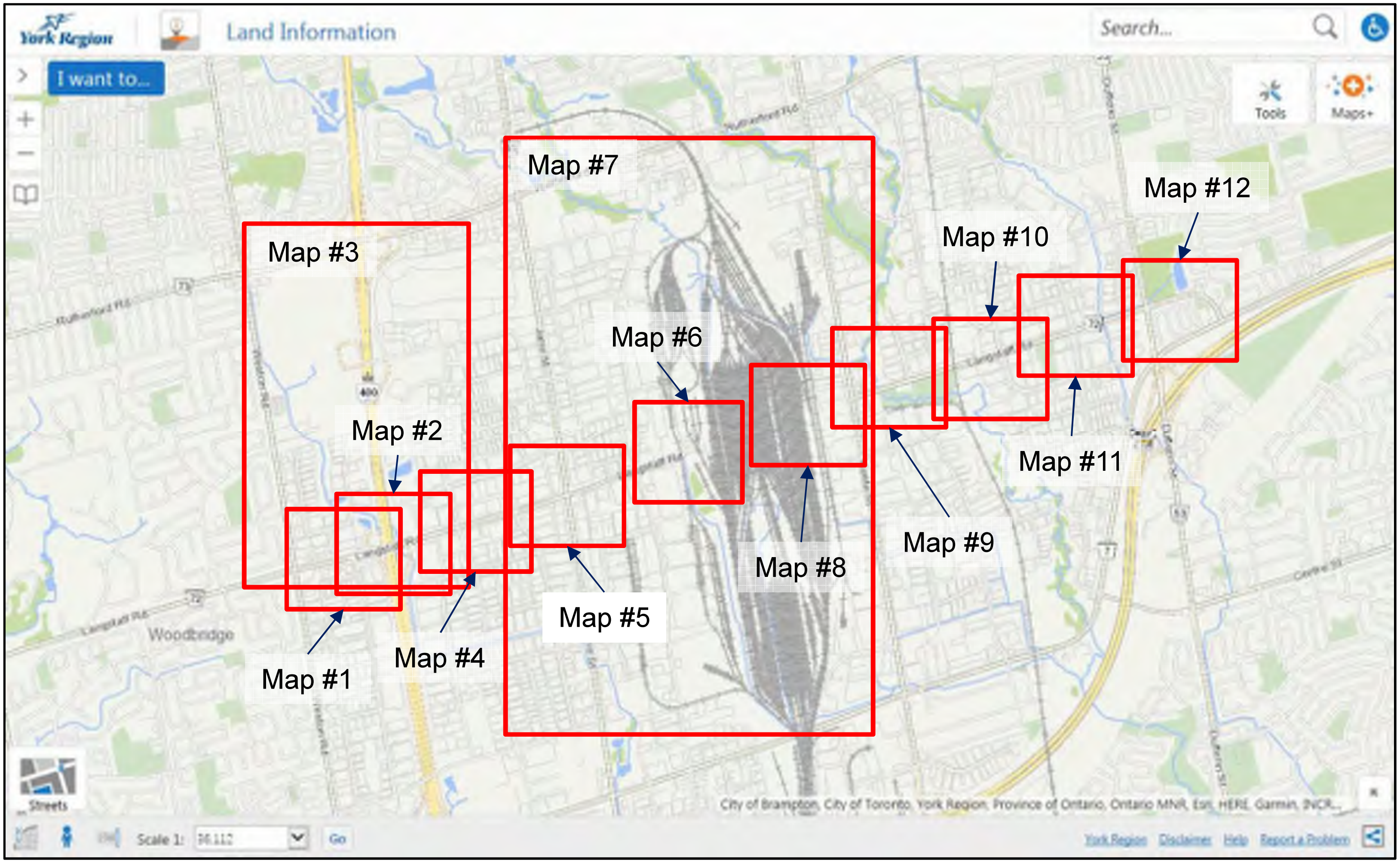
APPENDIX

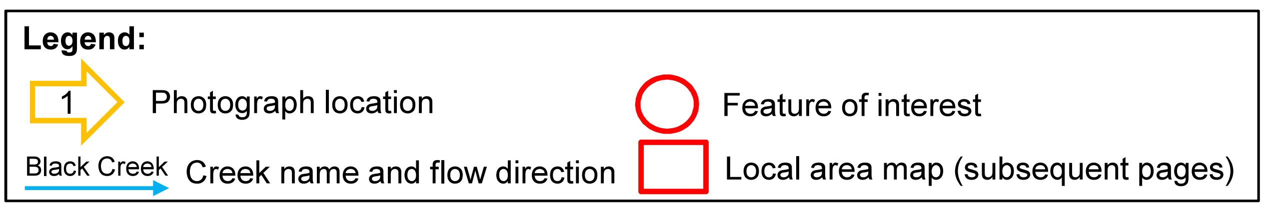
A

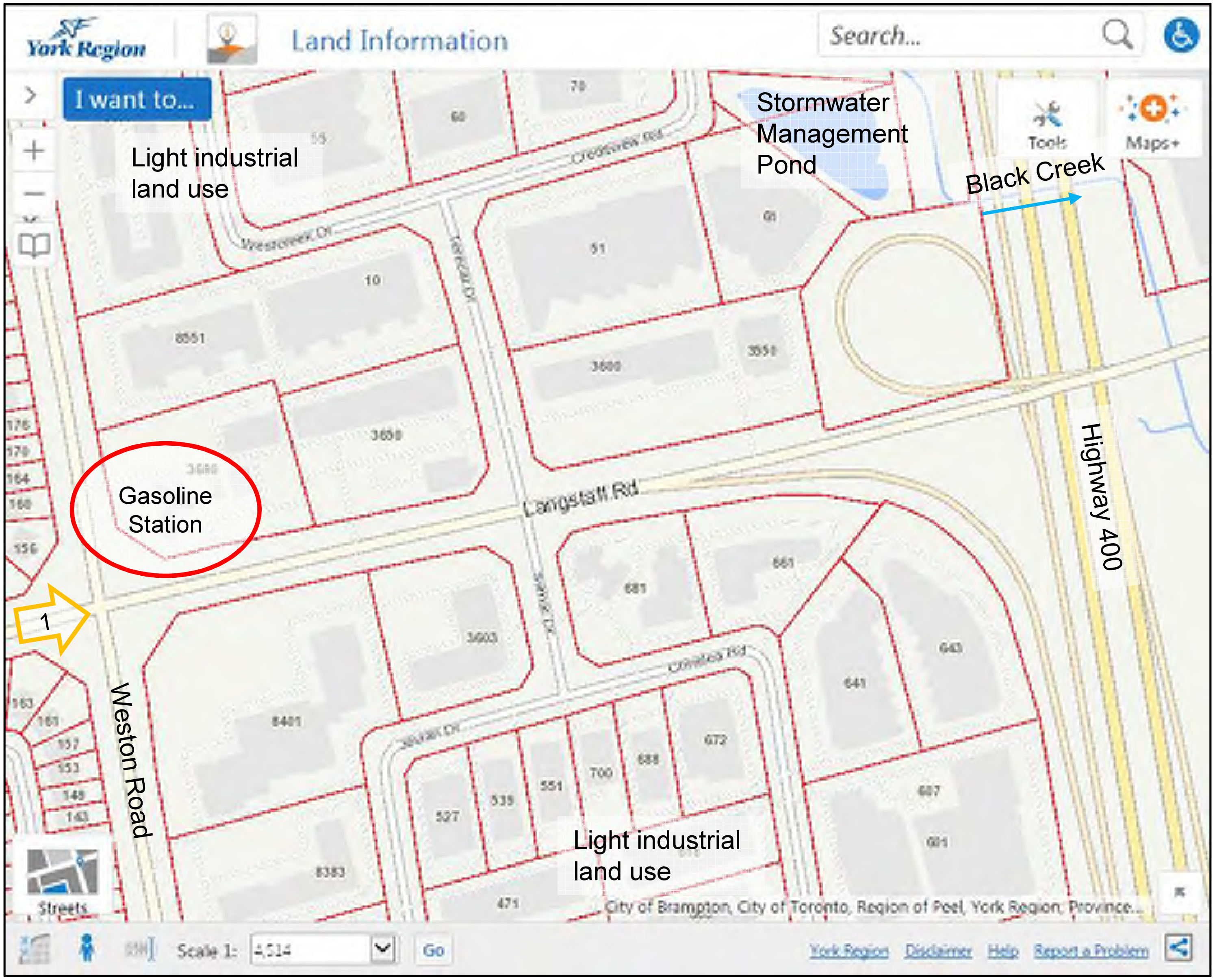
DETAILED SITE MAPS AND SITE PHOTOGRAPHS

Site Photographs
Langstaff Road between Weston Road to Highway 7
Hydrogeological Assessment

Appendix B Map Locator and Legend. Source: York Maps – www.yorkmaps.ca.





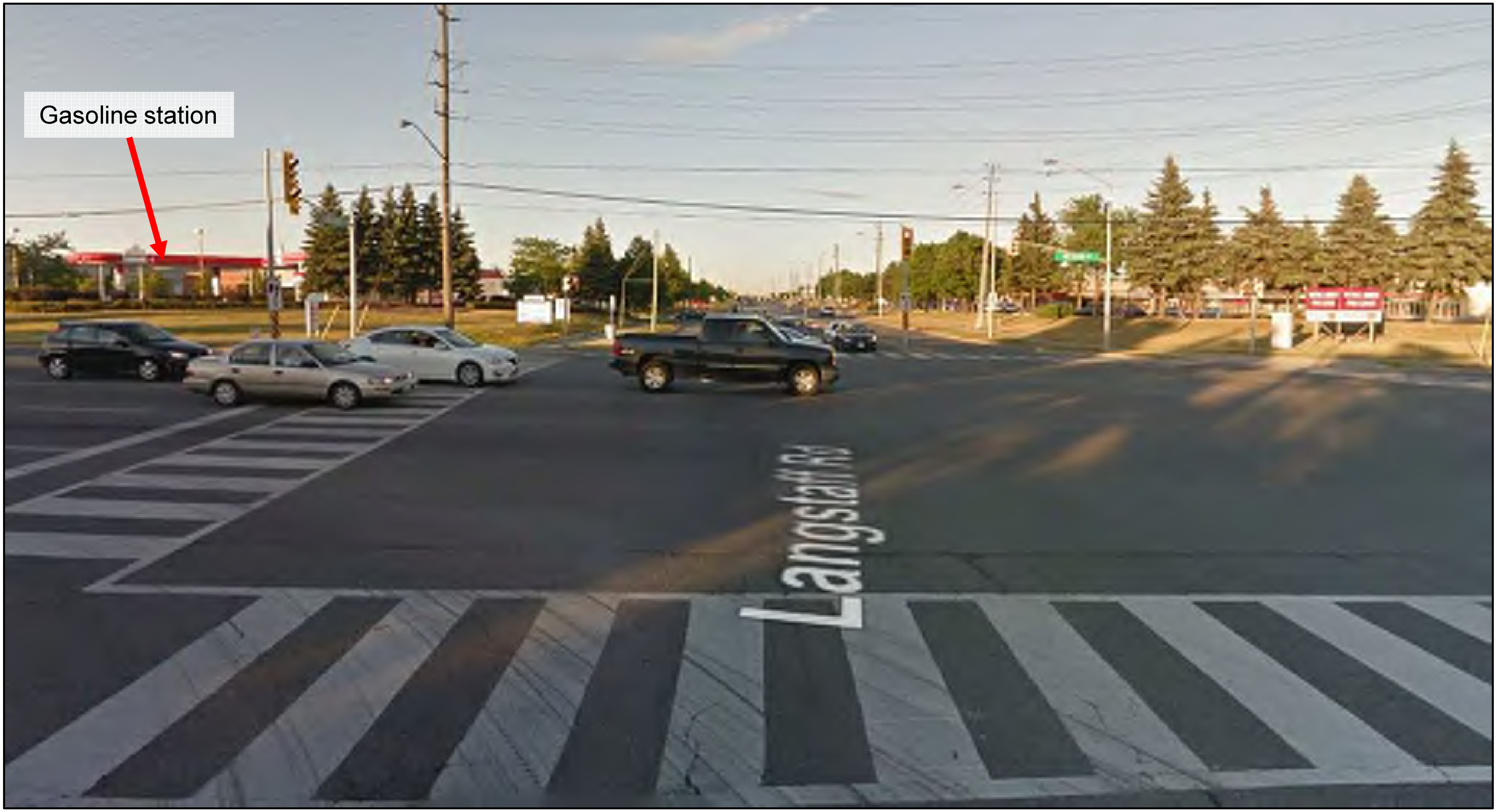


Map #1: Langstaff Road, Weston Road to Highway 400. Source: York Maps – www.yorkmaps.ca.

