east, south and north from 1980s to 2000s; and installation / realignment of Ira Needles Boulevard (2004-2017)

3.2 Natural Heritage Features & Designations

The following summarizes existing natural heritage features and designations, including recommendations from the Stage 1 EIS. Refer to Figure 2 for locations.

- No provincially designated features (e.g., *Provincially Significant Wetland* [PSW]; *Areas of Natural or Scientific Interest* [ANSI]) are found on or immediately adjacent to the study area.
- No regulated watercourses are present in the study area.
- There is intermittent drainage from two existing Region of Waterloo SWM facilities towards the outlet / culvert at Erb Street (Drainage Features 1 and 2), from a dug pond on the golf course northerly into the wet area adjacent to the Region SWM facility (Drainage Feature 3) and from agricultural fields on the hydro corridor (Drainage Feature 4)

  From the culvert at Erb Street, storm runoff is conveyed underground via a piped municipal drain to a SWM pond approximately 750m to the north and ultimately into Clair Creek.

  - None of these drainage features is identified as a *Regulated Watercourse* by GRCA. Per analysis in the Stage 1 EIS, Drainage Features 1 - 4 classifications under the City of Waterloo Official Plan were concluded to be Supporting "B" Natural Features
- Portions of the *Waldau East Wetland Complex* (evaluated, non-provincially significant wetland) are located on the landfill lands to the south/west
  - This wetland is designated as a *Core Natural Feature* in Schedule A4 of the City of Waterloo Official Plan and *Core Environmental Feature* on Map 4 of the Region of Waterloo Official Plan (2015)
- Five unevaluated wetlands are present in the study area. Additional wetlands are present on HEPC lands to the west / southwest.
  - All wetlands (not including the golf course ponds) as mapped by GRCA are regulated by GRCA under O. Reg. 150/06
  - Per the analysis in the Stage 1 EIS, wetland classifications under the City of Waterloo Official Plan were concluded to be:
    - W1: *Locally Significant Wetland – Supporting "A" Natural Feature*

- W2: *Other Wetland – Supporting "B" Natural Feature*
- W3: *Other Wetland – Supporting "B" Natural Feature*
- W4: *Other Wetland – Supporting "B" Natural Feature*

- Regenerating areas in the vicinity of the two SWM ponds are designated as *Supporting Natural Features* in Schedule A4 of the City of Waterloo Official Plan.
- The regenerating area in the vicinity of the Landfill SWM pond is designated as *Open Space (Parks and Other Green Space)* in Schedule A3 of the City of Waterloo Official Plan
- The pond/wetland area in the vicinity of the two SWM facilities (the "Erb Street Pond and Wetland System"; W1) was identified as a *Constraint Level 1* feature in the Laurel Creek Subwatershed 314 Management Plan (Mark L. Dorfman, Planner Inc., 1996).

The wetland in the vicinity of the Region SWM facility (W1) was delineated in 2003 by staff from the City of Waterloo, GRCA and NRSI in 2003 and surveyed by MTE, as shown on GRCA online mapping and Figures 2 and 3 herein. Note that wetland boundaries were updated as part of the Stage 1 EIS work; approximate limits are shown on Figure 3 and Figure 7.

3.3 Vegetation & Flora

3.3.1 Floristics

Based on a three-season botanical inventory (2016-2018) by WSP, vegetation community classification / mapping[1] and consideration of previous findings (NRSI 2003), key results are as follows:

- Wetland limits were approximated based on field work, as plotted on Figures 3 and 7. Wetlands include the following Vegetation Units:
  - W1 is comprised of Units 3, 4, 5, 7, 8 and 9

[1] Vegetation communities were classified using the Ecological Land Classification for Southern Ontario (ELC) (Lee et al. 1998) and ELC Ecosystem Catalogue: 2008 Version (Lee 2008), where applicable

- W2: is comprised of Units 2a and 2c
- W3: is comprised of Units 12 and 13[2]
- W4: is comprised of Unit 11

- In total, 116 vascular plant species were recorded by WSP[3]:
  - 69 (61%) are native and 45 (39%) are non-native.
  - Species are a mix of wetland and meadow plants, or non-native species typical of old field and disturbed areas. Planted species are also present.
  - None is provincially or nationally rare (i.e., Srank S1-S3; Grank G1-G3). All recorded native species have a provincial ranking of S4 or S5 [apparently secure (S4) or secure (S5) in Ontario].
  - None is listed as a *Species at Risk* (SAR) subject to the provisions of the ESA (2007) or SARA (2002)
  - CC values range from 0 to 6, with the majority between 2 and 4 (i.e., "tolerant" to "moderately conservative"). No "conservative" or "highly conservative" species were recorded.

3.3.1 Vegetation

Thirteen Vegetation Units and 11 Vegetation Community types were identified, as described in Table 2 of the Stage 1 EIS, with approximate boundaries shown on Figure 3[4]. Some are a mosaic of habitat types or have inclusions within the primary vegetation community. The following vegetation community types were identified, none of which is considered provincially significant (per Bakowsky 1996 / NHIC):

---

2 Unit 12 and Unit 13 wetlands were approved for removal per GRCA Permit No. 755/15

3 Consistent with NRSI (2003) in terms of composition and richness, where 104 species were recorded, none regionally or provincially rare

4 Results are generally consistent with previous findings, though some vegetation communities have succeeded (e.g., CUM to CUT, SWT and SWD) and/or boundaries have shifted slightly.

Cultural Communities – Units 2 and 6

- CUM1-1. Dry-Moist Mineral Cultural Meadow (Unit 2b; Unit 6; Unit 10)
- CUT1. Mineral Cultural Thicket (Unit 2b

Wetland Communities – Units 3, 4, 5, 7, 8, 9, 11, 12 and 13

- MAM2-2. Reed-Canary Grass Mineral Meadow Marsh (Unit 2a; Unit 3; Unit 13)
- MAMM1-12. European Common Reed Meadow Marsh (Unit 7)
- MAS2-1. Cattail Shallow Mineral Marsh (Inclusion within Unit 4)
- MAS2-2. Bulrush Mineral Shallow Marsh (Unit 12)
- SWT2. Mineral Thicket Swamp (Unit 4)
- SWT2-2. Willow Thicket Mineral Swamp (Unit 11)
- SWT2-5. Red Osier Dogwood Mineral Thicket Swamp (Unit 2a)
- SWD4-5. Poplar Mineral Deciduous Swamp (Unit 5; Unit 8)
- SAS1-1. Pondweed Submerged Shallow Aquatic (Unit 9). Note that this anthropogenic feature provides a storage / detention function associated with the Erb St. SWM facility.

3.4 Wildlife

Based on multi-season avifaunal, herpetofaunal and supplemental wildlife surveys and SAR / *Significant Wildlife Habitat* (SWH) habitat assessments undertaken by WSP on 17 dates from fall 2016 through summer 2018, key wildlife results for the study area are as follows:

- **Avifauna**. In total, 32 breeding bird species were recorded within the study area
    - None is a Species at Risk
    - None is a provincially or nationally rare species (i.e., Srank S1-S3; Grank G1-G3).
    - None is considered *Area-Sensitive* by MNRF (2000; 2015).
    - 25 species are subject to provisions of the Migratory Birds Convention Act, MBCA (1994)

- Most are generalist species, not associated with specific habitat types

- **Herpetofauna**
  - In total, 3 anuran species were recorded in low abundance during Marsh Monitoring Protocol (MMP) surveys: American Toad; Green Frog; and Northern Leopard Frog. No additional amphibian species were recorded during other field surveys.
  - Two turtle species were recorded in low abundance in golf course and SWM ponds: Midland Painted Turtle and Red-eared Slider. No turtle nesting was confirmed. The study area does not contain any ideal turtle nesting habitat and turtles likely nest in unsuitable areas which result in low nest success.
  - None of the recorded herpetofauna is a Species at Risk, or provincially or nationally rare species (i.e., Srank S1-S3; Grank G1-G3).
- The study area provides habitat for common, urban-adapted **mammal** species. Seven species were recorded: Eastern Cottontail; Long-tailed Weasel; Muskrat; Raccoon; Red Squirrel; White-tailed Deer; Groundhog.
- Two **invertebrate** species of note were recorded: Monarch (1 individual recorded in Unit 4); and Chimney Crayfish (evidence of use [burrows] in low abundance in marsh habitats in Unit 2 and Unit 4 abutting agricultural field)
- **SAR Wildlife**. No provincially *Endangered* or *Threatened* designated SAR species were recorded during surveys and we are aware of no recent records within the study area. For all other SAR species with some potentially suitable habitat in the vicinity of the proposed activities, but not recorded during field surveys, the likelihood and magnitude of impacts is 'none' or 'minimal', based on the size and/or quality of habitat, low likelihood of occurrence and presence of abundant (and generally much larger / higher quality) habitat in the local landscape.
- **Wildlife Movement**. The study area is isolated, with built / approved or planned urban development to the north, east and south and the Regional Landfill to the west. In addition, two major roads (Erb Street West and Ira Needles Boulevard) to the north and east are barriers to wildlife movement.
- **Significant Wildlife Habitat (SWH)**. An evaluation of *Significant Wildlife Habitat* was undertaken using the Significant Wildlife Habitat Ecoregion Criteria Schedules, Ecoregion 6E (MNRF 2015), as included in Appendix F of the Stage 1 EIS.
  - SWH was confirmed for two criteria: *Terrestrial Crayfish* - Chimney Crayfish confirmed SWH in Unit 2 (CUT) and Unit 4 (SWT); and *Special Concern and Rare Wildlife Species* - confirmed SWH for Monarch (*Special Concern* in Ontario;

Endangered in Canada [COSEWIC], *Special Concern* under SARA) in Unit 4 (SWT).

- With mitigation and restoration, it was concluded that anticipated activities will not result in negative impacts to SWH for terrestrial crayfish and Monarch

3.5 Aquatic Resources

Based on targeted aquatic habitat assessments / fish community sampling on November 3rd and 4th, 2016 and available background information, aquatic habitat is characterized as follows:

- Under current conditions, there are no defined watercourses in the study area, though there are several dug ponds, two SWM facility ponds and several drainage features (i.e., swales, diffuse flow areas). See Figure 5.

- Surface water for the study area is conveyed via diffuse flow to a culvert at Erb Street West, then conveyed northerly via a municipal drain for more than 750 m, outletting to a SWM Pond outside the study area. Ultimately, this runoff is conveyed to Clair Creek, a tributary of the Grand River.

- Three fish species were captured in the golf course and SWM ponds: Fathead Minnow (*Pimphales promelas*); Brown Bullhead (*Ameirus nebulosus*); and Goldfish (*Carassius auratus*).

- No fish were captured in the drainage features

    - The aquatic habitat within the trapped Ponds 1, 2, 3 and SWM / Pond 4 support warmwater fish communities consisting of either baitfish (Fathead Minnow) and/or sportfish (Brown Bullhead) species that are common in southern Ontario.

    - All aquatic features in the study area are considered 'disconnected' from downstream fisheries (i.e., Clair Creek and Clair Lake): fish present in the downstream habitats cannot move upstream to the study area features as the nearest waterbody is a SWM pond separated by more than 750m of underground pipe / municipal drain. Clair Creek and Clair Lake are downstream of this SWM pond, and each are several kilometres downstream of the study area. Flow to these habitats is further disrupted by additional underground pipes / municipal drains and online SWM ponds.

3.6 Hydrogeology

Hydrogeology has been assessed by MTE Consultants, as documented in through the following:

1. Surface Water Monitoring West Waterloo, Westhill District (WW-WD) North/South Collector Rd (NS-CR) (MTE December 2018)
2. Hydrogeological Assessment, West Waterloo, Westhill District (WW-WD) North/South Collector Rd (NS-CR) (MTE December 2018)
3. Erb Street Pond Chronology, West Waterloo, Westhill District (WW-WD) North/South Collector Rd (NS-CR) (MTE December 2018)

Key findings from the hydrogeological analyses are presented below.

Drainage

- Topography across the Study Area is rolling with scattered topographic low areas. Elevations range between 377 m and 394 m amsl, decreasing in elevation along the northwesterly direction;
- This drainage area includes a portion of the ROW Landfill facility. The existing topography is undulating with two drainage draws; one through the eastern half of the area which crosses the existing Westhill Meadows Golf Course, and a second along the existing hydro corridor which runs along the east side of the landfill. Drainage, predominantly from south to north, is captured in the Erb Street Detention Facility (ESDF) and outlets via the culvert/storm sewer under Erb Street.

Hydrogeology

- Stratigraphic conditions beneath the Study Area primarily consist of fine grained cohesive (silt and clayey silt till) materials;
- Groundwater levels in the Study Area were measured to range from 0.34 m bgs to 3.39 m bgs in installed monitoring wells and mini-piezometers;
- Local groundwater elevations are interpreted to generally follow the Study Area topography, ranging between 377 m and 382.5 m amsl, flowing northwesterly;
- Regional groundwater flow direction is generally to the south across the study area.

Surface Water

- A comparison of measured average surface water elevations and ground surface elevations at HEPC North (W2; Veg. Unit 2a/2c) and 1130814 Ontario Inc. West (W4; Veg. Unit 11) determined that these wetland features remained generally dry during the monitoring period (i.e. standing water levels of <0.03 m). This suggests that these features are likely topographic depressions which temporarily retain water following precipitation events, then become dry as a result of evapotranspiration and infiltration losses. Standing water was observed at W1 and W3. MTE has surface and groundwater monitoring at this location and it will be on-going. The Region of Waterloo Landfill 'pond' is a SWM facility which drains into the W1 wetland/SWM facility.

Water Quality

Overall trends identified from samples collected from the Study Area suggest the following:

- Groundwater concentrations of anions, nutrients, and total metals are generally lower than surface water concentrations;
- Surface water concentrations of anion, nutrients, and total metals generally increase across the Study Area to the north / northeast, following the inferred direction of surface water drainage;
- Groundwater concentrations of anion, nutrients, and total metals generally increase across the Study Area to the north / northeast, following the inferred direction of groundwater flow; and
- The elevated concentrations of sodium and chloride at W1 are interpreted to be a result of road salt application on the roadways located to the north and east (Erb St. and Ira Needles Boulevard).

