Final

Functional Servicing and SWM Report
720 Erbsville Road
Waterloo, ON

Prepared for Sunvest Development Corp.
by IBI Group

October 2021

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ORIGINATOR:	Tiffany Chan
REVIEWER:	Andy Kroess, Kelly Cobbe
AUTHORIZATION:	IBI Group
CIRCULATION LIST:	
HISTORY:	

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1 Introduction

IBI Group was retained by Sunvest Development Corp. to prepare Functional Servicing and SWM Reports for a proposed development at 720 Erbsville Road in Waterloo, Ontario.

The 3.1 ha development area (9.3 ha property area) is bound by Erbsville Road to the west; adjacent residential neighbours to the north and south; and Laurel Creek to the east. East of Laurel Creek, the lands are currently in process for a zone change application for future development.

Please refer to Figure 1 below for the location of the proposed development.

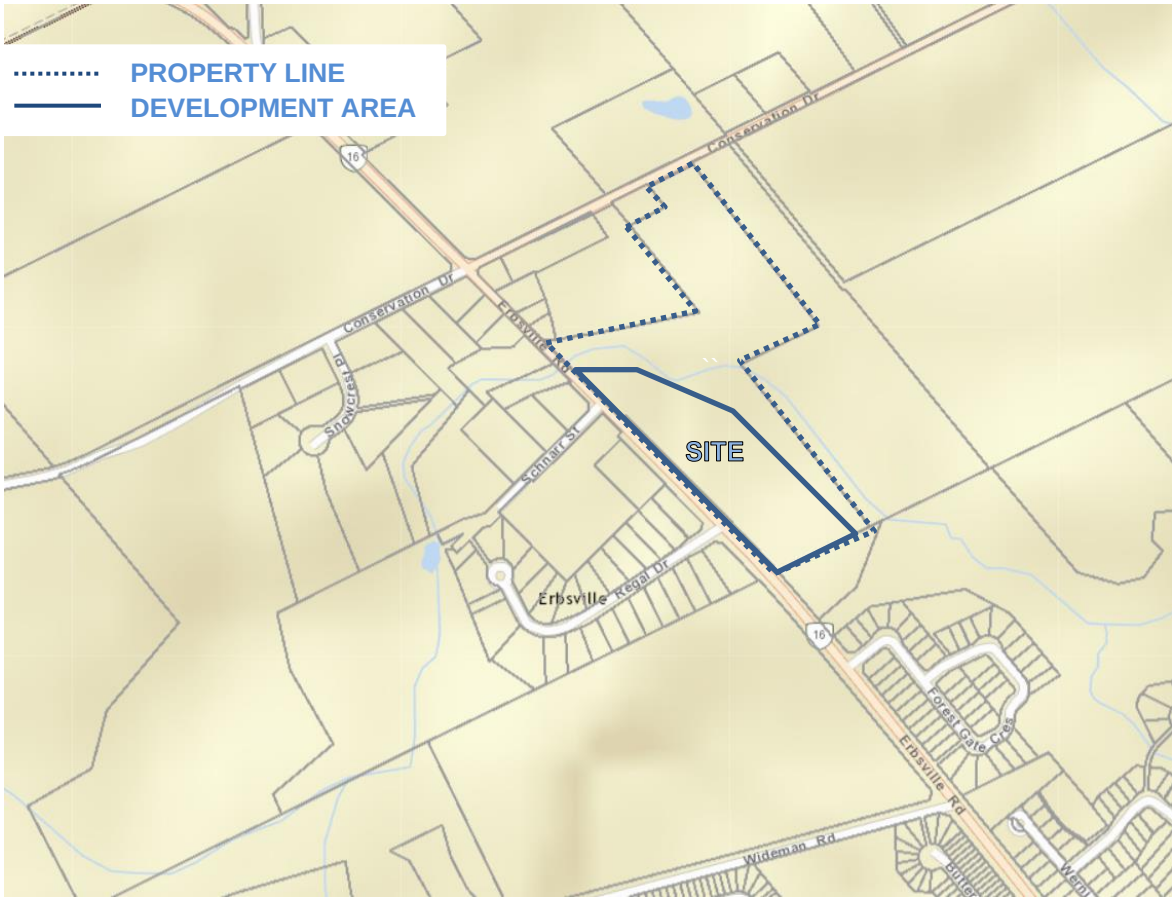


Figure 1: Site Location *(source Region of Waterloo gis.region.waterloo.on.ca)*

The proposed redevelopment will consist of six (6) stacked townhouse buildings (totalling 120 stacked townhouse units) and twelve (12) townhouse blocks (totalling 59 townhouse units). The development will also have on-site parking and an amenity space. Refer to **Appendix A** for the Site Plan.

This report will describe the functional grading and servicing proposed for the development to demonstrate the feasibility and design approach from a site municipal engineering perspective.

2 Existing Conditions

The subject property is currently occupied by a single detached home which will be demolished to facilitate the proposed development. Figure 2 below shows an aerial view of the site. Laurel Creek runs through the property and as such environmental buffers are in place.



Figure 2: Site Location and Aerial Photo *(source Google)*

2.1 Existing Topography and Drainage

The site is split by two ridges draining generally northward toward Laurel Creek.

2.2 Existing Municipal Servicing

On a review of existing information and visual field inspection, we have confirmed that with the exception of storm sewers, municipal services within Erbsville Road adjacent to the property are available to provide services to the proposed development.

Specifically:

- Sanitary Sewage: An existing 300mm diameter sanitary sewer on Erbsville Road;
- Potable Water: An existing 300m diameter watermain on Erbsville Road; and
- Fire protection: An existing hydrant connected to the existing 300mm diameter watermain on Erbsville Road within 15m of the south entrance to the site.

2.3 Utilities

Electric, natural gas, and telecommunication infrastructure exists within close proximity of the subject development on Erbsville Road.

3 Proposed Development

The development will consist of six (6) stacked townhouse buildings and twelve (12) townhouse blocks. Site Development will include removal of the existing vegetation and the addition of an amenity space and surface parking lot.

The following sections describe on a functional level how the property will be graded and how municipal services will be provided. The purpose of the functional design is to demonstrate the feasibility of the development, outline the general strategy for the grading, and confirm the municipal servicing strategy. Final, detailed design (completed during the Site Plan Approval process) will establish the details of the development's design.

3.1 Proposed Roads and Pedestrian Access

Vehicular access will be provided by two driveways off of Erbsville Road. Pedestrian access to the proposed development will be provided during a future road widening of Erbsville Road.

3.2 Proposed Grading

As proposed, the development will be graded such that runoff is collected at low areas within the proposed driveway and parking areas. In these low areas, the runoff will be captured by catchbasins and conveyed via site sewers to the proposed stormwater management pond at the northwest corner of the site. Runoff from major storm events in excess of the 100-year storm will be routed overland to the stormwater management pond.

All hard surfaces will be sloped from 0.5% (minimum) to 5% (maximum) to provide adequate drainage while ensuring that vehicular and pedestrian access routes are accessible. A minimum of 2% and a maximum of 33% (3:1) slope will be used for landscaped areas. In areas where 3:1 grading is not possible, retaining walls will be proposed to achieve the required slopes.

Refer to **Appendix A** for the preliminary grading design.

3.3 Proposed Sanitary Servicing

The site is located within the City of Waterloo's municipal sanitary servicing area. The proposed development will connect to the municipal sanitary sewer at the existing sanitary manhole #LWD45 at the intersection of Erbsville Road and Regal Place. This manhole drains to the sanitary network at Forest Gate Crescent to the south. An internal sanitary sewer is proposed along the private laneways of the development, extending to each building on the Site Plan. Sanitary manholes will be placed at key junctions within the network to facilitate maintenance access.

The City of Waterloo constructed sanitary sewer on Erbsville Road as part of the Regal Place subdivision project. The MECP approved the sanitary sewer design on August 26, 2013 as part of the Environmental Compliance Approval Application No. 0441-9AQJ8S. The approved Sanitary Drainage Plan and Sanitary Sewer Design Sheet accounted for the proposed development on Erbsville Road as well as external areas upstream of the site and is included in Appendix B.

The area of the proposed site (3.10 ha) is smaller than the pre-development area (4.68 ha) used to design the sewer. The total population (defining flows) of the proposed development is 437 persons (compared to 257 persons) included in the design. An updated rational design spreadsheet is included in Appendix B to demonstrate that sufficient capacity is available.

Refer to **Appendix A** for the functional servicing plans of the proposed development, and to **Appendix B** for the sanitary design sheet and catchment areas.

3.4 Proposed Water Supply and Distribution

Water supply for the subject development will be provided by the existing 300mm diameter watermain on Erbsville Road. The watermain within the site will generally run along the laneways and parking lot of the development in order to reach and service each proposed residential buildings. Each building will be serviced by a single connection to an internal 150mm watermain connected to the existing watermain on Erbsville Road. Individual services for each individual stacked townhouse unit will be routed internally.

The following DGSSMS criteria has been used to calculate domestic water demands and fire flow requirements:

Pressure requirements:

i. Minimum Pressure [Non Fire Scenario]: cannot be less than 275 kPa (40 psi).

ii. Maximum Day + Fire Scenario: Cannot be less than 140 kPa (20 psi) Maximum Pressure: 700kPa or 100psi

Population Densities:

- Townhouse unit density 2.44 pop/unit (provided by the Region of Waterloo Planning Department)

Three (3) private fire hydrants will be installed to provide adequate coverage to address fire flow requirements. A hydrant test has been completed on Erbsville Road to confirm system pressures. Based on a WaterCad model developed for the site, provided a maximum fire separation areas of 450 sq.m. (stacked townhouse buildings) and 250 sq.m. (townhouse units) are maintained, the proposed fire hydrants will be able to meet minimum fire flow and pressure requirements. Distribution system details will be finalized during the Site Plan process.

In terms of fire protection, the "Water Supply for Public Fire Protection" by the Fire Underwriters Survey, 1999, methodology was used. Fire flows based were calculated to determine the minimum fire flow requirements under three scenarios: the stacked townhouse buildings, the townhouse units along the north property line, and the townhouse units internal to the site. It is noted per the Ontario Building Code (section 6.3) that the absolute minimum fire flow required for residential development is 45 L/s at 20 psi.

Refer to **Appendix C** for water demand calculations, fire flow calculations and hydrant flow test results.

3.5 Proposed Storm Servicing

An on-site storm sewer system will collect runoff from buildings, landscaped areas and hard surface via sheet flow and catch basins. Internal storm sewer system will collect and convey runoff from minor storms (1:5) to discharge to the stormwater management pond at the northwest corner of the site and outlets to Laurel Creek. During major storms, flows in excess of the sewer capacity will be routed to the pond.

Foundation drains and sump pumps will be installed to maintain groundwater beneath basement floor elevations. Groundwater collected from foundation drains will be discharged to the surface.

Refer to **Appendix D** for storm sewer calculations.

3.6 Preliminary Stormwater Management

3.6.1 Existing Laurel Creek Floodplain

The location of the Regulatory Floodplain for Laurel Creek is shown on the preliminary grading plan. The elevations are based on information from the GRCA (Laurel Creek HEC-RAS model). The proposed developed area will remain outside of the Regulatory Floodplain. The outlet of the proposed stormwater management pond will be located above the 100 year floodline elevation.

3.6.2 Stormwater Management Criteria

The stormwater management criteria for the development have been set through previous studies including the Laurel Creek Watershed Study, the Subwatershed Report (Final Subwatershed Management Plan, Subwatershed Plans #313/309 (Planning Initiatives Ltd. and Associates, April 1996), and the requirements of the GRCA and the City of Waterloo. The key requirements outlined in those Reports include:

- Stormwater management facilities are required to provide water quality control for all flows not infiltrated across the site. The extent of treatment will meet water quality targets established in the Subwatershed Plan and MECP (2003) for Enhanced Protection Level;
- Stormwater management facilities are required to provide water quantity (peak flow) control for the 2, 5, 25, and 100 year storms. The targets control proposed conditions flows to pre-development levels as outlined in Table B4.3 of the Subwatershed Report;
- Extended detention control for erosion control is also required for runoff volume in excess of the existing 100 year runoff volume as outlined in Table B4.3 of the Subwatershed Management Plan and are to be released over a 48 hour period;
- Based on Section D1.3.1 of the Subwatershed Study, the existing annual infiltration rate of 195 mm must be maintained using on-site active infiltration measures;
- Grading and servicing design must ensure that there are no adverse impacts on groundwater and on the adjacent significant natural features; and
- All development must remain outside of the established buffers with the exception of minor encroachment to allow for the construction of stormwater management facilities.

The existing and proposed stormwater drainage area are shown on Figure 1 and Figure 2, respectively.

3.6.3 Stormwater Quantity Control

The stormwater management pond must provide stormwater quantity control for the 2, 5, 25, and 100 year storm events. The GAWSER hydrologic modelling for existing conditions was prepared in the Subwatershed Report and the target release rates for the 2 through 100 year storm events have been established as summarized in Table 1 (derived from Table B4.3, Page B-38 of the Subwatershed Report). Peak flow targets are based on the developing portions of the lands and any external areas tributary to the stormwater management pond.

