



Dundee Secondary Plan Scoped Subwatershed Study Report (Draft Final)

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Executive Summary

The Dundee Secondary Plan Scoped Subwatershed Study establishes the environmental and technical foundation required to guide future development within the 460 hectare Dundee Study Area in south Kitchener. The area is situated on the Waterloo Moraine and drains into both Blair Creek and Cedar Creek, two sensitive coldwater systems that rely on stable groundwater recharge and support brook trout habitat. The purpose of the study is to document existing conditions required as a baseline for the development of the Dundee Secondary Plan, analyze the impacts of future land use scenarios, and provide management strategies and implementation recommendations.

Two land use scenarios, Scenario A and Scenario B, were developed and evaluated to determine the impacts related to hydrology, hydrogeology, and natural heritage features within the Study Area. Scenario A includes more parks and schools and results in lower imperviousness than Scenario B. Scenario A also results in slightly lower flows in Blair Creek, while Scenario B results in slightly higher groundwater recharge in Cedar Creek. Both scenarios lead to increases in runoff and reductions in recharge from the existing conditions.

Infrastructure planning for the Secondary Plan incorporates the Strasburg Road and Blair Creek Drive extensions, watermain extensions in Pressure Zones 4 and 5, and reliance on the Kitchener Wastewater Treatment Plant, which has a rated capacity of 122,700 m³/day and approximately 38,570 m³/day of available capacity to support growth. Stormwater management remains a defining constraint, as uncontrolled development would substantially increase runoff and reduce recharge, reinforcing the need for a water balance approach, including distributed infiltration, conveyance, and end-of-pipe controls.

The study emphasizes maintaining groundwater recharge, minimizing changes to runoff and peak flows, and protecting natural heritage features, supported through an Adaptive Management Approach involving monitoring before, during, and after development. Coordinated planning across land use, transportation, water, wastewater, and stormwater infrastructure is necessary to help achieve the subwatershed goal to maintain, restore, or enhance the health of the Blair Creek and Cedar Creek Subwatersheds.

The Scoped Subwatershed Study fulfills the requirements for Phase 1 of the subwatershed planning process and defines the land use scenarios. The Phase 2 requirements for impacts assessment and management alternatives will be further developed as part of the overall project and incorporated into the Environmental Study Report.

Management strategies and implementation recommendations have been identified in the individual Scoped Subwatershed Study supportive studies reports that accompany this report. Management strategies and implementation recommendations will be revised to reflect the identified preferred land use when it is selected.

Key impacts to the City and Regional drinking water and sanitary services from the development of the New Dundee Secondary planning area are taken, in the absence of a selected preferred land use scenario, as the average of scenarios A and B:

- In general, an additional water demand of 11,545 m³/day will be added to the existing water supply system. The distribution network will require an additional water storage capacity of 11,695 m³ for redundancy and fire protection. The study area can be serviced by existing Kitchener Pressure Zones 4 and 5, with potential looping of Zone 4 to Zone 2W and of Zones 4 and 5 via zoning valves.

- An additional daily average wastewater flow of 10,865 m³/d will be generated by the serviced population, and a peak flow of 415 L/s is estimated to be collected by the sewer system. Verification of these flows require delineation of catchment areas followed by hydraulic model updates.

These impacts should be considered in ongoing planning studies relevant to the study area, including:

- The IUS Supply Master Plan being undertaken by the Region of Waterloo.
- The Water and Wastewater Master Plan Update underway by the Region of Waterloo.
- The Kitchener Official Plan Update.

Additionally, the Dundee Secondary Plan area should be incorporated in the following future planning studies to determine the impact of future populations on water and wastewater infrastructure:

- Future updates to the City's Water Servicing Master Plan.
- Future updates to the City's Sanitary Servicing Master Plan.

Future traffic associated with the Dundee Secondary Plan should be considered in ongoing studies including:

- Region of Waterloo Transportation Master Plan Update.
- City of Kitchener Transportation Master Plan Update.
- City of Kitchener Active Transportation Master Plan Update.
- City of Kitchener Transportation Master Plan Update.
- 2025-2034 Grand River Transit Business Plan, as updated.

The hydrologic modelling results completed as part of the Scoped Subwatershed Study indicate that future development, in the absence of mitigation, would result in a significant shift in the local water balance and flow regime across the study area. These effects are most pronounced within the Blair Creek headwaters, where development affects a larger proportion of the contributing drainage area. Impacts within the Cedar Creek catchments are comparatively smaller and more localized due to the more limited extent of urbanization.

Given the loss of natural storage and infiltration associated with urban development, the hydrologic management objective should aim to:

- Limit increases in peak flows at key outlets to reduce flood and erosion risk;
- Moderate runoff from frequent storm events that influence channel stability; and
- Maintain groundwater recharge patterns, where feasible, to support baseflow contributions.

While pre-development conditions cannot be fully maintained, the magnitude and downstream implications of hydrologic change can be managed at the planning level.

Within the Blair Creek subwatershed, emphasis should be placed on managing frequent-event runoff and preserving recharge opportunities in headwater areas. In the Cedar Creek subwatershed, the focus should be on maintaining the existing low-runoff regime and preventing cumulative increases in downstream flows.

Increased sources of contaminants related to urbanization like salt/chlorides, fertilizers, and metals may enter the surface water and groundwater systems. The management approach should incorporate structural measures such as the implementation of stormwater management (SWM) measures (i.e. source, conveyance and End-of-Pipe controls) and non-structural measures, including salt reduction protocols and operation-and-maintenance measures such as street sweeping, Oil-and-Grit Separators (OGS) cleanouts, and park maintenance.

A draft Heritage Impact Assessment (HIA) has been prepared to assess the cultural heritage significance of properties and roadways within the designated study area. The finds indicate that the proposed Dundee Secondary Plan may influence several cultural heritage resources shown below:

- Reidel Drive, from approximately 400 metres north of its junction with New Dundee Road to Stauffer Drive;
- Stauffer Drive, spanning from 500 Stauffer Drive to its intersection with Caryndale Drive;
- The trail segment formerly part of Caryndale Drive extending to Tilt Drive;
- A farmhouse building located at 1878 New Dundee Road;
- A former school building, now a single detached home at 1970 Plains Road; and
- A farmstead complex at 500 Stauffer Drive.

The draft HIA details the potential impacts on each highlighted cultural heritage resources and provides a summary of recommendations. These include, but are not limited to:

- Selecting a land use scenario that preserves the cultural heritage value of identified resources;
- Maintaining an 18 metre natural buffer to visually screen new development from heritage corridors;
- Retaining existing lighting conditions in heritage areas, unless modifications are necessary for safety;
- Balancing public and private access along Reidel Drive;
- Ensuring vehicular access and context is maintained for the farmhouse building located at 1878 New Dundee Road and the former school building at 1970 Plains Road;
- Explore the feasibility of establishing a park near the farmhouse at 1878 New Dundee Road; and
- Limit or relocate the low-density residential land uses adjacent to 500 Stauffer Drive.

The characterization of the Blair Creek Subwatershed is greatly informed by the monitoring program that has been implemented within the subwatershed. This monitoring program was initiated in 1994. The Cedar Creek subwatershed environmental monitoring was initiated in 2015 ahead of the subwatershed study. Modifications to the Blair Creek and Cedar Creek Monitoring Programs to incorporate the Dundee Secondary Study Area have been made as part of this Scoped Subwatershed Study report. The proposed monitoring plan updates the existing Blair Creek and Cedar Creek Monitoring Programs to include the Dundee Secondary Plan Study Area pre-, during-, and post-development. The intent of the monitoring plan is to maintain the goals, objectives, and targets established in the existing monitoring programs for Blair Creek and Cedar Creek.

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Acronyms and abbreviations

Acronym	Definition
ADF	Average Daily Flow
AMA	adaptive management study
ANSI	Areas of Natural and Scientific Interest
ARA	Aquatic Resources Area
BBB Study	Blair, Bechtel, and Bauman Creeks Subwatershed Plan
BDT	Blair Drive Trunk
CEA	Cumulative Effects Monitoring
City	City of Kitchener
CWA	Clean Water Act
DDT	Doon Drive Trunk
DFO	Department of Fisheries and Oceans Canada
DGSMS	Design Guidelines and Supplemental Specifications for Municipal Services
DSP	Dundee Secondary Plan
DWS	drinking water system
ELC	Ecological Land Classification
ESA	Environmentally Significant Areas
ESPA	Environmentally Sensitive Policy Area
FDS	Functional Drainage Study
GAWSER	Guelph All-Weather Storm Event Runoff
GRCA	Grand River Conservation Authority
GRT	Grand River Transit
HIA	Heritage Impact Assessment
ICI	institutional, commercial and industrial
ICL	impervious cover limits
IUS	Integrated Urban System
KDM	Kitchener Development Manual

Acronym	Definition
LIO	Land Information Ontario
MECP	Ministry of Environment, Conservation and Parks
MNR	Ministry of Natural Resources
MNRP	Ministry of Natural Resources and Forestry
MUP	multi-use path
NHF	Natural Heritage Features
NHIC	Natural Heritage Information Centre
NHS	Natural Heritage System
NRSI	Natural Resources Solutions Inc.
OBBA	Ontario Breeding Bird Atlas
PPS	Provincial Planning Statement
PRV	pressure reducing valves
PSW	Provincially Significant Wetlands
PWQO	Provincial Water Quality Objectives
Region	Region of Waterloo
RGA	Rapid fluvial geomorphic assessment
RMW	Regional Municipality of Waterloo
ROPA 6	Regional Official Plan Amendment No. 6
RSAT	Rapid Stream Assessment Technique
SAR	Species at Risk
SARA	Species At Risk Act
SKPA	Southwest Kitchener Policy
SOW	State of Watershed
SPS	sanitary pumping station / Sewage Pumping Station
SST	South Strasburg Trunk
SWM	stormwater management
SWMF	Stormwater Management Facility

Acronym	Definition
The Act	The Planning Act
The Regional Official Plan	Regional Municipality of Waterloo Official Plan
TMP	Transportation Master Plan
TP	total phosphorus
TSS	total suspended solids
UBC	Upper Blair Creek
UBC SOW	Upper Blair Creek State of the Watershed
UCCSSWS	Upper Cedar Creek Scoped Subwatershed Study
UFW	unaccounted for water
WSDOMP	Water Supply and Distribution Optimization Master Plan
WWIS	Water Well Information System

1. Introduction

1.1 Document Purpose and Objectives

The purpose of this scoped subwatershed study report is to document the existing Study Area conditions required as a baseline for the development of the Dundee Secondary Plan (DSP), analyze the impacts of future land use scenarios, and provide management strategies and implementation recommendations.

The subwatershed future land use scenarios, impacts and recommendations put forward in this report have been developed to be consistent with those put forward in previous relevant studies completed within the watershed and the 2020 Upper Blair State of the Watershed Report.

1.2 Study Area

The Study Area for the Dundee Secondary Plan (Study Area) is shown in Figure 1-1. As per the April 11, 2023, Regional Official Plan Amendment No. 6 (ROPA 6), the lands known as the Dundee North lands and Southwest Kitchener Policy (SKPA) lands were included in the Kitchener's Urban Area Boundary. Located within the City of Kitchener (City), the Study Area is approximately 460 hectares in size (approximately 56 percent for Dundee North and 44 percent for the Southwest Kitchener Policy Area east of Fischer Hallman Road within the urban area boundary). The Study Area is bound by the limits of the Huron South Plan of Subdivision to the north, New Dundee Road to the south, Fischer Hallman Road to the west, and Reidel Road to the east. The Study Area is within the Haldimand Tract and within the treaty lands of the Haudenosaunee, of the Six Nations of the Grand River First Nation, and on the territorial lands of the Mississaugas of the Credit First Nation.

The Study Area is situated on the Waterloo Moraine geological formation and includes lands tributary to both the Cedar Creek subwatershed and Blair Creek subwatershed. The Waterloo Moraine supplies the Region of Waterloo (the Region) with approximately 80 percent of its drinking water (Matrix Solutions et al, 2019).

The portion of the Study Area within Blair Creek is approximately 242.37 hectares (ha) and consists mainly of three tributaries in the headwaters of the Upper Blair Creek. Blair Creek is a groundwater fed coldwater perennial watercourse that flows through south Kitchener, the City of Cambridge, and the Township of North Dumfries before discharging to the Grand River. Blair Creek supports a brook trout population. The fishery is highly dependent on groundwater recharge and discharge characteristics and is sensitive to changes in flow and water temperature. To the east of the Study Area, Blair Creek flows through the provincially significant Roseville Swamp Cedar Creek Wetland Complex and the Blair Creek Wetland.

A 195.3-hectare portion of the Study Area is a tributary to the Cedar Creek subwatershed. Cedar Creek is a perennial coldwater stream draining approximately 7,463 ha within Kitchener and the Township of North Dumfries (Matrix Solutions et al, 2019). Cedar Creek headwaters are located on the Waterloo Moraine. Cedar Creek supports a coldwater brook trout fishery and drains primarily agricultural lands, remnant natural woodlands, and low-lying wetlands (Matrix Solutions et al, 2019).

1.3 Project Background

Subwatershed planning for Dundee Secondary Plan (DSP) was, until recently, governed by the Ontario Provincial Policy Statement (Government of Ontario, 2020), the Ontario "A Place to Grow" growth targets (the Growth Plan, 2024), and Regional and City Official Plans. In October 2024, the 2024 Provincial

Planning Statement (PPS) came into effect (Government of Ontario, 2024). The 2024 Provincial Planning Statement replaces the 2020 PPS and the Growth Plan for the Greater Golden Horseshoe. The other policy documents remain in place.

Several relevant studies of the Blair Creek subwatershed have been completed over the last few decades. These studies have previously characterized the subwatershed and put forward goals, objectives, and targets for the protection of the natural environment and management of water resources. These studies include:

- Blair, Bechtel, and Bauman Creeks Subwatershed Plan (BBB Study) (CH2M Gore & Storrie Ltd, 1997),
- Upper Blair Creek (Kitchener) Functional Drainage Study (FDS) (Stantec Consulting Ltd, 2009),
- 2016 Upper Blair Creek State of the Watershed (2016 SOW) (Aquafor Beech Ltd., 2016),
- Cumulative Effects Monitoring – Blair Creek Case Study (CEA) (Grand River Conservation Authority, 2018),
- 2020 Upper Blair Creek State of the Watershed (2020 SOW) (Jacobs Engineering Group, 2020) and
- 2008 Alder Strasburg Creek Watershed Study and Upper Strasburg Creek Watershed Plan (CH2MHILL, 2008).

The Upper Cedar Creek Scoped Subwatershed Study completed in 2019 for the Regional Municipality of Waterloo and Grand River Conservation Authority (GRCA), developed goals, objectives, and targets for the protection of the natural environment and management of water resources within the subwatershed. The subwatershed goals, objectives, and targets identified for the Study Area were primarily informed by the findings of the BBB Study, Upper Cedar Creek Scoped Subwatershed Study, and Upper Blair Functional Drainage Study (FDS). The FDS focused on the land within the Upper Blair Creek subwatershed west of Reidel Drive and provides planning guidance for monitoring, mitigation, and management development to manage subwatershed impacts using an adaptive management approach (AMA) which supports a “revising-as-appropriate” approach, continually modifying the management of Upper Blair Creek based on the results of monitoring data. This allows designs to be updated to better meet the needs of the subwatershed (Stantec Consulting Ltd, 2009). The objectives and targets put forward in the previous studies will inform those for the Dundee North lands and SKPA lands that represent the current Study Area. Blair, Bechtel, and Bauman Creek Subwatershed Plan (BBB Study)

The BBB study was initiated in 1993 by the GRCA, Region, Cities of Kitchener and Cambridge, Township of Dumfries, and the Ontario Ministries of Natural Resources (now Ministry of Natural Resources and Forestry [MNRF]), the Ministry of Environment and Energy (now Ministry of Environment, Conservation, and Parks [MECP]), and The Ministry of Transportation. The BBB Study, completed in 1997, provides a subwatershed plan for the Blair, Bechtel, and Bauman Creeks. This subwatershed plan established an approach to balancing development and the protection, preservation, and enhancement of natural heritage resources (CH2M Gore & Storrie Ltd, 1997).

The BBB study assessed the physical resources supported by Blair Creek, identified and modelled the potential impacts of development, examined existing issues within the watershed, and provided a subwatershed management plan. The BBB study identified maximum impervious cover limits (ICLs) of 25% within the Study Area intended as a planning level tool to restrict densities of paved surfaces associated with conventional development which was further updated in the 2009 Upper Blair Creek (Kitchener) Functional Drainage Study.

This plan included goals and objectives with specific recommendations for management practices to protect the groundwater recharge and Creek temperature regime. These goals included (CH2M Gore & Storrie Ltd, 1997):

1. "To restore, protect, and enhance surface water quality, and associated aquatic resources and water supplies."
2. "To conserve, protect, and restore natural land, water, forest, and wildlife resources."
3. "To protect, restore, and enhance groundwater quantity and quality."
4. "To minimize the threat to life and the destruction of property and natural resources from flooding and erosion and preserve natural flood plain hydrologic functions."

The BBB study completed an assessment of the hydrological, hydrogeological, and natural heritage conditions within the Blair Creek subwatershed. The study identifies targets and objectives for the subwatershed as well as important natural heritage resources and important natural heritage features and linkages to adjacent subwatersheds. Figure 1-2 illustrates the BBB Study recommendations related to the Study Area. These include greenspace identified to provide a natural heritage linkage between the Blair Creek greenspace to the Strasburg subwatershed natural heritage corridor.

1.3.1 Blair, Bechtel, and Bauman Creek Subwatershed Plan (BBB Study)

The BBB study was initiated in 1993 by the GRCA, Region, Cities of Kitchener and Cambridge, Township of Dumfries, and the Ontario Ministries of Natural Resources (now Ministry of Natural Resources and Forestry [MNR]), the Ministry of Environment and Energy (now Ministry of Environment, Conservation, and Parks [MECP]), and The Ministry of Transportation. The BBB Study, completed in 1997, provides a subwatershed plan for the Blair, Bechtel, and Bauman Creeks. This subwatershed plan established an approach to balancing development and the protection, preservation, and enhancement of natural heritage resources (CH2M Gore & Storrie Ltd, 1997).

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5. "To restore, protect, and enhance surface water quality, and associated aquatic resources and water supplies."
6. "To conserve, protect, and restore natural land, water, forest, and wildlife resources."
7. "To protect, restore, and enhance groundwater quantity and quality."
8. "To minimize the threat to life and the destruction of property and natural resources from flooding and erosion and preserve natural flood plain hydrologic functions."

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1.3.2 Upper Blair Creek (Kitchener) Functional Drainage Study (FDS)

The Upper Blair Creek FDS as detailed in Report P-09-022/E-09-035, dated March 11, 2009, was commissioned to determine if development could be accommodated in the Upper Blair Creek Subwatershed while mitigating impacts and achieving the protections, preservation, and enhancement recommendations outlined in the BBB Study (Stantec Consulting Ltd, 2009). The FDS was intended to provide the Region, City, and GRCA with a technical basis for development planning within the Upper Blair Creek Subwatershed. Within the East Upper Blair Study Area, the FDS focused on development methods in addition to ICLs, to identify if further development can proceed defined by the objectives and recommendations of the BBB study. The FDS also investigated whether using enhanced stormwater management (SWM) practices would allow for development to occur in the West Upper Blair Study Area of the Blair Creek Subwatershed.

The east and west Upper Blair Creek Study Areas with respect to the Study Area are shown in Figure 1-3.

For the purposes of the FDS, the Upper Blair subwatershed Study Area was divided into east and west areas with the East Study Area including the subwatershed east of Reidel Drive and the West Study Area including the subwatershed area west of Reidel Drive, representing a large portion of the Study Area. This approach was taken at the time of the FDS as the area within the West Study Area was outside of the urban boundary as defined at that time (Stantec Consulting Ltd, 2009).

The FDS determined that using SWM practices on smaller sub-catchments within the watershed could allow development to proceed more flexibly. The FDS determined that the ICLs put forward in the BBB Study were critical to incorporate in development design requirements such that the development meets the designated infiltration targets, which may be achieved through design measures other than ICLs.

The FDS investigated the existing geotechnical and hydrogeological conditions of the Blair Creek Subwatershed and reviewed and evaluated the SWM technologies. A SWM Implementation Plan was developed based on the evaluation results. The SWM Implementation plan emphasized an AMA which serves to provide guidance on appropriately revising management approaches, monitoring protocols, and targets over time as conditions change. The FDS's recommended approach includes revising targets and monitoring protocols based on the results from extensive and ongoing monitoring within the subwatershed (Stantec Consulting Ltd, 2009). In addition, recommending a monitoring approach and AMA for development of the Upper Blair Creek East Study Area, the FDS completed a review of SWM technologies and developed a "toolbox" of management practices to mitigate the potential impacts of urban development (Stantec Consulting Ltd, 2009).

The monitoring program has been implemented by the City and the GRCA and reported through the Upper Blair Creek State of the Watershed (SOW) reports. SOWs are currently completed on a 5-year interval in accordance with the FDS recommendations, with the most recent SOW completed in 2020. The current subwatershed targets and findings of the SOWs for the Upper Blair Creek Study Area are summarized in Section 1.3.3.

1.3.3 State of the Watershed (Upper Blair Creek)

The Upper Blair Creek State of the Watershed (UBC SOW) reporting is carried out in accordance with the recommendations from the FDS. The purpose of the SOW reports is to consolidate and interpret the monitoring data collected by the City, landowners (developers), Region, and GRCA with respect to the subwatershed targets and objectives put forward in the BBB study and FDS. At the time of this study, two SOW Reports have been completed. The next SOW report is anticipated to be initiated in 2025.

1.3.3.1 2016 Upper Blair Creek State of the Watershed

The purpose of the 2016 UBC SOW report was to establish the baseline environmental conditions, identify and determine the nature of any identified impacts due to development, and assess the effectiveness of the monitoring program (Aquafor Beech Ltd., 2016). This UBC SOW report consolidated and reviewed data collected since 2006 to establish the baseline environmental condition upon which future SOW reports can compare conditions and identify potential impacts due to urban development and land use.

The City, Region, GRCA, City of Cambridge, and Township of New Dumfries collaborated to develop goals, objectives, and targets for Upper Blair Creek. Thirteen environmental objectives were defined as in the 2016 UBC SOW Report (Aquafor Beech Ltd., 2016). These are as follows:

1. Restore, protect, and enhance surface water quality, surface water quantity, and associated aquatic resources and water supplies:
 - a. Control sediment discharges and provide erosion control during-development.
 - b. Maintain, enhance, or restore natural stream processes to achieve a balance of flow and sediment transport, and to maintain/reduce erosion rates post-development.
 - c. Maintain, enhance, or restore coldwater fisheries potential in the watercourses.
 - d. Maintain existing water quality and contribute to achieving federal, provincial, and municipal water and sediment quality objectives and guidelines within the watercourses.
 - e. Preserve and re-establish the natural hydrologic cycle.
 - f. Manage wet weather flows to maintain ecohydrology (e.g. stream, riparian, wetland).
2. Protect, restore, and enhance groundwater quantity and quality.
 - a. Maintain infiltration, baseflow, and discharge to natural features.
 - b. Maintain groundwater levels and baseflows (GW discharge to streams) to sustain watershed functions, human uses, and mitigate climate change.
 - c. Maintain groundwater quality to support watershed functions.
3. Conserve, protect, and restore natural land, water, forest, and wildlife resources.
 - a. Protect, restore, or enhance the integrity of the watershed ecosystem through an integrated approach involving natural areas, habitats, and connected links.
 - b. Design and operate stormwater management facilities to maintain a healthy aquatic ecosystem, that supports the existing coldwater fisheries.
 - c. Maintain or improve the ecohydrology of wetlands, especially the Roseville Swamp and wetlands within the Endangered Species habitat.
 - d. Protect, restore, or enhance native terrestrial and aquatic plant and animal species, community diversity, and productivity.

The 2016 UBC SOW report identified indicators, parameters, and target thresholds for each indicator.

1.3.3.2 Cumulative Effects Monitoring – Upper Blair Case Study

The Cumulative Effects Monitoring (CEM) Blair Case Study report was conducted in 2018 in partnership with the MECP, and the City to provide a case study of the Blair Creek Monitoring Program. The purpose was to evaluate the 2006 – 2016 monitoring data, categorized as pre-, during-, and post-development using a cumulative effects assessment framework. The objectives included improved characterization of

land-use and water quality, and increased awareness of cumulative effects monitoring (Grand River Conservation Authority, 2018).

The framework developed for this study identified refinements to the key indicators and statistical methods to differentiate the impact of climate change from land use stressors (Grand River Conservation Authority, 2018). This framework was recommended for use in subsequent SOW reports. This study highlighted the importance of monitoring selected site locations and recognizing early indicators of change, recommending a weight of evidence approach for future SOW reports. The CEM also adjusted the baseline conditions from those established in the 2016 SOW for several parameters, by using more comprehensive data sets and statistical tools (Grand River Conservation Authority, 2018). The updated baseline conditions established in this study form the basis of comparison for future SOW reports.

This case study did not identify impacts from urban development at the time but identified potential early indicators of change within the subwatershed. These include “flashiness” (rapid increase in flow) at the upstream confluence with the Roseville Tributary, increases in total suspended solids (TSS) concentrations at sites downstream from ongoing development, and slight changes in temperature at various monitoring locations within the stream (Grand River Conservation Authority, 2018).

1.3.3.3 2020 Upper Blair Creek State of the Watershed

The purpose of the 2020 UBC SOW report was to evaluate the results of the monitoring data collected during development within the western portion of the Upper Blair subwatershed and compare them against the indicator parameter baselines and targets established in the 2016 UBC SOW and 2018 CEM reports (Jacobs Engineering Group, 2020). The 2020 SOW report applied the AMA approach put forward in the FDS by assessing the effectiveness of the ongoing monitoring efforts and identifying recommendations for improvements to monitoring program as necessary. The primary areas of interest are:

- a) Changes to the flow regime impacting stream stability;
- b) Water quality, specifically the control of salts and chloride contamination;
- c) Thermal impacts to UBC and the associated habitats;
- d) Sediment release, loadings, and construction erosion and sediment control issues; and
- e) Groundwater recharge.

This evaluation was completed through monitoring quantitative and qualitative stream parameters throughout the subwatershed and with additional site-specific monitoring. The findings of this study will inform the subwatershed targets and objectives for the Study Area. The 2020 UBC SOW reported the following results (Jacobs Engineering Group, 2020):

1. **Flow regime:** Changes in the flow regime were identified. These included increase flow rates, flow peakiness, and increased hours of flow above critical erosive velocity. These changes are indicative of urban run-off and increases in impervious areas within the subwatershed. Hours above critical erosive velocity was found to significantly exceed the threshold indicator target.
2. **Water quality:** Water quality was found to be impacted with observations consistent with sediment releases. Sediment releases were observed at the Dodge Drive monitoring location and statistical analysis found that these impacts are likely a direct result of construction upstream of Dodge Drive. High concentrations of TSS were observed at the New Dundee Road location but were not seen at the downstream monitoring locations.

3. **Thermal impacts:** Stream temperatures are increasing but currently remain within the threshold target and are within a temperature that support the spawning and habitat of the local brook trout population.
4. **Sediment release, loading, and construction Erosion and Sediment Control:** The City and GRCA are using reporting protocols to manage the identification of sediment releases from sites under construction. The study found that the protocols in place are reasonable and recommended some potential improvements to increase response time to events.
5. **Groundwater recharge:** This SOW did not observe impacts in the groundwater levels and were found to have similar seasonal patterns to those prior to development.

The baselines established for indicator targets for the Upper Blair subwatershed are presented in Appendix A.

1.3.4 Upper Cedar Creek Scoped Subwatershed Study

The Upper Cedar Creek Scoped Subwatershed study was initiated in 2019 by the Region in partnership with the GRCA. The purpose of this Subwatershed Study was to inform the land use planning process within the subwatershed. Cedar Creek is a perennial coldwater stream with a coldwater brook trout fishery and comprises a high concentration of Areas of Natural and Scientific Interest (ANSI), Provincially Significant Wetlands (PSWs), and municipally designated Environmentally Sensitive Policy Areas (ESPAs). It drains approximately 7,463 ha of primarily agricultural lands, remnant woodlands, and low-lying wetlands south and west of the cities of Kitchener and Cambridge (Matrix Solutions et al, 2019). The headwaters are located on the Waterloo Moraine, which supplies the Region with approximately 80 percent of its drinking water (Matrix Solutions et al, 2019). The Cedar Creek Subwatershed and Study Area can be seen in Figure 1-2.

This Subwatershed Study developed future land use concepts for the purposes of assessing potential impacts of development within the subwatershed (Matrix Solutions et al, 2019). This Subwatershed Study did not select preferred land uses or provide support for potential future land uses. The Study did identify anticipated impacts should development occur without mitigation measures. Table 1-1 provides a summary of the identified impacts and mitigations for changes in land use within the Cedar Creek Subwatershed as identified in the Subwatershed report (Matrix Solutions et al, 2019).

Table 1-1. Potential Impacts & Mitigation

Area	Description of Impact	Identified Mitigation
Water Budget/Groundwater recharge	Changes in land use are anticipated to related evapotranspiration and infiltration. Infiltration reduction may reduce water available for groundwater recharge with potential impacts to the headwaters of Cedar Creek and Roseville Swamp.	Potential development should be required to maintain groundwater recharge. Strategies for this could include: ▪ Infiltration of clean runoff at the source ▪ Centralized stormwater management facility (SWMF) for treatment and infiltration

Area	Description of Impact	Identified Mitigation
Flooding	Changes in land use are anticipated to increase stormwater runoff volumes. Runoff will eventually discharge to Cedar Creek and are anticipated to cause increased peak flow rates between Roseville Road and Highway 401 by 33 to 490 percent, resulting in unacceptable flooding impacts. In addition to the riverine corridor flood water would likely spill across several parcels, regularly inundating these areas.	Potential urban developments shall only discharge stormwater offsite at an appropriate frequency, rate, and volume as to maintain baseline conditions.
Erosion	The unmitigated release of stormwater from potential development would increase channel erosion resulting in a loss of channel stability.	Modulating stormwater runoff from urban development to maintain baseline frequency, rate, and volumes is important.
Groundwater Quality	Urban stormwater typically includes contaminants ranging from nutrients, sediment, metals, and dissolved contaminants like salt. There is the potential to introduce these contaminants to the municipal water supply due to the Study Area's proximity to municipal well fields.	The Study recommends collecting and not infiltrating potentially contaminated urban stormwater runoff and targeting the infiltration of clean water (i.e. roof runoff). In addition, targeting the release of salt-laden stormwater during freshet or direct to sanitary, or evaporate during the summer months.
Natural Heritage	Four types of potential impacts. These includes direct impacts (i.e. land-clearing, grading, and construction), indirect impacts (i.e. lighting, noise, water balance), induced impacts (i.e. introduction of feral and domestic predators, dumping of yard waste), and cumulative impacts.	The primary strategy for mitigating these impacts is through the maintenance of the Greenlands Network. The study also identifies buffers including 10 m setback from upland forests, 15 m from non-provincially significant wetlands, and 30 m from PSWs and Natural Heritage System (NHS) features.

Source: (Matrix Solutions et al, 2019)

A comprehensive Water Management Plan and Natural Heritage System Strategy were developed as part of the Upper Cedar Creek Scoped Subwatershed Study (Matrix Solutions et al, 2019).

1.4 Integrated Environmental Assessment Process

The Dundee Secondary Plan will be completed as an integrated environmental assessment and is subject to both the Planning and Environmental Assessment Acts. This project will complete a detailed technical assessment of the Study Area consistent with the province's guidelines for subwatershed planning, engagement with stakeholders, landowners, residents, and Indigenous communities will be an important part of the development of the new secondary plan.

Figure 1-4 shows the hierarchy of watershed planning as it relates to secondary planning in Ontario.

This study will be completed in six steps. These steps will include the following:

1. **Technical Work (Component 1, Phase 1 – Existing Conditions).** This step will investigate the Existing Conditions for the Study Area. This memorandum documents the existing conditions needed to complete this step.
2. **Development of Preliminary Land Use Concepts.** This step will be led by City staff with support from the Jacobs technical team. The technical work completed in step 1 will inform and support the City during this task.
3. **Technical Work (Component 1, Phase 2 – Scoped Subwatershed Study).** This step will complete the Scoped Subwatershed Study for the Study Area. This report documents the existing conditions, discusses future land use scenarios, and provide management strategies and implementation recommendations.
4. **High Level Technical Input to the Preferred Land Use Plan.** This step will be led by City staff with support from the Jacobs technical team. Jacobs will provide high-level technical review of the draft preferred land-uses allowing for technical concerns to be identified and communicated to the City project team.
5. **Technical Work (Component 2 – Impact Assessment and Mitigation Measures).** During this step, impact assessments will be completed for each study discipline. These will include an environmental impact assessment, water management assessment, preliminary noise impact assessment, servicing impact assessment, transportation impact assessment, and a cultural heritage assessment.
6. **Secondary Plan.** This step will be led by City staff and supported by the technical work completed in the previous steps.
7. **Complete the EA.** An EA Report (Scoped Subwatershed Study Report) will be finalized documenting the technical, engagement, and planning activities completed throughout the project. This report will be filed with the appropriate agencies.

1.5 Scoped Subwatershed Study Goals and Objectives

1.5.1 Integrated Environmental Assessment Objectives

The objective of the Secondary Plan is to complete a comprehensive planning exercise for the Dundee Study Area. This Secondary Plan is a required exercise under the City's Official Plan (Policy 3.C.1.18).

This area is denoted as Dundee Study Area in Figure 1-1. The lands are designated as "Prime Agricultural", "Rural", and "Natural Heritage Conservation" by the City's Official Plan. Policy 3.C.1.18 of the City's Official Plan requires that a comprehensive planning exercise before development can occur.

The subwatershed plan for the Study Area reflects and refines the goals, objectives, targets, and assessments of watershed planning available at the time the subwatershed plan is completed and is tailored to subwatershed needs and addresses local issues. The subwatershed plan has considered existing development and evaluated impacts of any potential or proposed land uses and development; identified hydrologic features, areas, linkages, and functions; identified natural features, areas, and related hydrologic functions; and provided for protecting, improving, or restoring the quality and quantity of water within a subwatershed. The subwatershed plan is based on pre-development monitoring and evaluation, is integrated with natural heritage protection, and identifies specific criteria, objectives, actions, thresholds, targets, and best management practices for development, for water and wastewater servicing, for stormwater management, for managing and minimizing impacts related to severe weather events, and for the support of ecological needs.

Subwatershed planning is governed by the Clean Water Act (2006) in Ontario. The province of Ontario has put forward a draft update to the watershed planning guideline that is part of the Act. The draft guideline provides updated guidance for municipalities on incorporating Indigenous considerations into watershed planning and updated on expectations for conducting meaningful engagement with Indigenous communities as per the Provincial Planning Statement as noted in Section 2.1.2. This guidance also emphasizes the importance of considering the function and features of Study Areas within with wider watershed indirect and cumulative impacts.

1.5.2 Scoped Subwatershed Study Objectives

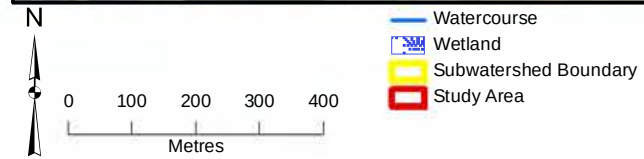
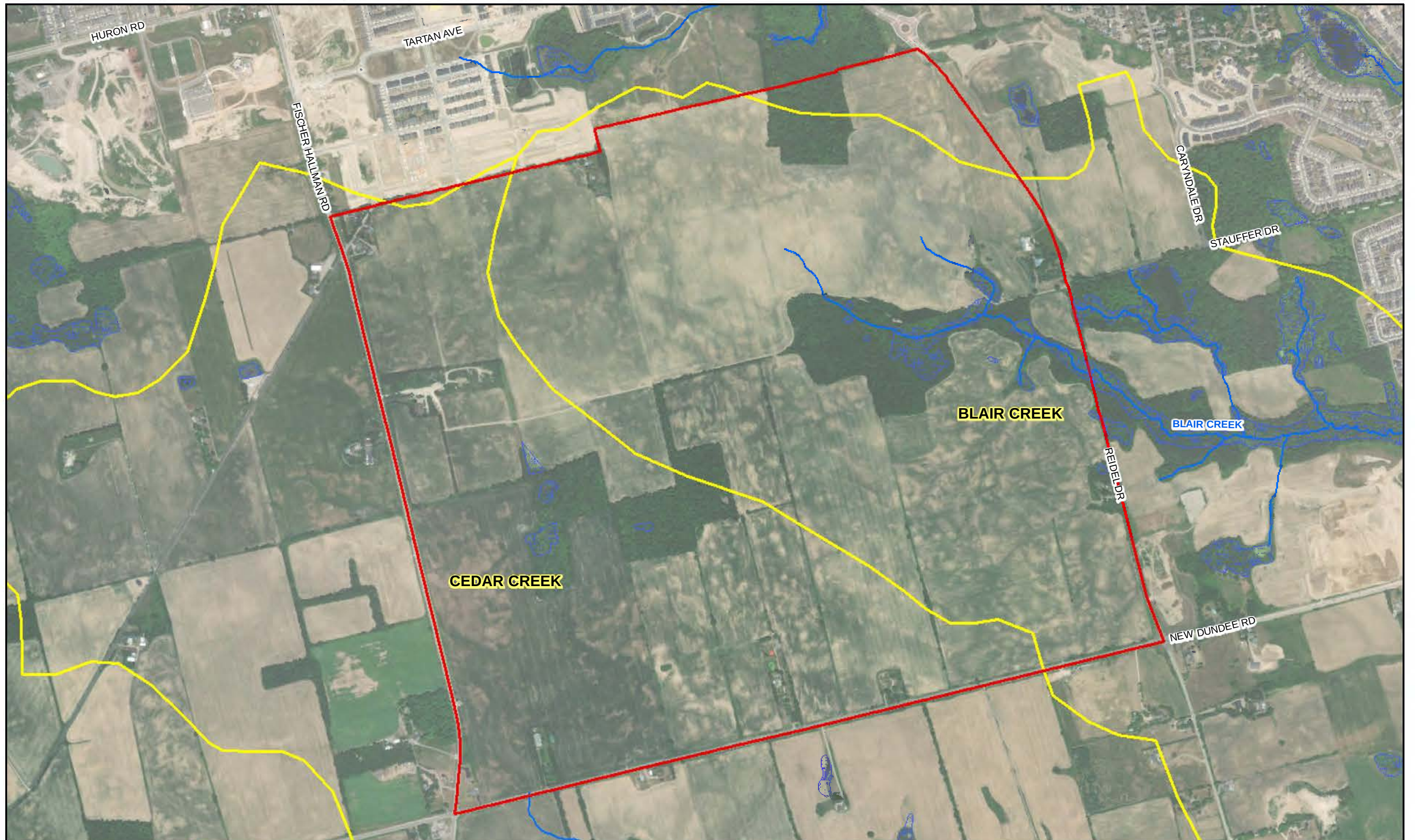
The Scoped Subwatershed Study fulfills the requirements for Phase 1 of the subwatershed planning process and defines the land use scenarios. The Phase 2 requirements for impacts assessment and management alternatives will be further developed as part of the overall project and incorporated into the Environmental Study Report.

The objective of this study is to:

- a) characterize the Study Area by establishing the existing conditions within the Study Area,
- b) determining the Study Area's functions within the subwatersheds to which it is tributary to,
- c) identify subwatershed goals, objectives, and targets applicable to the Study Area, and
- d) identify appropriate future land uses that meet the established subwatershed goals, objectives, and targets.

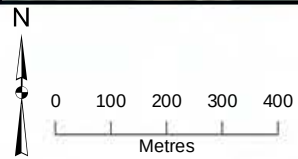
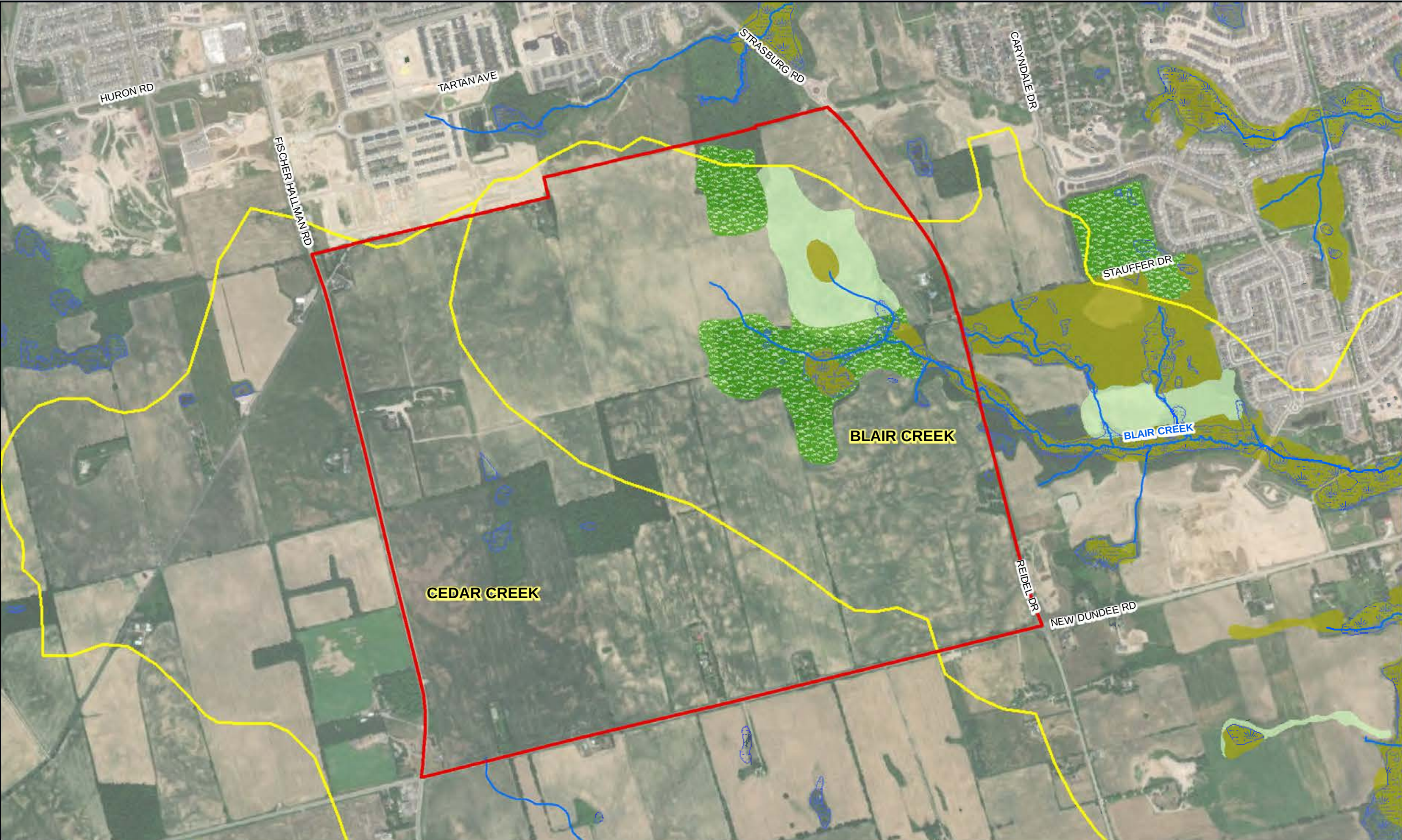
The goal of the Dundee Secondary Plan assignment is to support the City of Kitchener to develop a secondary plan through the integrated Class EA process that includes a framework for the Study Area that will maintain, restore, or enhance the health of the Blair Creek and Cedar Creek Subwatersheds.