Groundwater – wetland interaction

- It is interpreted that the wetland W1 receives minor volumes of groundwater discharge and is primarily sustained by surface water runoff. Surface water runoff directed to the wetland feature is general conveyed from the surrounding lands, Ira Needles Boulevard, and the hydraulically up-gradient Regional Landfill SWM pond.
- It is interpreted that wetland W3 formerly provided minor recharge volumes to the underlying groundwater table. Based on its small size, it was concluded that recharge

volumes generated through this feature were relatively insignificant and that local groundwater was therefore likely not sustained by this wetland. The wetland W3 has since been partially removed in accordance with GRCA Permit No. 755/15.

- An in-depth groundwater-wetland interaction assessment of the smaller unevaluated wetland features (HEPC North (W2), HEPC South, and 1130814 Ontario Inc. West (W4) was not completed based on review of collected surface water level data and the relatively small areas of the wetland features. Surface water level data at these locations suggest that the wetland features would generally behave as depression features, retaining water following precipitation events and then becoming dry as a result of evapotranspiration and infiltration losses.

4.0 EVALUATION OF ROAD ALIGNMENT ALTERNATIVES

A detailed overview of the evaluation approach and criteria, along with the full evaluation matrices, are provided in the Evaluation Report – Collector Road and Stormwater Management Alternatives Westhill District City of Waterloo (the 'Evaluation Report'; MHBC et.al. 2020). Briefly, the evaluation criteria were grouped into five factor categories: natural environment; socio-economic environment; cultural environment; transportation/municipal services and utilities; and financial / technical considerations. Within each category, there are various factor groups. All criteria were evaluated using a Numerical 'must-score' Evaluation approach – where the least preferred alternative receives a score of 1 and the most preferred alternative receives a score of 10. All other alternatives were scored between these values with ties permitted. A normalized scoring approach was used to calculate an average category score, then average category scores were added together for the total normalized score for each alternative. The alternative with the highest total normalized score emerged as the overall preferred alternative and the alternative with the lowest total normalized score was determined to be the least preferred alternative.

In response to agency input, road alternative options were subdivided into 'south' and 'north' sections, with an overview of the natural heritage analysis presented in Sections 4.1 and 4.2.

The full evaluation of road alternatives is presented in Section 4 and related appendices of the Evaluation Report.

4.1 South Alternatives

4.1.1 Natural Environment

Four alignment alternatives within 'Area 2' of the Stage 1 EIS were evaluated, as shown on Figure 6. All share a common starting point at the Thorndale Drive extension roundabout. Alternative S-1 connects directly to Ira Needles Boulevard. All other options connect to the portion of the 'North Alignment' that extends westerly from Ira Needles Boulevard.

Natural heritage features within 'Area 2' include a rural residential property and associated landscaped vegetation in the east portion, an area of pre-graded / filled lands north of the Boardwalk / Thorndale roundabout, cultural meadow (west half) and wetlands W3 and W4. As noted, ~0.8ha of W3 was removed in accordance with GRCA Permit No. 755/15, with ~ 0.1ha remaining.

Vegetation Units 10, 11, 12 and 13 are comprised of early successional and/or highly altered and isolated habitats with very limited botanical richness, no recorded SCC and widespread / abundant non-native species. No significant or specialized wildlife habitat elements are present, and a common suite of tolerant / generalist wildlife was recorded in this area, with no wildlife SCC recorded.

The key natural heritage factors in the evaluation of road alignment alternatives (i.e., those factors with the greatest differences between alignments) are the amount of vegetation / wildlife habitat removal and amount of 'Other Wetland / Supporting 'B'' Natural Feature removal, rather than impacts to significant and/or sensitive habitats or SCC or aquatic habitat.

None of the alignments would impact PSW wetland, SCC or their habitats or other high quality / sensitive vegetation communities or wildlife habitat.

For some natural heritage factors, there is no difference among alternatives (i.e., aquatic habitat, water quality, groundwater resources, plant SAR, aquatic SAR). Since Alignment S-4 removes the greatest amount of habitat, including wetland W4 and potential wildlife SAR habitat, it is rated lowest for all applicable measures. However, it is important to note that the magnitude of potential impact differences is not that large.

4.1.1 Overall Evaluation

Based on the evaluation, Alternative S-3 is recommended as the preferred south section road alignment. Alternative S-3 provides: a direct connection to the northern section of the collector road; appropriate spacing between intersections; regularly shaped development parcels; and can be coordinated with services and stormwater management facilities required for the development of the Westhill District.

4.2 North Alternatives

4.2.1 Natural Environment

Four alignment alternatives within 'Area 1' of the Stage 1 EIS were evaluated, as shown on Figure 6. All alignments share a common portion of the 'North Alignment' that extends westerly from Ira Needles Boulevard and all options connect to Erb Street West.

Natural heritage features within 'Area 2' include the golf course / associated buildings, the HEPC lands, the two Regional SWM ponds, the Waterloo Commons developed area, a small portion of

the Region Landfill and the natural features associated with the SWM outlets south of the Erb Street (including wetlands W1, W2 and the HEPC south wetland).

Vegetation Units 1 – 9 are comprised of early successional and/or highly altered meadow, marsh, thicket, swamp and open water habitats. Vegetation attributes vary among communities, though botanical richness and sensitivity are generally low, with moderate to high levels of anthropogenic disturbance, no recorded SCC and widespread / abundant non-native species.

Existing vegetation provides habitat for a mix of wildlife, including generalist species and some wetland associated species (avifauna, herpetofauna). No provincially or nationally rare species (i.e., Srank S1-S3; Grank G1-G3) were recorded. Specialized wildlife habitat elements are present (open water; SWH), and wildlife SCC and SAR / potential SAR habitat is present.

The key natural heritage factors in the evaluation of road alignment alternatives (i.e., those factors with the greatest differences between alignments) are the overall amount of vegetation / wildlife habitat removal, amount of *Locally Significant Wetland* (LSW) / Supporting "A" Natural Feature removal, amount of 'Other Wetland / Supporting 'B'' Natural Feature removal, and impacts to SCC habitat. For some natural heritage factors, there is no difference among alternatives (i.e., groundwater resources, plant SAR, aquatic SAR).

None of the alignments would impact PSW wetland, confirmed *Endangered* or *Threatened* SAR habitat, woodland or other high quality / sensitive vegetation communities or wildlife habitat. Although there are differences in impacts to aquatic habitat, these are not substantive and no alternative would impact regulated watercourses or fish habitat subject to the Fisheries Act (i.e., downstream of the study area).

Since Alignment N-1 removes the greatest amount of habitat, including LSW wetland, SWH, and wildlife SCC / herpetofauna habitat, it is rated lowest for all applicable measures. However, it is important to note that the magnitude of potential impact differences is not that large.

4.2.2 Overall Evaluation

It became clear through the evaluation process and ongoing consultation with review agencies, that alternatives N-2, N-3 and N-4 are not feasible from a variety of perspectives.

- Hydro One and the Region of Waterloo have confirmed road alignments that extend into the Region of Waterloo landfill site and/or that run parallel to and within the hydro corridor would not be supported.

- The Region of Waterloo have also confirmed that Alternative N-4 would not be supported given technical considerations relating to intersection spacing and proximity to the Erb Street/Ira Needles Boulevard roundabout.

- Alternative N-4 would also result in significant impacts to the Waterloo Commons development, the Canadian Tire Plaza as well as the locally significant wetland.

4.3 Conclusion

Based on the evaluation, Alternative S-3 and Alternative N-1 are recommended as the preferred road alignments. It is acknowledged that Alternative N-1 will result in impacts to the locally significant wetland and that particular focus should be given to mitigation, as well as habitat restoration measures. Refer to Section 7.0 for mitigation and restoration details.

5.0 EVALUATION OF SWM ALTERNATIVES

5.1 Approach

Storm servicing for the Study Area is to be coordinated with the preferred collector road alignment. The Study Area's storm outlet is located at the north end of the Study Area and includes an existing 900mm diameter storm sewer and a smaller diameter orifice at Erb St. The storm sewer conveys storm runoff northerly through the Clair Meadows Subdivision and discharges directly to Clair Creek.

Five alternative SWM strategies were evaluated. They differ in the number, location, size and type / ownership of SWM facilities, the degree to which ponding occurs under flooding / detention and the ability to improve treatment of existing runoff from the landfill. Refer to Figures MS11.0 through MS11.5 of the Westhill District Plan Preliminary Stormwater Management Report (MTE, June 5, 2020).

Alternative 1 (SWM-1)

- This alternative is considered the 'Do Nothing' alternative.
- The preferred north section collector road will bisect the existing regional storm detention storage and wetland area north of Waterloo Commons.
- The preferred south section collector roadway does not have a water quality control system upstream of the wetland and will outlet to the existing Erb Street SWMF.
- Flooding will occur over the preferred north section of the roadway in the vicinity of Erb Street.

Alternative 2 (SWM-2)

- Includes seven private SWM facilities and three public SWM facilities.
- Provides for a dual sewer within the municipal right of way and will allow for two water sewers. One sewer will operate as a "clean" water sewer for treated water from private sites and the other sewer will operate as a "dirty" water sewer for road drainage.
- The public SWM facilities will be located downstream of the preferred roadway with drainage towards Erb Street.
- Allows for double routings for large storm events.

- Requires extensive infrastructure with on-site private and public SWM facilities.
- Regional Storm Flooding will be contained within the SWMF.

Alternative 3 (SWM-3)

- Serviced by six public SWMF (City and Region) with dedicated storm outlets for each facility.
- Provides dual sewers that operate with a “clean” water sewer for treated water from private sites and a “dirty” water sewer for road drainage. Dual sewers will be provided for the Cressman SWMF, Home Hardware SWMF and road drainage.
- Regional Storm Flooding will be contained within the SWMF.

Alternative 4 (SWM-4)

- Includes three public SWM facilities with dedicated storm outlets for each facility.
- A dual sewer system will service the collector roadway section in the Waterloo Commons JV Inc. Lands.
- Removes two existing SWM facilities (one on the Waterloo Commons JV Inc. lands and one on Hydro One lands).
- Minimizes infrastructure cost and maintenance by providing the minimal number of municipal SWM facilities and providing a smaller section of dual sewer systems.
- Regional Storm Flooding will be contained within the SWMF.

Alternative 5 (SWM-5)

- This alternative was developed in consideration of feedback received from the City of Waterloo re; concern with the total number of SWM facilities and attenuation of the collector road within the hydro corridor.
- Includes attenuation of existing drainage from the Region’s landfill within the hydro corridor as it now exists and
- Includes construction of two new stormwater management facilities (one private and one public), which will receive drainage from the collector road
- The SWM ponds will be designed as extended detention wetland facilities to reduce impacts associated with phosphorus, suspended solids and bacteria and to provide thermal mitigation.

- Regional storm flooding will be contained within SWMF1 and SWMF2 and the level of flooding within the HECP hydro corridor will be maintained to current conditions.

The evaluation approach follows the same methodology as the road alignments, including criteria and normalized numerical evaluation. A detailed overview of the evaluation approach and criteria, along with the full evaluation matrices, are provided in the Evaluation Report. A summary of key natural environment evaluation results is provided in Section 5.2, with an overview of the consolidated evaluation and preferred strategy provided in Section 5.3.

The full evaluation of SWM options is presented in Section 6 and related appendices of the Evaluation Report.

5.2 Natural Environment

All options, except Option 1 (the 'do-nothing' option), include grading / disturbance in GRCA Regulated areas.

Options 3, 4 and 5 (and associated requirements for access through the Hydro Corridor) would remove *Significant Wildlife Habitat*. However, none of these options would result in negative impact to SWH with maintenance of suitable habitat in the local landscape and/or habitat enhancements.

No options impact PSWs, ESPAs, provincially significant vegetation communities, plant SCC, aquatic SCC, fish habitat subject to the Fisheries Act or *Significant Woodlands*.

The key natural heritage factors in the evaluation of SWM alternatives (i.e., those factors with the greatest differences between alignments) are:

- the ability to improve SWM treatment and downstream water quality;
- the overall amount of vegetation / wildlife habitat removal;
- the amount of *Locally Significant Wetland* (LSW) / Supporting "A" Natural Feature removal;
- the amount of 'Other Wetland / Supporting 'B'' Natural Feature removal;
- potential impacts to SWH; and
- ability to retain existing wildlife habitat or create new habitat with new SWM facilities.

For some natural heritage factors, there is no difference or very little difference among alternatives (i.e., groundwater resources, plant SAR, aquatic SAR / aquatic habitat).

For natural heritage factors, there is no consistent 'best' or 'worst' rated options – some options have relatively greater direct impacts (e.g., wetland removal), but relatively less indirect impact (e.g., larger ponded area and resulting impacts on vegetation, lack of improvement to downstream more sensitive aquatic habitat) or vice versa.

For those factors where greater direct impact to sensitive features / wetlands would occur, Option 4 rated lowest or very low and Option 1 or Option 5 often rated highest (e.g., wetlands, designated areas, vegetation, wildlife habitat).

5.2 Overall Evaluation

Alternative SWM-5 is recommended as the preferred stormwater management alternative. It includes the following key elements:

- Replaces the existing Erb Street Detention Facility with two new SWM facilities to the east of the preferred north section road alignment.
- Maintains existing storage within the hydro corridor; eliminates all storage east of the preferred road alignment (relative to the current condition where a substantial area is flooded)
- Minimizes the total number of new facilities to be maintained by the City of Waterloo
- Satisfies stormwater management objectives outlined in the current Ministry of the Environment SWM Planning and Design Manual (2003) as well as other objectives outlined in the Subwatershed 314 Management Plan.
- Includes recommendations for wetland / open water habitat restoration via native species plantings and/or seedbank/rootwad salvage, where appropriate, per GRCA policy
- Coordinates other elements of the storm drainage system with the collector road network in a manner that is both cost effective and efficient.
- Along with the recommended collector road, the preferred SWM is supported by land owners; together, these achieve an acceptable and appropriate pattern of development.

6.0 PROJECT DESCRIPTION

Based on the evaluation using all factors, Road Alignment N-1 / S-3 and SWM Alternative 5 are concluded to be the preferred options.

The preferred alignment and SWM strategy, including locations, preliminary / approximate grading and infrastructure, are shown on Figure 7.

6.1 Road

The extension of The Boardwalk is being planned and designed as a minor City collector road (22m right-of-way) that will facilitate pedestrian, bicycle and vehicular movements between Erb Street and Ira Needles Boulevard. Access to abutting properties will be permitted. The road allowance will be designed to accommodate two-way traffic flow with one travel lane in each direction and bicycle lanes in either direction. The preferred alternative includes a combination of one bicycle lane and a multi-use trail on opposite sides of the road.