Table 1: Peak Flow Calculations

Subcatchment	Area*	Return Event			
No.	(ha)	2 Year	5 Year	25 Year	100 Year
109	1.205	(Areas 101)			
Targets ($m^3/s/ha$)		0.0036	0.0092	0.0290	0.0490
Flow (m^3/s)		0.0043	0.0111	0.0350	0.0590
111	2.207	(Area 102)			
Targets ($m^3/s/ha$)		0.0026	0.0045	0.0083	0.0124
Flow (m^3/s)		0.0045	0.0091	0.0168	0.0251
Total Area	**3.232**				
Peak Flow (m^3/s)		**0.0010**	**0.020**	**0.052**	**0.084**

The peak discharges from the site for the modelled storm events are required to meet the targets provided in the Subwatershed Management Plan (see Table 1). The stormwater management modelling for the proposed development was prepared using the Visual OTTHYMO computer program (refer to Appendix E for program input and output files). The percent impervious for modelling purposes has been calculated as 70 percent for the developing area (area 201), which is reflective of the land use within the development. Rear yard areas and rooftop draining toward the infiltration swale have been calculated as 40 percent impervious. Modelling variables based on site-specific information are summarized in **Table 2**.

Table 2: Visual OTTHYMO Modelling Variables

CATCHMENT ID	DESCRIPTION	AREA (HA)	TIMP	XIMP	PERV. MANNINGS N	PERVIOUS CN
201	Developing Lots Draining to Pond	2.811	0.70	0.70	0.250	70
202	Developing Lots Draining to Infiltration Swale	0.421	0.40	0.40	0.250	70
	Total	**3.232**				

A 3-hour Chicago style storm based on the City of Waterloo intensity-duration-frequency (IDF) curves has been used for the modelling of the 2, 5, 25, and 100 year storm events. The rainfall depths for these events are summarized in **Table 3**.

Table 3: Rainfall Depths

RETURN EVENT	DEPTH (MM)
2 Year	32.4
5 Year	47.5
25 Year	69.1
100 Year	89.9

Using the Visual OTTHYMO model, the pond volume required to reduce proposed development flows to the required levels was determined for the above events. **Table 4** summarizes the total discharges from the site, and indicates that the proposed conditions peak discharges have been controlled to below allowable levels. The ponding volume requirements of the stormwater management pond for all storm events are shown in **Table 5**.

Table 4: Peak Discharges

RETURN EVENT	EXISTING CONDITIONS TARGETS (M^3/S)	PROPOSED CONDITIONS PRIOR TO POND ROUTING (M^3/S)	PROPOSED CONDITIONS AFTER POND ROUTING (M^3/S)
2 Year	0.010	0.519	0.007
5 Year	0.020	0.704	0.020
25 Year	0.052	1.005	0.047
100 Year	0.084	1.338	0.054

Table 5: Stormwater Management Pond Storage Characteristics

RETURN EVENT	STORAGE VOLUME (M^3)
2 Year	621
5 Year	916
25 Year	1291
100 Year	1753

Orifice controls will be provided at the pond outlet structure. A 75mm orifice will provide control for the water quality and erosion extended detention storage, and a 150mm diameter orifice will control events up to the 100 year storm event. The stormwater quantity control for all events up to and including the 100 year storm can be accommodated for with a single outlet with a maximum water level fluctuation of less than 1.5 m. An emergency overflow weir will be provided for events greater than the 100 year storm.

The pond outlet structure will discharge to a level stone spreader outlet, which will direct runoff toward Laurel Creek. This type of outlet structure will ensure that existing diffuse drainage patterns of the site are maintained and prevent erosion by slowing and spreading flow over a large area. The outlet will also provide mitigation of thermal impacts by cooling runoff before it discharges overland toward Laurel Creek. Details will be provided on the final design drawings.

The rear yard areas draining east toward Laurel Creek will require additional attenuation within a grass infiltration swale (shown on the preliminary Grading Plan), since these areas are too low to drain to the proposed stormwater management pond. These will be primarily be landscaped areas, and rooftop and asphalt areas would be directed toward the proposed storm sewer. Based on the Visual OTTHYMO output, the total storage volume of 250 m^3 is required in the swale to retain and infiltrate the 100 year storm runoff volume.

Preliminary grading details of the pond and infiltration swale are provided on the preliminary engineering drawings in Appendix A. The preliminary pond stage-storage-discharge calculations and the Visual OTTHYMO modelling are included in Appendix E.

3.6.4 Extended Detention Erosion Control

As required by the Subwatershed Report, the pond must detain the 100 year volume in excess of existing conditions and release this volume over a 48 hour period (for erosion control purposes). This volume has been calculated as approximately 955 m^3 (**Table 6**).

Table 6: Extended Detention Volumes

	EXTENDED DETENTION STORAGE		
	PERVIOUS	IMPERVIOUS*	TOTAL
Area 109			
Target (m^3/ha)	25	-	
Developing Areas (ha)*	0.36	0.84	1.205
Volume (m^3/ha)	9	-	9
Area 111			
Target (m^3/ha)	25	656	
Developing Areas (ha)*	0.61	1.42	2.027
Volume (m^3/ha)	15	931	946
Total (m^3)			955

* ***Based on average 70% imperviousness for developing areas.***

Based on a minimum orifice opening size of 75mm, a release time of approximately 64 hours can be achieved for a volume of approximately 955 m^3.

3.6.5 Stormwater Quality Control

The Subwatershed Report requires that a water quality facility be provided to control the first 25 mm of runoff if it is not infiltrated. Based on an Enhanced Protection Level for the downstream receiver, stormwater quality control must be provided to achieve 80 percent Total Suspended Solids (TSS) removal efficiency for 90 percent of annual flows. A treatment-train approach will be provided for stormwater quality control using an oil/grit separator (OGS) unit and additional polishing and extended detention within the dry pond facility to achieve the required Enhanced Protection Level.

A Stormceptor OGS unit (EFO12) will be installed at the inlet to the pond to provide stormwater quality control for flows generated from the developing areas tributary to the SWM pond. The total drainage area to this OGS is approximately 2.81 ha (areas 201, average 70 percent impervious). Based on output from the Stormceptor software, an EFO12 unit will provide a TSS removal efficiency of 80 percent for greater than 90 percent of annual flows generated by lands tributary to the unit (refer to Appendix E). This OGS sizing is conservative since is does not account for storage and infiltration in lot infiltration galleries.

The unit should be inspected and cleaned regularly (typically once every 6 to 12 months) as per the manufacturer's specifications. Although the unit by itself meets an Enhanced Protection Level, the treatment-train approach will provide additional tertiary treatment of runoff before it is discharged off site (polishing, extended detention).

OGS units are typically credited for a 50 percent TSS removal, therefore the remaining 30 percent TSS removal will be provided by the extended detention stormwater management pond. Based on the MECP SWMP Manual (2003), dry ponds with extended detention can provide a TSS removal of 60 percent. Therefore, the total TSS removal for the site treatment-train is 50 percent for the OGS, and (0.50 X 60% = 30%) for the pond for a total of 80 percent.

3.6.6 Infiltration

The Subwatershed Study and the Hydrogeological Investigation (LVM, June 2015) both require that post-development site infiltration should be designed to attempt to match pre-development recharge rates within the Study Area through methods such as at-source infiltration from rooftops connected to soakaway pits, where feasible.

The Hydrogeological Investigation drawing 5.09 (included in Appendix E) indicates high groundwater elevations of 347.5m and 349.0m at the east and west parts of the property, respectively. Based on the proposed preliminary grading, proposed site grades will be 3.0m to 5.0m above the high groundwater elevations. Therefore, the use of active infiltration measures will be feasible. The infiltration swale at the east limit of the development will remain 1.0m above the high groundwater elevation.

Active infiltration measures (e.g., lot-level infiltration galleries) will be utilized to ensure that the existing annual infiltration rate of 195 mm will be maintained. Runoff from rooftop areas will be routed to soakaway pits to be located throughout the developing area. Locations and details will be provided at the final design stage.

4 Proposed Utilities

Considering the adjacent developed areas, it is reasonable to assume there are existing hydro, gas, and telecommunication services in the vicinity of the site. It is anticipated that each of these utilities will, as required, identify their specific requirements through the standard application circulation, review and design process.

5 Erosion and Sediment Control

During construction, erosion and sediment control measures will be required, and will include:

- Silt fence erected around site perimeter before any work begins on the site to protect adjacent areas from migration of sediment in overland flow.
- A "mud mat" installed at the construction entrance(s) to the site to minimize the amount of sediment transported off site via construction vehicles; and
- Stabilization of all disturbed areas as quickly as possible to minimize erosion.

6 Summary

This Functional Servicing Report outlines the proposed site grading and municipal servicing design for the proposed development at 720 Erbsville Road, Waterloo, Ontario. It demonstrates that the development is feasible and can be designed and constructed in accordance with municipal standards.

The following summarizes the components of the design.

- The site grading will achieve gentle gradients between 0.5% to 5% for all vehicular and pedestrian areas. Landscaped areas will have gradients between 2% and 33%.
- A proposed stormwater management pond will provide stormwater quantity and erosion control for the developing area.
- An OGS unit in conjunction with the stormwater management pond will provide a treatment-train for stormwater quality control to provide 80 percent TSS removal.
- An infiltration swale will retain and infiltrate the 100 year storm from rear yard areas.
- Active infiltration of rooftop runoff will be provided throughout the site to be finalized during Site Plan Approval.
- The existing 300mm diameter sanitary sewer infrastructure on Erbsville Road will provide sanitary service to the site.
- The existing 300mm diameter watermain on Erbsville Road will provide potable water and fire protection for the site.
- Three (3) private fire hydrants will provide fire protection.

We trust the foregoing is satisfactory to support the development application. Should there be any questions or if further information is required, please do not hesitate to contact the undersigned.

All of which is respectfully submitted.

Yours truly

IBI GROUP





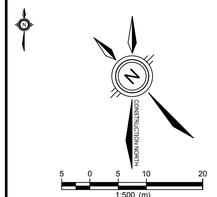
Kelly Cobbe, P.Eng.
Director – Office Lead

Tiffany Chan, P.Eng.
Civil Engineer

APPENDIX A: Drawings

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KEY MAP - N.T.S.

LEGEND

- S~MH – EXISTING SANITARY MANHOLE
- – EXISTING SANITARY FLOW DIRECTION
- HYD – EXISTING HYDRANT
- WV – EXISTING WATER VALVE
- – EXISTING WATERMAIN
- 364.00 – ORIGINAL GROUND CONTOUR

NOT FOR TENDER

BENCHMARK - ELEVATION
DESCRIPTION

#	DATE	BY	DESCRIPTION
01	2021-10-27	I.A.	ISSUED FOR ZBA – FIRST SUBMISSION

REVISIONS

APPROVALS

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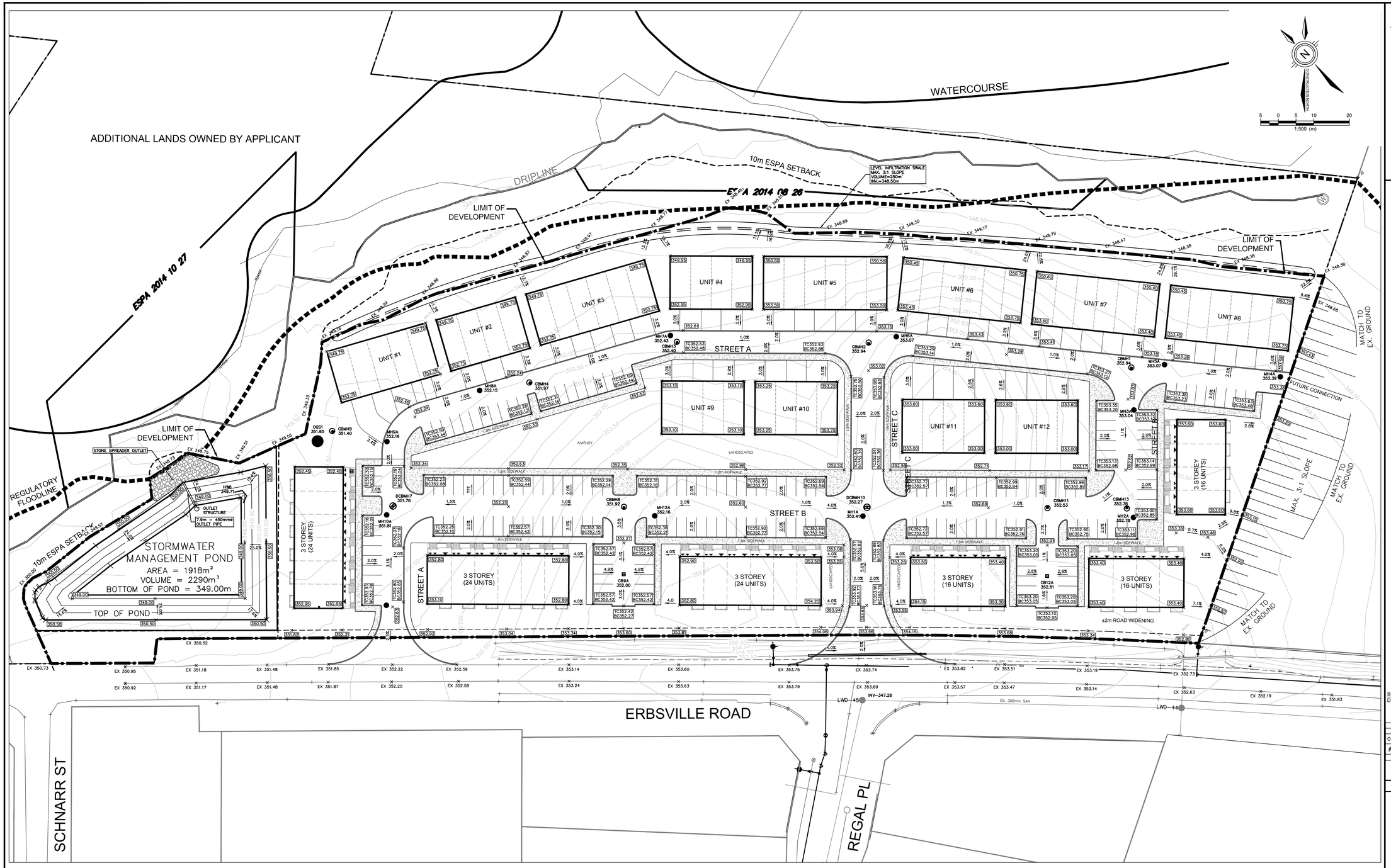
IBI GROUP
101 - 410 Albert Street
Waterloo ON N2L 3V3 Canada
tel 519 585 2255
ibigroup.com

CITY OF WATERLOO
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720 ERBSVILLE ROAD EAST
WATERLOO, ON

EXISTING CONDITIONS PLAN

DESIGNED BY:	I. AHOSSIVO	SCALE HORIZ:	1:500
DRAWN BY:	I. AHOSSIVO	SCALE VERT:	N/A
CHECKED BY:	K. COBBE	FILE NUMBER:	132405
DATE:	2021-10-27	SHEET NUMBER:	C01



KEY MAP - N.T.S.

