



Background Review Summary

Prepared for:
The City of Oshawa

Prepared by:
Matrix Solutions Inc., a Montrose Environmental Company

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Guelph, Ontario

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Background Review Summary

Prepared for City of Oshawa, September 2024

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1 Introduction

The City of Oshawa (City) and Matrix Solutions Inc., a Montrose Environmental Company, (Matrix) are developing a Stormwater Management Master Plan (SWM MP) in accordance with the provincial Phase 1 and 2 Municipal Class Environmental Assessment (MCEA) processes. The SWM MP is a City-wide comprehensive study that will evaluate the effectiveness of the City's existing key SWM assets and infrastructure and provide updated stormwater management recommendations and guidelines in a consolidated document.

Stormwater is rainfall and snowmelt that puddles on the ground, seeps into the ground, or flow overland into conveyance systems such as roadside ditches, storm sewers networks, creeks, and lakes (Government of Ontario 2021). The stormwater that flows over a land surface is referred to as "stormwater runoff", which is controlled using stormwater management practices. Stormwater management practices consist of traditional grey infrastructure, such as storm sewers or roadway culverts and stormwater management facilities (SWMF), and green infrastructure, such as rain gardens or tree trenches. Stormwater management practices are used to safely convey the volume of stormwater runoff and sometimes, to manage the quantity and quality of the stormwater by temporarily storing it, filtering it and/or infiltrating it.

The City's population is projected to increase from 175,383 in 2021 to approximately 300,000 by the year 2051. The SWM MP will help the City evaluate the effectiveness of its existing stormwater infrastructure and systems, including creek crossings (culverts and bridges under City-owned roads), SWMF, and watercourses (Oshawa Creek, Black/Harmony/Farewell Creek and Corbett Creek watersheds), and will develop stormwater management strategies and policies that support this future population growth in a sustainable manner.

The scope of work to prepare the SWM MP includes five primary tasks, which are outlined below:

- **Task 1: Review and Compilation of Existing Information** – This task includes a review of relevant policies, watershed studies, subwatershed plans, secondary plans, municipal environmental servicing plans, fluvial geomorphological studies, hydraulic and hydrological modelling, and other related documents.
- **Task 2: Establish the City's Stormwater Management Requirements** – This task includes establishing updated SWM requirements based on the City's current water quantity, quality, and erosion criteria identified in Task 1 and current industry standards. The existing

hydrologic models will be reviewed as part of this task and recommendations provided for the inputs (rainfall distribution, duration, volumes in consideration of climate change, imperviousness values).

- **Task 3: Review of current stormwater drainage system** – This task includes field assessments of the City-owned creek crossings (including hydraulic assessments), watercourses (identifying and evaluating sites of erosion), and SWMFs (condition assessments and bathymetric surveys), and identifying and prioritizing infrastructure needing maintenance, repair, retrofit, or replacement.
- **Task 4: Identify Stormwater Management Retrofit Opportunities** – This task includes assessing areas within the City which do not have stormwater management controls other than linear infrastructure (i.e., storm sewers) to identify and prioritize areas which may be retrofit with end-of-pipe or onsite SWM best management practices, such as a SWMF.
- **Task 5: Develop the Stormwater Management Master Plan** – This task includes the compilation of the results and recommendations from Tasks 1 through 4, to provide a consolidated program and implementation plan.

Low impact development (LID) asset inventory and condition assessments are not included in the current study scope; however, new LID systems may be recommended through Task 4. Furthermore, the study does not include a condition assessment or inventory of the existing storm sewer network network and foundation drain collector system.

This Task 1 Background Review Report provides a summary of the available background information pertaining to SWM in the City. The information was reviewed to understand existing conditions, locations of deficiencies, planned and completed repairs and restorations, and gaps in the available information. The results of the background review informed the field assessments of the City’s SWM infrastructure (Task 3) and will help inform the identification and prioritization of maintenance, repair, retrofit, or replacement projects that will be recommended as part of the final SWM MP.

As part of the MCEA planning process, the City must develop a clear statement of the identified problems and opportunities to be addressed through the SWM MP. Based on the background review, a draft problem and opportunity statement was prepared (Section 6). This statement will be refined based on public input and the information gathered during Tasks 2 through 4 of the study.

1.1 Plan and Policy Context

The need for the SWM MP has been directed by City council and endorsed through the City of Oshawa Official Plan (City of Oshawa 2024a) and the Oshawa Strategic Plan (City of Oshawa 2024b).

The City's Official Plan includes consideration and planning guidance for environmental management in the City, which includes protecting, conserving, and enhancing the natural environment, and minimizing and mitigating the impacts of development on the natural environment. The Official Plan describes the need for a watershed and subwatershed-based planning approach that recognizes natural heritage and hydrologic features. The Official Plan also recognizes that stormwater management is a vital component of a healthy watershed that supports groundwater and surface water features, protect ecosystem functions, and protect human life, property and infrastructure from flooding and erosion hazards.

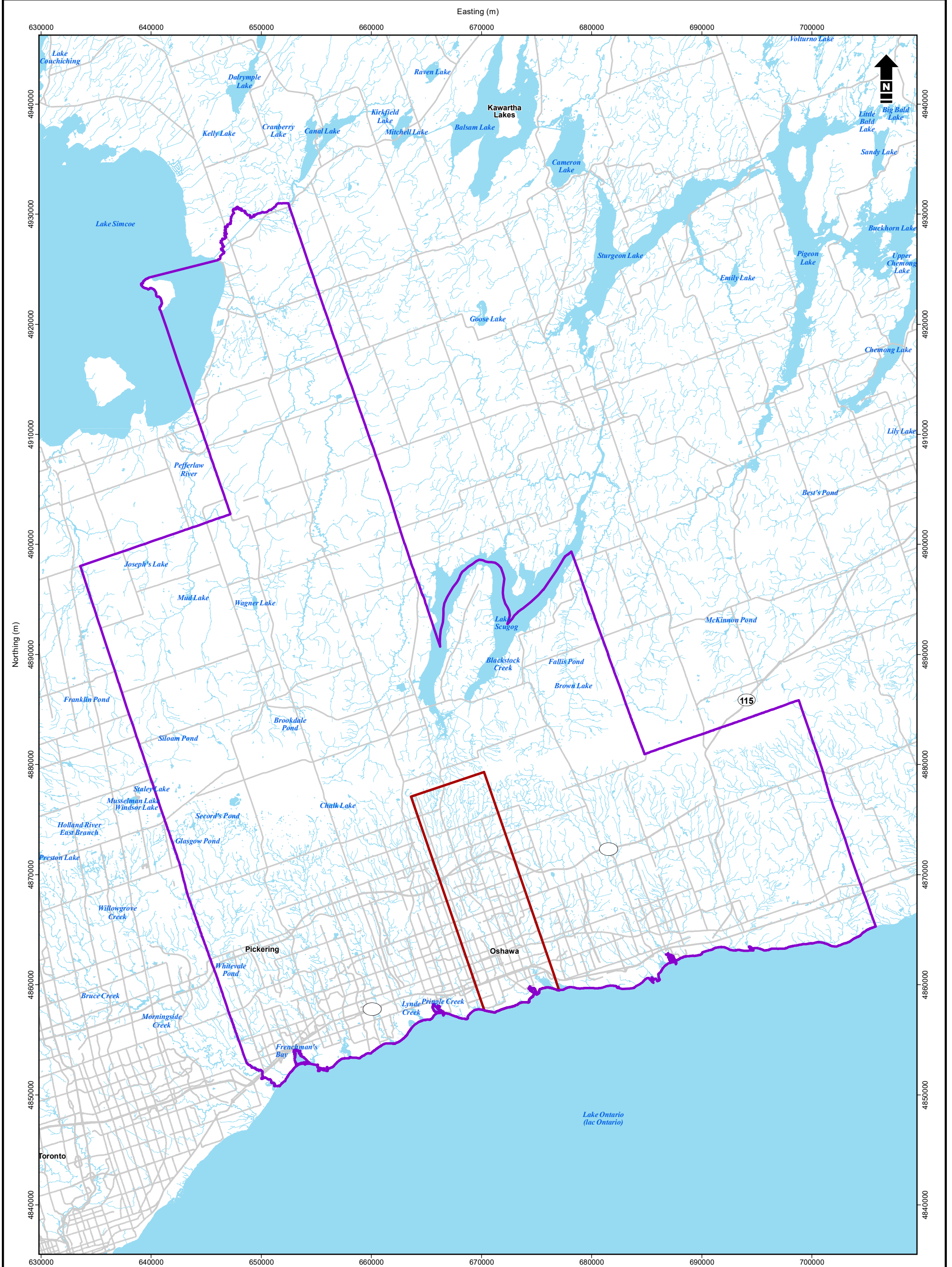
The City's Strategic Plan outlines goals and actions to creating a safe and sustainable community that enhances well-being. The Strategic Plan provides actions and tasks to manage impacts on natural assets including wetlands and waterways and one such action is the restoration of erosion sites, which ties in directly to the SWM MP. Further, this plan provides actions to enhance the City's emergency preparedness, which includes preparing for climate-related emergencies and significant weather events.

The City's 2021 Asset Management Plan includes a plan for all City-owned assets (e.g., watermains, sanitary sewers); however, has a primary focus on the core assets of roads, structures (i.e., culverts and bridges), and other stormwater management assets (e.g., SWMFs). The 2021 Asset Management Plan states that "the upcoming SWM MP will help the City of Oshawa to see opportunities for improving the knowledge of the risks, methods for planning that support growth and intensification, and decision-making regarding municipal stormwater infrastructure, grey, green and even our natural assets". The level of service for stormwater infrastructure will be updated based on the finding/recommendations of the current study (City of Oshawa 2021).

The Region of Durham's Community Climate Adaptation Plan specifies an objective of "Reduc[ing] the severity and frequency of urban flooding". This is accomplished by improved stormwater management practices, which may also include low impact development (LID) and other best management practices. These will be considered as part of the SWM MP.

1.2 Study Area

The City of Oshawa is the largest municipality in the Region of Durham and is bordered by the Town of Whitby to the west, the Township of Scugog to the north, the Municipality of Clarington to the east, and Lake Ontario to the South. Figure 1 illustrates the location of the City of Oshawa in relation to the Region of Durham and Lake Ontario.



| | |
|--|---------------------------------|
| | City of Oshawa (Study Area) |
| | Regional Municipality of Durham |
| | Water Body |
| | Watercourse |
| | Road |

References: Data obtained from GeoBase® and GeoGratis © Department of Natural Resources Canada (all rights reserved) used under license. References: Data obtained from Central Lake Ontario Conservation Authority (2024). Data obtained from City of Oshawa (2024). Contains information licensed under the Open Government Licence - Canada. Produced under Licence with the Ontario Ministry of Northern Development, Mines, Natural Resources and Forestry © Queen's Printer for Ontario (2024).

Matrix Solutions Inc.
A Montrose Environmental Company

City of Oshawa
Stormwater Management Master Plan

Study Area

| | | | |
|-------------------|----------------|----------------------|--------------------------|
| Date: August 2024 | Project: 40061 | Submitter: Z. Zimmer | Reviewer: T. Roumeliotis |
|-------------------|----------------|----------------------|--------------------------|

Disclaimer: The information contained herein may be compiled from numerous third party materials that are subject to periodic change without prior notification. While every effort has been made by Matrix Solutions Inc. to ensure the accuracy of the information presented at the time of publication, Matrix Solutions Inc. assumes no liability for any errors, omissions, or inaccuracies in the third party material.

1:325,000 kilometres
0 3 6
NAD 1983 UTM Zone 17N

Figure 1

The study area considered as part of the assessment is the area with the City of Oshawa's municipal boundary. The City covers an area of approximately 150 km² and includes portions of the Oshawa Creek, Black/Harmony/Farewell Creek, Pump House, and Corbett Creek watersheds. A watershed is a large area of land that catches rainfall and snow, which then drains overland or seeps underground into a stream, river, lake, or groundwater (Conservation Ontario 2024). Ultimately, any rainfall or snow that falls within a watershed will flow to a common outlet (e.g., Lake Ontario). Watershed area limits are defined by high elevation ridges that converges to a common low elevation. A subwatershed is an area of land where rainfall and snow drain into a stream or greater group of streams that contribute runoff within a larger watershed.

Figure 2 illustrates the watersheds and subwatershed boundaries within the study area. The planning areas within the City are also shown on the figure to provide context to where the City's strategic growth areas are in relation to the watersheds. While the study area encompasses the entire City of Oshawa, the assessment will focus on urban areas where flooding is a greater concern and stormwater management is a higher priority.

A drainage area is an area of land where all flowing surface water converges to a single point, such as a confluence with another river/creek/stream or a lake. In other words, the drainage area is the area where, if any precipitation falls, that precipitation will eventually reach that single convergence point, such as Lake Ontario.

The drainage area and stream lengths for each watershed that overlap with the City limits are summarized in Table 1. This is important information for stormwater management and planning purposes to understand runoff volumes and resulting flows, as flows will increase from the upstream to downstream end of a watershed. It also provides insight into how site development activities may impact the downstream watershed, as runoff volumes and peak flows increase with development activities (i.e., increased imperviousness).

Table 1 Watersheds within City Limits

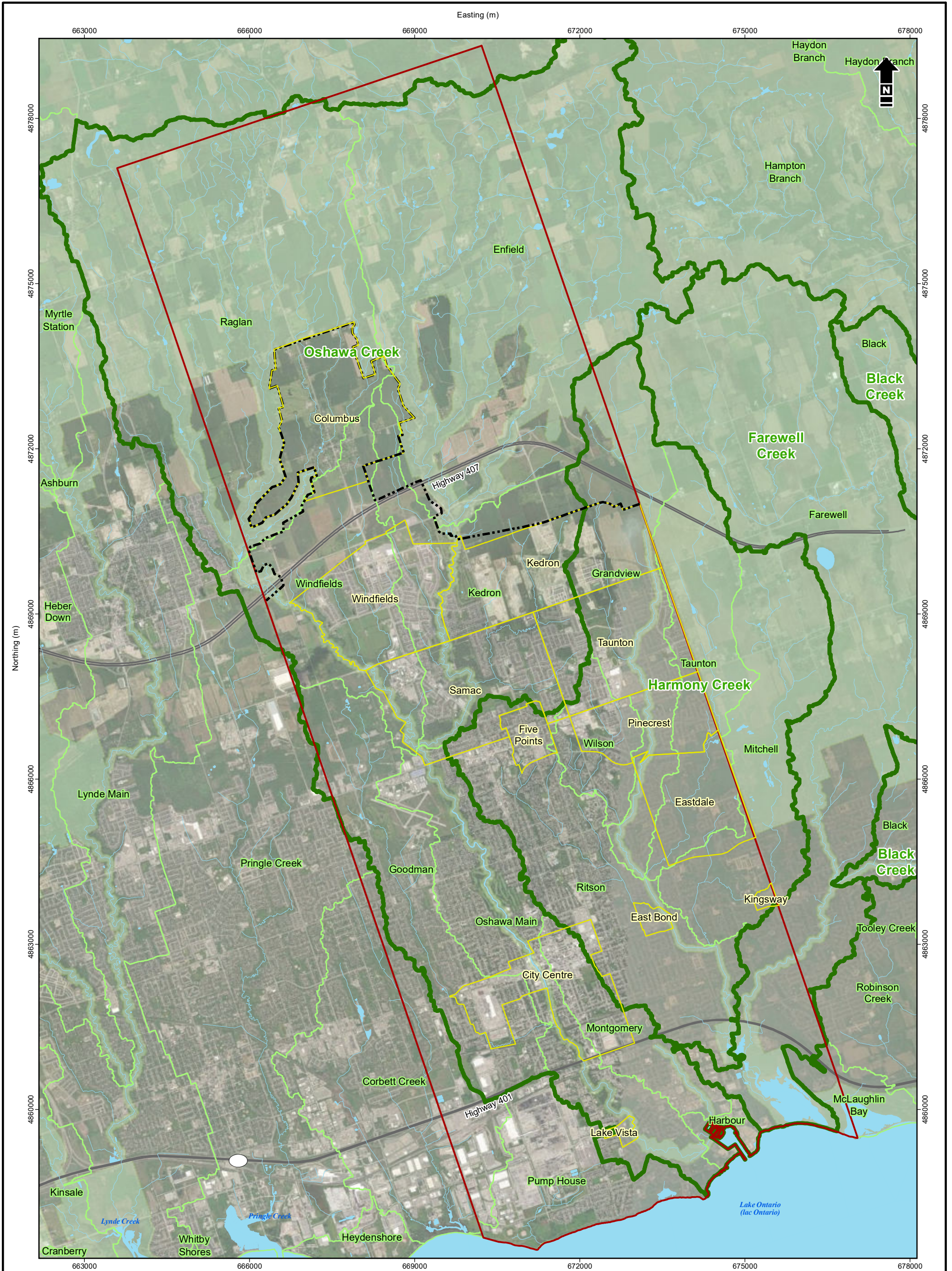
| Watershed Name | Total Drainage Area (ha) | Total Length of Regulated Watercourse | Drainage Area within City Limits (ha) | Length of Regulated Watercourse within City Limits ¹ (km) | Drainage Stream Length within City Limits ² (km) | Coverage within the City of Oshawa (%) |
|--------------------------------------|--------------------------|---------------------------------------|---------------------------------------|--|---|--|
| Oshawa Creek | 11,915 | 129 | 9,669 | 106 | 332 | 67% |
| Harmony/ Farewell/ Black Creek | 10,800 | 103 | 3,680 | 49 | 70 | 26% |
| Corbett Creek | 1,486 | 15 | 375 | 5 | 7 | 3% |
| Pump House ³ | 621 | - | 620 | - | 14 | 4% |

¹ Stream length was determined based on length of existing HEC-RAS reaches provided by CLOCA. Since not all stream reaches are included in the HEC-RAS modelling (only the larger tributaries and main branch), this length is smaller than the total drainage stream length, as defined in the right-most column.