In consideration of the intersection control study that was completed, the intersection of the collector road at Erb Street will be designed as a roundabout consistent with other roundabouts within this section of the Erb Street corridor.

The recommended road network requires a crossing through environmental features, and would travel immediately east of the Hydro One lands, with a terminus at the intersection of Erb Street West adjacent to the commercial development. The recommended road network includes alternatives N-1 and S-3 identified in Figures 6 and 7.

6.2 SWM Strategy

SWM Alternative 5 proposes to replace the Erb Street Detention Facility (ESDF) with 2 municipal SWMFs (SWMF1 and SWMF2) and retains the balance of the ESDF in the form of a detention storage located on the HEPC corridor referenced as the Hydro Corridor Detention Facility (HCDF).

A detailed discussion of the proposed SWM strategy is provided in the Westhill District Plan Preliminary Stormwater Management Report (MTE; June 5, 2020). Key elements of the SWM strategy are as follows:

- Replace the ESDF with two new SWM facilities (SWMF1 on Home Hardware lands and SWMF2 on Waterloo Commons lands) and the HCDF;

- SWMF1 and SWMF2 will be designed and constructed as wetland type facilities with Regional Storm controls and detention storage. It is important to note that the new SWM facility will not introduce a 'new' quality control function in the existing wetland – this function has already been present for many years

- The HCDF will maintain current storage and flood levels under post-development conditions on the HEPC lands (i.e., no additional impact to natural heritage features)

- Provide water quality to an "Enhanced" Level 1 protection, a conservative design in excess of MOE requirements ('Normal', Level 2) - per the Subwatershed 314 Management Plan

- Provide 24 to 48 hours of extended detention volume for the 25mm, 4-hour storm event for erosion protection of downstream receiving watercourses

- Attenuate post-development peak flows to pre-development levels for the 2-year to 100-year storm events

- Control the regional storm to the allowable flowrate of the original 24" (610mm) Erb Street Culvert under 3.3m of head/pressure conditions which occurred during the regional storm flood elevation of the predevelopment condition.

- Satisfy surface water quality parameters as outlined in the Subwatershed 314 Management Plan

- Restore wetland habitat removed by creating wetland habitat in the SWM facilities, including shallow open water, emergent wetland vegetation around the perimeter and terrestrial vegetation (trees, shrubs and herbaceous plants) on the berms

7.0 MITIGATION & RESTORATION

7.1 Mitigation Measures

To mitigate potential impacts to natural heritage features and functions, the following measures are recommended:

- Minimizing the disturbance footprint to the extent possible, via grading and design
- Avoiding significant and/or sensitive natural areas to the extent possible, in consideration of other evaluation factors
- Implementing a **Stormwater Management Strategy** to mitigate potential impacts on natural features (i.e., alterations to surface water quality and quantity), including several key elements:
    - Attenuation of peak flows for all storm events of surface flows to downstream receiving areas (ultimately Clair Creek)
    - Improved surface water quality treatment to an Enhanced Level, relative to the current condition (where some detention and settling function within the wetland may occur), by providing extended detention and 'Enhanced' water quality treatment within municipal SWMF for downstream receiving watercourses.

      Notwithstanding this, it is recommended that chloride management plans be prepared for future development applications.
    - Restoration of wetland habitat, with an overall net gain in area
    - Mitigation of flooding impacts relative to current condition
    - Enhanced surface water temperature and dissolved oxygen in downstream aquatic habitat relative to the current condition – achieved through SWM design measures
- **Timing of works** to minimize impact to wildlife
    - Breeding birds: undertake grading and vegetation removals in compliance with the Migratory Birds Convention Act, MBCA. Where possible, works (including vegetation removals) that have the potential to harm breeding birds will respect timing windows for breeding birds subject to the MBCA (i.e., removals undertaken outside of the approximate nesting period from early April through late August).
    - Herpetofauna: where possible, works in aquatic habitat should avoid the herpetofauna hibernation period (~ early September through late May)

- Bats: undertake tree removals outside the SAR bat active period (i.e., removals undertaken between October 1 and March 31)
- Fisheries Timing Window: not anticipated to be required. To be confirmed with MNRF prior to construction.

- **Re-stabilizing and re-vegetating all exposed surfaces** as soon as possible following construction, using appropriate seed mixes and planting or other appropriate cover.
- **Fish removal**
  - It is recommended that a fish removal be conducted by qualified biologists under a License to Collect Fish for Scientific Purposes (LTCF) issued by the Ontario Ministry of Resources and Forestry (MNRF). This is a best effort approach, undertaken in accordance with MNRF directives specified in the LTCF.
- **Wildlife rescue:**
  - It is recommended that a wildlife rescue (turtles and other herpetofauna) be conducted prior to removals of wetland (pond) habitat and SWM pond / storage areas
  - The wildlife rescues should be conducted under a Wildlife Scientific Collectors Authorization permit issued by the MNRF. Prior to conducting the wildlife rescue, a protocol should be developed in conjunction with the MNRF to ensure proper handling and care of any wildlife captured, prior to release to suitable habitats outside of the construction area.
  - Where possible, the removal of the existing forebay (including draw-downs and fish removal / wildlife rescues) should occur within a timing window to avoid disturbing hibernating reptiles and amphibians (i.e., completed during summer months, between June 1 and September 1 of any given year).
- Implementing additional construction **Best Management Practices (BMPs)** including:
  - **Erosion and Sediment Control Plan** - This strategy will mitigate impacts on vegetation, wildlife (including wildlife habitat) and downstream waterbodies by: installing ESC fencing at grading limits; preventing sedimentation in adjacent natural features; installing erosion blankets on steep slopes, where required; installing temporary rock check dams in swales; timely re-vegetation of exposed soils; and regular site inspection, maintenance and reporting to ensure the controls are working properly. Preliminary guidance is provided in the Section 6.0 of the SWM report (MTE, June 2020), with the final plan to be prepared at detailed design.

- **Tree and Vegetation Protection** - Temporary tree and vegetation protection fencing (which can often be combined with E&S fencing) is recommended to prevent damage to adjacent natural areas during construction (i.e., mechanical damage, soil compaction). To be prepared at detailed design.

  Vegetation clearing limits are to be clearly delineated on contract drawings, with on-site direction and confirmation during construction

- **Wildlife exclusion fencing –** the ESC / vegetation protection fencing will also function as interim (during construction) wildlife exclusion fencing

- **Spills Management Plan** - A *Spills Management Plan* should be prepared at final design and implemented throughout construction to reduce potential for contamination of groundwater, receiving waterbodies and adjacent vegetation.

- **Wetland Restoration**. Implementing appropriate remedial measures to restore and enhance features and functions of the wetlands impacted by installation of the preferred alignment and SWM strategy, as outlined in Section 7.2.

7.2 Wetland Restoration

7.2.1 Features and Functions

Wetland restoration is proposed as a remedial measure for impacts to regulated wetlands, namely the loss of wetland habitat which has the following attributes and functions:

- Overall: anthropogenically derived vegetation / habitats that currently function as storage for the existing SWM facilities; young, tolerant habitats with a prevalence of invasive species
- Hydrologic functions:
  - W1 is a surface water feature resulting from the perched culvert at Erb Street. It is part of a larger storage / detention area for surface runoff (minor, major and Regional storm events) to mitigate flooding and downstream erosion
  - Provides surface water inputs to downstream waterbodies (i.e., Clair Creek and Clair Lake)
- Vegetation:
  - Several anthropogenically influenced / derived wetland vegetation community types are present – predominantly marsh and thicket, with some open water and small areas of treed swamp

- No SAR and no provincially or nationally rare species are present; habitats are dominated by mostly 'tolerant' species (i.e., low CC)
- Phragmites dominates open water areas, and is likely expanding

- Wildlife:
  - Habitat for a common suite of generalist birds; no confirmed breeding habitat for area-sensitive species or habitat specialists
  - Habitat for breeding anurans and turtles (low abundance)
  - Provides a small amount of marginal habitat for Species of Conservation Concern (Monarch, Chimney Crayfish, potential SAR bat habitat); this habitat is well-represented in the local landscape, including the HEPC and landfill lands
- Aquatic habitat:
  - The impacted features are an anthropogenic pond (storage for the existing Erb St. SWM facility) and intermittent drainage features which provide a small amount of low quality aquatic habitat.
  - The Erb St. SWM facility provided some habitat for common warmwater fish, though it is 'disconnected' from downstream fisheries (i.e., Clair Creek and Clair Lake), due to intervening piped sections and SWM facilities.
  - Surface water flow from the study area is conveyed downstream via a culvert at Erb Street West and a municipal drain for more than 750 m, outletting to a SWM Pond outside the study area. Ultimately, this runoff is conveyed to Clair Creek, a tributary of the Grand River.

7.2.2 Conceptual Restoration Strategy

The conceptual strategy is to restore habitat to replace habitat impacted by the road and SWM installation, including both open water habitat and marsh habitat. The restored habitat will be provided within the two recommended SWM facility blocks as shown on Figure 7. Key elements of the restoration are as follows, with additional details and design to be provided at final design:

- Net improvement to aquatic habitat in downstream receiving areas (Clair Creek) due to improved water quality treatment relative to the current condition
- Enhancement to vegetation communities with removal of invasive Phragmites

- Provision of habitat for wildlife species using existing habitats, including avifauna, herpetofauna and other wildlife guilds
- Creation of targeted wildlife habitat areas or elements including for example: turtle nesting areas; turtle basking features (logs, rocks); suitable substrates for herpetofaunal overwintering; host-plants and nectaring plants for Lepidoptera and Odonata; open areas for thermal basking and foraging of Lepidoptera and Odonata.
- Provision of additional botanical diversity through planting of appropriate native species within the ponded areas and berms
- Consideration of seedbank salvage in appropriate areas where removals will occur (i.e., where no evidence of invasive non-native species is present)

8.0 IMPACT ASSESSENT

8.1 Direct Impacts

Vegetation. Removal of portions of existing anthropogenic wetland habitat in: Wetland W1 (Vegetation Units 3, 4, 5, 7, 8 and 9, consisting of Reed-Canary Grass Meadow Marsh, Swamp Thicket, Poplar Mineral Deciduous Swamp, European Common Reed Mineral Meadow Marsh and Pondweed Submerged Shallow Aquatic); and Wetland W3 (Vegetation Unit 12 and 13, consisting of Bulrush Shallow Marsh and Reed-Canary Grass Meadow Marsh).

Wildlife. Removal of habitat for predominantly tolerant, common wildlife including generalist avifauna, several herpetofaunal species in low abundance and a small amount of SWH for Monarch and Chimney Crayfish.

Aquatic habitat. Removal of a small amount of anthropogenic, low quality aquatic habitat. No direct impact to regulated watercourses or fish habitat subject to the Fisheries Act.

Conclusion

Negative direct impacts from the proposed works on vegetation, wildlife / habitat and aquatic habitat are anticipated to be minor, considering the anthropogenic origin and high level of disturbance in the study area.

Residual impacts will be further mitigated through:

- retention of habitat which provides the same functions in the local landscape, including habitat for species of conservation concern; and
- implementation of proposed wetland habitat restoration as described in Section 7.2.2.
- removal of invasive Phragmites

8.2 Indirect Impacts

With construction activities, there is potential for indirect impacts to adjacent retained vegetation features during and following construction, including, but not limited to, the following:

- ‘During-construction’ impacts:

- Vegetation clearing / damage beyond the working area;
    - Addressed by mitigation measures listed in Section 7 (e.g., vegetation protection fencing)
- Spills of contaminants, fuels, and other materials that may reach semi-natural areas;
    - Addressed by mitigation measures listed in Section 7 (e.g., ESC, spills management)
- Potential impacts to wildlife
    - Addressed by mitigation measures listed in Section 7 (e.g., timing, fencing)
- Release of construction-generated sediment to adjacent habitats;
    - Addressed by mitigation measures listed in Section 7
- Short term dewatering during construction is expected. See Hydrogeological report for further details.
    - Addressed by mitigation measures listed in Section 7.1 and best management practices, including isolation of the works. To be confirmed through future *Permit to Take Water*, as required.

- Edge impacts to adjacent wetland
    - Not of concern given the nature of vegetation and degree of existing disturbance (i.e., tolerant, anthropogenically derived and with evidence of existing edge impacts)

- Potential for elevated chlorides with a new road
    - Given the site context (existing development, parking lots and major roads) and presence of existing SWM facilities treating runoff from Ira Needles Boulevard and Erb Street, there are elevated concentrations of sodium and chloride at W1 in the current condition. Vegetation in this area is comprised primarily of tolerant and/or adventive species. No sensitive community types or flora are present.

      Notwithstanding this, it is recommended that chloride management plans be prepared for future development applications.
- Potential impacts on downstream aquatic habitat
    - Mitigated by 'during-construction' mitigation measures listed above and in Section 9.1.2

- The proposed SWM strategy is considered a net enhancement relative to the current condition and will result improved downstream water quality, maintenance of surface water inputs and mitigation of potential erosion impacts.

Conclusion

Negative indirect impacts from the proposed works on vegetation, wildlife / habitat and aquatic habitat are minor, and will be mitigated with proposed measures identified herein.

With implementation of proposed protection, mitigation and restoration / enhancement measures described herein, no residual impacts to vegetation, flora, wildlife or aquatic habitat are anticipated. The attributes and functions currently provided will continue post-construction, providing habitat for species currently found in or using the impacted areas.

9.0 POLICY COMPLIANCE

A discussion of natural heritage policy compliance was included in the Stage 1 EIS. It has been updated, as discussed herein; there are no substantive changes, though there have been some minor refinements.

9.1 Fisheries Act

9.1.1 Overview of Key Policies

In April 2018, the Government of Canada passed Bill C-68, which included updates to the Fisheries Act. These updates came into effect on August 28, 2019. Specific fish and fish habitat protection provisions of the updated Fisheries Act state:

> **Section 34.4 (1)**: "*No person shall carry on any work, undertaking or activity, other than fishing that results in the death of fish*", and:
>
> **Section 35 (1)**: "*No person shall carry on any work, undertaking or activity that results in harmful alteration, disruption or destruction of fish habitat*."