LEGEND

- PROPOSED GRADE ELEVATION
- EXISTING GRADE ELEVATION
- PROPOSED GRADE
- DRAINAGE DIVIDE
- PROPOSED MANHOLE
- PROPOSED CATCH BASIN MANHOLE
- PROPOSED DOUBLE CATCH BASIN MANHOLE
- PROPOSED MAX. 3:1 SLOPE
- PROPOSED INFILTRATION SWALE
- PROPOSED CONCRETE SIDEWALK
- LIMIT OF DEVELOPMENT
- REGULATORY FLOODLINE
- ESPA 10m SETBACK
- EXISTING PROPERTY LINE
- PROPOSED BUILDING OUTLINE
- EXISTING SANITARY MANHOLE
- EXISTING SANITARY FLOW DIRECTION
- EXISTING HYDRANT
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- ORIGINAL GROUND CONTOUR

NOT FOR TENDER

BENCHMARK - ELEVATION
DESCRIPTION

#	DATE	BY	DESCRIPTION
01	2021-10-27	I.A.	ISSUED FOR ZBA – FIRST SUBMISSION

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IBI GROUP
101 - 410 Albert Street
Waterloo ON N2L 3V3 Canada
tel 519 585 2255
ibigroup.com

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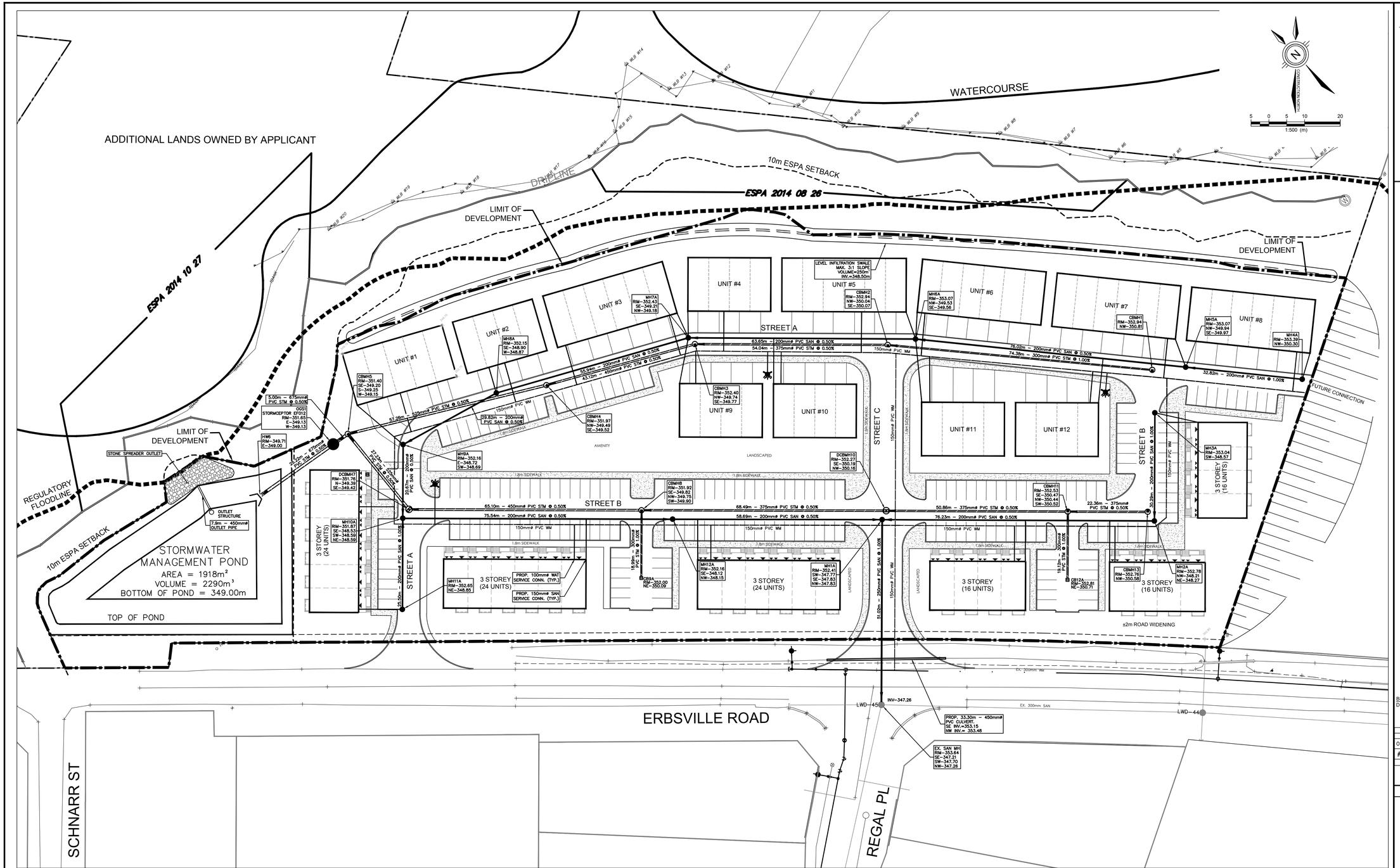
720 ERBSVILLE ROAD EAST
WATERLOO, ON

FUNCTIONAL GRADING PLAN

DESIGNED BY:	I. AHOSSIVO	SCALE HORIZ:	1:500
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DATE:	2021-10-27	SHEET NUMBER:	C02

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KEY MAP - N.T.S.

LEGEND

- PROPOSED GRADE ELEVATION
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- EXISTING SANITARY SEWER
- EXISTING WATERMAIN
- EXISTING FIRE HYDRANT
- EXISTING WATERMAIN
- ORIGINAL GROUND CONTOUR
- PROPOSED WATERMAIN
- PROPOSED WATER SERVICE
- PROPOSED STORM SEWER
- PROPOSED SANITARY SEWER
- PROPOSED SANITARY SERVICE

NOT FOR TENDER

BENCHMARK - ELEVATION
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01	2021-10-27	I.A.	ISSUED FOR ZBA – FIRST SUBMISSION

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IBI GROUP
101 - 410 Albert Street
Waterloo ON N2L 3V3 Canada
tel 519 585 2255
ibigroup.com

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WATERLOO, ON

FUNCTIONAL SERVICING PLAN

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DATE:	2021-10-27	SHEET NUMBER:	C03

N

CONSTRUCTION NORTH

15 0 10 20 40

1:1000 (m)

ESPA 2014 10 27

ESPA 2014 08 26

102
2.027ha

101
1.205ha

ERBSVILLE RD

SCHNARR ST

REGAL PL

EX. 300mm WM

EX. 300mm SAN

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101 - 410 Albert Street
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tel 519 585 2255
ibigroup.com

720 ERBSVILLE ROAD EAST

SCALE	1:1000
DATE	2021-10-27
PROJECT No.	132405

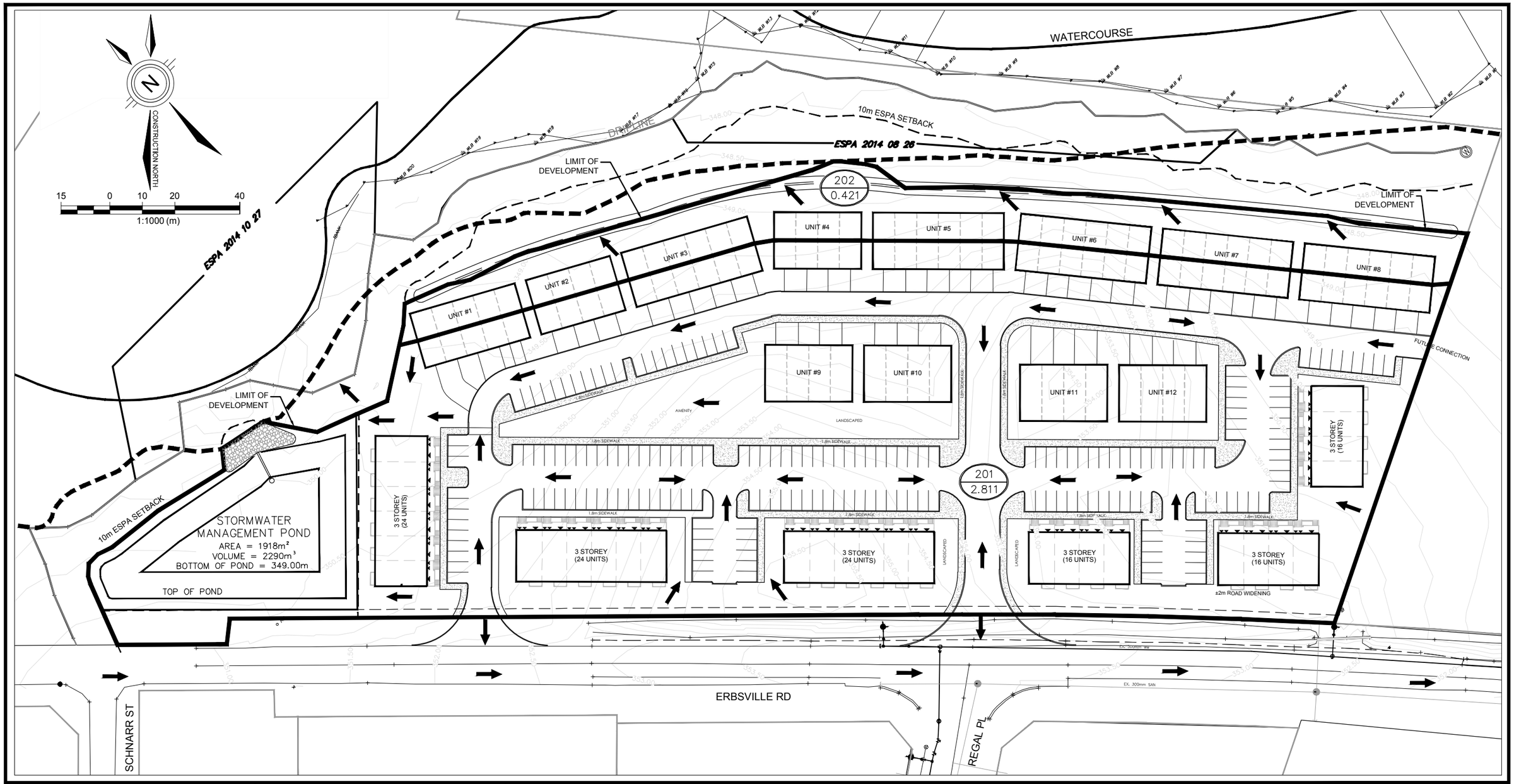
CITY OF WATERLOO
REGIONAL OF MUNICIPALITY WATERLOO

EXISTING STORM CATCHMENT AREAS

FIGURE 1

LEGEND

- EXISTING CATCHMENT BOUNDARIES
- DRANIAGE ARROWS
- EX. CATCHMENT SYMBOL
  - 101 / 0.0359ha
  - CATCHMENT AREA NUMBER
  - AREA (ha)



IBI GROUP
101 - 410 Albert Street
Waterloo ON N2L 3V3 Canada
tel 519 585 2255
ibigroup.com

SCALE	1:1000
DATE	2021-10-27
PROJECT No.	132405

CITY OF WATERLOO
REGIONAL MUNICIPALITY OF WATERLOO

720 ERBSVILLE ROAD EAST

EXISTING STORM CATCHMENT AREAS

FIGURE 2

LEGEND

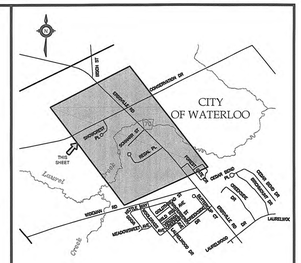
- PROPOSED CATCHMENT BOUNDARIES
- DRAINAGE ARROWS
- PROP. CATCHMENT SYMBOL
  - 201 ← CATCHMENT AREA NUMBER
  - 0.0563 ← AREA (ha)

APPENDIX B: Sanitary Calculations



LEGEND

- DRAINAGE AREA NUMBER
- AREA (HA)
- POPULATION DENSITY (ppu=POPULATION PER UNIT; pph=POPULATION PER HECTARE)
- POPULATION
- SANITARY DRAINAGE AREA BOUNDARY
- MHS# – PROPOSED SANITARY MANHOLE
- PROPOSED SANITARY SEWER


CITY OF WATERLOO
ERBSVILLE RD
HIGHRIDGE DR
HIGHRIDGE PLACE
KOHANN DR
KOHANN PL
THIS SHEET
Laurel Creek
KOHANN CRT
KOHANN PLACE
KOHANN PLACE
KOHANN CRT
KOHANN DR
KOHANN DR
KOHANN PL
KOHANN PL

SANITARY SEWER CALCULATIONS (REVISED)