² Stream length was determined based on CLOCA’s GIS drainage layer


³ No existing HEC-RAS model for the Pump House watershed was available for this study.

As outlined in Table 1 above, the Oshawa Creek watershed covers the majority of the area of the City. Local stormwater management practices influence the downstream watershed and their ecological features. As such, improvements and best management practices within the headwaters and upstream portions of the watershed have an impact on the water quality and quantity downstream.



| | |
|------------------------------|-------------------------------|
| City of Oshawa | Ritson Subwatershed Name |
| Part II Planning Area | Harmony Creek Watershed Name |
| Watershed | Lake Vista Planning Area Name |
| Subwatershed | |
| Greenbelt | |
| Water Body | |
| Watercourse | |
| Highway | |
| Boundary of Major Urban Area | |

References: Data obtained from Central Lake Ontario Conservation Authority (2024). Data obtained from City of Oshawa (2024). Contains information licensed under the Open Government Licence – Canada. Produced under Licence with the Ontario Ministry of Northern Development, Mines, Natural Resources and Forestry © Queen's Printer for Ontario (2024). Imagery (2022) Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community.



Matrix Solutions Inc.
A Montrose Environmental Company

City of Oshawa
Stormwater Management Master Plan

Watershed Map

| | | | |
|-------------------|----------------|----------------------|--------------------------|
| Date: August 2024 | Project: 40061 | Submitter: Z. Zimmer | Reviewer: T. Roumellotis |
|-------------------|----------------|----------------------|--------------------------|

1:65,000
0 650 1,300 metres
NAD 1983 UTM Zone 17N

 **2**

2 Background Data Available

The following sections provides a summary of the existing information relevant to the SWM MP including background reports and studies, models, Geographic Information Systems (GIS) data and land use mapping. The purpose of the data summary is to provide context to the existing conditions of the study area. There have been a number of stormwater management-related studies and modelling completed by or on behalf of the City (and their consultants) and CLOCA over the last three decades. Other contributors to stormwater management knowledge in the area include developers when preparing subwatershed, secondary, or master environmental servicing plans, and the University of Ontario Institute of Technology.

2.1 Background Reports

Background reports, primarily watershed assessments, were provided by the City to understand the existing drainage and stormwater conditions throughout the study area. There is extensive reporting available that characterizes the watersheds overlapping within City of Oshawa's limits. These reports were used for various purposes in developing the SWM MP, based on the content provided. The background reports provided were categorized into four groups: Oshawa Creek watershed documents, Black-Harmony-Farewell Creek watershed documents, Corbett Creek watershed documents, policy, and miscellaneous documents. The background reports are summarized in Appendix A.

2.2 Spatial Datasets

GIS is a technology used to create, manage, analyze, and map spatial data. Spatial data was used to create maps in GIS that characterize different spatial features, such as a watercourse, throughout the study area. The GIS data gathered and used throughout the SWM MP is outlined in Table 2.

Table 2 Spatial Datasets

| Data Source | Spatial Layer |
|--------------------------------|--|
| City of Oshawa | SWM Facilities |
| | Watercourses |
| | Existing Land Use/Official Plan/Future Land Use Maps |
| | Zoning |
| | Roads |
| | Municipal Boundary |
| | Railway Line |
| | Contour Lines |
| | Municipal Culverts /Bridges |
| | Watermain |
| | Storm Sewer |
| | Storm Sewer Outfalls |
| | Erosion Sites |
| Land Information Ontario (LIO) | Topography |
| Region of Durham | Regional Boundary |
| | Sewershed Mapping |
| | Storm Sewer Outfalls |
| | Sanitary Sewershed Mapping |
| CLOCA | Watershed |
| | Watercourses/Drainage |
| | Subwatershed |
| | Natural Heritage Systems |
| | Areas of Natural and Scientific Interest |
| | High Volume Recharge Areas |
| | Damage Centres |
| | Regulated Areas (includes floodplain mapping) |
| | Land Cover |
| | Existing Land Use |
| | HEC-RAS Reaches |
| HEC-RAS Cross-sections | |
| Ontario GEOHub | Greenbelt Boundary |
| | Oak Ridges Moraine Boundary |

2.3 Creek Crossings Data

Matrix has reviewed a number of documents that provide useful information, guidance, and information on design standards for creek crossings. These documents and the relevance to the study are described in Table 3. Relevant spatial datasets related to the creek crossings are described in Section 2.2. The key inputs provided included crossing inventories from both the City and CLOCA. The data has been summarized by type, including models, previously completed capacity assessments, flood risk assessments, and design standards.

CLOCA's hydrologic and hydraulic models and capacity assessments outlined in the subwatershed studies can provide the base data and tools for crossing capacity assessments. Flood risk assessments carried out by CLOCA provide useful information on high-risk flooding areas, while national, provincial, regional and municipal guidance documents inform engineering design standards.

Table 3 Creek Crossing Background Studies

| Data | Related Report | Description |
|---|--|---|
| Hydrological and Hydraulic Models | | |
| Oshawa Creek Models | Oshawa Creek Hydrology and Hydraulic Modelling Report (CLOCA 2014) | CLOCA provided hydrologic and hydraulic models for the Oshawa Creek watershed. The hydrologic model was developed in Visual OTTHYMO for the purposes of floodplain mapping and the model was not calibrated. The flood flows from the model functioned as inputs into the HEC-RAS hydraulic model. The HEC-RAS model crossing locations were individually surveyed with road elevations determined from a 2010 topographic data. |
| Black Harmony and Farewell Creek Hydrology | Hydrologic Modelling of Black, Harmony and Farewell Creeks (CLOCA 2013a) | <p>Hydrologic models were developed by Aquafor Beech Limited for the purposes of floodplain mapping for the Black, Harmony and Farewell watershed.</p> <p>The hydrologic model for the watershed was developed in Visual OTTHYMO in 2009 and revised in 2015.</p> <p>The results of the hydrologic model were used to examine peak flows within the watershed, subwatershed and catchments.</p> |
| Black Harmony and Farewell Creek Hydraulics | Black Harmony and Farewell Creek Floodplain Mapping Study (CLOCA 2010) | <p>This report describes floodplain mapping for Harmony, Black, and Farewell Creeks by CLOCA that was from original work by the City of Oshawa in 2001.</p> <p>The work included survey and modelling of many creek crossing structures in the catchment.</p> |
| Corbett Creek Models | Corbett Creek MDP Final PFR (TMIG 2020) | <p>The Municipal Infrastructure Group Ltd. (TMIG), along with team members GEO Morphix Ltd. (GEO Morphix) and Palmer Environmental Consulting Group Inc. (Palmer), developed hydrological and hydraulic models for a Master Drainage Plan (MDP) for the Corbett Creek watershed. The MDP was completed in partnership with CLOCA.</p> <p>The Corbett Creek watershed is located within the southeastern portion of the Town of Whitby with a portion of the catchment area within the City of Oshawa. It is a small watershed with a drainage area of approximately 14 km² that is about 6.3 km long, fully urbanized and has a very limited number of areas available for future development.</p> <p>A new hydrologic model for the watershed was developed for this MDP using Visual OTTHYMO and used to derive flows for the HEC-RAS model, though structure dimensions were derived from a 2006 HEC-RAS model.</p> |

| Data | Related Report | Description |
|---|--|---|
| Oshawa and Goodman Creek Hydraulic Model | Two-zone Floodplain Mapping and Flood Mitigation Study, Oshawa and Goodman Creeks (Greck 2021) | <p>Hydraulic models were developed to characterize significant flood hazards along Oshawa Creek and Goodman Creek upstream of the Canadian Pacific Railway (CPR) embankment Ltd in support of two-zone floodplain mapping.</p> <p>This study made use of existing hydrological modelling developed for Oshawa Creek and detailed HEC-RAS modelling to quantify velocities and depths for a hazard-based floodplain mapping exercise.</p> |
| Existing Site-Specific Studies/Reports | | |
| Columbus Subwatershed Study | Columbus Subwatershed Study Phase 2 Report (Stantec 2023) | Columbus Part 2 development which is in advanced stages should have drawings and plans that can be used in the crossing inventory. |
| Windfields Environmental Servicing Plan – West of Simcoe Street | Windfields Planning Area – West of Simcoe Street (MMM Group 2013) | This study identified ten road crossings that are within the study area which should be incorporated into the City’s crossing inventory. |
| Windfields Environmental Servicing Plan – East of Simcoe Street | Windfield Master Environmental Servicing Plan – East of Simcoe (MMM 2003) | This Planning Area study from 2003 assessed four road crossings. A bridge crossing over the East Branch of Oshawa Creek at Britannia Ave East was proposed which would be 5m above the Regional Flood line. Over the tributary (called tributary E1 in the report) to the east 3 parallel 2.4 m span 1.5m rise culverts were recommended to accommodate service crossings. The layout of the streets appears to have changed since this proposal (the report notes that the design was preliminary), however for the crossings of the tributary at Bridle Road, a 2 parallel 3m span 1.5m rise concrete box culvert and crossing D (now Symington Ave), 2 parallel 2.4m span by 1.5m rise culverts are recommended to maintain Regional Flood levels. |
| Northwood Business Park SWM Master Plan | City of Oshawa Northwood Business Park Master Stormwater Management Plan (Greck 2016) | SWM Masterplan which includes recommendations to upgrade a municipal crossing at Bermuda Ave to convey the 100-year design flow as well as upgrades as three Regional crossing locations. |

| Data | Related Report | Description |
|---|--|---|
| Kedron Planning Area Stormwater Management Plan | Kedron Part II Planning Area North Kedron and East Windfields Industrial Areas Concept Plan – Stormwater Management Plan (AMEC 2013) | Developed area north of Conlin Road (Kedron, see Kedron MESP) currently under construction with regulatory plans submitted that would be sufficient to use for crossing inventory. |
| Flood Risk Assessments | | |
| Assessment of Road Flood Vulnerability | Durham Community Climate Adaptation Plan Flood Vulnerable Road and Hydraulic Capacity Assessment (CLOCA 2022) | This study identified the flood risk of roads over watercourses within the Region of Durham. The assessment used a GIS driven approach and data extracted from an existing HEC-RAS model to determine if road crossings meet the applicable MTO design criteria. This report provides a useful baseline assessment based off existing hydrotechnical assessment information from CLOCA. |
| CLOCA Flood Risk Assessment | Central Lake Ontario Conservation Watershed Flood Risk Assessment (CLOCA 2017) | National Disaster Mitigation Program watershed flood risk assessment for the CLOCA jurisdiction evaluated 92 flood damage centres within CLOCA to determine the level of flood risk posed to the surrounding public and property. This report provides baseline information to direct future efforts in floodplain management by identifying the most vulnerable areas to flood risk in CLOCA’s watercourse jurisdictions. |
| Guidelines and Standards | | |
| | City of Oshawa Engineering Design Criteria Manual (City of Oshawa 2022) | This manual provides design criteria for newly constructed stormwater management infrastructure, including bridges and culverts. |
| | Technical Guidelines for Stormwater Management Submissions (CLOCA 2020a) | This report provides stormwater management criteria for new developments and outlines the need to safely convey major flows (e.g., flows exceeding storm sewer capacity) to an outlet without negatively impacting adjacent properties. The report includes watercourse crossings design considerations for indicate the “crossing must be sized and located such that there is no increase in upstream or downstream flooding”. |

| Data | Related Report | Description |
|--|---|---|
| Crossing hydraulic design guidelines and standards | MTO Highway Drainage Design Standards (MTO 2008) | The Ministry of Transport Ontario (MTO) Highway Drainage Design Standards provide design criteria for creek crossings under the jurisdiction of the provincial government. Many municipalities in the province choose to accept the MTO criteria as the basis for their crossing design to provide consistency across the regions. The design criteria include design flows by road classification, including the required freeboard and flow capacity to prevent failure of the crossings (e.g., washout of road, headwater embankments). |
| MTO guidance for hydrotechnical reports | MTO Guide for Water Crossing Hydrotechnical Reports (MTO 2022) | This guide contains general best practice guidance for steps that should be taken when performing hydrotechnical analysis, including: <ul style="list-style-type: none"> • Establish Design Criteria • Conduct the Hydrologic Analysis • Conduct the Hydraulic Analysis • Analyze Scour and Determine the Depth of Footings • Design for Ice Flow and Debris • Assess if Design shall Convey the Regulatory Storm Scour and ice flow analysis is typically determined at detailed design phase. |
| Canadian bridge design code | CAN/CSA-S6-14. (2014). Canadian Highway Bridge Design Code (CSA 2014) | Provides design guidance for bridges but is typically superseded by provincial standards and guidance. Provides useful guidance on scour and ice loading. |
| Bridge hydraulic design guidance | TAC Guide to Bridge Hydraulics (TAC 2021) | Provides guidance on the hydrotechnical analysis of bridges, including details on scour assessment. |
| Climate change consideration | MTO Provincial Engineering Memorandum #2016-14 | On October 28, 2016, MTO released Provincial Engineering Memorandum #2016-14, titled Implementation of the Ministry’s Climate Change Consideration in the Design of Highway Drainage Systems. PEM #2016-14 specifies that the future rainfall IDF values shall be used to size culverts and bridges. The University of Western Ontario IDF Curve Study recommended an increase of 20% to IDF curves. |
| Climate change consideration | Durham Community Climate Adaptation Plan 2016 (Durham Region 2016) | The Durham Community Climate Adaptation Plan provides the City an opportunity to participate in region-wide committees including on climate adaptation. Recommendations include implementing low impact development techniques and infrastructure and addressing climate change vulnerability in flood infrastructure design, such as conveyance systems, SWM facilities and creek crossings. The Oshawa Stormwater Management Plan provides an opportunity to implement the objectives of the Climate Adaptation Plan. |

2.4 Stormwater Management Facility Data

The City owns and manages SWMF throughout the study area. These facilities are implemented to control, store, and treat volumes of stormwater runoff leaving a particular area or property. Typically, SWMF are paid for and constructed by a private developer and are assumed by the City for operation and maintenance after a certain period post-construction. The City keeps records of the SWMF, which may include design drawings, design reports, and as-constructed drawings. The data and drawings for SWMF was used in this assessment to understand facilities design and as-constructed condition prior to conducting the field inventory and condition assessments. The field assessment will build upon the existing information, including the GIS data outlined in Table 3 above, to generate a comprehensive inventory.

The available records for all the SWMF included in this assessment are listed in Table 4 below.

Table 4 Stormwater Management (SWM) Facility Data

| Data Type | Data Summary | Project Use |
|--------------------------------------|--|---|
| SWM Facility Inventory | Extracted data from SWM Facility GIS data outlined in Section 2.2 above. | Establish an inventory of existing data on the stormwater management facilities to build upon in field assessments. |
| SWM Pond Design Drawings and Reports | Design drawings and reports that detail the design elements of the SWM facilities. Design reports were not available for each facility. Refer to Table 6 below for detail. | Used to inform the field inventory and condition assessments by providing an understanding of existing conditions. |

The data available for the SWMF that have been assumed by the City is summarized in Table 5 below. Assumed SWMF are maintained and operated by the City.