Proponents that plan to undertake activities in or near water have the potential to negatively affect fisheries, and as such, are responsible for avoiding, mitigating, and possibly offsetting potential negative effects. Avoidance is achieved by undertaking measures which avoid the potential for the project to cause the death of fish or otherwise alter, disrupt or destroy fish habitat. These measures include project design considerations, location of activity, and timing of works. Mitigation is implemented by following best practices as described in the Measures to protect fish and fish habitat on Fisheries and Oceans Canada's (DFO) Projects Near Water webpage[5]. If the project can follow the measures to protect fish and fish habitat, then a review of the project by DFO is not required.

[5] http://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures-eng.html

9.1.2 Study Assessment

Downstream of the study area, Clair Creek / Clair Lake provide fish habitat. However, as noted, those features are several kilometres downstream of the study area and disconnected from waterbodies in the study area by long sections of piped municipal drain and several SWM ponds.

Given that the waterbodies within the study area where fish were captured are artificial and are considered disconnected from natural waterbodies downstream of the study area, works that have the potential to impact these waterbodies do not require review by DFO under the Fisheries Act[6].

Though the project will not directly impact fish or fish habitat that are subject to the Fisheries Act, there are best practices that can be used to mitigate indirect impacts on fish and fish habitat in downstream waterbodies; need for implementation should be confirmed with appropriate agencies prior to construction taking place (i.e., MNRF and GRCA). These may include:

- Following appropriate timing windows for warmwater, if required: permissible construction timing window of July 1st to March 31st (i.e., no in-water works allowed from April 1st to June 30th in any given year)
- Developing and implementing an *Erosion and Sediment Control* (ESC) plan
- Developing and implementing a *Spills Management Plan*
- Maintaining inputs from SWM discharge to the municipal drain conveying flows to Clair Creek
- Re-vegetating and stabilizing soils exposed through works in a timely fashion
- Developing guidelines for operation of machinery (e.g., access, refueling, storage etc.).
- Undertaking a fish removal, in impacted areas where fish are present

[6] https://www.dfo-mpo.gc.ca/pnw-ppe/reviews-revues/request-review-demande-d-examen-003-eng.html

9.2 Species at Risk Act (2002)

9.2.1 Overview of Key Policies

The federal Species at Risk Act (SARA) includes several prohibitions to protect individuals and critical habitats of listed Species at Risk.

These prohibitions apply on private lands throughout Canada only to aquatic species and species of migratory birds protected by the Migratory Birds Convention Act listed as Endangered, Threatened, or Extirpated under Schedule 1 of SARA. For other listed wildlife species, these prohibitions apply only in federal lands. By special government provision, these prohibitions may apply to non-federal lands and provincial SAR on federal lands.

9.2.2 Study Assessment

9.2.2.1 Applicability

The project is on non-federal (private / municipal) lands and there is no order by Governor in Council; hence SARA applies to aquatic and migratory bird species / habitat.

9.2.2.2 Assessment & Conclusions

There is potential habitat for aquatic and migratory birds subject to SARA within the study area. Habitat suitability and presence / use was evaluated through field inventories and habitat assessments as described in the Stage 1 EIS. Key conclusions:

- No SARA-listed aquatic or migratory bird species were recorded in the study area and we are aware of no recent records.
- We are aware of no downstream critical habitat for aquatic SAR species which would be impacted by the proposed activities, with proper implementation of recommended mitigation and protection measures.
- No critical habitat for aquatic species is present within the proposed area of works and none is known on adjacent lands where there is potential for indirect impact.

There have been no changes to existing conditions, status or conclusions with respect to SARA compliance since the Stage 1 EIS submission.

9.3 Endangered Species Act (2007)

9.3.1 Overview of Key Polices

Species designated as *Threatened or Endangered* by the Committee on the Status of Species at Risk in Ontario (COSSARO), otherwise known as Species at Risk in Ontario (SARO), and their habitats (e.g., areas essential for breeding, rearing, feeding, hibernation and migration) are automatically afforded legal protection under the Endangered Species Act (ESA) (Government of Ontario 2007). ESA Subsection 9(1) and 10 include provisions against harm to individuals and damage / destruction of habitat.

9.3.2 Assessment

9.3.2.1 Applicability

Potentially suitable habitat is present and species afforded protection under the ESA (2007) and their habitats have been recorded within the study area.

9.3.2.2 Habitat Assessment / Screening

Direction from MNRF to assess the potential presence of SAR has been to undertake a screening exercise to identify which SAR have reasonable potential to be present within a given study area based on known occurrences of the species and the habitats present. That full SAR screening was included in Appendix E of the Stage 1 EIS (WSP; December 2018).

Based on the screening, potentially suitable habitat for a number of SAR (flora and fauna) was identified in the study area or general vicinity. To assess potential, we completed field inventories and habitat assessments as described in the Stage 1 EIS, including 3-season surveys on 17 separate dates.

9.3.2.3 Results and Conclusions

No SAR species subject to the provisions of the ESA were recorded during surveys and we are aware of no recent records within the study area.

For all other SAR species with some potentially suitable habitat in the vicinity of the proposed works, but not recorded during field surveys, the likelihood and magnitude of impacts is ‘none’ or ‘minimal’, based on the size and/or quality of habitat, low likelihood of occurrence and presence of abundant (and generally much larger / higher quality) habitat in the local landscape.

There have been no changes to existing conditions, status or conclusions with respect to ESA compliance since the Stage 1 EIS submission.

9.4 Provincial Policy Statement (2020)

9.4.1 Overview of Key Policies

A new Provincial Policy Statement came into effect May 1, 2020. Natural heritage policies listed in the in-force and new PPS are generally consistent with the previous PPS, particularly with respect to natural heritage policies (Section 2.1).

9.4.2 Study Assessment & Conclusions

Assessment of PPS natural heritage policies was undertaken in the Stage 1 EIS, as updated below.

- **Endangered or Threatened Species**[7]
    - No provincially designated Endangered or Threatened species were recorded in the study area. No SAR habitat was confirmed.
    - Conclusion: no potential for impact to endangered or threatened species or confirmed habitat. Impacts to potential habitat mitigated by implementation of recommended protection, mitigation and restoration measures.
- **PSW**
    - None is present within the study area.
    - Conclusion: no potential impacts to PSW
- **Significant Woodlands**
    - None is present within the study area.
    - Conclusion: no potential impacts to significant woodland.

[7] Note that the "significant habitat of Endangered and Threatened species is also considered a Core Environmental Feature in the Regional Official Plan – policy 7.C.1 (a).

- **Significant Valleylands**
    - None is present within the study area.
    - Conclusion: no potential impacts to significant valleyland.
- **Significant Wildlife Habitat**.
    - An evaluation of *Significant Wildlife Habitat* was undertaken using the Significant Wildlife Habitat Ecoregion Criteria Schedules, Ecoregion 6E (MNRF 2015). The full assessment was included in Appendix F of the Stage 1 EIS with conclusions and recommendations summarized below.

      Within the study area, candidate SWH was identified for 11 criteria. Based on field survey results, SWH was confirmed for two criteria: *Terrestrial Crayfish - Chimney Crayfish* confirmed SWH in Unit 2 (CUT) and Unit 4 (SWT); and *Special Concern and Rare Wildlife Species* - confirmed SWH for Monarch (*Special Concern*) in Unit 4 (SWT).
    - Conclusion: Anticipated activities will not result in negative impacts to SWH for terrestrial crayfish with maintenance of suitable habitat on adjacent lands. Additional mitigation measures such as relocation of individuals to suitable habitat could be considered, as required.

      Anticipated activities will not result in negative impacts to SWH for Monarch given the low abundance (1 individual), and since the location in which Monarch was recorded (Unit 4; SWT) would not be critical habitat for any component of this species life cycle. Moreover, abundant larval and adult habitat is present in the local landscape and additional suitable habitat will be created with the recommended restoration described herein.
- **ANSI**
    - No ANSIs are present within the study area
    - Conclusion: no potential impact to ANSIs.
- **Fish Habitat**
    - Some of the waterbodies within the study area provide habitat for a few common fish species, but they are artificial and disconnected from natural waterbodies downstream of the study area.
    - Compliance with the Fisheries Act will be achieved by implementation of best practices to mitigate indirect impacts on fish and fish habitat in downstream waterbodies.

9.5 Waterloo Regional Official Plan (2015)

9.5.1 Overview of Key Policies

The Regional Official Plan (ROP; 2015) identifies a 'Greenlands Network' of *environmental features* and *linkages* among them. Policies of the ROP have the goal of maintaining, enhancing, or where feasible restoring the Greenlands Network. The Greenlands Network (ROP Map 4) is comprised of *Landscape Level Systems (including Environmental Significant Landscapes), Core Environmental Features* (CEF), Fish Habitat, *Supporting Environmental Features*, and the *linkages* between them.

Per ROP policies, development and site alteration proposed adjacent to the above noted features requires the completion of an *Environmental Impact Statement* to evaluate potential impacts.

9.5.2 Study Assessment

No ROP designated natural features are present within the study area. A *Core Environmental Feature* (CEF) is present on lands to the west; this is part of the Waldau East Wetland Complex.

Considering results of the current study (background review + field survey findings), no features which meet criteria for inclusion in the Greenlands Network (per Section 7 of the ROP) are present in the study area, per the following analysis:

Landscape Level Systems:

- none is present

Core Environmental Features (CEF), as defined in Section 7.C of the ROP – which states that the CEF designation applies to lands that meet the following criteria:

- Significant Habitat of Endangered or Threatened Species
    - None is present. See Sections 9.2 and 9.3
- Provincially Significant Wetlands
    - None is present on or adjacent to the study area. Wetlands within the study area are small, anthropogenically influenced and generally comprised of tolerant flora and fauna.

- Environmentally Sensitive Policy Areas
    - None is present. Features within the study area do not meet ESPA criteria.
- Significant Woodlands
    - None is present. Treed vegetation communities are limited to two small, immature areas.
- Environmentally Significant Valley Features
    - None is present. No defined watercourse / floodplains are present.
- Significant Areas of Natural and Scientific Interest
    - None is present.
- Fish Habitat
    - No anticipated impacts to fish habitat subject to the provisions of the Fisheries Act. See Section 9.1.

Supporting Environmental Features (SEF)

- Identified by municipalities. See Section 9.6
- Includes areas that are regulated by the GRCA under the Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses (Ontario Regulation 150/06). See Section 9.7.
- Includes *Linkages* – none is present as the site is isolated and bordered by major roads and urban development.

9.5.3 Conclusion

The proposed undertaking complies with applicable ROP natural heritage policies.

9.6 City of Waterloo Official Plan (2016)

9.6.1 Overview of Key Policies

The City of Waterloo Official Plan (2016; under appeal to the OMB) includes a *Natural System* consisting of Landscape Level Systems, Core Natural Features, and Supporting Natural Features, as well as fish habitat, Restoration Areas, and Linkages. Landscape Level Systems, Core Natural Features and fish habitat are discussed in Section 4.3.1.

9.6.2 Study Assessment

The study area currently has the follow Official Plan environmental designations:

- Schedule A3: *Parks and Other Green Space* – including a portion of the HEPC North / wetland W2 south of Erb Street
- Schedule A4: *Supporting Natural Features* – wetland W1 south of Erb Street

An evaluation of Supporting "A" and Supporting "B" Natural Features is provided below.

9.6.2.1 Supporting "A" Natural Features

Supporting "A" Natural Features include the following:

(a) Locally Significant Wetlands[8]

- Of the three wetlands currently identified on Schedule A4 (W1, W2 and W3), one would be considered a *Locally Significant Wetland*: W1 (comprised of Vegetation Units 3 / 4 / 5 / 7 / 8 / 9), a wetland of anthropogenic origin with a total estimated area of ~ 3.4 ha
- W2 (comprised of Vegetation Units 2a and 2c), is a wetland of anthropogenic origin, with a total estimated area of ~ 0.57 ha, below the 2ha threshold

[8] **Locally Significant Wetlands** – Wetlands that are naturally-occurring and 0.5 hectares or greater in size or anthropogenic in origin and 2 hectares or greater in size, which are not classified as Provincially Significant Wetlands.

- W3 (comprised of Vegetation Units 12 and 13), is a wetland of anthropogenic origin, with ~90% of the wetland previously removed in accordance with GRCA Permit No. 755/15

- One additional wetland not currently mapped in the City Official Plan, W4 (comprised of Vegetation Unit 11), is a wetland or anthropogenic origin and a total estimated area of ~ 0.07 ha, well below the 2ha threshold

(b) Locally Significant Woodlands[9]

- None is present. Two woodland habitat types are present: Unit 5 SWD (0.33 ha); and Unit 8 SWD (0.11 ha). Neither meets the size threshold for 'Locally Significant Woodlands'

(c) Significant Wildlife Habitat

- SWH for two criteria is present, but works are anticipated to have no impact. See Section 3.4.

(d) Perennial Watercourses[10]

- None is present

9.6.2.1 Supporting "B" Natural Features

Supporting "B" Natural Features include:

(a) Intermittent Watercourses[11]

- Four intermittent watercourses are present: Drainage Features 1 through 4, as shown on Figure 5. These convey intermittent flows / discharge from dug ponds, SWM ponds and agricultural fields.

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9 **Locally Significant Woodlands** – Woodlands that are 1 hectare or greater in size, generally excluding adjoining hedgerows and treed areas on small individual lots, that consist primarily of native tree species, which do not meet the criteria of a Regionally Significant Woodland. Cultivated fruit or nut orchards, actively managed plantations, or plantations established for the purpose of producing Christmas Trees or nursery stock are not included.

10 **Perennial Watercourse** – A watercourse that continually flows in an average year

11 **Intermittent Watercourse** – A watercourse that is dry at times of the year but generally flows during wet seasons.

(b) Other Wetlands[12]

- W2 and W4, as noted above

(c) Other Woodlands[13]

- None is present. The two woodland habitat types present (Unit 5 SWD (0.33 ha) and Unit 8 SWD (0.11 ha)) do not meet the size threshold for 'other woodlands'

(d) Environmentally Significant Discharge Areas[14] and Environmentally Significant Recharge Areas[15].

- The study area is not a significant discharge or re-charge area, per the Hydrogeological Assessment (MTE; 2018)

(e) Linkages[16]

- None is present. The study area is isolated, with urban development and major roads to the north, east and south and the landfill to the west. There are no existing natural corridors and limited potential for establishment given the barriers and landscape context.