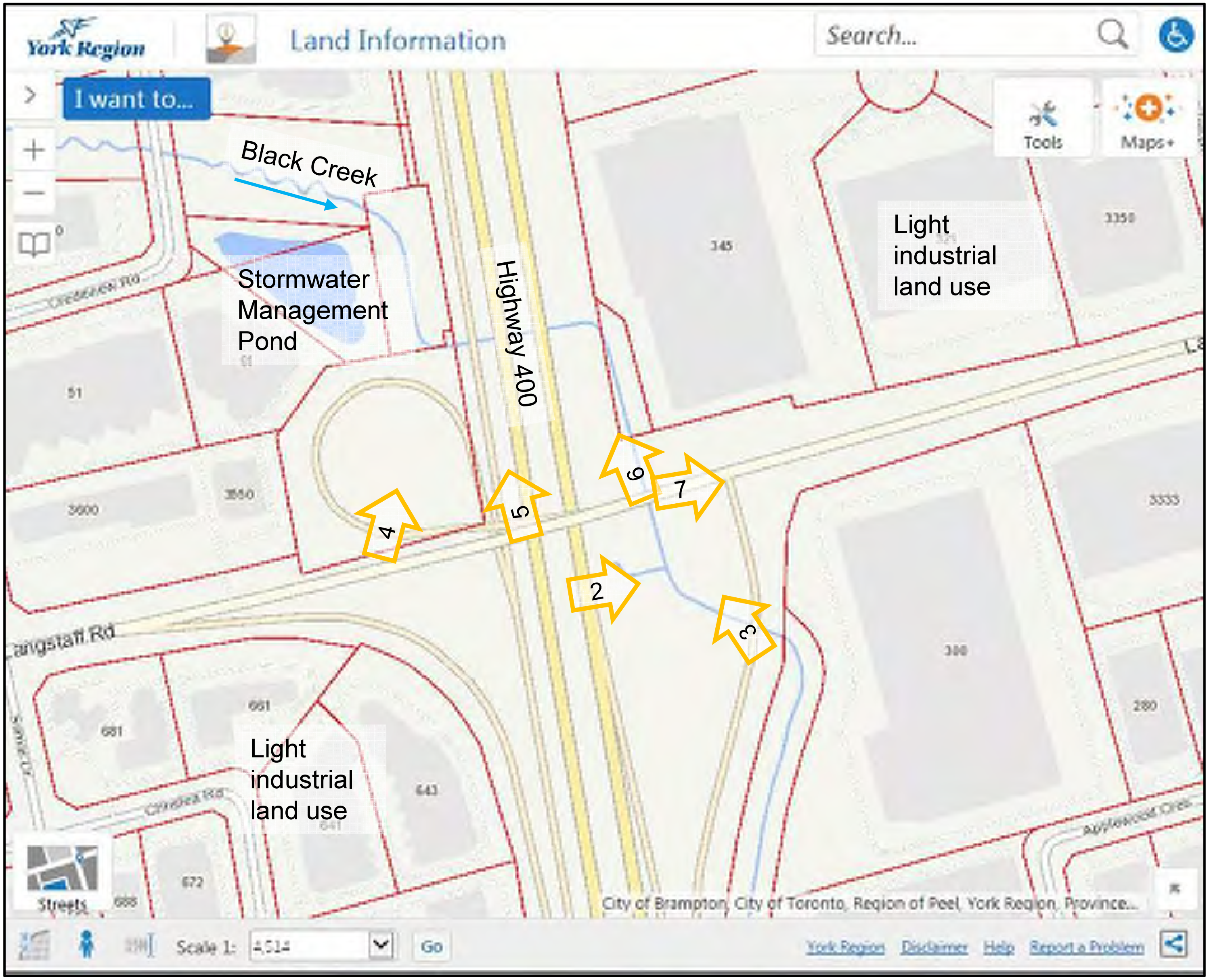
Site Photographs
Langstaff Road between Weston Road to Highway 7
Hydrogeological Assessment

Map #1 (Aerial): Langstaff Road, Weston Road to Highway 400. Source: Google Earth.

Site Photographs
Langstaff Road between Weston Road to Highway 7
Hydrogeological Assessment



Photograph 1: Langstaff Road and Weston Road intersection, looking east, July 2016. Source: Google Street View.



Map #2: Langstaff Road and Highway 400 Interchange. Source: York Maps – www.yorkmaps.ca.

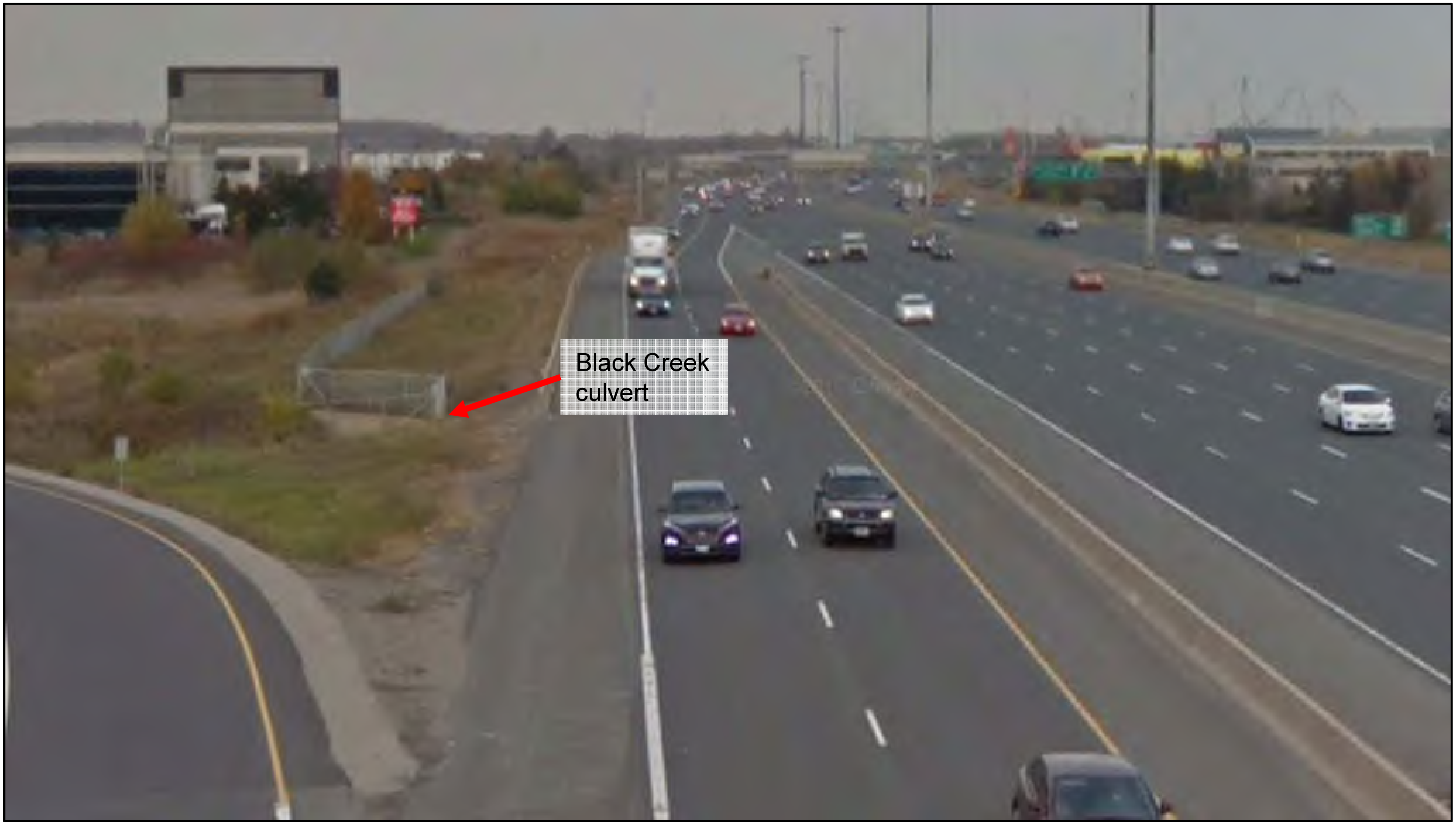
Site Photographs
Langstaff Road between Weston Road to Highway 7
Hydrogeological Assessment

Map #2 (Aerial): Langstaff Road and Highway 400 Interchange. Source: Google Earth.

Photograph 2: Looking East from Highway 400 South of Overpass. Source: Google Street View, 2017.

Photograph 3: Looking Northwest from Highway 400 – Langstaff Road N-E/W Ramp. Source: Google Street View, 2017.

Photograph 4: Looking North from Langstaff Road on the west side of Highway 400. Source: Google Street View, 2017.

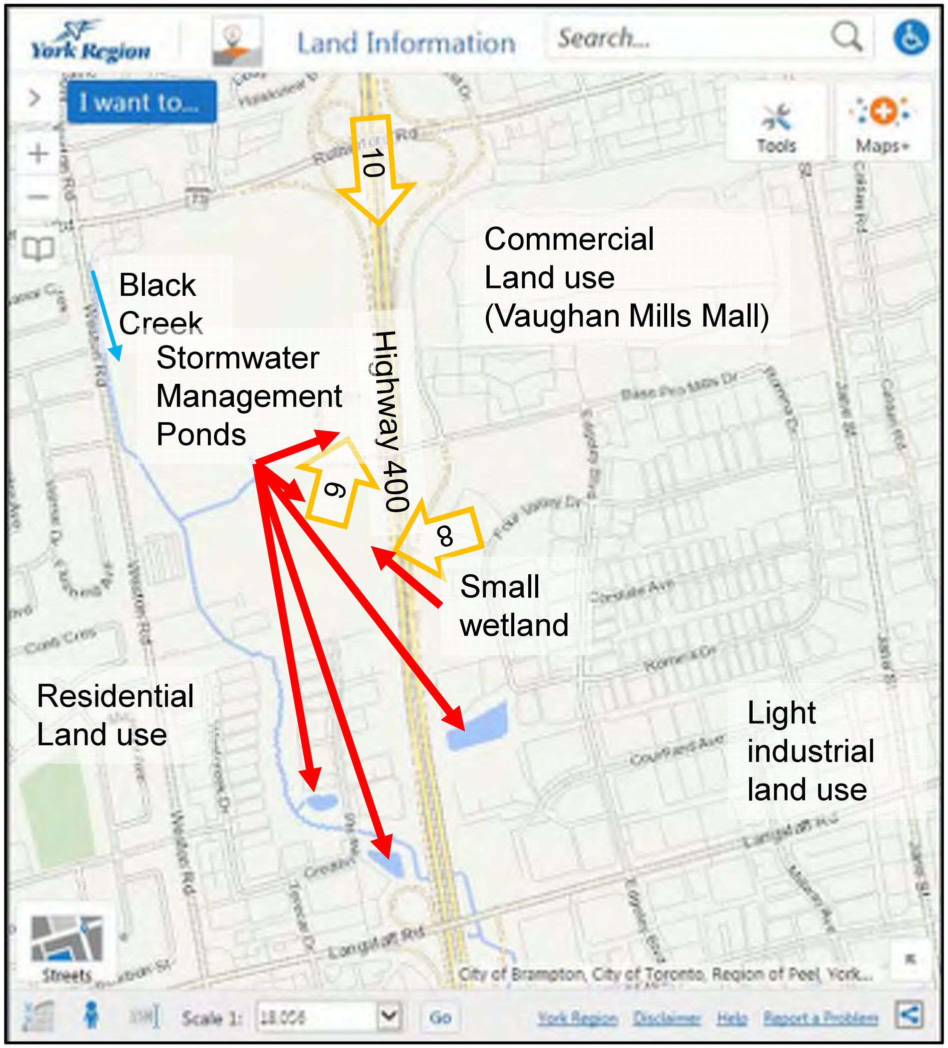


Photograph 5: Looking North along Highway 400 from the Langstaff Avenue overpass. Source: Google Street View, 2017.

Photograph 6: Looking North from Langstaff Road on the east side of Highway 400 showing Black Creek. Source: Google Street View, 2017.

Site Photographs
Langstaff Road between Weston Road to Highway 7
Hydrogeological Assessment

Photograph 7: Looking east along Langstaff Road on the east side of Highway 400 showing light industrial land use, including large buildings, manicured lawns, and planted trees. Source: Google Street View, 2017.

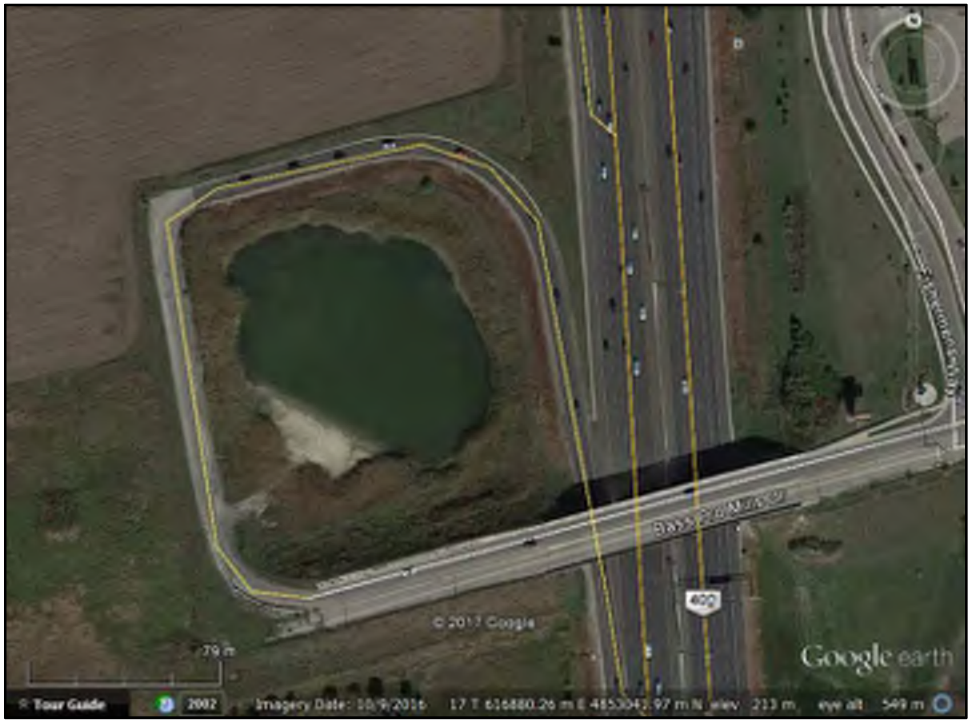


Map #3: Highway 400 between Langstaff Road and Rutherford Road. Source: York Maps – www.yorkmaps.ca and Google Earth.