Table 5 Assumed Stormwater Management Facilities

| SWM Facility I.D. | Data Available |
|-------------------|--|
| SWMF 3 and 4 | <ul style="list-style-type: none"> Design drawings Goodman Creek Flood Control Works Environmental Study Report (Dillon Consulting 1988) |
| SWMF 5 | <ul style="list-style-type: none"> Design drawings Stormwater Drainage and Erosion Control Report (D.G. Biddle & Associates Limited 1992a) Geotechnical Investigation (Golder 1992) Culvert Design Report (D.G. Biddle & Associates Limited 1992b) |
| SWMF 6 | <ul style="list-style-type: none"> Design drawings |

| SWM Facility I.D. | Data Available |
|-------------------|---|
| SWMF 7 | <ul style="list-style-type: none"> • Design drawings • Subdivision agreement |
| SWMF 9 | <ul style="list-style-type: none"> • Design drawings • Water Quality Pond Report (G.M. Sernas & Associates Ltd. 1992) |
| SWMF 11 | <ul style="list-style-type: none"> • Design drawings • Stormwater Drainage and Erosion Control Report (D.G. Biddle & Associates Limited 1991) • Soil Investigation (Soil-Eng Limited 1996) |
| SWMF 12 | <ul style="list-style-type: none"> • Design drawings • Storm sewer design sheets • Stormwater Management Design Brief (G.M. Sernas & Associates Ltd. 1998) |
| SWMF 13 | <ul style="list-style-type: none"> • Design drawings • Stormwater Management Design Brief (D.G. Biddle & Associates Limited 1998) |
| SWMF 14 | <ul style="list-style-type: none"> • Design drawings • Stormwater Drainage and Erosion Control Report (D.G. Biddle & Associates Limited 1997) • Email correspondence |
| SWMF 16 | <ul style="list-style-type: none"> • Design drawings • Stormwater Management Report (Schaeffer 1998) |
| SWMF 17 | <ul style="list-style-type: none"> • Design drawings • Hydrogeologic Investigation (MMM 1995a) • Stormwater Management Report (MMM 1995b) • Geotechnical Investigation (Golder 1999) |
| SWMF 18 | <ul style="list-style-type: none"> • Design drawings • Stormwater Drainage and Erosion Control Report (D.G. Biddle & Associates Limited 1993) |
| SWMF 19 | <ul style="list-style-type: none"> • Design drawings • Functional Servicing Report (D.G. Biddle & Associates Limited 1987) • Preliminary Engineering Report (MMM 2000) |
| SWMF 24 | <ul style="list-style-type: none"> • Design drawings • Stormwater Management Report (D.G. Biddle & Associates Limited 2004a) |
| SWMF 28 | <ul style="list-style-type: none"> • Design drawings • Stormwater Management Pond Design Brief (MMM 2004a) |
| SWMF 29 | <ul style="list-style-type: none"> • Design drawings • Stormwater Management Facility Design Brief (D.G. Biddle & Associates Limited 2004b) |
| SWMF 30 | <ul style="list-style-type: none"> • Design drawings • Stormwater drainage documentation |

| SWM Facility I.D. | Data Available |
|-------------------|---|
| SWMF 31 | <ul style="list-style-type: none"> • Design drawings • Stormwater Management Facility Design Brief (D.G. Biddle & Associates Limited 2005) |
| SWMF 32 | <ul style="list-style-type: none"> • Design drawings • Stormwater Management Report (Sernas 2005) |
| SWMF 33 | <ul style="list-style-type: none"> • Design drawings • Functional Servicing Plan (MMM 2004b) • Stormwater Management Report (MMM 2006) |
| SWMF 34 | <ul style="list-style-type: none"> • Design drawings • Functional Servicing and Stormwater Management Report (Sabourin Kimble & Associates Ltd. 2005) |
| SWMF 35 | <ul style="list-style-type: none"> • Design drawings • Stormwater Management Report (MMM 2005) |
| SWMF 48 | <ul style="list-style-type: none"> • Design drawings • Stormwater Management Report (D.G. Biddle & Associates Limited 2004c) |

Note: Not all versions of reports provided have been outlined in this table.

2.5 Watercourse Data

As field assessment of the City’s watercourses is included as part of Task 3 of the SWM MP project. The City currently keeps an erosion inventory, which is a record of the erosion sites noted and assessed along the City’s watercourses. Prior to the watercourse field assessment, the existing erosion sites will be mapped in GIS to understand where there is record of vulnerability along watercourses in the study area. The field assessment will build upon the City’s erosion inventory. Previous studies at the watershed, subwatershed, and reach scale were also reviewed to generally understand the existing conditions of watercourses within the study area.

The watercourse inventory data are summarized in Table 6 below.

Table 6 Watercourse Data

| Study Type | Study Name | Description |
|--|--|--|
| Oshawa/Goodman/Montgomery Watershed | | |
| Watershed Study | Oshawa Creek Watershed Study (TSH 1995) | The study includes an erosion site inventory and priority for the Oshawa Creek watershed in Exhibit C – Erosion Inventory and Priority Report. |
| | City of Oshawa Erosion Inventory Binders 1 and 2 | Documents erosion sites identified within the Oshawa Creek watershed within 1990s to 2000s (including sites from TSH 1995). Includes site location/extent, photographs (up to 2007), sketches, structures/utilities, bank conditions, and erosion processes. |
| | Oshawa Creek Watershed Management Plan (CLOCA 2002) | Watershed management planning document. The report includes watercourse mapping, geomorphic characterization of 11 reaches within the watershed, and provides subwatershed scale recommendations. |
| | Oshawa Creek Watershed Plan (CLOCA 2013b) | Watershed plan outlining planning goals and initiatives. Includes a fluvial geomorphology goal to have natural stream channels and corridors that allow for natural streamflow patterns and channel migration (where possible), support diverse aquatic habitat, limit sediment loadings and protect human life, property and infrastructure from risks associated with erosion and slope instability. |
| | Oshawa Creek Watershed Plan Update (CLOCA 2020b) | An update to the 2013 Watershed Plan based on changes to provincial planning legislation and land use. |
| Subwatershed Study | Columbus Subwatershed Study Phase 1 Report (Stantec 2022) | The Phase 1 Study characterizes existing fluvial geomorphic conditions within the Columbus Subwatershed Study area. The report provides reach breaks and identifies areas of active erosion. |
| | Columbus Subwatershed Plan Study Phase 2 (Stantec 2023) | The Phase 2 Study provides fluvial geomorphic input including erosion thresholds and details for watercourse crossings within the study area. |
| | Northwood Business Park Master Stormwater Management Plan (Greck 2016) | Stormwater management study for the Northwood Business Park. Includes a qualitative assessment of the impacts of development on the stability of Goodman Creek and Oshawa Creek within the study area, which identified a potential for channel size to increase by as much as six times. Erosion control measures recommended along Goodman Creek where required following development. |

| Study Type | Study Name | Description |
|---------------------|---|---|
| | MESP Windfields Planning Area (MMM Group 2013) | The MESP for the Windfields planning area west of Simcoe Street includes an erosion and geomorphologic assessment of the West Branch of Oshawa Creek and its Tributaries W1 and W2. Objectives were to assess channel stability and make recommendations for channel remediation. |
| | Windfields Planning Area (East) – MESP (MMM 2003) | MESP for the Windfields Planning Area east of Simcoe Street. The report includes a geomorphic assessment of the East Branch of Oshawa Creek through the area and provides management recommendations. Conceptual natural channel designs were also provided for Tributaries E1 and E2. |
| | Kedron Part II Planning Area North Kedron and East Windfields Industrial Areas Concept Plan (AMEC 2013) | Stormwater management plan for the Kedron Study Area which includes the Kedron Part II Planning Area (549 ha), North Kedron Industrial Area (287 ha), and East Windfields Industrial Area (45 ha). The report provides reach mapping for Oshawa and Harmony Creek within the study area. |
| Site-Specific Study | Fluvial Geomorphological Assessment Study for the Oshawa Creek Main Branch between Thomas Street to Wentworth Street West (Palmer 2021) | Fluvial geomorphological assessment of Oshawa Creek between Thomas Street and Wentworth Street West. This report provides a recent characterization of geomorphic conditions within the reach and identified eight erosion sites. Concept designs were provided for the three highest priority sites. |
| | Fluvial Geomorphological Assessment for Oshawa Creek and Evaluation of Erosion Mitigation Strategies at Prioritized Sites, Bloor Street West to Wentworth Street West (Palmer 2020) | Fluvial geomorphological assessment of Oshawa Creek between Bloor Street West and Wentworth Street West. This report provides a recent characterization of geomorphic conditions within the reach and identified 16 erosion sites. Concept designs were provided for the four highest priority sites. |
| | Goodman Creek Channel Improvements Feasibility Study (Greck 2015) | Phase 1 Feasibility Study to address issues of flooding and erosion along Goodman Creek between King Street West and Gibb Street. This report provides a geomorphic characterization of two reaches within the study area and an evaluation of alternative solutions. |

| Study Type | Study Name | Description |
|---|--|---|
| | City of Oshawa Erosion Inventory Binders 1 and 2 (City of Oshawa n.d.) | Documents erosion sites identified within the Oshawa Creek watershed within 1990s to 2000s. Includes site location/extent, photos (up to 2007), sketches, structures/utilities, bank conditions, and erosion processes. |
| Harmony/Farewell/Black Creek Watershed | | |
| Watershed Study | City of Oshawa Erosion Inventory Binders 1 and 2 | Documents erosion sites identified within the Harmony Creek Watershed within 1990s to 2000s. Includes site location/extent, photos (up to 2007), sketches, structures/utilities, bank conditions, and erosion processes. |
| | Black/Harmony/Farewell Watershed Existing Conditions Report (CLOCA 2011) | Characterization of existing conditions within the watershed. Includes watercourse mapping and geomorphic assessment of reaches within the urban portion of the watershed. The report also provides mapping of hard channel treatments, stream order, and fish barriers and discusses opportunities for restoration and enhanced stormwater management. |
| | Black/Harmony/Farewell Watershed Plan (CLOCA 2013b) | Watershed Plan which includes a summary of the fluvial geomorphology conditions from the existing conditions report (CLOCA 2011). Includes watercourse mapping and planning initiatives. |
| | Black/Harmony/Farewell Watershed Plan (CLOCA 2020b) | Update to the 2013 Watershed Plan. Identifies legislation changes, updates resource mapping, and provides new guidance for land use management in the watershed. It discusses a goal to achieve and maintain an average stream stability index score of <0.2 in the watershed, remove instream barriers, and improve riparian vegetation by 2024. The report refers to a new CLOCA action to complete rapid geomorphic assessments (RGAs). |
| Subwatershed Study | Harmony Creek Subwatershed Plan (Aquafor Beech 2001) | The Subwatershed Plan provides a baseline fluvial geomorphic assessment of Harmony Creek on a tributary basis and insight into impacts of development. The study includes an assessment of channel sensitivity to alteration in hydrological/sediment regime, assessment of rate of sediment accumulation in Oshawa Second Marsh, and development of a strategy for implementation of remedial measures to maintain channel stability, habitat, and water quality for existing reaches of instability and future development scenarios. |

| Study Type | Study Name | Description |
|-----------------------|---|---|
| | Harmony Creek Stormwater Management Study (TSH 1990) | This study includes an erosion inventory and priority for the Harmony Creek watershed conducted in 1989. 117 erosion sites were identified and 7 were considered high priority. Silt deposition was also assessed and not considered to be a major problem. |
| | Kedron Part II Planning Area North Kedron and East Windfields Industrial Areas Concept Plan (AMEC 2013) | Stormwater management plan for the Kedron Study Area which includes the Kedron Part II Planning Area (549 ha), North Kedron Industrial Area (287 ha), and East Windfields Industrial Area (45 ha). The report provides reach mapping for Oshawa and Harmony Creek within the study area. |
| | Master Stormwater Management Plan for the Taunton Community Area (Sernas 2004) | Stormwater management plan for the Taunton Community Planning Area. No areas of significant stream erosion were identified within Harmony Creek. The report provides recommendations for creek crossings, natural channel design for reaches altered by agriculture, and management/regeneration of the existing creek and valley. |
| Site-Specific Studies | Harmony Creek Erosion Control Feasibility Study for the Harmony Creek Golf Centre (Greck 2014) | Study of erosion along Harmony Creek within the Harmony Creek Golf Centre. Concerns were erosion leading to exposure/damage to irrigation pipes, falling trees, and flooding. The study provides a geomorphic characterization of the study area and a conceptual restoration plan. Farewell Creek also flows through the property. |
| | Fluvial Geomorphological Assessment for the Harmony Creek Branch 1 and Evaluation of Erosion Mitigation Strategies at Prioritized Sites, Wilson Road North to Bond Street East (Palmer 2019a) | Fluvial geomorphological assessment of Harmony Creek Branch 1 (HCB1) between Wilson Road North and Bond Street East. This report provides a characterization of geomorphic conditions and identified five erosion sites within the study area. Concept designs were provided for the three highest priority sites. |
| | Fluvial Geomorphological Assessment for the Harmony Creek Branch 3 and Evaluation of Erosion Mitigation Strategies at Prioritized Sites, Taunton Road East to Harmony Road North (Palmer 2019b) | Fluvial geomorphological assessment of Harmony Creek Branch 3 (HCB3) between Taunton Road East and Harmony Road North. This report provides a characterization of geomorphic conditions and identified 18 erosion sites within the study area. Concept designs were provided for the seven highest priority sites. |

| Study Type | Study Name | Description |
|--------------------------------|--|---|
| | Fluvial Geomorphological Assessment Study for the Harmony Creek Branch between Hillcroft Street to Rossland Road (Palmer 2022) | Fluvial geomorphological assessment of Harmony Creek Branch 3 (HCB3) between Hillcroft Steet and Rossland Road East. This report provides a recent characterization of geomorphic conditions and identified 13 erosion sites within the study area. Concept designs were provided for the three highest priority sites. |
| | Fluvial Geomorphological Assessment for the Farewell Creek to Support the Evaluation of Erosion Mitigation Strategies at Augusta Court within the City of Oshawa (Palmer 2016) | Fluvial geomorphological assessment of Farewell Creek between Grandview Street South and Townline Road South. Study focused on a failing (undermined, beginning to collapse) 55 m long gabion wall along outer bend adjacent to cul-de-sac at the end of Augusta Court. The report provides a geomorphic characterization and an evaluation of alternative solutions. |
| | Fluvial Geomorphological Assessment for Harmony Creek and Evaluation of Erosion Mitigation Strategies at Prioritized Sites (Palmer 2024) | Fluvial geomorphological assessment of Harmony Creek Branch 1 between Rossland Road West and Central Park Boulevard North. This report provides a recent characterization of geomorphic conditions and identified 23 erosion sites within the study area. Concept designs were provided for three areas encompassing nine of the highest priority sites. |
| | City of Oshawa Erosion Inventory Binders 1 and 2 (City of Oshawa n.d.) | Documents erosion sites identified within the Harmony Creek Watershed within 1990s to 2000s. Includes site location/extent, photos (up to 2007), sketches, structures/utilities, bank conditions, and erosion processes. |
| Corbett Creek Watershed | | |
| Watershed Study | Corbett Creek Master Drainage Plan (TMIG 2020) | Watershed management plan for the Corbett Creek watershed. The study provides reach mapping and geomorphic characterization for the whole watershed. It identifies areas of concern for erosion and channel instability. |

3 Study Area Conditions Summary

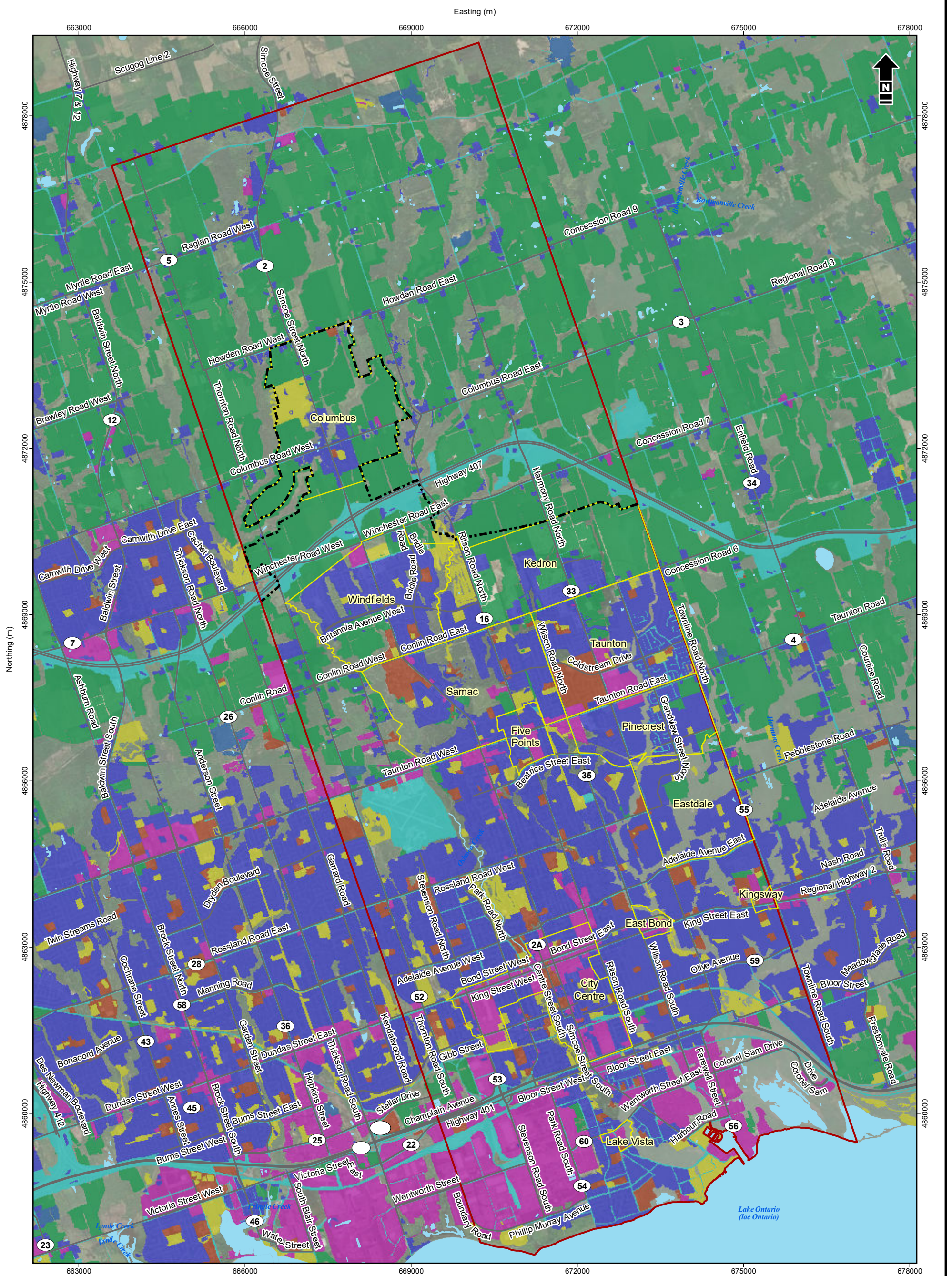
3.1 Land Use

The City of Oshawa is effectively “split” by the Highway 407 (Hwy 407), with the land north of the highway being mainly agricultural and the land south of the highway being mainly urban (Figure 3). North of the Hwy 407 includes the Oak Ridges Moraine and some rural residential properties. The Provincial Greenbelt encompasses the Oak Ridges Moraine and the major valleylands, including urban (CLOCA 2020b). The northern portion also includes proposed development known as the Columbus Part II Planning Area.