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12 **Other Wetlands** – Wetlands that are naturally-occurring and less than 0.5 hectares in size or anthropogenic in origin and less than 2 hectares in size, which are not classified as Provincially Significant Wetlands

13 **Other Woodlands** – Woodlands that are greater than 0.5 hectares but less than 1 hectare in size, generally excluding adjoining hedgerows and treed areas on small individual lots that consist primarily of native tree species. Cultivated fruit or nut orchards, actively managed plantations, or plantations established for the purpose of producing Christmas Trees or nursery stock are not included. Prior to development or site alteration, Other Woodlands must be evaluated to determine their significance and the need for protection

14 **Environmentally Significant Discharge Areas** – Lands where groundwater discharges to the surface of the soil or to surface water bodies to sustain wetlands, fisheries, or other specialized natural habitats.

15 **Environmentally Significant Recharge Areas** – Lands where water infiltrates into the ground to replenish an aquifer that sustains, in full or in part, natural features.

16 **Linkages** – Areas that connect natural features along which plants and animals can propagate, genetic interchange can occur, populations can move in response to environmental changes and life-cycle requirements, and species can be replenished from other natural features. Linkages can also include those areas currently performing, or with the potential to perform, through restoration, linkage functions. Although linkages help to maintain and improve natural features, they can also serve as important natural features in their own right.

9.6.2 Compliance

With the preferred road alignment and SWM strategy, there will be impacts to **Supporting A Features**: removal of *Locally Significant Wetland* (W1) and removal of *Significant Wildlife Habitat* (Unit 4 / edge).

- In accordance with Policy 8.2.5 (2), the ecological function of the LSW / SWH will be restored with the proposed conceptual restoration plan described in Section 7.2.2.
- The current study satisfies the requirement for ecological impact assessment per relevant policies.
- In accordance with Policy 8.2.5 (15)(c), the current study (as part of the broader Evaluation Report) demonstrates that the proposed road / SWM installation will result in 'widespread adverse environmental impacts to the Supporting 'A' feature or ecological functions'; however, there is a clearly demonstrated need, and all other potential alternatives are less feasible, as described in the consolidated evaluation of alternatives, and in consideration of the mitigation and restoration / enhancement measures discussed herein.
- EIS as part of broader study, including evaluation of alternatives, completed as discussed herein and in the Evaluation Report.

With the preferred road alignment and SWM strategy, there will be impacts to **Supporting B Features** – Intermittent Watercourses (Drainage Features 1, 2 and 4).

- In accordance with Policy 8.2.5 (16) and (18), the ecological function of these features (i.e., surface water contributions to receiving / downstream areas) will be maintained, but the form will be modified.
- In accordance with Policy 8.2.5 (29), it is not feasible for the proposed infrastructure to avoid the Supporting B features, however their ecological function (i.e., surface water contributions) will be maintained. Function will be enhanced through the improved surface water treatment via the recommended SWM strategy.

9.7 Grand River Conservation Authority

9.7.1 Overview of Key Policies

The Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses (Ontario Regulation 150/06), is a regulation issued under the Conservation Authorities Act, R.S.O. 1990. Through this, GRCA has the responsibility to regulate activities in natural and hazardous areas (e.g., areas in and near rivers, streams, floodplains, wetlands, slopes and shorelines).

9.7.3 Study Assessment

Works are proposed within and in 'areas of interference' of two regulated features: W1 and W3. As noted however, 0.8ha of W3 has been removed per GRCA Permit No. 755/15.

In accordance with Policies 8.4.6 and 8.4.7, of the Grand River Conservation Authority Policies for the Administration of the Development, Interference with Wetlands and Alterations to Shorelines and Watercourses Regulation (GRCA 2015), this public infrastructure project (road and SWM strategy) is permitted within / adjacent to regulated wetlands W1 and W3, based on the following:

- The need and location for the collector road connection is identified in approved documents and studies as referenced in Section 1.2. The Stage 1 EIS and current report have been prepared as more detailed, site-specific assessments.
- Alternatives to avoid wetland loss have been comprehensively evaluated for both the road alignment alternatives and SWM alternatives, as discussed in Sections 4 and 5.
- As noted, the majority of the road alignment is within active agricultural lands (HEPC) or the golf course, avoiding natural areas. Where avoidance in not feasible based on other constraints (i.e., challenges locating the road / SWM on HEPC or landfill lands, existing built structures / grades on Waterloo Commons, distance from road intersections, fixed end points of the road), the alignment / SWM facility locations represent the preferred locations, based on consideration of all factors, not only natural environment. In those areas, intrusions in wetland and the footprint of works has been minimized to the extent possible.
- The SWM strategy will result in a net improvement to downstream aquatic habitat through improvements to treatment of existing surface runoff relative to the current condition.
- Mitigation, protection and restoration measures as discussed in Section 7 demonstrate how the hydrologic and ecological functions of the impacted wetland will be protected, restored and enhanced.

10.0 FUTURE WORK

As input to final design of the collector road and recommended SWM strategy, the recommended mitigation, protection and ecological restoration measures will be confirmed or refined, then implemented through the proposed works. Specific tasks include:

- Final Wetland Restoration Plan
- Spills Management Plan
- Erosion & Sediment Control Plan
- Dewatering plans and application for Permit to Take Water, if required
- GRCA Permit under O. Reg. 150/06

Future development applications will include an updated impact assessment in support of specific site plans, based on existing conditions and applicable policy / guidance at the time of report preparation, and in consideration of relevant recommendations presented herein.

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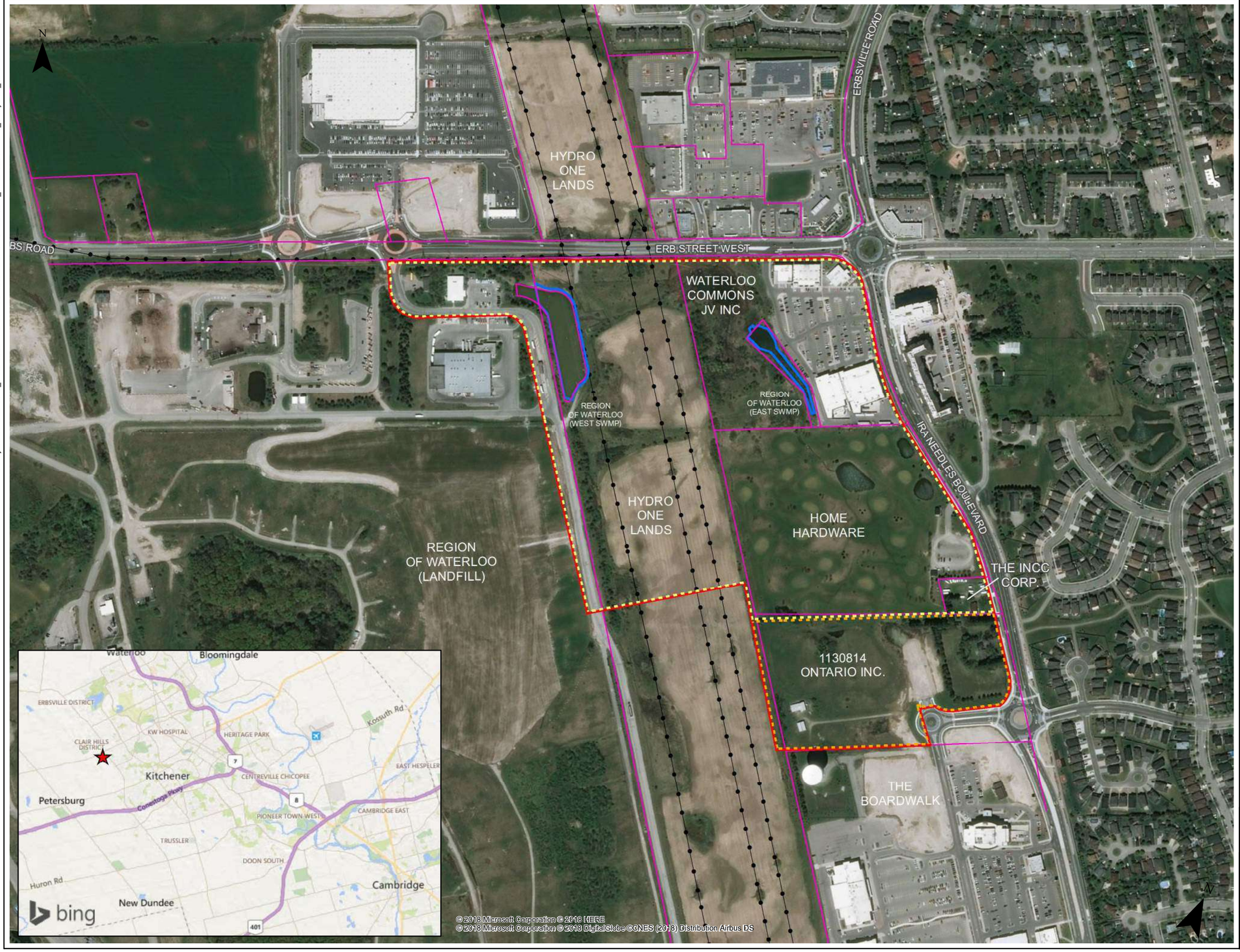
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FIGURE 1
WESTHILL DISTRICT
NORTH-SOUTH COLLECTOR
ROAD STUDY

Study Area

Legend

- Study Area
- Area 1
- Area 2
- Property Boundaries (Approximate)
- Utility Line (LIO)



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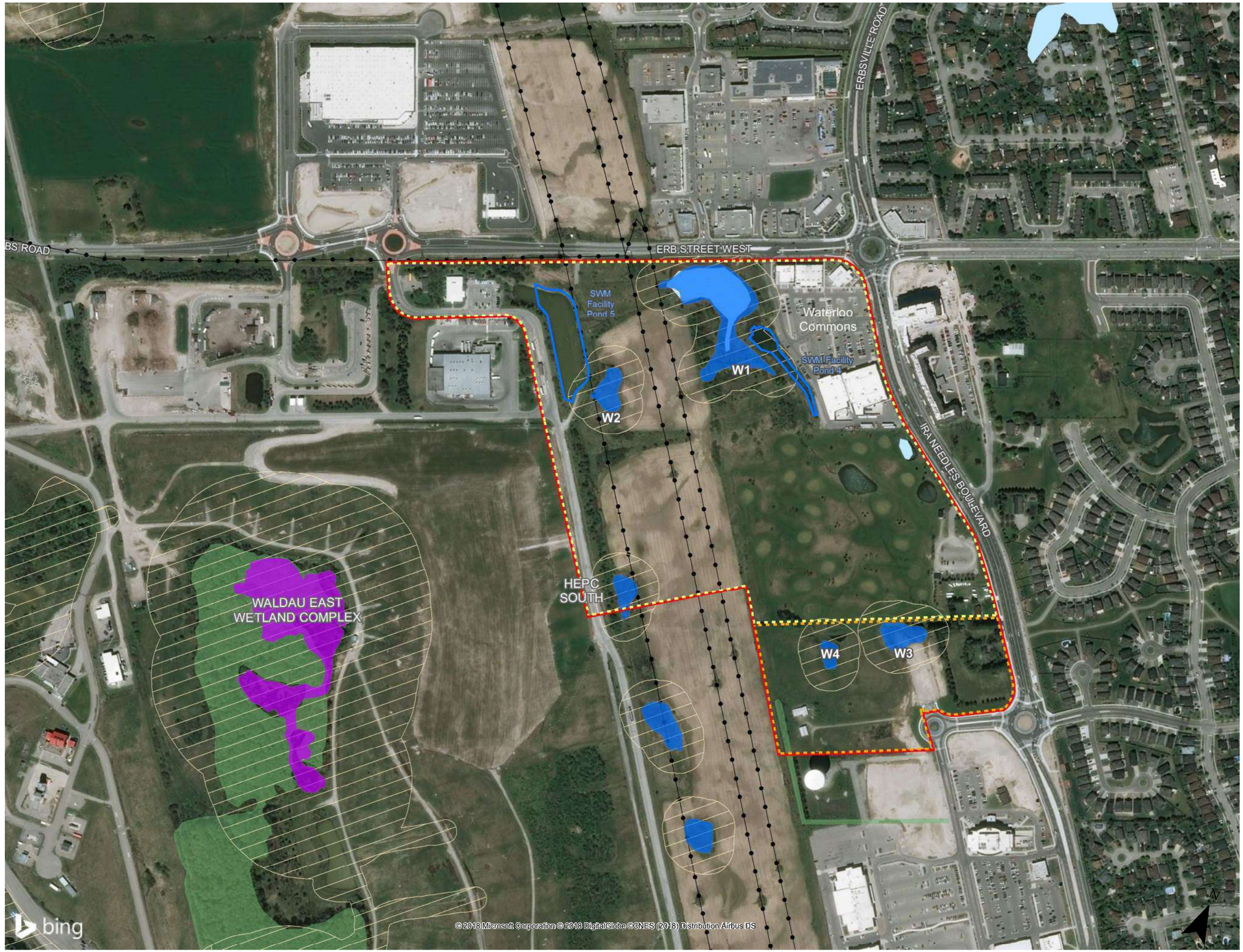
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Project No.:3316542
Date Created: 20 June 2018
Date Modified: 06 December 2018
Coordinate System: NAD 1983 UTM Zone 17N
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WSP

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FIGURE 2
WESTHILL DISTRICT
NORTH-SOUTH COLLECTOR
ROAD STUDY

Natural Heritage Features



Legend

- Study
- Area 1
- Area 2
- Utility Line (LIO)
- Regulation Limit
- Evaluated Wetland (GRCA)
- Unevaluated Wetland (GRCA)
- Waterbody
- Wooded
- SWM Facilities