Subwatershed studies have been previously completed for both the Blair and Cedar Creek subwatershed and have put forward subwatershed objectives and targets. This previous work will form the foundation of goals, objectives, and targets established through previous work.



Notes:
1. Aerial Source: City of Kitchener, 2019.

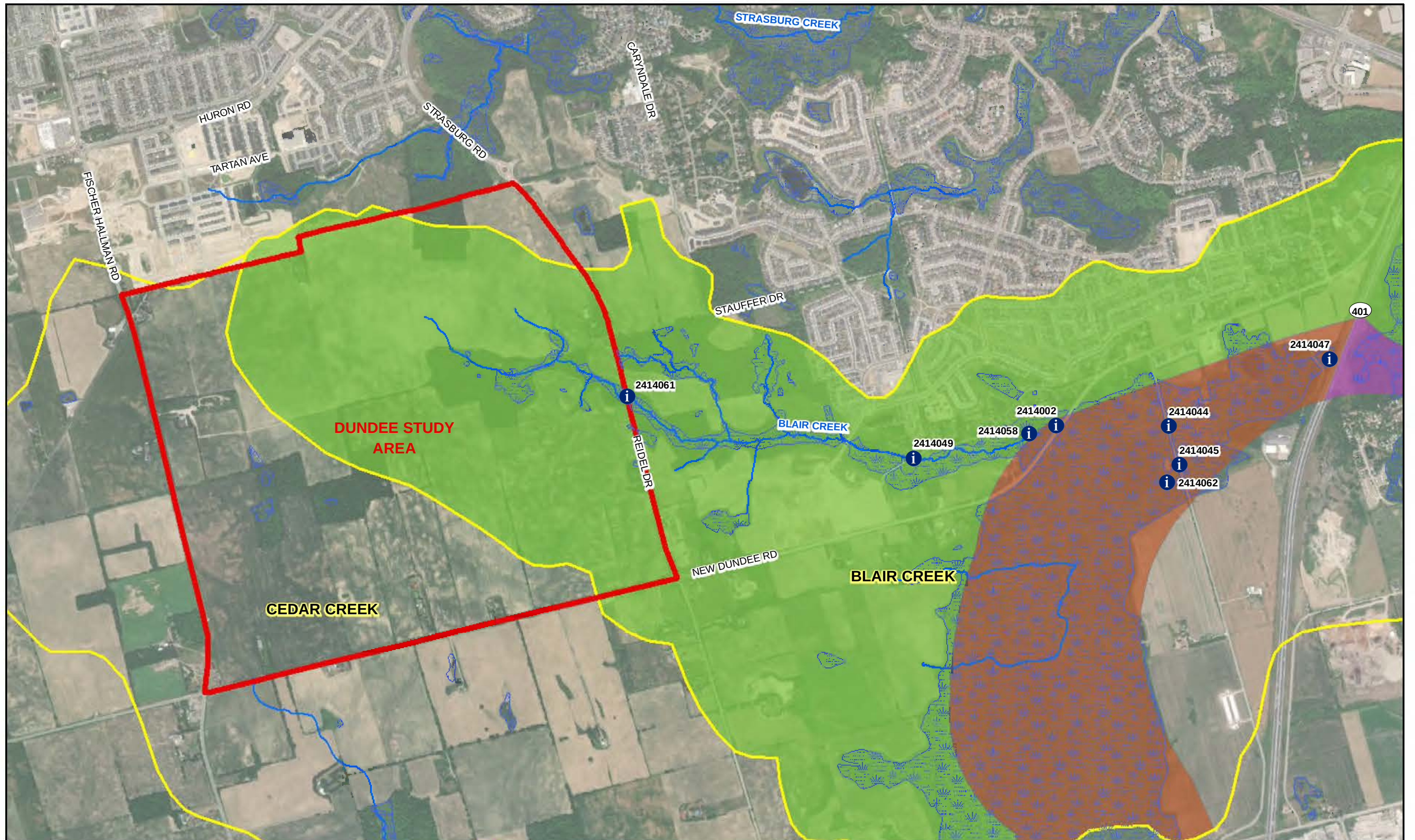
Figure 1-1
Dundee Secondary Plan Study Area
Dundee Secondary Plan Scoped Subwatershed Study Report
City of Kitchener
Kitchener, Ontario



- | | |
|-----------------------|----------------------|
| Watercourse | Greenspace System |
| Wetland | Core Areas |
| Subwatershed Boundary | Existing Opportunity |
| Study Area | Rehabilitation Areas |

Notes:
1. Aerial Source: City of Kitchener, 2019.
2. Greenspace System areas are approximate and were digitized based on Figure 3-3, Recommended Greenspace System, 1993 BBB Study.

Figure 1-2
BBB Study Recommendations
Dundee Secondary Plan Scoped Subwatershed Study Report
City of Kitchener
Kitchener, Ontario

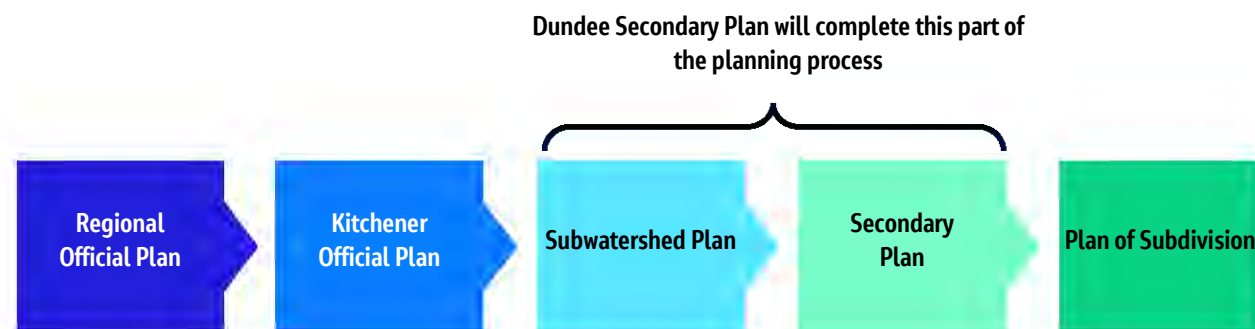


- i GRCA Long-Term Stream Gauges
- Watercourse
- Wetland
- Subwatershed Boundary
- Blair Uplands
- Blair Wetlands
- Roseville Swamp
- Upper Blair Study Area
- Study Area

Notes:
1. Aerial Source: City of Kitchener, 2019.

Figure 1-3
Upper Blair Creek Subwatershed
Dundee Secondary Plan Scoped Subwatershed Study Report
City of Kitchener
Kitchener, Ontario

Figure 1-4: Hierarchy of Watershed Planning



Source. City of Kitchener Official Plan

2. Governing Acts, Guidelines, and Policies

This section provides an overview of the relevant acts, guidelines, and policies relevant to this scoped subwatershed study.

2.1 Provincial

This section outlines the relevant provincial acts, guidelines, and policies.

2.1.1 Planning Act

The *Planning Act* (the Act) is a provincial legislation that establishes a framework for land use planning in Ontario. It describes how land uses may be controlled, and who may control them.

The following sections of the *Planning Act* are relevant to the Dundee Secondary Plan:

- Section 2 of the *Planning Act*, sets out matters of provincial interest in local land use planning, stating that the council of a municipality “shall have regard to, among other matters, matters of provincial interest”.
- Section 3 (1) of the Act gives the province the authority to issue policy statements on matters related to municipal planning that are of provincial interest.
- Section 3 (5) of the Act requires a decision of the council of a municipality affecting a planning matter to be consistent with policy statements and conform or not conflict with provincial plans that are in effect on the date of the decision.
- Part III of the Act pertains to and provides direction for official plans including secondary plans. A Secondary plan is part of an official plan, added by way of an amendment, that contains policies and land use designations that apply to multiple contiguous parcels of land, but not an entire municipality, and that provides more detailed land use policy direction in respect of those parcels than was provided before the amendment.

2.1.2 Provincial Planning Statement

The Provincial Planning Statement (PPS), 2024 came into effect on October 20, 2024, integrating both the Provincial Policy Statement, 2020 and A Place to Grow: Growth Plan for the Greater Golden Horseshoe, 2020. PPS 2024 provides overall policy directions on matters of provincial interest related to land use planning and development in Ontario. It is a policy statement, issued under section 3 of the Planning Act, which requires that decisions affecting planning matters shall be consistent with the minimum standards set in the policy statement. Municipal official plans (including secondary plans by way of amendment to municipal official plans) are considered the most important vehicle for implementation of the PPS and for achieving comprehensive, integrated and long-term planning.

The PPS 2024 is to be read in its entirety with all relevant policies to be considered to understand how they work together and are to be implemented.

The following are a summary of key relevant policies to the Dundee Secondary Plan:

Chapter 2: Building Homes, Sustaining Strong and Competitive Communities

2.1.6 Planning authorities should support the achievement of *complete communities* by:

- a) accommodating an appropriate range and mix of land uses, *housing options*, transportation options with *multimodal* access, employment, *public service facilities* and other institutional uses (including schools and associated child care facilities, long-term care facilities, places of worship and cemeteries), recreation, parks and open space, and other uses to meet long-term needs;
- b) improving accessibility for people of all ages and abilities by addressing land use barriers which restrict their full participation in society; and
- c) improving social equity and overall quality of life for people of all ages, abilities, and incomes, including equity-deserving groups.

2.3.1.1. Settlement areas shall be the focus of growth and development. Within settlement areas, growth should be focused in, where applicable, strategic growth areas, including major transit station areas.

2.3.1.2 Land use patterns within *settlement areas* should be based on densities and a mix of land uses which:

- a) efficiently use land and resources;
- b) optimize existing and planned *infrastructure* and *public service facilities*;
- c) support *active transportation*;
- d) are *transit-supportive*, as appropriate; and
- e) are *freight-supportive*.

2.9.1 Planning authorities shall plan to reduce greenhouse gas emissions and prepare for the impacts of a changing climate through approaches that:

- a) support the achievement of compact, transit-supportive, and complete communities;
- b) incorporate climate change considerations in planning for and the development of infrastructure, including stormwater management systems, and public service facilities;
- c) support energy conservation and efficiency;
- d) promote green infrastructure, low impact development, and active transportation, protect the environment and improve air quality; and
- e) take into consideration any additional approaches that help reduce greenhouse gas emissions and build community resilience to the impacts of a changing climate.

Chapter 3: Infrastructure and Facilities

3.1.1 Infrastructure and public service facilities shall be provided in an efficient manner while accommodating projected needs.

Planning for infrastructure and public service facilities shall be coordinated and integrated with land use planning and growth management so that they:

- a) are financially viable over their life cycle, which may be demonstrated through asset management planning;
- b) leverage the capacity of development proponents, where appropriate; and
- c) are available to meet current and projected needs.

3.1.4 Public service facilities should be planned and co-located with one another, along with parks and open space where appropriate, to promote cost-effectiveness and facilitate service integration, access to transit and active transportation.

3.1.5 Planning authorities, in collaboration with school boards, should consider and encourage innovative approaches in the design of schools and associated child care facilities, such as schools integrated in high-rise developments, in strategic growth areas, and other areas with a compact built form.

3.2.1 Transportation systems should be provided which are safe, energy efficient, facilitate the movement of people and goods, are appropriate to address projected needs, and support the use of zero-and low-emission vehicles.

3.6.1 Planning for sewage and water services shall:

- a) accommodate forecasted growth in a timely manner that promotes the efficient use and optimization of existing municipal sewage services and municipal water services and existing private communal sewage services and private communal water services;
- b) ensure that these services are provided in a manner that:
 - 1. can be sustained by the water resources upon which such services rely;
 - 2. is feasible and financially viable over their life cycle;
 - 3. protects human health and safety, and the natural environment, including the quality and quantity of water; and
 - 4. aligns with comprehensive municipal planning for these services, where applicable.
- c) promote water and energy conservation and efficiency;
- d) integrate servicing and land use considerations at all stages of the planning process;
- e) consider opportunities to allocate, and re-allocate if necessary, the unused system capacity of municipal water services and municipal sewage services to support efficient use of these services to meet current and projected needs for increased housing supply; and
- f) be in accordance with the servicing options outlined through policies 3.6.2, 3.6.3, 3.6.4 and 3.6.5.

3.6.8. Planning for stormwater management shall:

- a) be integrated with planning for sewage and water services and ensure that systems are optimized, retrofitted as appropriate, feasible and financially viable over their full life cycle;
- b) minimize, or, where possible, prevent or reduce increases in stormwater volumes and contaminant loads;
- c) minimize erosion and changes in water balance including through the use of green infrastructure;
- d) mitigate risks to human health, safety, property and the environment;
- e) maximize the extent and function of vegetative and pervious surfaces;
- f) promote best practices, including stormwater attenuation and re-use, water conservation and efficiency, and low impact development; and
- g) align with any comprehensive municipal plans for stormwater management that consider cumulative impacts of stormwater from development on a watershed scale.

3.8.1 Planning authorities should provide opportunities for the development of energy supply including electricity generation facilities and transmission and distribution systems, energy storage systems, district energy, renewable energy systems, and alternative energy systems, to accommodate current and projected needs.

3.9.1 Healthy, active, and inclusive communities should be promoted by:

- a) planning public streets, spaces and facilities to be safe, meet the needs of persons of all ages and abilities, including pedestrians, foster social interaction and facilitate active transportation and community connectivity;
- b) planning and providing for the needs of persons of all ages and abilities in the distribution of a full range of publicly-accessible built and natural settings for recreation, including facilities, parklands, public spaces, open space areas, trails and linkages, and, where practical, water-based resources;
- c) providing opportunities for public access to shorelines; and
- d) recognizing provincial parks, conservation reserves, and other protected areas, and minimizing negative impacts on these areas.

Chapter 4: Wise Use and Management of Resources

4.1.1 Natural features and areas shall be protected for the long term.

4.2.2 The diversity and connectivity of natural features in an area, and the long-term ecological function and biodiversity of natural heritage systems, should be maintained, restored or, where possible, improved, recognizing linkages between and among natural heritage features and areas, surface water features and ground water features.

4.2.1 Planning authorities shall protect, improve or restore the quality and quantity of water by:

- using the watershed as the ecologically meaningful scale for integrated and long-term planning, which can be a foundation for considering cumulative impacts of development;
- minimizing potential negative impacts, including cross-jurisdictional and cross-watershed impacts;

- identifying water resource systems;
- maintaining linkages and functions of water resource systems;
- implementing necessary restrictions on development and site alteration to:
 - 1. protect all municipal drinking water supplies and designated vulnerable areas; and
 - 2. protect, improve or restore vulnerable surface and ground water, and their hydrologic functions;
- f) planning for efficient and sustainable use of water resources, through practices for water conservation and sustaining water quality; and
- g) ensuring consideration of environmental lake capacity, where applicable.

4.2.2 Development and site alteration shall be restricted in or near sensitive surface water features and sensitive ground water features such that these features and their related hydrologic functions will be protected, improved or restored, which may require mitigative measures and/or alternative development approaches.

4.6.1 Protected heritage property, which may contain built heritage resources or cultural heritage landscapes, shall be conserved.

4.6.2 Planning authorities shall not permit development and site alteration on lands containing archaeological resources or areas of archaeological potential unless the significant archaeological resources have been conserved.

4.6.3 Planning authorities shall not permit development and site alteration on adjacent lands to protected heritage property unless the heritage attributes of the protected heritage property will be conserved.

4.6.4 Planning authorities are encouraged to develop and implement:

- a) archaeological management plans for conserving archaeological resources; and
- b) proactive strategies for conserving significant built heritage resources and cultural heritage landscapes.

4.6.5 Planning authorities shall engage early with Indigenous communities and ensure their interests are considered when identifying, protecting and managing archaeological resources, built heritage resources and cultural heritage landscapes.

Chapter 5: Protecting Public Health and Safety

5.2.1 Planning authorities shall, in collaboration with conservation authorities where they exist, identify hazardous lands and hazardous sites and manage development in these areas, in accordance with provincial guidance.

5.2.2 Development shall generally be directed to areas outside of:

- a) hazardous lands adjacent to the shorelines of the Great Lakes -St. Lawrence River System and large inland lakes which are impacted by flooding hazards, erosion hazards and/or dynamic beach hazards;
- b) hazardous lands adjacent to river, stream and small inland lake systems which are impacted by flooding hazards and/or erosion hazards; and

- c) hazardous sites.

5.2.3 Development and site alteration shall not be permitted within:

- a) the dynamic beach hazard;
- b) defined portions of the flooding hazard along connecting channels (the St. Mary's, St. Clair, Detroit, Niagara and St. Lawrence Rivers);
- c) areas that would be rendered inaccessible to people and vehicles during times of flooding hazards, erosion hazards and/or dynamic beach hazards, unless it has been demonstrated that the site has safe access appropriate for the nature of the development and the natural hazard; and
- d) a floodway regardless of whether the area of inundation contains high points of land not subject to flooding.

5.2.4 Planning authorities shall prepare for the impacts of a changing climate that may increase the risk associated with natural hazards.

2.2 Region of Waterloo Official Plan

The Regional Municipality of Waterloo (the Region) is an upper-tier municipality without planning responsibilities as of January 1, 2025. This means that the Regional Municipality of Waterloo Official Plan (the Regional Official Plan) is now deemed to constitute Kitchener's Official Plan (as per Section 70.13 (2) of the More Homes Built Faster Act) until such time as Kitchener's Official Plan is updated.

Other relevant regional plans and documents that are still under the umbrella of the Region are:

- Moving Forward – 2018 Transportation Master Plan
- Grand River Transit Business Plan
- TransformWR Strategy
- Region of Waterloo Water Efficiency Master Plan / Water Supply Strategy

2.3 Kitchener Official Plan

Kitchener is currently in the process of updating their Official Plan. The new Official Plan will guide growth and shape the way that neighbourhoods evolve and change, as well as be ambitious and clear for the City's future to 2051.

The City's current Official Plan was approved on November 19, 2014. The Plan incorporates the policy and regulatory framework established by the Province, other Provincial legislation, and incorporates policies established by the Region as provided in the Regional Official Plan. Within this framework, the Plan contains goals, objectives and policies that reflect the city's unique local needs and circumstances. Additionally, the City's current role with planning responsibilities places an obligation to make land use planning decisions consistent with the Provincial Planning Statement.

The following are a summary of key relevant Official Plan Sections to the Dundee Secondary Plan and this Scoped Subwatershed Study:

Section 3.C.2: Urban Structure: This Section of the Plan identifies Urban Structure Components that provide guidance on growth management and structure for the City's Urban Area. Understanding the

organization of the city on a macro level is necessary for directing growth to appropriate locations while protecting established and stable areas.

Section 4: Housing: This section of the Plan supports the provision of suitable, affordable and attractive living accommodations for all residents as housing is a basic necessity and determinant of quality of life. The policies also seek to address the characteristics and types of housing that may be required to support Kitchener's residents' needs as well as the appropriateness and quality of the community settings in which the housing is located to support our complete and healthy community.

Section 6: Public Health and Safety: The policies in this Section will ensure that land use planning decisions promote and protect the health and well-being of people and achieve a complete and healthy community (Natural Hazards, Noise, Vibration, Light and Other Emissions, and Human-Made Hazards).

Section 7: Natural Heritage & Environmental Management: This section of the Plan contains policies for the protection and conservation of the City's drinking water resources (Source Water Protection Areas), Natural Heritage System, Watershed Planning, Sustainable Development, Water Conservation, Energy Conservation and Generation, Air Quality, and Waste Reduction and Management.

Section 8: Parks, Open Space, Urban Forestry and Community Facilities: The provision of community infrastructure and facilities is essential for the enhancement of the quality of life for residents in Kitchener. There are a wide range of facilities that are required to meet the physical, social, cultural and recreational needs of its residents. While the City may not be directly involved in the provision of all community and cultural facilities and services, it can help ensure the provision and expansion of some of these facilities and services through facilitation.

The City recognizes the importance of parks, open space, multi-use pathways and trails as key elements in providing the Kitchener residents with a healthy physical environment and a high quality of life. As such, the City is committed to providing and maintaining sufficient publicly accessible parks and open space for both active and passive recreational pursuits to satisfy the recreational needs of all age groups and lifestyles, while having regard for the city's natural areas.

Section 12: Cultural Heritage Resources: The policies of this Section provide the framework to ensure the conservation of those cultural heritage resources which reflect and contribute to the history, identity and character of Kitchener.

Section 13: Integrated Transportation System: An integrated transportation system is an essential part of the city's urban structure and a key element in shaping the form and character of growth in the city. Transportation is made more efficient when complemented by appropriate built form, mix of land uses and appropriate population and employment densities. For the city to grow and evolve into a complete and healthy community, it is critical that land use and transportation policies be mutually supportive.

Other relevant plans and documents that are under the umbrella of the City are:

- City of Kitchener Growth Management Strategy
- City of Kitchener Parks Strategic Plan
- City of Kitchener Cycling and Trails Master Plan
- City of Kitchener Integrated Sanitary Master Plan
- City of Kitchener Integrated Stormwater Management Master Plan
- City's Transportation Master Plan

- Transportation Demand Management Plan,
- Pedestrian Charter
- Rosenberg Secondary Plan
- Doon South Community Plan
- Brigadoon Community Plan

2.4 Municipal Services Design Criteria

This section provides an overview of the City of Kitchener guidelines, plans, and policies referred for developing the municipal servicing strategy for the New Dundee Secondary planning area.

The Regional Municipality of Waterloo is a two-tier municipality. The Region is responsible for drinking water supply, treatment, transmission, and wastewater treatment. The Region is also partially responsible for sanitary sewage collection and conveyance to wastewater treatment facilities through Regional sewage pumping stations. The City of Kitchener is responsible for drinking water distribution and sanitary collection and conveyance to the Region's wastewater treatment facility.

Municipal services for the secondary study area are based on the level of service criteria established in the Kitchener Development Manual (KDM) and the Regional of Waterloo and Area Municipalities' Design Guidelines and Supplemental Specifications for Municipal Services (DGSSMS) (Region of Waterloo, 2022). Both documents also direct for compliance with the Ministry of Environment, Conservation and Parks' (MECP) Design Guidelines for Drinking-Water Systems (MECP Drinking Water Technical Working Group, 2023) and Design Guidelines for Sewage Works (MECP Sewage Technical Working Group, 2024).

The approach for determining New Dundee Secondary Plan area's water and wastewater servicing needs comprised of the following tasks:

- Residential population projections based on the residential zoning within the study area, which includes low, medium and high-density areas;
- Employment population projections based on the institutional (schools and community centres), commercial and industrial land uses within the study area;
- Determining the additional water demand and wastewater flow generated from the projected population;
- Establishing the design criteria for drinking water distribution network;
- Establishing the design criteria for sewage collection and conveyance; and
- If applicable, assessing the capacity of existing municipal infrastructure directly impacted by the secondary planning area.

Additionally, impacts to municipal services considered servicing requirements beyond the delineated service area to allow efficient integration with potential future growth areas while also integrating with the existing infrastructure.

The following subsections summarize the design criteria used for projecting water demand and wastewater flow and for providing recommendations for servicing the study area.

2.4.1 Population Projections

The City's Zoning Bylaw 2019-051 provides standard population per hectare factors for the zoned land-uses (City of Kitchener, 2021). The factors used for estimating the future serviced population for the secondary area is presented in Table 2-1.

Mixed-use residential under zoning designation RES – 6 is to accommodate mixed-use buildings and developments within neighbourhood nodes that are adjacent to low-rise residential zones. The population per hectare factor is 312 under By-Law 2019-051. This factor assumes a permanent population within the entire zoned area, which is an overestimation since only temporary population is expected within the non-residential areas under this zone. As such, the population per hectare factor for RES-5 (143 people per hectare) is used for MIX-1 zone (City of Kitchener, 2021).

Table 2-1: Population Density Factors per Bylaw 2019 - 051

Land-Use Zone	Zone	Population per Hectare
Low Density Residential	RES-2	36
High Density Residential	RES-7	387
Mixed-Use One (including neighborhood nodes)	MIX-1	143 ^a

a: Replaced with Population Per Hectare factor of RES-5.

The City has generated a population estimate for this study area based on relevant policies and planned growth strategies. The New Dundee Secondary study area is anticipated to provide permanent residential dwelling to approximately 35,000 people. Therefore, population estimates generated using the Table 2-1 for the two land-use scenarios will be a check against the City's population estimate.

2.4.2 Drinking Water System

2.4.2.1 Water Supply Capacity

Municipal drinking water system (DWS) for the City of Kitchener falls under the Integrated Urban System (IUS) as described in Section 3.4.3 in this report. The IUS system has MECP approval to be designed for the maximum week demand instead of the maximum day demand that the MECP typically requires of all Ontario DWSs (Region of Waterloo, 2025).

The KDM references the Design Guidelines and Supplemental Specifications for Municipal Services (DGSSMS) (Region of Waterloo, 2022) for the basis of design criteria of municipal drinking water system. The per capita usage rate established in the Regions' *2015 Water Supply and Distribution Optimization Master Plan* (2015 WSDOMP) (Stantec Consulting Ltd., 2015) is 225 lpcd in accordance with the DGSSMS. The actual (2019 – 2023) historical per capita water consumption by the IUS as reported in the 2025 WWMR is 324 lpcd. This per capita consumption is calculated from the week with the highest water consumption (maximum week demand) as opposed to maximum day demand. In comparison, the MECP guidelines recommends using historical data for projecting future demand and comparing to a typical per capita water usage of 250 – 450 lpcd on an average day, with a peaking factor of 1.5 for maximum day. Since the per capita water use in the 2025 WWMR falls between the MECP provided range, it is used to project future water demand.

2.4.2.2 Water Distribution System

Maps of the existing water pressure zones provided in the 2015 WSDOMP was referred to identify existing pressure zones that could service the study area. The DGSSMS requires that pressure zones for water distribution are to be maintained between 50 to 80 PSI during average day and 40 to 100 PSI between minimum hour and peak hour (Region of Waterloo, 2022). For areas unable to meet the minimum demand of 40 PSI, booster pumps are to be recommended. Likewise, pressure reducing devices are to be recommended for areas exceeding the maximum allowable pressure of 80 PSI. Pressure zone delineation of the study area will be based on average day demands, confirmation of which will require updating the City's hydraulic model.

For a redundant system and to bring in accuracy to predicting future water demand, the standard design criteria is typically optimized to reflect actual conditions that impact water demand such as non-revenue water use. The 2015 WSDOMP identifies non-revenue water use as unaccounted for water (UFW) that can result from distribution system leaks and flushing of watermains and provides a baseline of 11 percent of UFW for Kitchener (Stantec Consulting Ltd., 2015). As such, the projected water demand is recommended to be increased by 11 percent to account for UFW. Although an assumption that new watermains are less susceptible to leakage can be made, this factor is being retained to provide contingency in the projection calculations.

2.4.2.3 Water Storage System

The water storage capacity required to service the study area is determined using the MECP criteria for sizing storage facilities as described below:

- Fire Storage, which is dependent on the equivalent serviced populations.
- Equalization storage to be 25 percent of the maximum day demand.
- Emergency storage to be 25 percent of the equalization plus the fire storage.
- The required treated water storage capacity is the sum of the three components above.

2.4.3 Sewage System

2.4.3.1 Sewage Collection System

The KDM provides the following criteria for sizing the wastewater treatment system, in accordance with the Bylaw 2019-051 (City of Kitchener, 2021):

- Per capita sewage factor of 305 lpcd.
- Population to be estimated using the density factors provided in Kitchener Site Plan Engineering Guidelines, as listed in Table 2-2.
- The non-residential or ICI (institutional, commercial and industrial) sewage flows to be referenced from the DGSSMS.
- Sewage pumping stations are to be designed for a minimum 10-yr peak flows with the largest capacity pump out of operation.

Peak flows are to be calculated using the Harmon Factor for residential population, and the peaking factors provided in the DGSSMS. For the purposes of this study, an overall peak flow estimated using methods provided in the *Water Environmental Federation* (WEF) guidelines is used (WEF, 2010). Once the

preferred land-use is established, individual peak flows per land-use zone can be established and used to determine municipal infrastructure needs.

Table 2-2: Sewage Flow Estimation Factors

Parameter	Value	Source
Commercial Areas	0.5 L/s/ha	DGSSMS Section B.3.1.2.3
Institutional Areas	0.15 L/s/ha	DGSSMS Section B.3.1.2.4

2.4.3.2 Sewage Treatment System

Per the MECP, the rated hydraulic capacity of a sewage treatment facilities is to be greater than the average day flow projected for a serviced population over a recommended 20-year period (MECP Sewage Technical Working Group, 2024). Additionally, industry best practices state that WWTPs typically begin experiencing some capacity constraints when flows reach approximately 85 percent of the rated capacity. Initiating projects for capacity expansion when 80 percent of rated capacity is reached is recommended.

3. Existing Conditions

3.1 Land Use

The Study Area shown as Dundee Study Area in Figure 1-1. Lands in the Study Area are designated Prime Agriculture, Rural and Natural Heritage Conservation (City of Kitchener, 2014). The Study Area includes environmental features within the Region's Greenlands Network which contain defined Core Environmental Features such as Provincially Significant Wetlands and Environmentally Sensitive Policy Area (Regional Municipality of Waterloo, 2015). The Study Area does not encounter defined Countryside or Urban Areas.

3.2 Physiography

The Study Area is located in the Waterloo Moraine Complex, comprised of primarily sand till deposited by glaciers.

The physiography of the region is generally hilly. Ground surface elevations are highest northwest of the Site and tend to decrease towards the Grand River to the east. Localized areas of lower elevation are associated with surface water features such as the Blair Creek and its tributaries or the Roseville Swamp.

Within the Site boundary, a topographic high of 358 mASL is associated with a mound between two tributaries of Blair Creek and Cedar Creek. Ground elevation is also high to the west and south of the Blair Creek tributaries (342 mASL to 356 mASL). The ground surface elevation is much lower along the Blair Creek itself; at the connection of the two northern tributaries, ground elevation is approximately 323 mASL. This shows a fairly steep gradient towards the Blair Creek over the Study Area. Following Blair Creek to the west, the ground surface elevation tends to decrease steadily towards the Grand River at an average 0.8 percent downward slope.

The Cedar Creek subwatershed lies primarily north of New Dundee Road, between Trussler Road and Reidel Drive. Ground elevations within Cedar Creek exhibit a steep gradient toward the southwest corner of the Study Area, descending from high points near the northwest corner and the mound between the two creeks (approximately 356 to 358 mASL) down to about 334 mASL.

Land cover within the Study Area is predominantly farmland, interspersed with deciduous forest patches primarily around the Blair Creek tributaries. In the Cedar Creek portion, deciduous woodlands and small, low-lying wetlands are present, including Provincially Significant Wetlands such as the Roseville Swamp Cedar Creek Wetland Complex located in the eastern part of the Study Area. A regulatory floodplain exists at the intersection of New Dundee Road and Fischer Hallman Road. Wetlands are also associated with the Blair Creek tributaries.

3.3 Water Quality

Understanding baseline water quality and thermal regime is important to watershed characterization. The surface water quality has been characterized for the Cedar Creek Subwatershed through the Upper Cedar Creek Scoped Subwatershed Study (Matrix Solutions et al, 2019) and through the Upper Blair Creek State of the Watersheds [(Aquafor Beech Ltd., 2016) (Jacobs Engineering Group, 2020)]. This informs the form and function of the Study Area within the context of these two subwatersheds.

This section summarizes the findings of the characterization for each subwatershed.

3.3.1 Cedar Creek Subwatershed Surface Water Quality

The Upper Cedar Creek Scoped Subwatershed study surface water characterization found that the water quality of Cedar Creek is good but decreases as water travels downstream (Matrix Solutions et al, 2019). The analysis found:

- Nitrate-nitrogen values are elevated throughout Cedar Creek and are particularly elevated at the headwaters near Roseville Road and Cedar Creek Road. This suggests agricultural practices are a primary source of nutrient load. (Matrix Solutions et al, 2019).
- Total phosphorous also increases as water travels downstream in the spring but decreases moving downstream in the summer. This suggests that phosphorous inputs are related to freshet, and during the summer groundwater contributions increase and decrease phosphorous concentrations. Phosphorous exceeded guidelines at all sampling locations (Matrix Solutions et al, 2019).
- Metals were found to be within guidelines with the exception of two stations downstream of the 401 highway where copper concentrations exceeded the guidelines (Matrix Solutions et al, 2019).
- Analyses of the thermal regime found that most stations are classified as "cold" or "cold-cool" water. Areas within the creek classified as "cool-warm" indicated a smaller portion of stream flow coming from groundwater than other reaches or may be due to upstream ponding (Matrix Solutions et al, 2019).

3.3.2 Blair Creek Subwatershed Surface Water Quality

Water quality monitoring of Upper Blair Creek has been ongoing since 1994. The monitoring network covers the headwaters to the mouth of the creek. The BBB study characterized the creek into three areas, Blair Creek headwaters, Roseville swamp tributary, and Blair Creek wetlands.

The Blair Creek headwaters drain into soils of medium permeability resulting in little baseflow and measurable runoff during wet periods as well as significant infiltration. Roseville swamp is the discharge for many local and regional overburden aquifer inputs. It is a poorly drained flat area with a high storage volume which attenuates runoff resulting in bog and swamp deposits. Roseville swamp is most often saturated from groundwater and tributary discharge; therefore, precipitation contributes significantly to runoff. Blair Creek flows perennially from its confluence at Roseville swamp through the Blair Creek wetlands to the Grand River. Blair Creek wetlands have high permeability soils resulting in little runoff except for in impervious areas. This area receives plentiful groundwater input, and its corresponding temperature allows for brook trout spawning.

Succeeding the completion of the BBB Study (CH2M Gore & Storrie Limited 1997), the GRCA installed long term flow gauges. These have been used to complete continuous flow monitoring at New Dundee Road, upstream of Roseville swamp, and Dickie Settlement Road, downstream of Roseville swamp. The FDS (Stantec 2009) developed a monitoring program and the AMA which were subsequently used to adapt the GRCA monitoring program, and to form recommendations in the 2016 SOW.

In 2020, the State of the Watershed report was completed for Upper Blair Creek. The objective of this State of the Watershed is to compare the current conditions with the 2020 State of the watershed identified observations by monitoring location (Jacobs Engineering Group, 2020):

1. At Reidel Drive, the average values for copper and zinc exceeded their respective PWQO thresholds (Province of Ontario, 1994). The increase in the upper percentiles of the box plot for phosphorus at Reidel Drive station is most likely due to agricultural activities upstream.

2. At Dodge Drive, the average DO value was found to be below the Provincial Water Quality Objectives (PWQO) and the average values for copper and zinc were found to exceed their respective PWQO thresholds (Province of Ontario, 1994). The TSS average in wet weather for Dodge Drive was 195.5 mg/L which is higher than all maximum and average values for all stations and weather types prior to 2014. Additionally, an increase of 60 mg/L for the median value of TSS was observed between pre- and during-development conditions. Phosphorus at Dodge Drive increased by more than a factor of five in wet weather conditions. The TSS 90th and 95th percentiles more than tripled and BACI analysis, ANOVA test, and Mann-Kendall trend tests all support that TSS increased due to development near Dodge Drive.
3. TSS 90th and 95th percentiles more than tripled at New Dundee Road.
4. Roseville Tributary saw increases in upper percentiles for phosphorus, most likely due to agricultural activities upstream.
5. At the Mouth, the upper percentiles and median value for chloride increased between pre and during-development.

Many of these changes are indicative of impacts from construction activities.

The 2020 State of the Watershed also identified general conclusions were made and apply in general to Upper Blair Creek (Jacobs Engineering Group, 2020). The observed changes are typical of impacts of development and urbanization.

1. Using the 2016 SOW wet weather and dry weather stratification method (Aquafor Beech Ltd., 2016) and observing the corresponding general statistics tables the conclusions were:
 - a. Chloride maximum concentrations have increased at every station at either wet and/or dry weather conditions.
 - b. Total phosphorus maximum concentrations increased at six stations at either wet and/or dry weather, and wet weather average phosphorus concentrations exceeded the PWQO of 0.03 mg/L at all stations (Province of Ontario, 1994). Average nitrate concentration at either dry or wet weather conditions did not exceed PWQO at any stations between 2014 and 2019.
 - c. Total copper maximum concentrations have increased at either wet and/or dry weather at six monitoring stations.
 - d. Total zinc maximum concentrations increased during wet weather at all stations upstream of Dickie Settlement Road.
 - e. TSS maximum concentrations increased at five stations for wet weather and at six stations for dry weather. The maximum values at five stations exceeded the previous overall maximum TSS in the 2016 SOW.
2. Using the 2018 CEA wet and dry stratification method (Grand River Conservation Authority, 2018) and observing the Wilcoxon rank-sum non-parametric test results the conclusions were:
 - a. All stations had a statistically significant change in median values for at least one parameter (TSS, total phosphorus (TP), NO₃ or Cl).
 - b. For the 12 cases of dry weather median values with statistically significant change, all but one case decreased for during-development. The opposite trend was observed for wet weather where all statistically significant median changes were increases, except those for nitrate which decreased. A decrease in nitrate under wet weather conditions could indicate dilution.
 - c. In wet weather conditions, median TSS values increased for all seven stations, and by more than double for four stations where the latter includes both control sites. Furthermore, at Dodge Drive

- an increase of 60 mg/L for the wet weather median value of TSS was observed between pre- and during-development conditions.
- d. Median wet weather concentrations of TSS and TP are observed to be statistically significantly higher than dry concentrations for all stations during-development.
 - e. For during-development data, there are ten more occurrences of statistical significance between wet and dry weather samples than there are for pre-development. This further highlights the importance of stratifying chemistry grab samples into wet and dry.
3. From the box plots produced for the 5th to 95th percentiles for pre and during-development conditions the following conclusions were made:
- a. Increases in the upper percentiles of TSS and phosphorus at New Dundee Road and Dodge Drive is a potential product of development (which was further analyzed through BACI and Mann-Kendall tests). The effects of high concentrations of TSS or phosphorus associated with development is not seen downstream of these monitoring sites.
 - b. Nitrate concentration values for high percentiles generally decreased for the during-development period, which suggests changes in agricultural practices upstream.

3.4 Infrastructure

3.4.1 Transportation

The existing transportation network surrounding the Dundee Secondary Plan is defined by three primary roadways that includes Fischer-Hallman Road, New Dundee Road, and Reidel Drive. Fischer-Hallman Road forms the western boundary of the study area and is designated as a north-south regional road. It features a two-lane cross section with a posted speed limit of 70 km/h. Currently the roadway does not include active transportation infrastructure such as sidewalks or bike lanes.

New Dundee Road forms the southern boundary of the study area and serves as an east-west regional road. It features a two-lane cross section and a posted speed limit of 80 km/h. This roadway does not include active transportation infrastructure such as sidewalks or bike lanes.

Reidel Drive forms the eastern boundary of the study area and is classified as a north-south local street. It features a rural two-lane cross section with a posted speed limit of 50km/h. The roadway does not include any active transportation infrastructure such as sidewalks or bike lanes.

Two existing roads located outside of the study area are planned for extension to service the transportation network within the study area. This includes Blair Creek Drive and Strasburg Road. Blair Creek Drive currently ends at Stauffer Woods Trail. This road is designated as a major east-west community collector road in the City's Official Plan. It features an urban two-lane cross section with a posted speed limit of 40km/h, reduced to 30km/h in school zones. Sidewalks and bike lanes are provided on both sides of the roadway. As of October 2025, Blair Creek Drive ends at Stauffer Woods Trail, with a planned westward extension to Reidel Drive. The alignment through the Stauffer Woods subdivision has already been established to support this extension.

Strasburg Road is located at the northeastern corner of the Study Area and is designated as an arterial street. It features a four-lane urban cross section with a posted speed limit of 60km/h. A multi-use trail is provided on both sides of the roadway. Strasburg Road currently ends at Rockcliffe Drive, with a planned southward extension to New Dundee Road which will travel through the Study Area. Figure 3-1 shows the locations of existing roadways surround the study area.

3.4.2 Stormwater Management

An overarching goal of the Upper Cedar Creek Scoped Subwatershed study, FDS and BBB studies [(Matrix Solutions et al, 2019), (Stantec Consulting Ltd, 2009), (CH2M Gore & Storrie Ltd, 1997)] was to implement a water balance approach to managing activity in the subwatershed which would limit changes to the hydrologic cycle.