South of the Hwy 407, the City is comprised of a mixture of land uses, including agricultural, industrial and commercial, institutional, greenspace, residential and transportation.

Immediately south of the Hwy 407, the existing land use is predominantly agricultural except for two new approved developments - the Windfields Planning Area, which is in the advanced stages of construction, and the Kedron Planning Area, which is under construction. Residential land use occupies most of the space between the Hwy 407 and Hwy 401. South of the Hwy 401, the land use is largely industrial and commercial, with some residential land use, institutional and manicured greenspaces (e.g., Lakefront Park West, Lakeview Park, Oshawa Valleylands Conservation Area) near Lake Ontario.

There is an airport, the Oshawa Executive Airport, located near the western boundary of the City. Durham College and Ontario Tech University are located south of the Hwy 407 and south of the Conlin Road at Simcoe Street North. The Durham campus of Trent University is located on Thornton Road, south of King Street West. The Oshawa Waste Management Facility (operated by the Durham Region) is located on Ritson Road, north of Taunton Road.



| | |
|--|--|
| <ul style="list-style-type: none"> City of Oshawa The Regional Municipality of Durham Part II Planning Area Water Body Road Boundary of Major Urban Area | <p>Existing Land Use</p> <ul style="list-style-type: none"> Agricultural Industrial & Commercial Institutional Landfill & Aggregate Manicured greenspace Residential Transportation & Utility |
|--|--|

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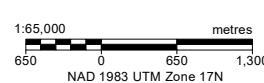
City of Oshawa
Stormwater Management Master Plan

Existing Land Use

| | | | |
|-------------------|----------------|----------------------|--------------------------|
| Date: August 2024 | Project: 40061 | Submitter: Z. Zimmer | Reviewer: T. Roumeliotis |
|-------------------|----------------|----------------------|--------------------------|

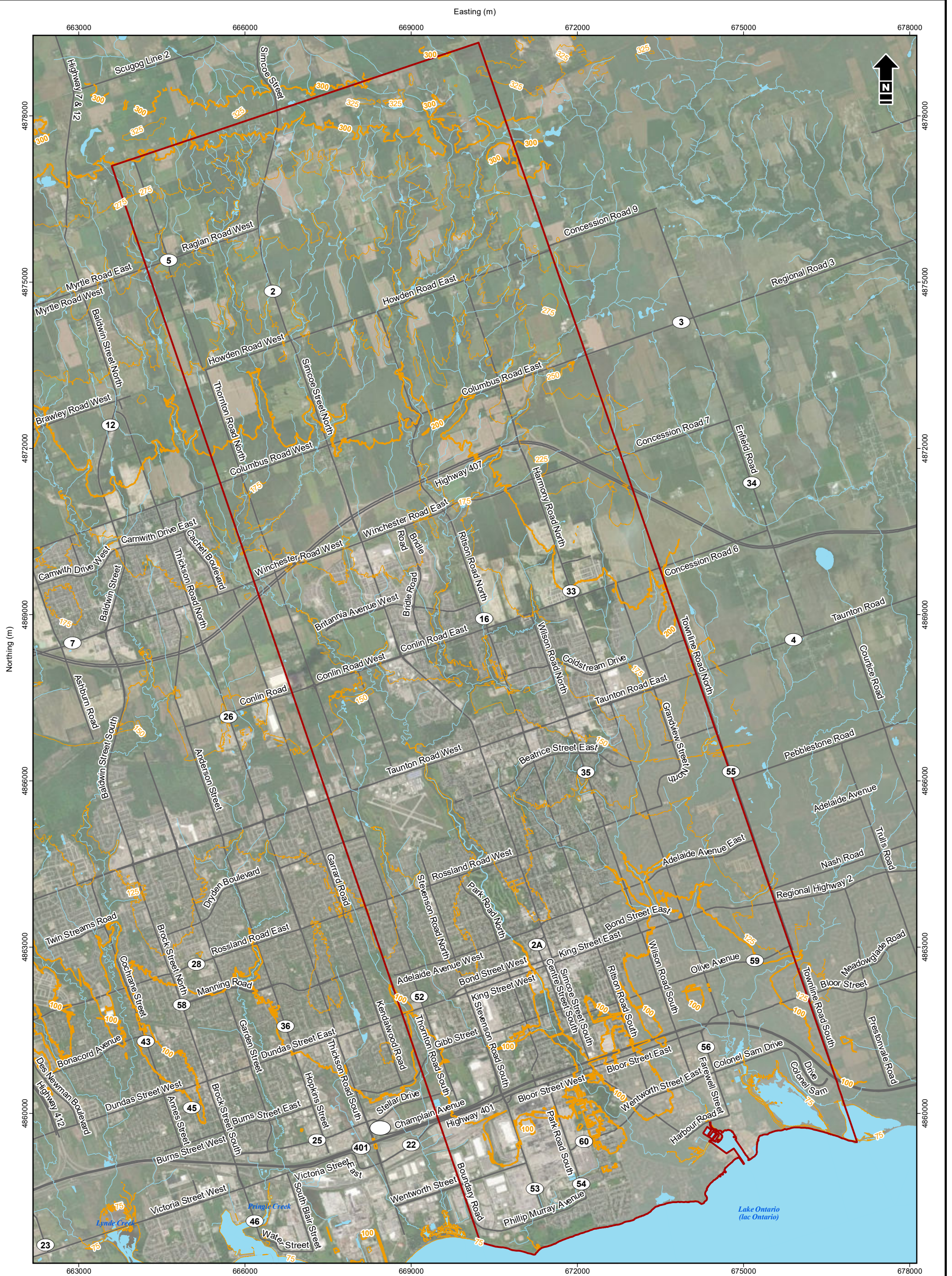
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3



3.2 Topography

The ground elevation of the City is highest at the northern extent of the City limits, at an elevation of 325 m above sea level (asl), and sloping downward toward the southern city limits, at an elevation of about 75 m asl at Lake Ontario (Figure 4). The ridge of the prehistoric Lake Iroquois shoreline, described in detail in Section 3.3, is apparent in the Grandview Street North area (Oshawa Museum 2023). There is a distinct valley created by present-day Oshawa Creek and to a lesser extent, some of its tributaries.

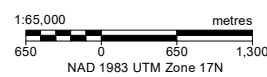


- + City of Oshawa
- Water Body
- Watercourse
- Road
- Elevation Contour (100 m)
- Elevation Contour (25 m)



City of Oshawa
Stormwater Management Master Plan

Topography



| | | | | | | | |
|-------|-------------|----------|-------|------------|-----------|-----------|----------------|
| Date: | August 2024 | Project: | 40061 | Submitter: | Z. Zimmer | Reviewer: | T. Roumeliotis |
|-------|-------------|----------|-------|------------|-----------|-----------|----------------|

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3.3 Physiography, Geology and Hydrogeology

The physiography of the City is reflective of the prehistoric Lake Iroquois, which existed over 12,000 years ago. Lake Iroquois was a proglacial lake formed by melting glacial ice. The old shoreline of the lake ran approximately parallel to present-day King Street, with the north shoreline of the lake being the southern edge of a retreating glacier (Oshawa Museum 2023).

The land north of Hwy 407 is largely characterized by the Oak Ridges Moraine left by the retreating glacier and consisting of largely clay to silt till (Figure 5). The clay to silt till extends to just south of Hwy 407. The headwaters of Oshawa Creek consist of alluvial deposits.

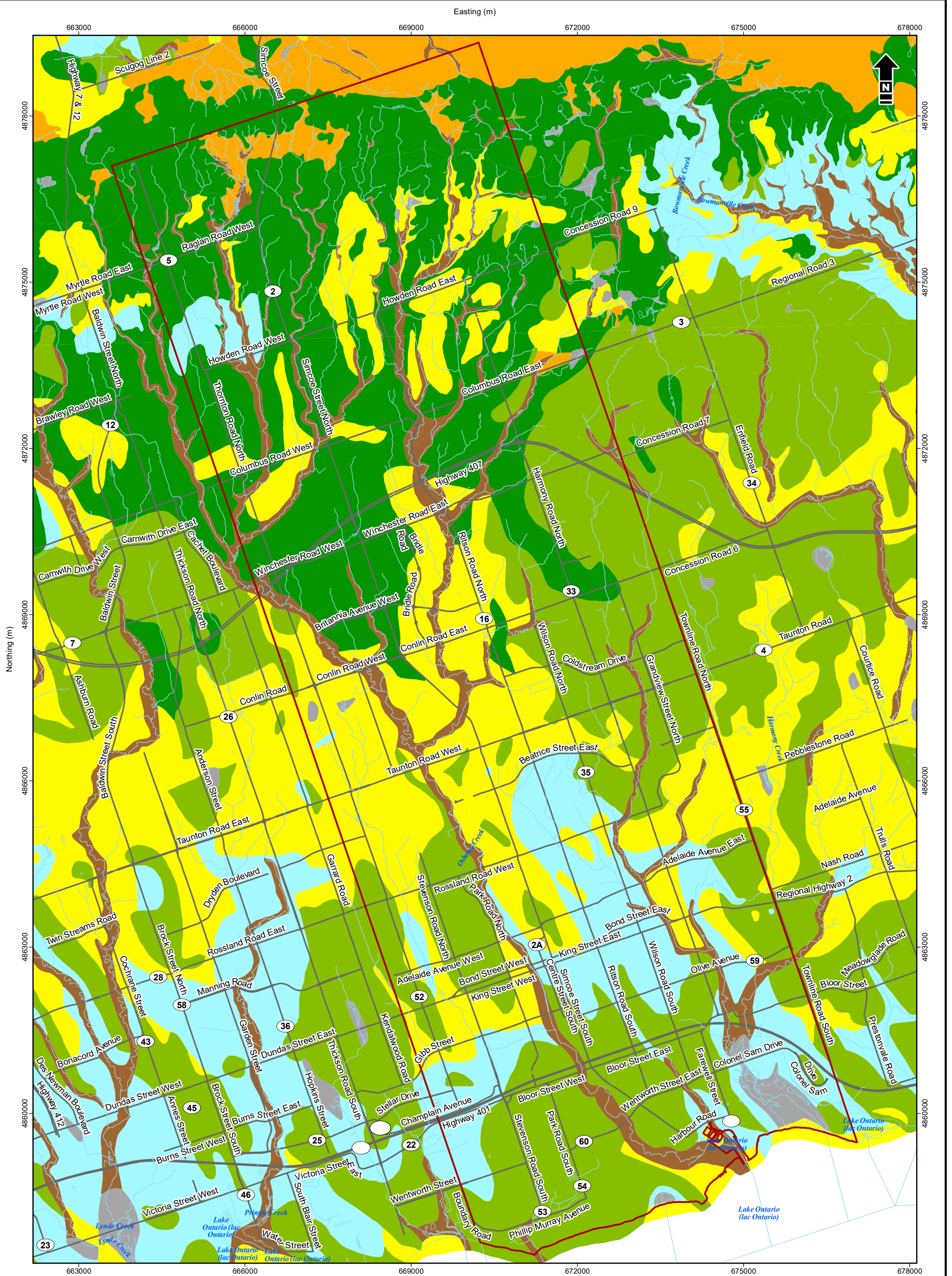
The land south of Hwy 407 is largely comprised of coarse- and fine-grained glaciolacustrine deposits, which are remnants of Lake Iroquois, followed by sandy silt to silty sand in the areas typically close to Lake Ontario (Figure 5).

Till and fine-grained soils are typically less permeable and will infiltrate stormwater at a slower rate than coarse-grained soils such as sand. This is evident in examining the high volume groundwater recharge areas (Figure 6) within the City, which directly coincide with the areas of coarse-grained glaciolacustrine deposits (Figure 5). As such, there is significant groundwater recharge occurring in the headwaters region at the north end of the City limits, as well as north and west of the airport and within the Windfields and Kedron Planning Areas.

3.4 Hydrology and Floodplain Mapping

As noted in Section 1.2, there are portions of three watersheds within city limits – Corbett Creek watershed, Oshawa Creek watershed and the Black-Harmony-Farewell Creek watershed. Of the total city area, the Oshawa Creek watershed represents 70% of this area, followed by Black-Harmony-Farewell Creek watershed at 27% and Corbett Creek watershed at 3% (Figure 2).

The Oshawa Creek watershed headwaters are located at the northern end of the City, within the Oak Ridges Moraine and drain south to Lake Ontario. The Black-Harmony-Farewell Creek watershed originates near the east city limit of Oshawa, near Hwy 407, and immediately east of the City near the Village of Solina, and drain south to Lake Ontario. The Corbett Creek watershed originates near the east city limit of Oshawa, south of the airport, and within the City of Whitby. The watershed drains into Lake Ontario in the City of Whitby.



| | |
|--|--|
| <ul style="list-style-type: none"> + City of Oshawa Watercourse Road <p>Surficial Geology</p> <ul style="list-style-type: none"> 5b: Stone-poor, sandy silt to silty sand till 5d: Clay to silt till 6: Ice-contact stratified sand and gravel deposits 8a: Fine-grained glaciolacustrine deposits (silt, clay) 8b: Fine-grained glaciolacustrine deposits (silt, clay) 9b: Coarse-grained glaciolacustrine deposits (sand, gravel) 9c: Coarse-grained glaciolacustrine deposits (sand, gravel) 12: Older alluvial deposits 14b: Coarse-grained lacustrine deposits (sand, gravel) 19: Modern alluvial deposits 20: Organic deposits (e.g., peat, marl) | <p>1:65,000</p> <p>metres</p> <p>NAD 1983 UTM Zone 17N</p> |
|--|--|

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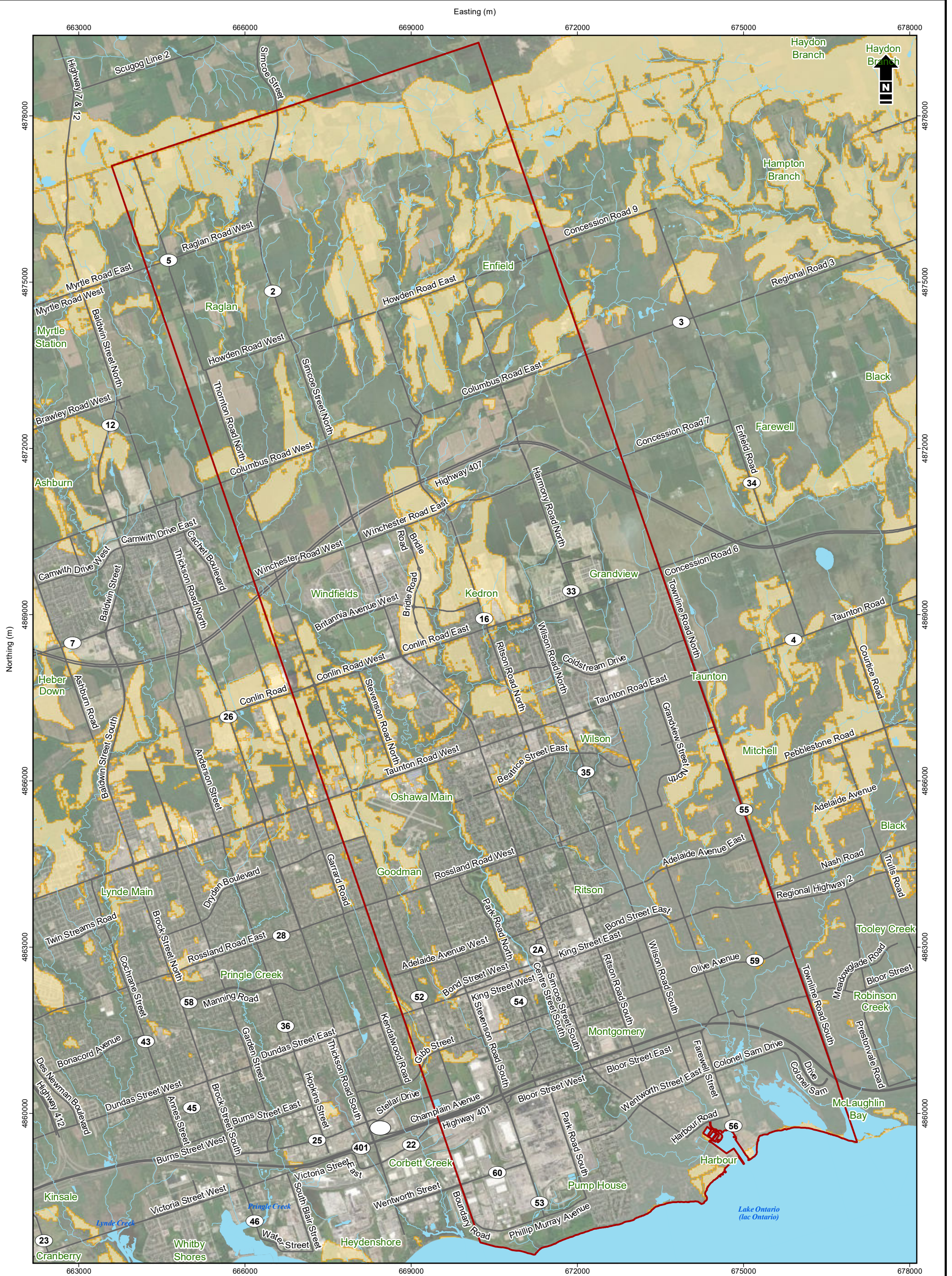
City of Oshawa
Stormwater Management Master Plan