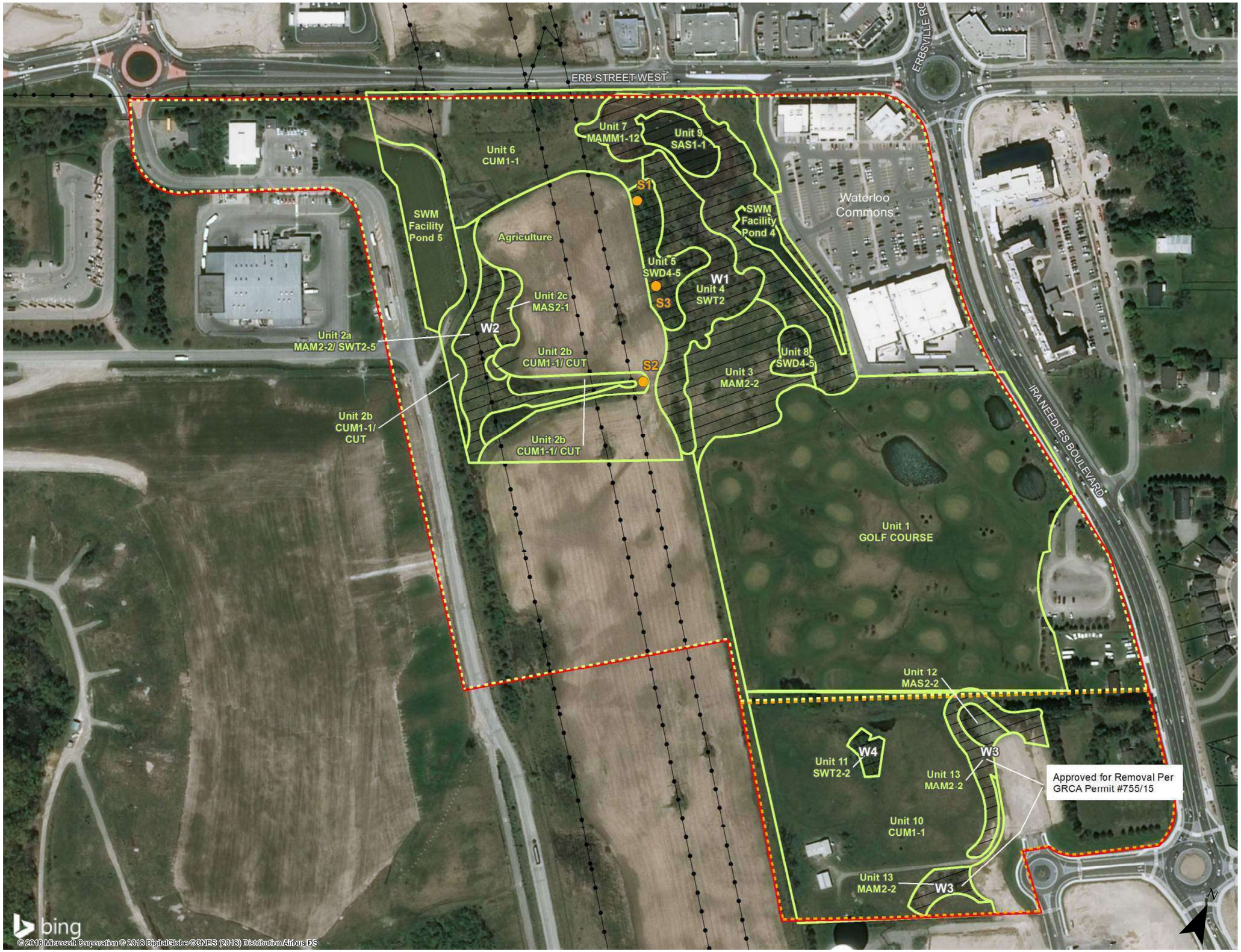
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Figure: 2
Project No.:3316542
Date Created: 28 November 2018
Date Modified: 29 November 2018
Coordinate System: NAD 1983 UTM Zone 17N
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FIGURE 3
WESTHILL DISTRICT
NORTH-SOUTH COLLECTOR
ROAD STUDY

Vegetation Communities



Legend

- Study Area
- Area 1
- Area 2
- Utility Line (LIO)
- Ecological Land Classification
- Soil Sample Location
- Wetland

ELC - Description

- AG: Agriculture
- CUM1-1: Dry-Fresh Cultural Meadow
- CUT: Cultural Thicket
- MAM2-2: Reed-Canary Grass Meadow Marsh
- MAMM1-12: European Common Reed Mineral Meadow Marsh
- MAS2-1: Cattail Mineral Shallow Marsh
- MAS2-2: Bulrush Mineral Shallow Marsh
- SAS1-1: Pondweed Submerged Shallow Aquatic
- SWD4-5: Poplar Mineral Deciduous Swamp
- SWM Facility: Storm Water Management Facility
- SWT2: Swamp Thicket Mosaic
- SWT2-2: Missouri Willow Mineral Deciduous Thicket Swamp
- SWT2-5: Red-osier Dogwood Mineral Deciduous Thicket Swamp

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Figure: 3
Project No.:3316542
Date Created: 28 November 2018
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Coordinate System: NAD 1983 UTM Zone 17N
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FIGURE 4
WESTHILL DISTRICT
NORTH-SOUTH COLLECTOR ROAD STUDY
Wildlife Survey Locations and Results



Legend

- Amphibian Calling Station
- Chimney Crayfish Burrows
- Cavity Tree
- Potential Turtle Nesting Habitat
- Potential Bat Habitat / Structure
- Open Water
- SWM Facilities
- Vegetation Boundaries
- Utility Line (LIO)

Turtle Basking / Emergence Surveys (April 2017)
Pond 1
- 6 Midland Painted Turtles
Pond 2
- 2 Midland Painted Turtles
- 1 Red-Eared Slider
Pond 3
- No turtle observations
SWM Pond 4
- 8 Midland Painted Turtles
Wetland (Unit 7 and 9)
- 2 Midland Painted Turtles

Amphibian Calling Surveys		
Station	Species	Max C.C.
AC1	AMTO	1
	GRFR	1
AC2	GRFR	1
AC3	GRFR	1
AC4	AMTO	1
	GRFR	2
AC5	AMTO	1
	GRFR	1
	NLFR	2-3
AC6	GRFR	1
	NLFR	1

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Figure: 4
Project No.:3316542
Date Created: 28 November 2018
Date Modified: 30 November 2018
Coordinate System: NAD 1983 UTM Zone 17N
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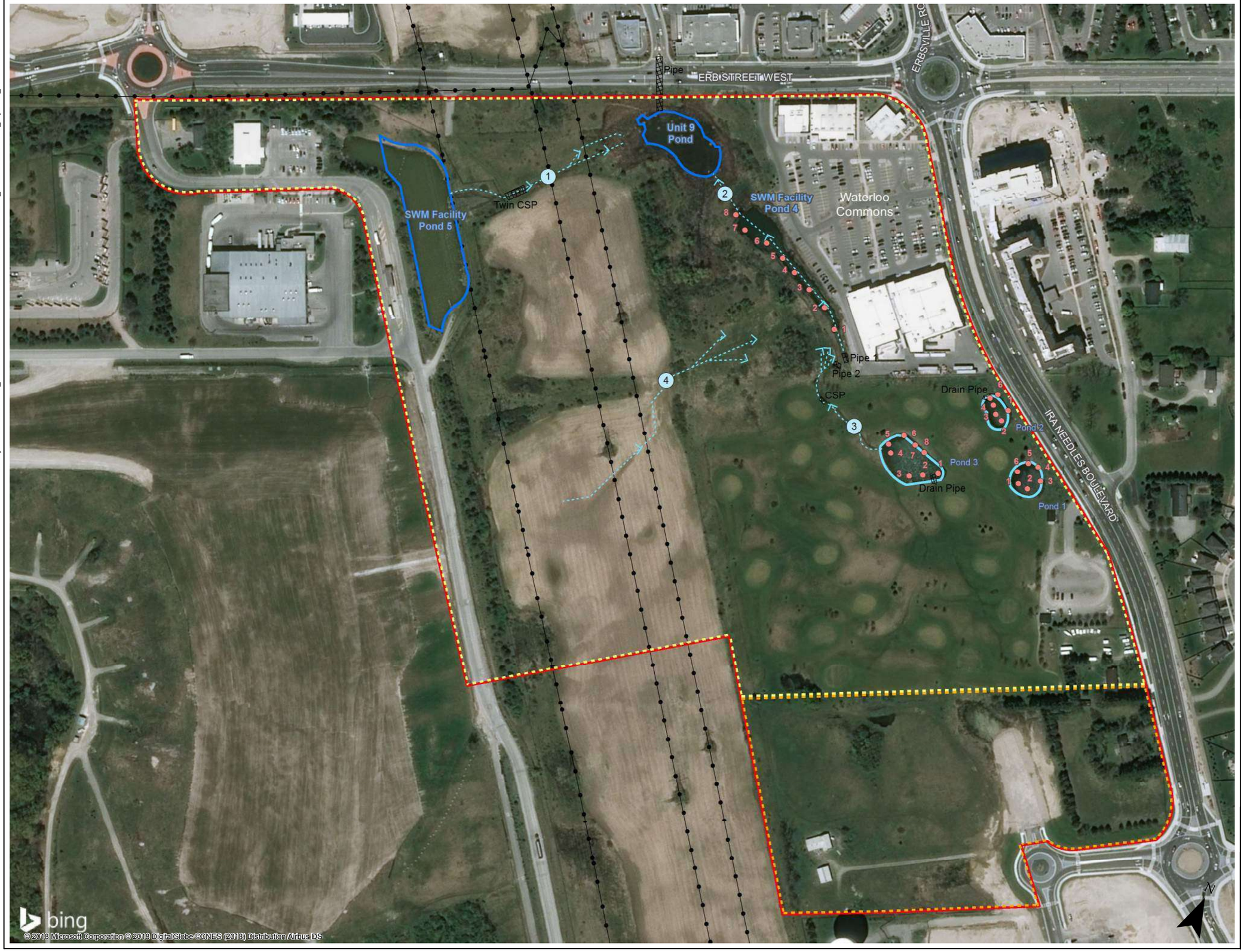


FIGURE 5

WESTHILL DISTRICT
NORTH-SOUTH COLLECTOR
ROAD STUDY

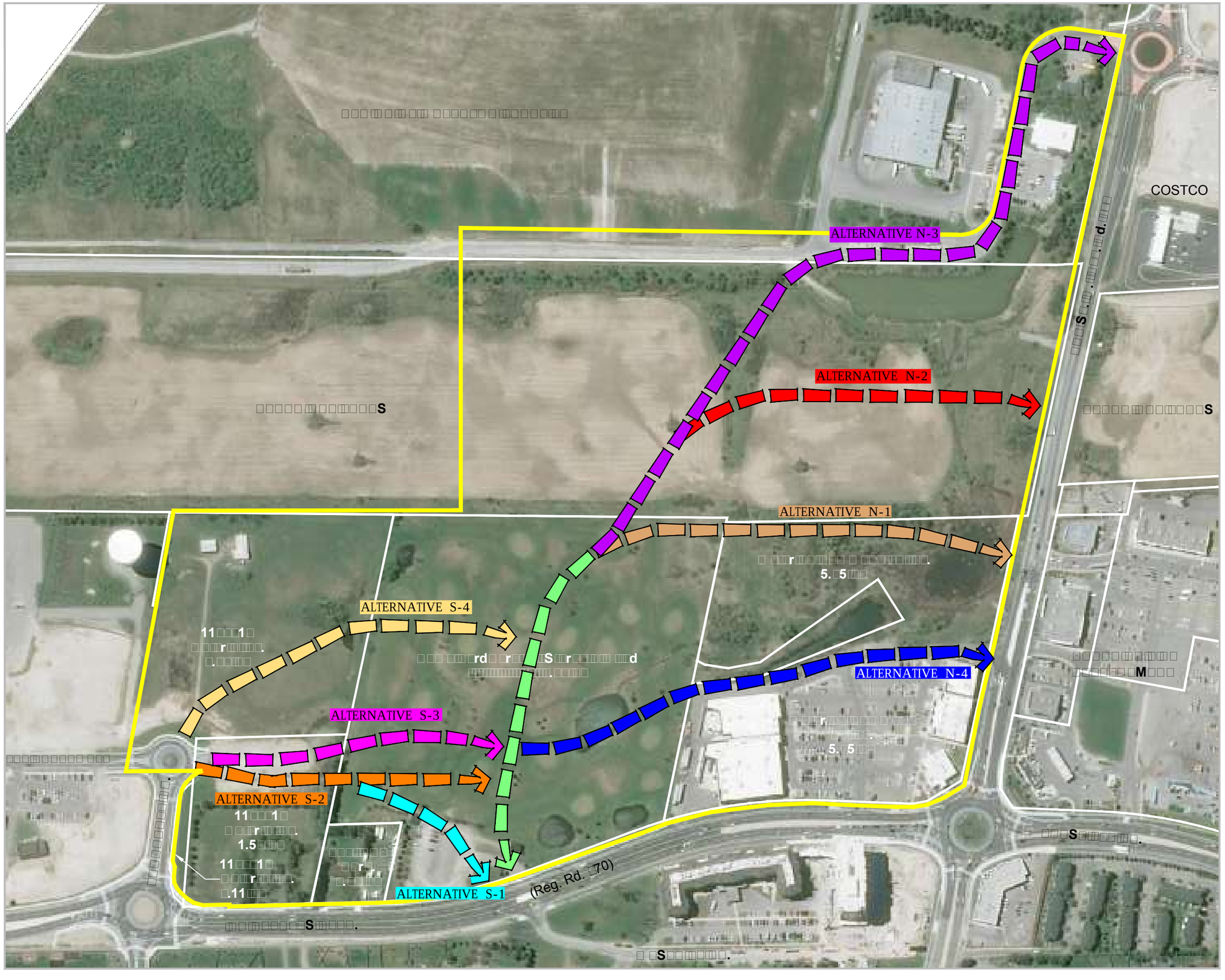
Aquatic Survey Locations and Results

Legend

- Study
- Area 1
- Area 2
- Utility Line (LIO)
- Minnow Trap
- Drainge Feature
- Flow Direction
- Intermittent Drainage
- Drainage Stucture
- Open Water
- SWM Facilities

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Figure: 5
Project No.:3316542
Date Created: 29 November 2018
Date Modified: 30 November 2018
Coordinate System: NAD 1983 UTM Zone 17N
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City o Waterloo
Region o Waterloo

Study Area

Parcel Fabric (MPAC)