Many factors affect the hydrologic cycle including natural features such as soil, topography, vegetation, geology and climate, and anthropogenic features such as climate change and development. The main mechanisms that maintain the hydrologic cycle are evaporation and transpiration (evapotranspiration), runoff, infiltration, and precipitation. These components are used in the water balance equation, normally expressed as:

$$\text{Precipitation (P)} = \text{Evapotranspiration (ET)} + \text{Runoff (R)} + \text{Infiltration (I)}$$

Changes to the hydrologic cycle result in impacts on water quantity and quality as well as stream morphology. Urbanization and the corresponding increase in impervious cover has a strong impact on the mechanisms that maintain the hydrologic cycle. Urbanization reduces evapotranspiration and infiltration which results in increased runoff causing more frequent high flows in watercourses, correspondingly increasing flooding and erosion. Additionally, reduction in infiltration results in decreased groundwater recharge which can affect cool water streams and well access to aquifers.

The general goal of the water balance approach is to maintain the pre-development water balance condition within a developed area, hence avoiding the consequences of changes in evapotranspiration, runoff, and infiltration. Some of the objectives that correspond to this goal are maintaining groundwater recharge to aquifers, maintaining the continuity of flow paths between recharge and discharge areas, protecting natural features and ecological habitats, practicing water management practices which acknowledge the hydrologic interdependencies of the headwaters and downstream locations, reducing erosion, and improving water quality. These objectives help to maintain the integrity of natural areas as well as ensure continued access to water.

The FDS (Stantec 2009) established post-development water balance volume targets for runoff and infiltration to be used in the Upper Blair Creek Subwatershed. "All proposed development/SWM scenarios sufficiently mitigate potential impacts pertaining to the quantity of surface runoff, infiltrated water, and baseflows" (Stantec 2009). All future developments must also continue to achieve these water balance targets to maintain the condition of the Upper Blair Creek Subwatershed.

The Upper Cedar Creek Scoped Subwatershed study developed a water management strategy for the subwatershed on principles similar to those developed for the Blair Creek subwatershed. The Cedar Creek subwatershed is a unique environment in that due to the highly permeable soil conditions, which allow most rainfall and snowmelt to infiltrate directly into the ground rather than causing surface runoff. As a result, the subwatershed lacks a defined water course to handle drainage from the Study Area. This presents significant challenges for the development of the SKPA, as the proposed water management plan must effectively address the stormwater generated by future developments.

3.4.2.1 Cedar Creek Stormwater Management

The subwatershed has a low density of perennial watercourses, particularly in the headwaters of the watershed, where the Dundee Secondary Plan Study Area is located. The perennial watercourses have strong baseflow components and infrequently receive overland runoff. In addition, the low density of water courses and highly pervious materials results in a lack of drainage features. This of particular

importance during development of land use scenarios for the portion of the Study Area within the Cedar Creek subwatershed. The management strategies in the Upper Cedar Creek Scoped Subwatershed Study include (Matrix Solutions et al, 2019):

1. Potential urban developments shall only discharge stormwater management offsite at an approximate frequency similar to those occurring during baseline conditions.
2. Infiltration of potentially contaminated water should only be performed in areas where there is a reduced chance of contaminated water reaching the municipal supply aquifer (AFD1).
 - a. In lands where recharge may interact with the municipal wellfields only clean water should be infiltrated.
 - b. Infiltrate clean water at the source. This allows for spatial distribution of groundwater recharge and increases the likelihood of maintaining baseflows.
 - c. Runoff from areas likely to be contaminated (e.g. roads, sidewalks, parking) should be directed to end of pipe recharge facilities that are sited outside of the land contributing to the municipal well field.
3. Sensitive ecological features relying on groundwater discharge (Cedar Creek, Roseville Swamp), care should be taken to limit the introduction of potential contaminants to infiltrated stormwater.
 - a. Implement Low Impact Development technologies aimed at managing runoff quality such as bioswales/filters.
 - b. Implement salt management strategies to reduce the mass loading of chlorides into stormwater, and thereby groundwater and watercourses.

3.4.2.2 Upper Blair Creek Stormwater Management Plans

The 2009 FDS established a stormwater management plan for the Upper Blair Creek Subwatershed. The plan is based on achieving the following goals (Stantec Consulting Ltd, 2009):

- Infiltration – maintain or increase existing infiltration volume.
- Water Quality – adhere to MECP guidelines or Enhanced Water Quality Standards.
- Erosion (flow duration) – maintain existing erosion hours by meeting flow targets and implementing stormwater management recommendations.
- Peak Flow / Flooding – maintain existing in-stream flow rates by meeting flow targets.

The detailed implementation plan identified infiltration and greenspace as the primary stormwater management strategy for lands within the Dundee Secondary Plan Study. The implementation plan identified in the FDS are summarized as follows (Stantec Consulting Ltd, 2009):

- A hierarchical approach to development design and stormwater management should be taken, including prevention measures feasible within design. This approach emphasizes managing stormwater “higher” closer to the source. Where conditions permit development, design should at sources, conveyance, and end-of-pipe facilities should be distributed.
- During preliminary design, if in-situ soils are found to be more permeable than predicted, infiltration measures should be implemented as feasible.
- Continuous updates of the Guelph All-Weather Storm Event Runoff (GAWSER) model should be completed as development continues, and more monitoring data is available.
- Achieve reductions in impervious cover through the planning and design as a strategy to reduce the extent of stormwater management infrastructure requirements. For instance, site plans for private development lands (like condominiums) rather than public developments (like subdivisions).

- Preliminary planning and engineering design should work toward minimizing major roads and road grades, reducing the salt and sand requirements.
- Private developments, like condominiums or commercial/retail properties, that include internal road networks or vehicle parking areas that will retain private maintenance responsibilities must develop winter maintenance plans as part of the site plan approval process. These plans will emphasize minimizing the negative impacts of winter maintenance on water quality and should include plans for snow storage, plowing, and reducing the use of road salt.
- Implementation of as many preventing-based stormwater management techniques as feasible will contribute to the volume of water infiltrated. These include rain barrel programs and regular lawn aeration.
- The proposed stormwater management strategy will require more storage than a typical system. The municipality should be consulted on the stormwater management facilities options being considered as the ultimate owner of the facilities.

Table 3-1 includes a summary of stormwater management technologies recommended for implementation in public infrastructure in the FDS (Stantec Consulting Ltd, 2009).

Table 3-1. Summary of Stormwater Management Technologies Recommended for Implementation on Public Infrastructure

Category	Recommendations on Public Infrastructure
Prevention	Promotion of high-density development clustered with accompanied open space areas.
At-Source / Lot-level controls	Infiltration galleries/soakaway pits (privately owned) Infiltration trenches (public ownership) Parking lot/rooftop storage Rooftop gardens/green roofs
Conveyance Controls	Grassed swales Off-line infiltration galleries within parkettes Pervious pipes (outside of road right-of-way) Filter/buffer strips
End-of-Pipe Controls	Wet ponds Constructed wetlands Hybrid wet pond/wetland systems Infiltration Basins/trenches Greenway infiltration systems Oil/grit separation units (as a component in a treatment train approach) Dry ponds Filters

Source: (Stantec Consulting Ltd, 2009)

The FDS identified stormwater management criteria for the subcatchments (101, 103, 104, 105, 106, and 111) within the Dundee Study Area, these are (Stantec Consulting Ltd, 2009):

- Lot-level infiltration systems are designed to accept 25 mm of runoff from roof, facilities to be oversized by 15 percent to account for efficiency reduction over time.

- Conveyance (e.g. within parkettes) and end-of-pipe (e.g. stormwater management basin) infiltration as required to achieve a reasonable stormwater management facility drawdown time when combined with allowable surface discharge.
- 50 percent redundancy in infiltration capacity design.
- Infiltration galleries should be able to be taken 'off-line' during periods of high chloride loading.
- An "enhanced" (formerly level 1) level of water quality treatment is required – design accordance with MECP Design Guidelines.
- Storage/detention facilities designed in accordance with MECP/City guidelines capable of achieving the required peak flow reductions.

3.4.2.3 Summary of Stormwater Management Facilities in Blair Creek Subwatershed

Development has proceeded within the Blair Creek Subwatershed, downstream of the Study Area. The stormwater management facilities that currently exist and are operating within the subwatershed are summarized in Table 3-2. No City stormwater management facilities currently exist within the Cedar Creek Subwatershed.

Table 3-2. Upper Stormwater Management Facility Storage Volumes and MECP Requirements

SWM Facility	Type	Protection Level	Impervious Level (%)	MECP Required Storage Volume (m ³ /ha) ^[a]	Design Storage Volume (m ³ /ha)
Dodge Drive	Dry Pond	Basic (60% TSS Removal)	49.7	134.1	134
Hallman Groh South	Hybrid Wet Pond/ Wetland	Enhanced (80% TSS Removal)	56.4	152.3	152.5
Ormston	Hybrid Wet Pond/ Wetland	Enhanced (80% TSS Removal)	55	150	147.5
Stauffer Woods SWMF1	Wetland	Enhanced (80% TSS Removal)	57.5	107.5	107.5
Stauffer Woods SWMF 2	Wetland	Enhanced (80% TSS Removal)	63.5	113.5	113.5
Stauffer Woods SWMF 3	Hybrid Wet Pond/ Wetland	Enhanced (80% TSS Removal)	54.6	149.2	149

^[a] Interpolated based on Table 3.2 in MECP guidelines

3.4.3 Drinking Water System

The City of Kitchener is provided drinking water through the IUS that is owned and operated by the Regional Municipality of Waterloo. The IUS supplies the Cities of Cambridge, Kitchener, Waterloo, and Towns of St. Jacobs and Elmira, and smaller communities in parts of Woolwich, Wilmot and North Dumfries Townships. Figure 3-2 is a map of the existing water distribution network.

As detailed in the WSDOMP, the City of Kitchener is divided into eight pressure zones, and the study area is bordered by Zones 4 and 5 to the north and Zone 2W to the east. The topographic relief of the study area mimics that of the overall IUS system, with ground surface elevations lowest in Cambridge and increasing towards northwest Waterloo. Zone 4 is the largest pressure zone in the IUS, and all three zones are supplied primarily by the Mannheim WTP and groundwater sources in central Kitchener. The following are the ranges of the hydraulic grade line of each zone (Stantec Consulting Ltd., 2015):

- Zone 2W: 350.1 – 375 mASL
- Zone 4: 375.1 – 400 mASL
- Zone 5: 400.1 – 425 mASL

The Strasburg Road Extension Project includes extensions of the City's existing watermain to the vicinity of the study area. The proposed works consists of a 300 mm watermain located within the Strasburg Road Extension corridor (including the Blair Creek Drive Extension west of Reidel Drive) to service Zone 4 in Doon South, as noted in the 2013 Strasburg Road Extension Environmental Study Report (ESR) (SNC-Lavalin Inc., 2013).

3.4.4 Sanitary System Collection and Treatment

Sewage treatment for the City of Kitchener is provided by the Kitchener Wastewater Treatment Plant (WWTP) located at 368 Mill Park Drive. The WWTP has a rated capacity of 122,700 m³/d (Region of Waterloo, 2025). According to the Region of Waterloo's 2025 Water and Wastewater Monitoring Report (WWWMR) (Region of Waterloo, 2025), the WWTP that services the City of Kitchener has a committed capacity of 85,809 m³/d, allocated to existing connections and future registered developments. This leaves approximately 36,892 m³/d of available capacity to service future growth (Region of Waterloo, 2025).

The Kitchener sewage collection system comprises of gravity sewers that convey flows from higher elevated areas in the north to the lower elevations in the south, and ultimately to the Kitchener WWTP. Where topography inhibits the gravity system, sewage flows are pumped from sewage pumping stations (SPSs) via forcemains that eventually outlet either to a gravity main or directly to the WWTP.

Figure 3-3 presents the existing collection system and shows that the closest SPS to the study area is the New Dundee Sanitary SPS, located at 640 New Dundee Road. This SPS receives flow from the Dodge Drive Trunk (DDT) and pumps northward to the Homer Watson SPS located at 2200 Homer Watson Boulevard, from where wastewater is then directed to the Kitchener WWTP. Capacity details of the New Dundee SPS and Homer Watson SPSs are provided in Table 3-3 based on information from the Municipal Sewerage Collection System ECA (City of Kitchener, 2023).

Table 3-3: Existing SPS in the vicinity of Study Area (City of Kitchener, 2023)

Name	Capacity	Description
New Dundee SPS	56 L/s	▪ Wastewater is conveyed via a 600 mm diameter sanitary sewer. ▪ The SPS has 2 sewage pumps (1 duty, 1 standby). 1 duty pump has a discharge capacity of 56 L/s via 200 mm forcemain.
Homer Watson SPS	310 L/s	▪ Wastewater is conveyed via a 600 mm diameter sanitary sewer. ▪ The SPS has 3 sewage pumps (2 duty, 1 standby). 2 duty pumps have a discharge capacity of 310 L/s via twin 400 mm forcemain.

Figure 3-4 also illustrates the surface water drainage. General surface drainage flow is southeast in accordance with the natural topographical alignment.

3.5 Stream Geomorphology

Fluvial geomorphology refers to the relationship between the stream basin form and fluvial processes. A stable stream system does not mean firmly fixed or unchanging. Within a stream system, stability refers to a balance between erosion and sedimentation that enhances aquatic habitat and ecosystems within the subwatershed.

A detailed baseline for the Blair Creek was established in the BBB Study. Fluvial geomorphological monitoring has been conducted on Blair Creek at regular intervals since that time. Since the initiation of the first State of the Watershed study and report, rapid fluvial geomorphic assessments (RGAs), of the Creek have been included in those reports.

A baseline fluvial geomorphological baseline was established for Cedar Creek in 2019 as part of the Upper Cedar Creek Scoped Subwatershed study.

The fluvial geomorphology baseline was established for both watercourses using on the methods below:

- Reach delineation
- Rapid assessments
- Detailed characterization
- Headwater drainage feature assessment
- Geomorphic monitoring

3.5.1 Upper Blair Creek

Geomorphological measurements of Blair Creek have been undertaken at established creek cross sections since the BBB Study commenced in 1994. This section provides an overview of the ongoing monitoring and the findings of the RGAs completed for the upper reaches of Blair Creek completed for this study.

- **Pre-Development**
 - Blair, Bechtel, and Bauman Creeks Subwatershed Plan (CH2M Gore and Storrie 1997): This study established the pre-development geomorphic conditions within the Blair Creek watershed. The BBB Study established the Blair Creek as a C4 stream and established the reaches of Blair Creek discussed in subsequent studies and field monitoring studies.
 - Functional Drainage Study (Stantec, 2009): This study established the expectations for the Upper Blair Creek monitoring program including the annual geomorphic monitoring activities.
 - 2016 Upper Blair Creek State of the Watershed Report (Aquafor Beech Limited, 2016): This was the first state of the watershed report and established the pre-development baseline condition and identified indicators of change.
 - An RGA was completed for the upper reaches for this assignment (in Fall 2021).
- **During-Development**
 - Ongoing geomorphic monitoring reports (2015 to 2019) by Water's Edge

The field investigations completed through the BBB Study established two reaches of Blair Creek (CH2M Gore and Storrie 1997):

- Between Highway 401 and Dickie Settlement Road (reaches 1 and 2), and
- Between Dickie Settlement Road and Old Mill Road (reaches 3 and 4).

Two representative riffle sections in the creek were selected for measurements within each reach. These include monitoring sites XS-1 to XS-3 for reaches 1 and 2 and XS-4 to XS-6 for reaches 3 and 4 respectively. Measurements included cross-sectional surveys and bulk sampling of bed sediment material.

These reaches are maintained as the study reaches throughout the Upper Blair Creek monitoring program with some additional cross-sections added early in the during-development period.

3.5.1.1 Reach Delineation

The BBB Study defined representative reaches for Blair Creek based on defined criteria for main reaches (Reach 1 through Reach 4) that were based on desktop studies and field assessments. These reaches are shown in Figure 3-5 and are the basis for the RGAs completed annually as part of the ongoing subwatershed monitoring program.

3.5.1.2 Rapid Assessments

Rapid geomorphic assessments are completed annually for Blair Creek under the oversight of the GRCA as part of the Upper Blair Monitoring Program. Previous efforts did not establish cross sections for the portion of Blair Creek within the Dundee Secondary Plan Study Area. As part of this study, four new cross sections were established upstream of Riedel Drive, shown in Figure 3-6. The results of the “during-development” RGAs can be found in Appendix B along with the 2021 Water’s Edge RGAs for the cross sections established within the Study Area.

Table 3-4 and Table 3-5 present the 2021 RGA survey results for the cross sections located within the Study Area. These values serve as the baseline conditions for these cross sections.

Table 3-4. Summary of 2021 RSAT Results

Location	Channel Stability	Scour and Deposition	In-stream habitat	Water Quality	Riparian Conditions	Biological Indicators	Total Score	Condition
XS A	3.0	2.0	1.0	4.0	6.0	2.0	18.0	Poor
XS B	5.0	4.0	2.0	5.0	6.0	2.0	24.0	Fair
XS C	5.0	4.0	2.0	5.0	6.0	2.0	24.0	Fair
XS D	3.0	3.0	1.0	4.0	6.0	2.0	19.0	Poor

Table 3-5. Summary of 2021 RSAT Results

Location	Aggradation	Degredation	Widening	Planform Adjustment	Stability	Condition
XS A	0.57	0.00	0.20	0.86	0.41	In adjustment
XS B	0.57	0.10	0.40	0.29	0.34	Transitional
XS C	0.57	0.10	0.40	0.43	0.38	Transitional
XS D	0.57	0.00	0.30	0.57	0.36	Transitional

3.5.1.3 Summary of 2020 State of the Watershed Findings

The 2020 UBC SOW found that indicators of change for monitoring impacts on the fluvial geomorphology within the Blair Creek Subwatershed were found to be within thresholds as defined in the 2016 SOW (Aquafor Beech Limited 2016). Exceedances of thresholds have occurred; however, they are in areas which have other known impacts causing geomorphological changes, primarily due to beaver activity.

The first during-development monitoring report completed by Water's Edge did not identify any changes that were identified as related to development activities. However, the three cross sections immediately downstream of the developments (XS-7, 8 and 9) are significantly impacted by beaver activity. As noted by Water's Edge, the beaver pond had submerged the bank and erosion pins at these cross sections. They concluded that the ponded area is likely functioning as a stormwater management pond (Water's Edge 2020) and may be mitigating any potential development impacts downstream.

Other water quality and quantity indicators may be impacted by the observed beaver activity in the Study Area. The stream morphology monitoring concurs with the water quantity finding with respect to an observed significant increase in hours during which flows exceed the critical flow erosive threshold. At this time this exceedance of thresholds (increase of hours of erosive flows) has not resulted in observable impacts on stream morphology, however, this may change over the next monitoring period.

3.5.2 Cedar Creek

The Upper Cedar Creek Scoped Subwatershed study establishes the baseline conditions for Cedar Creek. Reaches and fluvial geomorphic conditions were established using similar methods to those used for Blair Creek. The Upper Cedar Creek Scoped Subwatershed study also completed a headwater drainage assessment for Cedar Creek.

3.5.2.1 Reach Delineation

Cedar Creek was delineated into six main reaches (CC-01 through CC-06) based on the desktop and field assessment (Matrix Solutions et al, 2019). Several tributaries and the headwaters drainage assessment were completed.

The reaches delineated for Cedar Creek can be seen in Figure 3-7.

3.5.2.2 Rapid Assessments

RGAs were completed where property access was granted. Table 3-6 and Table 3-7 provide a summary of these results.

The RGA results are similar across the reaches. All reaches are found to be transitional or in adjustment, both classifications indicate instability in the in the stream. (Matrix Solutions et al, 2019)

Table 3-6. Summary of RGA Results for Cedar Creek (Matrix Solutions et al, 2019)

Location	Channel Stability	Scour and deposition	In-stream habitat	Water Quality	Riparian Conditions	Biological Indicators	Overall Score	Condition
CC-01	2	1	3	8	7	6	27	Moderate
CC-02	1	2	4	8	7	6	28	Moderate
CC-03	1	2	3	8	6	6	26	Moderate
CC-04	1	2	3	8	6	6	26	Moderate
CC-05	3	2	6	8	7	6	32	Moderate
CC-06	4	3	7	7	6	8	35	High

Table 3-7. Summary of RGA Results for Cedar Creek (Matrix Solutions et al, 2019)

Location	Aggradation	Degradation	Widening	Planform Adjustment	Stability Index	Classification
CC-01	0.5	0	0.57	0.43	0.38	Transitional
CC-02	0.63	0	0.57	0.29	0.37	Transitional
CC-03	0.63	0.14	0.57	0.57	0.48	In adjustment
CC-04	0.56	0.14	0.63	0.57	0.47	In adjustment
CC-05	0.56	0.14	0.75	0.29	0.43	In adjustment
CC-06	0.44	0.14	0.50	0.29	0.34	Transitional

3.5.2.3 Headwater Drainage Features Classification

The goal of a headwater drainage feature classification is to classify features on the landscape that are not permanent watercourses but serve hydrologic, terrestrial, riparian, or aquatic function within the subwatershed (Matrix Solutions et al, 2019). The reaches identified can be seen in Figure 3-8.

Within the detailed Study Area for the Upper Cedar Creek Scoped Subwatershed study the following management recommendations were identified based on the results of the headwater drainage feature classification (Matrix Solutions et al, 2019):

- Reach CC-H1-S1 was preliminary designated as “protection” but was unconfirmed during the site visit.
- Reach CC-H1-S4 was designated as “conservation” due to the presence of water during the third site visit and the presence of woody riparian zone.
- No reaches were identified as “mitigation”.
- Reach CC-H1-S3 was designated as “recharge protection” as the feature is found downstream from a “conservation” headwater drainage feature that was observed to contain water.
- No reaches were designated as “maintain or replicate terrestrial linkage”.
- Several reaches were designated as “no management required” due to a lack of observed flow during the first site visit and no defined channel.

Where headwater drainage features are subsequently confirmed to function as regulated watercourses, they are subject to Ontario Regulation 41/24 and the GRCA's Consolidated Policies, including policies governing straightening, changing, diverting, or interfering with the existing channel of a river, creek, stream or watercourse. In such cases, regulatory requirements take precedence over the headwater drainage feature classification and permitting and policy compliance will be required.

3.6 Hydrology

The drainage features in the Study Area are located within the headwaters of two subwatersheds: the Blair Creek (to the northeast) and the Cedar Creek (to the southwest). The portion of the Study Area within Blair Creek is approximately 242.37 ha and consists mainly of three tributaries in the headwaters of the Upper Blair Creek. The tributary creeks normally have minimal baseflow but can convey higher flows during storm events. The tributaries converge near Reidel Drive and flow southeast out of the Study Area. The creek continues to be fed by tributaries along its course. After it passes south of Dodge Drive it enters a marshland and is fed by headwaters from the Roseville Swamp. Ultimately, Blair Creek discharges to the Grand River.

The southwestern portion of the Study Area lies within the northwest headwaters of the Upper Cedar Creek subwatershed. This area (approximately 206.39 ha) is located north of New Dundee Road, and generally between Trussler Road and Reidel Drive. The drainage system in this area extends through agricultural fields, with largely poorly defined or undefined drainage features (swales and low areas that traverse agricultural fields), with infrequent overland flow conveyance. These areas of the Cedar Creek do, however, play a role in seasonal conveyance (extreme rainfall and snowmelt events).

Cedar Creek becomes a more of a permanently flowing watercourse after it passes south of New Dundee Road, the southern boundary of the Study Area. It continues to flow southeast to the 401, and then south towards the town of Ayr where it discharges into the Nith River.

Figure 3-9 illustrates the existing drainage patterns and subwatersheds within the Study Area and immediate surrounding area.

3.6.1 Study Procedure

Hydrologic modeling of the Study Area was undertaken using the GAWSER modeling program. An existing hydrologic model representing the existing conditions of the area was provided to Jacobs from the City as a starting point for modelling.

For the Cedar Creek portion of the Study Area, current conditions were taken from an existing model developed for the Upper Cedar Creek Scoped Subwatershed Study (UCCSSWS) (Matrix Solutions et al, 2019), which also used the GAWSER methodology.

3.6.1.1 Climate Data

For the Blair Creek, precipitation measurements were collected from available monitoring stations from 1960 to 2019. The following stations were referenced for climate data:

- a) Preston Station (1960-1999)
- b) Roseville Swamp Station (2000-2019)
- c) Blair Creek Station (Intermittently used 2006-2019)

Each station recorded data for a portion of the period; as such, the full climate record is based on a combination of data from these weather stations. The data was combined as follows:

- Climate data from 1960 to 1999 was recorded from the Preston weather station. As this climate data was used in previous iterations of the model, it was left unchanged for this surface water simulation.
- Climate data from 2009 to 2019 was obtained from the GRCA, which evaluated a climate record based on Roseville Station supplemented by data from the Blair Creek Station.
- For the period from 2000 to 2006, and to supplement some gaps that were encountered in the GRCA database, climate data from the Roseville Swamp climate station, maintained by Environment Canada, was used.

For the Cedar Creek, climate data for the following stations and date ranges were utilized by the 2019 Study:

- Preston Gauge (1950-2017)
- Roseville Gauge (1950-2016)
- Waterloo/Wellington Gauge (1950-2016)

The locations of the climate monitoring stations are presented in Figure 3-10. 30-year climate normals, representing average monthly and annual weather conditions from 1981 to 2010 for Roseville Swamp, Preston and Waterloo/Wellington Stations are presented in Figure 3-10. The climate normals show a seasonal trend of higher rainfall from April to November, and lower rainfall from December to March. Average snowfall is highest from December to March, with smaller amounts in October, November, and April. Total annual precipitation recorded was 916-976 mm/year.

Table 3-8. Environment Canada Weather Station Climate Normals

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Year
Roseville Station													
Daily Average Temp (°C)	-6.5	-5.4	-1.0	6.5	12.7	18.2	20.5	19.5	15.2	8.7	2.6	-3.5	7.3
Rainfall (mm)	29.2	29.6	35.0	71.7	87.7	76.3	98.2	83.9	85.4	73.7	76.7	36.9	784.3
Snowfall (cm)	38.9	25.0	20.1	5.5	0.2	0.0	0.0	0.0	0.0	1.5	11.7	31.6	134.4
Precipitation (mm)	68.1	54.6	55.0	77.2	87.9	76.3	98.2	83.9	85.4	75.3	88.4	68.5	918.7
Preston Station													
Daily Average Temp (°C)	-6.4	-5.6	-0.8	6.5	13.0	18.0	20.7	19.6	15.0	8.9	2.8	-3.2	7.4
Rainfall (mm)	29.0	26.8	40.3	78.2	88.7	79.4	106.2	96.6	87.1	79.0	86.8	40.8	838.9
Snowfall (cm)	36.1	30.0	19.7	5.5	0.5	0.0	0.0	0.0	0.0	1.4	12.0	32.0	137.1
Precipitation (mm)	65.1	56.8	60.0	83.7	89.2	79.4	106.2	96.6	87.1	80.4	98.8	72.8	976.0
Waterloo/Wellington Station													
Daily Average Temp (°C)	-6.5	-5.5	-1.0	6.2	12.5	17.6	20.0	18.9	14.2	8.2	2.5	-3.3	7.0
Rainfall (mm)	28.7	29.7	36.8	68.0	81.8	82.4	98.6	83.9	87.8	66.1	75.0	38.0	776.8
Snowfall (cm)	43.7	30.3	26.5	7.3	0.4	0.0	0.0	0.0	0.0	1.4	13.0	37.2	159.7
Precipitation (mm)	65.2	54.9	61.0	74.5	82.3	82.4	98.6	83.9	87.8	67.4	87.1	71.2	916.5

3.6.1.2 Blair Creek Model

The Current Conditions model that represented the Upper Blair Creek watershed was divided into several drainage areas and surface water features. Each of these was assigned several numerical values representing physical features of the area for use in the modeling, such as land area and soil hydraulic conductivity. Most of the characteristics were left unchanged from how they were provided to Jacobs. However, Jacobs made some alterations to the Developer's Pre-Construction model parameters in order to incorporate new data that has been obtained from the hydrogeological investigations of the Activa and Grambian Lands. The following alterations were made:

- Portions of Subcatchment 101 and Subcatchment 105 were subdivided into separate areas, and the land types were changed to low permeability to reflect the presence of silt intrusions in the subsurface. This soil type will have lower hydraulic conductivity and thus be less permeable to groundwater infiltration. The area assigned the low permeability was based on the proportional area of the silt lens in the FEFLOW model compared to the total area of Catchments 101 and 105.
- The hydraulic conductivity of the sand was raised to align with the results of hydraulic conductivity testing more closely in Area 101.
- Forested areas were defined in the model in areas 101 and 105 that were not previously present. These catchments were subdivided along the boundaries of the forested areas. New subcatchments corresponding to the forested areas were assigned as being completely covered by forest land type category.

3.6.1.3 Cedar Creek Model

A GAWSER model, first developed for the 2005 Floodline Mapping Study (McCormick Rankin Corporation, 2005), and later built upon and refined for the 2019 Scoped Subwatershed Study (Matrix Solutions et al, 2019) has been used to characterize the baseline (existing) hydrologic conditions in the Upper Cedar Creek portion of the current Study Area. No updates were made to the model for baseline conditions.

3.6.2 Gauged Rainfall-Runoff Events

3.6.2.1 Blair Creek

For the Blair Creek portion of the Study Area, streamflow results calculated by the continuous hydrological model were compared to streamflow measurements of the Upper Blair Creek to calibrate the hydrologic model. The streamflow observations were taken from the Region's monitoring of the streamflow at the monitoring station upstream of Reidel Drive and upstream of New Dundee Road. Data from the Reidel Drive monitoring station was available from April 11, 2016, to June 19, 2016, while data from the New Dundee Road station was available from March 2, 2006, to October 30, 2019. The results are summarized in Table 3-9 below.

Table 3-9. Modelled Flow Results Compared to Surface Observations

	Flow Rate (m ³ /s)			
	Modeled Average Flow	Modeled Peak Flow	Observed Average Flow	Observed Peak Flow
Reidel Drive	0.001	0.002	0.002	0.007
New Dundee Road	0.060	1.12	.049	2.18

Modeled flow data were generally in agreement with observed flows. Flows at Reidel drive were modelled as typically being very low, which was in agreement flow observations for the monitoring period. The average flow upstream of New Dundee Road was also fairly close to the observations.

3.6.2.2 Cedar Creek

The 2019 model used continuous water level data collected during 2017, supplemented by GRCA-provided flow data as well as local rainfall data, to validate their hydrologic model as well as to characterize runoff response within the Upper Cedar Creek subwatershed.

3.6.3 Single Event Modelling

Storm events were also modeled using GAWSER. Both the Blair Creek and Cedar Creek models were set to simulate Chicago-distribution precipitation events over four-hour duration corresponding to 25 mm, 2-, 5-, 10-, 25-, 50- and 100- year storms, as well as a 48-hour regional storm event (Hurricane Hazel). These storm events are the same as have been used in previous studies (BBB, FDS) to simulate peak river flows. Water balances were calculated for each of these events. Recharge values from each storm event are presented in Table 3-10 (Blair Creek) and Table 3-11 (Cedar Creek).

Table 3-10. Simulated Flow Rates for Storm Events (Blair Creek Model)

	Flow Rate (m ³ /s)						
	2-year Storm	5-year Storm	10-year Storm	25-year Storm	50-year Storm	100-year Storm	Regional
Reidel Drive	0.02	0.11	0.21	0.36	0.50	0.66	4.12
New Dundee Road	0.10	0.31	0.46	0.67	0.87	1.09	15.33
Roseville Swamp Gauge 2	0.18	0.68	1.04	1.50	1.86	2.22	8.37

Table 3-11. Simulated Flow Rates for Storm Events (Cedar Creek Model)

	Flow Rate (m ³ /s)						Regional
	2-year Storm	5-year Storm	10-year Storm	25-year Storm	50-year Storm	100-year Storm	
101: NW Branch d/s New Dundee Rd	0.18	0.42	0.60	0.82	0.99	1.16	4.02

3.6.4 Continuous Simulation Modelling

3.6.4.1 Blair Creek

One of the main purposes of running the GAWSER model was to calculate the contribution of precipitation to groundwater recharge. The GAWSER model was run under Continuous Mode to simulate the hydrological water balance for each defined area over a long-term period, from 1960 to 2019. This period is an extension of the previous climate model, which ran from 1960 to 1999. Climate data from 1960-2019 recorded at the nearby Blair, Roseville and Preston weather stations were input to the model. The total water balance of each drainage area of the model can be represented as the following equation:

$$\text{Precipitation} = \text{Recharge} + \text{Evapotranspiration} + \text{Run-off}$$

Where precipitation represents the combined rainfall and snowfall, recharge represents the contribution to groundwater, evapotranspiration represents the amount of water that is evaporated or taken up by vegetation, and run-off is the overland flow (including through creeks and streams). The model calculates the proportion of precipitation that contributes to recharge, evapotranspiration and run-off based on a number of factors, including land topography, land cover type and soil characteristics.

The GAWSER model output values for each part of the water balance equation for each defined area. Table 3-12 presents the simulation outputs. The model areas correspond to defined catchment areas. Some of the catchment areas that were previously defined were subdivided into areas corresponding to specific characteristics, such as the presence of impermeable silt in the subsurface or forested areas. These are shown in Figure 3-9 indicated in the table.

Table 3-12. Water Balance Calculation for Continuous Model

Catchment	Precipitation (mm)	Evapotranspiration (mm)	Runoff (mm)	Recharge (mm)
101 - Sand	844.2	373.9	123.7	346.6
101- Forest	844.2	274.3	34.4	535.5
101- Silt	844.2	356.7	344.8	142.7
103	844.2	399.7	104.4	340.1
104	844.2	391.3	116.8	336.1
105 - Sand	844.2	388	127	329.2

Catchment	Precipitation (mm)	Evapotranspiration (mm)	Runoff (mm)	Recharge (mm)
105- Forest	844.2	401.7	17.8	424.7
105- Silt	844.2	356.7	344.7	142.8
106	844.2	204.3	394	245.9
107	844.2	438.1	125.6	280.5
108	844.2	440.8	62.7	340.7
109	844.2	448.9	10.7	384.6
110	844.2	434.9	55	354.3
111	844.2	439.4	71.7	333.1

3.6.4.2 Cedar Creek

As part of the 2019 Scoped Subwatershed Study, the Cedar Creek GAWSER model was executed in continuous mode, using a long term meteorologic timeseries provided by GRCA for Roseville station. A surface water budget for the Upper Cedar Creek Subwatershed was established using the results and is presented in Table 3-13.

Table 3-13. Monthly Water Budget Calculation for Upper Cedar Creek Subwatershed - Existing Conditions (From: Matrix et al, 2019)

Month	Rainfall ¹ (mm)	Runoff		Infiltration and Evapotranspiration / Storage	
		Total (mm)	% of Rainfall	Total (mm)	% of Infiltration
June	71.8	5.3	7.40%	66.5	93%
July	77.2	3.9	5.00%	73.3	95%
August	102.8	3.7	3.60%	99.2	96%
September	32.4	0.9	2.90%	31.5	97%
October	70.6	3.0	4.20%	67.6	96%
November	85.8	3.4	4.00%	82.4	96%
Mean	73.76	3.0	3.90%	70.9	96%
GRCA Gauge					
January	26.5	3.9	15%	22.6	85%
February	19.6	0.4	2%	19.2	98%
March	68.1	2.1	3%	66	97%
April	26.7	3.0	11%	23.7	89%
May	48.6	3.0	6%	45.6	94%
June	86.0	2.6	3%	83.4	97%
July	81.4	2.7	3%	78.7	97%

Month	Rainfall ¹ (mm)	Runoff		Infiltration and Evapotranspiration / Storage	
		Total (mm)	% of Rainfall	Total (mm)	% of Infiltration
August	122.3	3.5	3%	118.8	97%
September	45.4	1.3	3%	44.1	97%
October	66.8	2.0	3%	64.8	97%
November	74.1	2.4	3%	71.7	97%
December	59.2	1.4	2%	57.8	98%
Mean	60.4	2.3	4.80%	58.0	95%

¹Average Total Rainfall from Roseville Gauge (1960-2016)

The results of the continuous simulation, presented in Table 3-13, indicate the majority of rainfall would be infiltrated into the ground rather than become overland flow or direct runoff to receiving watercourses. The Subwatershed Study considered these results to be consistent with the characterization of the existing land use for the area, which is primarily rural, and hydrologic conditions within the subwatershed whereby soils exhibit low runoff and high infiltration potential.

3.7 Hydrogeology

The Study Area is located on the eastern flank of the Waterloo Moraine and is part of the Waterloo Hills physiographic region (Chapman & Putnam, 1984). Regional hydrogeology generally consists of a multi-layered aquifer and aquitard system that was mapped on a regional scale by the Ontario Geological Survey (Bajc & Shiota, 2007).

3.7.1 Data Sources

The following data sources were reviewed to develop an interpretation of the hydrogeologic setting within the Study Area and surrounding area.

3.7.1.1 Hydrogeology Reports

The following local hydrogeology reports were reviewed in this study:

- Blair, Bechtel, and Bauman Creeks Subwatershed Plan (CH2M Gore & Storrie Ltd, 1997),
- Detailed Hydrogeological Investigation for Southwest Kitchener (East of Fischer Hallman and West of Reidel Drive) (MTE, 2014),
- Upper Cedar Creek Scoped Subwatershed Study (Matrix Solutions et al, 2019),
- Scoped Environmental Impact Study, Part of Lots 25, 26 and 27, Concession XI, Township of North Dumfries, Region of Waterloo (Aboud & Associates Inc., 2020), and
- Upper Blair Creek State of the Watershed (Jacobs Engineering Group, 2020).

- And the following regional-scale geology and hydrogeology reports were reviewed:
- Three Dimensional Mapping of Surficial Deposits within the Regional Municipality of Waterloo (Bajc & Shirota, 2007) and
- Region of Waterloo Tier Three Water Budget and Local Area Risk Assessment (Matrix Solutions Inc and SSP&A, 2014).

3.7.1.2 Local Hydrogeology Data

In addition to the hydrogeologic reports, data was also provided by local land developers who commissioned the installation of several groundwater monitoring wells, and provided well construction details, lithologic data, water levels, and interpreted results of pumping test and single well response tests. Figure 3-11 illustrates the location of the monitoring wells and Table 3-14 summarizes the well names, coordinates, and screened information.

The Region of Waterloo (Region) also provided the following data to support this project:

- Static water levels at former monitoring wells and test wells.
- Transducer water level data from 23 actively monitored wells (data from 2019 to 2021) from the Strasburg Area.
- Manual water level data from 15 actively monitored wells (data from 2019 to 2021)
- Pumping data (2021) from the municipal pumping wells.

The Region also provided the following data to support this project (with all data in the area surrounding the Study Area):

- Static water levels at former monitoring wells and test wells,
- Transducer water level data from 23 actively monitored wells (data from 2019 to 2021) from the Strasburg area,
- Manual water level data from 15 actively monitored wells (data from 2019 to 2021), and
- Pumping data (2021) from the municipal pumping wells.

3.7.2 Regional Hydrogeological Setting

3.7.2.1 Regional Groundwater Flow and Discharge / Discharge Features

Groundwater flows from the core of the Waterloo Moraine in the west, towards the Grand River in the east. The Waterloo Moraine is a significant groundwater recharge area, due to the rapid infiltration of precipitation on coarse-grained sands and gravels, and because the topographic surface is hummocky in many places, leading to a reduction in groundwater runoff. Groundwater recharge is greatest in the spring and fall when plant transpiration is low, and precipitation exceeds shallow moisture storage.

Groundwater infiltrating to the water table on the Waterloo Moraine, flows downwards through the upper aquifers to the underlying deeper aquifers and then flows laterally towards the Grand River, and other nearby discharge features including Roseville Swamp, Blair Creek, and Cedar Creek.

3.7.2.2 Groundwater Use

The Region of Waterloo obtains approximately 75 percent of its drinking water use from a distributed set of groundwater supply wells. Municipal supply wells in the vicinity of the Study Area include:

- Wells K34 and K36 of the Strasburg Well Field, located approximately 2.5 kilometres (km) northeast of the Study Area, are screened in the Pre-Catfish Creek Aquifer unit.
- Wells A1, A2 and A3 of the Ayr Well Field, Well Field, located approximately 2.5 km south of the Study Area, are screened in the Pre-Catfish Creek Aquifer unit.
- Wells ND4 and ND5 of the New Dundee Well Field, Well Field, located approximately 5 km west of the Study Area, and are screened in the Upper Waterloo Moraine Sands Aquifer unit.
- Wells K23, K24 and K26 of the Mannheim West Well Field, located approximately 5 km northeast of the Study Area, and screened in the shallow Upper and Middle Waterloo Moraine Sands aquifer.

Rural homeowners in the area also are reliant on groundwater wells for their drinking water supplies. Their well construction details are in the provincial Water Well Information System (WWIS). Refer to the Grand River Assessment Report under the (CWA), 2006 for additional information on locally driven watershed protection plans.

3.7.3 Local Hydrogeologic Setting

3.7.3.1 Local Depth to Water Table

Groundwater elevations on the Study Area are influenced by localized topographic features, surface water bodies, and discontinuous shallow aquitards create perched groundwater conditions in some areas. Hydrogeologic investigations of the Study Area (2021) found that shallow groundwater was encountered at depths ranging from 0.4 to 9.8 m below ground surface corresponding to groundwater elevations of 315.3 to 333.2 metres above sea level (m asl), with perched conditions interpreted in some areas on top of the discontinuous Upper and/or Middle Maryhill Till.

3.7.3.2 Groundwater Flow Directions

Topography, surface water features, and underlying geology influence the lateral groundwater flow direction in the shallow system (i.e. Upper and Middle Waterloo Moraine Sands). Figure 3-12 and Figure 3-13 illustrate regional interpreted groundwater contours, and interpreted flow directions, based on the assembled water level dataset for the Upper and Middle Waterloo Moraine Sands, respectively. The groundwater flow directions largely mirror each other, supporting the conceptualization that these units are hydraulically connected and only separated in places where the Middle Maryhill Till is present.

From a regional perspective, the core of the Waterloo Moraine, west of the Study Area, acts as a recharge area and surface water flow divide for at least four surface water features: Alder Creek to the west, Strasburg Creek to the northeast, Upper Blair Creek to the East, and Roseville Swamp to the southeast. Some groundwater that flows west towards Alder Creek several kilometres west of the Study Area is also likely captured by the Region of Waterloo's Mannheim well fields, which pump water from the Middle Waterloo Moraine Sand aquifer.