Zoomed Map #3 (Aerial): Wetland along west side of Highway 400, 900 meters north of Langstaff Road. Source Google Earth.

Photograph 8: Wetland along west side of Highway 400, 900 meters north of Langstaff Road. Source Google Street View.

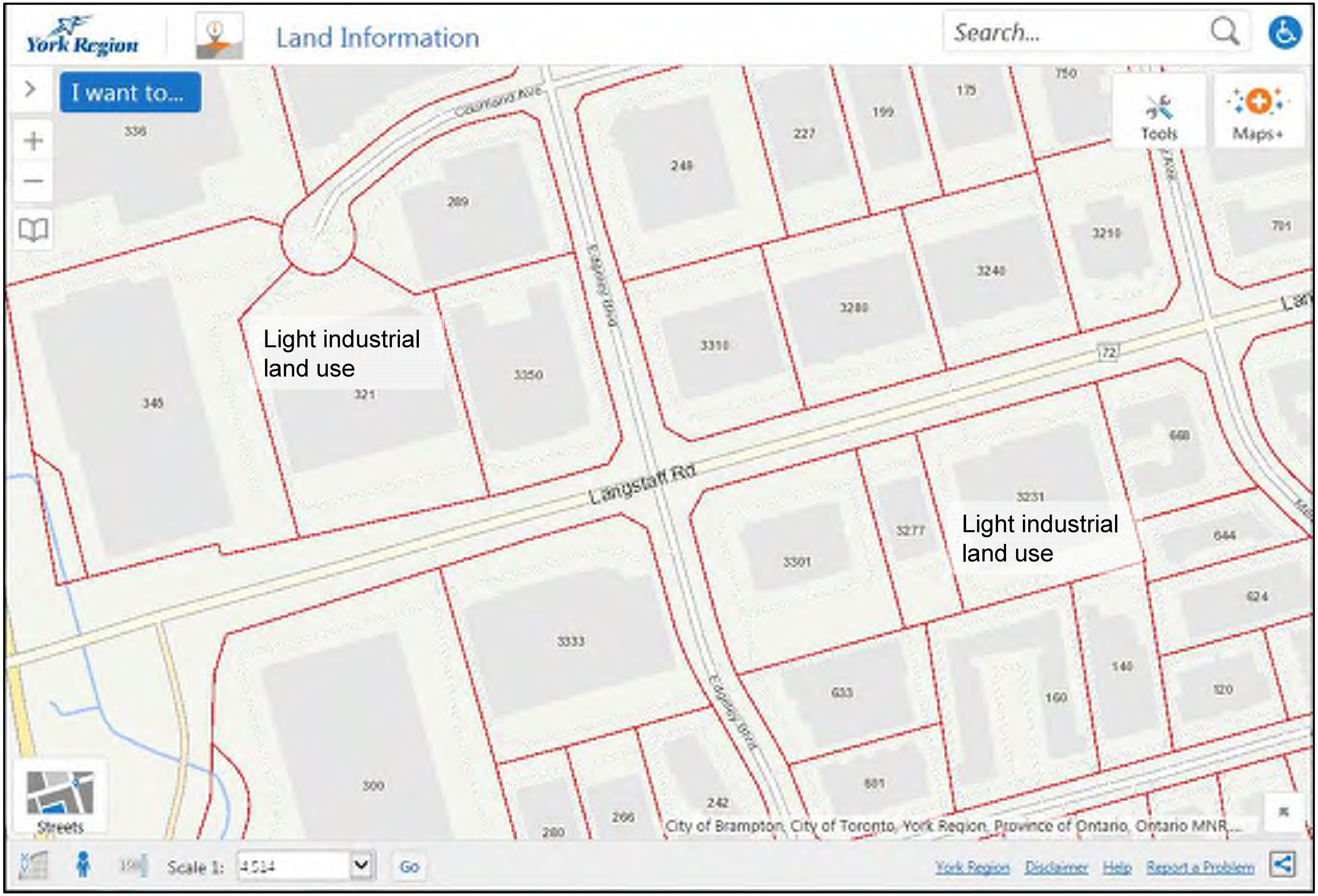
Site Photographs
Langstaff Road between Weston Road to Highway 7
Hydrogeological Assessment



Zoomed Map #3 (Aerial): Highway 400 and Bass Pro Mills Drive. Source: Google Earth.

Photograph 9: Stormwater management pond within interchange loop from Bass Pro Mills Drive to Highway 400 W-S Ramp. Source: Google Street View.

Photograph 10: View of Highway 400 looking south from Rutherford Road. Source: Google Street View, 2017.



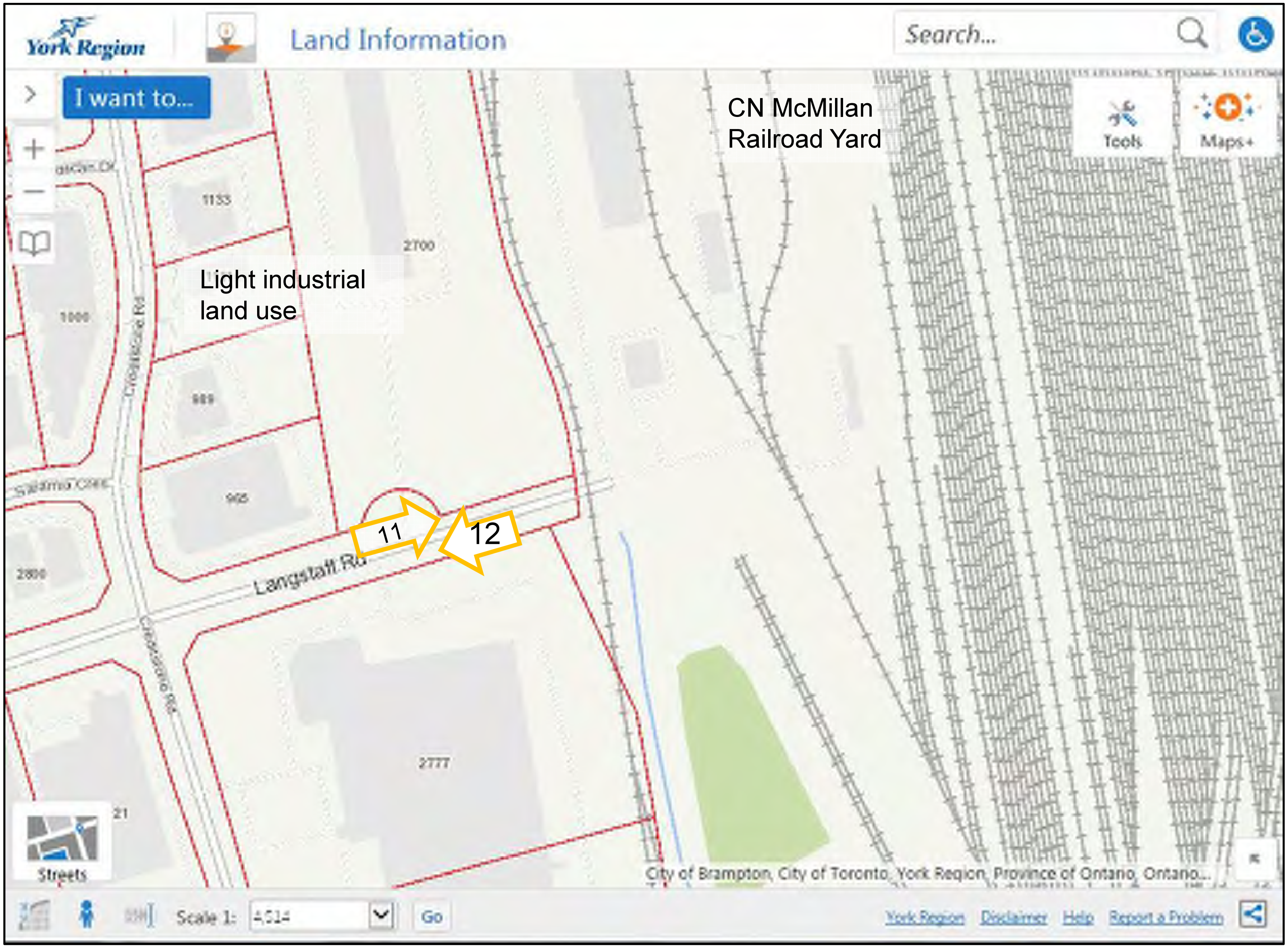
Map #4: Langstaff Road, East of Highway 400 to Millway Avenue. Source: York Maps – www.yorkmaps.ca.

Map #4 (Aerial): Langstaff Road, East of Highway 400 to Millway Avenue. Source: Google Earth.

Map #5: Langstaff Road and Jane Street Interchange. Source: York Maps – www.yorkmaps.ca.

Site Photographs
Langstaff Road between Weston Road to Highway 7
Hydrogeological Assessment

Map #5 (Aerial): Langstaff Road and Jane Street Interchange. Source: Google Earth.



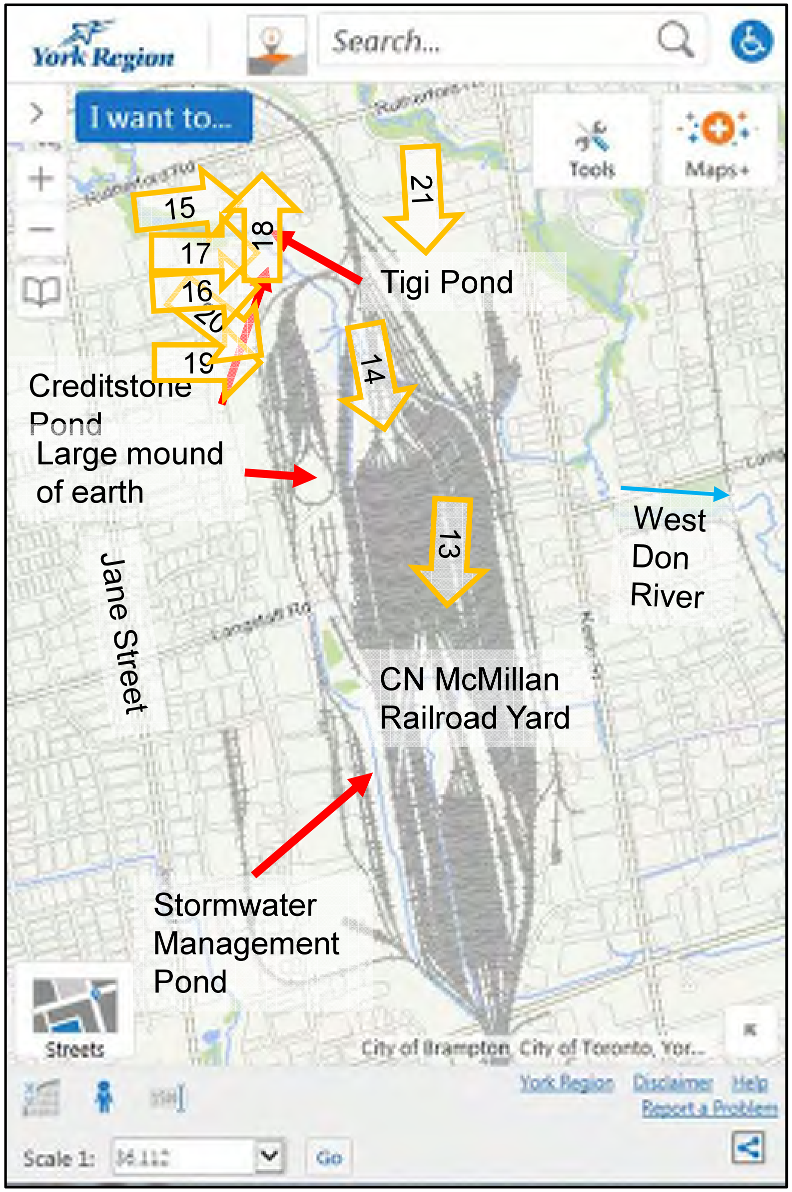
Map #6: Langstaff Road East of Creditstone Drive. Source: York Maps – www.yorkmaps.ca.

Map #6 (Aerial): Langstaff Road East of Creditstone Drive. Source: Google Earth.