Surficial Geology

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|-------|-------------|----------|-------|------------|-----------|-----------|----------------|
| Date: | August 2024 | Project: | 40061 | Submitter: | Z. Zimmer | Reviewer: | T. Roumellotis |
|-------|-------------|----------|-------|------------|-----------|-----------|----------------|

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| | |
|---------------------------|--------------------------|
| City of Oshawa | Ritson Subwatershed Name |
| High Volume Recharge Area | |
| Water Body | |
| Watercourse | |
| Road | |

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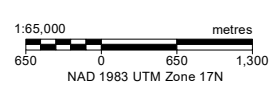
City of Oshawa
Stormwater Management Master Plan

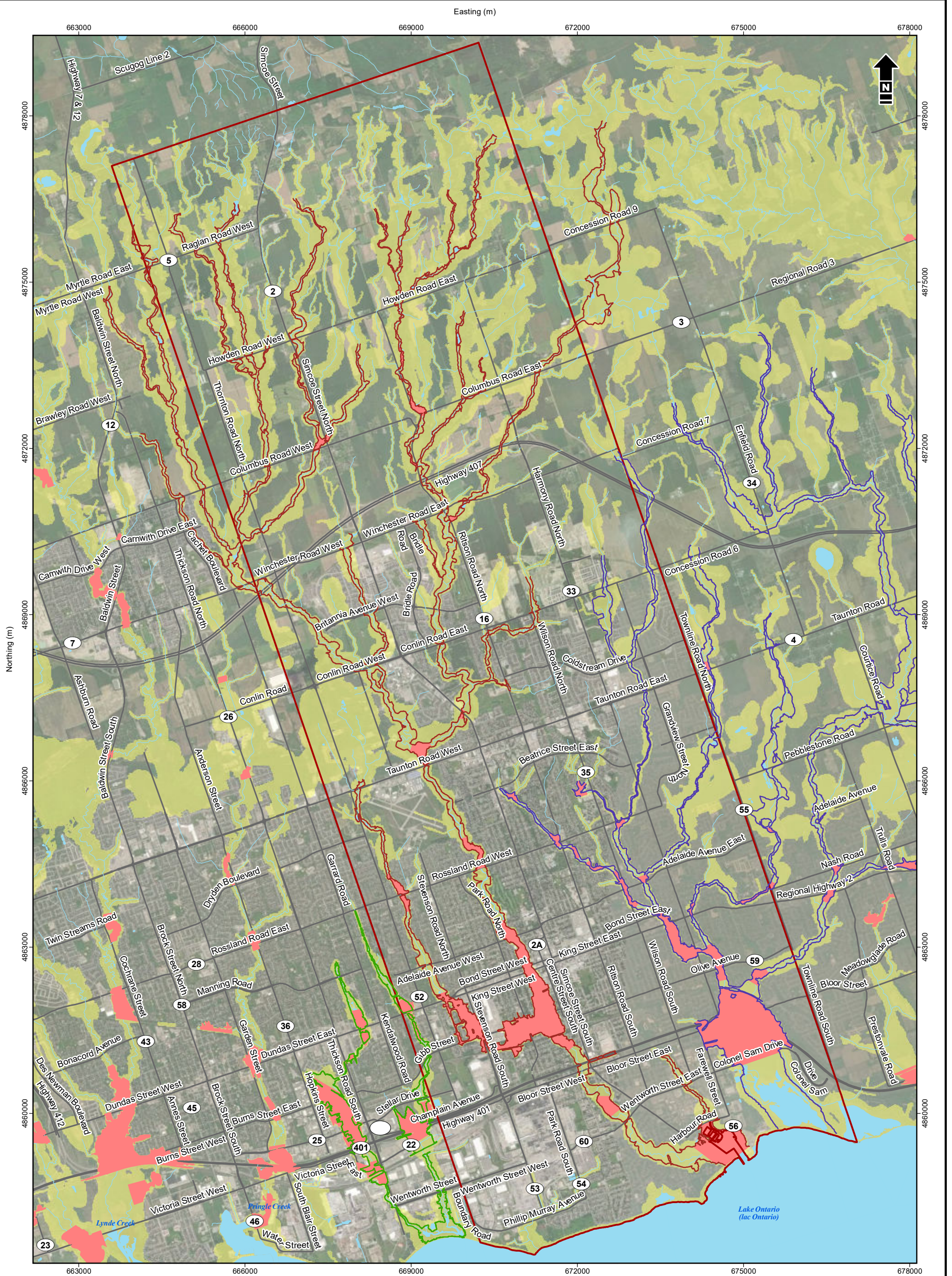
Significant Groundwater Recharge Areas

| | | | |
|-------------------|----------------|----------------------|--------------------------|
| Date: August 2024 | Project: 40061 | Submitter: Z. Zimmer | Reviewer: T. Roumeliotis |
|-------------------|----------------|----------------------|--------------------------|

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6





- City of Oshawa
- Flood Damage Centres
- CLOCA Regulated Area
- Water Body
- Watercourse
- Road
- Floodline**
- BHF
- Corbett
- Oshawa

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City of Oshawa
Stormwater Management Master Plan

Floodplain and Regulation Limits

| | | | | | | | |
|-------|-------------|----------|-------|------------|-----------|-----------|----------------|
| Date: | August 2024 | Project: | 40061 | Submitter: | Z. Zimmer | Reviewer: | T. Roumeliotis |
|-------|-------------|----------|-------|------------|-----------|-----------|----------------|

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1:65,000
650 0 650 1,300 metres
NAD 1983 UTM Zone 17N

7

The floodline mapping for the three watersheds is presented in Figure 7. The floodline mapping is indicative of the area which may be subject to flooding under the modelled Regulatory event and future land use. The Regulatory event is greater of the peak flows resulting from the regional storm (i.e., Hurricane Hazel) or the 100-year design storm (MNR 2002).

For the most part, the City employs a One-Zone Flood Hazard Policy such that development and/or site alteration within the flood hazard limit (floodline mapping) is prohibited or restricted. There is a single Two-Zone Flood Hazard Policy Area in the City which is located at the confluence of Oshawa Creek and Goodman Creek, between King Street West and McMillan Drive. Under the Two-Zone Hazard Policy, a floodway and a flood fringe area are identified. The floodway is the inner portion of the floodplain, and development is prohibited or restricted in this area. The flood fringe is within the outer portion of the flooding hazard limit and there is some conditional development allowed in this area (Greck 2021).

The Two-Zone Flood Hazard Policy Area coincides with an identified Flood Damage Centre (FDC; Figure 7). FDCs are areas consisting of residential, commercial and institutional development that are adjacent to a creek and prone to flooding that threatens public safety and may result in damage to public or private property (CLOCA 2020a). The FDC and Two-Zone Flood Hazard Policy Area located at the Goodman Creek confluence with Oshawa Creek has been shown to be the result of flow restrictions due to the existing Canadian Pacific Railway (CPR) crossing (15 m span bridge) and embankment located on Oshawa Creek just downstream of the confluence with Goodman Creek. Recent hydraulic modelling showed that doubling the bridge opening to a total span of 45 m provided some flooding relief on this FDC. However, the City do not have jurisdiction over CPR's transportation corridor.

All FDCs identified within the Oshawa Creek watershed were ranked by CLOCA as being of high, moderate or low risk. The FDC located in the Two-Zone Flood Hazard Policy Area was ranked as high-risk, while the remaining FDCs located in the Oshawa Creek watershed were all ranked as low-risk. Within the Black-Harmony-Farewell Creek watershed, the largest FDC was located upstream of the Oshawa Second Marsh. Similar to the situation on Oshawa Creek, the CNR Railway and the Hwy 401 crossings are undersized and create flooding upstream of these restriction points.

Under Ontario Regulation 166/06, CLOCA regulates construction, alteration and development activities within and around valleys, streams, wetlands, and along the Lake Ontario shoreline. This is known as the regulated area, which is depicted in Figure 7. The regulated area is a predefined setback length from any water feature including creeks and wetlands.

3.5 Natural Heritage Systems

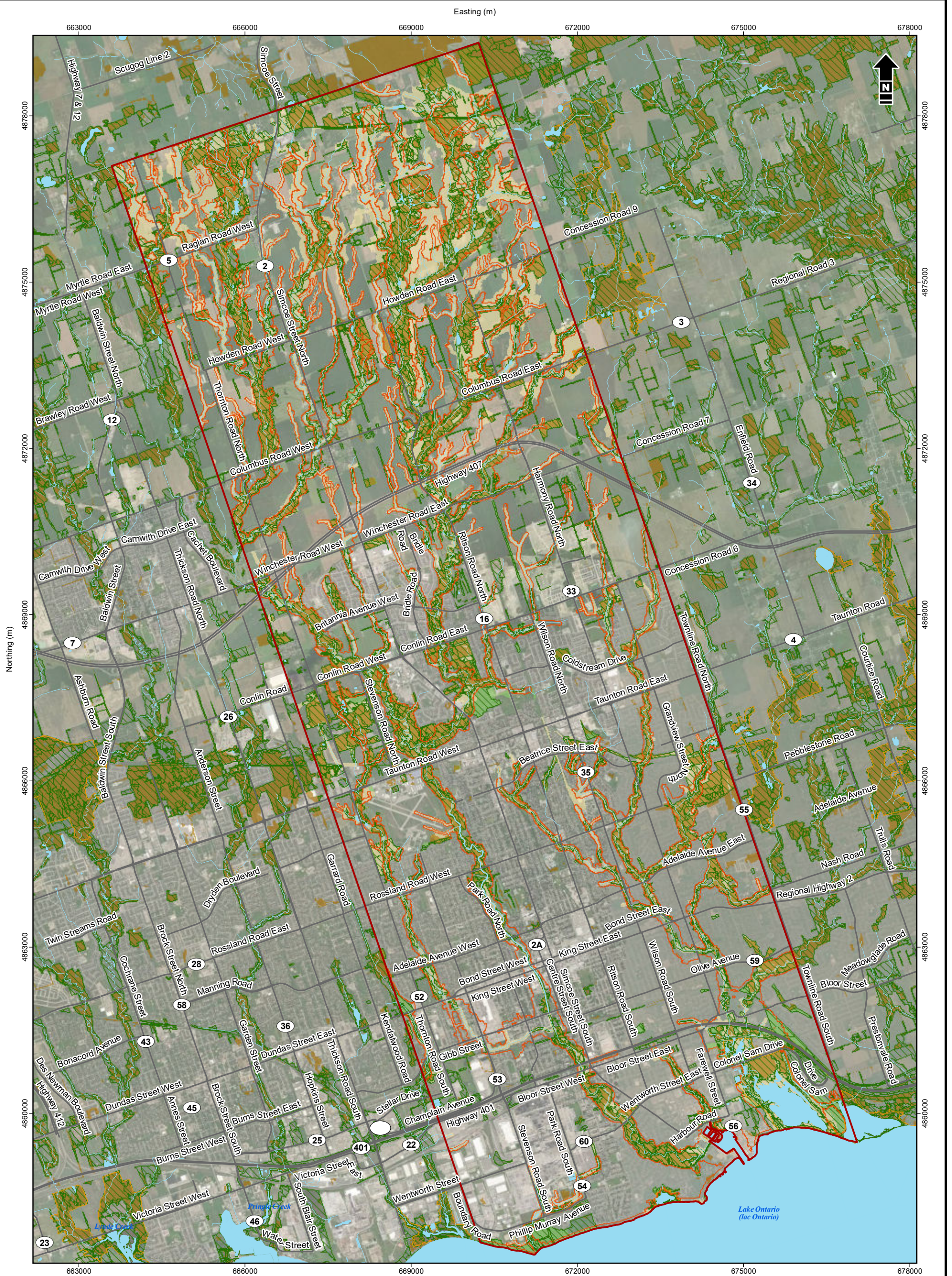
The City's Natural Heritage System (NHS) includes lands with the highest concentration of sensitive or significant natural features denoted as key natural heritage and key hydrologic features. These include wetlands, life science areas of natural and scientific interest (ANSI), habitat of endangered and threatened species, fish habitat, significant woodlands, significant wildlife habitat, and the Greenbelt-protected countryside area (Figure 8). The NHS generally includes lands in and around the main branches of the Oshawa, Corbett, Harmony and Farewell Creeks and their tributaries, with buffers on either side of the watercourse to delineate and protect riparian corridors. The NHS also includes extended lands in the Oak Ridges Moraine and the Lake Iroquois Beach, which are groundwater recharge areas, and the Oshawa Second Marsh at Lake Ontario. Since the NHS follows the City's surface water systems, there is a continuous connectivity from the north end of the City to the south end of the City (Lake Ontario) via the NHS.

From the City's Official Plan (2024), development and site alternation are prohibited within the NHS except for certain uses (e.g., conservation projects, fish and wildlife management, forestry and existing uses), which also then must follow the Official Plan in terms of planning the site (e.g., maximum impervious surface area percentage, limits on building areas, and maintaining connectivity 120 m buffer around features of the NHS). The Official Plan is very clear in that subwatershed plans must be developed for new developments that consider the water budget and seek to preserve this balance.

CLOCA has noted that there has been a 1% (or 32 ha) loss of natural cover in the Oshawa Creek and a 2.9% (or 46 ha) loss in the Black-Harmony-Farewell Creek watershed since 2013, largely due to the Hwy 407 construction and new development (CLOCA 2020a).

3.6 Water Quality and Aquatic Life

The Oshawa and Black-Harmony-Farewell Creek watersheds consist of cold water, headwater tributaries, followed by cool water mid-reaches as the creeks flow through agricultural and urban land uses characterized by less shading and more stormwater runoff from impervious surfaces, followed by warm water lower reaches through the most urbanized portion of the watershed (TSH 1995, CLOCA 2020a, CLOCA 2011). The portion of the Corbett Creek watershed within the City is entirely urbanized (TMIG 2020). These watersheds were previously predominantly cold water; however, increasing land development within the watersheds has resulted in a warming of the creeks in some areas of the watershed.



- City of Oshawa
- Area of Natural and Scientific Interest (ANSI)
- Ecological Land Classification (ELC)
- Hazard Lands
- Natural Heritage System (NHS)
- Natural Heritage/Hydrologic Features Outside NHS
- Wooded Area
- Water Body
- Watercourse
- Road

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City of Oshawa
Stormwater Management Master Plan

Natural Heritage

| | | | |
|-------------------|----------------|----------------------|--------------------------|
| Date: August 2024 | Project: 40061 | Submitter: Z. Zimmer | Reviewer: T. Roumeliotis |
|-------------------|----------------|----------------------|--------------------------|

1:65,000
650 0 650 1,300 metres
NAD 1983 UTM Zone 17N

Figure **8**

Within the Oshawa Creek watershed, water quality is generally good in the headwaters and degrades through the urbanized portion of the watershed, but most notably downstream of the confluence between Goodman Creek and Oshawa Creek (CLOCA 2013a). Water quality sampling in the Oshawa Creek watershed found occasional exceedances of the Ontario Provincial Water Quality Objectives (PWQO) for total phosphorus, fecal coliforms and some metals (TSH 1995). Total aluminum concentrations exceeded PWQO most frequently and at all monitored stations on the creek, while total iron and total zinc were exceeded at most stations. Based on monitoring in the headwaters, there is a portion of the aluminum, iron, zinc, and total phosphorus that is natural to the system due to soil and bedrock erosion; however, loadings through the urbanized portion of the City are anthropogenic (TSH 1995).

The water quality in the watershed is notably influenced by storm events, as there are a number of outfalls from the City's storm sewer system (discussed in Section 4.4) that discharge into the creeks. This stormwater discharge results in suspended and dissolved solids loading, metals loading, and nutrient loading (phosphorus). This loading is the result of runoff moving across impervious surfaces, such as roads and parking lots, and capturing contaminants present on these surfaces (e.g., metal dust and emissions from vehicles). Chloride concentrations were found to be elevated through the winter road salting period.

Within the Black-Harmony-Farewell Creek watershed, the Harmony Creek watershed water quality is the poorest and follows a similar trend to that of the Oshawa Creek watershed, where water quality in the headwaters is good but degrades as the creek travels through the urbanized areas. In contrast, the Black and Farewell Creek watersheds are located in a primarily rural area within the Municipality of Clarington (CLOCA 2011).