FOR

Regal Place

CITY OF WATERLOO

Date: 2013 07 09 (REVISED 2021-10-28)

File: 28249

Designed by: PCK Revision by: TC

Checked by : JRP Checked by: KC

LOCATION	FROM MH	TO MH	CATCHMENT AREA NUMBER	NUMBER OF UNITS	POP.	ACCUM. POP.	PEAK FACTOR	PEAK SEWAGE FLOW	NON-RESIDENTIAL FLOW				INFILTRATION FLOW			TOTAL DESIGN FLOW	PIPE CHARACTERISTICS				
									AREA	PEAK FLOW RATE	FLOW	ACCUM FLOW	AREA	ACCUM AREA	FLOW		PIPE SIZE	SLOPE	CAPACITY	VELOCITY	
					(persons)			(m3/s)	(ha)	(m3/s)	(ha)	(m3/s)	(ha)	(ha)	(m3/s)	(m3/s)	(mm)	(%)	(m3/s)	(m/s)	Full
REGAL PLACE	MH S10	MH S9	1	6	18	18	4.39	0.0003					1.45	1.45	0.0002	0.0005	200	1.00	0.0328	1.04	2%
	MH S9	MH S8	2	2	6	24	4.37	0.0004					0.56	2.01	0.0003	0.0007	200	0.50	0.0232	0.74	3%
	MH S8	MH S7	3	3	9	33	4.35	0.0006					0.62	2.63	0.0004	0.0010	200	0.50	0.0232	0.74	4%
	MH S7	MH S6	4	3	9	42	4.33	0.0007					0.51	3.14	0.0005	0.0012	200	0.50	0.0232	0.74	5%
	MH S6	MH S5	5	7	21	63	4.29	0.0011					1.22	4.36	0.0007	0.0017	200	0.50	0.0232	0.74	7%
	MH S5	MH S4	6	6	18	81	4.27	0.0014					1.38	5.74	0.0009	0.0022	200	0.50	0.0232	0.74	10%
ERBSVILLE ROAD	MH S4	MH S3	Area A (Σ A1 to A10)	-	2327	2408	3.52	0.0340					37.48	43.22	0.0065	0.0404	300	0.35	0.0572	0.81	71%
			A1, A3 to A10		1890	1890	3.60	0.0273					34.38	34.38	0.0052	0.0324					
720 Erbsville Road (Site)			A2		437	437	4.00	0.0070					3.10	3.10	0.0005	0.0075					
	MH S3	MH S2	Area B	-	234	2642	3.49	0.0369					4.26	47.48	0.0071	0.0440	300	0.35	0.0572	0.81	77%
	MH S2	MH S1	Area C	-	113	2755	3.47	0.0383					2.05	49.53	0.0074	0.0458	300	0.25	0.0484	0.68	95%
FOREST GLEN CRESCENT	MH S1	EX MH		-	0	2755	3.47	0.0383					0.00	49.53	0.0074	0.0458	450	0.35	0.1687	1.06	27%

DESIGN PARAMETERS:

Revised

Avg. consumption 346 l/person/day

manning's n 0.013

Population

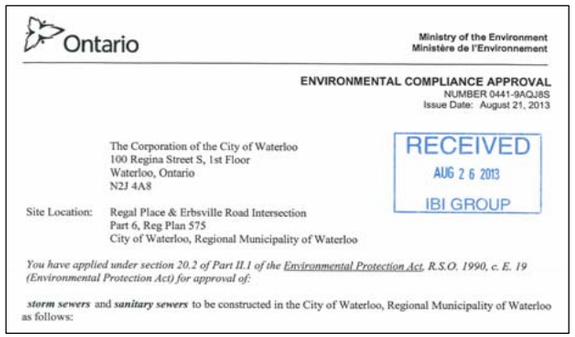
3 persons/unit (detached/semi-detached)

2 persons/unit (Townhouse)

55 people/ha (detached/semi-detached)

100 people/ha (Townhouse)

200 people/ha (Apartment)



Ontario

Ministry of the Environment
Ministère de l'Environnement

ENVIRONMENTAL COMPLIANCE APPROVAL
NUMBER 0441-9AQJ8S
Issue Date: August 21, 2013

The Corporation of the City of Waterloo
100 Regina Street S, 1st Floor
Waterloo, Ontario
N2J 4A8

RECEIVED
AUG 2 6 2013
IBI GROUP

Site Location: Regal Place & Erbsville Road Intersection
Part 6, Reg Plan 575
City of Waterloo, Regional Municipality of Waterloo

You have applied under section 20.2 of Part II.1 of the Environmental Protection Act, R.S.O. 1990, c. E. 19 (Environmental Protection Act) for approval of:

storm sewers and ***sanitary sewers*** to be constructed in the City of Waterloo, Regional Municipality of Waterloo as follows:

SANITARY SEWER CALCULATIONS
FOR
720 Erbsville Road (Internal)

CITY OF WATERLOO

Designed by: TC
Checked by : KC

Date: October 25, 2021
File: 132405

LOCATION	FROM MH	TO MH	NUMBER OF UNITS	POP. (persons)	ACCUM. POP.	PEAK FACTOR	PEAK SEWAGE FLOW (m3/s)	INFILTRATION FLOW AREA (ha)	INFILTRATION FLOW ACCUM AREA (ha)	INFILTRATION FLOW FLOW (m3/s)	TOTAL DESIGN FLOW (m3/s)	PIPE CHARACTERISTICS PIPE SIZE (mm)	SLOPE (%)	CAPACITY (m3/s)	VELOCITY (m/s)	% Full	INVERT U/S	INVERT D/S	T/G U/S	T/G D/S	COVER U/S	COVER D/S
Street A	MH4A	MH5A	6	15	15	4.40	0.0002	3.10	3.10	0.0005	0.0007	200	1.00	0.0328	1.04	2%	350.3	349.97	353.39	353.07	3.29	3.3
Street A	MH5A	MH6A	10	24	39	4.34	0.0005	3.10	6.20	0.0009	0.0015	200	0.50	0.0232	0.74	6%	349.94	349.56	353.07	353.07	3.33	3.71
Street A	MH6A	MH7A	20	49	88	4.26	0.0012	3.10	9.30	0.0014	0.0026	200	0.50	0.0232	0.74	11%	349.53	349.21	353.07	352.01	3.74	3
Street A	MH7A	MH8A	14	34	122	4.22	0.0016	3.10	12.40	0.0019	0.0035	200	0.50	0.0232	0.74	15%	349.18	348.9	352.01	352.15	3.03	3.45
Street A	MH8A	MH9A	4	10	132	4.21	0.0018	3.10	15.50	0.0023	0.0041	200	0.50	0.0232	0.74	18%	348.87	348.72	352.15	352.16	3.48	3.64
Street A	MH9A	MH10A	5	12	144	4.20	0.0019	3.10	18.60	0.0028	0.0047	200	0.50	0.0232	0.74	20%	348.69	348.59	352.16	351.87	3.67	3.48
Street A	MH11A	MH10A	24	59	59	4.30	0.0008	3.10	18.60	0.0028	0.0036	200	1.00	0.0328	1.04	11%	348.85	348.59	352.65	351.87	4	3.48
Street B	MH10A	MH12A	24	59	261	4.10	0.0034	3.10	3.10	0.0005	0.0039	200	0.50	0.0232	0.74	17%	348.53	348.15	351.87	352.04	3.54	4.09
	MH12A	MH1A	24	59	320	4.07	0.0041	3.10	21.70	0.0033	0.0074	200	0.50	0.0232	0.74	32%	348.12	347.83	352.04	352.14	4.12	4.51
Street B	MH3A	MH2A	16	39	39	4.34	0.0005	3.10	6.20	0.0009	0.0015	200	1.00	0.0328	1.04	4%	348.57	348.27	353.04	352.78	4.67	4.71
	MH2A	MH1A	32	78	117	4.22	0.0016	3.10	24.80	0.0037	0.0053	200	0.50	0.0232	0.74	23%	348.21	347.83	352.78	352.14	4.77	4.51
Street C	MH1A	LWD45			437	4.00	0.0056	3.10	9.30	0.0014	0.0070	200	1.00	0.0328	1.04	21%	347.77	347.26				

DESIGN PARAMETERS:

Avg. consumption 275 l/person/day
manning's n 0.013

Population
3 persons/unit (detached/semi-detached)
2.44 persons/unit (Townhouse)
55 people/ha (detached/semi-detached)
100 people/ha (Townhouse)
200 people/ha (Apartment)

APPENDIX C: Water Demand and Fire Flow Calculations

720 Erbsville Road
City of Waterloo
DOMESTIC WATER DEMAND

File No: 132405
Date: 15-Oct-21
Sheet By: TC
Checked By: KC

Proposed Residential Apartment	Population Density[1]	Units	Equivalent Population (persons)	Water Demand[1] @ 225 L/p/day (L/day)
Townhouse	2.44 PPU	179	437	117,990
	Total	**179**	**437**	**117,990**

	Peaking Factor[1]	Total Flow
Average day (L/day)	0.4	47,196
Average day (L/s)	0.4	0.55
Maximum day (L/day)	2.75	129,789
Maximum day (L/s)	2.75	1.50
Peak hour (L/hr)	4.13	8,122
Peak hour (L/s)	4.13	2.26

1 - Region of Waterloo - Planning Department
2 - MECP-Design Guidelines for Drinking-Water Systems

FUS Fire Flow Estimation - Stacked Townhouse Building

Based on Part II of Water Supply for Public Fire Protection 1999 (Page 17 to 20 Guide for determination of required fire flow)

Project: 132405, 720 Erbsville Road, Waterloo
Date: October 2021

Floor area (each unit)	5898	ft^2 (or 548m^2)	*Actual Area
Fire Wall Requirement	No		
Construction Type	Wood Frame		
Provision of Sprinkler	No		

Item A to D, P20) Fire flow rate based on type of construction
Item 1, P17 $F1=220C1A^{0.5}$ Fire Flow Formula (Rounded off to nearest 1000 L/min)
F1= Required fire Flow (L/min)
A= **450** m^2 Total Floor area Based on the site statistics prepared by architectsAlliance
*450sq.m. max area for provided hydrant flow 107 L/s

C1 = 1.5 Type of construction (Page 17)
C1=1.5 for wood frame construction (structure essentially all combustible)
C1=1.0 for ordinary construction (brick or other masonry walls, combustibles floor and interior)
C1=0.8 for non-combustible construction (unprotected metal structural components, masonry or metal walls)
C1=0.6 for fire-resistive construction (fully protected frame, floors, roof)
a) fire-resistive construction with vertical opening inadequately protected:
two largest floors plus 50% of each of any floors immediately above up to eight
b) fire-resistive construction with vertical opening and exterior communications adequately protected (one hour rating):
one largest floor plus 25% of each of the two immediately adjoining floors

F1= **7000** L/min

Item E, P20) Determine the increase or decrease for type of occupancies (Do not round off the answer)
Item 2, P18)
F2= F1 * C2 Adjusted Fire Flow rate (L/s)
C2= -25% C2=-25% Non-Combustible, P18
F2= **5250** L/min C2=-15% Limited Combustible, P18
C2=0 Non-residential

Item F, P20) Determine the decrease for automatic sprinkler system protection and standard design
Item 3, P18) (Do not round off the answer)
F3 = F2 *C3 C3=0 Non-Sprinkler
C3= 0% C3=-50% Complete automatic sprinkler System, if the water supply is standard for
F3= **0** L/min both the system and fire department hose lines required, P18
C3=-30% Adequately designed system conforming to NFPA 13 and other NFPA Sprinkler standards

Item G, P20) Determine the increase for structure exposure distance, P18 (Do not round off the answer)
Item 4, p18)
F4 = F2 *C4 Exposure to the other buildings,
C4= 20% C4 = 0% if >45 m
F4= **1050** L/min C4 = 25% (if 0 to 3 m)
C4 = 20% (if 3 to 10 m)
C4 = 15% (if 10 to 20 m)
C4 = 10% (if 20 to 30 m)
C4 = 5% (if 30 to 45 m)
C4=10% (if fire wall), P19

	Exposure	Percentage
Side	Distance (m)	Charge (%)
North	34	5
South	45	5
East	25	5
West	31	5
	Total	20

Item H, P20) Adjust the Fire Flow Value
F5= F2+F3+F4
F5= 6300 L/min
F5= 6000 L/min (Rounded off to nearest 1000 L/min)
F5= **100** L/s

FUS Fire Flow Estimation - Townhouses

Based on Part II of Water Supply for Public Fire Protection 1999 (Page 17 to 20 Guide for determination of required fire flow)

Project: 132405, 720 Erbsville Road, Waterloo
Date: October 2021

Floor area (each unit)	5898	ft^2 (or 548m^2)	*Actual Area
Fire Wall Requirement	No		
Construction Type	Wood Frame		
Provision of Sprinkler	No		

Item A to D, P20) Fire flow rate based on type of construction
Item 1, P17 $F1=220C1A^{0.5}$ Fire Flow Formula (Rounded off to nearest 1000 L/min)
F1= Required fire Flow (L/min)
A= **250** m^2 Total Floor area Based on the site statistics prepared by architectsAlliance
*250sq.m. max area for provided hydrant flow 107 L/s

C1 = 1.5 Type of construction (Page 17)
C1=1.5 for wood frame construction (structure essentially all combustible)
C1=1.0 for ordinary construction (brick or other masonry walls, combustibles floor and interior)
C1=0.8 for non-combustible construction (unprotected metal structural components, masonry or metal walls)
C1=0.6 for fire-resistive construction (fully protected frame, floors, roof)
a) fire-resistive construction with vertical opening inadequately protected:
two largest floors plus 50% of each of any floors immediately above up to eight
b) fire-resistive construction with vertical opening and exterior communications adequately protected (one hour rating):
one largest floor plus 25% of each of the two immediately adjoining floors