Figure 3-14 illustrates the interpreted shallow groundwater contours within the Study Area. Lateral groundwater flow is interpreted to flow to three different receptors:

- the southern portion of the Study Area flows towards Roseville Swamp;
- the central portion of the Study Area flows towards Upper Blair Creek; and
- the northern portion of the Study Area flows towards Strasburg Creek.

Figure 3-15 illustrates interpreted groundwater flow contours in the Pre-Catfish Creek Sand Aquifer. The Region of Waterloo's Strasburg Wells K34 and K36 pump groundwater from this aquifer and interpreted groundwater contours (Figure 3-15) show lateral groundwater flow in this aquifer from the northern portion of the Study Area toward these wells.

3.7.3.3 Vertical Hydraulic Gradients

Vertical hydraulic gradient is a measure of the vertical flow potential and is a component of the vertical groundwater flux. Assessment of the vertical gradients in headwater areas is critical to characterization as it helps differentiate between recharging areas (downward gradients) and discharge areas (upward gradients). Continuously measured vertical gradients also provide insight into the seasonality and overall transient variability of vertical flow directions, especially surrounding wetland complexes.

Vertical groundwater gradients were calculated using both manual and transducer datasets, from monitored multi-screen wells and nested drive point piezometers within the Study Area. This consisted of:

- Manual water level data collected at 16 well locations: ten (10) from the developer dataset and another six (6) from the Upper Cedar Creek Scoped Subwatershed Study (Matrix Solutions Inc and SSP&A, 2014).
- Transducer water level data recorded from approximately November 2020 to November 2021 at two (2) well locations, and seven (7) drive point piezometer locations from the developer supplied dataset.

Vertical gradients were averaged over time and mapped (Figure 3-16). Strong downward gradients were observed on the western edge of the Study Area and weakened to near zero moving east to the headwaters of Blair Creek. Roseville Swamp, located in a low-lying area three kilometres southeast of the Study Area, experiences upward gradients, indicating the wetland is supported by groundwater discharge. This interpretation is consistent with conclusions from the Upper Cedar Creek Scoped Subwatershed Study (Matrix Solutions et al, 2019) and (Aboud & Associates Inc., 2020).

Transducer data recording water levels in the Upper Blair Creek headwaters area, west of Reidel Drive, indicate overall long-term vertical gradients as weakly downward, with the exception of DP102-20, which recorded a consistent upward gradient; however, this was only monitored from June to September 2021. Other drive point piezometers recorded seasonally variable vertical gradients: DPs 101, 105, 106 and 107 all recorded upwards gradients in summer and downward gradients in winter/spring. These transient observations are illustrated in Figure 3-17 to Figure 3-23.

Vertical gradients can also be used to approximate vertical leakage rates. Figure 3-14 and Figure 3-15 illustrate downward gradients between the Middle Waterloo Moraine Sands and the deeper, confined Pre-Catfish Creek Sand aquifer. This indicates the continuous presence of the Lower Maryhill Till and/or Catfish Creek Till beneath the Study Area. This downward gradient is generally on the order of 5 metres of

difference in water level elevations across approximately 11 m of combined thickness of Lower Maryhill and Catfish Creek Till. Using an estimated vertical hydraulic conductivity value of 1×10^{-8} m/s for these tills (based on an anisotropy ratio of 10, and MTE (2014) tests results), this corresponds to 143 mm/year of vertical leakage, or approximately 45% of the total estimated recharge of approximately 300 mm/year. If a low end vertical hydraulic conductivity estimate of 5×10^{-9} m/s is used for this calculation instead, the vertical leakage drops to 71 mm/year, or only 23% of the estimated groundwater recharge rate.

3.7.3.4 Overall Conceptualization of Groundwater Flow

The above observations and interpretations support the following conceptualization of groundwater flow within the Study Area, that are illustrated and annotated in Figure 3-24, and discussed in the following paragraphs.

The upland area on the Waterloo Moraine (see “A” in Figure 3-24) provides strong downward gradients and high groundwater recharge rates. Groundwater migrates primarily downward into the Upper and Middle Moraine Sands. The Upper Waterloo Moraine Sands are primarily unsaturated, but where present, the highly discontinuous Middle Maryhill Till facilitates local perched systems and lateral saturated groundwater flow towards three surface water features: Strasburg Creek from the northern portion of the Study Area, Upper Blair Creek from the central portion, and Roseville Swamp from the southern portion.

The Upper Blair Creek headwaters west of Reidel Drive (see “B” on Figure 3-24) receive limited seasonal groundwater discharge. During winter and spring, when there is a moisture surplus at the surface, the headwaters receive consistent surface water input and these downward gradients lead to downward groundwater flow. In summer and fall, when there is a moisture deficit at the surface, weak upward gradients exist in the shallowest saturated portions of the Upper Waterloo Moraine Sands, which provide some groundwater discharge into the headwater riparian wetland vegetation, but not enough to support perennial flow in Upper Blair Creek, west of Reidel Drive.

East of Reidel Drive (see “C” on Figure 3-24), Blair Creek begins flowing perennially via groundwater discharge primarily from the Middle Waterloo Moraine Sands. Upper Blair Creek continues to gain more groundwater discharge as water flows downstream to Blair Creek Drive.

Strong downward vertical gradients drive between 70 and 140 mm/year, or approximately 23-45 percent of groundwater recharge from the Middle Waterloo Sands across the Lower Maryhill/Catfish Creek Tills down into the Pre-Catfish Creek Sand Aquifer in area “D” on Figure 3-24. Once in this aquifer, groundwater flow is interpreted to travel from this area northeastward toward the Region of Waterloo’s Wells K34 and K36 in the Strasburg Well Field.

3.8 Legislative Framework

The Region must operate within the administrative, legislative and financial framework established by relevant levels of government. Key provincial, federal and municipal acts and regulations provide directives and guidance for the planning process. Relevant acts and regulations are described in the following section.

3.8.1 Water Treatment and Distributions

Water treatment processes must meet the requirements of the following environmental protection legislation and regulations:

- Grand River Source Protection Plan (GRCA, 2025): includes plans and policies that apply to activities that are identified as drinking water source threats and delineates wellhead protection zones. Examples of these threats can be chemical (i.e., diesel) or the release of untreated sewage and require mitigation measures to promote source water protection. The Source Protection Plan (GRCA, 2025), along with the GRCA Web Map (GRCA, 2025) delineates locations of vulnerable areas. Impacts on Source Water Protection will be identified in the Dundee Secondary Plan EA Project File.

A map illustrating the wellhead vulnerable areas surrounding the Dundee Secondary Plan area has been prepared using data from the GRCA Web Map (GRCA, 2025) and is provided in Figure 3-25.

3.9 Geology

3.9.1 Regional Hydrostratigraphy Units

To characterize groundwater flow directions, gradients and the interaction between groundwater and surface water flow systems, a conceptual understanding of the regional and local subsurface hydrostratigraphic environment was conducted. The regional groundwater flow system provides broad context for the characterization of the local groundwater flow system.

3.9.1.1 Bedrock Stratigraphic Units

Paleozoic bedrock formations beneath the Waterloo Moraine, including the south Kitchener area, consist of limestone, dolostone and shale formations (Armstrong & Dodge, 2007). Due to the thickness of the Waterloo Moraine and its underlying sediments, few boreholes extend to bedrock in the Kitchener area. Available data and mapping (Johnson, Armstrong, Sanford, Telford, & Rutka, 1992) suggests the uppermost bedrock units beneath the Kitchener area are likely to include:

- Salina Formation- poor aquifer/ aquitard: Interbedded dolostone, mudstone and shale with lenses of evaporates.
- Guelph Formation – aquifer/ local fine grained aquitard beds: Cream coloured, medium to thickly bedded, fossiliferous dolostone (Brunton, 2009).
- Eramosa Formation: subdivided into an upper Reformatory Quarry Member (aquifer), a light brown, thickly bedded dolostone, and a lower Vinemount Member (aquitard), a grey-black, thinly bedded fine crystalline dolostone with shaley beds (Brunton, 2009).

Underlying these bedrock formations are thick carbonate rocks including the Goat Island and Gasport formations (aquifers).

3.9.1.2 Overburden Stratigraphy Units

Overburden hydrostratigraphic units within the Waterloo Moraine area are complex and consist of interbeds of aquifers and aquitards. Bajc and Shirota (2007) mapped over 20 hydrostratigraphic units in the Region of Waterloo, and these were simplified in the Kitchener area as follows:

- Upper Maryhill Till: silty clay-rich till; sporadically present at/ near surface in the Kitchener area.
- Upper Waterloo Moraine Sands: sands and some gravel.
- Middle Maryhill Till: silty clay-rich till; locally present but eroded in some areas in the Kitchener area.
- Middle Waterloo Moraine Sands: sands and some gravel.
- Lower Maryhill Till and Catfish Creek Till: silty clay-rich till and stoney, silty to sandy till, present throughout the Region of Waterloo.
- Lower aquifers and aquitards that include the Pre-Catfish Creek Sands (discontinuous sands and gravels), and the Canning Drift (aquifers and aquitards).

3.9.2 Local Hydrostatigraphic Units

The local lithologic data from the Dundee Secondary Plan (Study Area) and surrounding publicly available data were assembled and cross-sections were generated to bring the Study Area data into the regional context. A 3 km long west to east cross-section was generated across the northern portions of the Study Area passing through five monitoring wells drilled on the Study Area and is illustrated on Figure 3-26.

Local hydrogeological investigations were carried out in the vicinity of the Study Area, and reports and data were provided to Jacobs (see Section 3.7). Surficial till (Upper Maryhill Till) was encountered in a few locations on the Study Area, including in the northwest reaches of the Study Area (MW209-21; see Figure 3-26), and the till is thickest at MW3-11 in the south-central portion of the Study Area at MW3-11, where over 10 m of till is reported at surface.

The Upper Waterloo Moraine Sands are interpreted to be present across the Study Area and as illustrated on Figure 3-26, varies from fine sand to coarse sand, to sands with gravel. The unit is interpreted to be over 30 m thick in the northwestern portion of the Study Area near well MW209-21 (Figure 3-26) to less than 5 m in the southern portions of the Study Area along New Dundee Road (Figure 3-27). The layers illustrated on Figure 3-26 and Figure 3-27 were generated by interpreting cross-sections throughout the area and interpolating all available lithological information within the Study Area and surrounding areas.

The silt to clay-rich till (Middle Maryhill Till; Figure 3-26) was encountered at several monitoring well locations on the Study Area at elevations of approximately 316 to 320 m asl. The till is interpreted to vary in thickness from less than 1 m at MW207-21 (Figure 3-27) to over 10 m in the southern reaches of the Site near New Dundee Road near Well MW212-21.

The Middle Waterloo Moraine Sands underlie the Middle Maryhill Till and this sand aquifer is interpreted to be present across the Study Area and be thickest in the western reaches of the Study Area (over 20 m) and thin to less than 4 m in the eastern reaches of the Study Area near the headwaters of Blair Creek (Figure 3-26).

As illustrated on Figure 3-26 and Figure 3-27. There are additional aquifers and aquitards that underlie the upper sediments discussed, and the total thickness of overburden beneath the Study Area exceeds 90 m in some places.

3.9.2.1 Local Hydraulic Conductivity Values

Hydraulic conductivity tests were completed across the Study Area and the interpreted hydraulic conductivity values for the various aquifers and aquitards tested are illustrated on Figure 3-11 and a summary is provided in Table 3-14.

Table 3-14. Summary of Aquifer Testing

Well Name	Screened Aquifer	Interpreted Conductivity (m/s)	Source
MW 101-20(S)	Upper Waterloo Moraine Sand	6.2×10^{-6}	Grambian (Stantec)
MW 101-20(D)	Middle Maryhill Till	1.0×10^{-8}	Grambian (Stantec)
MW 102-20(S)	Upper Waterloo Moraine Sand	1.0×10^{-4}	Grambian (Stantec)
MW 102-20(D)	Middle Maryhill Till	1.2×10^{-7}	Grambian (Stantec)
MW 103-20(S)	Middle Maryhill Till	1.3×10^{-7}	Grambian (Stantec)
MW 103-20(D)	Middle Maryhill Till	4.0×10^{-8}	Grambian (Stantec)
MW 104-20(D)	Middle Maryhill Till	5.8×10^{-7}	Grambian (Stantec)
TW1-12	PreCatfish Sands	4.0×10^{-4}	Activa Lands (MTE)
MW1B-10	Catfish Creek Till	1.0×10^{-6}	Activa Lands (MTE)
MW1C-10	Middle Waterloo Moraine Sand	2.1×10^{-4}	Activa Lands (MTE)
MW1D-10	Upper Waterloo Moraine Sand	2.6×10^{-5} and 1.2×10^{-5}	Activa Lands (MTE)
MW2A-10	Lower Waterloo Moraine Sand	1.2×10^{-3}	Activa Lands (MTE)
MW2C-10	Middle Waterloo Moraine Sand	9.9×10^{-4}	Activa Lands (MTE)
MW1A-11	PreCanning Sands	5.2×10^{-4}	Activa Lands (MTE)
MW1B-11	PreCatfish Sands	4×10^{-5} and 9×10^{-6}	Activa Lands (MTE)
MW1C-11	Catfish Creek Till	8.7×10^{-4}	Activa Lands (MTE)
MW2A-11	Catfish Creek Till	1.6×10^{-6}	Activa Lands (MTE)
MW3-11	Lower Maryhill Till	2×10^{-6} and 3×10^{-7}	Activa Lands (MTE)
MW4A-11	Catfish Creek Till	2.5×10^{-7}	Activa Lands (MTE)
OW1D-17	PreCatfish Sands	1.0×10^{-3}	Cedar Creek SWS (Matrix et al, 2019)

Well Name	Screened Aquifer	Interpreted Conductivity (m/s)	Source
OW1S-17	Middle Waterloo Moraine Sand	1.0×10^{-3}	Cedar Creek SWS (Matrix et al, 2019)
OW2D-17	Middle Waterloo Moraine Sand	5.0×10^{-4}	Cedar Creek SWS (Matrix et al, 2019)
MW3A-10	PreCanning Sands	8.5×10^{-5}	Cedar Creek SWS (Matrix et al, 2019)
MW3B-10	PreCatfish Sands	3.5×10^{-5}	Cedar Creek SWS (Matrix et al, 2019)

3.10 Natural Heritage

Ontario's 2024 Provincial Planning Statement (PPS) defines Natural Heritage Features (NHF) as:

"features and areas, including significant wetlands, significant coastal wetlands, other coastal wetlands in Ecoregions 5E, 6E and 7E, fish habitat, significant woodlands and significant valleylands in Ecoregions 6E and 7E (excluding islands in Lake Huron and the St. Marys River), habitat of endangered species and threatened species, significant wildlife habitat, and significant areas of natural and scientific interest, which are important for their environmental and social values as a legacy of the natural landscapes of an area." (Government of Ontario, 2024).

The objective and scope of the Natural Heritage Assessment presented in Appendix D is to identify and provide information on NHFs within and proximal to the Study Area. This will assist in future development planning to ensure protection and recommendations for disturbance mitigation for NHFs.

3.10.1 Information Sources

WSP completed two reports, Existing Conditions & Ecological Constraints Report 2021 and 2025, for two areas surveyed within this Study Area shown Figure 3-28. In addition, Stantec completed a report for the northeastern portion of the Study Area in 2013, also shown in Figure 3-28. A 2025 desktop review of natural heritage features and fieldwork highlights from the WSP and Stantec reports are provided within this report, with more details in Appendix D.

Available online background data were accessed in 2025 to screen for existing data on NHFs and Species at Risk (SAR) within the Study Area and 120 m adjacent lands. In accordance with the Natural Heritage Reference Manual (Ontario Ministry of Natural Resources, 2010), 120 m is a standard distance from NHFs for which an evaluation is required to assess potential negative impacts on said features.

The following sources were accessed to identify any potential NHFs or SAR that may be present within or proximal to the Study Area:

- Department of Fisheries and Oceans Canada (DFO) online Aquatic Species at Risk Map (DFO, 2025)

- Direct consultation with the NHIC (Natural Heritage Information Centre)
- Grand River Conservation Authority (GRCA) mapping (MNR, 2025b)
- iNaturalist (iNaturalist, 2025)
- Ministry of Natural Resources (MNR) Lands Information Ontario (LIO) data sets (LIO, 2025a and 2025b) and Make a Natural Heritage Map (MNR, 2025b)
- Ontario Breeding Bird Atlas (OBBA) data (Bird Studies Canada, 2021)

Additionally, the following reports were referenced for field investigation information:

- *Existing Conditions & Ecological Constraints Report. WSP Canada Inc. 2021*, (WSP Canada Inc., 2021).
- *Existing Conditions & Ecological Constraints Report. WSP Canada Inc. 2025*, (WSP Canada Inc., 2025).
- *Robert Ferrie Drive Alignment Alternatives, Southwest Kitchener Natural Environment Existing Conditions Report. Stantec Consulting Ltd. 2013*, (Stantec, 2013).

Results from the background desktop review, conducted by Jacobs in 2025, are summarized in the following sections and in detail in Appendix D.

3.10.2 Natural Heritage Features

NHFs within the Study Area and 120 m adjacent lands (shown in Figure 3-29) were investigated by referencing available mapping from GRCA (MNR, 2025b), LIO datasets (LIO, 2025a and 2025b), City of Kitchener's Official Plan (City of Kitchener, 2014), and online Make a Natural Heritage Map (MNR, 2025b). Features reviewed are summarized as follows:

- **Areas of Natural and Scientific Interest (ANSIs):** ANSIs do not occur within the Dundee Secondary Plan Study Area or within 120m of the adjacent lands. Blair Creek originates in the Study Area and is hydrologically connected to the Roseville Swamp ANSI (located approximately 1.3 km southeast of the study area).
- **Environmentally Significant Areas (ESAs):** ESAs do not occur within the Dundee Secondary Plan Study Area or within 120m of the adjacent lands.
- **Natural Heritage System (NHS):** The extend of the NHS for the Dundee Secondary Plan are illustrated in Figure 3-29.
- **Provincially Significant Wetlands (PSWs):** The Roseville Swamp Cedar Creek Wetland Complex occurs within the eastern portions of the Dundee Secondary Plan Study area. The Strasburg Creek Wetland Complex occurs within the Dundee Secondary Plan Study Area and extends beyond the 120 m adjacent lands (illustrated in Figure 3-29).
- **Wetlands:** GRCA and MNR mapping identify an unevaluated wetland with in the western portion of the Dundee Secondary Plan Study Area. There are two smaller unevaluated wetlands located within the 120 m adjacent lands west of Fischer-Halman Road. Wetlands are illustrated on Figure 3-29.
- **Woodlands and valleylands:** There are woodlands occurring within the Dundee Secondary Plan Study Area and within the 120 m adjacent lands. A large stretch of woodland occurs along Blair Creek within and outside of the study area east of Reidel Drive. There are also pockets of woodlands intermittently throughout the study areas and portions of woodlands in the northern boundary of the Study Area and in the center of the study area. No valleylands were identified

within the Study Area or 120 m adjacent lands. The extent of woodlands within the Study Area and 120 m adjacent lands are shown in Figure 3-29.

- **Water bodies and watercourses:** The Blair Creek headwaters occur within the Dundee Secondary Plan Study Area, Blair Creek flows eastward to the Grand River.

Additional details regarding the NHR characterization are available in Appendix D.

3.10.3 Wildlife and Wildlife Habitat

Background data obtained for wildlife included a review of the OBBA, which provides information on avifauna occurrences based on a 10 square kilometer (km²) area. The 2nd atlas of the OBBA was utilized, which includes data collected from 2001 to 2005. The Study Area occurs within OBBA Square Summary 17NJ44 Region # 7: Waterloo. iNaturalist was also accessed for research grade observations.

3.10.3.1 Significant Wildlife Habitat (SWH)

Significant Wildlife Habitat (SWH) is designated by criteria outlined within the Significant Wildlife Habitat Technical Guide (MNR, 2000) and divides habitat into four main categories:

- 1) Seasonal Concentration Areas include the following:
 - (a) At certain times of the year, some species of wildlife are highly concentrated within relatively small areas. In spring and autumn, migratory species of birds and butterflies concentrate in critical stopover areas where they can rest and feed. Other examples of such habitat include winter deer yards, bird breeding colonies, and hibernation sites for bats or snakes (MNR, 2000).
- 2) Rare Vegetation Communities or Specialized Habitat for Wildlife include the following:
 - (a) Areas that contain a provincially rare vegetation community and areas that contain a vegetation community that is rare within the planning area. Specialized habitats include areas that support wildlife species that have highly specific habitat requirements, and areas with exceptionally high species diversity or community diversity areas that provide habitat that greatly enhances a species' survival (MNR, 2000).
- 3) Habitat for Species of Conservation Concern (Not including Endangered or Threatened Species):
 - (a) Rare species status is defined by SAR legislation and global or provincial ranks provided by the NHIC.
- 4) Animal Movement Corridors:
 - (a) Animal movement corridors are elongated, naturally vegetated parts of the landscape used by animals to move from one habitat to another. They exist at different scales and frequently link or border natural areas. Animal movement corridors encompass a wide variety of landscape features including riparian zones and shorelines, wetland buffers, stream and river valleys, woodlands, and anthropogenic features such as hydro and pipeline corridors, abandoned road and rail allowances, and fencerows and windbreaks (MNR, 2000).

Based on the background review, reports reviewed, and available mapping, candidate and confirmed SWH does occur within the Study Area.

3.10.3.2 SAR and SAR Habitat

The background screening provides a list of SAR, which are flora and fauna which are at risk of extirpating from the wild due to factors such as habitat loss, anthropogenic disturbances, or climatic change. SAR within Ontario are primarily protected under the Endangered Species Act (ESA, 2007). Species can be ranked as follows:

1. Endangered - species facing imminent extirpation or extinction
2. Threatened - species likely to become endangered if limiting factors are not reversed
3. Special Concern - species may become threatened or endangered due to identified threats
4. Extirpated - species no longer existing in the wild at this location but may occur elsewhere

SAR listed under the ESA are under the jurisdiction of the Ministry of the Environment, Conservation and Parks (MECP) and aquatic SAR (e.g., fish and mussels) are protected federally, as administered by DFO under the Species at Risk Act (SARA). Special Concern species are not protected under these Acts; however, habitat for these species is typically afforded protection under SWH criteria.

The NHIC provides current and historical data on SAR and Natural Features occurrences within Ontario using 1 km² areas. The Aquatic Species at Risk Map (DFO, 2025) provides data on occurrences of critical habitat and the distribution of aquatic SAR. Available SAR data within the Study Area and 120 m adjacent lands are presented within Table 3-15, based on the NHIC database (MNR, 2025b), OBBA (square 17NJ40, Region #7 Waterloo), the Aquatic Species at Risk Map (DFO, 2025), and iNaturalist research grade observations (iNaturalist, 2025).

In addition to the SAR identified during 2025 background screening, consultation with MECP in 2022 indicated the potential presence of American Badger and SAR Bats within the Study Area. As such, they have been included in Table 3-15.

Table 3-15: Species at Risk from Background Screening

Common Name	Scientific Name	S Rank ^a	SARO ^b	COSEWIC ^c	SARA ^d
Birds					
Acadian Flycatcher	<i>Empidonax vireescens</i>	S1B	END	END	END
Bank Swallow	<i>Riparia riparia</i>	S4B	THR	THR	THR
Barn Swallow	<i>Hirundo rustica</i>	S4B	SC	SC	THR
Black Tern	<i>Chlidonias niger</i>	S3B,S4M	SC	NAR	-
Bobolink	<i>Dolichonyx oryzivorus</i>	S4B	THR	SC	THR
Canada Warbler	<i>Cardellina canadensis</i>	S5B	SC	SC	THR
Cerulean Warbler	<i>Setophaga cerulea</i>	S2B	THR	END	END
Chimney Swift	<i>Chaetura pelagica</i>	S3B	THR	THR	THR
Common Nighthawk	<i>Chordeiles minor</i>	S4B	SC	SC	SC
Eastern Meadowlark	<i>Sturnella magna</i>	S4B,S3N	THR	THR	THR
Eastern Wood-pewee	<i>Contopus virens</i>	S4B	SC	SC	SC
Golden-winged Warbler	<i>Vermivora chrysoptera</i>	S3B	SC	THR	THR

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Common Name	Scientific Name	S Rank ^a	SARO ^b	COSEWIC ^c	SARA ^d
Grasshopper Sparrow	<i>Ammodramus</i> <i>savannarum</i>	S4B	SC	SC	-
Least Bittern	<i>Botaurus exilis</i>	S4B	THR	THR	THR
Northern Bobwhite	<i>Colinus virginianus</i>	S1?	END	END	END
Olive-sided Flycatcher	<i>Contopus cooperi</i>	S4B	SC	SC	SC
Red-headed Woodpecker	<i>Melanerpes</i> <i>erythrocephalus</i>	S3	END	END	END
Short-eared Owl	<i>Asio flammeus</i>	S4?B,S2S3N	THR	THR	SC
Wood Thrush	<i>Hylocichla mustelina</i>	S4B	SC	THR	THR
Mammals					
American Badger (Southwestern Ontario population)*	<i>Taxidea taxus jacksoni</i>	S1	END	END	END
Eastern Red Bat	<i>Lasiurus borealis</i>	S3	END	END	-
Eastern Small-footed Myotis	<i>Myotis leibii</i>	S2S3	END	-	-
Little Brown Myotis	<i>Myotis lucifugus</i>	S3	END	END	END
Northern Hoary Bat	<i>Lasiurus cinereus</i>	S3	END	END	-
Northern Myotis	<i>Myotis septentrionalis</i>	S3	END	END	END
Silver-haired Bat	<i>Lasionycteris noctivagans</i>	S3	END	END	-
Tricolored Bat	<i>Perimyotis subflavus</i>	S3?	END	END	END
Amphibians					
Unisexual Ambystoma (Jefferson Salamander dependent population)	<i>Ambystoma hybrid pop. 1</i>	S2	END	END	-
Insects					
American Bumble Bee	<i>Bombus pensylvanicus</i>	S3S4	SC	SC	SC
Monarch	<i>Danaus plexippus</i>	S2N, S4B	SC	END	SC
Rapids Clubtail	<i>Phanogomphus</i> <i>quadricolor</i>	S2	THR	END	END
Aquatics					
Black Redhorse	<i>Moxostoma duquesnei</i>	S2	THR	THR	THR
Silver Shiner	<i>Notropis photogenis</i>	S2S3	THR	THR	THR
Wavy-rayed Lampmussel	<i>Lampsilis fasciola</i>	S2	THR	SC	SC
Herptiles					
Blanding's Turtle	<i>Emydoidea blandingii</i>	S3	THR	END	-
Eastern Milksnake	<i>Lampropeltis triangulum</i>	S4	NAR	SC	SC
Midland Painted Turtle	<i>Chrysemys picta</i> <i>marginata</i>	S4	-	SC	SC
Snapping Turtle	<i>Chelydra serpentina</i>	S4	SC	SC	SC
Plants					

Common Name	Scientific Name	S Rank ^a	SARO ^b	COSEWIC ^c	SARA ^d
Black Ash	<i>Fraxinus nigra</i>	S4	END	THR	-
Butternut	<i>Juglans cinerea</i>	S2?	END	END	END
Kentucky Coffee-tree	<i>Gymnocladus dioicus</i>	S2	THR	THR	THR
Scarlet Beebalm	<i>Monarda didyma</i>	S3	-	-	-

a SRank (Subnational Rank) is the conservation status of a species/plant community within Ontario, assigned by the NHIC (MNR, 2024)

b Species at risk in Ontario (Government of Ontario, 2025)

c Committee on the Status of Endangered Wildlife in Canada recommended status (COSEWIC, 2025)

d Species at Risk Act, 2002 (Government of Canada, 2025)

* Identified by MECP consultation

? = more data required

- = not at risk

B = status qualifier; breeding

END = endangered

H = status qualifier; possibly extirpated

M = status qualifier; migrant species

N = status qualifier; nonbreeding

S#S# = range given due to uncertainty

S1 = critically imperilled (often 5 or fewer occurrences)

S2 = imperilled (often 20 or fewer occurrences)

S3 = vulnerable (restricted range with relatively few populations – often 80 or fewer)

S4 = uncommon but not rare; some cause for long-term concern due to declines or other factors

S5 = secure species, common, widespread, and abundant

SC = special concern

THR = threatened

3.10.3.3 Six Nations of the Grand River

The Haudenosaunee – Six Nations of the Grand River, is the largest First Nations population in Canada. Their current territory spans 46,500 acres, in which the Study Area is situated. As such, meaningful and proactive consultations with the Six Nations of the Grand River Elected Council (SNGREC) and reference to the Six Nations of the Grand River Environmental Levy Policy are recommended to better understand the mitigations required to address the impacts of past and future development.

It is recognized that the current baseline efforts may not cover details on all natural heritage components valued by indigenous partners. For example, in addition to species afforded protections under federal and provincial legislation, special considerations should be paid for Haudenosaunee-specific species of importance (i.e. medicinal plants, clan animals, flora and fauna used as country foods or in ceremony).

3.10.3.4 Grand River Conservation Authority (GRCA) Regulated Area

A portion of the Study Area occurs within the GRCA Regulated Area. As such, the Study Area is governed in accordance with O. Reg.41/24 Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses. The GRCA regulation limits are shown in Figure 3-29.

3.10.4 Aquatic Habitat

Two watercourses were identified within the Study Area. Tributaries and head waters to Blair Creek, a coldwater watercourse, extend west of Reidel Drive into the centre of the Study Area and are predominantly surrounded by the Roseville Swamp Cedar Creek Wetland Complex. The main branch of Blair Creek continues east beyond the Study Area. According to LIO's Aquatic Resource Area (ARA) Line Segments GU-3005-BOW, (MNR, 2025c) located within the Study Area the following fish have been identified in Blair Creek within or proximal to the Study Area:

- Brook Stickleback (*Culaea inconstans*)
- Central Mudminnow (*Umbra limi*)

In addition, further downstream, approximately 2 kilometres east of the Study Area, Brook Trout (*Salvelinus fontinalis*) was observed at LIO ARA Survey Point GU-3004-BOW.

A second, unnamed tributary to Cedar Creek is located in the southwestern portion of the Study Area. The watercourse originates just north of New Dundee Road, where it crosses underneath the road, and flows southeast beyond the 120 m adjacent lands. According to LIO's Aquatic Resource Area (ARA) Line Segments GU-3003-CED, (MNR, 2025c) located within and beyond the Study Area the following fish have

been identified in the unnamed tributary to Cedar Creek:

- Blacknose Dace (*Rhinichthys atratulus*)
- Brook Stickleback
- Brook Trout
- Creek Chub (*Semotilus atromaculatus*)
- Fathead Minnow (*Pimephales promelas*)
- Iowa Darter (*Etheostoma exile*)
- Johnny Darter (*Etheostoma nigrum*)
- Largemouth Bass (*Micropterus salmoides*)
- Mottled Sculpin (*Cottus bairdii*)
- Pumpkinseed (*Lepomis gibbosus*)
- Slimy Sculpin (*Cottus cognatus*)
- White Sucker (*Catostomus commersonii*)

Outside of the 120 m adjacent lands, just north of the Study Area, is Strasburg Creek which runs through the Strasburg Creek Wetland Complex. According to LIO ARA Survey Points GU-3004-STR (four separate points with the same identification), the following fish were identified in Strasburg Creek, downstream of the Study Area (MNR, 2025d):

- Blacknose Dace
- Brook Stickleback
- Brook Trout
- Creek Chub
- Fathead Minnow
- Goldfish (*Carassius auratus*)
- Longnose Dace (*Rhinichthys cataractae*)
- Mottled Sculpin
- Pumpkinseed
- White Sucker

These watercourses and the above mentioned LIO ARA Line Segments and Survey Points are shown in Figure 3-29.

3.10.5 Field Investigations

While Jacobs has not conducted field work within the Study Area to date, existing fieldwork and reports authored by other groups have been compiled. The methodologies and field results presented within this report are based on the 2021 and 2025 reports, authored by WSP Canada Inc. (WSP), *Existing Conditions & Ecological Constraints Report* (WSP Canada Inc., 2021) (WSP Canada Inc., 2025) and the *Robert Ferrie Drive Alignment Alternatives, Southwest Kitchener Natural Environment Existing Conditions Report* (Stantec, 2013).

The WSP's *Existing Conditions & Ecological Constraints Report 2021* documented their methodology and results from field investigations within their survey area which was, located in the northern and northwestern limits of the updated Study Area. Their 2025 covered their methodology and results from field investigations within the southwestern limits of the updated Study Area. Stantec's 2013 report covers a portion of the northeastern limits of the updated Study Area and was accessed for supplementary information. Figure 3-28 shows these study areas in relation to the updated Study Area.

A comprehensive field survey program was conducted by WSP and Natural Resource Solution Inc. (NRSI) within the northwestern portion of the updated Study Area from 2017 – 2024. This and the related studies and their methodologies are summarized in Appendix D.

3.10.6 Results

Jacobs has not conducted field work within the Study Area to date. The summarized results below are based on the 2021 and 2025 reports, authored by WSP Canada Inc. (WSP), *Existing Conditions & Ecological Constraints Report* (WSP Canada Inc., 2021) (WSP Canada Inc., 2025) and the *Robert Ferrie Drive Alignment Alternatives, Southwest Kitchener Natural Environment Existing Conditions Report* (Stantec, 2013). These reports provide more detailed information about their recorded observations and results from field surveys.

3.10.6.1 Terrestrial Habitat & Wildlife

While the updated Study Area consists primarily of active agricultural fields, WSP identified a total of twenty-six (26) ecological communities in their 2021 report and ten (10) natural/cultural vegetation communities in their 2025 report. These communities are identified by a Vegetation Unit number (Unit #) and associated with an ELC (Ecological Land Classification) code. The location of these vegetation

communities is shown in Appendix D while a description of each community, can be found in the WSP NH overview and constraint reports (WSP Canada Inc., 2021) (WSP Canada Inc., 2025). The Vegetation Communities identified within the Study Area are provided in are summarized in Appendix D.

Additionally, the area north of the Stauffer Drive and Reidel Drive intersection was identified as a cultural area with only agricultural and residential lands as well as some hedgerows (Stantec, 2013). Cultural vegetative communities are anthropogenically disturbed and therefore do not contribute the same quality of ecological value and are therefore awarded less protection.

WSP identified a total of 285 vascular plant species within their 2025 report and a total of 370 in their 2021 report. No globally rare species (i.e. G-rank G1-G3) were identified, and most species were common and secure or apparently secure in Ontario (i.e. ranked S5, S4, SE5 or SE4). However, there were three SAR identified during field investigation:

- American Chestnut (*Castanea dentata*), an Endangered species under the *ESA* and *SARA*. There were two planted individuals that were observed within Unit 7 (WSP Canada Inc., 2025). Despite being planted, these individuals are subject to provisions under the *ESA*.
 - Note: Native American Chestnut is considered provincially critically imperiled/imperiled (S1S2)
- Black Ash (*Fraxinus nigra*), an Endangered species under the *ESA*. There were seven individuals observed within Vegetation Unit 3 (WSP Canada Inc., 2025) and three individuals identified in Units 7 and 14 (WSP Canada Inc., 2021). However, as per the *ESA*, Black Ash over 8 cm DBH, deemed healthy through a Black Ash assessment, receive legal protection. Only 2 of these individuals were over 8 cm DBH and will require a Black Ash assessment to determine whether provisions under the *ESA* apply.
- Butternut (*Juglans cinerea*), an Endangered species under the *ESA* and *SARA*. There were six individuals identified within Units 7 and 14 (WSP Canada Inc., 2021).
 - In addition, 81 putative Hybrid Butternut (*Juglans x bixbyi*) were observed in Vegetation Unit 7 (WSP, 2025). However, morphological evidence and DNA testing confirmed that these were hybrids, not true Butternut (*Juglans cinerea*), which is an Endangered species both provincially and federally. As such, they are not afforded any legal protections under the *ESA*.

24 species identified within the WSP 2021 and 2025 reports are considered significant within the Regional Municipality of Waterloo (RMW), as per the *Region of Waterloo Significant Species List: Vascular Plants Component, PC-99-028.1* (Region of Waterloo, 1999). These are presented in Appendix D.

Wetland limits and the Core Environmental Feature (CEF) / dripline limits were delineated by WSP in 2019 and 2020. WSP conducted in-person and email correspondence to confirm the wetland limits.

In their 2025 report, WSP identified the following species of conservation concern which had not previously been recorded in the study area conducted by NRSI in 2019 including:

- American Chestnut – regionally rare, *Endangered* Federally and Provincially
- Burreed Sedge – regionally rare
- Canada Moonseed – regionally rare
- Common Hackberry – regionally rare
- Tuckerman’s Sedge – regionally rare
- White Spruce – regionally rare

In addition, a large White Oak (*Quercus alba*) with a diameter-at-breast height of 103 cm was identified in the agricultural field in the northeast portion of their study area, east of Unit 4.

A full list of wildlife species identified by WSP within their 2021 and 2025 reports. The following results summarize the species identified and/or results of targeted surveys. The results are summarized in this section additional details are available in Appendix D.

- WSP recorded 54 avifauna species in their 2021 report and 48 species in their 2025 report.
- WSP recorded 6 anuran species in their 2021 report and in their 2025 reports. Some stations had multiple species present while a few did not have any observations of amphibians.
- Based on the MNR/MECP criteria listed above, WSP determined that vernal pools VP4a, VP5, VP7 and VP9 (located in Units 3 and 4) may provide suitable habitat for Jefferson Salamander (WSP, 2025). As such, further documentation of ESA compliance may be required.
- WSP recorded 3 road-killed American Toads along the surveyed portion of Reidel Drive in their 2021 report and no species in their 2025 report.
- WSP recorded no observations of turtles or evidence of turtle nesting in their 2021 and 2025 reports.
- In addition, WSP recorded the following amphibians and reptiles in their 2021 report:
 - Eastern Red-backed Salamander (*Plethodon cinereus*) – recorded incidentally during 2020 breeding bird surveys
 - Jefferson Salamander – confirmed breeding habitat is present on adjacent lands and regulated habitat for this species is present in portions of the survey area. However no confirmed Jefferson Salamander individuals have been recorded within this survey area during the years of study.
 - Spotted Salamander (*Ambystoma maculatum*) – recorded during breeding bird surveys. In addition, there are historical recordings of this species within the survey area from 2008-2017.
 - Dekay's Brownsnake (*Storeria dekayi*) – recorded incidentally during 2020 wildlife surveys
 - Eastern Gartersnake (*Thamnophis sirtalis sirtalis*) – recorded during 2020 breeding bird surveys. In addition, there have been historical recordings of this species within the survey area (2008, 2016 – 2018)
 - Snapping Turtle - recorded occasionally in low abundance in Wildlife Survey Area (WSA) 11 as part of on-going monitoring
 - Midland Painted Turtle – recorded occasionally in low abundance in WSA 11 as part of on-going monitoring

None of the surveyed burrows reported by WSP in their 2021 and 2025 reports demonstrated the characteristics of potential Badger burrows nor was any evidence of badgers observed during targeted or incidental surveys. In addition, WSP did not find any recent or historic records of American Badger within 1 km of their survey areas and there were no rail lines present (which are known to act as dispersal routes). As such WSP concluded that there was no evidence of American Badger presence or use.

After assessing potential wildlife movement throughout different portions of their survey areas, WSP concluded in both their 2021 and 2025 reports that while the agricultural fields might provide movement opportunities for more tolerant species, they do not contain defined wildlife movement areas, nor do they provide opportunities for movement of more sensitive species.

In their 2021 report, WSP notes that the important natural linkages / corridors for wildlife movement in their survey area are the Blair Creek and Strasburg Creek valleylands and associated natural areas. As such, they did not recommend establishing linkages/wildlife movement areas through the agricultural fields and instead recommended that the existing movement areas be maintained and enhanced through improved buffers (WSP Canada Inc., 2021).

WSP reported that they found evidence of the following signification wildlife habitat (WSP Canada Inc., 2021):

- **Candidate SWH:**
 - Bat Maternity Colonies
 - Turtle Wintering Areas
 - Reptile Hibernaculum
- **Confirmed SWH**
 - Seeps and Springs
 - Amphibian Breeding Habitat
 - Special Concern and Rare Wildlife Species

As such, in their 2021 report, WSP recommended that all confirmed SWH are included in the Natural Heritage System and are retained in full. They also recommended that candidate/unconfirmed SWH, were also retained within the NHS.

In their 2025 report, WSP reported the following SWH but determined that no impacts were anticipated due to the SWH being retained in full with a naturalized buffer:

- **Candidate SWH:**
 - Bat Maternity Colonies
- **Confirmed SWH**
 - Amphibian Breeding Habitat
 - Special Concern and Rare Wildlife Species

3.10.6.2 Aquatic Habitat

In their 2021 report, WSP concluded based on their field surveys that Upper Blair Creek, within their study area, features not well-developed morphology that has predominantly riffle/flat morphology with some deeper 'pools'. The substrate was dominated by detritus, silt, and sand, overlying clay, such that the soft substrate and location of this reach, within an area that seasonally floods, makes the morphology less stable. This allows some alterations to occur from year to year, especially with high flows.

Overhead cover is provided by dogwood shrubs and herbaceous wetland plants and there were observations of iron staining and watercress throughout this area indicate presence of local groundwater inputs.

Agricultural field Drainage Features were identified in the survey areas, and as such were assessed by WSP, using the TRCA / CVC HDF Guidelines. The reaches of these Drainage Features which extend through active crop fields are typically intermittent, undefined features with limited to no natural vegetation. As such, the management recommendation identified in the reports listed below was "Maintain Recharge".

Drainage features with reaches within natural areas typically have more defined channels and/or evident flow and standing water. These reaches are associated with wetland, woodland and wildlife habitat such as

amphibian breeding. As such, the management recommendation identified in the reports below was "Conservation" or "Protection."