Within the Corbett Creek watershed, water quality is reported as being fair (CLOCA 2013a). This watershed is located entirely within an urbanized land use, with several storm sewer outfalls into the creek. As such, the water quality is heavily influenced by anthropogenic activities and stormwater runoff.

The SWMFs located within the City have the primary function of providing water quantity and water quality control of stormwater runoff such that water discharging from the SWMF into the receiving watercourse is at a flow that eliminates the first flush volume of runoff, minimizes erosion in the watercourse and improves the water quality of the stormwater entering the SWMF. The water quality is improved by settling out suspended solids and constituents that are bound to the solids, including nutrients and metals, within the SWMF prior to discharging to the receiving watercourse. Research has also suggested that the aquatic plants that typically inhabit a SWMF, which may or may not be intentionally planted, may act to reduce certain parameters

such as nitrogen, while becoming a net source of phosphorus to the downstream receiver during plant die off in the fall (Johnston 2020).

The Corbett Creek watershed, Oshawa Creek watershed and the Black-Harmony-Farewell Creeks watershed all support both cold water and warm water fisheries. Within the Oshawa Creek, cold water species include, for example, blacknose dace and mottled sculpin, while warm water species include, for example, northern redbelly dace and fathead minnow. Sport fish including coho and chinook salmon as well as brook trout, brown trout, and rainbow trout were observed, although brook trout were generally only noted in the headwater tributaries of Oshawa Creek. The creek provides excellent cold-water fishery spawning and nursery opportunities for migratory and resident species (TSH 1995).

The Black-Harmony-Farewell Creek watershed discharges to Lake Ontario via the Second Marsh, the largest and most biodiverse coastal wetland on the north shore of Lake Ontario. While many species inhabit Second Marsh, a number of species also inhabit upstream in Black Creek, Harmony Creek and Farewell Creek. Of note, sport fish also found in Oshawa Creek such as coho salmon, chinook salmon, rainbow trout, brook trout, and brown trout, can be found in the Black-Harmony-Farewell Creek watershed (Ontario Ministry of Natural Resources 1997). The Species at Risk (SAR) American eel is also present in this watershed.

Within Corbett Creek, there is a varied community of fish species supported that includes carps and minnows. There are also records of young-of-the-year northern pike and adult chinook salmon closer to Lake Ontario. No provincial or federal fish SAR have been captured (TMIG 2020).

The aquatic biota populations in the three watersheds are impacted by expansion of urban development and the resulting loss in permeable surfaces leading to increased stormwater runoff and poorer creek water quality due to elevated water temperatures, nutrient and metals enrichment.

4 Existing Conditions – Key Stormwater Management Assets

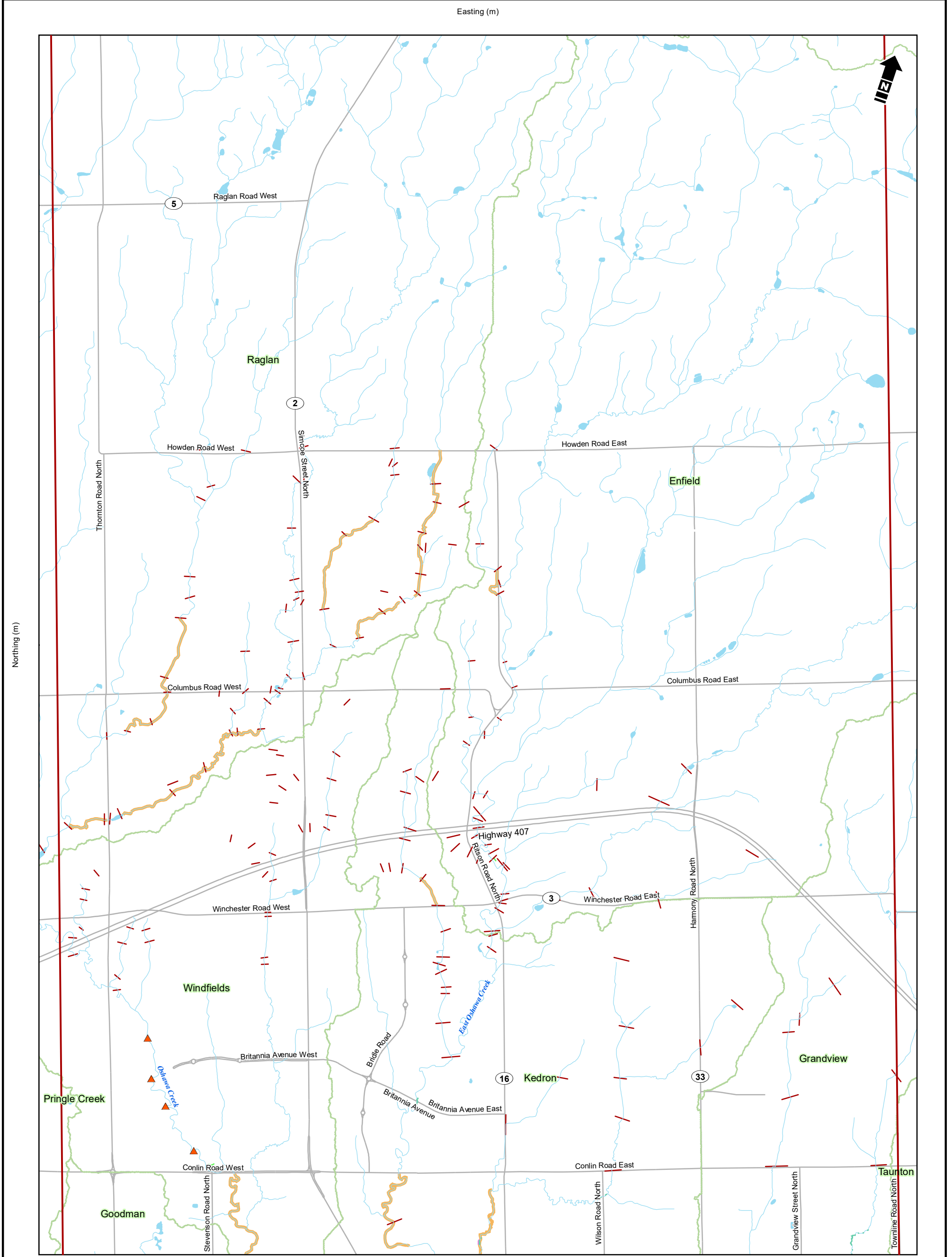
This section summarizes the existing conditions of the key stormwater management assets in the City based on review of the data available, as described in Section 2. The conditions are summarized for the City’s watercourses, creek crossings, and SWMFs, respectively.

4.1 Watercourses

The study area includes the Oshawa Watershed (also described as the Oshawa/Goodman/Montgomery Creek Watershed), the Black/Harmony/Farewell Creek Watershed, and the Corbett Creek watershed. The approximate length of channel within the study area is 400 km.

A review of background documents identified areas where previous watercourses assessments have been completed. This included reach delineation, field and desktop assessments to characterize geomorphic conditions within watercourse reaches, identification of erosion hazards, and recommended mitigation options.

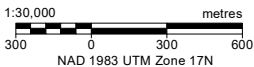
Previously identified erosion sites, reach breaks, and previously assessed reaches are compiled in Figures 9a and 8b.



- + City of Oshawa
- Water Body
- Watercourse
- Road
- ▲ Known Erosion Site
- Existing Erosion Assessment (City of Oshawa, Binder 1, 1990s-2000s)
- Existing Erosion Assessment (City of Oshawa, Binder 2, 1990s-2000s)
- Reach with Completed RGAs
- Previously Defined Reach Breaks
- **Watercourse Improvement**
- - - Post 1990 Construction

Note: Multiple watercourse layers were reviewed which may result in small variations in watercourse tracing.

Some features are drawn with an offset to improve map readability.



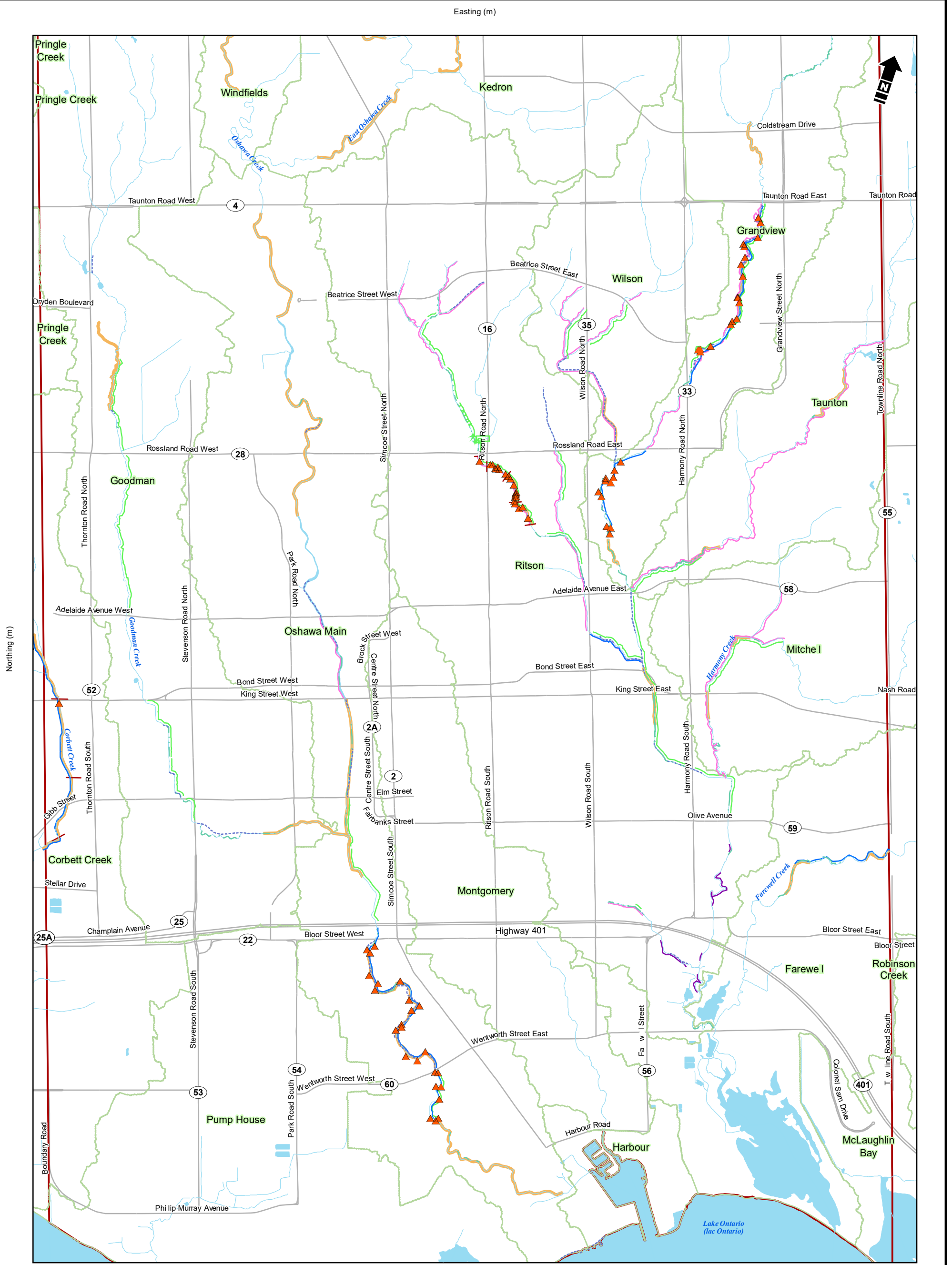
City of Oshawa
Stormwater Management Master Plan

Known Erosion Sites and Watercourse Assessment Locations (North)

| | | | |
|-------------------|----------------|----------------------|--------------------------|
| Date: August 2024 | Project: 40061 | Submitter: Z. Zimmer | Reviewer: T. Roumeliotis |
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Stormwater Management Master Plan

Known Erosion Sites and Watercourse Assessment Locations (South)

| | | | |
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9B

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4.1.1 Geomorphic Characterization

The Oshawa Creek Watershed Management Plan (CLOCA 2002) summarized rapid geomorphic assessments (RGAs) completed by TSH in 1995. All reaches assessed within Oshawa Creek were classified as stressed or unstable. Areas of erosion identified were generally south of Columbus Road. Within the urban area there is significant history of channel alteration (CLOCA 2002). Within the Columbus Subwatershed Study (Stantec 2022), RGA conditions for reaches assessed were 'in regime' or 'in transition/stressed'. Reaches 'in transition/stressed' are generally south of Columbus Road. Widening was found to be the dominant process in most reaches.

Within the Black/Harmony/Farewell Creek Watershed RGAs indicated upstream reaches are most stable, the mid-watershed reaches show more signs of adjustment, and the downstream reaches become unstable (CLOCA 2011). This trend is likely a result of land use within the watershed; as the amount of development draining to the creek increase, the stability of the watercourse decreases. This is most evident in the Black/Farewell Creek subwatersheds. Channel disturbance is greatest in Harmony Creek which has extensive armouring, and lowest in Farewell Creek (CLOCA 2011). The Harmony Creek Subwatershed Plan (Aquafor Beech 2001) found that Branches 1, 3, and 4 (Ritson, Grandview, and Mitchell) upstream of Adelaide Road were the most unstable due to the sensitive nature of the sand/gravel soils in Iroquois Beach areas and impacts from upstream development.

The Corbett Creek MDP includes reach mapping and geomorphic characterization of the entire watershed. Most reaches were found to be 'in transition'. Erosion and channel instability concerns included undermined storm were outfalls, knickpoint migration, exposed piping, valley wall erosion, and deteriorating previous remedial channel works (gabion baskets, geocells, etc.; TMIG 2020). These are indicative and channel degradation and widening.

4.1.2 Erosion Sites

TSH (1990) and TSH (1995) completed erosion inventories which identified erosion sites throughout the Harmony Creek and Oshawa Creek watersheds. 117 erosion sites were identified in Harmony Creek, seven of which were high priority. Twenty-seven erosion sites were ranked as medium or high priority in Oshawa Creek, with highest priority sites generally found in the lower reaches. Erosion sites from the TSH (1995) study could not be accurately mapped due to the scale of map in the report. The City of Oshawa provided two Erosion Inventory Binders which document erosion sites identified and evaluated within the 1990s to 2000s. Sites from the TSH (1990) and TSH (1995) studies were included in the binders. Erosion sites were located within the Oshawa Creek and Harmony Creek watersheds south of Highway 407 within urban areas. Binder 1 included 30 erosion sites and Binder 2 included 33 reaches,

which are shown on Figures 9a and 9b. Erosion sites within Harmony Creek from the TSH (1990) study appear to correspond to locations included in the binders. Sections of channel with erosion sites not captured in the binders were added to Figures 9a and 9b. This inventory is dated and requires an update.

More recent studies by Palmer have identified erosion sites within reaches of Oshawa Creek, Harmony Creek, and Farewell Creek based on risks to City property, private property, and/or infrastructure. Additional studies by Greck investigated flooding and erosion issues within sections of Goodman Creek and Harmony Creek. These are summarized in Table 7 below. Areas of erosion noted in subwatershed studies, and the Corbett Creek watershed are also included in Table 7.