F1= **5218** L/min

Item E, P20) Determine the increase or decrease for type of occupancies (Do not round off the answer)
Item 2, P18)
F2= F1 * C2 Adjusted Fire Flow rate (L/s)
C2= -25% C2=-25% Non-Combustible, P18
F2= **3913** L/min C2=-15% Limited Combustible, P18
C2=0 Non-residential

Item F, P20) Determine the decrease for automatic sprinkler system protection and standard design
Item 3, P18) (Do not round off the answer)
F3 = F2 *C3 C3=0 Non-Sprinkler
C3= 0% C3=-50% Complete automatic sprinkler System, if the water supply is standard for
F3= **0** L/min both the system and fire department hose lines required, P18
C3=-30% Adequately designed system conforming to NFPA 13 and other NFPA Sprinkler standards

Item G, P20) Determine the increase for structure exposure distance, P18 (Do not round off the answer)
Item 4, p18)
F4 = F2 *C4 Exposure to the other buildings,
C4= 55% C4 = 0% if >45 m
F4= **2152** L/min C4 = 25% (if 0 to 3 m)
C4 = 20% (if 3 to 10 m)
C4 = 15% (if 10 to 20 m)
C4 = 10% (if 20 to 30 m)
C4 = 5% (if 30 to 45 m)
C4=10% (if fire wall), P19

	Exposure	Percentage
Side	Distance (m)	Charge (%)
North	175	0
South	20	5
East	3	25
West	3	25
	Total	55

Item H, P20) Adjust the Fire Flow Value
F5= F2+F3+F4
F5= 6066 L/min
F5= 6000 L/min (Rounded off to nearest 1000 L/min)
F5= **100** L/s

FUS Fire Flow Estimation - Internal Townhouse Units

Based on Part II of Water Supply for Public Fire Protection 1999 (Page 17 to 20 Guide for determination of required fire flow)

Project: 132405, 720 Erbsville Road, Waterloo
Date: October 2021

Floor area (each unit)	3745	ft^2 (or $1000m^2$)
Fire Wall Requirement	No	
Construction Type	Wood Frame	
Provision of Sprinkler	No	

Item A to D, P20) Fire flow rate based on type of construction
Item 1, P17 $F1=220C1A^{0.5}$ Fire Flow Formula (Rounded off to nearest 1000 L/min)
F1= Required fire Flow (L/min)
A= **348** m^2 Total Floor area Based on the site statistics prepared by architectsAlliance
re

C1 = 1.5 Type of construction (Page 17)
C1=1.5 for wood frame construction (structure essentially all combustible)
C1=1.0 for ordinary construction (brick or other masonry walls, combustibles floor and interior)
C1=0.8 for non-combustible construction (unprotected metal structural components, masonry or metal walls)
C1=0.6 for fire-resistive construction (fully protected frame, floors, roof)
a) fire-resistive construction with vertical opening inadequately protected:
two largest floors plus 50% of each of any floors immediately above up to eight
b) fire-resistive construction with vertical opening and exterior communications adequately protected (one hour rating):
one largest floor plus 25% of each of the two immediately adjoining floors

F1= **6157** L/min

Item E, P20) Determine the increase or decrease for type of occupancies (Do not round off the answer)
Item 2, P18)
F2= F1 * C2 Adjusted Fire Flow rate (L/s)
C2= -25% C2=-25% Non-Combustible, P18
F2= **4618** L/min C2=-15% Limited Combustible, P18
C2=0 Non-residential

Item F, P20) Determine the decrease for automatic sprinkler system protection and standard design
Item 3, P18) (Do not round off the answer)
F3 = F2 *C3 C3=0 Non-Sprinkler
C3= 0% C3=-50% Complete automatic sprinkler System, if the water supply is standard for
F3= **0** L/min both the system and fire department hose lines required, P18
C3=-30% Adequately designed system conforming to NFPA 13 and other NFPA Sprinkler standards

Item G, P20) Determine the increase for structure exposure distance, P18 (Do not round off the answer)
Item 4, p18)
F4 = F2 *C4 Exposure to the other buildings,
C4= 30% C4 = 0% if >45 m
F4= **1385** L/min C4 = 25% (if 0 to 3 m)
C4 = 20% (if 3 to 10 m)
C4 = 15% (if 10 to 20 m)
C4 = 10% (if 20 to 30 m)
C4 = 5% (if 30 to 45 m)
C4=10% (if fire wall), P19

	Exposure	Percentage
Side	Distance (m)	Charge (%)
North	21	10
South	30	5
East	29	10
West	30	5
	Total	30

Item H, P20) Adjust the Fire Flow Value
F5= F2+F3+F4
F5= 6003 L/min
F5= 6000 L/min (Rounded off to nearest 1000 L/min)
F5= **100** L/s

Hydrant Flow Test : 720 ERBSVILLE RD, Waterloo, Ontario WO 42328

C&H FIRE SUPPRESSION SYSTEMS INC.

Static Hydrant: ERBSVILLE RD, Waterloo, Ontario.
Flowing Hydrant: ERBSVILLE RD & REGAL PL , Waterloo, Ontario.

Static Pressure	74 PSI
Residual Pressure (1)	62 PSI
Residual Pressure (2)	50 PSI
Residual Pressure (3)	

Co efficient value	0.9

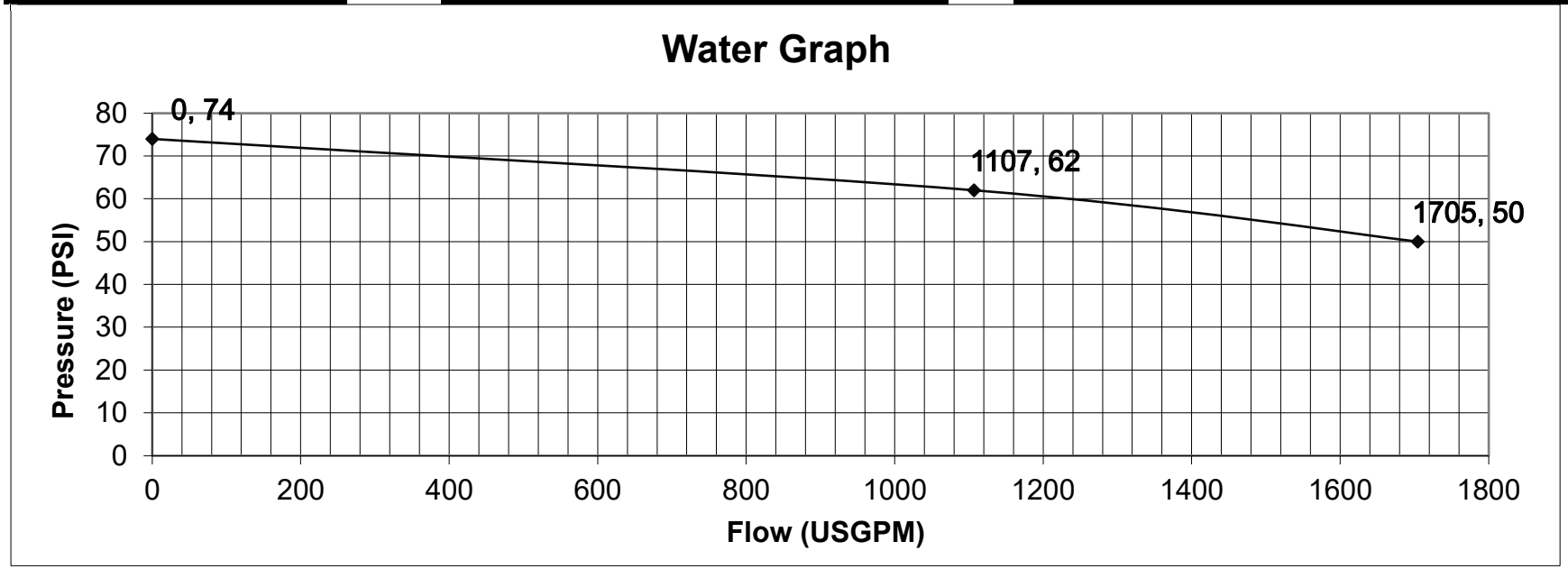
Pitot Reading (1)	43.5 PSI
Outlet Size (1)	2.5 inches
Pitot Reading (2)	25.8 PSI
	25.8 PSI
Outlet Size (2)	2.5 inches
Pitot Reading (3)	
Outlet Size (3)	
Flow 1 Calculated	
	1107 USGPM
Flow 2 Calculated	
	1705 USGPM
Flow 3 Calculated	
	0.00

# of Outlets Flowed (1)	1
# of Outlets Flowed (2)	2
# of Outlets Flowed (3)	0

Graph Data:

Pressure Values (y-axis)	Flow Values (x-axis)
74	0
62	1107
50	1705

Time of Test :	10:00 AM
05-Oct-21	
Performed by:	SRM & Tye



APPENDIX D: Storm Sewer Calculations

STORM DESIGN SHEET

File: *132405*
Calc'd by: *TC*
Date: *25-Oct-21*
Chk'd by: *KC*

720 Erbsville Road (Internal)
CITY OF WATERLOO
5-year Storm

I=A/(Tc+B)^C
A= *1755* mm/hr
B= *12.347*
C= *0.895*
Ti= *10*

k= *0.00277*
n= *0.024* CSP
n= *0.013* Conc./PVC
Pipe Velocities: *0.75* m/s min.
6.00 m/s max.

Location				Incremental Area			Accum.	Concentration Time					Proposed Sewer							Invert	Invert	T/G	T/G	Cover	Cover
From Area	Catchment No.	From MH	To MH	Area (ha)	"C" Blended	"AC"	"AC"	Inlet	In Pipe	Total	"I" (mm/hr)	Q=kACi (m³/s)	Length (m)	Diameter (mm)	Slope (%)	Capacity (m³/s)	Full Velocity (m/s)	Actual Velocity (m/s)	Gen. Flow/ Pipe Cap.	U/S	D/S	U/S	D/S	U/S	D/S
Street B	6	CBMH13	CBMH11	0.266	0.80	0.213	0.213	10.000	0.332	10.332	108.824	0.064	22.36	375	0.50	0.124	1.123	1.123	**52%**	350.58	350.47	352.76	351.30	2.56	1.20
Street B	7	CBMH11	DCBMH10	0.122	0.80	0.098	0.098	10.332	0.755	11.087	107.397	0.029	50.86	375	0.50	0.124	1.123	0.876	**23%**	350.44	350.19	351.30	352.27	1.24	2.45
Street B	8	DCBMH10	CBMH8	0.353	0.80	0.282	0.282	11.087	1.017	12.104	104.295	0.081	68.49	375	0.50	0.124	1.123	1.201	**66%**	350.16	349.82	352.27	351.40	2.48	1.95
Street B	9	CBMH8	DCBMH7	0.279	0.80	0.223	0.505	12.104	0.856	12.960	100.404	0.141	65.10	450	0.50	0.202	1.268	1.375	**70%**	349.75	349.42	351.40	351.76	2.10	2.79
Street B	10	DCBMH7	CBMH5	0.398	0.80	0.319	0.824	12.960	0.323	13.283	97.359	0.222	27.23	525	0.50	0.304	1.405	1.545	**73%**	349.39	349.25	351.76	351.60	2.90	2.88
Street A	1	CBMH1	CBMH2	0.119	0.80	0.095	0.095	10.000	1.282	11.282	108.824	0.029	74.38	300	0.50	0.068	0.967	0.909	**42%**	350.81	350.07	352.94	352.65	2.43	2.88
Street A	2	CBMH2	CBMH3	0.247	0.80	0.197	0.292	11.282	0.945	12.227	103.527	0.084	63.65	375	0.50	0.124	1.123	1.207	**68%**	350.04	349.77	352.65	351.90	2.98	2.51
Street A	3	CBMH3	CBMH4	0.202	0.80	0.162	0.454	12.227	0.736	12.962	99.956	0.126	55.94	450	0.50	0.202	1.268	1.344	**62%**	349.74	349.52	351.90	352.70	2.61	3.63
Street A	4	CBMH4	CBMH5	0.131	0.80	0.104	0.558	12.962	0.679	13.641	97.352	0.151	57.26	525	0.50	0.304	1.405	1.391	**50%**	349.49	349.20	352.70	351.60	3.73	2.93
Street A to SWM Pond	5+11	CBMH5	HW6A	0.357	0.80	0.286	1.668	13.641	0.303	13.945	95.071	0.439	30.22	675	0.50	0.594	1.661	1.827	**74%**	349.15	349.00				

APPENDIX E: SWM Modelling Output

132405 - Erbsville East Development, City of Waterloo
Preliminary Stormwater Management Pond Stage-Storage-Discharge Relationship

Orifice # 1 (Minor Quantity Control)

Orifice Invert =	349.00	m
Orifice Radius =	0.038	m
Orifice Diameter =	75	mm
Orifice Centreline =	349.000	m
Orifice Coefficient =	0.6	
Opening Area =	0.0044	m^2

Orifice # 2 (Minor/Major Quantity Control)

Orifice Invert =	348.90	m
Orifice Radius =	0.075	m
Orifice Diameter =	150	mm
Orifice Centreline =	348.900	m
Orifice Coefficient =	0.6	
Opening Area =	0.0177	m^2

Overflow Weir (Major Quantity Control)

Weir Crest Elevation =	350.45	m
Weir Length =	5.00	m
Weir Coefficient =	1.6	

Orifice equation: $Q = C_o \times A \times (2 \times g \times h)^{0.5}$

Weir equation: $Q = C_w \times L \times H^{1.5}$

where:

A = orifice area (m^2)
g = 9.806 m/s^2
h = head above c/l of orifice (m)
L = weir length (m)
H = head above weir crest (m)

Active Depth (m)	Elevation (m)	Description	Orifice #1 Flow (m^3/s)	Orifice #2 Flow (m^3/s)	Weir Flow (m^3/s)	Total Flow (m^3/s)	Total Storage (m^3)	Active Storage (m^3)	Detention (hours)
0.00	349.00	Pond Invert	0.0000	0.0000	0.0000	0.0000	0	0	0.0
0.05	349.05	Orifice #1 Operates	0.0026	0.0000	0.0000	0.0026	123	123	26.0
0.10	349.10		0.0037	0.0000	0.0000	0.0037	202	202	32.9
0.15	349.15		0.0045	0.0000	0.0000	0.0045	305	305	39.9
0.20	349.20		0.0052	0.0000	0.0000	0.0052	405	405	45.6
0.25	349.25		0.0059	0.0000	0.0000	0.0059	457	457	48.2
0.30	349.30		0.0064	0.0000	0.0000	0.0064	511	511	50.6
0.35	349.35		0.0069	0.0000	0.0000	0.0069	566	566	52.9
0.40	349.40		0.0074	0.0000	0.0000	0.0074	623	623	55.1
0.45	349.45		0.0079	0.0000	0.0000	0.0079	681	681	57.2
0.50	349.50		0.0083	0.0000	0.0000	0.0083	741	741	59.2
0.55	349.55		0.0087	0.0000	0.0000	0.0087	802	802	61.2
0.60	349.60		0.0091	0.0000	0.0000	0.0091	865	865	63.2
0.65	349.65	Erosion Control Storage	0.0000	0.0407	0.0000	0.0407	930	930	63.9
0.70	349.70	Orifice # 2 Controls	0.0000	0.0420	0.0000	0.0420	996	996	64.4
0.75	349.75		0.0000	0.0433	0.0000	0.0433	1063	1063	64.8
0.80	349.80		0.0000	0.0445	0.0000	0.0445	1133	1133	65.2
0.85	349.85		0.0000	0.0458	0.0000	0.0458	1204	1204	65.7
0.90	349.90		0.0000	0.0470	0.0000	0.0470	1277	1277	66.1
0.95	349.95		0.0000	0.0481	0.0000	0.0481	1351	1351	66.5
1.00	350.00		0.0000	0.0492	0.0000	0.0492	1428	1428	67.0
1.05	350.05		0.0000	0.0504	0.0000	0.0504	1506	1506	67.4
1.10	350.10		0.0000	0.0514	0.0000	0.0514	1585	1585	67.9
1.15	350.15		0.0000	0.0525	0.0000	0.0525	1667	1667	68.3
1.20	350.20		0.0000	0.0535	0.0000	0.0535	1750	1750	68.7
1.25	350.25		0.0000	0.0546	0.0000	0.0546	1835	1835	69.2
1.30	350.30		0.0000	0.0556	0.0000	0.0556	1923	1923	69.6
1.35	350.35		0.0000	0.0565	0.0000	0.0565	2011	2011	70.0
1.40	350.40		0.0000	0.0575	0.0000	0.0575	2102	2102	70.5
1.45	350.45	Spill Elevation	0.0000	0.0585	0.0000	0.0585	2195	2195	70.9
1.50	350.50		0.0000	0.0594	0.0894	0.1488	2289	2289	71.2

```
================================================================================================================
=====

       V    V   I    SSSSS  U   U    A    L
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
```

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***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 5.0\VO2\voin.dat

Output filename:
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DATE: 10-26-2021 TIME: 04:44:43

USER:

COMMENTS: _____

****
** SIMULATION : 2 Year Waterloo **
****

| CHICAGO STORM |
| Ptotal= 32.39 mm |

IDF curve parameters: A=1101.000
B= 9.258
C= 0.882
used in: INTENSITY = A / (t + B)^C

Duration of storm = 3.00 hrs
Storm time step = 5.00 min
Time to peak ratio = 0.40

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.08	1.97	0.83	7.99	1.58	9.38	2.33	2.81
0.17	2.15	0.92	11.43	1.67	7.56	2.42	2.60
0.25	2.37	1.00	18.89	1.75	6.30	2.50	2.41
0.33	2.65	1.08	42.64	1.83	5.38	2.58	2.26
0.42	2.99	1.17	105.66	1.92	4.68	2.67	2.12
0.50	3.44	1.25	49.25	2.00	4.14	2.75	1.99
0.58	4.03	1.33	26.13	2.08	3.70	2.83	1.88
0.67	4.85	1.42	16.91	2.17	3.35	2.92	1.79

```
                0.75    6.06 |  1.50   12.18 |  2.25    3.06 |  3.00    1.70


--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0201)|   Area    (ha)=   2.81
|ID= 1 DT= 5.0 min |   Total Imp(%)=  70.00   Dir. Conn.(%)=  70.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.97         0.84
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     136.89        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     105.66        15.47
               over (min)          5.00        10.00
     Storage Coeff.  (min)=       3.02 (ii)    7.94 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.28         0.13
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.51         0.02          0.519 (iii)
     TIME TO PEAK    (hrs)=       1.17         1.33           1.17
     RUNOFF VOLUME    (mm)=      31.39         6.34          23.88
     TOTAL RAINFALL   (mm)=      32.39        32.39          32.39
     RUNOFF COEFFICIENT   =       0.97         0.20           0.74

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  68.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0301)|
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.0445      0.1133
                          0.0037     0.0202   |   0.0470      0.1277
                          0.0052     0.0405   |   0.0492      0.1428
                          0.0064     0.0511   |   0.0514      0.1585
                          0.0074     0.0623   |   0.0535      0.1750
                          0.0083     0.0741   |   0.0556      0.1922
                          0.0091     0.0865   |   0.0575      0.2102
                          0.0420     0.0996   |   0.1488      0.2289

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0201)     2.811      0.519      1.17      23.88
   OUTFLOW: ID= 1 (  0301)     2.811      0.007      3.00      23.39

                 PEAK   FLOW   REDUCTION [Qout/Qin](%)=  1.43
                 TIME SHIFT OF PEAK FLOW         (min)=110.00
                 MAXIMUM  STORAGE   USED       (ha.m.)=  0.0621

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0202)|   Area    (ha)=   0.42
|ID= 1 DT= 5.0 min |   Total Imp(%)=  40.00   Dir. Conn.(%)=  40.00
--------------------
```

		IMPERVIOUS	PERVIOUS (i)	
Surface Area	(ha)=	0.17	0.25	
Dep. Storage	(mm)=	1.00	1.50	
Average Slope	(%)=	1.00	2.00	
Length	(m)=	52.98	40.00	
Mannings n	=	0.013	0.250	
Max.Eff.Inten.(mm/hr)	=	105.66	10.87	
over (min)		5.00	20.00	
Storage Coeff.	(min)=	1.71 (ii)	18.85 (ii)	
Unit Hyd. Tpeak	(min)=	5.00	20.00	
Unit Hyd. peak	(cms)=	0.32	0.06	
				TOTALS
PEAK FLOW	(cms)=	0.05	0.00	0.049 (iii)
TIME TO PEAK	(hrs)=	1.17	1.50	1.17
RUNOFF VOLUME	(mm)=	31.39	6.34	16.34
TOTAL RAINFALL	(mm)=	32.39	32.39	32.39
RUNOFF COEFFICIENT	=	0.97	0.20	0.50

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 68.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

RESERVOIR(0004)				
IN= 2---> OUT= 1				
DT= 5.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	0.0000	0.0000	0.0003	0.0250
	0.0002	0.0125	0.0000	0.0000

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0202)	0.421	0.049	1.17	16.34
OUTFLOW: ID= 1 (0004)	0.421	0.000	3.67	0.22

PEAK FLOW REDUCTION [Qout/Qin](%)= 0.22
TIME SHIFT OF PEAK FLOW (min)=150.00
MAXIMUM STORAGE USED (ha.m.)= 0.0068

```
================================================================================================================
=====

       V    V   I    SSSSS  U   U    A    L
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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b78d-5f22117ee29b\


DATE: 10-26-2021                          TIME: 04:44:43

USER:



COMMENTS: _____________________________________________________________


---------------------------------------------------------------------------------------------------------------
-----
  ***********************************************
  ** SIMULATION : 5 Year Waterloo               **
  ***********************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1755.000
| Ptotal= 47.53 mm |                          B=  12.347
--------------------                          C=   0.895
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  =  3.00 hrs
                       Storm time step    =  5.00 min
                       Time to peak ratio =  0.40

                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.08    2.93 |  0.83   12.74 |  1.58   14.99 |  2.33    4.29
                0.17    3.23 |  0.92   18.26 |  1.67   12.05 |  2.42    3.94
                0.25    3.58 |  1.00   29.81 |  1.75    9.99 |  2.50    3.65
                0.33    4.03 |  1.08   62.98 |  1.83    8.49 |  2.58    3.40
                0.42    4.58 |  1.17  136.51 |  1.92    7.35 |  2.67    3.17
                0.50    5.31 |  1.25   71.84 |  2.00    6.46 |  2.75    2.98
                0.58    6.27 |  1.33   40.53 |  2.08    5.75 |  2.83    2.80
                0.67    7.62 |  1.42   26.82 |  2.17    5.17 |  2.92    2.65
```

```
                0.75    9.60 |  1.50   19.46 |  2.25    4.69 |  3.00    2.51


--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0201)|   Area    (ha)=   2.81
|ID= 1 DT= 5.0 min |   Total Imp(%)=  70.00   Dir. Conn.(%)=  70.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.97         0.84
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     136.89        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     136.51        28.98
               over (min)        5.00        10.00
     Storage Coeff.  (min)=       2.72 (ii)    7.16 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.29         0.14
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.68         0.05          0.704 (iii)
     TIME TO PEAK    (hrs)=       1.17         1.25           1.17
     RUNOFF VOLUME    (mm)=      46.53        12.80          36.41
     TOTAL RAINFALL   (mm)=      47.53        47.53          47.53
     RUNOFF COEFFICIENT   =       0.98         0.27           0.77

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  68.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0301)|
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.0445      0.1133
                          0.0037     0.0202   |   0.0470      0.1277
                          0.0052     0.0405   |   0.0492      0.1428
                          0.0064     0.0511   |   0.0514      0.1585
                          0.0074     0.0623   |   0.0535      0.1750
                          0.0083     0.0741   |   0.0556      0.1922
                          0.0091     0.0865   |   0.0575      0.2102
                          0.0420     0.0996   |   0.1488      0.2289

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0201)     2.811      0.704      1.17      36.41
   OUTFLOW: ID= 1 (  0301)     2.811      0.020      2.67      35.92

                 PEAK   FLOW   REDUCTION [Qout/Qin](%)=  3.13
                 TIME SHIFT OF PEAK FLOW         (min)= 90.00
                 MAXIMUM  STORAGE   USED       (ha.m.)=  0.0916

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0202)|   Area    (ha)=   0.42
|ID= 1 DT= 5.0 min |   Total Imp(%)=  40.00   Dir. Conn.(%)=  40.00
--------------------
```

		IMPERVIOUS	PERVIOUS (i)	
Surface Area	(ha)=	0.17	0.25	
Dep. Storage	(mm)=	1.00	1.50	
Average Slope	(%)=	1.00	2.00	
Length	(m)=	52.98	40.00	
Mannings n	=	0.013	0.250	
Max.Eff.Inten.(mm/hr)	=	136.51	24.40	
over	(min)	5.00	15.00	
Storage Coeff.	(min)=	1.54 (ii)	13.95 (ii)	
Unit Hyd. Tpeak	(min)=	5.00	15.00	
Unit Hyd. peak	(cms)=	0.33	0.08	
				TOTALS
PEAK FLOW	(cms)=	0.06	0.01	0.066 (iii)
TIME TO PEAK	(hrs)=	1.17	1.42	1.17
RUNOFF VOLUME	(mm)=	46.53	12.80	26.27
TOTAL RAINFALL	(mm)=	47.53	47.53	47.53
RUNOFF COEFFICIENT	=	0.98	0.27	0.55

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 68.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

RESERVOIR(0004)				
IN= 2---> OUT= 1				
DT= 5.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	0.0000	0.0000	0.0003	0.0250
	0.0002	0.0125	0.0000	0.0000

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0202)	0.421	0.066	1.17	26.27
OUTFLOW: ID= 1 (0004)	0.421	0.000	3.50	0.34

PEAK FLOW REDUCTION [Qout/Qin](%)= 0.26
TIME SHIFT OF PEAK FLOW (min)=140.00
MAXIMUM STORAGE USED (ha.m.)= 0.0109

```
================================================================================================================
=====

       V    V   I    SSSSS  U   U    A    L
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
```

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Input filename: C:\Program Files (x86)\Visual OTTHYMO 5.0\VO2\voin.dat

Output filename:
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DATE: 10-26-2021 TIME: 04:44:43

USER:

COMMENTS: _____

****
** SIMULATION : 25 Year Waterloo **
****

| CHICAGO STORM |
| Ptotal= 69.15 mm |

IDF curve parameters: A=3261.000
B= 16.193
C= 0.938
used in: INTENSITY = A / (t + B)^C

Duration of storm = 3.00 hrs
Storm time step = 5.00 min
Time to peak ratio = 0.40

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.08	3.74	0.83	19.39	1.58	23.04	2.33	5.81
0.17	4.18	0.92	28.29	1.67	18.28	2.42	5.28
0.25	4.73	1.00	46.36	1.75	14.95	2.50	4.83
0.33	5.41	1.08	94.14	1.83	12.51	2.58	4.44
0.42	6.27	1.17	185.94	1.92	10.67	2.67	4.10
0.50	7.41	1.25	106.41	2.00	9.24	2.75	3.81
0.58	8.94	1.33	62.56	2.08	8.10	2.83	3.55
0.67	11.11	1.42	41.78	2.17	7.19	2.92	3.32