Further information can be found within the following reports:

- WSP. September 2017. Activa Southwest Kitchener Lands – Headwater Drainage Feature Assessment, (WSP Canada Inc., 2017)
- WSP. September 2018. Grambian Southwest Kitchener Lands - Headwater Drainage Features Assessment Report, (WSP Canada Inc., 2018)

WSP reported that only one HDF was present within their survey area extending southwest of Fischer-Hallman Road. Assessment of this HDF determined that there was 'No Management Required' for this feature, which was consistent with earlier reports (WSP Canada Inc., 2025). A full summary of the HDF results is presented in the WSP 2025 report.

WSP found that Upper Blair Creek appears to support a moderately healthy benthic community, with a range of tolerant and intolerant organisms, and although the taxa richness is not high – which is expected with headwater stream – the high Dissolved Oxygen concentrations and cool stream temperatures measured at all stations appear to help to maintain the moderately high quality benthic community (WSP Canada Inc., 2021).

No obvious water quality degradation due to nutrient loading was recorded throughout the sampled reaches. Dissolved chloride measurements recorded in groundwater monitoring wells have been typically less than 25 mg/L. WSP found that stations closest to existing roads have exhibited predominantly "good" or "fair" water quality on average over the monitoring period, and have shown relatively stable taxa richness, EPT richness and % EPT. As such WSP suggested that road salt, if applied, has not had enough impact to negatively affect the existing benthic community.

Results recorded by WSP in their 2021 report confirmed Brook Trout spawning in Upper Blair Creek, downstream of Dodge Drive which was outside of their survey area and outside of the updated 2025 Study Area. These findings were consistent with previously collected fisheries data.

3.10.6.3 Species at Risk

WSP concluded in both their 2021 and 2025 reports that for many of the species identified during the background screening the likelihood of them occurring within their survey areas was 'none' or 'minimal' due to a lack of suitable or preferred habitat and/or rarity of the species.

For species with some potential to occur within the survey areas due to the presence of potentially suitable habitat, WSP provided comments and/or recommendations for future work which are summarized below:

2021

- Threatened/Endangered Species: subject to provisions under the *ESA*
 - Regulated habitat for **Jefferson Salamander** (Endangered) is present within this survey area, and this species is known to occur on adjacent lands.
 - A small area of Regulated (Category 3) habitat for **Blanding's Turtle** (Threatened) may extend within the northeast portion of the Study Area – subject to confirmation by MECP
 - **6 Butternut**, an Endangered species, was observed during field surveys. All recorded trees are within areas recommended for retention in the Natural Heritage System (NHS). Further assessment is required at the time of development applications to confirm *ESA* compliance.

- Potential maternity roosting habitat for Endangered **SAR bats** is present within the survey area, however no impact to potential bat habitat is anticipated with the retention of woodland habitats and implementation of development setbacks and buffer enhancements.
 - Mitigation of potential impacts to isolated trees and hedgerows and buildings to be identified through future studies.
- **Bank Swallow**, a threatened species was recorded as foraging visitants. Suitable nesting habitat for is present in the local landscape.
- Special Concern Species: not subject to provisions under the *ESA*:
 - **Barn Swallow**: Recorded as foraging visitants. Suitable nesting habitat is present in the local landscape.
 - **Eastern Wood-pewee**: Probable breeders recorded in low numbers (1-2 individuals) across various dates within the survey area in addition to a single individual with 'Possible' breeding evidence. No impacts to Eastern Wood Pewee habitat are anticipated with retention of woodland habitats and implementation of development setbacks and buffer enhancements.
 - **Monarch**: Single individual recorded flying through /foraging in active cropland and suitable habitat is abundant in the local landscape although no impacts to Monarch habitat are anticipated with retention of natural habitats and implementation of development setbacks and buffer enhancements.
 - **Wood Thrush**: Single individual recorded with 'Probable' breeding evidence within the survey area and no impacts to Wood Thrush habitat are anticipated with retention of woodland habitats and implementation of development setbacks and buffer enhancements
 - For other SAR species with some potentially suitable habitat present, but not recorded during field surveys, no impacts are anticipated, based on one or more of the following factors
 - The most sensitive natural features with potential SAR habitat (i.e., woodlands and associated wetlands) are proposed for retention within the NHS, with development setbacks and future naturalized and enhanced buffers
 - The small size and/or marginal quality of potentially suitable habitat outside of the larger, contiguous habitat features
 - Potential impacts are restricted to non-critical habitat
 - Presence of abundant and generally much larger/higher quality habitat in the local landscape
 - Low likelihood of occurrence
 - Implementation of additional mitigation/protection measures to be determined during future development applications.

2025

- Threatened/Endangered Species: subject to provisions under the *ESA*
 - **Jefferson Salamander**: potentially suitable breeding and overwintering habitat is present within their survey area, however all forested habitat containing potential habitat for Jefferson Salamander will be retained, in addition to implementation of recommended mitigation measures, no impacts to potential habitat are anticipated.
 - **American Chestnut**: two planted American Chestnuts were observed and are subject to provision under the *ESA*.

- **Black Ash:** Seven individuals were observed however, only two trees met the criteria of being over 8 cm. As such, only two of the individuals are subject to provisions under the *ESA* and will require a 30 m radial buffer from each stem. No impacts to these individuals or their potential habitat are anticipated.
 - It is recommended that a Black Ash health assessment report is completed to demonstrate *ESA* compliance.
- **SAR Bats:** potential suitable habitat is present within the survey area, however since all woodland habitat encompassing this potential suitable habitat will be retained, and appropriate vegetation clearing timing will be implemented, impacts to potential habitats and individuals can be mitigated
- Note that for the above species/groups, WSP recommended that compliance/documentation requirements under applicable legislation in force at the time of application are followed.
- **Special Concern Species:** not subject to provisions under the *ESA*:
 - **Eastern Wood-pewee:** confirmed habitat is present within the survey area however all forested habitats containing confirmed habitat will be retained with setbacks. As such, no impacts to potential Eastern Wood Pewee habitat are anticipated.
 - **Barn Swallow:** confirmed nesting habitat is present within buildings located in the survey area, whose nests are protected under the *Migratory Birds Convention Act* (MBCA) and *SARA*. As such, building/structure removals or other works that impact Barn Swallow nesting habitat must be completed outside of the protected nesting period.

3.10.6.4 Natural Heritage System

WSP determined that the following areas within and immediately adjacent to the Primary Study Area are recommended for retention through the secondary plan process. Preliminary development setbacks and potential enhancement measures have also been identified, subject to further studies in support of future development applications.

2021

- WSA 1 – Agricultural Field
 - May include Category 3 Habitat for Blanding's Turtle (pending confirmation from MECP)
 - Recommendations: Enhance portions of the current agricultural field within future naturalized buffers to WSA 2, 4 and 5
- WSA 2 – Wetland
 - Identified as a *Core Natural Heritage Feature* and an *Ecological Restoration Area* in the City of Kitchener Official Plan (OP) and as a *Core Environmental Feature* in the Region of Waterloo Official Plan
 - Includes candidate/unconfirmed SWH: Turtle Wintering Areas
 - Recommendations: Retain in full, with 15m development setback from the identified wetland limit, incorporate buffer enhancements into future development plans and maintain water inputs
- WSA 3 – Agricultural Field
 - No natural heritage designations, candidate/confirmed SWH or SAR habitat

- Recommendation: Enhance portions of the current agricultural field within future naturalized buffers to WSA 8 and WSA 9
- WSA 4 – Strasburg South Natural Area
 - Identified as a *Core Natural Heritage Feature* and the southern edge is identified as an *Ecological Restoration Area* in the City of Kitchener OP and as a *Core Environmental Feature* in the Region of Waterloo OP
 - Includes candidate SWH (Bat Maternity Colonies, Reptile Hibernaculum), confirmed SWH (Special Concern and Rare Wildlife Species) and potential and confirmed SAR habitat (SAR bats, Eastern Wood-pewee)
 - Recommendations: Retain and protect with a minimum 10 m development setback from the dripline and incorporate buffer enhancements into future development plans to protect the woodland edge
- WSA 5 – Doon South/Blair Creek Natural Area
 - Identified as a *Core Natural Heritage Feature* with portions identified as an *Ecological Restoration Area* in the City of Kitchener OP and as a *Core Environmental Feature* in the Region of Waterloo OP
 - Contains a portion of the Roseville Swamp – Cedar Creek Provincially Significant Wetland (PSW) Complex
 - Includes candidate SWH (Bat Maternity Colonies, Turtle Wintering Areas, Reptile Hibernaculum), confirmed SWH (Seeps and Springs, Woodland Amphibian Breeding Habitat, Special Concern and Rare Wildlife Species), potential and confirmed SAR habitat (Butternut, SAR bats, Black Ash, Eastern Wood-pewee, Wood Thrush) and Regulated habitat for Jefferson Salamander
 - Recommendations: Incorporate buffer enhancements into future development plans to protect the habitat edges, maintain water inputs to receiving areas and retain/protect with the following development setbacks (with the greater setback in any given area identified as the development limit at that location):
 - Dripline + 10 m
 - Blair Creek + 30 m
 - Roseville Swamp – Cedar Creek PSW + 30 m
 - Unevaluated wetlands + 15 m
- WSA 6 – Agricultural Field
 - Includes an area of Regulated JESA habitat movement/dispersal between breeding ponds but no natural heritage designations, candidate/confirmed SWH or confirmed SAR habitat
 - Recommendations: Enhance portions of the current agricultural field within future naturalized buffers to WSA 5 and demonstrate ESA compliance re; JESA habitat through a future development application
- WSA 7 – Residential Property
 - Includes candidate/unconfirmed SWH (Reptile Hibernaculum) but no natural heritage designations, confirmed SWH or confirmed SAR habitat

- Recommendations: Not within the recommended NHS, therefore functions to be maintained elsewhere in the survey area via enhancements as part of the recommended NHS. Further analysis to be included in future studies
- WSA 8 – Cedar Creek Natural Area (west) – located outside of WSP's survey area
 - Identified as a *Core Natural Heritage Feature* with portions identified as an *Ecological Restoration Area* in the City of Kitchener OP and as a *Core Environmental Feature* in the Region of Waterloo OP
 - Includes candidate SWH (Bat Maternity Colonies, Turtle Wintering Areas, Reptile Hibernaculum), confirmed SWH (Special Concern and Rare Wildlife Species) and potential and confirmed SAR habitat (SAR bats, Eastern Wood-pewee)
 - Recommendations: Retain and protect with a minimum 10 m development setback from the identified dripline, incorporate buffer enhancements into future development plans to protect the woodland edge and maintain water inputs, as required
- Area 9 – Cedar Creek Natural Area (east) – located outside of WSP's survey area
 - Identified as a *Core Natural Heritage Feature* in the City of Kitchener OP and as a *Core Environmental Feature* in the Region of Waterloo OP
 - Includes candidate SWH (Bat Maternity Colonies, Reptile Hibernaculum), confirmed SWH (Special Concern and Rare Wildlife Species) and potential and confirmed SAR habitat (SAR bats, Eastern Wood-pewee)
 - Recommendations: Retain and protect with a minimum 10 m development setback from the identified dripline, incorporate buffer enhancements into future development plans to protect the woodland edge and maintain water inputs, as required
- WSA 10 – Reidel Drive and Stauffer Drive – located outside of WSP's survey area
 - Recommendations: Future improvements and/or planning should consider incorporating design elements to enhance connectivity between the natural areas associated with the Blair Creek valleylands (e.g., wildlife crossings, funnel fencing, lighting considerations), where appropriate and in consideration of future land uses.
- WSA 11 – Stauffer Woods Development – located outside of WSP's survey area
 - Protection and enhancement measures have been incorporated into approved development plans.

2025

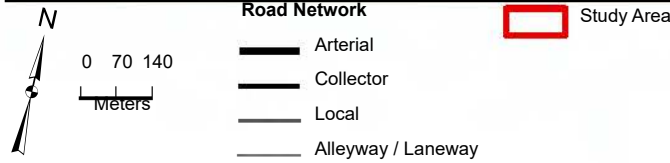
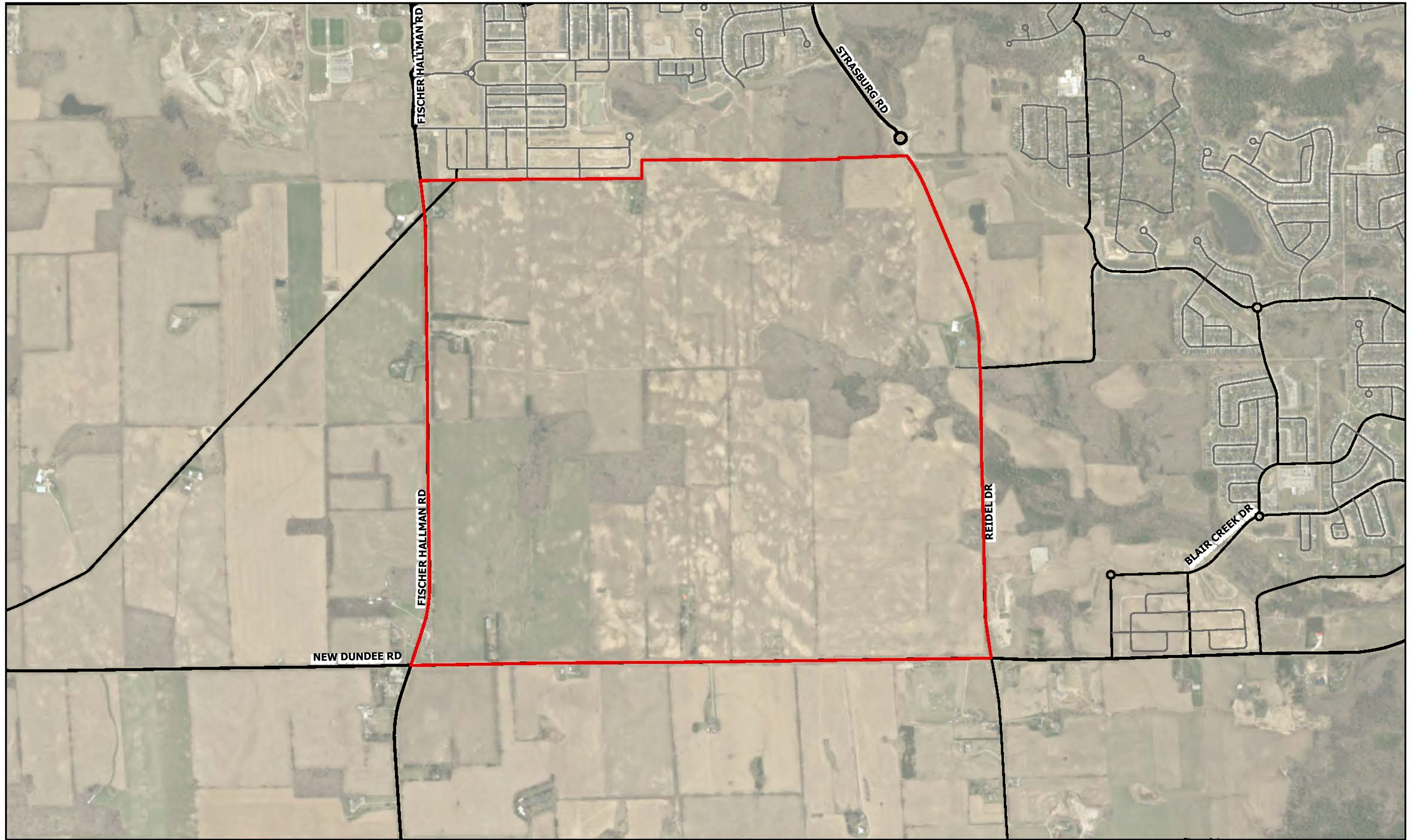
- Unit 3 wetland/Unit 4 woodland
 - Identified as a *Core Natural Heritage Feature* and as an *Ecological Restoration Area* in the City of Kitchener OP and as a *Core Environmental Feature* in the Region of Waterloo OP
 - Includes confirmed SWH, candidate/unconfirmed SWH and potential habitat for SAR as well as amphibian breeding habitat
 - Recommendations: Retain in full and protect with a minimum 10 m development setback from the dripline/15 m setback from the wetland habitat along the edge of the woodland, incorporate buffer enhancements into future development plans and maintain water inputs, as required
- Unit 8 woodland
 - Identified as a *Core Natural Heritage Feature* in the City of Kitchener OP and as a *Core Environmental Feature* in the Region of Waterloo OP

- Includes confirmed SWH, candidate/unconfirmed SWH and potential habitat for SAR as well as potential amphibian breeding habitat
- Retain in full and protect with a minimum 10 m development setback from the dripline, incorporate buffer enhancements into future development plans and maintain water inputs, as required

WSP noted in their 2025 report that documentation of compliance with relevant natural heritage policies for those mapped and other features would be undertaken as part of a planning application and may require additional study or documentation.

3.10.7 Conclusion

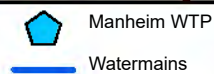
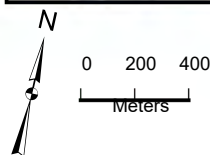
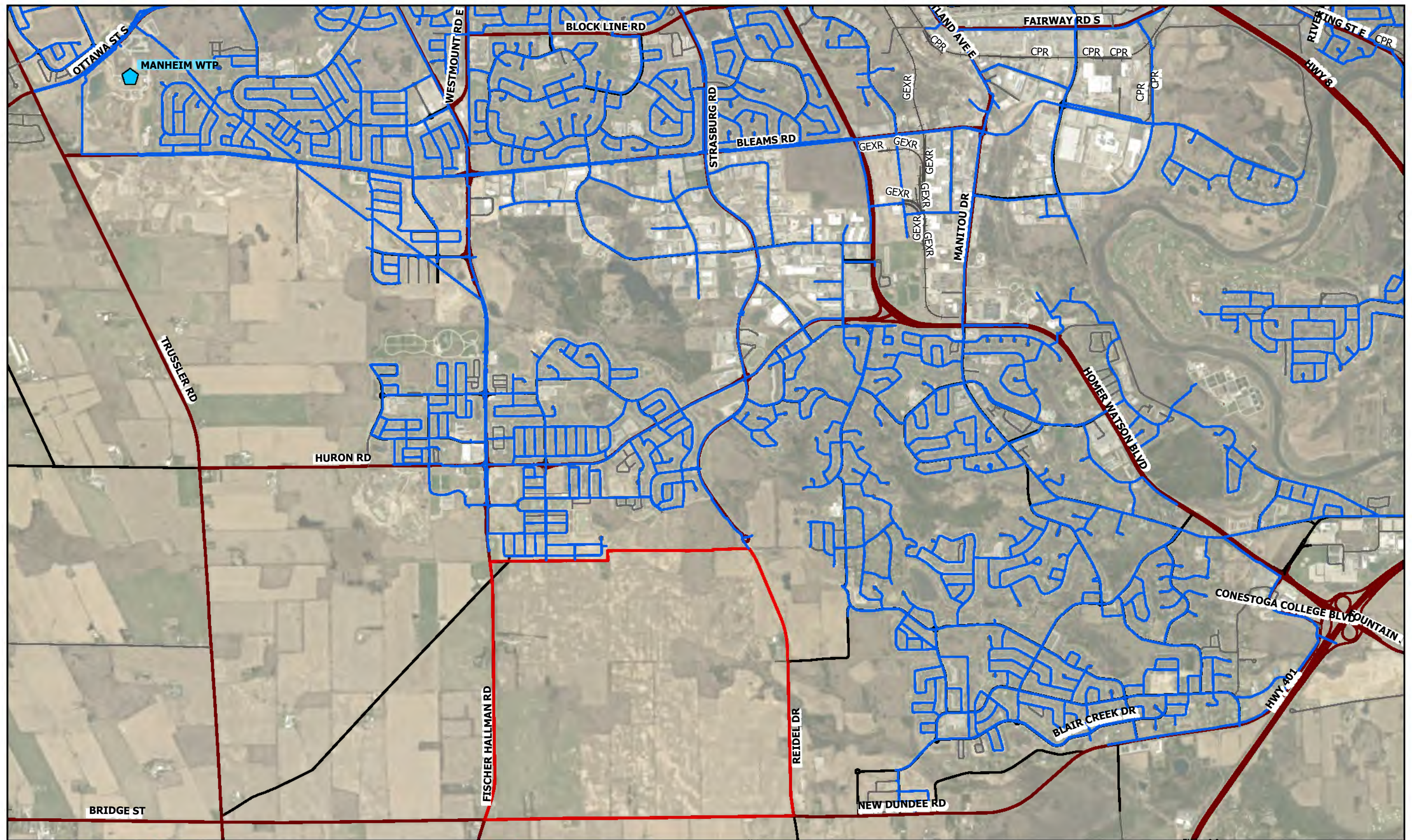
The baseline summarized natural heritage field study efforts between 2013 and 2024 and provided a comprehensive NHFs 2025 desktop screening. The Study Area extent encompasses NHFs including Grand River Conservation Authority Regulated Area, Provincially Significant Roseville Swamp Cedar Creek Wetland Complex and Strasburg Creek Wetland Complex, unevaluated wetland, woodlands, SWH, 3 watercourses, SAR habitat, Core Natural Heritage Feature, Ecological Restoration Area, and Core Environmental Feature. In addition, the presence of several SAR (American Chestnut, Bank Swallow, Black Ash, Butternut, etc.) have been confirmed within the Study Area. Future works should strive to avoid, reduce, and mitigate the impact on these features, as well as the SAR and SAR habitats they support.



Notes:
 1. Aerial Source: Region of Waterloo, Maxar
 2. Road network is from Land Information Ontario.

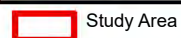
DRAFT

Figure 3-1
 Existing Roadways Surrounding the Dundee Secondary Plan
 Dundee Secondary Plan Scoped Subwatershed Study Report
 City of Kitchener
 Kitchener, Ontario



Road Network

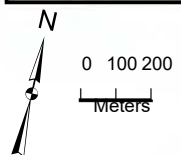
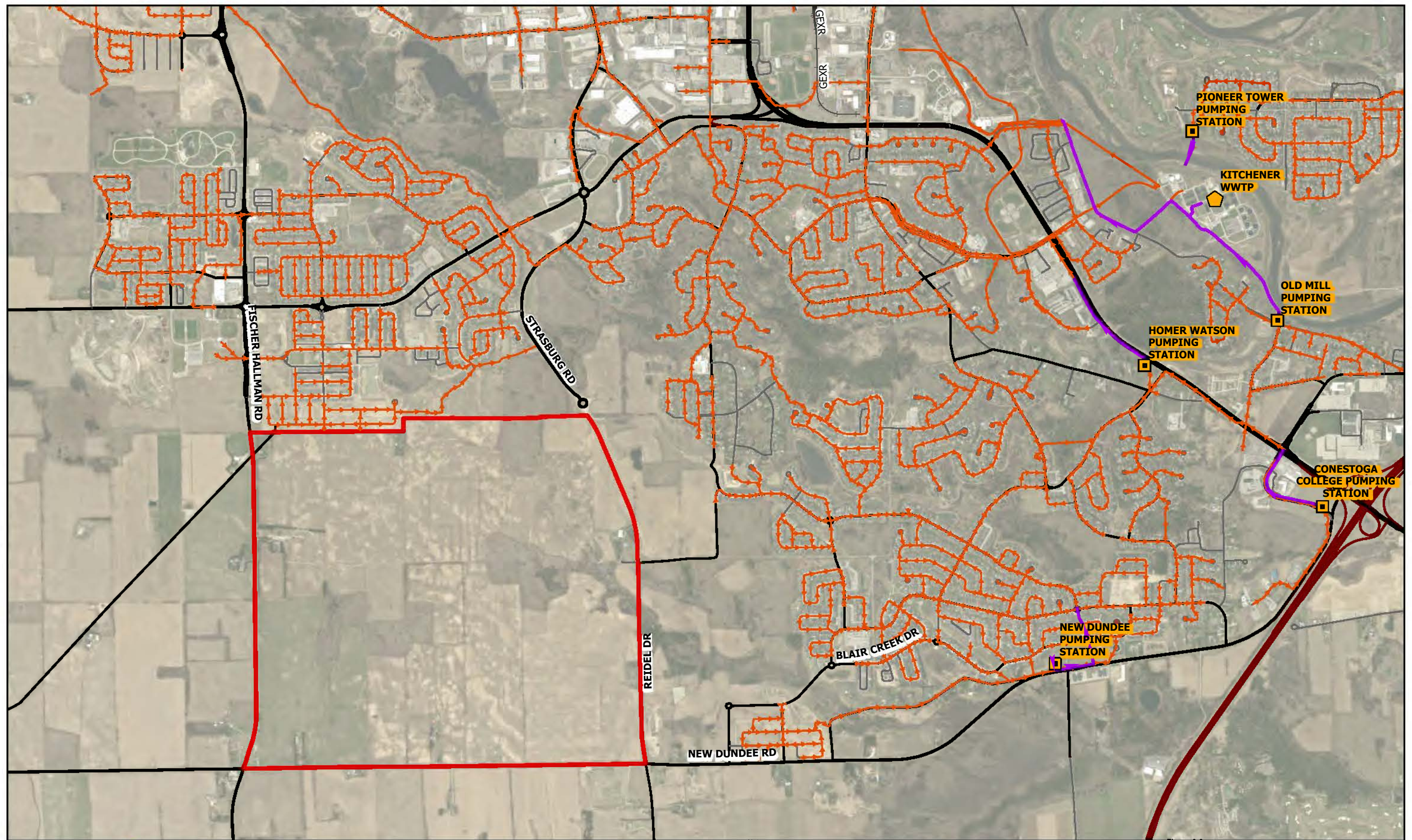
- Freeway
- Ramp
- Arterial
- Collector
- Local
- Alleyway / Laneway
- Other
- Canadian National Railway



- Notes:
1. Aerial Source: Region of Waterloo, Maxar
 2. Road network is from Land Information Ontario.

DRAFT

Figure 3-2
City of Kitchener Water Supply and Distribution Network
Dundee Secondary Plan Scoped Subwatershed Study Report
City of Kitchener
Kitchener, Ontario



- Kitchener WWTP Location
- Sanitary Pumping Station
- Sanitary Pipes
- Sanitary Pipes - Forcemain

Road Network

- Freeway
- Ramp
- Arterial
- Collector

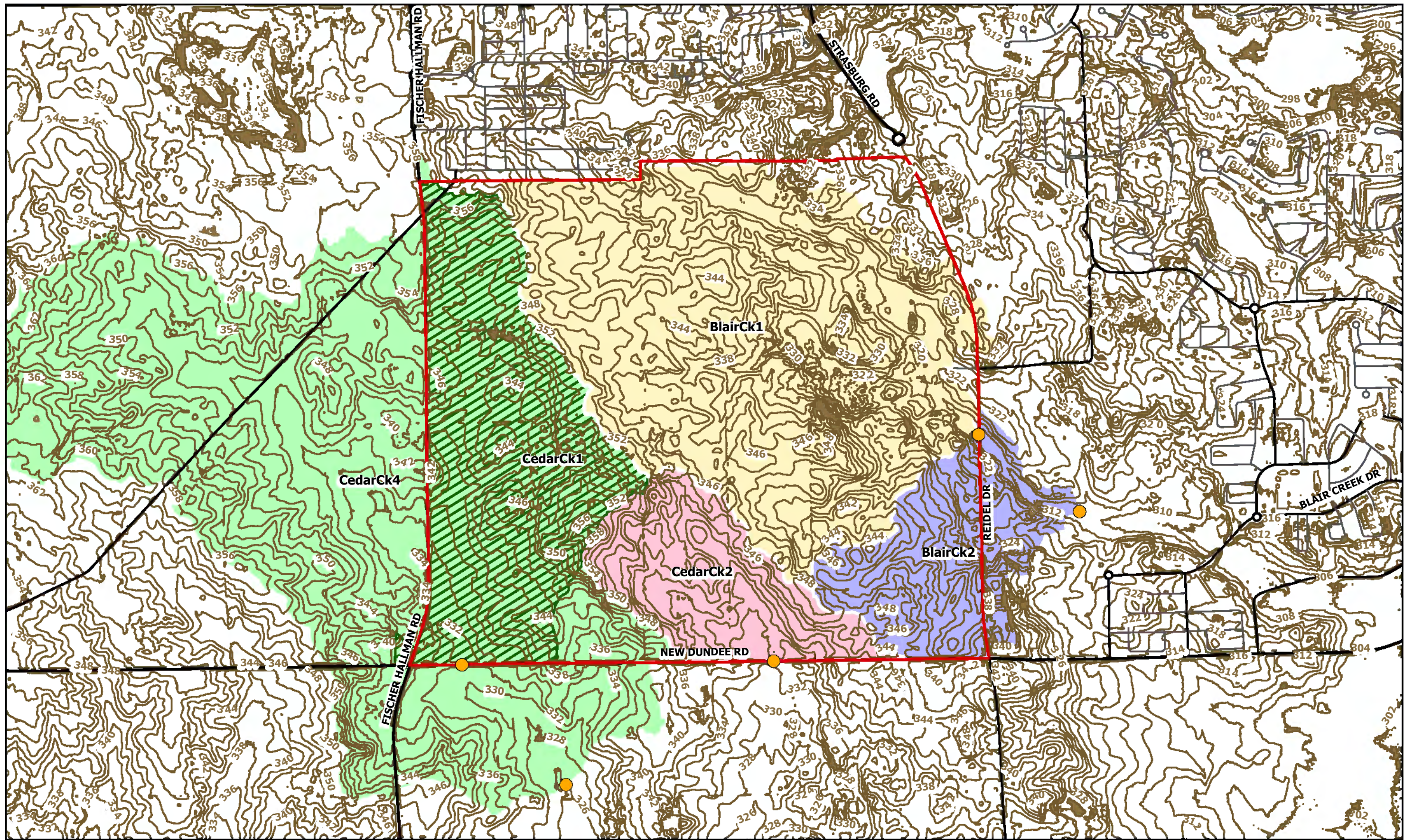
- Local
- Alleyway / Laneway

- Canadian National Railway
- Study Area

Notes:
 1. Aerial Source: Region of Waterloo, Maxar
 2. Road network is from Land Information Ontario.

DRAFT

Figure 3-3
 Existing Sanitary System Surrounding the Dundee Secondary Plan
 Dundee Secondary Plan Scoped Subwatershed Study Report
 City of Kitchener
 Kitchener, Ontario



Notes:
 1. Aerial Source:
 2. Road network is from Land Information Ontario.
 3. Topography Contours were generated based on High Resolution DEM Terrain from Government of Canada.

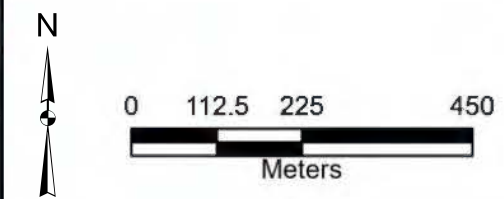
Figure 3-4
 Surface Water Flow Delineation Within Dundee Secondary Plan
 Dundee Secondary Plan Scoped Subwatershed Study Report
 City of Kitchener
 Kitchener, Ontario

DRAFT



Legend

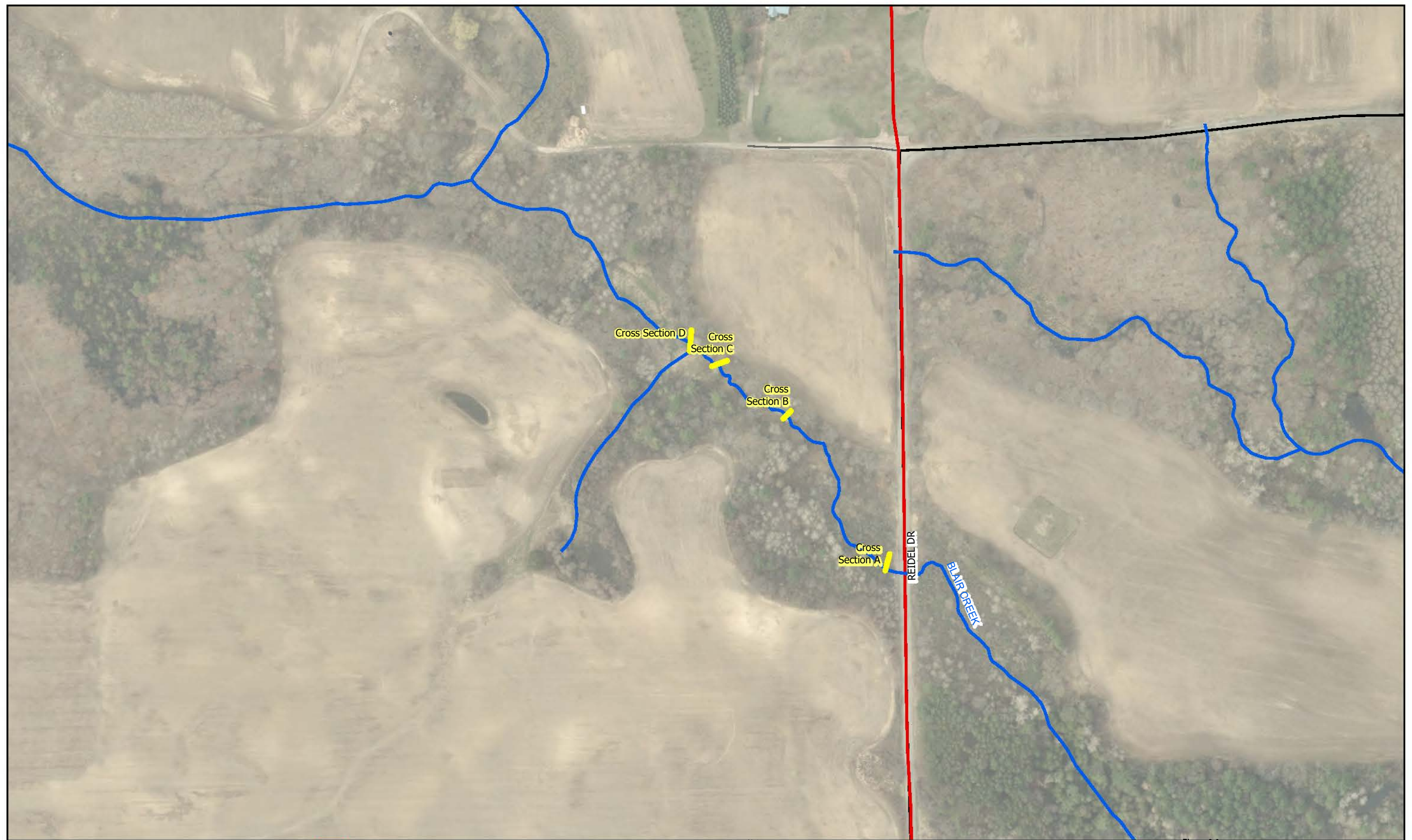
- ✕ GRCA Flow Station
- ✕ Proposed Site 6 Relocation
- ✕ Existing Sites
- Reach Breaks
- Watercourse
- Property Fabric



Notes:
1. Image of map No. 1, Blair Creek Geomorphic Monitoring, by Grand River Conservation Authority, June 4 2020.

Figure 3-5 -
Blair Creek Cross-Sections and Reaches
Dundee Secondary Plan Scoped Subwatershed Study Report
City of Kitchener
Upper Blair Creek Subwatershed, Kitchener, Ontario

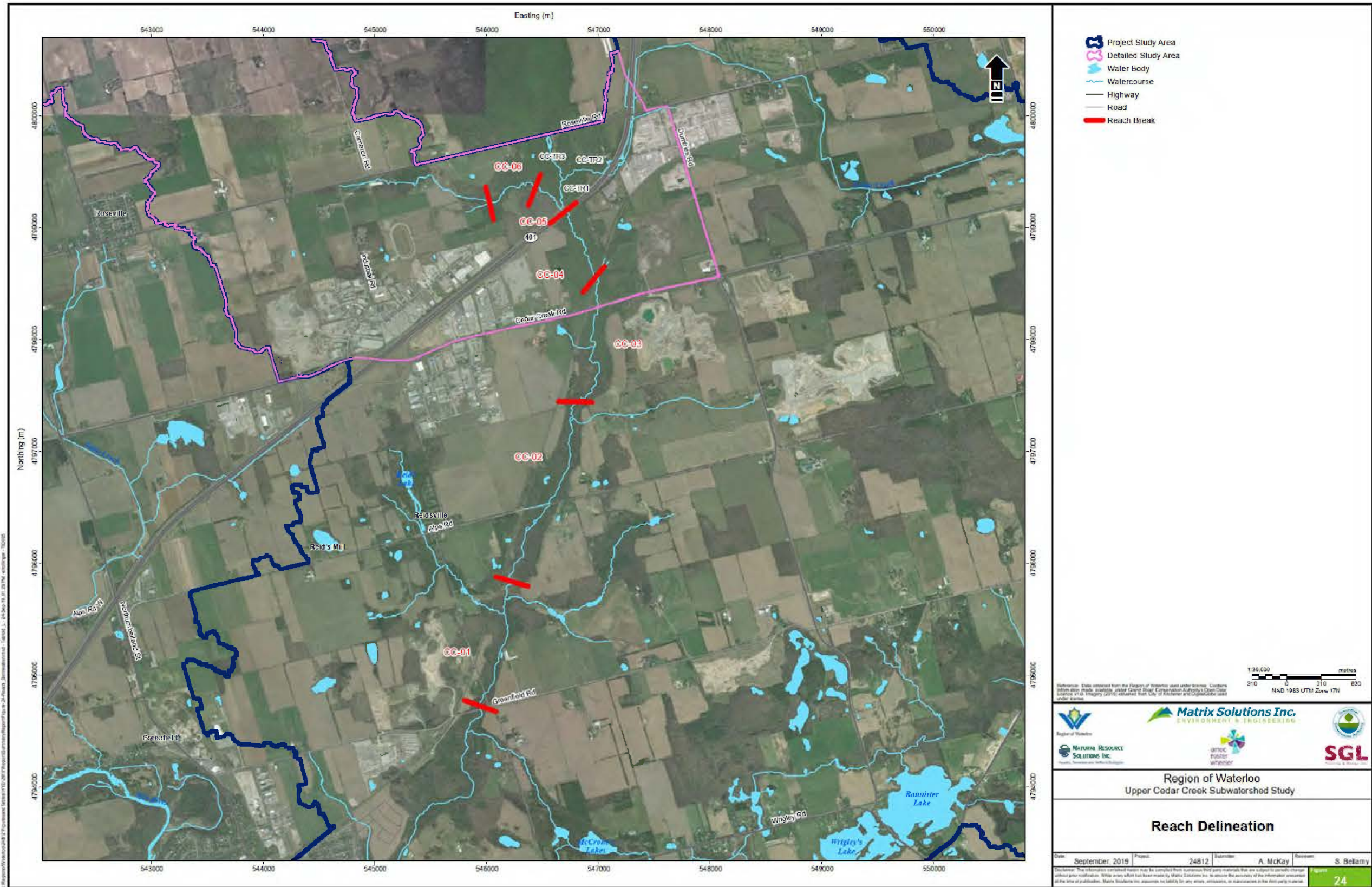
DRAFT



Notes:
 1. Aerial Source: Region of Waterloo, Maxar, Microsoft
 2. Road network is from Land Information Ontario.
 3. 2021 Stream Monitored Cross Sections are from Blair Creek (Dundee North) Stream Morphology Monitoring Program, 2021 Report, Water's Edge Environmental Solutions Team, April 18, 2022.