Table 7 Erosion Sites Identified Through Previous Studies

| Watercourse | Location | Erosion Sites/Issues |
|--------------|---|---|
| Oshawa Creek | Thomas Street to Wentworth Street (Palmer 2021) | <ul style="list-style-type: none"> • Erosion most pronounced at meander bends • 8 erosion sites identified • Concept designs provided for three highest priority sites (two of the three priority sites were recommended for immediate action) • Other recommendations: geotechnical investigation and monitoring benchmarks |
| | Bloor Street West to Wentworth Street (Palmer 2020) | <ul style="list-style-type: none"> • Affected by historic dam (destroyed by flooding ca. 1990) • Instability due to combination of fluvial and slope processes • 16 erosion sites identified • Concept designs provided for four highest priority sites (two of the four priority sites were recommended for immediate action) • Other recommendations: mapping of pond deposits and monitoring benchmarks |
| | Columbus Subwatershed (Stantec 2022) | <ul style="list-style-type: none"> • Areas of active erosion including bank erosion, valley wall contacts, and at crossings were identified • Most ranked low priority due to no risk to infrastructure • Two crossings at Columbus Road ranked medium (5 to 10 years) to low (>10 year) priority for restoration |

| Watercourse | Location | Erosion Sites/Issues |
|--------------------------|---|--|
| | Windfields Planning Area – West (MMM Group 2013) | <ul style="list-style-type: none"> • Three erosion sites identified within Oshawa Creek West Branch posing no risk to structures or infrastructure • 1,500 mm diameter stormwater outfall located downstream of a sharp meander bend identified for monitoring but no immediate risk |
| Goodman Creek | King Street West to Gibb Street (Greck 2015) | <ul style="list-style-type: none"> • Channel responding to historic realignment • Erosion and flooding issues in backyards • Private ownership of land and watercourse • Concepts for alternative solutions provided • Recommendations: removing trees and debris in channel to provide greater flow capacity, culvert improvements, channel design/erosion protection if possible |
| Harmony Creek (Branch 1) | Rosland Road West to Central Park Boulevard North (Palmer 2024) | <ul style="list-style-type: none"> • 22 in-channel erosion control structures (armourstone, riprap, gabion baskets, and concrete slabs) most of which are deteriorating or have failed • Erosion most pronounced in unprotected sections of channel • 23 erosion sites identified • Three areas encompassing nine erosion sites total were prioritized and conceptual designs were provided • Risks to public property (Hillsdale Public School), pedestrian trails, private property, and infrastructure (sanitary sewer, stormwater outfall) • Other recommendations: erosion control structure inventory and regular monitoring, basic monitoring benchmarks or real-time erosion sensors |
| Harmony Creek (Branch 1) | Wilson Road North to Bond Street East (Palmer 2019a) | <ul style="list-style-type: none"> • Upstream and downstream sections historically straightened • Outer bend erosion and valley wall processes (gully) • Five erosion sites identified • Concept designs provided for two highest priority sites • Other recommendations: instream woody debris removal, maintaining downstream grade control structure, and possible culvert cleaning at Wilson Road (hydraulic capacity) |

| Watercourse | Location | Erosion Sites/Issues |
|--------------------------|--|--|
| Harmony Creek (Branch 1) | Harmony Creek Golf Centre (CPR to Bloor Street; (Greck 2014) | <ul style="list-style-type: none"> Erosion and flooding issues Concept restoration plans provided |
| Harmony Creek (Branch 3) | Taunton Road East to Harmony Road North (Palmer 2019b) | <ul style="list-style-type: none"> Outer bend erosion and valley wall processes 18 erosion sites identified Concept designs provided for seven highest priority sites (one of the seven priority sites was recommended for immediate action) Other recommendations: instream woody debris removal and monitoring benchmarks |
| Harmony Creek (Branch 3) | Hillcroft Street to Rossland Road East (Palmer 2022) | <ul style="list-style-type: none"> Historic realignment and stabilization measures Bed degradation, outer bend erosion, and erosion downstream of failing erosion control measures 13 erosion hazard sites identified Concept designs provided for three highest priority sites (two of the three priority sites were requiring immediate attention) Other recommendations: erosion control structure inventory/regular monitoring, monitoring benchmarks, and other proximity sites (pedestrian bridge repair) |
| Farewell Creek | Grandview Street South to Townline Road (Augusta Court; Palmer 2016) | <ul style="list-style-type: none"> Failing 55 m gabion basket wall along outer bend adjacent to cul-de-sac at end of Augusta Court Concept mitigation options provided |
| Corbett Creek | South of King Street to North of Donegal Avenue (TMIG 2020) | <ul style="list-style-type: none"> Reach EB7 is unstable with an exposed concrete pipe on the channel bed between King Street and Monaghan Avenue Channel stabilization recommended (rock weirs for grade control and bioengineered banks) Other watercourse rehabilitation recommendations are outside of the current study area |

4.1.3 Watercourse Improvement/Erosion Control Works

The City’s watercourse improvement GIS layer was reviewed to determine where erosion control works have been completed. It included 104 locations including local works and larger scale capital projects with construction dates ranging from 1954 to 2022. These locations are shown on Figures 9a and 9b. Prior to the 1990s “hard” erosion control measures including gabion baskets, armourstone, riprap, and concrete were implemented.

Based on the review of erosion sites above, many of these erosion control works are deteriorating or have failed and may be causing increased erosion. Starting in the 1990s, “softer” or more natural channel design methods were used such as crib walls, live stakes, root wads, vortex rock weirs, and riffle-pool sequences. Descriptions were not provided for the most recent channel works. The condition of erosion works will be confirmed as part of the field assessment.

4.2 Creek Crossings

A review of the City’s creek crossings was completed using available GIS data, background reports and design standards summarized in Section 2.3. The objective of the review was to identify existing watercourse crossing locations, relevant crossing design criteria, and areas of concern relating to poor crossing operation (e.g., crossings where flows overtop roads).

The existing creek crossings within the City were identified using the spatial datasets provided by the City and CLOCA. The available datasets consisted of creek crossings, as well as lot-level or site drainage assets (i.e., culverts not associated with a watercourse). Matrix worked with the City to refine the existing inventory to locations aligning with municipal roads along watercourses.

To understand how the existing assets are sized for conveyance capacity, several crossing design standards were reviewed and are summarized below.

- Engineering Design Criteria Manual (City of Oshawa 2022): for municipal jurisdiction creek culvert and bridge crossings, there are no specific hydrotechnical design criteria standards.
- CLOCA’s Technical Guidelines for Stormwater Management Submissions (2020a): provides stormwater management criteria for new developments and outlines the need to safely convey major flows to an outlet without negatively impacting adjacent properties. The report includes watercourse crossings design considerations for indicate the “crossing must be sized and located such that there is no increase in upstream or downstream flooding”.
- MTO Highway Drainage Design Standards (MTO 2008): this document includes design criteria for creek crossings under the jurisdiction of the provincial government.

Many municipalities in the province have accepted the MTO criteria as the basis for their municipal crossing design to provide consistency across the regions. Matrix notes that the City has also largely adopted the MTO design standards as the background review identified that most subwatershed and subdivision studies completed within the City assessed crossing size per the design standards.

The City provided several master planning, stormwater and environmental management reports that included inventory and capacity assessment data for some of the City's crossing assets. CLOCA also completed the Durham Community Climate Adaptation Plan: Flood Vulnerable Road and Hydraulic Capacity Assessment report (2022) which identified flood vulnerable crossings within the Region of Durham. The assessment used a GIS driven approach and data from existing HEC-RAS models to identify hydraulically deficient road crossings per the MTO design criteria (2008). GIS data obtained from CLOCA from this report identified 24 municipal crossings that did not meet MTO standard criteria, primarily in the urbanized region of the City of Oshawa south of Taunton Road West.

CLOCA's Watershed Flood-Risk Assessment report (2017) evaluated 92 flood damage centres within CLOCA jurisdiction to determine the level of flood risk posed to the surrounding public and property. Four of the most vulnerable flood risk centres were located in downtown Oshawa, upstream of the Canadian Pacific Railway line (described in Section 3.4, and Figure 7). Crossing locations associated with the flood risk centres include:

- Oshawa Creek between King Street West & McMillan Drive
- Goodman Creek between Gibb Street and Park Road South
- Goodman Creek between King Street West and Stevenson Road South
- Harmony Creek between Bloor Street East and Harmony Road South

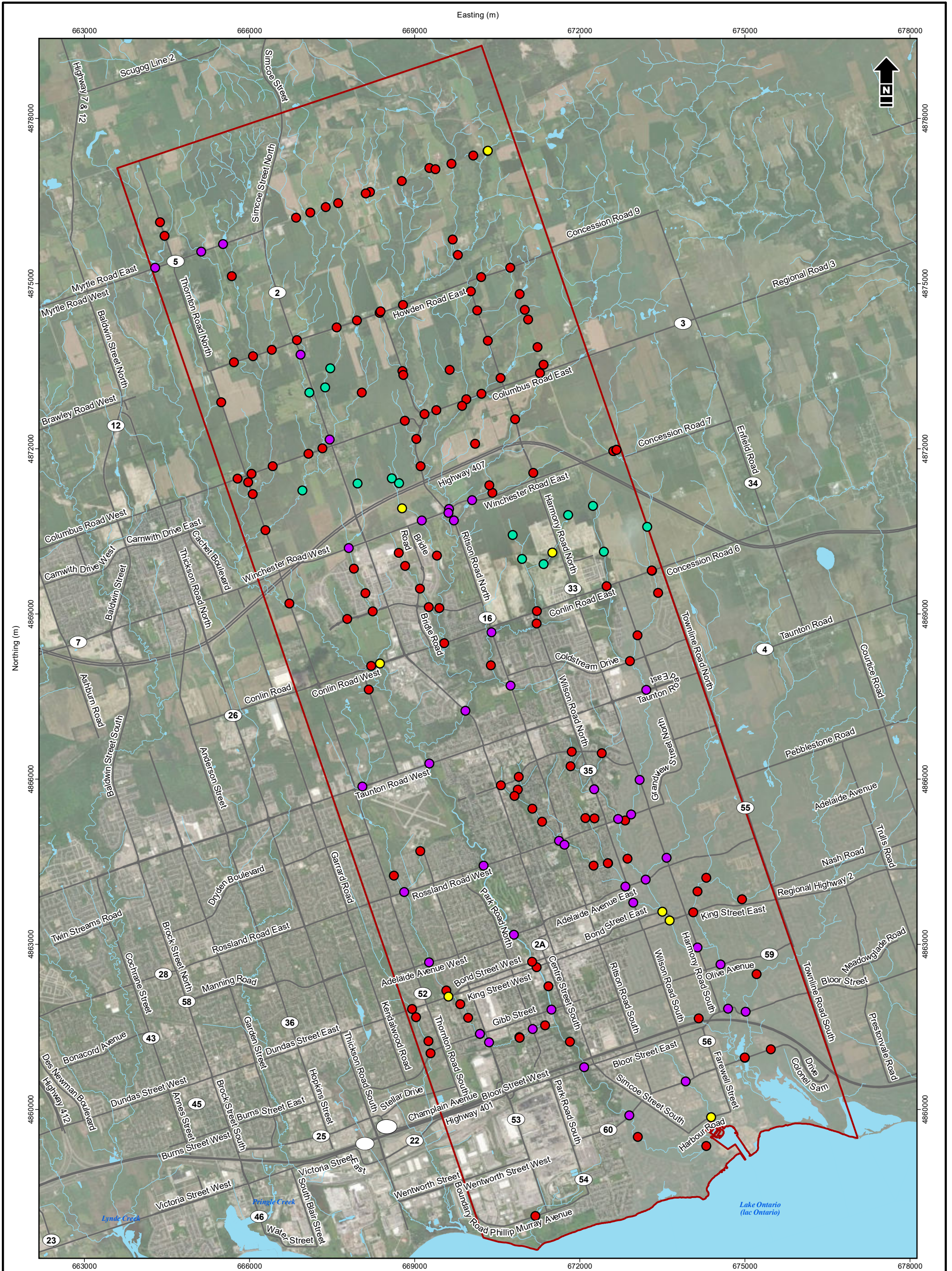
Based on the findings and communications with the TCC members, no reconstruction work has been completed on any of the deficient municipal crossings identified from this background review. While Matrix is completing independent hydraulic performance checks for the City's watercourse crossings as part of Task 3 of the SWM MP project, the data presented in these background reports will be useful to understand previously identified hydraulic performance and hydraulically deficient structures.

4.2.1 Summary of Assets for Assessment

The scope of the study was to investigate creek crossings along municipally owned roads. Due to the extent of crossing data received by the City and CLOCA that fell outside of the scope of work (e.g., driveway culverts, site drainage culverts, etc.), in consultation with the Technical Coordinating Committee, Matrix completed a preliminary GIS based desktop assessment to identify creek crossings associated with regional and municipal road. The findings of this assessment are shown in Figure 10 and Table 8. Per the City’s request, watercourse crossing in new developments, including Columbus and Kedron, were identified and are also presented in Figure 10. Matrix is currently reviewing the hydraulic capacity assumptions for these developments to determine if additional capacity assessments are warranted.

Table 8 City of Oshawa Watercourse Road Crossings

| Jurisdiction | Culverts | Bridges | Total Crossings |
|------------------|------------|-----------|-----------------|
| Regional | 32 | 10 | 42 |
| Municipal | 119 | 18 | 137 |
| New Developments | 14 | - | 14 |
| Total | 165 | 28 | 193 |



- City of Oshawa
- Water Body
- Watercourse
- Road

Watercourse Crossing Location

- City of Oshawa (Municipal)
- New Development Area (Municipal)
- Region of Durham (Regional)
- Gap Analysis Crossings (Matrix)

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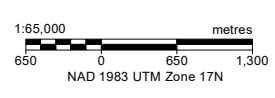
City of Oshawa
Stormwater Management Master Plan

Watercourse Crossing Locations

| | | | |
|-------------------|----------------|----------------------|--------------------------|
| Date: August 2024 | Project: 40061 | Submitter: Z. Zimmer | Reviewer: T. Roumeliotis |
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10



4.3 SWM Pond Facilities

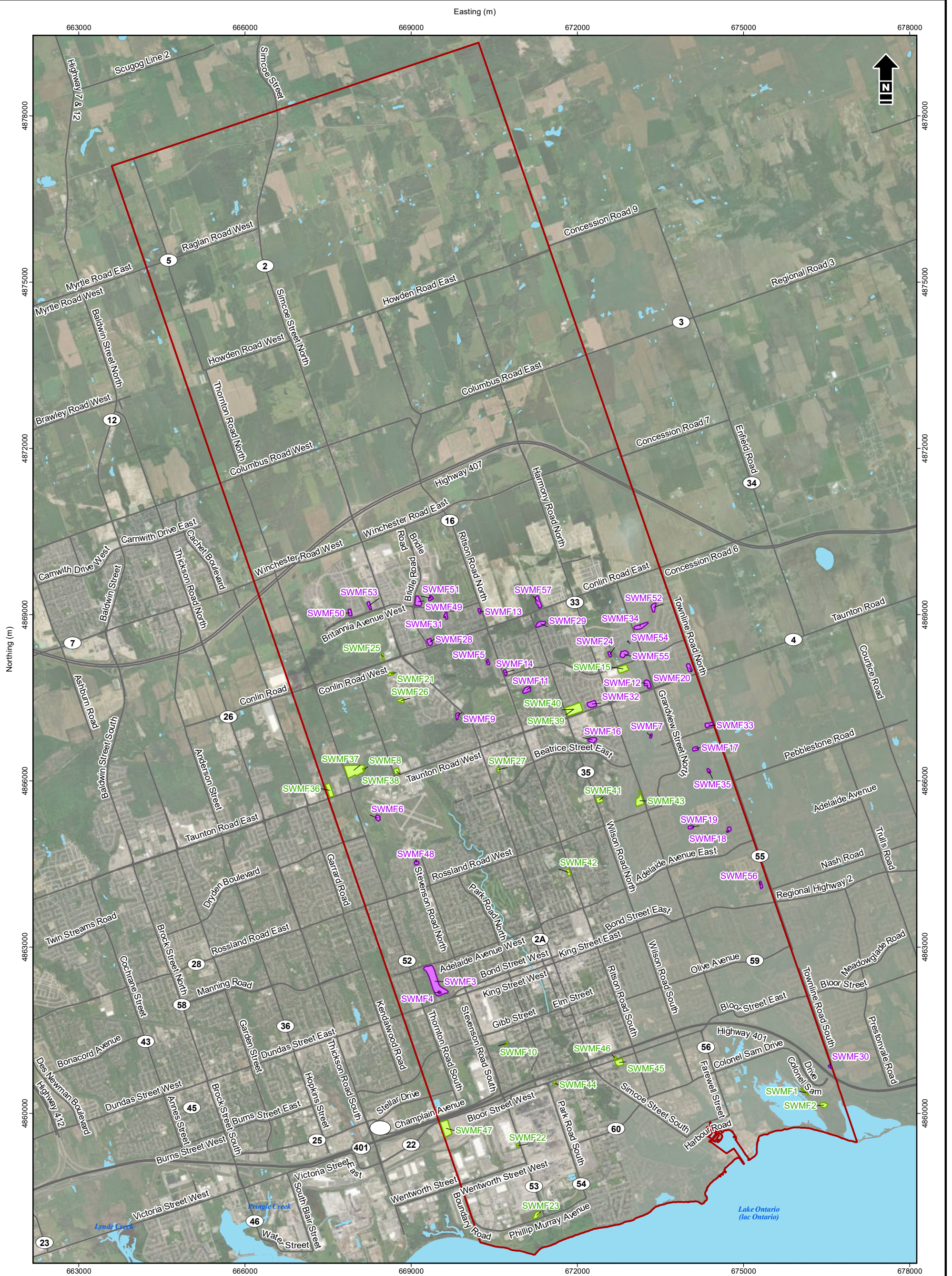
The City provided an inventory of the SWMF data that is available. The inventory contains data for 57 SWMFs, of which 24 are assumed. As part of Task 3 of the SMW MP project, the 24 assumed SWMFs will be surveyed and inspected to assess the condition of each. Figure 12 depicts the SWMFs, both assumed and not assumed.

Most of the SWMFs are located centrally within the City, where development has happened more within the last 20 to 30 years. There are no identified SWMFs north of Winchester Road East (Highway 3). There are nine SWMFs located nearest to Lake Ontario, but most of those facilities are not assumed.

4.3.1 Summary of Assets for Assessment

The background data provided for the SWMFs was reviewed and the data has been compiled into Table 9. Drawings were available for all of the assumed SWMFs. Reports were available for some of the SWMFs; the reports were reviewed to determine the drainage area and impervious percent of the land to the SWMFs, if provided. Some reports provided were either preliminary or did not include complete information about the drainage area. In this case, we may have stated that a report was not provided. The City has stated that they complete regular maintenance of SWMFs, usually dredging one SWMF per year. The record of past cleanouts are to be provided by the City and the table will be updated accordingly once received.

SWMF 16 is currently being dredged and maintenance pipe repairs are being completed; this work began in May and is anticipated to be completed in approximately mid-August. SWMF28 will be dredged this fall; the construction will occur by October. The City plans to cleanout another pond in 2025, but the facility has not yet been selected.