The INCC Corp. Property Ownership

Air Photo Source: Bing

March 25, 2020

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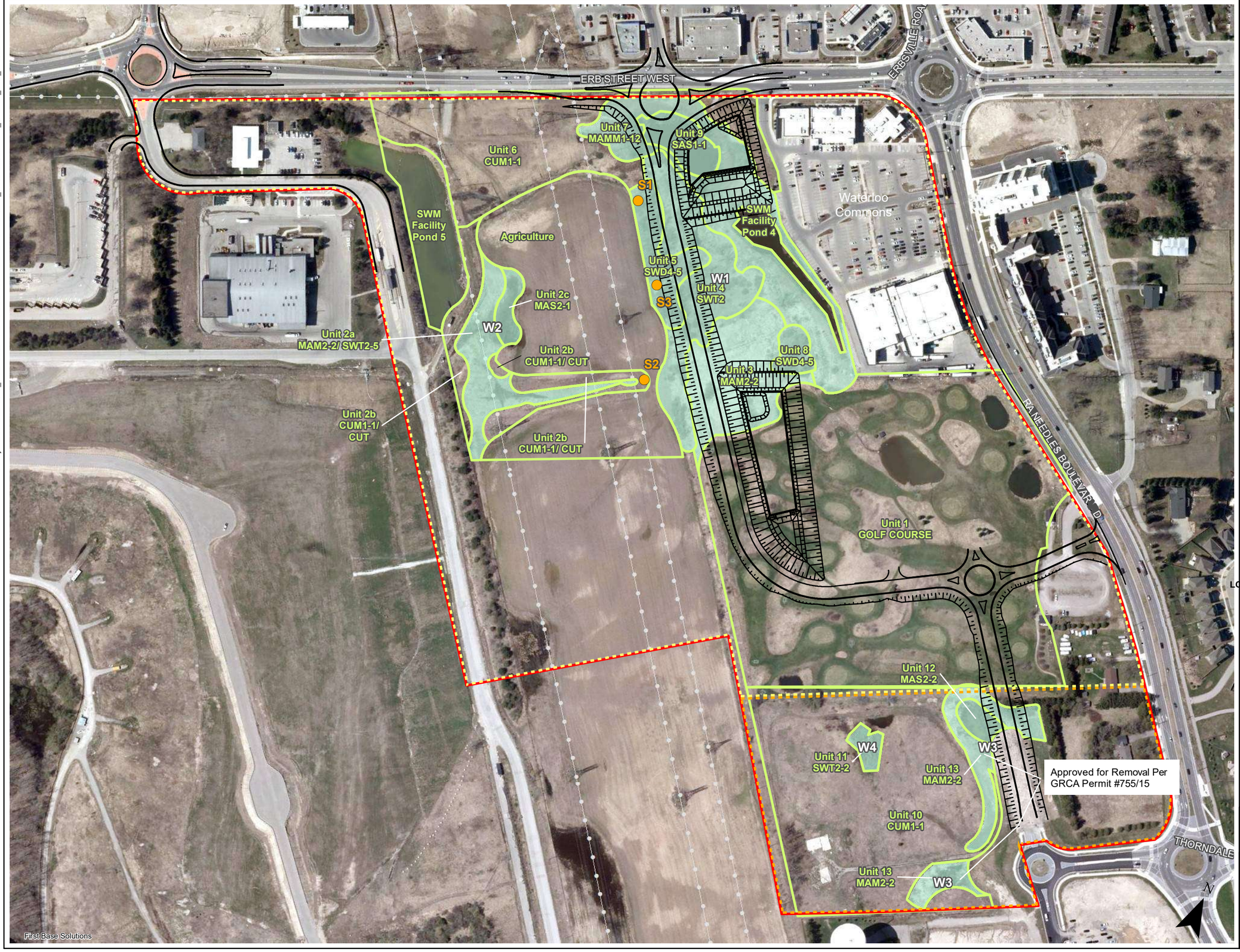
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200-540 BINGEMANS CENTRE DR. KITCHENER, ON, N2B 3X9
P: 519.576.3650 F: 519.576.0121 | WWW.MHBCPLAN.COM

FIGURE 7
WESTHILL DISTRICT
N-S COLLECTOR RD STUDY
NATURAL ENVIRONMENT
STAGE 2 REPORT
Impact Areas



Legend

- Study Area
- Area 1
- Area 2
- Proposed Alignment
- Utility Line (LIO)
- Ecological Land Classification
- Soil Sample Location
- Wetland

LC - Description

AG: Agriculture
CUM1-1: Dry-Fresh Cultural Meadow
CUT: Cultural Thicket
MAM2-2: Reed-Canary Grass Meadow Marsh
MAMM1-12: European Common Reed Mineral Meadow Marsh
MAS2-1: Cattail Mineral Shallow Marsh
MAS2-2: Bulrush Mineral Shallow Marsh
SAS1-1: Pondweed Submerged Shallow Aquatic
SWD4-5: Poplar Mineral Deciduous Swamp
SWM Facility: Storm Water Management Facility
SWT2: Swamp Thicket Mosaic
SWT2-2: Missouri Willow Mineral Deciduous Thicket Swamp
SWT2-5: Red-osier Dogwood Mineral Deciduous Thicket Swamp

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Project No.:3316542
Date Created: 28 November 2018
Date Modified: 04 June 2020
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Appendix Q

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Project: (180136)

Paul Britton, MCIP, RPP
Vice President/Treasurer
MHBC Planning, Urban Design & Landscape Architecture
540 Bingemans Centre Drive, Suite 200
Kitchener ON N2B 3X9

Dear Mr. Britton:

RE: WATERLOO WEST SIDE TRANSPORTATION NETWORK STUDY COLLECTOR ROAD ALTERNATIVES (WESTHILL DISTRICT) TRANSPORTATION EVALUATION

In August 2019, the Waterloo West Side Transportation Network Study[1] was submitted in support of the planning applications for the Westhill District lands. The purpose of the study was to assess the broader West Waterloo area from a transportation perspective considering the development of the Westhill District. In addition, the study was to consider collector road alternatives servicing these lands and to provide direction and support for the preferred collector alignment.

Study Area

The identified overall study area followed the Waterloo West Side Integrated Multi Modal Transportation Study[2]. It was bounded on the west by Wilmot Line, on the north by Columbia Street, on the east by Ira Needles Boulevard and on the south by University Avenue. East of the study area is the Westvale neighbourhood.

The Westhill lands fell within the overall study area, north of The Boardwalk commercial development, west of Ira Needles Boulevard and south of Erb Street. This was referred to as the “primary study area”.

[1] Waterloo Westside Transportation Network Study, Paradigm Transportation Solutions Limited, August 2019.
[2] Waterloo Multi-Modal Transportation Study – DRAFT report, City of Waterloo, WSP, June 2018.

Scope

This report documented the additional traffic forecast to occur as a result of future development of the subject lands and identified:

- the current traffic and operations of the intersections within the study area;
- the impact of the net increase in traffic on the intersections within the study area; and
- the appropriateness and effectiveness of the alternative connections to the existing road network.

Future Committed Road Construction

The Region of Waterloo recently completed its Transportation Master Plan and did not identify the need for infrastructure upgrades within the primary study area, specifically for Erbsville Road and Platinum Drive, over the 2019 to 2031 period. The intersection of Erbsville Road and Keats Way is planned to be upgraded to a roundabout under the infrastructure upgrades.

Erb Street Road Municipal Class Environmental Assessment also identified that Erb Street will be widened to four lanes from Fischer-Hallman Road to Wilmot Line.

2031 Do-Nothing Traffic Operational Assessment

Under the **Do-Nothing Case**, there were multiple operational issues including:

- **Erbsville Road and Columbia St West** eastbound shared through-right-turn movements are forecast to operate at a LOS F with a v/c > 1.0 during both the AM and PM peak hours. The westbound left-turn movement is forecast to operate at a LOS F with a v/c > 1.0 during all peak hours. The northbound left-turn movement is forecast to operate at LOS F with a v/c > 1.0 during the AM peak hour. The southbound left-turn movement is forecast to operate at LOS F with a v/c > 1.0 during the AM peak hour, and the shared through-right movement is forecast to operate at LOS F with a v/c > 1.0 during the PM Peak Hour. Overall, the intersection is forecast to operate at a LOS E during the AM and LOS F during PM peak hour;
- **Ira Needles Boulevard/Erbsville Road and Erb St West** eastbound approach is forecast to operate at LOS F with a v/c > 1.0 during all peak hours. The westbound approach is forecast to operate at LOS F with a v/c > 1.0 during all peak hours. The northbound approach is forecast to operate at LOS F with a v/c > 1.0 during all peak hours. The southbound approach is forecast to operate at LOS F with a v/c > 1.0 during all peak hours. Overall, the intersection is forecast to operate at a LOS F with a v/c > 1.0 during all peak hours;
- **Ira Needles Boulevard and Westhill Drive** eastbound right-turn movement is forecast to operate at LOS F with a v/c > 1.0 during the PM peak hour;
- **Ira Needles Boulevard and The Boardwalk/Thorndale Drive** eastbound approach is forecast to operate at LOS F with a v/c > 1.0 during the PM peak hour. The westbound

approach is forecast to operate at LOS F with a v/c > 1.0 during all peak hours. The northbound approach is forecast to operate at LOS F with a v/c > 1.0 during the AM and Saturday peak hours. The southbound approach is forecast to operate at LOS F with a v/c > 1.0 during the PM and Saturday peak hours. Overall, the intersection is forecast to operate at a LOS F during all peak hours;

- **Ira Needles Boulevard and Boardwalk Entrance 1** eastbound right-turn movement is forecast to operate at a LOS E during the PM peak hour; and
- **Ira Needles Boulevard and Boardwalk Entrance 2 (Lifestyle Way)** eastbound left-turn movement is forecast to operate at LOS F during all peak hours with a v/c > 1.0 during the PM and Saturday peak hours. The eastbound right-turn movement is forecast to operate at LOS F during the PM peak hour. The northbound left-turn movement is forecast to operate at LOS F during the PM peak hour. Overall, the intersection is forecast to operate at LOS F during the PM hour; and
- **University Ave W and Ira-Needles Boulevard** eastbound movements are forecast to operate at LOS F and a v/c > 1.0 during the PM peak hour. The westbound movements are forecast to operate at LOS F and a v/c > 1.0 the PM and Saturday peak hours. The northbound movements are forecast to operate at LOS F and a v/c > 1.0 during the all peak hours. The southbound movements are forecast to operate at LOS F and a v/c > 1.0 during the PM and Saturday peak hours. Overall, the intersection is forecast to operate at a LOS F during all peak hours.

Problem Statement

With the 2031 “Do-Nothing” transportation network and intersection configurations and with the forecast additional traffic arising from the developments, some study area intersections were forecast to operate with delays above desired levels. To mitigate the network and intersection deficiencies, consideration was given to the RTMP and IMMTS transportation improvements, including the northerly extension of the Boardwalk as a new collector road.

Collector Road Alternatives

Overall, the Westhill District is being developed with the following guiding principles in mind:

- Integration with the Existing Development
- Transportation Network Efficiency
- Development Intensity and Distribution

Based on the above (and the “Do-Nothing assessment), an evaluation of extending the Boardwalk northerly to Erb Street West as a collector road was undertaken. **Figure 1** illustrates the three alternatives assessed:

- **Alternative A:** Extension Northwesterly to the BMO Access Signalized Intersection;
- **Alternative B:** Extension Northwesterly to New Intersection on Hydro One lands; and

- **Alternative C:** Extension Northwesterly to Costco Roundabout via the Waterloo Waste Road.

Evaluation of Alternatives

The primary benefit observed from the use of these roads is the diversion of traffic from Ira Needles Boulevard onto the proposed Boardwalk extension between Erb Street West and Thorndale Drive. From this analysis it was found Alternative A would keep most in line with the guiding principles have the greatest diversion from the Ira Needles corridor at about 65% of the site traffic.

Preferred Alternative

Alternative A was forecast to have the highest usage and divert the highest volumes from Ira Needles Boulevard resulting in the greatest benefit to the corridor. Microsimulation results indicate that compared to the "Do-Nothing" network, Alternative A reduces the forecast overall network travel time by as much as 7.4% (Saturday Peak hour), overall travel delay by 7.8% (Saturday Peak hour) and the fuel consumption by 7.3% (AM Peak hour). Therefore, from a transportation planning perspective, Alternative A is the preferred option

2031 Traffic Operational Assessment with The Boardwalk Extension

Under the **Alternative A extension**, there are multiple operational issues including the following:

- **Erbsville Road and Columbia St West** eastbound shared through-right movements are forecast to operate at a LOS F and a v/c > 1.0 during both the AM and PM peak hours. The westbound left movements are forecast to operate at a LOS F and a v/c > 1.0 during all peak hours. The northbound left movements are forecast to operate at LOS F and a v/c > 1.0 during the AM peak hour. The southbound left-turn movements are forecast to operate at LOS F and a v/c > 1.0 during the AM Peak hour, and the shared through-right movements are forecast to operate at LOS F and a v/c > 1.0 during the PM Peak Hour. Overall, the intersection is forecast to operate at a LOS E and LOS F during the AM and PM peak hour, respectively;
- **Ira Needles Boulevard/Erbsville Road and Erb St West** eastbound movements are forecast to operate at LOS F and a v/c > 1.0 during all peak hours. The westbound movements are forecast to operate at LOS F and a v/c > 1.0 during all peak hours. The northbound movements are forecast to operate at LOS F and a v/c > 1.0 during the AM and Saturday peak hours, and a LOS E and v/c > 0.85 during the PM peak hour. The southbound movements are forecast to operate at LOS F and a v/c > 1.0 during the PM and Saturday peak hours. Overall, the intersection is forecast to operate at a LOS F during all peak hours;
- **Ira Needles Boulevard and Westhill Drive** eastbound right movements are forecast to operate at LOS F and a v/c > 0.85 during the PM peak hour;

- **Ira Needles Boulevard and The Boardwalk/Thorndale Drive** eastbound movements are forecast to operate at LOS F and a v/c > 1.0 during the PM peak hour. The westbound movements are forecast to operate at LOS F and a v/c > 1.0 during all peak hours. The northbound movements are forecast to operate at LOS F and a v/c > 1.0 during the AM hour, and LOS E and a v/c > 0.85 during the Saturday peak. The southbound movements are forecast to operate at LOS F and a v/c > 1.0 during the PM and Saturday peak hours. Overall, the intersection is forecast to operate at a LOS F during all peak hours;
- **Ira Needles Boulevard and Boardwalk Entrance 1** eastbound right-turn movements are forecast to operate with a LOS E during the PM peak hour; and
- **Ira Needles Boulevard and Boardwalk Entrance 2 (Lifestyle Way)** eastbound left-turn movement is forecast to operate with a LOS F during all peak hours and a v/c > 1.0 during the PM and Saturday peak hours. The eastbound right-turn movement is forecast to operate with a LOS F during the PM peak hour. The northbound left-turn movement is forecast to operate with a LOS F during the PM peak hour. Overall, the intersection is forecast to operate at a LOS F during the PM hour; and
- **University Ave W and Ira-Needles Boulevard** eastbound movements are forecast to operate at LOS F and a v/c > 1.0 during the PM peak hour. The westbound movements are forecast to operate at LOS F and a v/c > 1.0 the PM and Saturday peak hours. The northbound movements are forecast to operate at LOS F and a v/c > 1.0 during the all peak hours. The southbound movements are forecast to operate at LOS F and a v/c > 1.0 during the PM and Saturday peak hours. Overall, the intersection is forecast to operate at a LOS F during all peak hours.