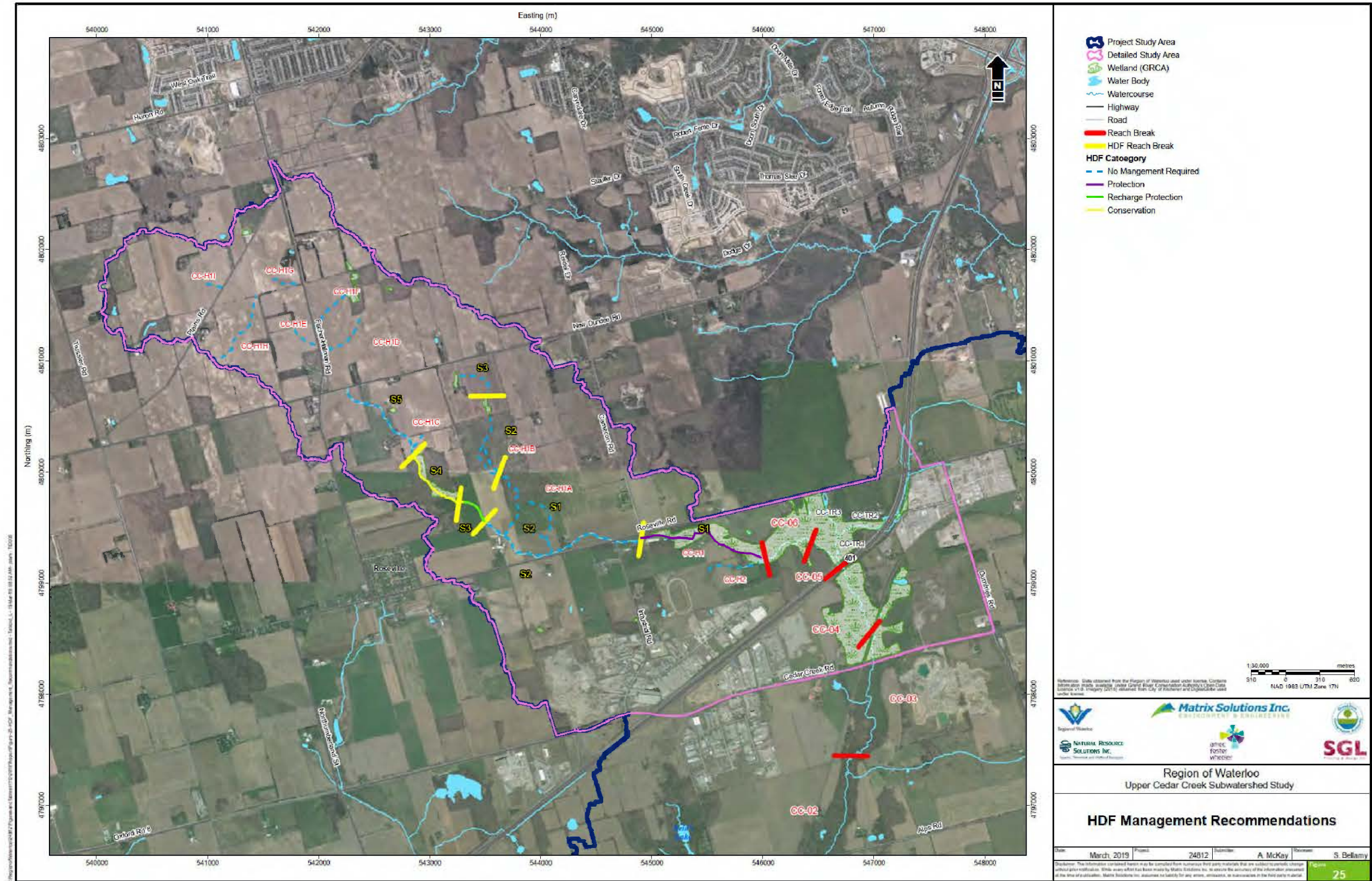
DRAFT

Figure 3-6
 New Blair Creek Cross Sections Upstream of Riedel Drive
 Dundee Secondary Plan Scoped Subwatershed Study Report
 City of Kitchener
 Kitchener, Ontario



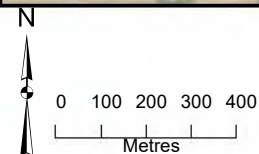
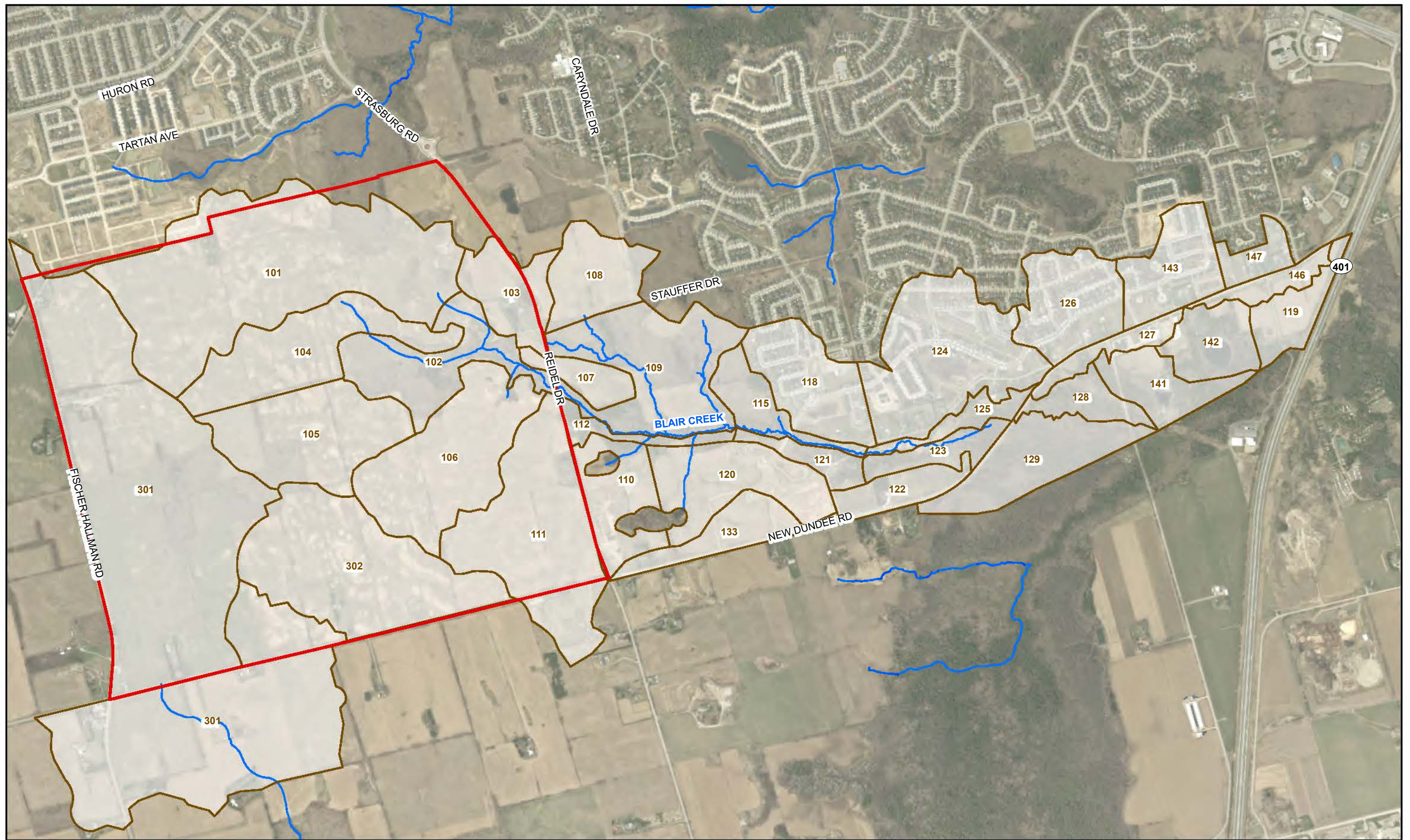
Notes:
 1. Figure is from page 25 of Final Cedar Creek Scoped SWS, Appendix A. September 2019.

Figure 3-7
 Cedar Creek Cross-Sections and Reaches
 Dundee Secondary Plan Scoped Subwatershed Study Report
 City of Kitchener
 Kitchener, Ontario



Notes:
1. Figure is from page 26 of Final Cedar Creek Scoped SWS, Appendix A. September 2019.

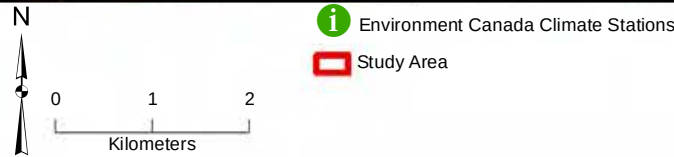
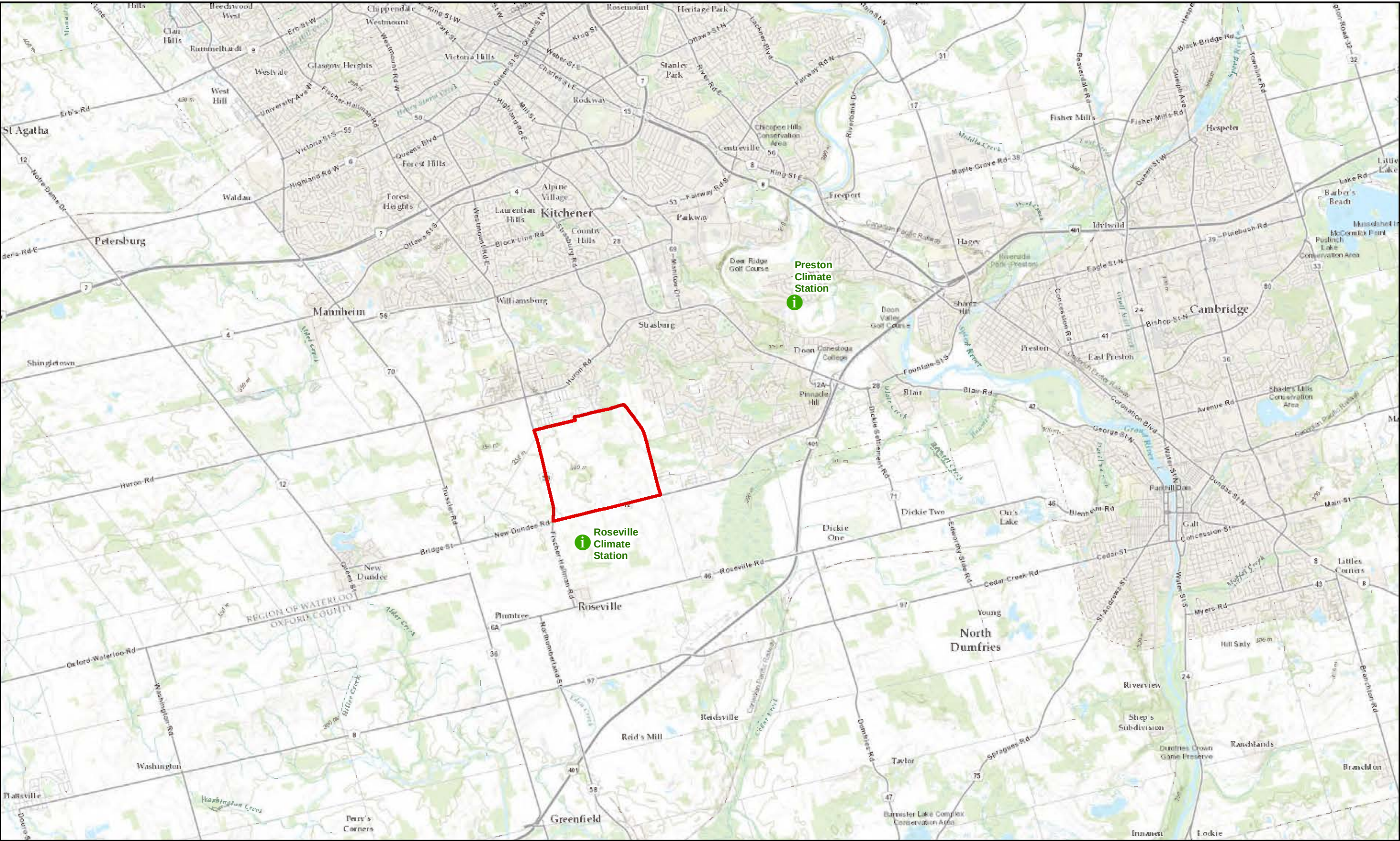
Figure 3-8
Cedar Creek Headwater Drainage Features
Dundee Secondary Plan Scoped Subwatershed Study Report
City of Kitchener
Kitchener, Ontario



- Watercourse
- Hydrologic Model Drainage Areas
- Study Area

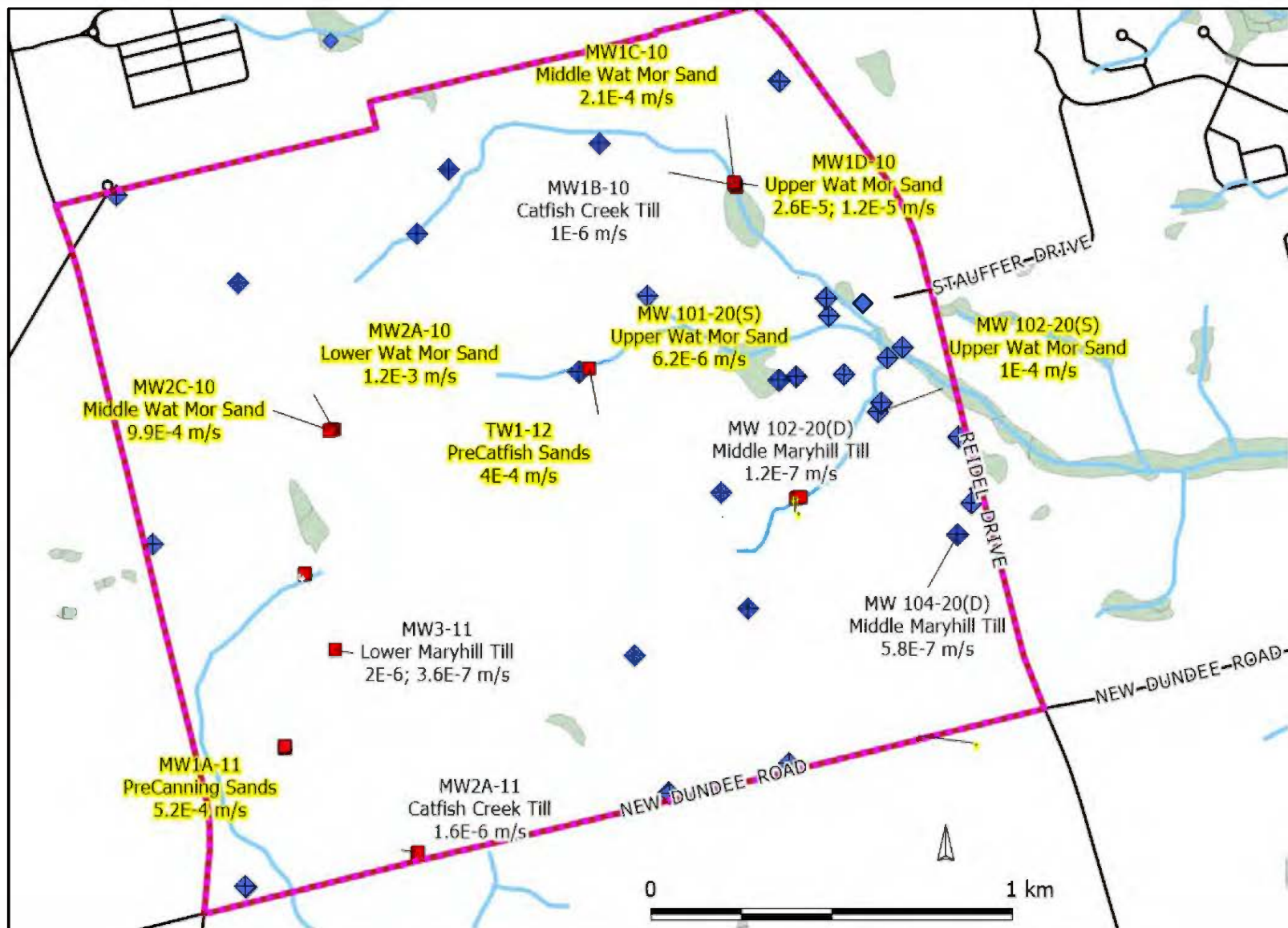
Notes:
1. Aerial Source: City of Waterloo, 2022.

Figure 3-9
Hydrologic Model Drainage Areas
Dundee Secondary Plan Scoped Subwatershed Study Report
City of Kitchener
Kitchener, Ontario



Notes:
1. Aerial Source: City of Kitchener, 2019.

Figure 3-10
Climate Station Locations
Dundee Secondary Plan Scoped Subwatershed Study Report
City of Kitchener
Kitchener, Ontario



Legend

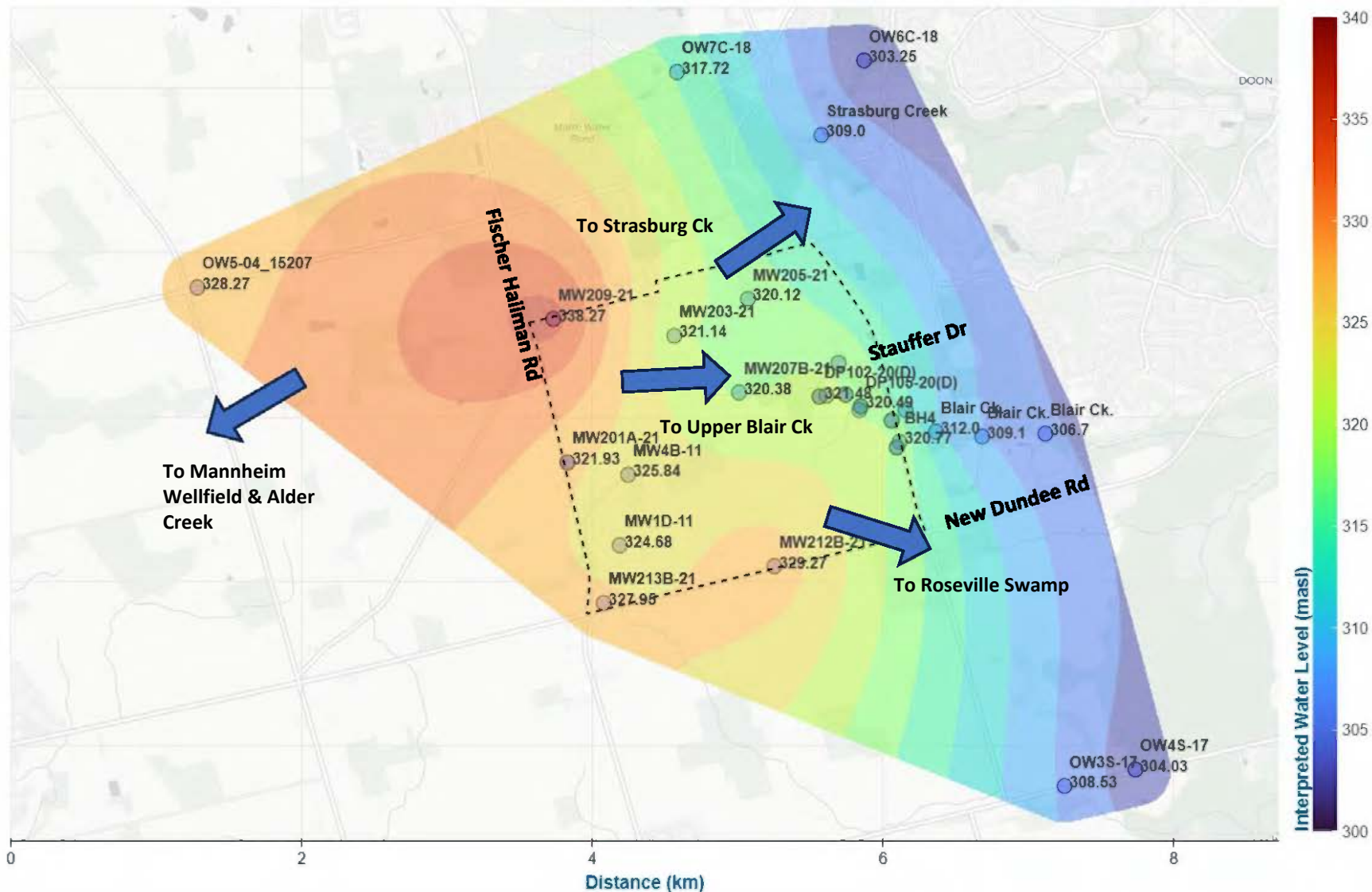
- ▬ Study Area
- ▬ Road
- ▬ Creek/Stream
- ▬ Wetland
- Monitoring Well (MTE, 2014)
- ◆ Monitoring Well (Region of Waterloo)
- ◆ Monitoring Well (Developer Supplied Data)

1e-4 m/s Hydraulic Conductivity Value in Aquifer Unit

1e-4 m/s Hydraulic Conductivity Value in Aquitard Unit

Hydrogeologic Characterization – Dundee

Locations and Interpreted Results of Hydraulic Test Data

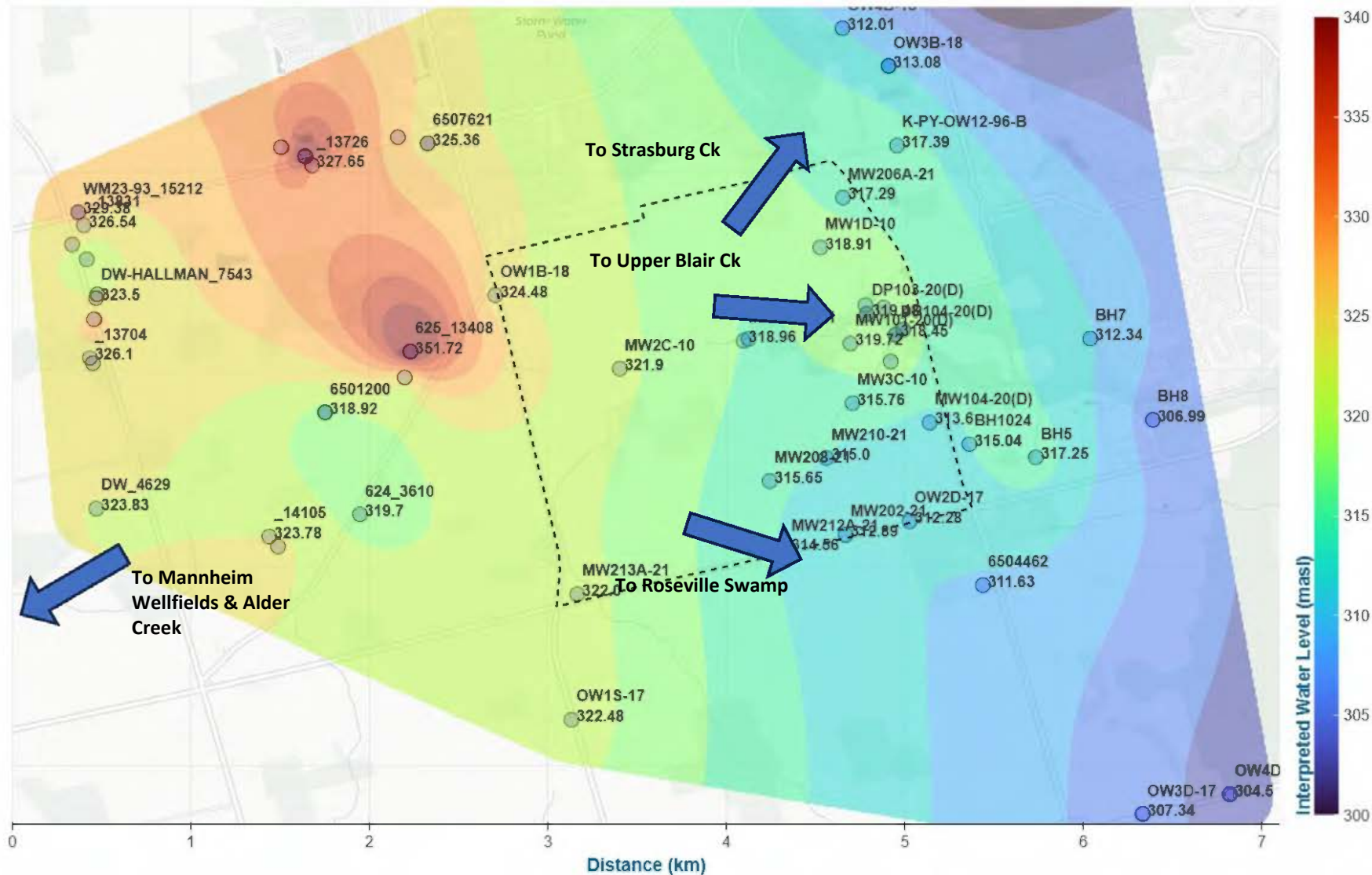


Legend

-  Groundwater Flow Direction
-  Study Area

Hydrogeologic Characterization – Dundee

Regional Interpreted Shallow Upper Waterloo Moraine Sands Groundwater Contours

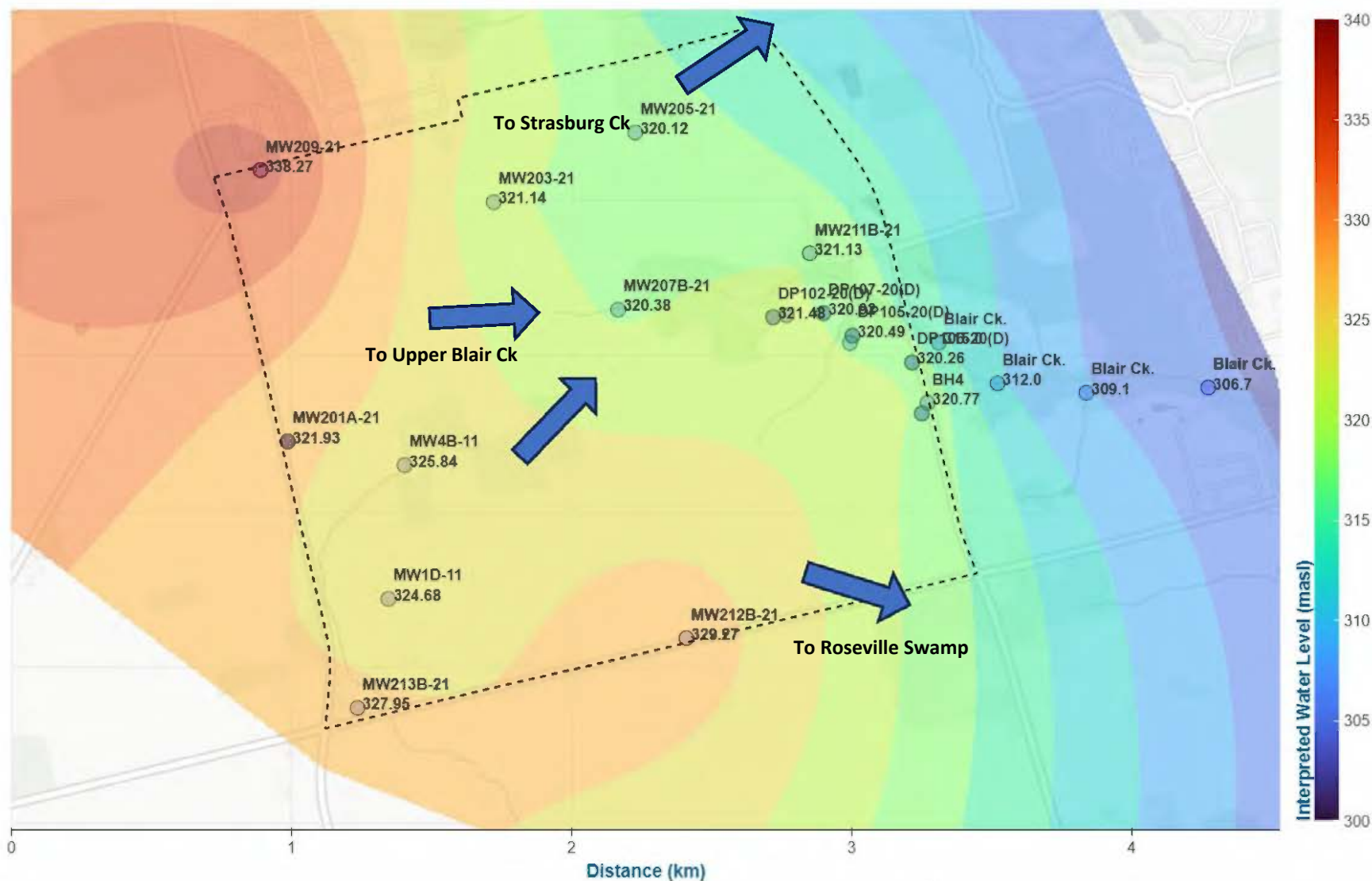


Legend

- Groundwater Flow Direction
- Study Area

Hydrogeologic Characterization – Dundee

Interpreted Middle Waterloo Moraine Sands
Groundwater Contours (Regional)

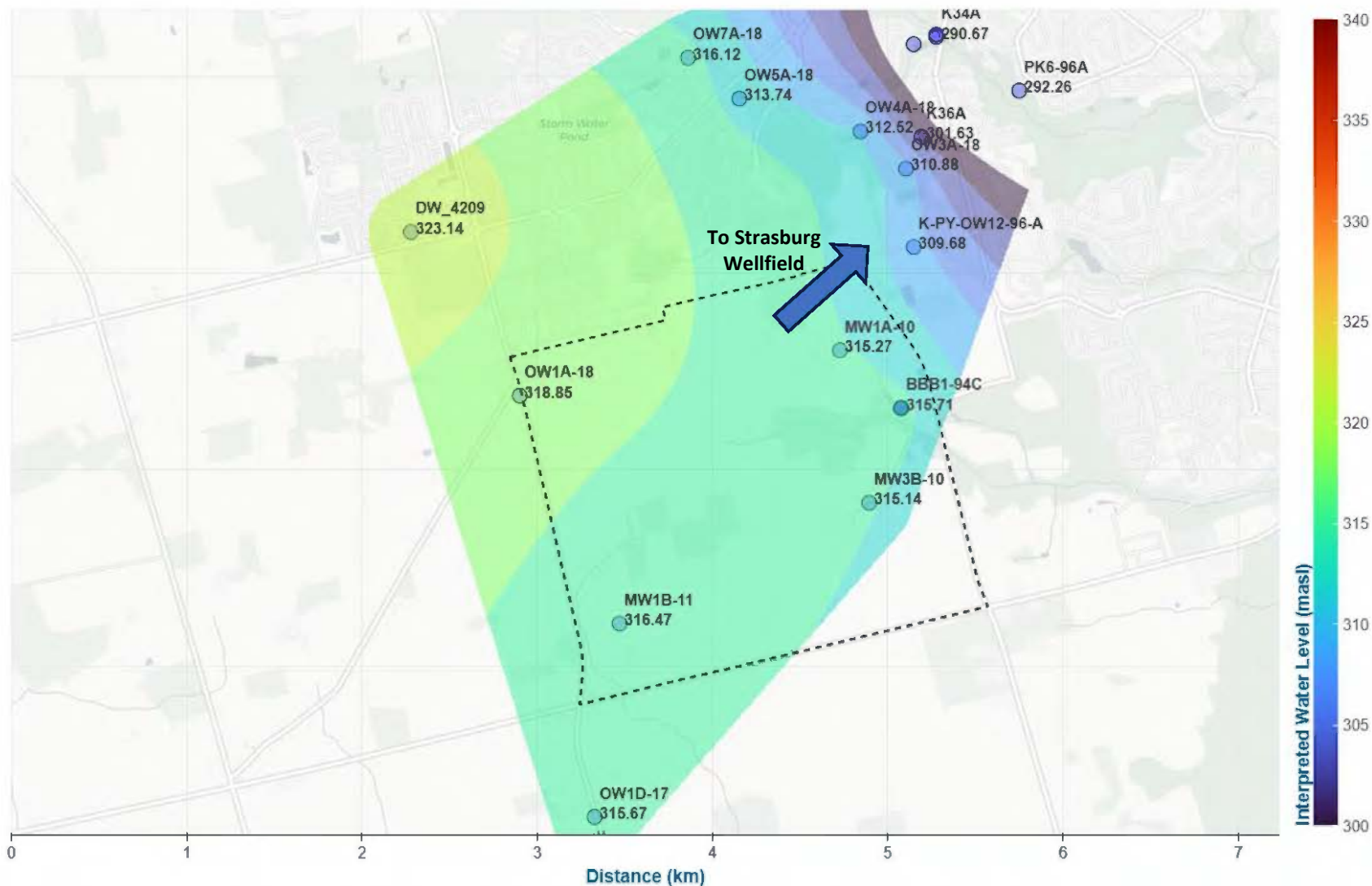


Legend

-  Groundwater Flow Direction
-  Study Area

Hydrogeologic Characterization – Dundee

Interpreted Shallow (Upper Waterloo Moraine and above) Groundwater Contours



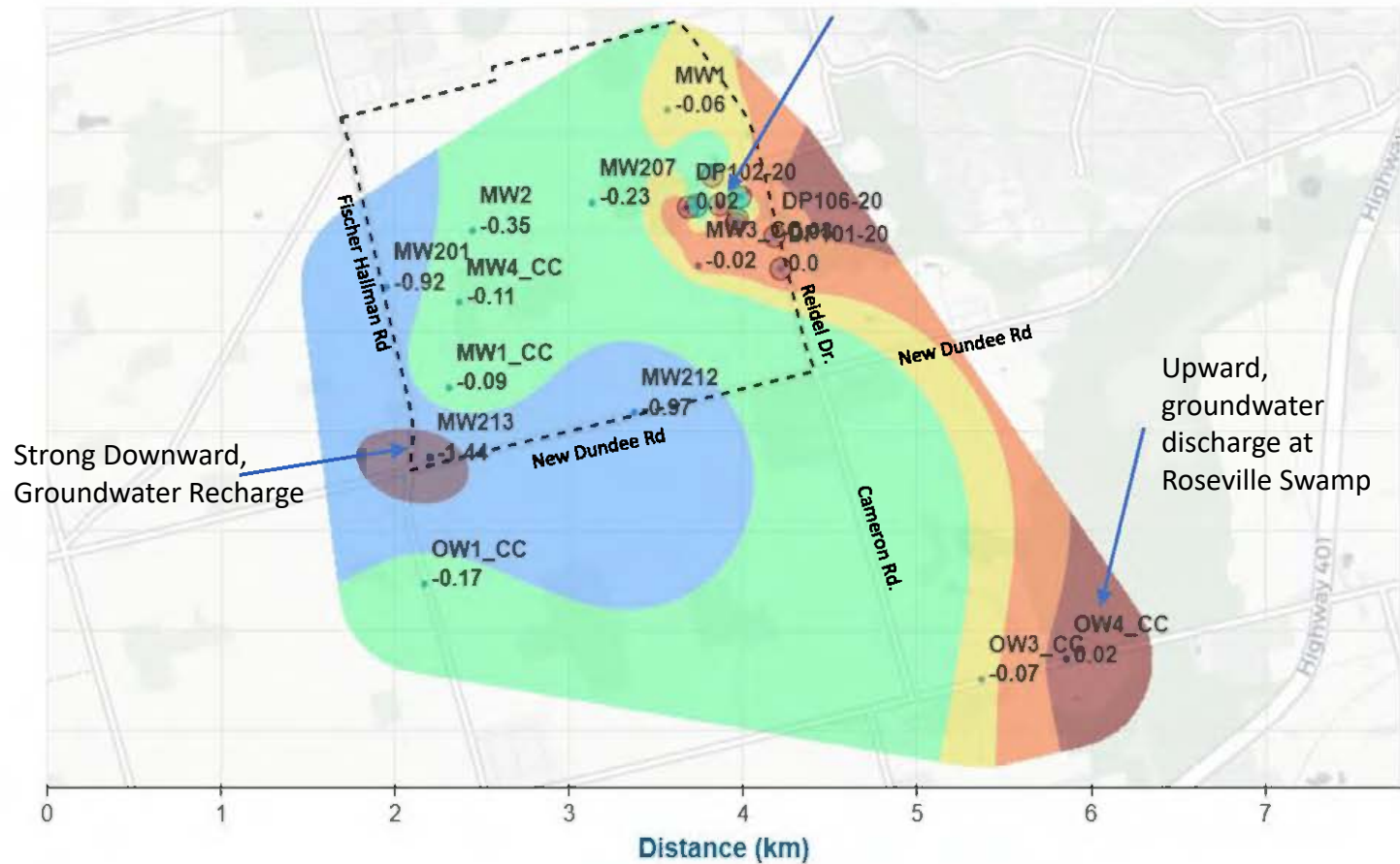
Legend

-  Groundwater Flow Direction
-  Study Area

Hydrogeologic Characterization – Dundee

Interpreted Pre-Catfish Creek Sand Aquifer
Groundwater Contours

Downward, transitioning to upward moving downstream along Upper Blair Creek as groundwater discharge increases



Legend

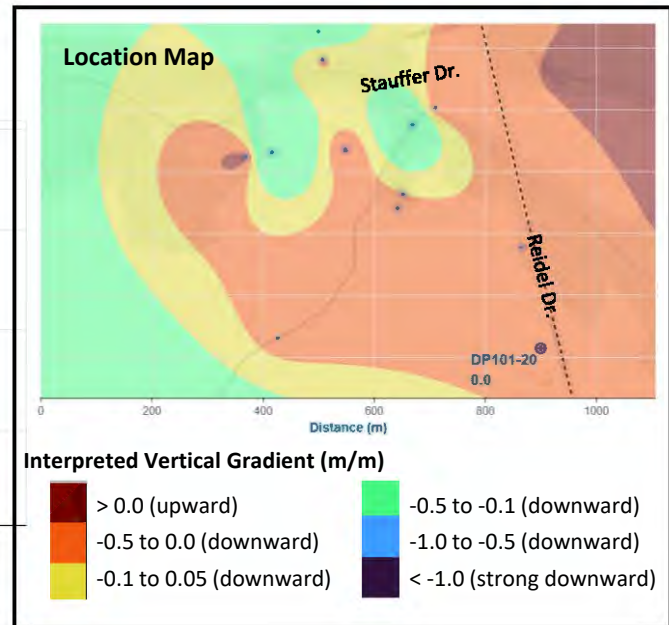
..... Study Area

Interpreted Vertical Gradient (m/m)



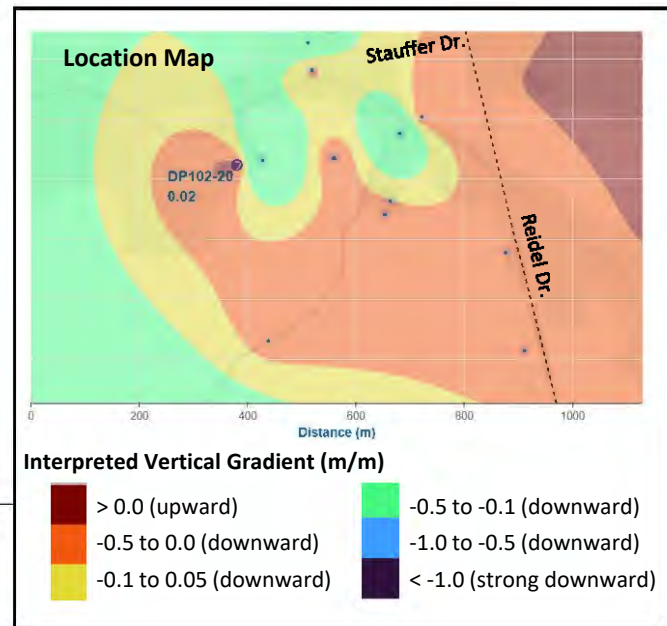
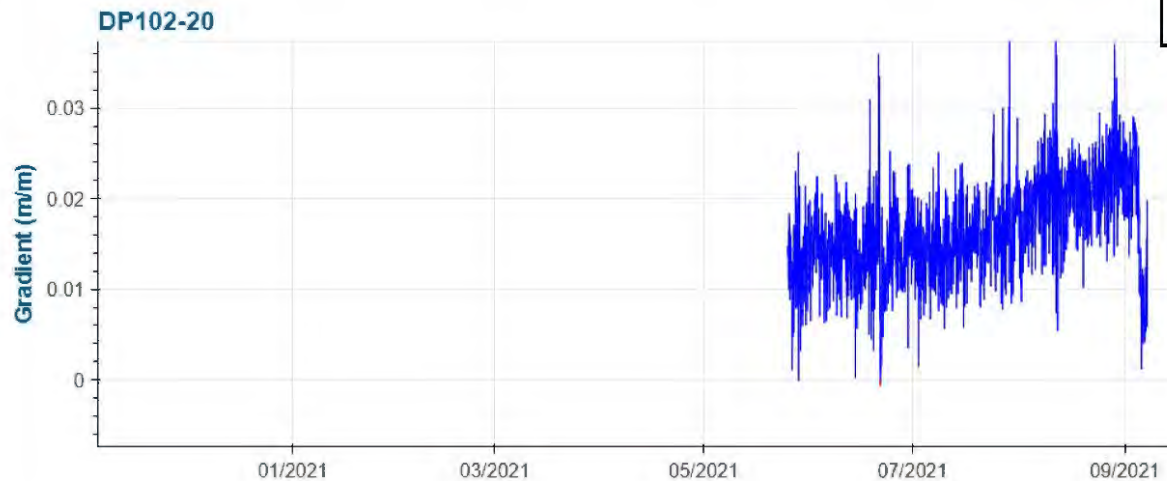
Hydrogeologic Characterization – Dundee

Interpreted Vertical Gradients



Hydrogeologic Characterization – Dundee

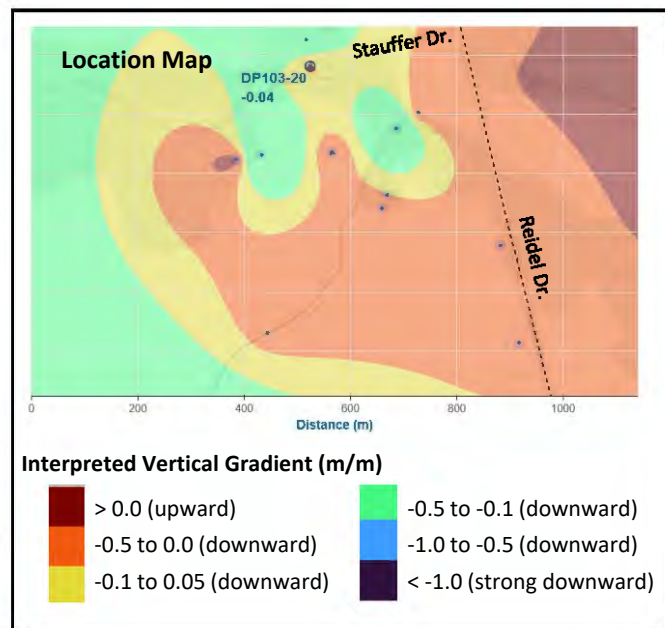
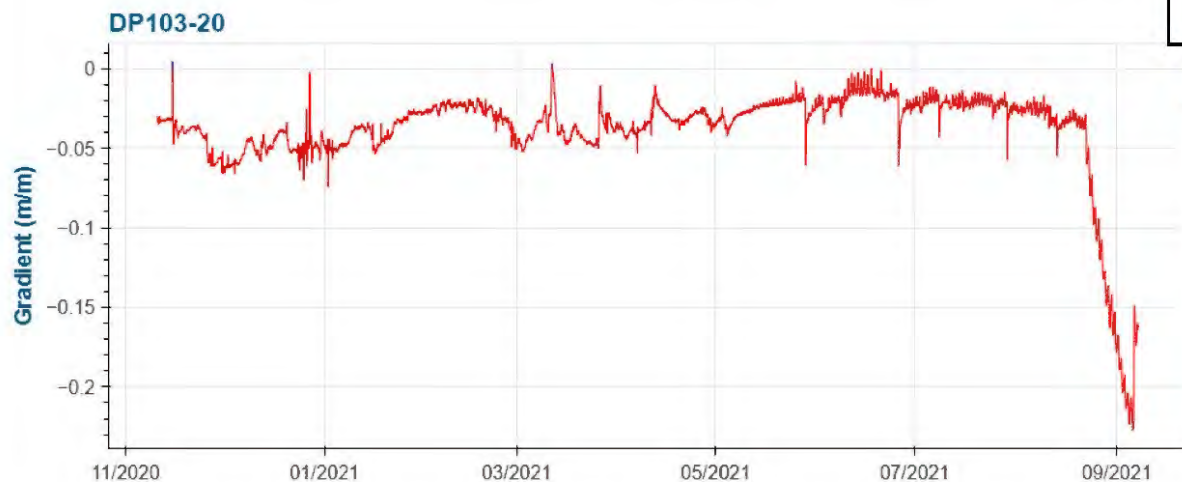
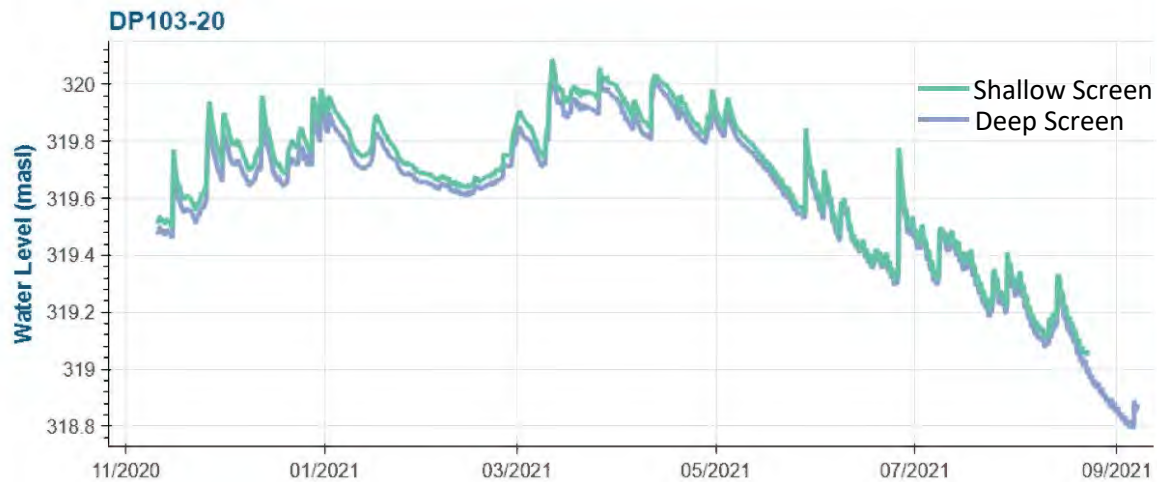
Transient Vertical Gradients – DP101-20