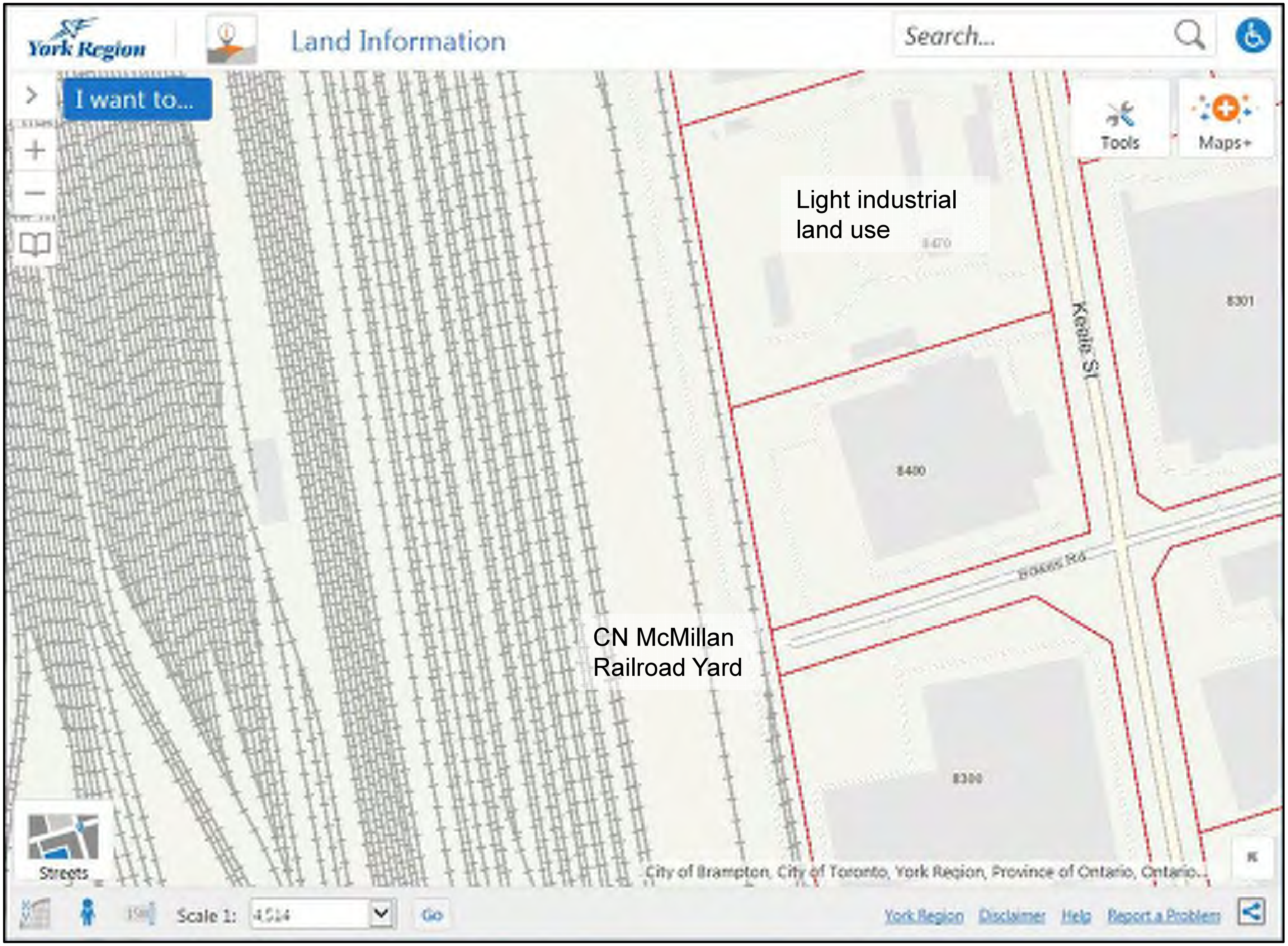
Photograph 11: End of Langstaff Road east of Creditstone Road, looking east (September 28, 2017).

Photograph 12: End of Langstaff Road east of Creditstone Road, looking west (September 28, 2017).

Site Photographs
Langstaff Road between Weston Road to Highway 7
Hydrogeological Assessment



Map #7: CN McMillan Train Yard. Source: York Maps – www.yorkmaps.ca and Google Earth.



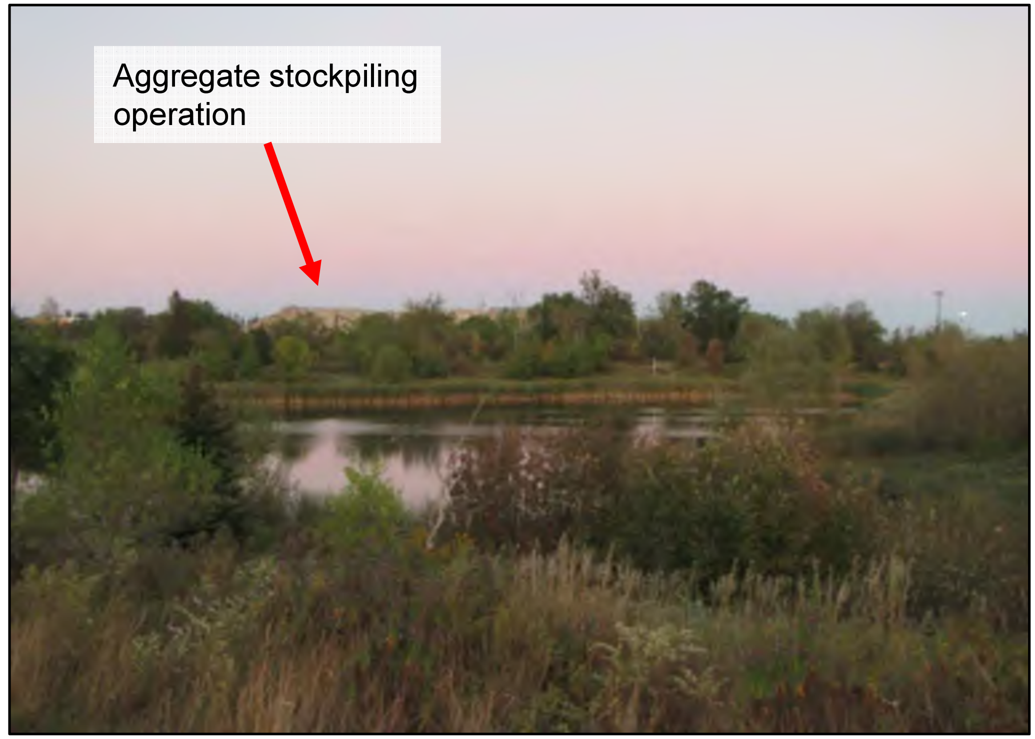
Map #8: CN McMillan Train Yard west of Keele Street and Bowes Road Interchange. Source: York Maps – www.yorkmaps.ca.

Map #8 (Aerial): CN McMillan Train Yard west of Keele Street and Bowes Road Interchange.
Source: Google Earth.

Photograph 13: Aerial view of the McMillan Train Yard, looking south. Source: https://www.youtube.com/watch?v=vakKyD5zR6s (August 2015).

Photograph 14: General view of the McMillan Train Yard. Source: https://www.youtube.com/watch?v=LdynjfM-7FI.

Photograph 15: Tigi Pond, east of Creditstone Road (September 28, 2017).

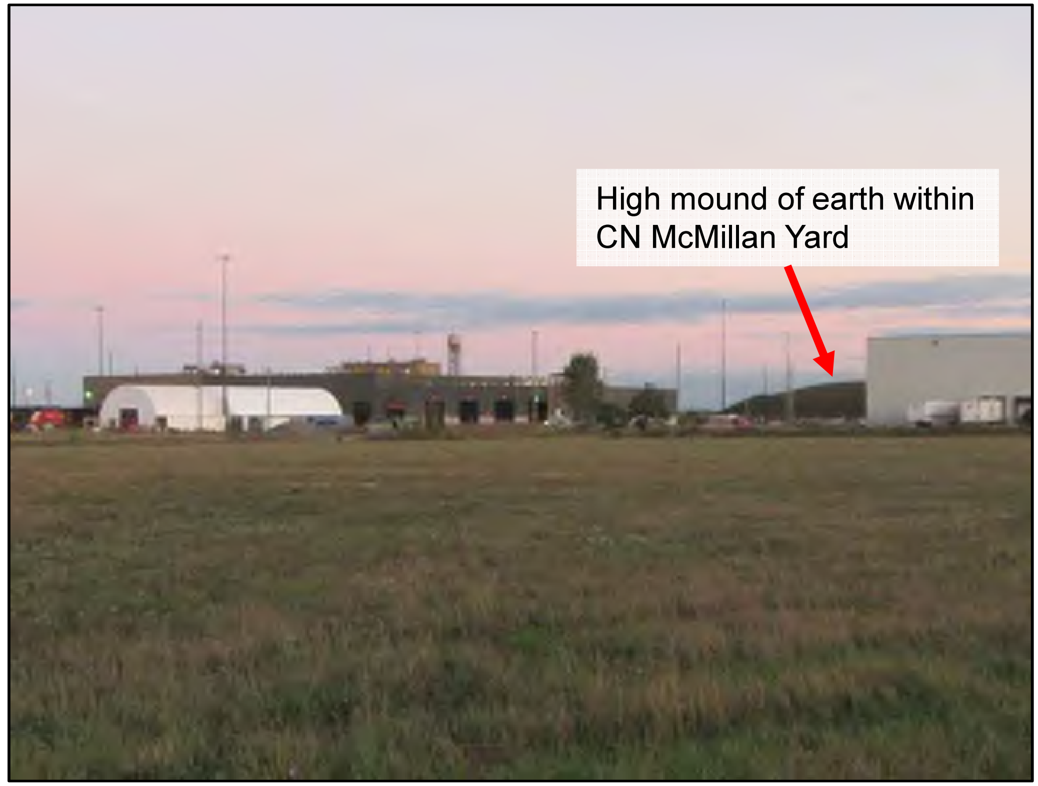


Photograph 16: Creditstone Pond, east of Langstaff Road (September 28, 2017).

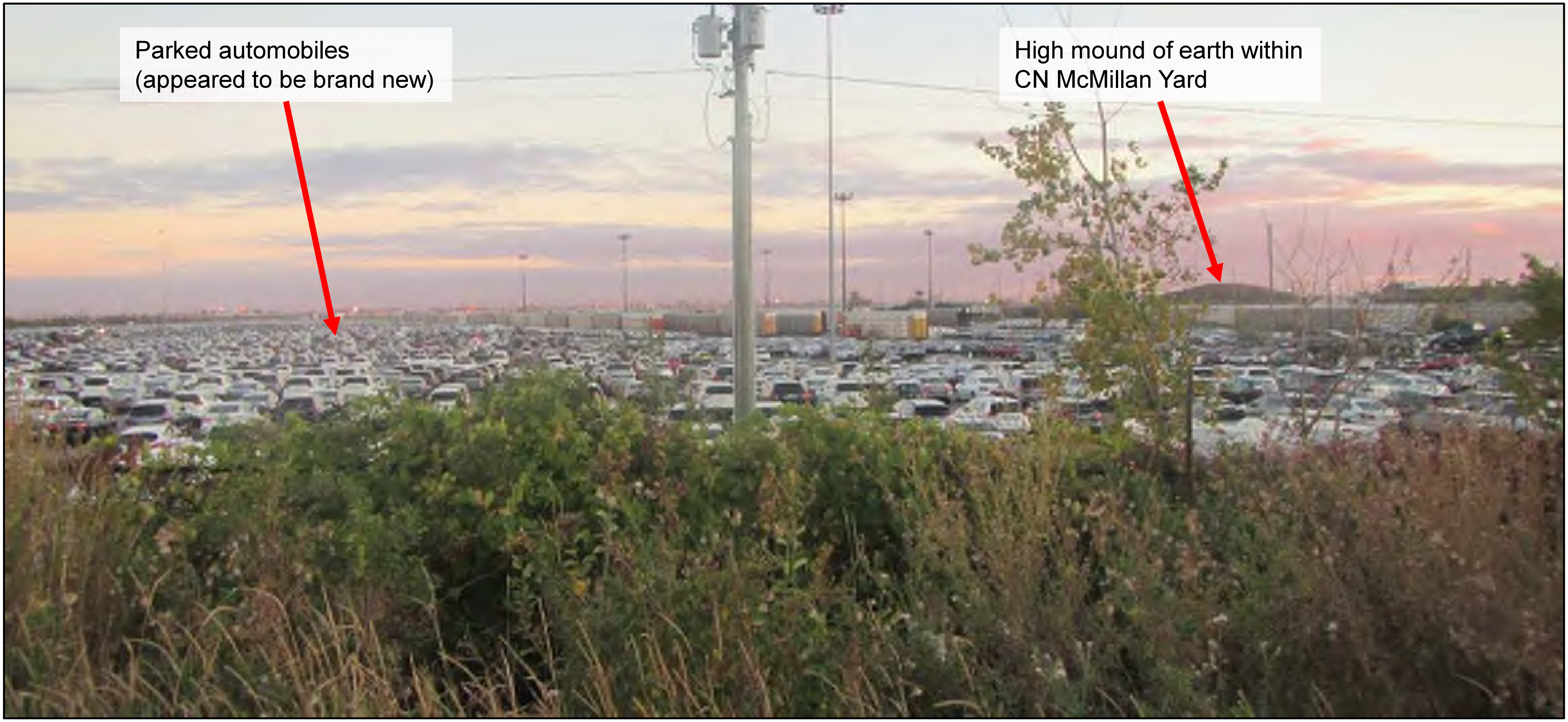
Photograph 17: West Don River looking east from Creditstone Road (September 28, 2017).