- City of Oshawa
- Assumed Stormwater Management Facilities
- Unassumed Stormwater Management Facilities
- Water Body
- Road



City of Oshawa
Stormwater Management Master Plan

Stormwater Management Pond Facilities (SWMF)

| | | | | | | | |
|-------|-------------|----------|-------|------------|-----------|-----------|----------------|
| Date: | August 2024 | Project: | 40061 | Submitter: | Z. Zimmer | Reviewer: | T. Roumeliotis |
|-------|-------------|----------|-------|------------|-----------|-----------|----------------|

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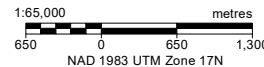


Table 9 Available Data for Assumed SWMFs

| SWMF ID | SWMF Type | Year Const. | Year Last Dredged | Provided by City? | | Drainage Area and Imp. % | Data Gap |
|--------------------|-----------|-------------|-----------------------------|-------------------|---------|--------------------------|---|
| | | | | DWGs | Reports | | |
| SWMF3 ¹ | dry pond | 1987 | N/A | Y | N | N/A | Drainage area and impervious percentage |
| SWMF4 ¹ | wet pond | 1987 | N/A | Y | N | N/A | Drainage area and impervious percentage |
| SWMF5 | marsh | 1993 | 2018 | Y | Y | 15.13 ha / 41% | Sufficient data to proceed with SWMF assessment |
| SWMF6 | wet pond | 1994 | 2018 | Y | N | N/A | Drainage area and impervious percentage |
| SWMF7 | wet pond | 1994 | 2019 | Y | N | N/A | Drainage area and impervious percentage |
| SWMF9 | wet pond | 1997 | 2020 | Y | Y | 41.8 ha / unknown | Impervious percent of drainage area |
| SWMF11 | wet pond | 1999 | 2018 (partial) ² | Y | Y | 47.63 ha / 40% | Sufficient data to proceed with SWMF assessment |
| SWMF12 | wet pond | 1999 | 2017 | Y | Y | 69.8 ha / 48% | Sufficient data to proceed with SWMF assessment |
| SWMF13 | wet pond | 2001 | 2018 | Y | N | N/A | Drainage area and impervious percentage |
| SWMF14 | wet pond | 2001 | 2016 | Y | Y | 22 ha / 50% | Drainage area and impervious percentage |
| SWMF16 | wet pond | 2001 | 2024 | Y | Y | 97 ha / 54% | Impervious percent of drainage area |
| SWMF17 | wet pond | 2002 | 2018 | Y | Y | 26.99 ha / 45% | Sufficient data to proceed with SWMF assessment |
| SWMF18 | wet pond | 1992 | 2020 | Y | Y | 37.7 ha / 55% | Sufficient data to proceed with SWMF assessment |
| SWMF19 | wet pond | 2003 | 2015 | Y | N | 13.02 ha / 40% | Sufficient data to proceed with SWMF assessment |

| SWMF ID | SWMF Type | Year Const. | Year Last Dredged | Provided by City? | | Drainage Area and Imp. % | Data Gap |
|---------|-----------|-------------|-------------------|-------------------|---------|--------------------------|---|
| | | | | DWGs | Reports | | |
| SWMF24 | dry pond | 2003 | 2018 | Y | Y | 9.32 ha / 70% | Sufficient data to proceed with SWMF assessment |
| SWMF28 | wet pond | 2006 | 2024 | Y | Y | 51.69 ha / 43% | Drainage area and impervious percentage |
| SWMF29 | wet pond | 2005 | 2022 | Y | Y | 62.62 ha / 45% | Sufficient data to proceed with SWMF assessment |
| SWMF30 | wet pond | 2005 | 2018 | Y | N | N/A | Drainage area and impervious percentage |
| SWMF31 | wet pond | 2005 | 2018 | Y | Y | 20.28 ha / 45% | Sufficient data to proceed with SWMF assessment |
| SWMF32 | wet pond | 2005 | 2021 | Y | Y | 42.25 ha / 61% | Sufficient data to proceed with SWMF assessment |
| SWMF33 | wet pond | 2007 | 2018 | Y | Y | 48 ha / 48% | Sufficient data to proceed with SWMF assessment |
| SWMF34 | wet pond | 2006 | 2023 | Y | Y | 43.1 ha / 45% | Sufficient data to proceed with SWMF assessment |
| SWMF35 | wet pond | 2007 | 2013 | Y | Y | 9.31 / 46% | Sufficient data to proceed with SWMF assessment |
| SWMF48 | wet pond | 2006 | 2015 | Y | N | N/A | Drainage area and impervious percentage |

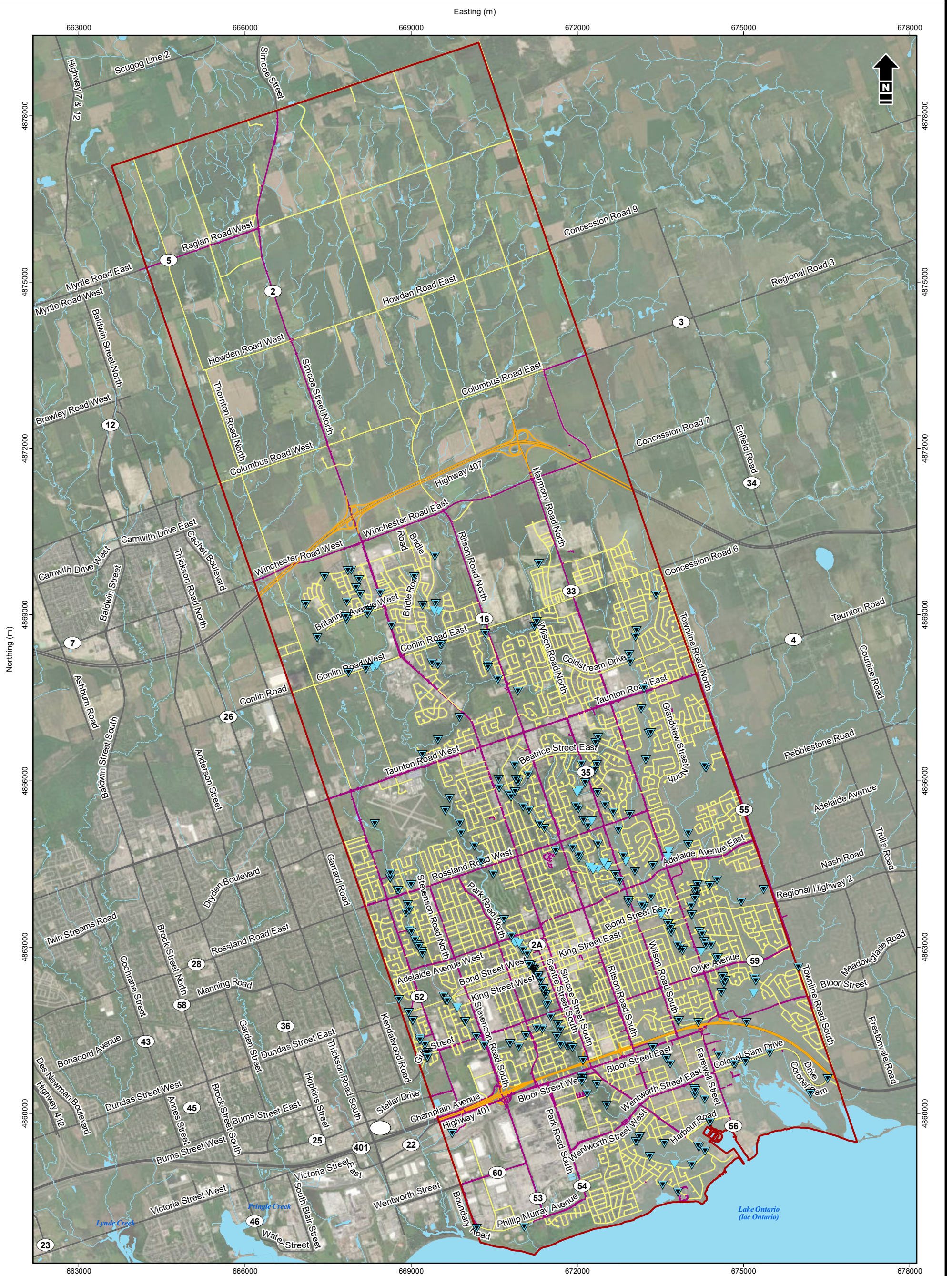
Notes:

1 - SWMF 3 and 4 are a combined facility, called Goodman Pond. This facility provides Regulatory Flood Control and the maintenance of this facility to ensure proper function is critical for downstream flood control.

2 - In 2014, the SWMF 11 forebays and approximately 35% of the main cell was cleaned out. In 2018, approximately 40% of the sediment in the main cell was removed. These decisions were made due to the size of the facility, the depth of the accumulated sediment and the required costs for a complete cleanout.

4.4 Storm Sewer Network

The storm sewer network within the Oshawa city limits is owned by Durham Region on regional roads, such as Taunton Road and Simcoe Street, and by the City on all local roads. The storm sewer network (Figure 12) generally follows the urban road system with several outfalls into the Corbett Creek, Oshawa Creek, Harmony Creek and Farewell Creek watersheds.



- ▭ City of Oshawa
- ▭ Water Body
- ~ Watercourse
- Road
- Storm Sewer Systems**
- Municipal (City of Oshawa)
- Provincial (MTO)
- Regional (Region of Durham)
- ▴ Storm Sewer Outfall Location

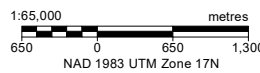


City of Oshawa
Stormwater Management Master Plan

Storm Sewer Network

Date: August 2024 Project: 40061 Submitter: Z. Zimmer Reviewer: T. Roumeliotis

Disclaimer: The information contained herein may be compiled from numerous third party materials that are subject to periodic change without prior notification. While every effort has been made by Matrix Solutions Inc. to ensure the accuracy of the information presented at the time of publication, Matrix Solutions Inc. assumes no liability for any errors, omissions, or inaccuracies in the third party material.



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5 Gap Analysis

Based on the background information provided, the additional information required to develop a more fulsome understanding of existing conditions of the City's watercourse, creek crossings, and SWMFs is described below.

5.1 Watercourses

The background review identified reports or figures that were not provided. These included:

- Appendices to the Oshawa Creek Watershed Study, Exhibit B, Hydraulics report. Appendix H of Exhibit B includes 1:2,000 mapping of medium and high priority erosion sites as noted in the 1995 TSH (Exhibit C) Erosion Inventory and Priority Site report. The detailed mapping would be of value to obtain to incorporate into the compiled mapping of previously identified erosion sites (Figure 9) and to inform the watercourse field assessment.

Other data gaps include:

- Historic aerial imagery owned by the City. If not available, Matrix can obtain historic photographs as needed from other sources.
- Capital construction project mapping, as shown on the City of Oshawa mapper.
- GIS layers from Integrated Transportation Master Plan maps (priority specific layers – Figure 5 New Road construction and road).

The existing City of Oshawa erosion inventory is outdated and does not cover the whole study area. The TSH (1990) and TSH (1995) erosion inventories cover the Harmony Creek and Oshawa Creek watersheds; however, they are over 30 years old and many of the issues may have been addressed. The erosion sites cannot be accurately mapped due to the scale of the map in the report. Through the field assessment, Matrix will build upon and update existing erosion inventories within the study area.

Background studies identified areas for restoration, with some providing conceptual designs. More detailed information on planned or recently completed channel works within the study area has not been provided but would be useful to inform where erosion issues may have been addressed as well as the success of any channel work. Records of post-construction monitoring, failure of restored channel areas or emergency channel works completed would also be of value to characterize current channel conditions.

5.2 Creek Crossings

Following the background review, a gap analysis was completed to locate additional assets not included in the City's or CLOCA's crossing inventories. Matrix conducted a GIS desktop assessment to determine the number of potential creek crossings locations under the City's jurisdiction, noting that the scope of this assessment was focused on watercourse crossings, and excludes roadside drainage crossings stormwater primary drainage networks, and crossings not under the City's jurisdiction (private, regional, and provincial).

A total of eight additional crossing locations were identified and are shown in Figure 10. The City clarified this assessment should not prioritize assessment of crossings north of Howden Road as these are not likely to present a significant flood risk as the assets are outside future development areas. Considering the assumption that crossings north of Howden are not to be included in the creek crossing assessment, a total of 109 crossings were identified for field surveys to be conducted as part of Task 3 of the project.

To complete the hydraulic capacity assessments for the crossing locations, Matrix will utilize the existing CLOCA hydraulic models. It is understood that the survey information included in these models was collected prior to 2014 and therefore Matrix intends collect new field survey data to be used to complete the hydraulic assessments. From the 109 crossings to be surveyed, 56 crossings are in the existing HEC-RAS models and will be updated, while the remaining 53 crossings assessments will be completed using a standard inlet/outlet control calculation based on the MTO design guidelines.

5.3 SWM Pond Facilities

Design reports are important to determine the drainage area to the pond, and the MECP required permanent pool volume. The background review identified that final design reports were not provided for ten of the assumed SWMFs. For some of these facilities, the City may have provided a preliminary report or a larger subwatershed report, but the reports did not have information on the design parameters of the SWMFs.

The MECP recommends removing the stored sediment when the total suspended solids (TSS) removal rate drops by 5% below the required design removal rate. This equates to a permanent pool that is 30% filled with sediment. Once the drainage area and impervious percent for a given SWMF are known, a more specific assessment of the remaining permanent pool volume can be completed. If the SWMF is oversized for the drainage area, cleanout may be able to be delayed and save construction costs. If the SWMF is undersized, the cleanout may need to occur more frequently.

Under the current methodology for prioritizing SWMF cleanouts, if the drainage area to the SWMF is unknown, Matrix will set the permanent pool cleanout target at 30% of the surveyed permanent pool being filled with sediment, based on the Task 3 bathymetric surveys to be completed as part of this project. Alternatively, to provide a more precise approach to prioritizing SWMF cleanouts, and if directed by the City, Matrix could complete an assessment to map the existing drainage area and impervious percent of the ten unknown SWMF using the storm sewer network and LiDAR.

6 Key Deficiencies and Recommendations Identified from the Background Review

Key deficiencies and recommendations that apply to the SWM MP identified as part of the background review and existing conditions assessment include:

- In general, previously completed RGAs indicate that reaches in urban settings are generally less stable further downstream within the stream network as urban impacts increase. RGA scores indicate that urban reaches are typically in transition / stressed or unstable. Local variation in surficial materials also contributes to this instability.
- TSH (1995) completed an erosion inventory for the City which identified erosion sites throughout the Oshawa Creek watershed. Twenty-seven erosion sites were ranked as medium or high priority. Highest priority sites were generally found in the lower reaches. These sites were monitored through the 1990s and 2000s as documented in the Erosion Inventory Binders. Erosion mitigation concepts were included for high priority sites. The erosion site inventory is considered out of date.
- Recent site-specific studies have provided erosion mitigation design concepts and recommendations. Limited information has been received regarding the extent to which these concepts have been constructed. Recommendations to improve the deficient locations have included:
 - ✦ geotechnical investigation and monitoring benchmarks
 - ✦ mapping of pond deposits
 - ✦ crossing improvements, maintaining downstream grade control structure, and possible culvert cleaning
 - ✦ channel design/erosion protection

- ✦ instream woody debris removal for greater flow conveyance; and
 - ✦ erosion control structure inventory/regular monitoring of erosion sites and other proximity sites (i.e., crossings).
- Hydraulically deficient watercourse crossings pose a high flood risk to surrounding public and property. Of note, the undersized Oshawa Creek CP Rail bridge due to the rail bridge and embankment has resulted in a high risk of flooding to the area immediately upstream at the confluence of Goodman and Oshawa Creeks. Recommendations to improve conveyance at this location include:
 - ✦ Re-design to effectively convey the flows to the design capacity to prevent backwatering that results in overbank flooding.
 - Unmaintained SWMFs will result in reductions in both quantity and quality control. Regular maintenance of City-owned SWMF, including removal of overgrown vegetation, inspection of infrastructure for function and sediment removal is recommended.

7 Draft Problem and Opportunity Statement

As part of the MCEA planning process, the City must develop a clear statement of the identified problems and opportunities to be addressed through the SWM MP. Based on the background review, a draft problem and opportunity statement was developed but will be refined based on public input and the information gathered during Tasks 2 through 4 of the project.

Problem/Background:

The City of Oshawa has been identified as one of the fastest-growing municipalities in Ontario, with a population growth projection of 300,000 by 2051.

Numerous stormwater management-related studies, including watershed/subwatershed studies, have been conducted by the City and its consultants in collaboration with CLOCA or developers for various purposes with the recommendations typically focused on site-specific applications.

The inventory of the City's key stormwater management infrastructure (e.g., watercourse improvement sites, creek crossings, and SWMF) has become antiquated.

Opportunity:

The City requires a comprehensive and holistic SWM MP summarizing SWM goals, objectives, policies, and recommendations to help guide the growth of the City without adversely affecting its environment and water resources. This plan will also provide the City with insights into the condition of existing key SWM infrastructure and recommend works that needs to be done on them to ensure that the infrastructure meets their respective design criteria. Additionally, the findings/recommendations of this plan will help the City to proactively plan and prioritize maintenance, upgrades, and new stormwater projects in a fiscally-responsible manner.

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