Upward
Downward

Hydrogeologic Characterization – Dundee

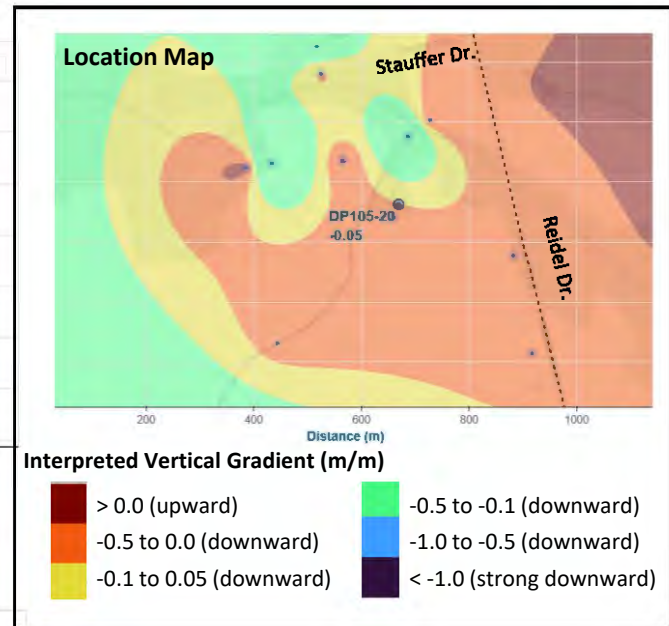
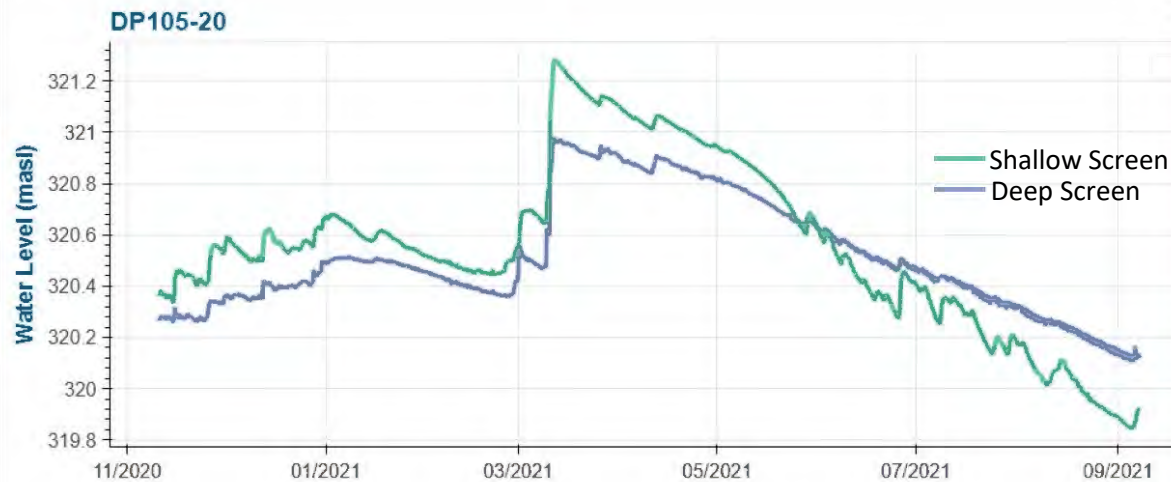
Transient Vertical Gradients – DP102-20



Upward
Downward

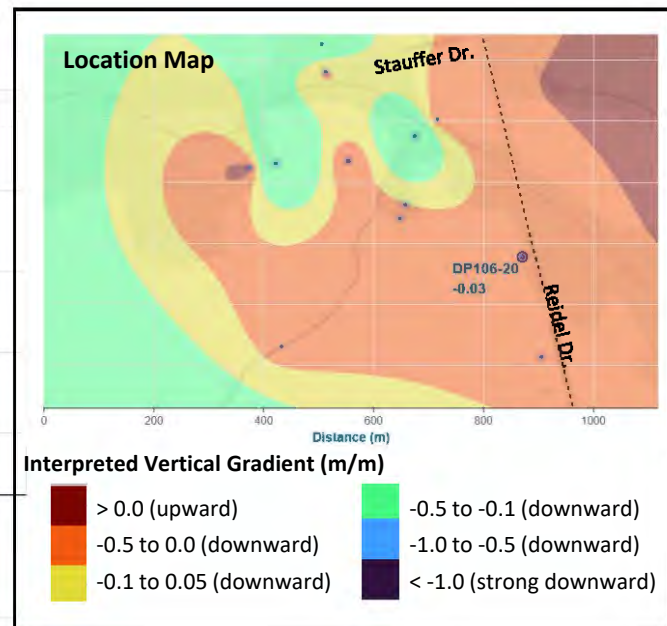
Hydrogeologic Characterization – Dundee

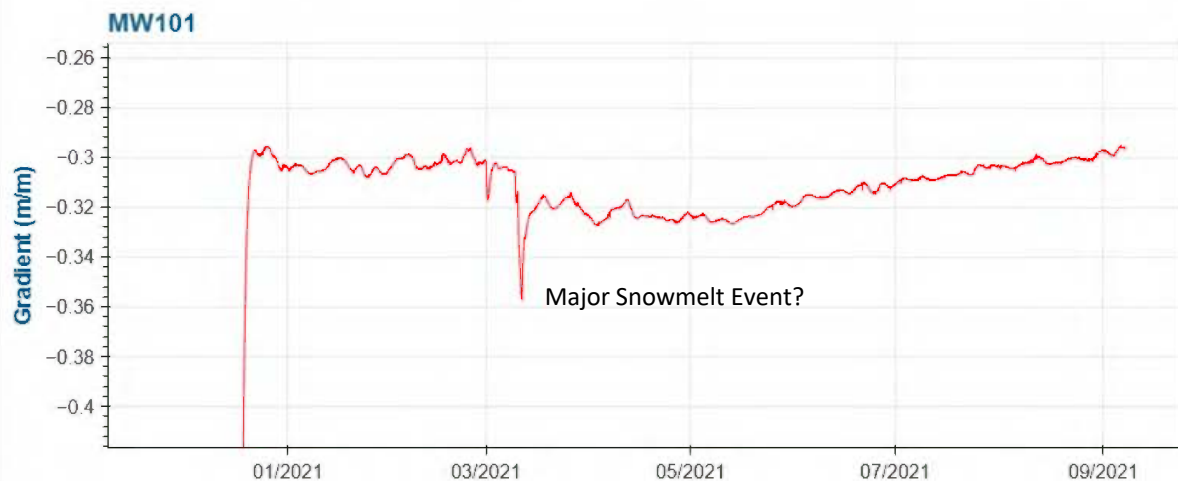
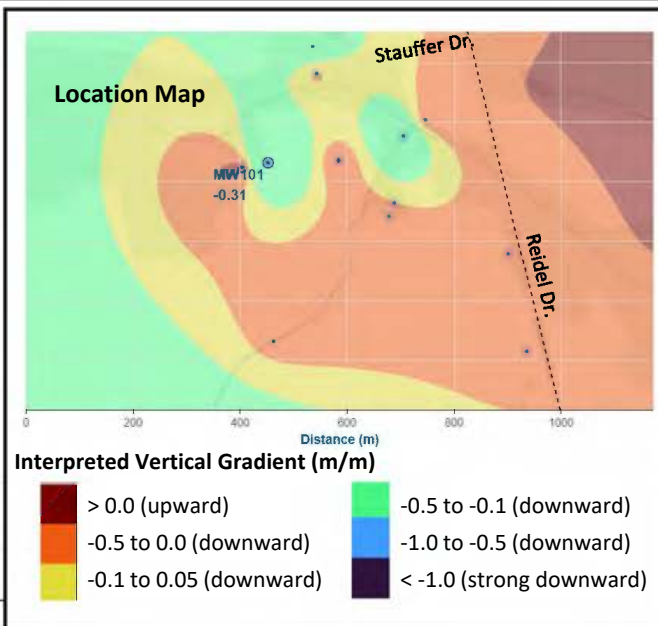
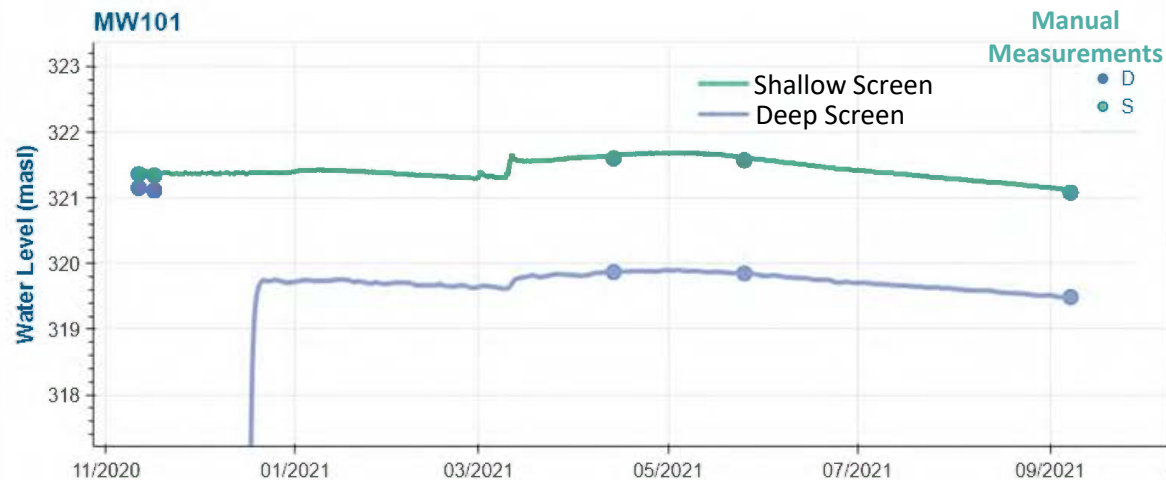
Transient Vertical Gradients – DP103-20



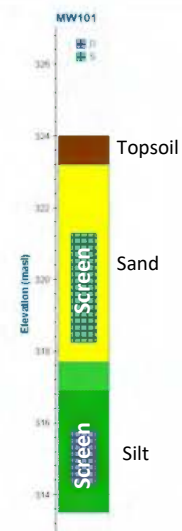
Hydrogeologic Characterization – Dundee

Transient Vertical Gradients – DP105-20



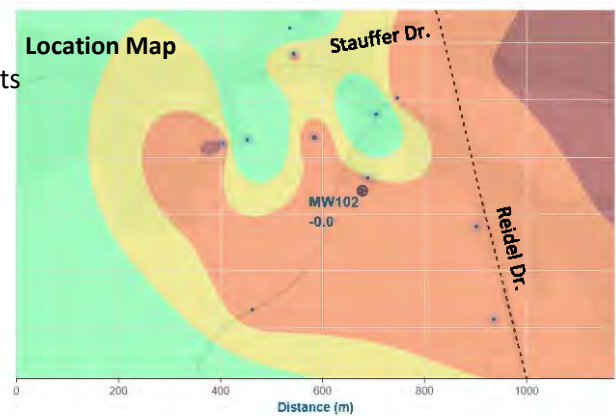
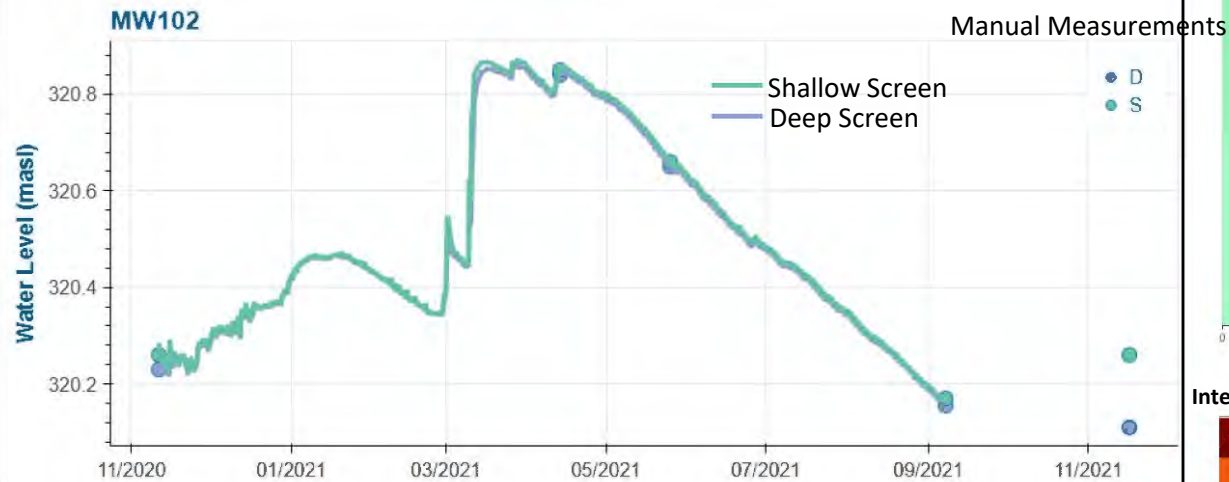


Upward
Downward

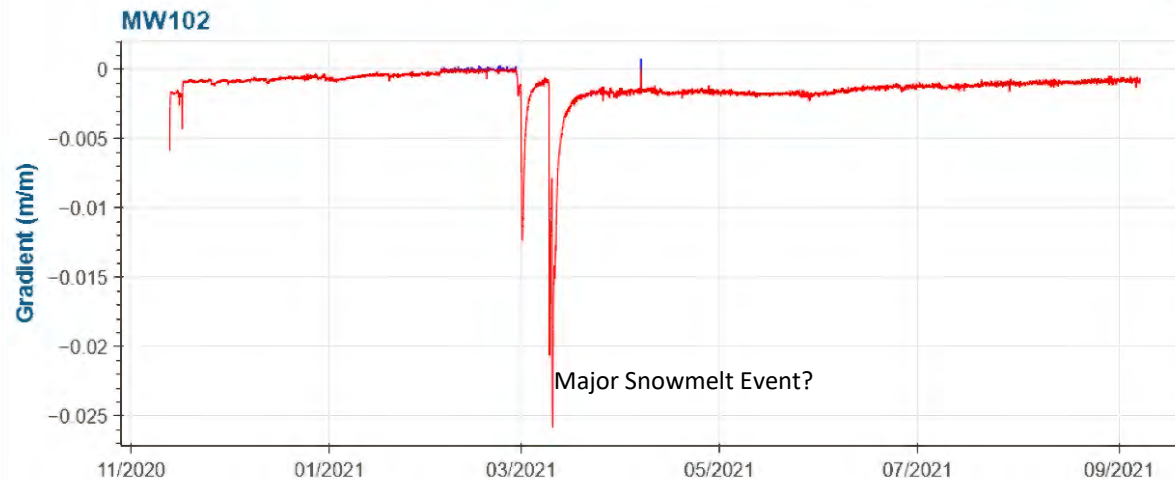


Hydrogeologic Characterization – Dundee

Transient Vertical Gradients – MW101

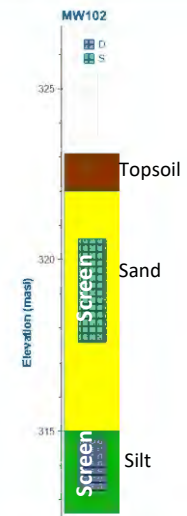


Interpreted Vertical Gradient (m/m)



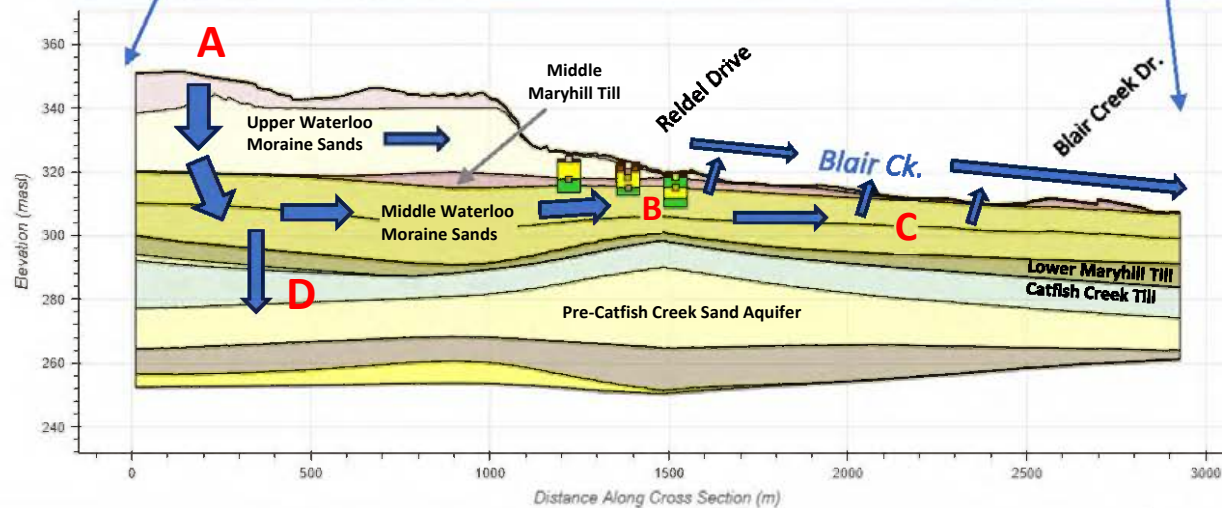
Upward

Downward

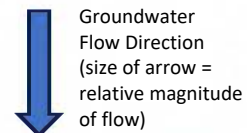


Hydrogeologic Characterization – Dundee

Transient Vertical Gradients – MW102



Legend: Borehole Lithology



Hydrogeologic Characterization – Dundee

Conceptual Cross-Section of Groundwater Flow



Figure 3-25: Dundee Secondary
Plan Drinking Water Vulnerability

Legend

Slope Erosion (GRCA)

- Steep
- Oversteep
- Toe

● Municipal Well (GRCA)

WHPA Vulnerability (GRCA)

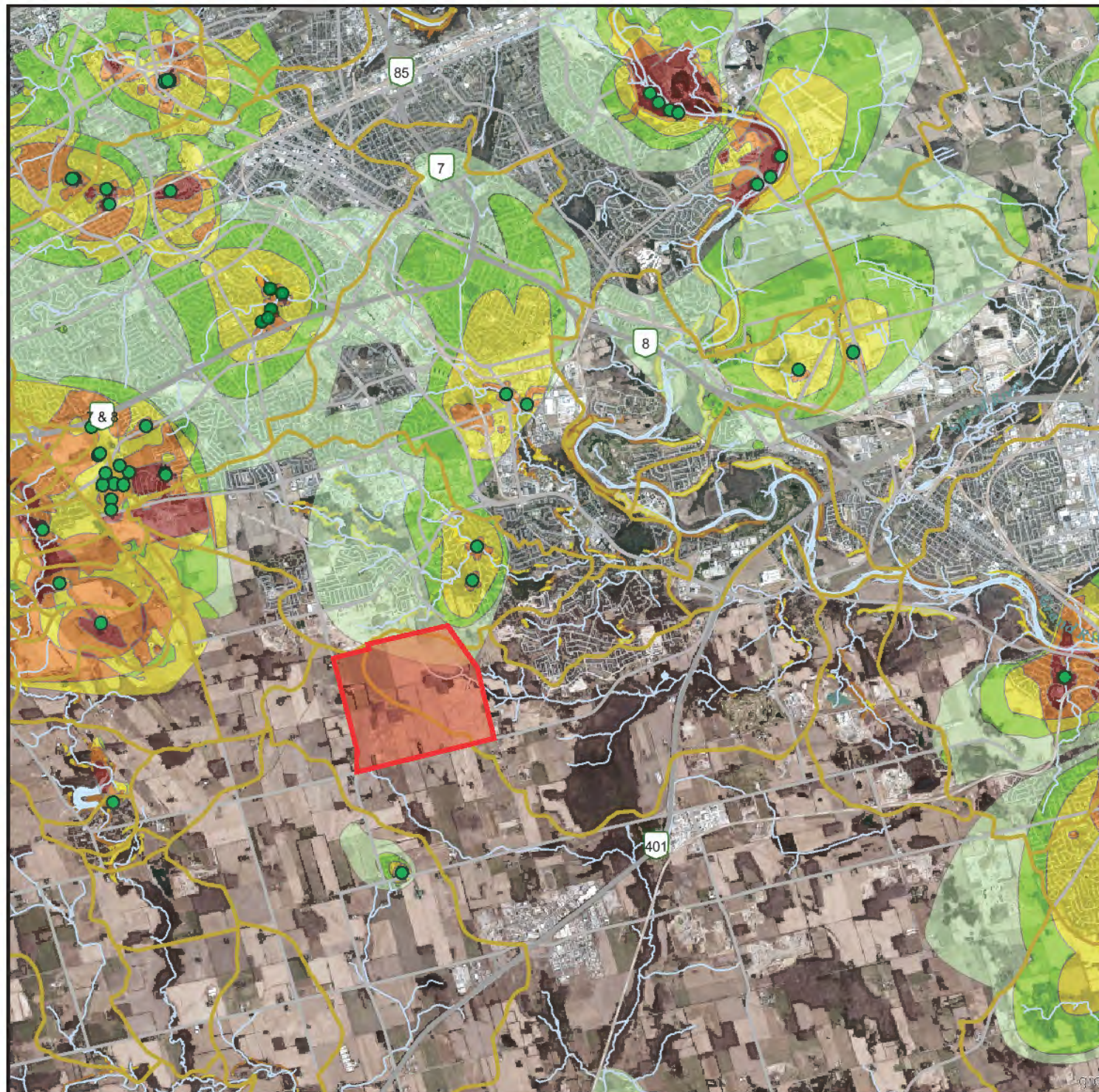
- 10
- 8
- 6
- 4
- 2

Subcatchment (GRCA)

Watercourse (GRCA)

Waterbody (GRCA)

Dundee Secondary Plan



Copyright Grand River Conservation Authority, 2025.

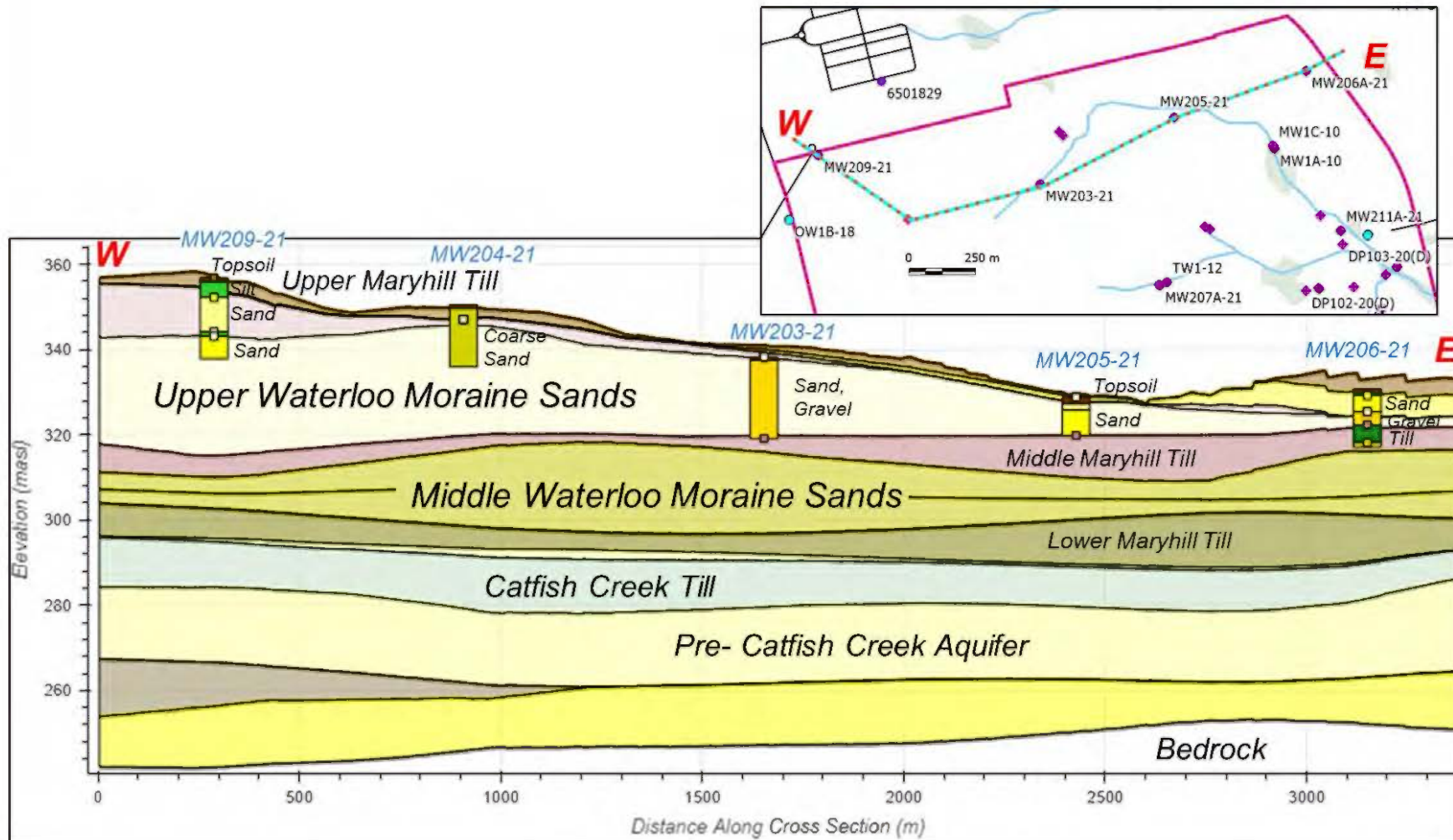
Disclaimer: This map is for illustrative purposes only. Information contained herein is not a substitute for professional review or a site survey and is subject to change without notice. The Grand River Conservation Authority takes no responsibility for, nor guarantees, the accuracy of the information contained on this map. Any interpretations or conclusions drawn from this map are the sole responsibility of the user.

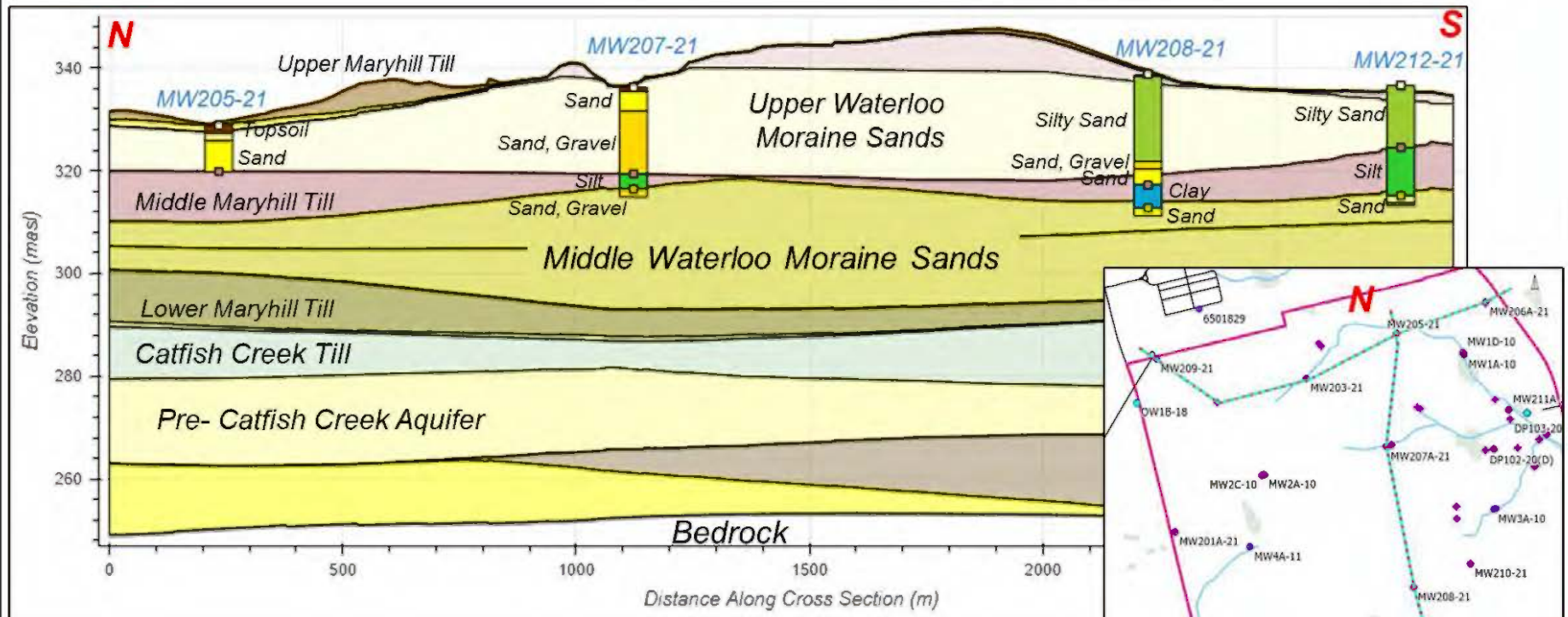
The source for each data layer is shown in parentheses in the map legend. See Sources and Citations for details.

Scale 1:93,761

NAD83 UTM zone 17 (EPSG:26917)





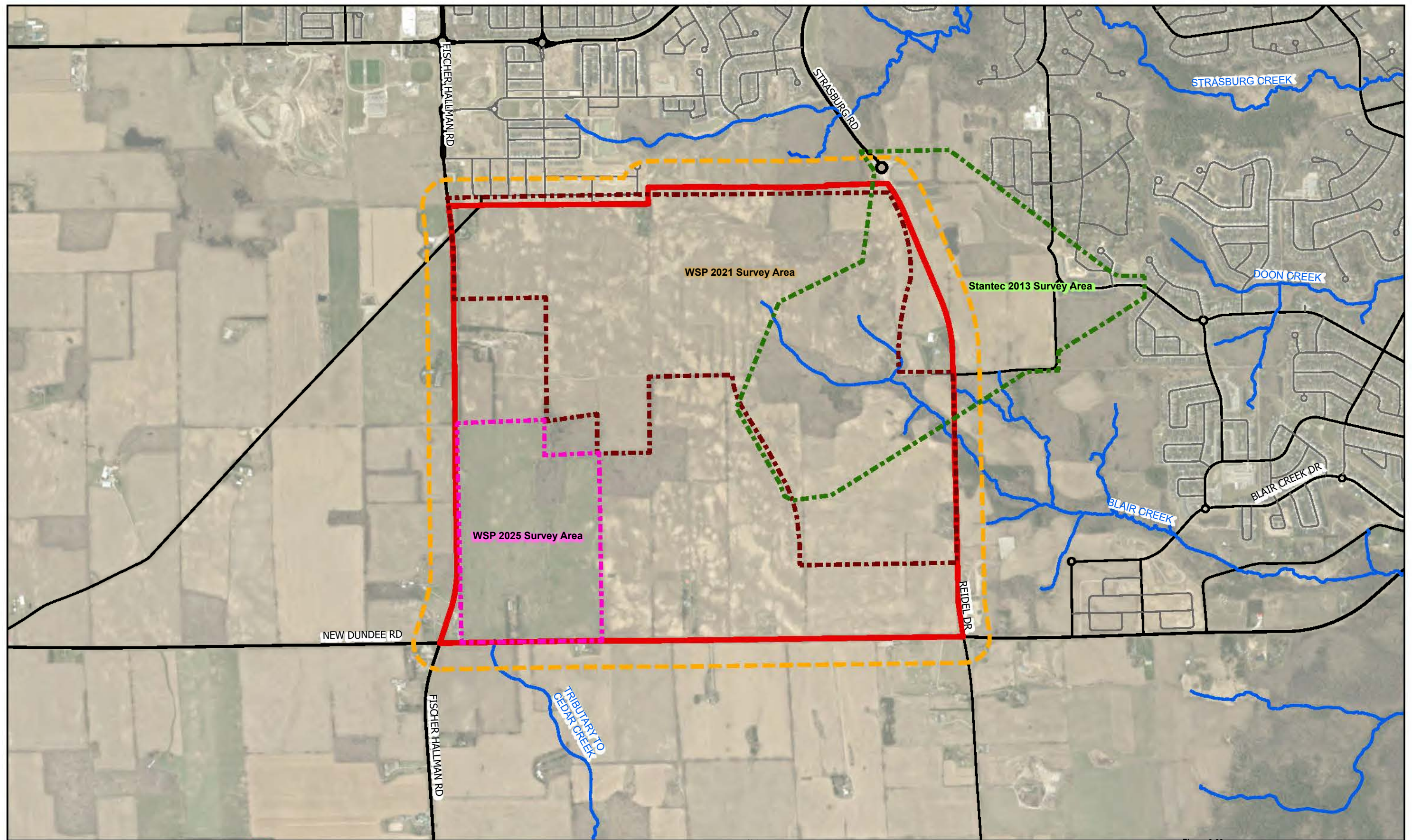


Legend: Borehole Lithology

	Topsoil		Sand		Silt		Clay with Sand
	Sand and Gravel		Fine Sand		Silt with Clay		Clay
	Coarse Sand		Silt with Sand		Clay with Silt		

Hydrogeologic Characterization – Dundee

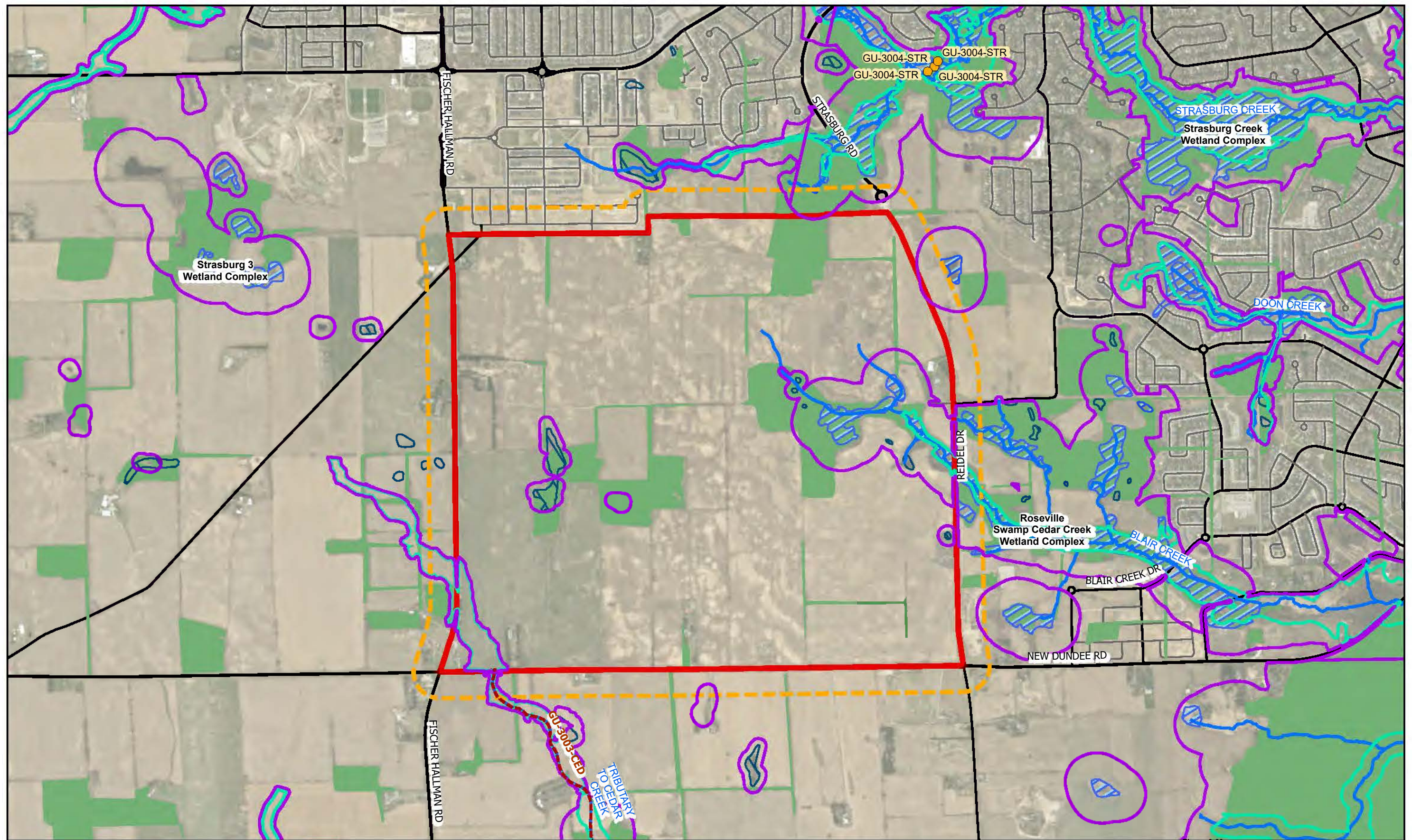
North -South Cross Section



Notes:
 1. Aerial Source: Region of Waterloo, Maxar
 2. Road network is from Land Information Ontario.

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Figure 3-28
 Natural Heritage Re-Baseline Study Area
 Natural Heritage Re-baseline
 Dundee Secondary Plan Scoped Subwatershed Study Report
 City of Kitchener
 Kitchener, Ontario



Notes:
 1. Aerial Source: Region of Waterloo, Maxar
 2. Road network is from Land Information Ontario.
 3. Natural features data is from Land Information Ontario or Grand River Conservation Authority (GRCA).

Figure 3-29
 Natural Heritage Re-Baseline Boundary
 Natural Heritage Re-baseline
 Dundee Secondary Plan Scoped Subwatershed Study Report
 City of Kitchener
 Kitchener, Ontario

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4. Future Land Use Scenarios

The City has provided two land use scenarios for the future development of the Study Area with the land use typologies given below:

- **Low density residential:** supports a variety of low density dwelling types (i.e. single detached, duplex, semi detached, street townhouse) on a range of lot sizes in low rise areas.
- **Medium density residential:** supports a variety of medium density dwelling types (cluster and stacked townhouses, medium rise multiple dwelling) and some complementary non-residential uses in medium rise residential areas.
- **High density residential:** supports a variety of high density dwelling types and a range of complementary non-residential uses in high rise residential areas.
- **Dundee urban centre:** includes recreational facilities, art and cultural spaces, and community amenities and services that help support higher density development.
- **Institutional:** range of institutional uses such as educational establishments, community facilities, etc.
- **Mixed-use:** supports a variety of uses such as retail, commercial, or institutional that are compatible within mixed-use buildings and mixed-use developments.
- **Commercial:** a range of retail and service commercial uses catering to daily and weekly needs of surrounding neighbourhoods.
- **Parks & open space:** provides a comprehensive and connected parkland and open space system.
- **Storm water management facilities:** facilities that provide multiple ecological benefits and support water resource system such as stormwater ponds and infiltration galleries.
- **Nodes / Corridors:** range of uses including medium to high density residential, mixed-use, and commercial.
- **Natural Heritage:** protection of features such as wetlands, woodlands, valley lands, etc. and their ecological functions.

A visualization of land use scenario A and B is illustrated in Figure 4-1 and Figure 4-2, respectively.

Future transportation and transit networks for the secondary plan study area have been established through previously completed environmental assessments and are the same for both Land Use scenarios. The intent of both land use scenarios is to support sustainable transit ridership early in the development of the study area. The future transportation networks are presented in Section 4.3.

Stormwater management facility locations are the same between both land use scenarios.

4.1 Land Use Scenario A

Scenario A depicts the maximum number of schools anticipated to serve the community, comprising of eight elementary schools and two secondary schools. This scenario has less area for low and medium density residential areas due to the higher number of schools. Description and sizes of each land use for scenario A is summarized in Table 4-1.

Table 4-1. Scenario A Land Use Description

Land use type	Description
Low Density Residential	193 hectares
High Density Residential	62 hectares
Dundee Urban Centre	Located in the center of the study area 18 hectares
Institutional	2 secondary schools – 18 hectares 8 elementary schools – 28 hectares
Stormwater Management Facilities	7 stormwater management facilities are shown 3 are located in the Blair Creek Subwatershed 4 are located in the Cedar Creek Subwatershed
Parks	37 hectares
Nodes	29 hectares
Natural Heritage	50 hectares
Cultural Heritage Resources	25 hectares

4.2 Land Use Scenario B

Scenario B represents the minimum number of schools to support and enable an active transportation network, consisting of five elementary schools and one secondary school. Additional school sites may be identified through future subdivision applications, based on community needs and development patterns. Description and sizes of each land use for scenario A is summarized in Table 4-2.