Photograph 18: Creditstone Bridge over the West Don River, looking north (September 28, 2017).

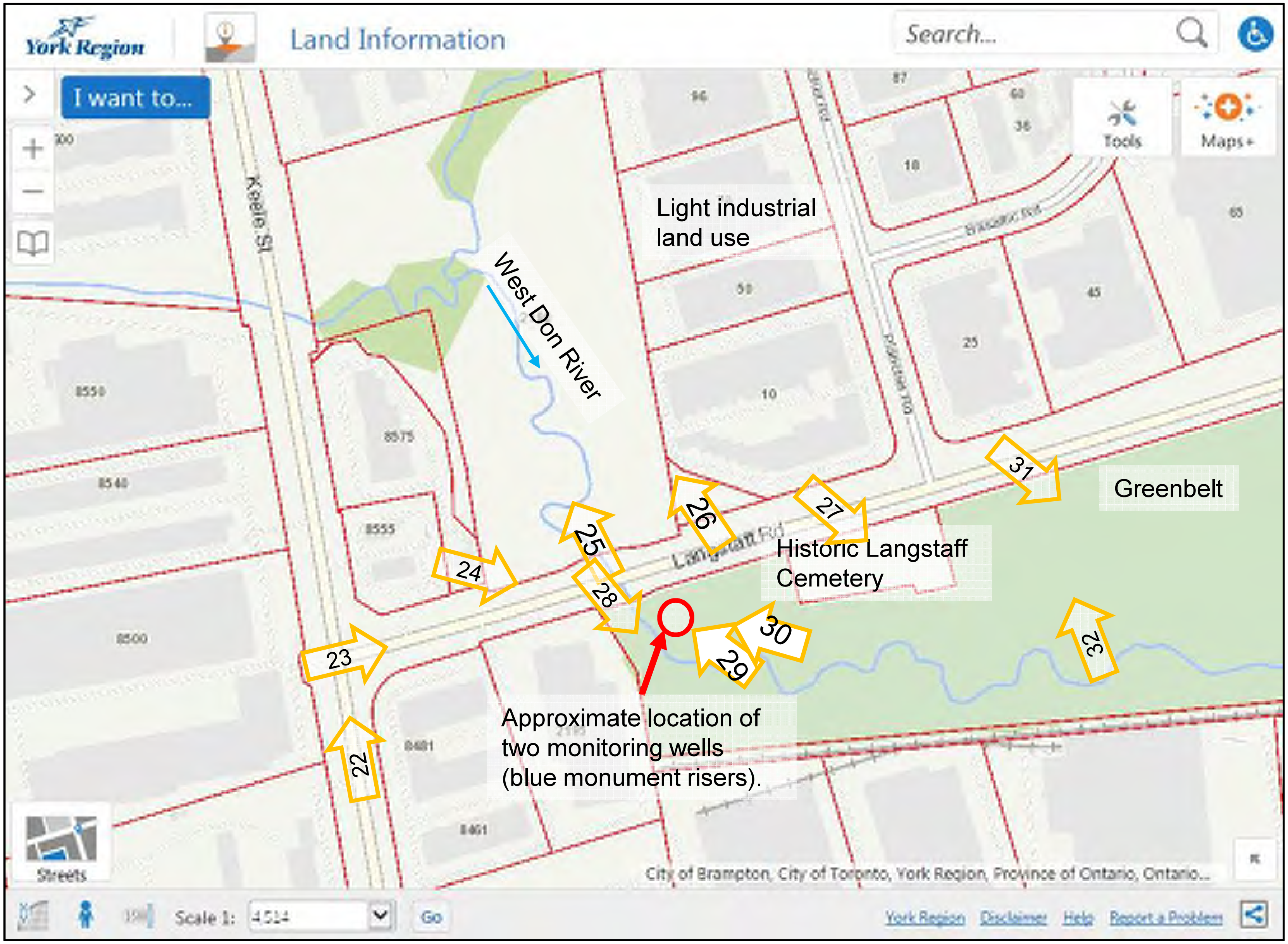
Photograph 19: Large aboveground fuel storage tank within CN McMillan Yard, seen from Creditstone Road (September 28, 2017).



Photograph 20: Train garage and high mound of earth within CN McMillan Yard, seen from Creditstone Road (September 28, 2017).

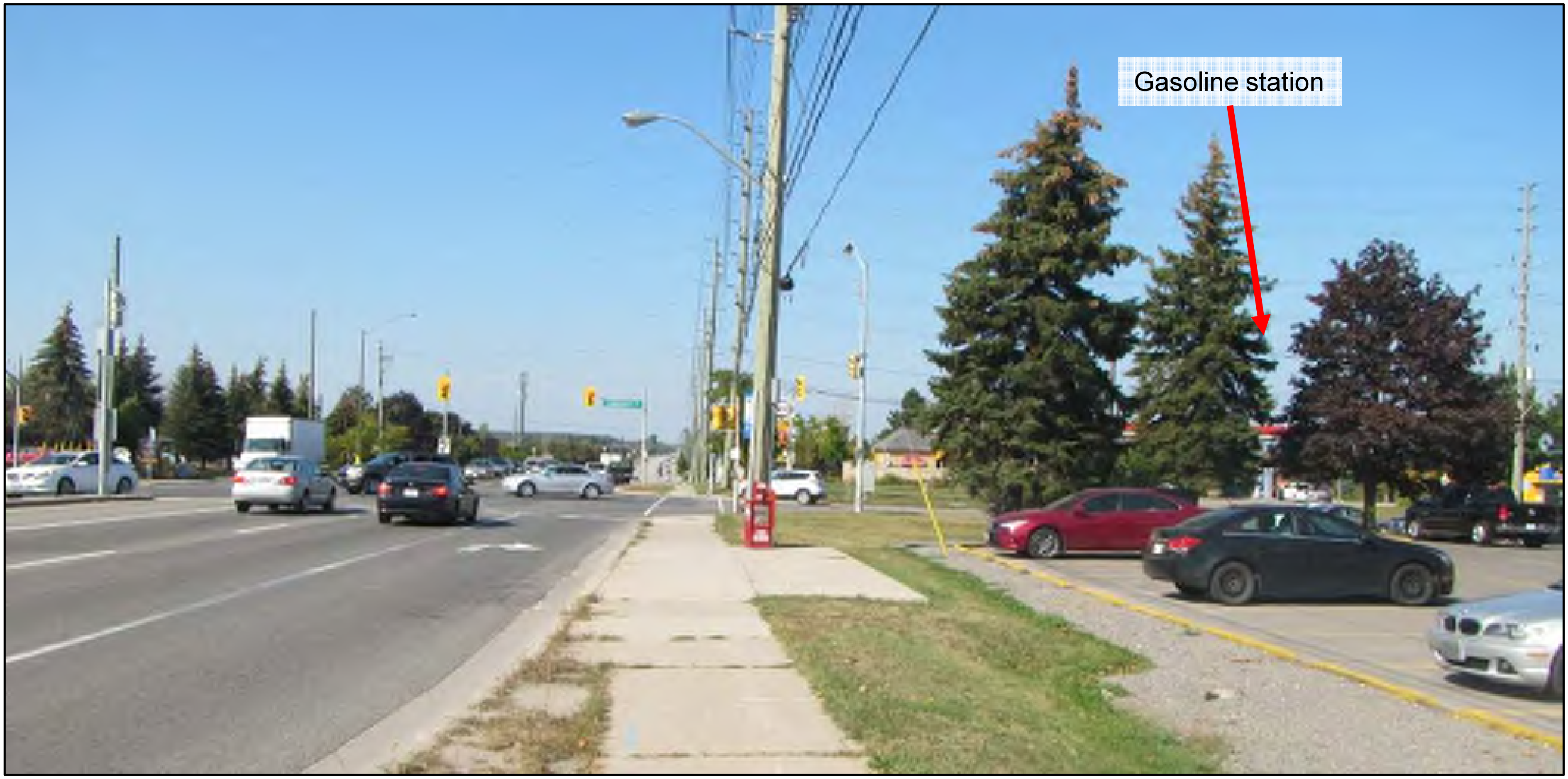


Photograph 21: View looking south from Rotational Drive, showing parking lot with brand new automobiles awaiting shipping by rail (September 28, 2017).



Map #9: Langstaff Road East of Keele Street. Source: York Maps – www.yorkmaps.ca.

Map #9 (Aerial): Langstaff Road East of Keele Street. Source: Google Earth.



Photograph 22: View looking north along Keele Street at Langstaff Road (September 21, 2017).

Photograph 23: View looking north along Keele Street at Langstaff Road (September 21, 2017).

Photograph 24: Existing Langstaff Avenue bridge over the West Don River, looking southeast (September 21, 2017).

Photograph 25: West Don River north of Langstaff road (September 21, 2017).

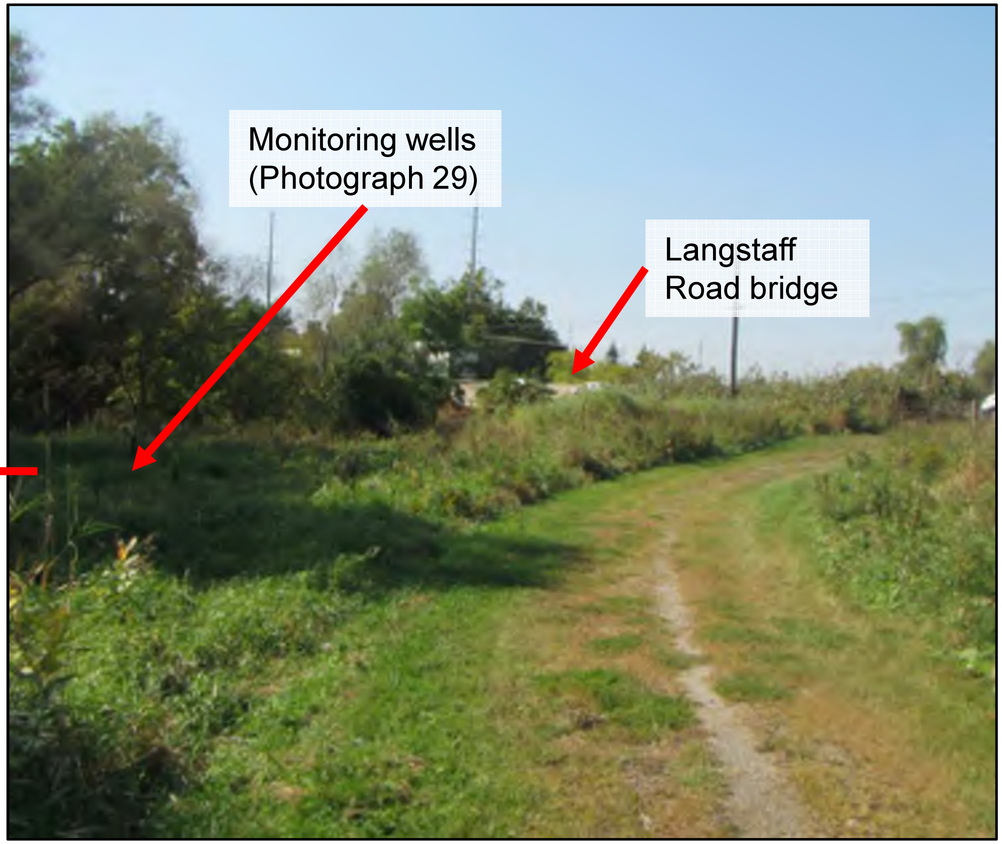
A staff gauge and ruler was observed in the river in this general area, on September 21, 2017.

Photograph 26: West Don River valley north of Langstaff Road (September 21, 2017).

Photograph 27: Historical Langstaff Cemetery on the south side of Langstaff Road (September 21, 2017).

Photograph 28: West Don River south of Langstaff Road (September 21, 2017).