New Transportation Opportunities

The completion of the Boardwalk as an extension through the Westhill District to Erb Street offers the City an improved network and has the potential to off-load some traffic from Erb Street and Ira Needles Boulevard. In addition, this extension will result in other transportation improvements to the area including:

- reducing traffic volumes at the Erb Street/ Ira Needles Blvd roundabout;
- improving traffic flow and connections;
- providing improved vehicular circulation and accessibility to the lands in Westhill, with independent access via the collector to Erb Street;
- providing a secondary vehicle connection to southbound traffic, for emergency response vehicles and access to/from the Regional landfill;
- providing improved vehicular access to Waterloo Commons;
- providing improved cycling and pedestrian connections; and
- providing an opportunity to increase the number of people, jobs and public places served by public transit.

Additional Considerations and Agency Input

In their review of the Transportation Network Study and the other supporting documents (Natural Environment, Technical Environment), the review agencies identified additional routes/segments to be considered. **Figure 2** illustrates the set of four southern segments (S1-S4 and four northern segments (N1-N4) identified:

- **Waterloo Commons Connection (Alternative N-1) :** This alignment travels east of and parallel to the Hydro One lands and terminates at Erb Street West adjacent to the Waterloo Commons development to the east. Two intersection control alternatives were considered, including a signalized intersection and a roundabout. To assist the evaluation, an intersection control study was completed. It was concluded that a roundabout is preferred.
- **Hydro One Lands Connection (Alternative N-2):** This alignment includes an extension into the Hydro One corridor then running parallel to and within the Hydro One Lands, terminating at Erb Street West. In consideration of the intersection control study that was completed, a roundabout at this intersection was also assumed.
- **Region of Waterloo Landfill Lands Connection (Alternative N-3):** This alignment includes bisects the Hydro One Lands and extends into the Region of Waterloo Landfill. The alignment would then travel around the Region's Training Facility and Waste Management Offices terminating at the existing roundabout located at the entrances to the landfill and the West Waterloo Centre (Costco site).
- **Waterloo Commons Connection Adjustment (Alternative N-4):** This alternative was identified based on input from review agencies and in particular the Region of Waterloo and GRCA. Alternative N-4 is similar to Alternative N-1 with an adjustment to the alignment that is intended to minimize impacts on the locally significant wetland. This alignment runs through a portion of the Waterloo Commons development and intersects with Erb Street West at a location that is closer to the Erb Street / Ira Needles Boulevard roundabout compared to the other alternatives. In consideration of the intersection control study that was completed, a roundabout at this location was also assumed.
- **Westhill District Implementation Route (Alternative S-1):** This alignment connects the roundabout west of Ira Needles Boulevard on Thorndale Drive through the 1130814 Ontario Inc. lands and Home Hardware lands. A right-in right-out intersection is assumed where this road intersects with Ira Needles Boulevard.
- **East Route (Alternative S-2):** This alignment connects the roundabout west of Ira Needles Boulevard on Thorndale Drive through the 1130814 Ontario Inc. lands and Home Hardware lands. The alignment connects to the portion of the north section alternative that is in common with each of the south section alignment alternatives. A right-in right-out intersection is assumed where this road intersects with Ira Needles Boulevard.
- **Central Route (Alternative S-3):** This alternative is similar to S-2 but further west adjacent to the existing Storm Water Management retention area.

- **West Route (Alternative S-4):** This alternative acts as an extension of Thorndale Drive westerly and then northerly through the 1130814 Ontario Inc. lands and Home Hardware lands. This alignment is furthest removed from Ira Needles Boulevard and has the longest length of all south section alternatives.

Evaluation of Collector Road Alignment Alternatives

Alignment alternatives were systematically assessed and evaluated relative to all criteria and factors in accordance with the selected methodology. Consideration of key agency staff (City, Region and GRCA) input along with a systematic evaluation process against a broad set of criteria led to the evaluation scores and alternative ranking.

Table 1 summarizes the transportation criteria and the measures/impacts/benefits considered.

TABLE 1: TRANSPORTATION CRITERIA AND MEASURES OF EFFECTIVENESS

Criterion	Measures Considered
• Transportation Network	- Relieve future demand on other arterial / collector roads within the community - Potential impacts to local roads/intersections
• Traffic Operations	- Road safety and accessibility (sight distance; turning movements)
• Transportation policy initiatives • Capacity/capability to accommodate forecast traffic demand. • Provides for appropriate access to existing properties	- Capability to support municipal policy initiatives (transit, active transportation, roundabouts) - Impact on access to existing properties - Connectivity to Ira Needles Boulevard and Erb Street

Northern Routes

Considering the **Transportation Network** measures (the ability to relieve future demand on other arterial /collector roads and potential impacts to local roads/intersections) the routes generally closer and more parallel to Ira Needles Boulevard were found to have the most benefit. Similarly routes that traversed further west and ultimately impacted the Regional Landfill had greater impacts on the local roads. Using the “Must Score” approach, the preferred option (N-4) scored 10 and the least preferred option (N-2) scored 1. N-2 was least preferred owing to its separation from Ira Needles Boulevard and lack of connections to adjacent land uses. Alternative N-1 scored similar to N-4 but was less effective owing to the further separation from Ira Needles Boulevard. N-3 was preferred over N-2 owing to its direct

connection to higher traffic generating land uses (i.e. Costco) despite being furthest away from Ira Needles Boulevard.

Considering the **Traffic Operations** measures (Road safety and accessibility (sight distance; turning movements)) each of the routes performed well with roundabout intersection control. The preferred route (N-1) integrates lands north and south of Erb Street provides turning movement opportunities in all directions and functions at a high level. The least preferred alternative (N-3) scored poorly owing to the horizontal and vertical alignment complexities traversing the Region of Waterloo Landfill site. Alternative N-2 provides good separation from existing intersections, however, since its connection to Erb Street west would be a T-intersection and would not justify signalization under the forecast volumes. Without a signal or roundabout at this intersection, left-turn movements would experience high delays given the eastbound and westbound approach volumes. Alternative N-4 is not sufficiently separated from the existing roundabout on Ira Needles Boulevard and Erb Street. Forecast queue spillback between the roundabouts would interfere with each other's function.

Considering the **Transportation Policy** measures (Capability to support municipal policy initiatives (transit, active transportation, roundabouts), Impact on access to existing properties, Connectivity to Ira Needles Boulevard and Erb Street) , Alternative N-1 was the most preferred route as it did not impact the Hydro One or RMOW lands and provided an opportunity for active transportation and transit linking lands north and south of Erb Street. Alternative N-2 was least preferred as it impacted the Hydro One lands, and its location made transit service more difficult and costly (no adjacent uses). Alternative N-3 impacts two landowners but provides a linkage to and important commercial area that would drive transit use. Alternative N-4 provides excellent support to municipal policy objectives linking active uses north and south of Erb Street but at the same time impacting several existing commercial businesses to be implemented.

Southern Routes

Considering the **Transportation Network** measures (the ability to relieve future demand on other arterial /collector roads and potential impacts to local roads/intersections) the routes generally closer and more parallel to Ira Needles Boulevard were found to have the most benefit. Similarly routes that traversed further west and ultimately impacted the Regional Landfill had greater impacts on the local roads. Using the "Must Score" approach, the preferred option (S-3) scored 10 and the least preferred option (S-1) scored 1. S-1 was least preferred owing to its separation from Ira Needles Boulevard and the it redirects traffic directly into the Ira Needles Boulevard corridor. Alternative S-2 scored similar to S-3 but was less effective owing to the closer separation to Ira Needles Boulevard presenting potential operational issues with closely spaced intersections. S-4 was preferred over S-1 owing to its ability to direct traffic away from Ira Needles Boulevard.

Considering the **Traffic Operations** measures (Road safety and accessibility (sight distance; turning movements)) each of the routes performed well with roundabout intersection control. The preferred route (S-3) provides land access and turning movement opportunities in all directions and functions at a high level. The least preferred alternative (S-1) scored poorly

owing to the limited land access opportunities for the Westhill District lands and the limited right-in-right-out function at Ira Needles Boulevard. Alternative S-2 provides undesirable separation from the intersection with Ira Needles Boulevard, but does provide similar land access to S-3. Alternative S-4 provides sufficient separation from Ira Needles Boulevard for an intersection, however, has the potential to create possible sight-distance issues with Alternative N-1 on its southerly approach to the intersection.

Considering the **Transportation Policy** measures (Capability to support municipal policy initiatives (transit, active transportation, roundabouts), Impact on access to existing properties, Connectivity to Ira Needles Boulevard and Erb Street) , Alternative S-3 was the most preferred route as it did not impact and existing development lands and provides an opportunity for active transportation and transit on the Westhill District lands. Alternative S-1 was least preferred as it limits the developability of the Westhill District lands and its location made servicing the Westhill lands by transit and active transportation more difficult. Alternative S-2 performs similar to S-3, but the location of the intersection close to Ira Needles Boulevard may impact transit operations and make transit access to the western part of the lands more difficult. Alternative S-4 does not serve the central part of the site for transit or active transportation as well as either Alternative S-3 or S-2, but better than S-1.

Conclusion

The above analysis and evaluation confirm that the preferred transportation solution (S-3 + N-1) remains similar to preliminary preferred Alternative “A” that had been analysed in the Waterloo West Side Transportation Network Study[3]. From a traffic operations and transportation planning perspective this provides additional confidence in the direction for planning development on the Westhill District lands.

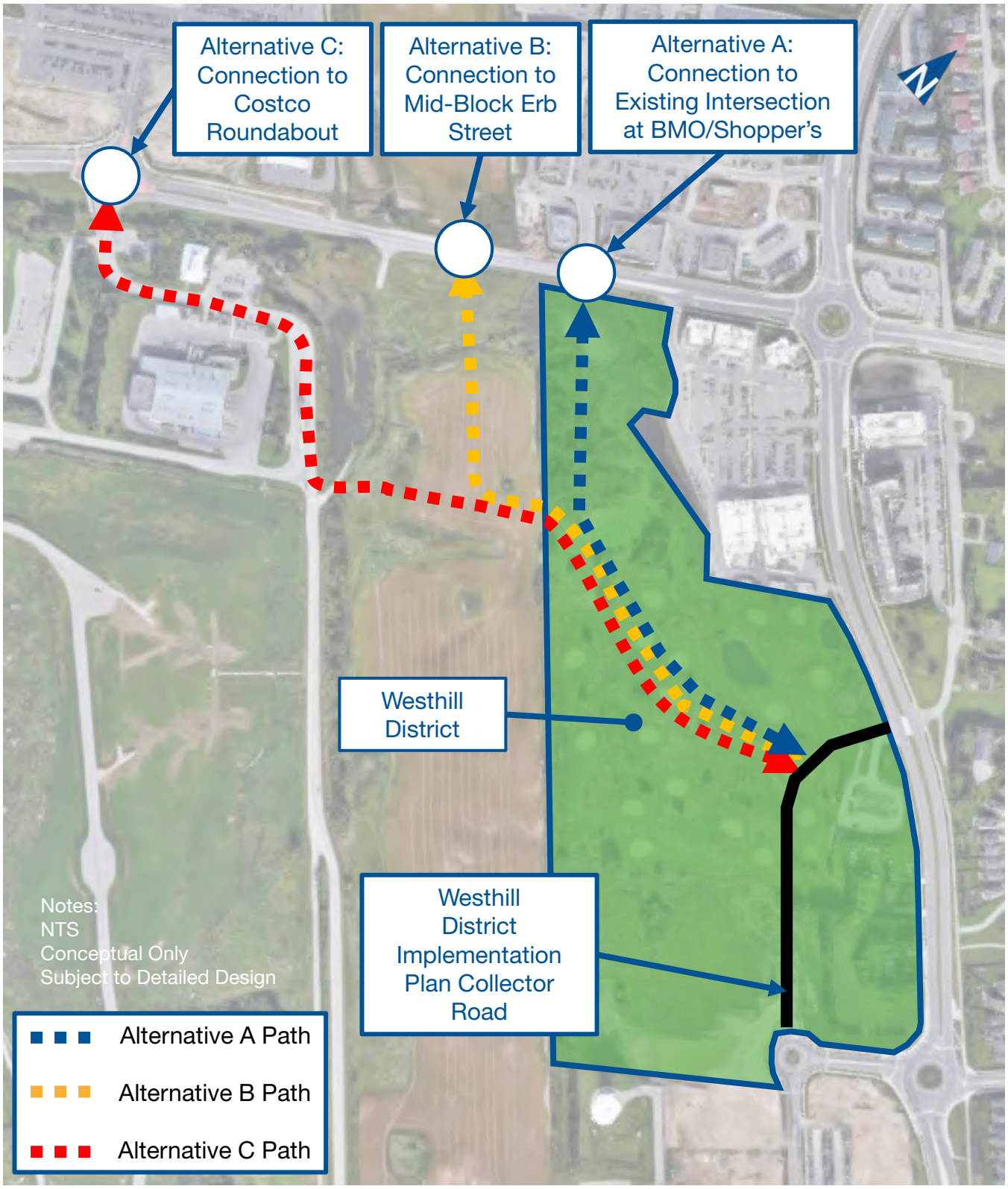
Yours very truly,

PARADIGM TRANSPORTATION SOLUTIONS LIMITED



Jim Mallett
M.A.Sc., P.Eng., PTOE
President and Chief Executive Officer

[3] Waterloo Westside Transportation Network Study, Paradigm Transportation Solutions Limited, August 2019.



paradigm TRANSPORTATION SOLUTIONS LIMITED

Initial Collector Road Alternatives

West Hills Commercial
180136

Figure 1

Refined Collector Road Alternatives

West Hills Commercial
180136

Figure 2