Table 4-2. Scenario B Land Use Description

Land use type	Description
Low Density Residential	221 hectares
High Density Residential	65 hectares
Dundee Urban Centre	Located in the bottom right of the study area 19 hectares
Institutional	1 secondary schools – 9 hectares 5 elementary schools – 18 hectares
Stormwater Management Facilities	7 stormwater management facilities are shown

Land use type	Description
	3 are located in the Blair Creek Subwatershed 4 are located in the Cedar Creek Subwatershed
Parks	33 hectares
Nodes	22 hectares
Natural Heritage	50 hectares
Cultural Heritage Resources	24 hectares

4.3 Transportation

4.3.1 Roadways

Both land use scenarios include Strasburg Road and Blair Creek Drive extensions identified through previously completed municipal class EAs (MTE Consultants Inc., 2024). These roads will form the primary transportation network within the secondary plan Study Area.

Blair Creek Drive currently runs west of Thomas Slee Drive, with a planned westward extension connection to Reidel Road and intersecting with future Strasburg Road. According to the preferred alternative identified in the Blair Creek Extension EA, the proposed road will feature a 26.0 m right-of-way and a posted speed limit of 40 km/h, reduced to 30 km/h in designated school zones. The design includes two travel lanes and a dedicated parking lane, with sidewalks and bike lanes provided on both sides. The vehicle lanes and bike lanes will be separated by a 4.0 m wide boulevard to enhance pedestrian safety (MTE Consultants Inc., 2024).

Strasburg Road currently ends at Rockcliffe Drive, with a planned southward extension to New Dundee Road which will travel through the Study Area and will connect to New Dundee Road. According to the preferred alternative identified in the Strasburg Road Extension EA from 2013, the proposed road will feature a 30 m right-of-way and a posted speed of 60 km/h. The design includes four travel lanes and a multi-use path (MUP) on both sides. The vehicle lanes and MUPs will be separated by a 7.5 m boulevard to enhance pedestrian safety (SNC-Lavalin Inc., 2013).

To further support sustainable transportation, the Region of Waterloo is currently conducting a transit priority feasibility study to add transit lanes along Fischer-Hallman Road, which forms the western boundary of the study area. This initiative aims to optimize the existing transportation system and promote transit ridership in alignment with the Region's 2018 Transportation Master Plan (TMP). For more information, refer to the Fischer-Hallman Transit Priority Feasibility Study (Region of Waterloo, 2024).

In addition, two roundabouts have been proposed within the study area. The first is planned at the intersection of Strasburg Road and New Dundee Road. While the Blair Drive Extension EA report (MTE Consultants Inc., 2024) concluded that a roundabout at this location is not necessary, a council report dated May 7, 2024, recommended its implementation based on updated studies indicating it would enhance safety and intersection performance (Waterloo, 2024).

The second roundabout is proposed at the intersection of Fischer-Hallman Road and New Dundee Road to improve safety and manage traffic flow. This design includes two lanes: a southbound through-right lane and a left-turn lane, a westbound through-left lane and a right-turn lane, with single-lane configurations for the remaining approaches. For further details, refer to the Region's meeting minute EES-DCS-22-001 (Region of Waterloo, 2022).

Figure 4-3 shows the proposed extension of Blair Creek Drive and Strasburg Road as well as the proposed locations of the roundabouts.

4.3.2 Transit

The Grand River Transit Business Plan (Region of Waterloo, 2025) guides all transit planning, operations, and strategic investments. The current Business Plan has not yet formally identified or approved transit routes within the area of the Dundee Secondary Plan. Future routes will be included in the next update to the GRT Business Plan and will be developed through a comprehensive process that considers:

- The approved land uses designated in the Dundee Secondary Plan.
- Spatial analysis of the approved road networks and locations of equity-deserving populations.
- Consultation with stakeholders and the public.

Any new transit routes will require Regional Council approval and dedicated funding. To effectively facilitate future transit integration, the primary transportation network (Major and Minor Collector Roads) within the Dundee Secondary Plan must ensure that right-of-way widths and intersection geometries are protected to safely accommodate the placement of transit infrastructure and the safe movement of bus vehicles.

4.4 Municipal Services

4.4.1 Population Projections

Table 4-3 and Table 4-4 provide the population estimated for Land Use Scenario A and B respectively, using the population per hectare factors provided in Table 2-1 and the areas provided in Table 4-1 and Table 4-2. ICI populations are assumed to be accounted for within the residential populations for both scenarios, based on the following assumptions:

- Institutional land uses, comprising mainly of elementary and secondary schools, are typically attended by local residents;
- Urban Centres are typically filled with small commercial properties as compared to those in Downtown/Core Kitchener. As such, it can be assumed that use of ancillary sanitary services (washrooms, sinks etc.) will only be by residential populations dwelling within the secondary study area, and contribution to overall municipal services demand from population outside the secondary study area will be low.
- *2025 Population & Employment Forecast Update & Housing Needs Assessment* (Watson and Associates Economists Ltd., 2025) identifies that 47 percent of Kitchener residents worked within the City while the remaining 53 percent commuted outside Kitchener for work. The same percentage was applied to this study area. This reinforces the assumption regarding lower municipal service use by populations residing outside the study area.

- Nodes are described as *Mixed-Use* zones shared between commercial and residential properties, and population estimates will use the factor for MIX-1 from Table 2-1. Nodes do not include major industrial areas (that can include non-residential populations from outside the study area). Therefore, the use of municipal services within the commercial properties is expected from the residents of the study area.

Table 4-3: Population Estimation for Land Use Scenario A

Row Labels	Area (hectares) ¹	Population per hectare	Population ¹
Mixed-Use Residential	62	387	23,840
Low Density Residential	193	36	6,960
Nodes	29	143	4,200
Total	284	-	35,000

1: Rounded to nearest 10th for clarity

Table 4-4: Population Estimation for Land Use Scenario B

Zones	Area (hectares) ¹	Population per hectare	Population ¹
Mixed-Use Residential	65	387	25,160
Low Density Residential	221	36	7,960
Nodes	22	143	3,150
Total	309	-	36,270

1: Rounded to nearest 10th for clarity

As described in Section 2.4.1, the population per hectare factor for Mixed-Use or Nodes zones is taken as that of RES-5 based on the understanding that nodes will include both commercial and residential areas, and not all the area will be used for residential homes. Therefore, a lower density factor multiplied by the entire area will account for the temporary population related to commercial areas, mitigating overestimation of the permanent residential population that will be the major contributors to municipal service demand.

Scenario A generates the exact population estimate as that of the City, while Scenario B generates a slightly higher population. Water demand and wastewater flows are estimated for both scenarios, to identify and compare the impact on these municipal services.

4.4.2 Drinking Water Systems

4.4.2.1 Additional Water Supply Demand and Storage Capacity Required

The design criteria established in Section 2.4.1 was applied to the populations projected for each Land Use Scenario. The water demand and required water storage capacity for the population estimate provided by the City is also calculated for comparison. The results are presented in Table 4-5.

Table 4-5: Projected Water Supply and Storage Demand for Land Use Scenarios A and B

Parameter	Scenario A	Scenario B
Population	35,000	36,270
Maximum Week Capita Water Demand (lpcd)	324	
Maximum Week Water Demand (m³/day)	11,340	11,750
Fire Flow Capacity (m ³)	6,420	6,520
Equalization Storage (m ³)	2,840	2,940
Emergency Storage (m ³)	2,310	2,360
Total Storage Capacity Required (m³)	11,570	11,820

Scenario B generates a water demand that's roughly 490 m³/d higher than Scenario A / City provided population. This is expected, as the water demand is population dependent and Scenario B generates a higher population than the other two.

Both scenarios estimate relatively similar water storage capacities for the study area, as the major contributing factor to storage sizing is fire flows which are typically the same for a range of population.

4.4.2.2 Water Distribution

The topography of the study area is illustrated in

Figure 4-4 and shows that elevations range from 316 mASL in the southeast (lower) areas to approximately 360 mASL towards the north. This translates to a maximum HGL of 372 mASL in the lower elevations (to prevent exceeding 80P PSI) and a minimum HGL of 395 mASL in the higher elevations (to prevent pressures below 50 PSI) to maintain between 50 – 80 PSI on average day, per the design criteria detailed in Section 3.4.3. As such, the study area will require to be connected to both pressure zones 4 and 5, as follows:

- Zone 5 has an average HGL of 413 mASL per the WSDOMP. As such, areas with elevations (typically taken as finished-lot elevations) higher than 378mASL will require booster pumps. Likewise, elevations lower than 357 will require pressure reducing valves (PRVs).
- Zone 4 has an average HGL of 388, and following the same justification above, can service lots with elevations from 353 to 332 without the need of booster pumps or PRVs.

Zone 4 watermain can be extended into the study area via the proposed Strasburg Road extension project. Looping can be implemented by connecting this watermain to the watermain extension proposed for the Blair Creek Drive extension project. The proposed watermain under the future extended Blair Creek drive connects to Zone 2W (from Stauffer Drive) ; therefore, appropriate zoning valve is required for looping Zone 4 to Zone 2W.

Zone 5 can be looped into Zone 4 within the study area with appropriate zoning valve.

It is expected that right-of-ways under future roadways will be used for watermain routing. Planning of roadway / transportation routes is to consider water distribution pressure zones as described in this Section, in conjunction with development plans proposed by developers. Appropriate roadway planning would allow watermains to service all areas within a specific pressure zone with limited or eliminated need for additional in-line booster pumps or PRVs.

4.4.3 Wastewater Collection and Treatment System

4.4.3.1 Wastewater Treatment

The design criteria for projecting wastewater flow as established in Section 2.4.3 were applied to the populations projected for each Land Use Scenario and the results are provided in Table 4-6.

Table 4-6: Projected Wastewater Flow for Each Land Use Scenario

Parameter	Scenario A	Scenario B
Population	35,000	36,270
Average Day Per Capita Water Sewage Flow (lpcd)	305	
Average Day (Sewage) Flow (ADF) (m ³ /d)	10,670	11,060

4.4.3.2 Wastewater Collection and Pumping

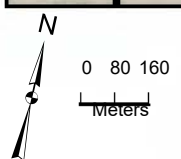
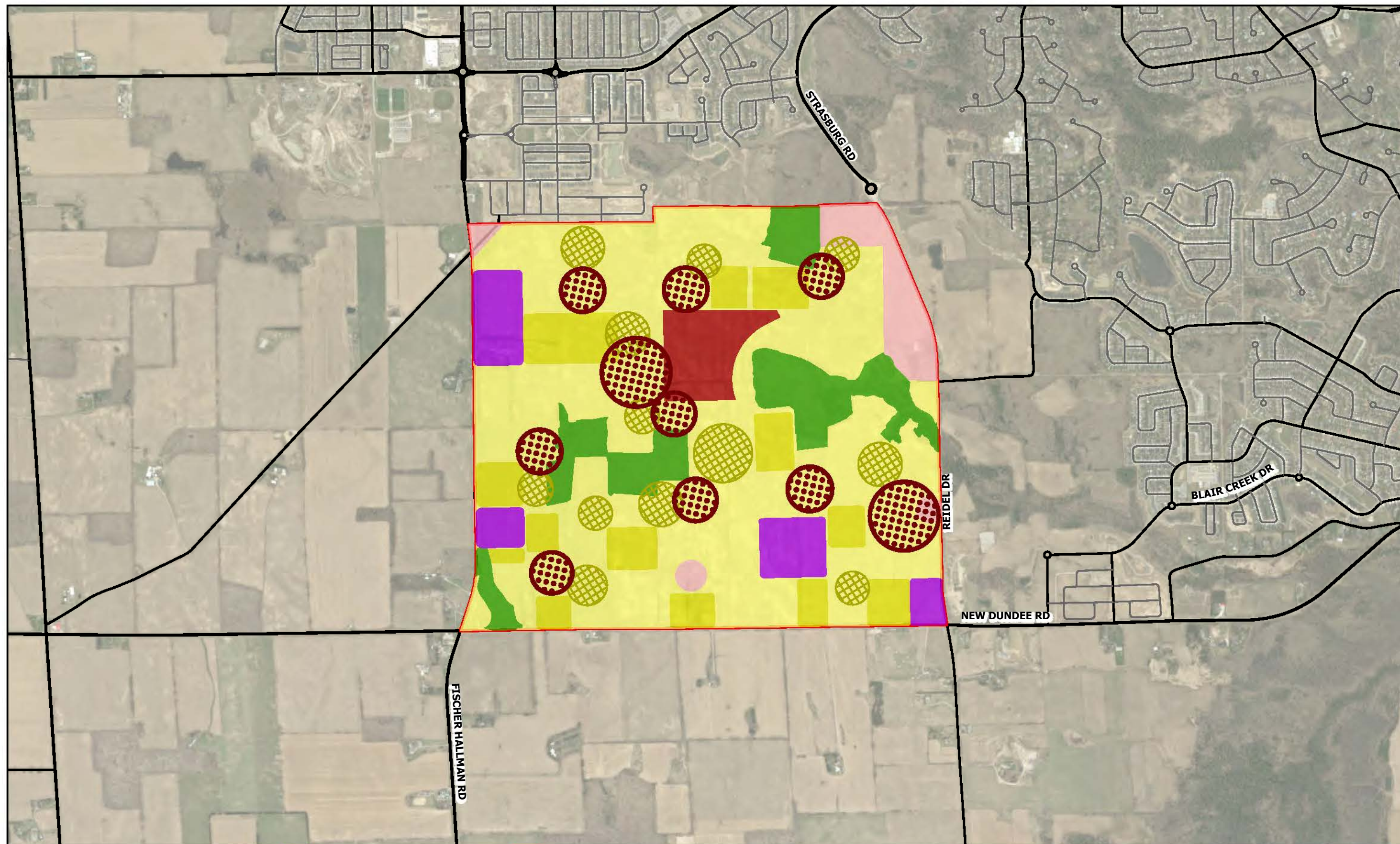
Peak flows Table 4-7 provides the peak wet weather flows for each scenario. The WEF guidelines provides peaking factors based on ADFs. Since both scenarios have relatively similar ADFs, the peaking factor are the same.

Table 4-7: Peak Wastewater Flows

Parameter	WEF Factor	Peak Flow (ADF x Factor)
Scenario A	3.3	410
Scenario B	3.3	420

Peak flows for both scenarios are to be used for sizing the wastewater conveyance systems (linear wastewater infrastructure and SPSs). As noted earlier, the terrain gradually lowers from north to south of the study area, reflecting the general route that gravity conveyance will allow. Figure 4-5 presents watershed drainage areas in the study area, which also represents the general route that I&I will follow. Verification of wastewater catchment areas will rely on gradings proposed in further planning studies which will dictate the wet weather flow rates and patterns.

Extension of the existing wastewater collection system up to the vicinity of the study area was initially proposed as part of the Blair Creek Drive extension project (MTE Consultants Inc., 2024), via a 525 mm sanitary sewer up to the east of Reidel Drive. The report noted that a sanitary trunk sewer for the greater surrounding area will likely not follow the alignment of Blair Creek Drive due to the sewer depths required. This is to be verified once the preferred land-use is established by the City based on the findings of this report. If gravity conveyance is not practical, a new sewage pumping station will be proposed for the study area. The sewershed serviced by this SPS will greatly depend on future development plans (which will include site grading).



Land Use

- Cultural Heritage Resources
- High Density Residential
- Low Density Residential
- Natural Heritage

Nodes

- Urban Centre
- Schools
- Parks

Road Network

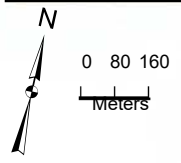
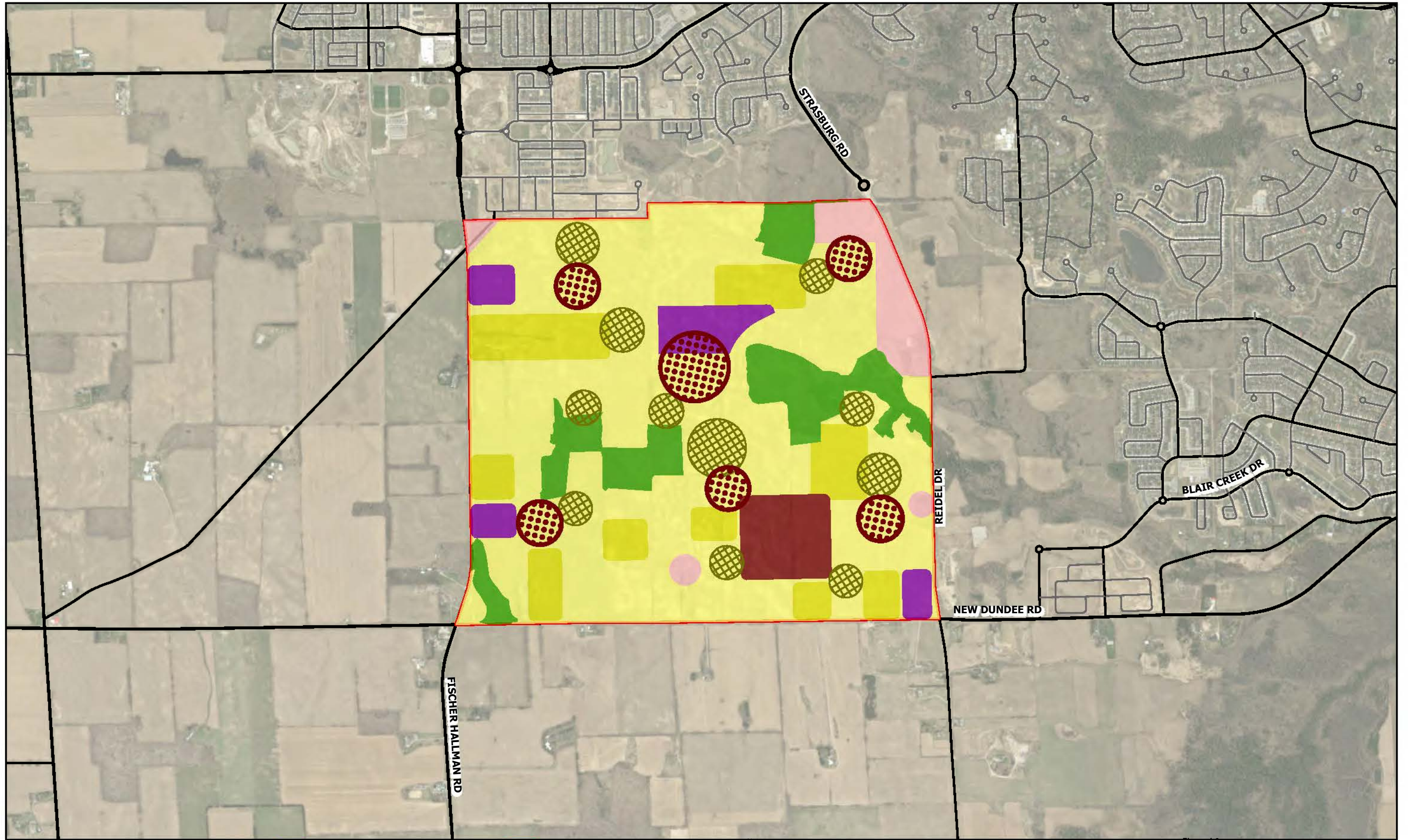
- Arterial
- Collector
- Local
- Alleyway / Laneway

Study Area

Notes:
 1. Aerial Source: Earthstar Geographics, Region of Waterloo, Maxar
 2. Road network is from Land Information Ontario.

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Figure 4-1
 Land Use Scenario A
 Dundee Secondary Plan Scoped Subwatershed Study Report
 City of Kitchener
 Kitchener, Ontario



- Land Use**
- Cultural Heritage Resources
 - High Density Residential
 - Low Density Residential
 - Natural Heritage

- Nodes**
- Nodes
 - Urban Centre
 - Schools
 - Parks

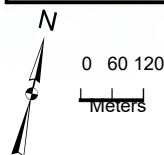
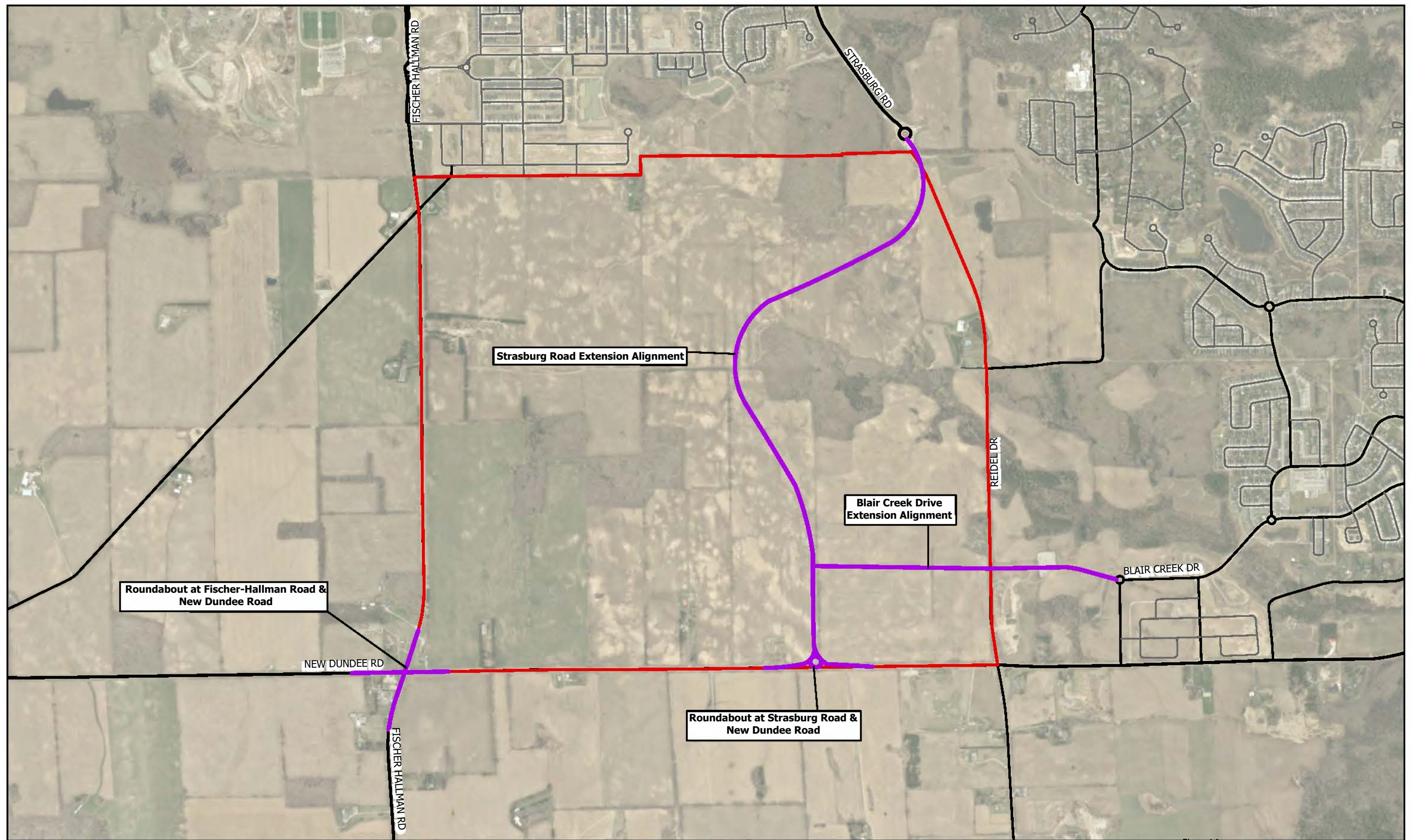
- Road Network**
- Arterial
 - Collector
 - Local
 - Alleyway / Laneway

Study Area

Notes:
 1. Aerial Source: Earthstar Geographics, Region of Waterloo, Maxar
 2. Road network is from Land Information Ontario.

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Figure 4-2
 Land Use Scenario B
 Dundee Secondary Plan Scoped Subwatershed Study Report
 City of Kitchener
 Kitchener, Ontario



Proposed Transportation Network

Road Network

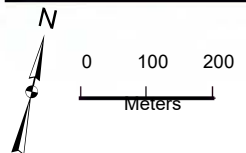
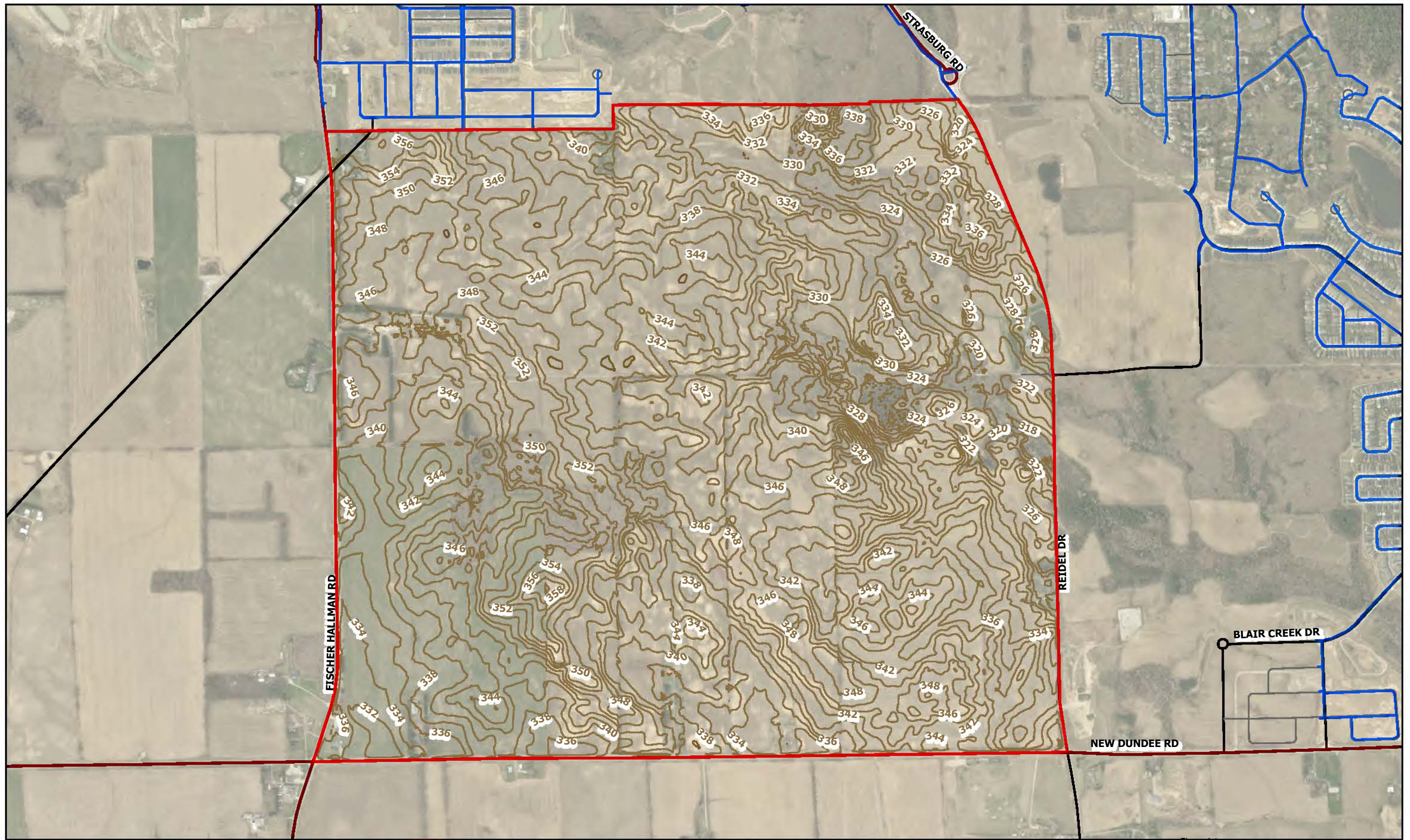
- Arterial
- Collector
- Local
- Alleyway / Laneway

Study Area

Notes:
 1. Aerial Source: Region of Waterloo, Maxar
 2. Road network is from Land Information Ontario.

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Figure 4-3
 Proposed Transportation Network
 Dundee Secondary Plan Scoped Subwatershed Study Report
 City of Kitchener
 Kitchener, Ontario

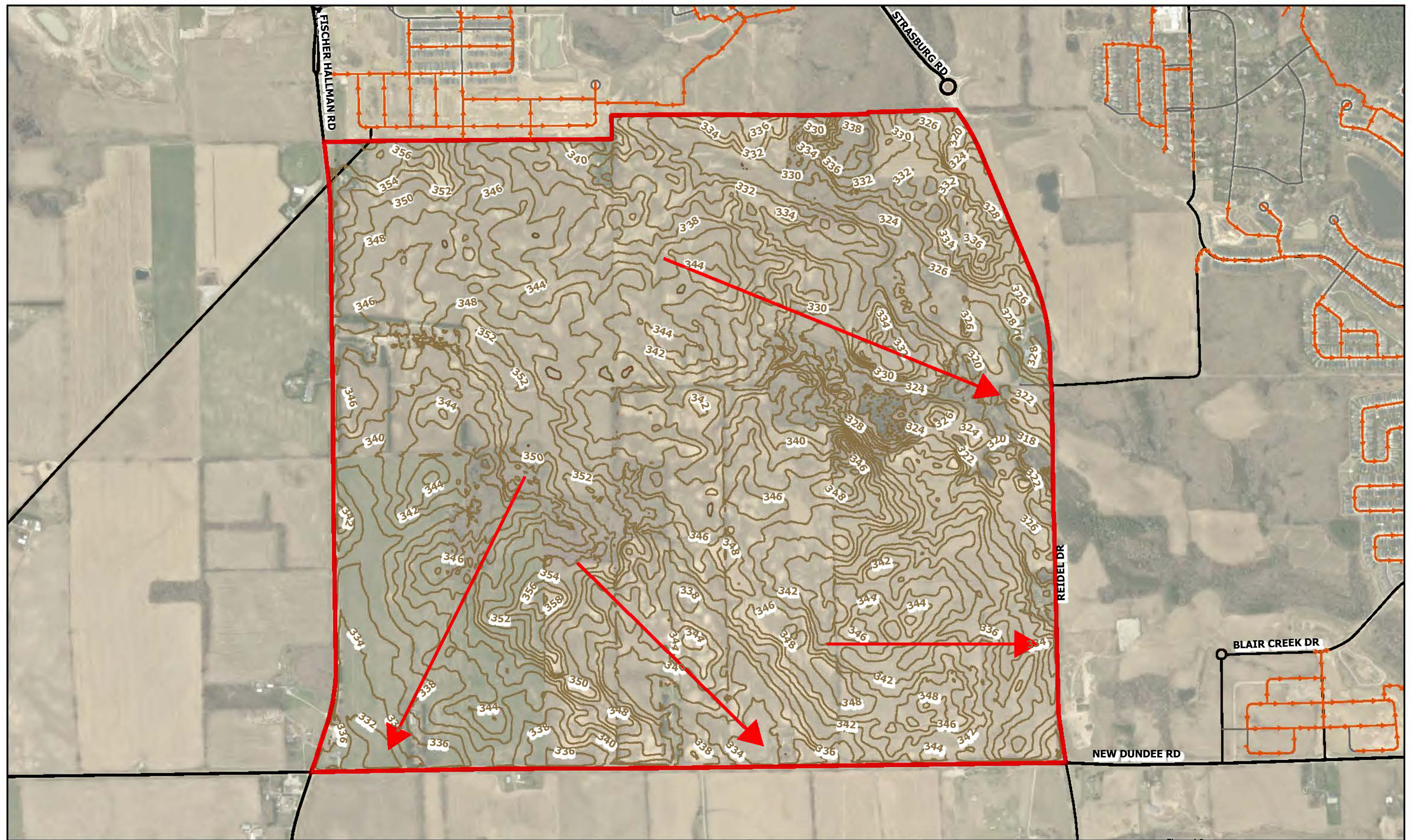


- | | | | |
|---|---|--|---|
| — Watermain | — Topography Contours - 2 m Interval | — Arterial | Study Area |
| | | — Collector | |
| | | — Local | |

Notes:
 1. Aerial Source: Region of Waterloo, Maxar
 2. Road network is from Land Information Ontario.
 3. Topography Contours were generated based on High Resolution DEM Terrain from Government of Canada.

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Figure 4-4
 Potential Water Pressure Zoning within Study Area
 Dundee Secondary Plan Scoped Subwatershed Study Report
 City of Kitchener
 Kitchener, Ontario



Notes:
 1. Aerial Source: Region of Waterloo, Maxar
 2. Road network is from Land Information Ontario.
 3. Topography Contours were generated based on High Resolution DEM Terrain from Government of Canada.

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Figure 4-5
 Sewershed Draining within Study Area
 Dundee Secondary Plan Scoped Subwatershed Study Report
 City of Kitchener
 Kitchener, Ontario

5. Land Use Scenario Impacts

The purpose of this section is to identify and compare the expected impacts of the two land use scenarios. The focus of the subwatershed study report is related to hydrology, hydrogeology, and natural heritage features. However, information related to the existing nearby transportation, transit, water, and wastewater have also been considered. In many cases the benefits and impacts of the infrastructure is consistent between the two land use scenarios and cannot be meaningfully differentiated from a scoped subwatershed study perspective.

5.1 Infrastructure

5.1.1 Transportation & Transit

The transportation and transit networks are consistent between the two land use scenarios. Differences between the two land uses cannot objectively differentiate the two land use scenarios.

5.1.2 Municipal Services

Water and wastewater projections of both scenarios show that Scenario B generates higher water demands and wastewater flows. As such, projection calculations were also undertaken for a population of 35,000 people forecasted by the City and compared to both scenarios. The results show that Scenario A and the City-Provided Population generated similar demand and flows, and therefore, exhibit more accuracy than projections made using Scenario B areas.

5.2 Stormwater

Overall, Scenario A is marginally preferred due to its lower total imperviousness (44 percent versus 46 percent) and generally lower peak flows compared to Scenario B.

Scenario A also features greater coverage of schools (46.58 ha compared to 27.15 ha) and parks (37.34 ha compared to 32.70 ha). This increased spatial coverage is significant, as it supports more pervious surfaces and indirectly connected impervious areas—key considerations for stormwater management strategies focused on infiltration and retention.

Additionally, the presence of more schools and open space in Scenario A could facilitate the development of green corridors and Natural Heritage linkages throughout the Study Area. These elements are vital to a comprehensive Treatment Train approach, which integrates Lot-level controls, Conveyance controls, and End-of-Pipe controls.

5.3 Hydrology and Hydrogeology

The hydrologic modelling results presented in Appendix A indicate that future development, in the absence of stormwater management, would lead to a pronounced shift in the local water balance and hydrologic response, particularly within the Blair Creek headwaters. Under both land use scenarios, the conversion of rural, pervious lands to urbanized uses, combined with the removal of natural storage features, results in substantial increases in surface runoff and corresponding reductions in groundwater recharge. These effects are most pronounced locally (at the Secondary Plan scale) where annual runoff is projected to nearly triple and recharge declines by over 163 mm per year.

At the broader subwatershed outlet near Highway 401, the same trends are observed but with notably smaller magnitudes, reflecting downstream attenuation.

Scenario A and Scenario B produce similar overall hydrologic responses, with Scenario A showing marginally lower peak flows and runoff in Blair Creek, and Scenario B slightly higher recharge in Cedar Creek due to more preserved open space.

Further discussion, including supporting tables and detailed model results, is provided in Appendix A.

5.4 Natural Heritage

The proposed land use scenarios, Scenario A and Scenario B, impact Natural Heritage similarly. The Natural Heritage Areas proposed are consistent between scenarios, making the other land uses and their indirect impacts on NH the primary focus on assessing differences through a NH perspective. The intensive land use proposed and removal of agricultural land that was marginally used for wildlife movement has cumulative impacts that further fragment NH areas on the landscape. When selecting a land use scenario it will be important to consider linkages between green spaces and NH areas as well as opportunities for ecological restoration. Scenario A has more proposed parks and schools, assuming that there are opportunities to integrate NH on both school properties and parks then Scenario A has a larger potential for ecological restoration and green space NH linkages. Integrating NH into schools also fosters environmental education and promote sustainable practices within the community. Further details and mitigation recommendations, not specific to a particular land use scenario, will be discussed in the Natural Heritage Strategy.

6. Management Strategy & Implementation Recommendations

The following section outlines the management strategies and implementations identified in the individual supportive study reports included in the Appendices of this report. Management strategies and implementation recommendations will be revised to reflect the identified preferred land use.

6.1 Infrastructure

This section identifies implementation recommendations for water and wastewater servicing, transportation, and transit.

6.1.1 Water & Wastewater Municipal Services

The following summarizes key impacts to the City and Regional drinking water and sanitary services from the development of the New Dundee Secondary planning area, taken as the average of scenarios A and B:

- In general, an additional water demand of 11,545 m³/day will be added to the existing water supply system. The distribution network will require an additional water storage capacity of 11,695 m³ for redundancy and fire protection. The study area can be serviced by existing Kitchener Pressure Zones 4 and 5, with potential looping of Zone 4 to Zone 2W and of Zones 4 and 5 via zoning valves.
- An additional daily average wastewater flow of 10,865 m³/d will be generated by the serviced population, and a peak flow of 415 L/s is estimated to be collected by the sewer system. Verification of these flows require delineation of catchment areas followed by hydraulic model updates.

These impacts should be considered in ongoing planning studies relevant to the study area, including:

- The IUS Supply Master Plan being undertaken by the Region of Waterloo.
- The Water and Wastewater Master Plan Update underway by the Region of Waterloo.
- The Kitchener Official Plan Update.

Additionally, the Dundee Secondary Plan area should be incorporated in the following future planning studies to determine the impact of future populations on water and wastewater infrastructure:

- Future updates to the City's Water Servicing Master Plan.
- Future updates to the City's Sanitary Servicing Master Plan.

6.1.2 Transportation and Transit

Future traffic associated with the Dundee Secondary Plan should be considered in ongoing studies including:

- Region of Waterloo Transportation Master Plan Update.
- City of Kitchener Transportation Master Plan Update.
- City of Kitchener Active Transportation Master Plan Update.
- City of Kitchener Transportation Master Plan Update.
- 2025-2034 Grand River Transit Business Plan, as updated.

6.2 Hydrology & Hydrogeology

The hydrologic modelling results presented in Appendix A indicate that future development, in the absence of mitigation, would result in a significant shift in the local water balance and flow regime across the study area. These effects are most pronounced within the Blair Creek headwaters, where development affects a larger proportion of the contributing drainage area. Impacts within the Cedar Creek catchments are comparatively smaller and more localized due to the more limited extent of urbanization.

Given the loss of natural storage and infiltration associated with urban development, the hydrologic management objective should aim to:

- Limit increases in peak flows at key outlets to reduce flood and erosion risk;
- Moderate runoff from frequent storm events that influence channel stability; and
- Maintain groundwater recharge patterns, where feasible, to support baseflow contributions.

While pre-development conditions cannot be fully maintained, the magnitude and downstream implications of hydrologic change can be managed at the planning level.

Within the Blair Creek, emphasis should be placed on managing frequent-event runoff and preserving recharge opportunities in headwater areas. In the Cedar Creek, the focus should be on maintaining the existing low-runoff regime and preventing cumulative increases in downstream flows.

The findings summarized above are supported by the hydrologic and hydrogeologic modelling results presented in Appendix A.

6.3 Water Quality

Increased sources of contaminants related to urbanization like salt/chlorides, fertilizers, and metals may enter the surface water and groundwater systems. The management approach should incorporate structural measures such as the implementation of stormwater management (SWM) measures (i.e. source, conveyance and End-of-Pipe controls) and non-structural measures, including salt reduction protocols and operation-and-maintenance measures such as street sweeping, Oil-and-Grit Separators (OGS) cleanouts, and park maintenance.

6.4 Cultural Heritage and Archaeological Resources

A draft Heritage Impact Assessment (HIA) has been prepared by Archaeological Services Inc., in partnership with The Landplan Studios Inc., to assess the cultural heritage significance of properties and roadways within the designated study area. The finds indicate that the proposed Dundee Secondary Plan may influence several cultural heritage resources shown below:

- Reidel Drive, from approximately 400 metres north of its junction with New Dundee Road to Stauffer Drive;
- Stauffer Drive, spanning from 500 Stauffer Drive to its intersection with Caryndale Drive;
- The trail segment formerly part of Caryndale Drive extending to Tilt Drive;
- A farmhouse building located at 1878 New Dundee Road;
- A former school building, now a single detached home at 1970 Plains Road; and
- A farmstead complex at 500 Stauffer Drive.

The draft HIA details the potential impacts on each highlighted cultural heritage resources and provides a summary of recommendations. These include, but are not limited to:

- Selecting a land use scenario that preserves the cultural heritage value of identified resources;
- Maintaining an 18 metre natural buffer to visually screen new development from heritage corridors;
- Retaining existing lighting conditions in heritage areas, unless modifications are necessary for safety;
- Balancing public and private access along Reidel Drive;
- Ensuring vehicular access and context is maintained for the farmhouse building located at 1878 New Dundee Road and the former school building at 1970 Plains Road;
- Explore the feasibility of establishing a park near the farmhouse at 1878 New Dundee Road; and
- Limit or relocate the low-density residential land uses adjacent to 500 Stauffer Drive.

For more information regarding recommendations, refer to the Heritage Impact Assessment for the Dundee Secondary Plan (Archaeological Services Inc., 2025).

6.5 Monitoring Plan

The characterization of the Blair Creek Subwatershed is greatly informed by the monitoring program that has been implemented within the subwatershed. This monitoring program was initiated in 1994. The Cedar Creek subwatershed environmental monitoring was initiated in 2015 ahead of the subwatershed study. Modifications to the Blair Creek and Cedar Creek Monitoring Programs to incorporate the Dundee Secondary Study Area is included in Appendix E.

The proposed monitoring plan updates the existing Blair Creek and Cedar Creek Monitoring Programs to include the Dundee Secondary Plan Study Area pre-, during-, and post-development. The intent of the monitoring plan is to maintain the goals, objectives, and targets established in the existing monitoring programs for Blair Creek and Cedar Creek. The monitoring plan in Appendix E provide guidance for the selection of new monitoring locations, parameters, sampling frequencies, monitoring, and reporting responsibilities by the development phase of development.

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