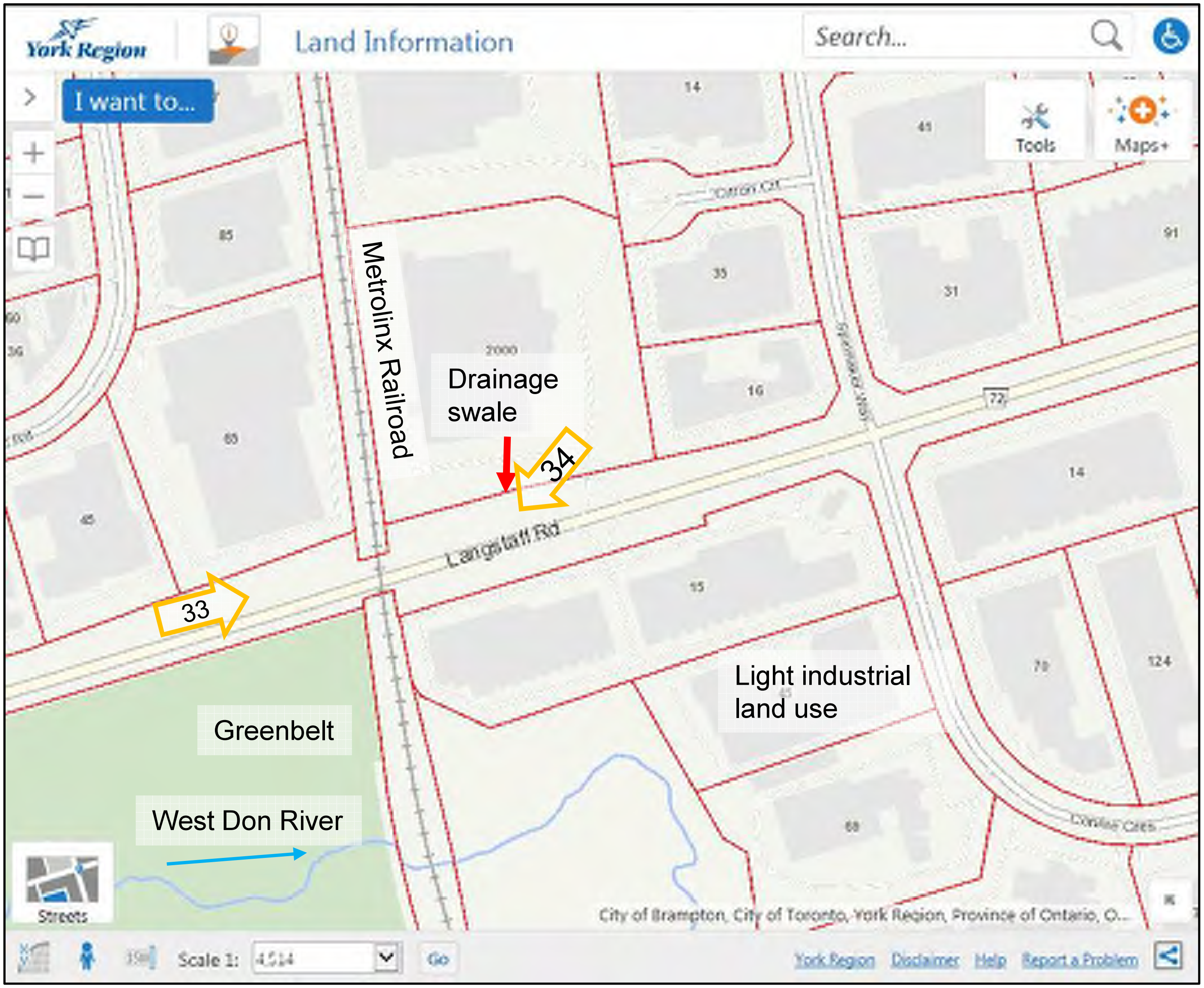
Photograph 29: Monitoring wells in Langstaff Park, on the east side of the West Don River, 50 meters south of Langstaff Road (September 21, 2017).



Photograph 30: West Don River greenbelt in Langstaff Park, south of Langstaff Road (September 21, 2017).

Photograph 31: Drainage swale in Langstaff Park, view from the north, looking south (September 21, 2017).

Photograph 32: Drainage swale in Langstaff Park, view from the south, looking north (September 21, 2017).



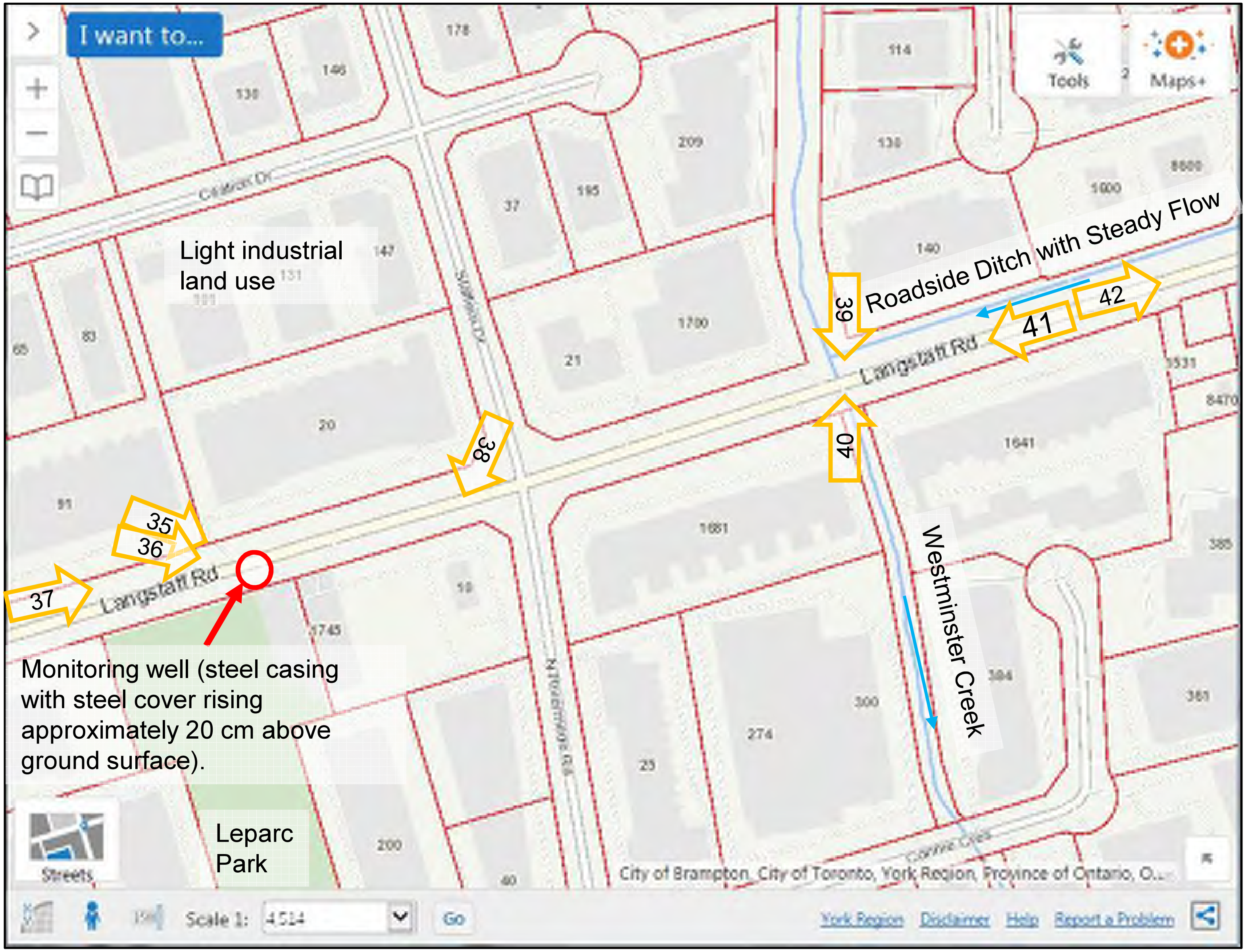
Map #10: Langstaff Road West of Metrolinx Railroad to East of Spinnaker Way. Source: York Maps – www.yorkmaps.ca.

Site Photographs
Langstaff Road between Weston Road to Highway 7
Hydrogeological Assessment

Map #10 (Aerial): Langstaff Road West of Metrolinx Railroad to East of Spinnaker Way. Source: Google Earth.

Photograph 33: Existing level railroad crossing of Langstaff Road and the Metrolinx Railroad, looking east (September 21, 2017).

Photograph 34: Existing level railroad crossing of Langstaff Road and the Metrolinx Railroad, looking southwest (September 21, 2017). Note the drainage swale in the foreground.



Map #11: Langstaff Road and Staffern Drive / N Rivermede Road Interchange. Source: York Maps – www.yorkmaps.ca.

Map #11 (Aerial): Langstaff Road and Staffern Drive / N Rivermede Road Interchange. Source: Google Earth.

Close-up view showing the monitoring well, it does not appear to be locked.

Photographs 35 and 36: Monitoring well on the north side of Langstaff Road, in a traffic island within a driveway entrance (property address 20 Staffern Drive (east building) and 91 Citation Drive (west building)), across the road from LeParc Park, Vaughan, ON (September 21, 2017).

Photograph 37: View looking west along Langstaff Road, east of Leparc Park, note ongoing ditch works (September 21, 2017).

Exposed soil observed to consist of silty sand.

Photograph 38: View looking east along Langstaff Road, beside Leparc Park (September 21, 2017).

Photograph 39: Westminster Creek culvert, north side of Langstaff Road (September 21, 2017).

Photograph 40: Westminster Creek culvert, south side of Langstaff Road (September 21, 2017).

Site Photographs
Langstaff Road between Weston Road to Highway 7
Hydrogeological Assessment

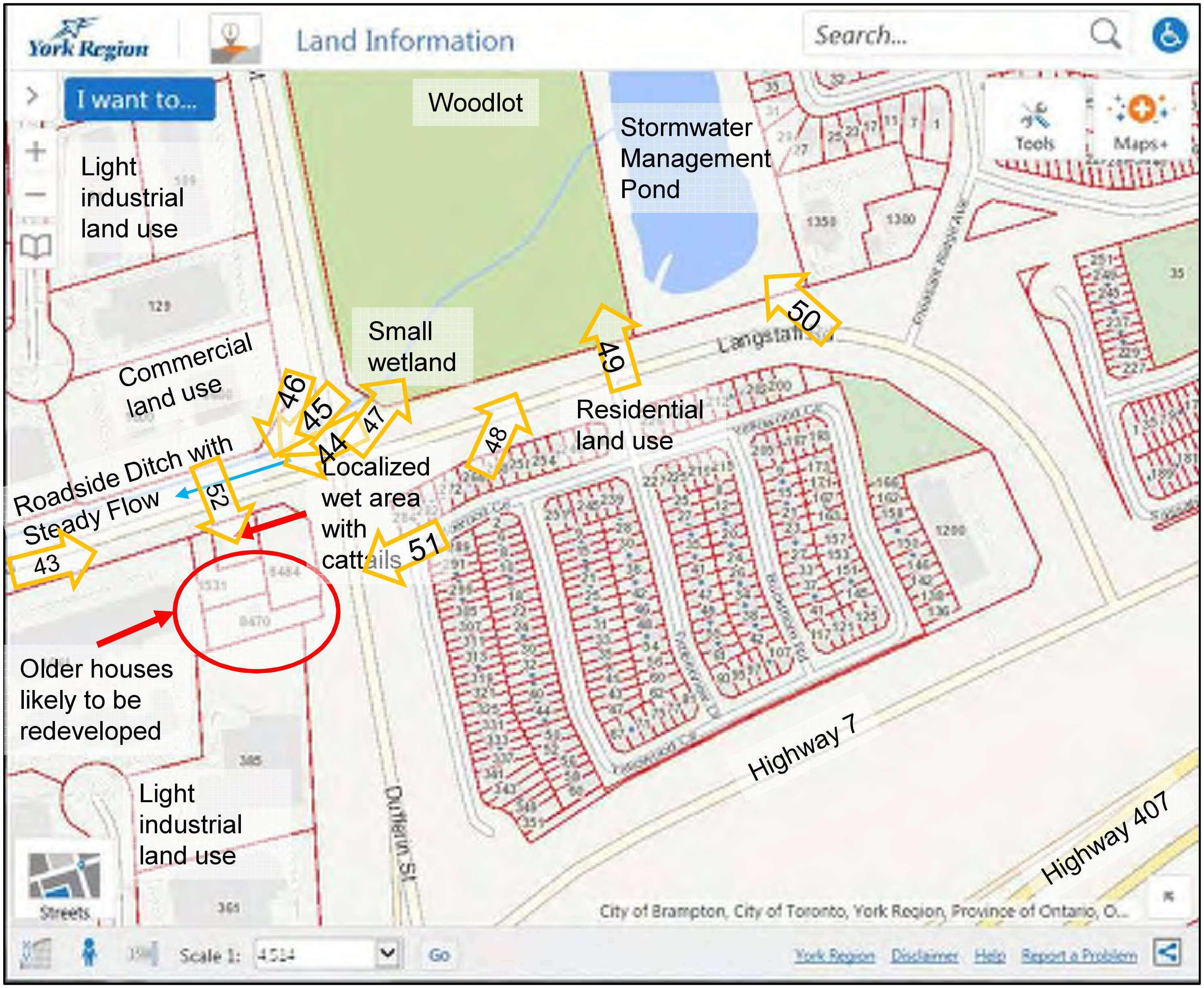
Photograph 41: Drainage in roadside ditch along the north side of Langstaff Road, 200 m west of Dufferin Street, looking east (September 21, 2017).

Storm sewer outfall to Westminster Creek.

Looks like creek bed was recently dredged.