0.75	14.31	1.50	30.20	2.25	6.43	3.00	3.12

CALIB					
STANDHYD (0201)	Area (ha)= 2.81				
ID= 1 DT= 5.0 min	Total Imp(%)= 70.00	Dir. Conn.(%)= 70.00			

		IMPERVIOUS	PERVIOUS (i)	
Surface Area	(ha)=	1.97	0.84	
Dep. Storage	(mm)=	1.00	1.50	
Average Slope	(%)=	1.00	2.00	
Length	(m)=	136.89	40.00	
Mannings n	=	0.013	0.250	
Max.Eff.Inten.(mm/hr)=		185.94	54.47	
over (min)		5.00	10.00	
Storage Coeff.	(min)=	2.41 (ii)	6.33 (ii)	
Unit Hyd. Tpeak	(min)=	5.00	10.00	
Unit Hyd. peak	(cms)=	0.30	0.15	
				TOTALS
PEAK FLOW	(cms)=	0.95	0.10	1.005 (iii)
TIME TO PEAK	(hrs)=	1.17	1.25	1.17
RUNOFF VOLUME	(mm)=	68.15	24.45	55.04
TOTAL RAINFALL	(mm)=	69.15	69.15	69.15
RUNOFF COEFFICIENT	=	0.99	0.35	0.80

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 68.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

RESERVOIR(0301)				
IN= 2---> OUT= 1				
DT= 5.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	0.0000	0.0000	0.0445	0.1133
	0.0037	0.0202	0.0470	0.1277
	0.0052	0.0405	0.0492	0.1428
	0.0064	0.0511	0.0514	0.1585
	0.0074	0.0623	0.0535	0.1750
	0.0083	0.0741	0.0556	0.1922
	0.0091	0.0865	0.0575	0.2102
	0.0420	0.0996	0.1488	0.2289

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0201)	2.811	1.005	1.17	55.04
OUTFLOW: ID= 1 (0301)	2.811	0.047	2.25	54.55

PEAK FLOW REDUCTION [Qout/Qin](%)= 4.69
TIME SHIFT OF PEAK FLOW (min)= 65.00
MAXIMUM STORAGE USED (ha.m.)= 0.1291

CALIB			
STANDHYD (0202)	Area (ha)= 0.42		
ID= 1 DT= 5.0 min	Total Imp(%)= 40.00	Dir. Conn.(%)= 40.00	

		IMPERVIOUS	PERVIOUS (i)	
Surface Area	(ha)=	0.17	0.25	
Dep. Storage	(mm)=	1.00	1.50	
Average Slope	(%)=	1.00	2.00	
Length	(m)=	52.98	40.00	
Mannings n	=	0.013	0.250	
Max.Eff.Inten.(mm/hr)	=	185.94	54.47	
over (min)		5.00	15.00	
Storage Coeff.	(min)=	1.36 (ii)	10.36 (ii)	
Unit Hyd. Tpeak	(min)=	5.00	15.00	
Unit Hyd. peak	(cms)=	0.33	0.09	
				TOTALS
PEAK FLOW	(cms)=	0.09	0.02	0.094 (iii)
TIME TO PEAK	(hrs)=	1.17	1.42	1.17
RUNOFF VOLUME	(mm)=	68.15	24.45	41.91
TOTAL RAINFALL	(mm)=	69.15	69.15	69.15
RUNOFF COEFFICIENT	=	0.99	0.35	0.61

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 68.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

RESERVOIR(0004)				
IN= 2---> OUT= 1				
DT= 5.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	0.0000	0.0000	0.0003	0.0250
	0.0002	0.0125	0.0000	0.0000

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0202)	0.421	0.094	1.17	41.91
OUTFLOW: ID= 1 (0004)	0.421	0.000	3.42	0.47

PEAK FLOW REDUCTION [Qout/Qin](%)= 0.25
TIME SHIFT OF PEAK FLOW (min)=135.00
MAXIMUM STORAGE USED (ha.m.)= 0.0175

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================================================================================================================
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       V    V   I    SSSSS  U   U    A    L
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                  *****  D E T A I L E D   O U T P U T *****


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  Output  filename:
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81eb-12e2138688af\


DATE: 10-26-2021                          TIME: 04:44:43

USER:



COMMENTS: _____________________________________________________________


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  ***********************************************
  ** SIMULATION : 100 Year Waterloo             **
  ***********************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A=4692.000
| Ptotal= 89.93 mm |                          B=  17.437
--------------------                          C=   0.956
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  =  3.00 hrs
                       Storm time step    =  5.00 min
                       Time to peak ratio =  0.40

                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.08    4.53 |  0.83   25.42 |  1.58   30.32 |  2.33    7.23
                0.17    5.11 |  0.92   37.36 |  1.67   23.93 |  2.42    6.54
                0.25    5.82 |  1.00   61.48 |  1.75   19.44 |  2.50    5.95
                0.33    6.71 |  1.08  123.92 |  1.83   16.17 |  2.58    5.44
                0.42    7.85 |  1.17  239.79 |  1.92   13.70 |  2.67    5.00
                0.50    9.35 |  1.25  139.80 |  2.00   11.79 |  2.75    4.62
                0.58   11.40 |  1.33   82.91 |  2.08   10.28 |  2.83    4.28
                0.67   14.29 |  1.42   55.40 |  2.17    9.06 |  2.92    3.99
```

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                0.75   18.59 |  1.50   39.93 |  2.25    8.06 |  3.00    3.72


--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0201)|   Area    (ha)=   2.81
|ID= 1 DT= 5.0 min |   Total Imp(%)=  70.00   Dir. Conn.(%)=  70.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.97         0.84
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     136.89        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     239.79        84.82
               over (min)          5.00        10.00
     Storage Coeff.  (min)=       2.17 (ii)    5.72 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.31         0.15
                                                          *TOTALS*
     PEAK FLOW       (cms)=       1.24         0.16          1.338 (iii)
     TIME TO PEAK    (hrs)=       1.17         1.25           1.17
     RUNOFF VOLUME    (mm)=      88.93        37.60          73.53
     TOTAL RAINFALL   (mm)=      89.93        89.93          89.93
     RUNOFF COEFFICIENT   =       0.99         0.42           0.82

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  68.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0301)|
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.0445      0.1133
                          0.0037     0.0202   |   0.0470      0.1277
                          0.0052     0.0405   |   0.0492      0.1428
                          0.0064     0.0511   |   0.0514      0.1585
                          0.0074     0.0623   |   0.0535      0.1750
                          0.0083     0.0741   |   0.0556      0.1922
                          0.0091     0.0865   |   0.0575      0.2102
                          0.0420     0.0996   |   0.1488      0.2289

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0201)     2.811      1.338      1.17      73.53
   OUTFLOW: ID= 1 (  0301)     2.811      0.054      2.33      73.04

                 PEAK   FLOW   REDUCTION [Qout/Qin](%)=  4.00
                 TIME SHIFT OF PEAK FLOW         (min)= 70.00
                 MAXIMUM  STORAGE   USED       (ha.m.)=  0.1753

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0202)|   Area    (ha)=   0.42
|ID= 1 DT= 5.0 min |   Total Imp(%)=  40.00   Dir. Conn.(%)=  40.00
--------------------
```

		IMPERVIOUS	PERVIOUS (i)	
Surface Area	(ha)=	0.17	0.25	
Dep. Storage	(mm)=	1.00	1.50	
Average Slope	(%)=	1.00	2.00	
Length	(m)=	52.98	40.00	
Mannings n	=	0.013	0.250	
Max.Eff.Inten.(mm/hr)	=	239.79	84.82	
over (min)		5.00	10.00	
Storage Coeff.	(min)=	1.23 (ii)	8.77 (ii)	
Unit Hyd. Tpeak	(min)=	5.00	10.00	
Unit Hyd. peak	(cms)=	0.33	0.12	
				TOTALS
PEAK FLOW	(cms)=	0.11	0.04	0.134 (iii)
TIME TO PEAK	(hrs)=	1.17	1.33	1.17
RUNOFF VOLUME	(mm)=	88.93	37.60	58.12
TOTAL RAINFALL	(mm)=	89.93	89.93	89.93
RUNOFF COEFFICIENT	=	0.99	0.42	0.65

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 68.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

RESERVOIR(0004)				
IN= 2---> OUT= 1				
DT= 5.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	0.0000	0.0000	0.0003	0.0250
	0.0002	0.0125	0.0000	0.0000

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0202)	0.421	0.134	1.17	58.12
OUTFLOW: ID= 1 (0004)	0.421	0.000	3.33	12.16

PEAK FLOW REDUCTION [Qout/Qin](%)= 0.22
TIME SHIFT OF PEAK FLOW (min)=130.00
MAXIMUM STORAGE USED (ha.m.)= 0.0242

FINISH

==========

Stormceptor®

FORTERRA

Stormceptor® EF Sizing Report

STORMCEPTOR®
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

10/27/2021

Province:	Ontario
City:	Waterloo
Nearest Rainfall Station:	WATERLOO WELLINGTON AP
Climate Station Id:	6149387
Years of Rainfall Data:	34

Site Name:	Erbsville East
Drainage Area (ha):	2.81
% Imperviousness:	70.00

Runoff Coefficient 'c': 0.72

Particle Size Distribution:	Fine
Target TSS Removal (%):	80.0

Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	80.54
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	No
Peak Conveyance (maximum) Flow Rate (L/s):	
Site Sediment Transport Rate (kg/ha/yr):	

Project Name:	Erbsville East
Project Number:	132405
Designer Name:	Andy Kroess
Designer Company:	IBI Group
Designer Email:	andy.kroess@ibigroup.com
Designer Phone:	519-585-2255
EOR Name:	
EOR Company:	
EOR Email:	
EOR Phone:	

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	44
EFO6	59
EFO8	68
EFO10	75
EFO12	80

Recommended Stormceptor EFO Model: EFO12

Estimated Net Annual Sediment (TSS) Load Reduction (%): 80

Water Quality Runoff Volume Capture (%): > 90

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THIRD-PARTY TESTING AND VERIFICATION

►**Stormceptor® EF and Stormceptor® EFO** are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

PERFORMANCE

►**Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterwavs.

PARTICLE SIZE DISTRIBUTION (PSD)

►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

Particle Size (µm)	Percent Less Than	Particle Size Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

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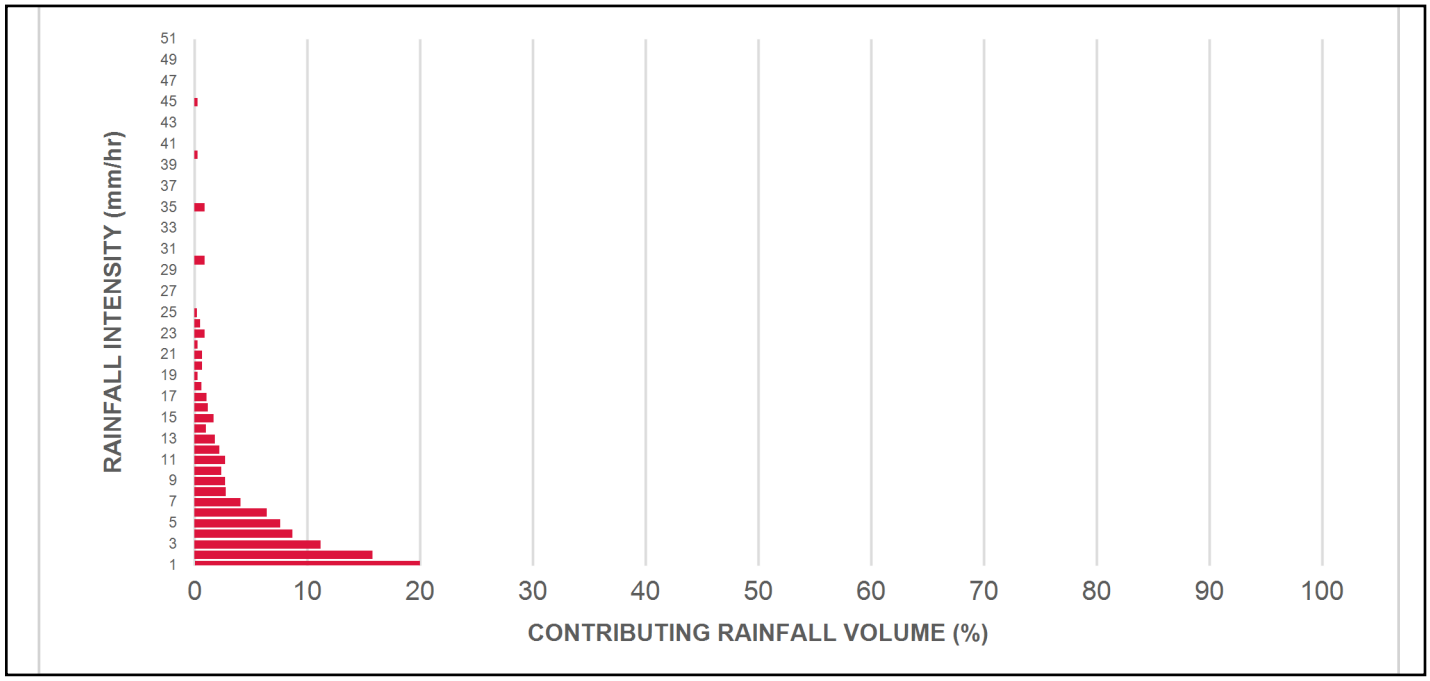
Stormceptor® EF Sizing Report

Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
1	20.0	20.0	5.62	337.0	32.0	93	18.6	18.6
2	15.8	35.8	11.25	675.0	64.0	91	14.4	33.0
3	11.2	47.0	16.87	1012.0	96.0	88	9.8	42.8
4	8.7	55.7	22.50	1350.0	129.0	85	7.4	50.2
5	7.6	63.3	28.12	1687.0	161.0	80	6.1	56.3
6	6.4	69.7	33.75	2025.0	193.0	77	5.0	61.2
7	4.1	73.8	39.37	2362.0	225.0	74	3.1	64.3
8	2.8	76.7	45.00	2700.0	257.0	72	2.0	66.3
9	2.7	79.4	50.62	3037.0	289.0	68	1.8	68.2
10	2.4	81.7	56.24	3375.0	321.0	65	1.5	69.7
11	2.7	84.5	61.87	3712.0	354.0	63	1.7	71.4
12	2.2	86.7	67.49	4050.0	386.0	60	1.3	72.7
13	1.8	88.4	73.12	4387.0	418.0	58	1.0	73.7
14	1.0	89.5	78.74	4725.0	450.0	57	0.6	74.3
15	1.7	91.2	84.37	5062.0	482.0	56	1.0	75.3
16	1.2	92.3	89.99	5400.0	514.0	55	0.6	75.9
17	1.1	93.5	95.62	5737.0	546.0	54	0.6	76.5
18	0.6	94.1	101.24	6074.0	579.0	53	0.3	76.8
19	0.3	94.3	106.87	6412.0	611.0	52	0.1	77.0
20	0.7	95.0	112.49	6749.0	643.0	52	0.4	77.3
21	0.7	95.7	118.11	7087.0	675.0	52	0.4	77.7
22	0.3	96.0	123.74	7424.0	707.0	52	0.2	77.8
23	0.9	96.9	129.36	7762.0	739.0	51	0.5	78.3
24	0.5	97.4	134.99	8099.0	771.0	51	0.2	78.6
25	0.2	97.6	140.61	8437.0	803.0	51	0.1	78.7
30	0.9	98.5	168.73	10124.0	964.0	50	0.5	79.1
35	0.9	99.4	196.86	11811.0	1125.0	49	0.4	79.6
40	0.3	99.7	224.98	13499.0	1286.0	47	0.1	79.7
45	0.3	100.0	253.10	15186.0	1446.0	45	0.1	79.8
50	0.0	100.0	281.22	16873.0	1607.0	40	0.0	79.8
Estimated Net Annual Sediment (TSS) Load Reduction =								**80 %**

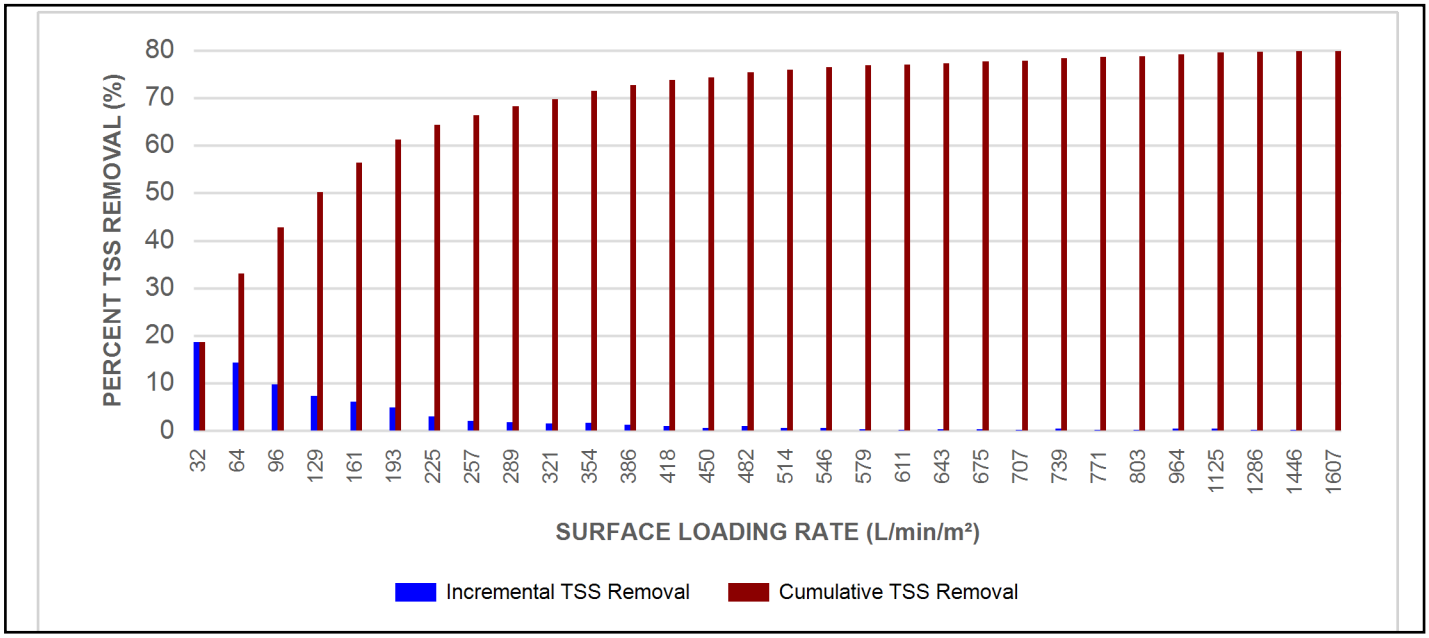
Climate Station ID: 6149387 *Years of Rainfall Data*: 34

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RAINFALL DATA FROM WATERLOO WELLINGTON AP RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



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Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter		Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter		Max Outlet Pipe Diameter		Peak Conveyance Flow Rate	
	(m)	(ft)		(mm)	(in)	(mm)	(in)	(L/s)	(cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

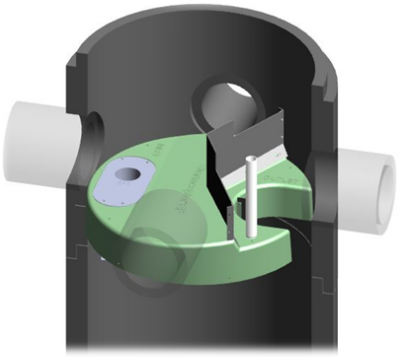
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

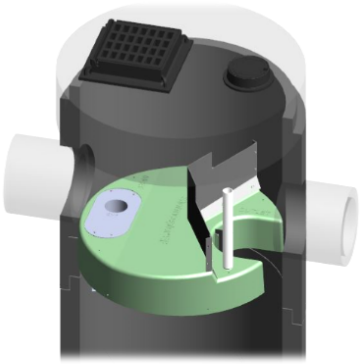
DESIGN FLEXIBILITY

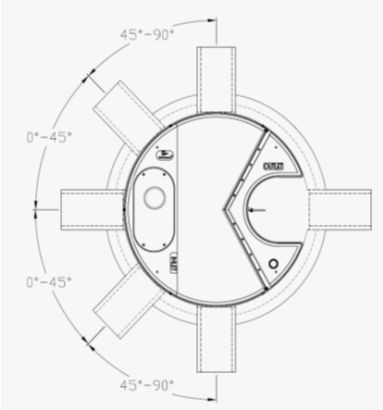
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

►While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.







INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.

0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.

45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft^3)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity

** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft^3)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

For specifications, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD PERFORMANCE SPECIFICATION FOR "OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

2.1.1	4 ft (1219 mm) Diameter OGS Units:	1.19 m^3 sediment / 265 L oil
	6 ft (1829 mm) Diameter OGS Units:	3.48 m^3 sediment / 609 L oil
	8 ft (2438 mm) Diameter OGS Units:	8.78 m^3 sediment / 1,071 L oil
	10 ft (3048 mm) Diameter OGS Units:	17.78 m^3 sediment / 1,673 L oil
	12 ft (3657 mm) Diameter OGS Units:	31.23 m^3 sediment / 2,476 L oil

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall

remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing shall be determined using historical rainfall data and a sediment removal performance curve derived from the actual third-party verified laboratory testing data. The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

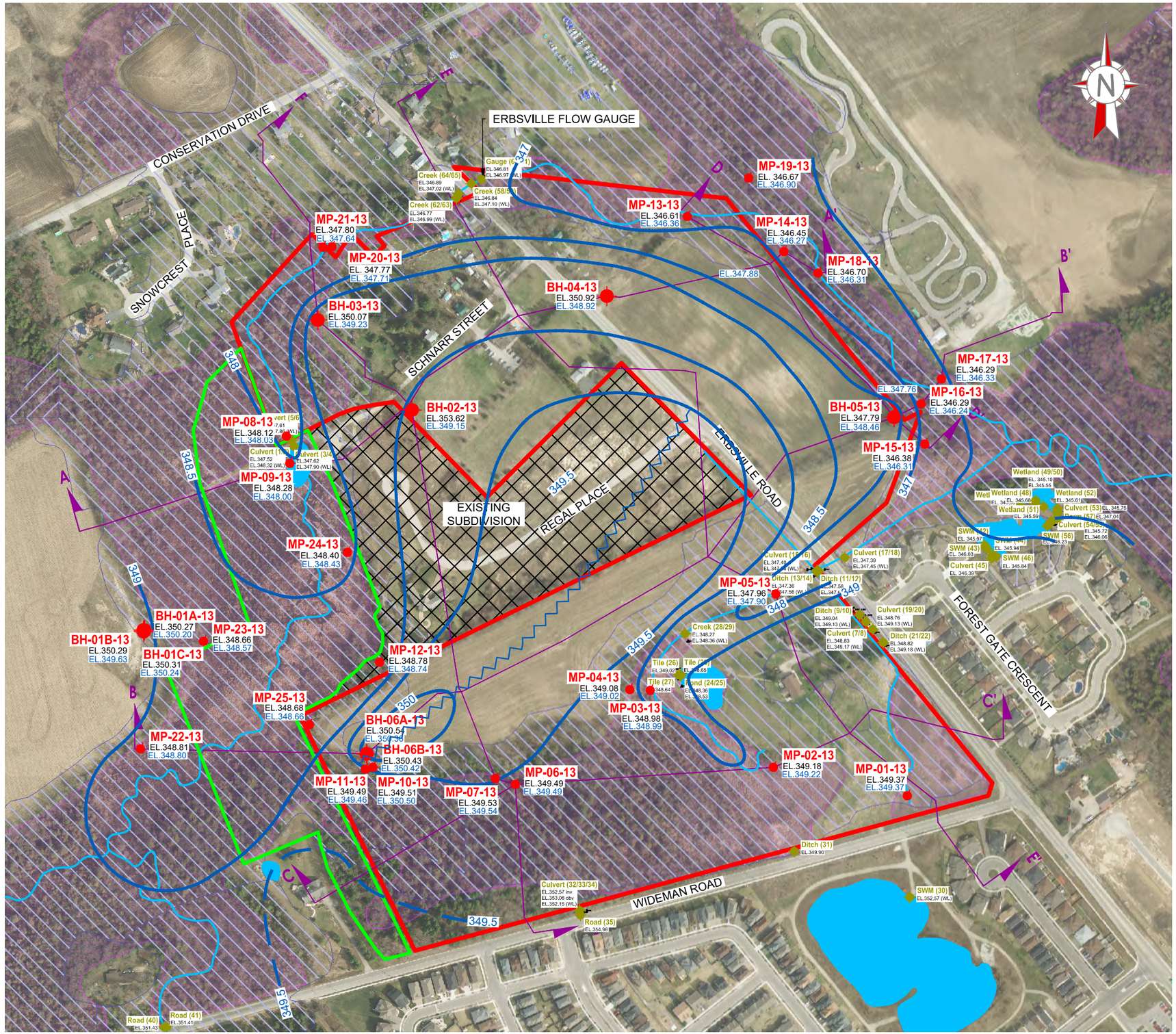
The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m2 to 2600 L/min/m2) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.



LEGEND :

- STUDY AREA
- EXTENDED STUDY AREA
- EXCLUDED STUDY AREA
- GRCA WETLANDS
- GRCA FLOODPLAIN
- BOREHOLE LOCATION Current Investigation
- SURFACE WATER ELEVATION (mASL) Current Investigation
- MINI PIEZOMETER LOCATION Current Investigation
- EL.356.54 GROUND SURFACE ELEVATION (mASL)
- GROUNDWATER CONTOURS Composite High
- EL.346.24 GROUNDWATER ELEVATION (mASL) Composite High
- GROUNDWATER DIVIDE

0 50 100 150 m

SCALE 1:4000

NOTES :
1-REFERENCES: GRAND RIVER CONSERVATION AUTHORITY, 2010 Aerial Photograph (2013).
2-REFERENCES: VARIOUS CONSULTANTS, North Waterloo Scoped Subwatershed Study, Figure 5.7, 2011-04.
2-Drawing scale may be distorted due to file conversion and/or copying. Measurements taken from the drawing must be verified in the field.

Project

Erbsville South Environmental Study

Erbsville Road and Wideman Road, Waterloo, Ontario

Title

GROUNDWATER CONTOURS
Composite High November 2013 to November 2014

LVM
353, Bridge Street East
Kitchener (Ontario) N2K 2Y5
Telephone : 519.741.1313
Fax : 519.741.5422

Prepared	A.Higgins	Discipline	HYDROGEOLOGY
Drawn	A.Higgins	Scale	1 : 4000
Checked	S.Meteer	Date	2015-06-11

Project manager: R.Zapata

Sequence no.: 09 of 15

M. dept.	Project	Disc.	Dwg no.	Rev.
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