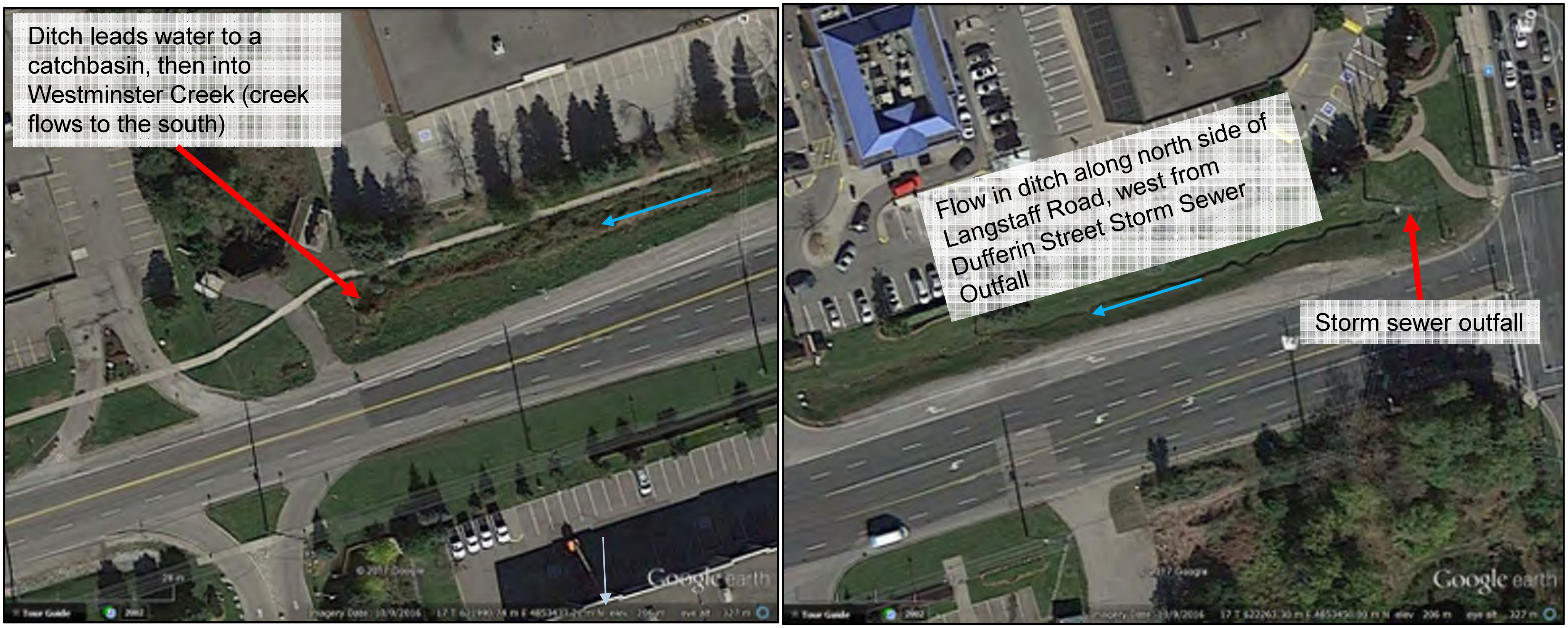
Photograph 42: Drainage in roadside ditch along the north side of Langstaff Road, 200 m west of Dufferin Street, looking west (September 21, 2017).

Site Photographs
Langstaff Road between Weston Road to Highway 7
Hydrogeological Assessment



Map #12: Langstaff Road and Dufferin Street Interchange. Source: York Maps – www.yorkmaps.ca.

Map #12 (Aerial): Langstaff Road and Dufferin Street Interchange. Source: Google Earth.



Zoomed Map #12 (Aerial): Langstaff Road West of Dufferin Street. Steady flow of water in ditch, 3-5 L/s observed on Sept. 21, 2017, during warm, dry weather. Source: Google Earth.

Site Photographs
Langstaff Road between Weston Road to Highway 7
Hydrogeological Assessment

Map #12 (Historical Aerial Photograph 1965): Langstaff Road and Dufferin Street Interchange. Flow in ditch along north side of Langstaff Road, west from Dufferin. Source: City of Toronto (2018).

Site Photographs
Langstaff Road between Weston Road to Highway 7
Hydrogeological Assessment

Water had a pH of 8.10, Electrical conductivity of 908, and a temperature of 24.5 Celsius (air temperature 28-29 Celsius), water was clear, flow estimated at 3-5 L/min. There had been warm, dry weather for 4 days before this site visit (no precipitation).

Photographs 43 and 44: Storm sewer outfall at the northwest corner of Dufferin Street and Langstaff Road (September 21, 2017).

Photograph 45: Roadside ditch on the north side of Langstaff Road west of Dufferin Street, Google Street View from July 2016 shows flow.

Photograph 46: Roadside ditch on the north side of Langstaff Road west of Dufferin Street, Google Street View from June 2015 shows flow.

Photograph 47: Small wetland at the northwest corner of Dufferin Street and Langstaff Road (September 21, 2017).

Photograph 48: Woods along the north side of Langstaff Road at Dufferin Street (September 21, 2017).

Photograph 49: Trail along the east side of the woodlot at Dufferin Street and Langstaff Road (September 21, 2017).

Photograph 50: Storm water management pond north of Dufferin Street and east of the woodlot (September 21, 2017).

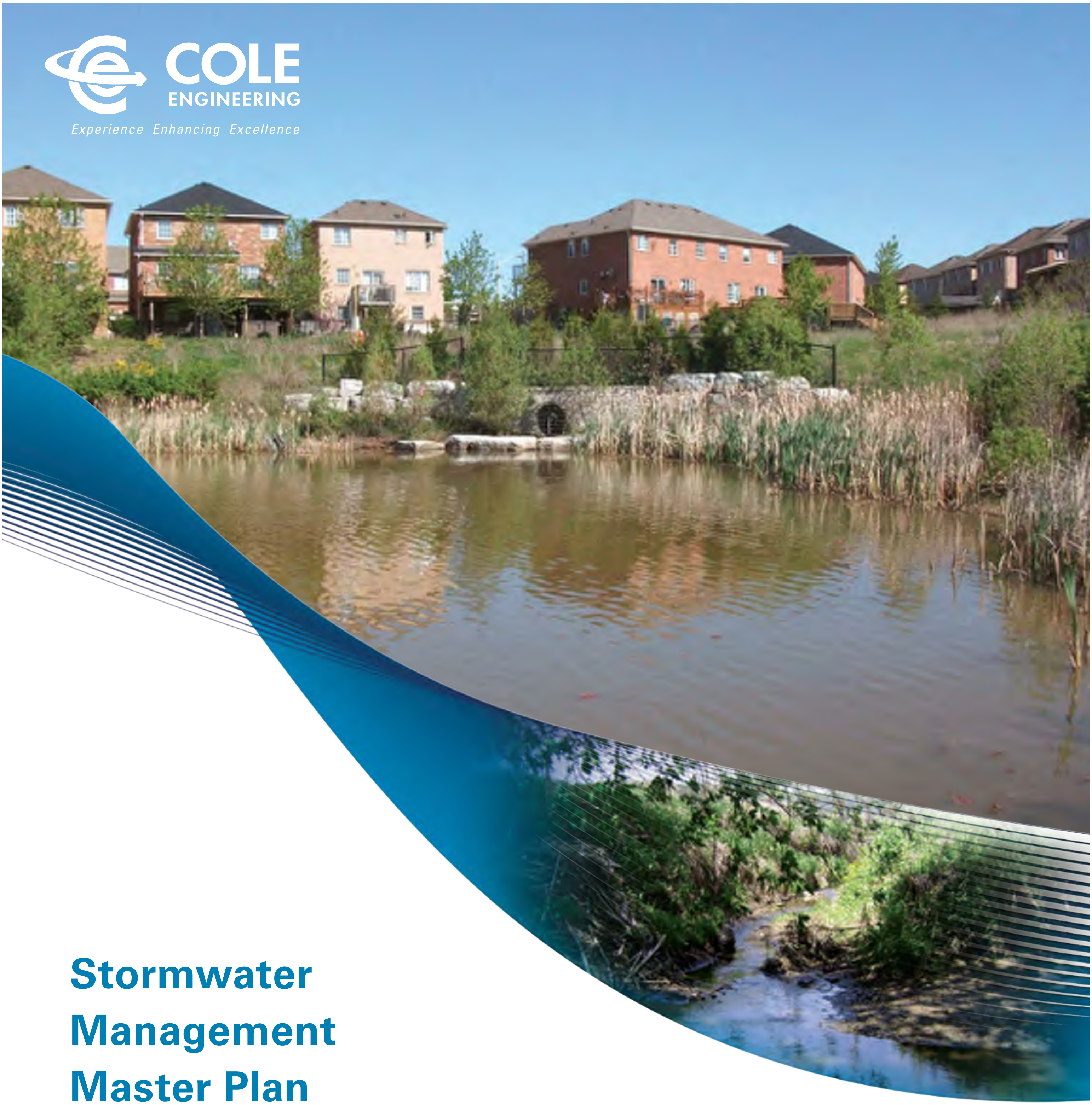
Photograph 51: Old and boarded up house surrounded by overgrown property along Dufferin Street south of Langstaff Road (September 21, 2017).

Photograph 52: House / small business along Langstaff Road west of Dufferin Street, along with localized area of wetland vegetation (September 21, 2017).

APPENDIX

B

EXCERPTS FROM THE CITY OF VAUGHAN STORM WATER MASTER PLAN



Stormwater Management Master Plan

THE CITY OF VAUGHAN

JUNE 2014

COLE ENGINEERING GROUP LTD.

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Appendix D – Technical Advisory Committee and Management
Appendix E – Climate Change Calculations

1.0 Introduction

1.1. Study Purpose

In 2007, City of Vaughan (City) Council approved the Terms of Reference for the new City-Wide Official (Plan (OP), a component of the City's Consolidated Growth Management Strategy to a planning horizon of 2031. The new OP updates the City's community planning policies in a manner consistent with the principles of sustainability. Now that the framework for continued urban growth to 2031 is unfolding through the new OP, it is appropriate for the City to undertake the preparation of City-wide SWMMP study. The stormwater management (SWM) / Drainage Master Plan will evaluate the effectiveness of the existing SWM infrastructure within the City. Additional attention was be given to the Rainbow Creek Subwatershed to identify where and how infrastructure needs may change to address new development areas outside of the current urban boundary and development intensification within the built boundary. The study will evaluate the use of alternative SWM practices for effective treatment of stormwater from source, conveyance, and end-of-pipe controls, to promote protection of the natural environmental systems. The study is being conducted in accordance with the Mater Plan process as outlined in the Municipal Engineers Association Municipal Class Environmental Assessment (MPCEA) document (October 2000, as amended in 2007 and 2011) and is further described in **Section 2.0**.

1.2. Location

The City Vaughan is located within the Region of York and is bounded by the Township of King to the north, the Town of Richmond Hill and the City of Markham to the east, the City of Toronto to the south, and the Town of Caledon and City of Brampton to the west. The City consists of mixed land uses consisting of residential, commercial, industrial, institutional, and rural areas. A portion of the Greenbelt and the Oakridges Moraine also fall within the municipal boundaries of the City. **Figure 1-1** illustrates the City's existing urban boundary.

This study focuses on several growth areas within the municipal boundary including New Secondary Plan Areas, intensification corridors, and future Secondary Plan Areas and includes an update to the Rainbow Creek Subwatershed Plan. **Figure 1-2** illustrates the planned growth and intensification areas within the City including approved, new, and future Secondary Plan Areas and Intensification corridors on which this study will focus. **Figure 1-2** also illustrates the Rainbow Creek Subwatershed Area in relation to the urban boundary and proposed growth and intensification areas.

The City falls within the Don River and Humber River Watersheds which are regulated by the Toronto Region Conservation Authority (TRCA). There are nine (9) subwatersheds in the City's municipal boundary which include: 1) West Humber, 2) Main Humber, 3) East Humber, 4) Lower Humber, 5) Black Creek, 6) Upper Don East, 7) Upper Don West, 8) Lower Don East; and, 9) German Mills. The Rainbow Creek Subwatershed is part of the Main Humber Subwatershed. The subwatershed boundaries are illustrated in **Figure 1-3**.

Existing Urban Boundary

Note: Limits of the Natural Heritage System are conceptual and have not been established at the site level.

Legend

- Municipal Boundary
- Urban Boundary
- Watercourse
- Natural Areas

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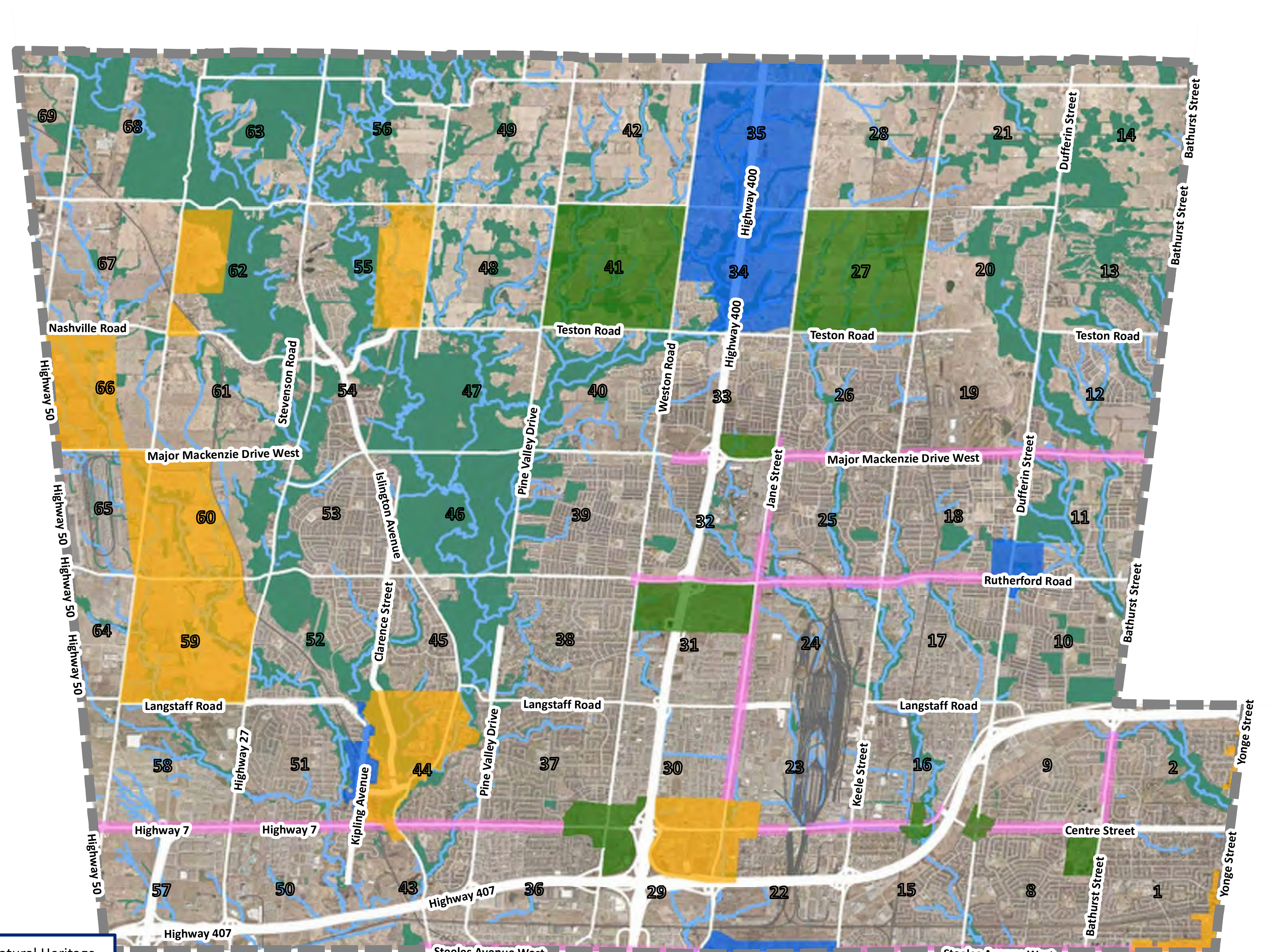
Stormwater Management Master Plan
November 2013

City of Vaughan
Urban Boundary

SCALE 1:75,000
0 270 540 1,080 1,620 2,160 Meters

FIGURE
1-1

New and Future Secondary Plan Areas



Note: Limits of the Natural Heritage System are conceptual and have not been established at the site level.

Legend

- Municipal Boundary
- Watercourse
- Natural Areas
- Approved Secondary Plan Areas
- Secondary Plan Areas to be Approved
- Future Secondary Plan Areas
- Intensification Corridors

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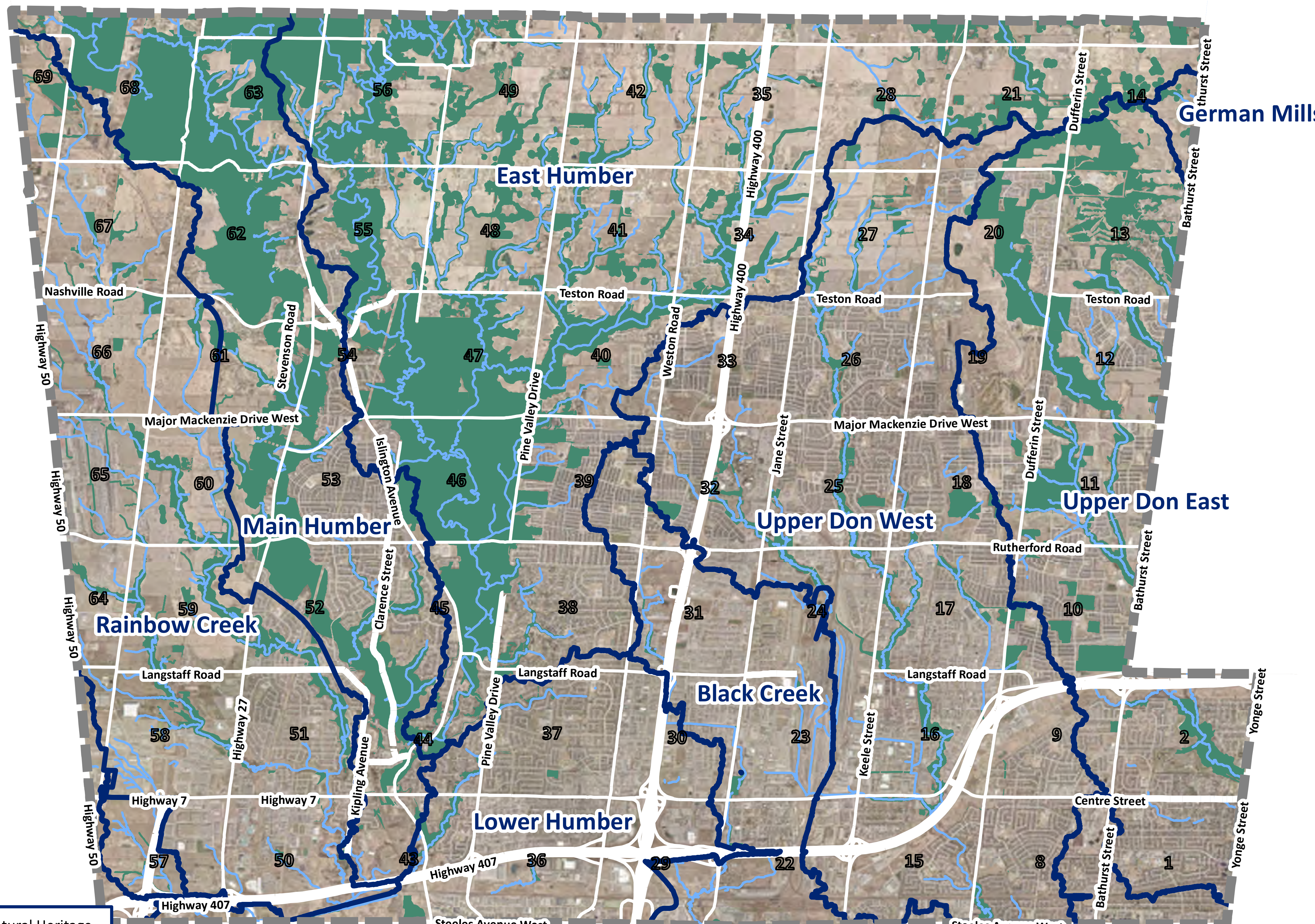
Storm Water Management Master Plan
November 2013

Planned Growth and Intensification Areas

SCALE 1:75,000
0 225 450 900 1,350 1,800 Meters

FIGURE
1-2

Watershed Boundaries



Note: Limits of the Natural Heritage System are conceptual and have not been established at the site level.

Legend

- Municipal Boundary
- Watercourse
- Natural Areas

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Storm Water Management Master Plan

November 2013

Watershed Boundaries

SCALE 1:75,000

FIGURE 1-3

1.3. Study Overview

In September of 2010, the City adopted the new City-Wide OP, a component of the City's Consolidated Growth Management Strategy – 2031. The OP represents an update to the City's community planning policies in a manner consistent with the principles of sustainability. The City is now proceeding with the preparation of a City-Wide Storm Drainage / SWM Master Plan Class Environmental Assessment Study (SWM MPCEA) to complement the new OP and direct the required SWM infrastructure improvements to support the build-out of the new OP.

As part of the overall SWM MPCEA, the City is also undertaking an update study to the Rainbow Creek Subwatershed Master Plan. The TRCA has been working with the City to rehabilitate and enhance the environmental conditions in deteriorated streams in urbanized areas including the Rainbow Creek Subwatershed. The City is committed to developing and implementing a regeneration plan for the Rainbow Creek Watershed.

The MPCEA Study will include a detailed and comprehensive evaluation of the drainage and SWM infrastructure needed to efficiently accommodate the population and employment growth projections resulting from the implementation of the City's Growth Management Strategy. A key component of the study will be the coordination and integration with current sustainable initiatives / policies as identified by the Region of York, the TRCA and the City's recently approved Community Environmental Sustainability Master Plan – Green Directions Vaughan.

The Storm Drainage / SWM Master Plan will strive to achieve the goals of Green Directions through ongoing consultation with the Region of York, TRCA, the Development Community, and the General Public as well as take into consideration emerging technologies to achieve waste reduction and sustainability goals.

1.4. Background and Existing Studies

A number of studies have been developed within the study area by the City, TRCA and other consultants.

These studies include:

- City OP 2010 – Urban Strategies Inc., September 2010;
- North Kleinburg-Nashvillle Secondary Plan – The Planning Partnership in association with Plan B Natural Heritage, Bray Heritage, September 2010;
- The VMC Plan – Secondary Plan for the Vaughan metropolitan centre – Urban Strategies Inc. with assistance from AECOM, September 2010;
- The West Vaughan Employment Area (WVEA) Plan – Secondary Plan for the WVEA– Urban Strategies Ind., September 2010;
- Woodbridge Centre Secondary Plan – Office for Urbanism, September 2010;
- Yonge Street Study, Background Report – Younge + Wright / IBI Group Architects, GHK International (Canada) Ltd., Dillon Consulting Ltd., February 2010;
- Yonge Steeles Corridor Secondary Plan – Younge + Wright / IBI Group Architects, GHK International (Canada) Ltd., Dillon Consulting Ltd., September 2010;

- Black Creek Stormwater Optimization Study, Municipal Class Environmental Assessment Master Plan Report (Phases 1 & 2) – AECOM, May 2011;
- Municipal Servicing Master Plan Class Environmental Assessment Study, Steeles Corridor: Jane to Keele Official Plan Amendment (OPA) 620, City– Sernas, October 2011;
- Municipal Servicing Strategy Master Plan Class Environmental Assessment Study, Vaughan Metropolitan Centre, City – The Municipal Infrastructure Group, April (Draft) 2012;
- SWM and Floodplain Analysis Report – Cole Engineering, April 2010;
- City-Wide Drainage and SWM Criteria Study – Clarifica, August 2009;
- City SWM Retrofit Study – Aquafor Beech Limited, November 2009;
- Rainbow Creek, Master Drainage Plan, Town of Vaughan – Cosburn, Patterson, Wardman Limited Consulting Engineers, December 1989;
- Rainbow Creek Erosion Assessment, City – Stantec, April 2002 (Revised September 2002);
- Digital Floodline Mapping for the Rainbow Creek Subwatershed Summary Report – Hatch Acres, June 2006;
- Development Charges Background Study, City – Hemson Consulting Ltd., Revised September 2008;
- Humber River Watershed Hydrology / Hydraulics and SWM Study – Aquafor Beech Limited, April 1997;
- Humber River Watershed Hydrology Update – Aquafor Beech Limited, November 2002;
- Hydrologic Study of Impacts on Flood Flows and Mitigation of Future Development in the Humber River – AMEC Environment & Infrastructure, June (Draft) 2012; and,
- Don River Hydrology Update, TRCA – Marshall, Macklin, Monaghan, December 2004.

Key aspects of existing studies relevant to Master Plan are the within the City are summarized below.

1.4.1. Black Creek Stormwater Optimization Study, Municipal Class Environmental Master Plan Report (Phases 1 and 2)

There were several important SWM issues within the Black Creek Subwatershed identified by the City and the TRCA. These issues were identified through field investigations conducted after major storm events, including the August 19, 2005 storm event as well through hydrologic and hydraulic modelling.

These considerations include:

- There are several structures located within the regulatory floodplain;
- There is insufficient capacity within the certain portions of the Black Creek channel which results in flooding during frequent storm events;
- There is a lack of stormwater quality control within a majority of the older industrial areas;
- Channel erosion is occurring in the certain portions of the Creek; and,
- Increasing the capacity of the existing channel may be constrained by existing structures and municipal infrastructure adjacent to Black Creek.

The recommended solutions that were developed include:

- Flood Control – Construction of a new naturalized channel to replace the existing segment of Black Creek between the Edgeley Pond and the 407 ETR which include new bridges and crossings;
- Water Quality – Retrofits to many existing SWM ponds and the construction of at least one (1) new pond; and,
- Erosion Control – In-stream restoration measures as well as erosion control provided through pond retrofits and construction of new pond.

1.4.2. Municipal Servicing Master Plan Class Environmental Assessment Study, Steeles Corridor: Jane to Keele Official Plan Amendment (OPA 620)

The Steeles Corridor bounded by Steeles Avenue to the south, the CN Rail York Subdivision to the north, Jane Street to the west and Keele Street to the east. It is expected to house 10,000 – 11,000 residents and provide employment for approximately 4,000 – 5,000 employees. As such, the City had initiated the Steeles Corridor Secondary Plan OPA 620 which was a comprehensive review and analysis of water, wastewater and stormwater servicing requirements.

The majority of the existing stomwater drainage is captured by a trunk storm sewer along the north side of Steeles Avenue. The recommended SWM strategy for this area includes three (3) SWM ponds. One (1) quantity control facility (dry), one (1) quantity / quality facility (wet), and one (1) retrofit to an existing quantity / quality facility. This strategy provides the maximum flexibility by making use of existing infrastructure and provides for future upgrades in stages.

1.4.3. Municipal Servicing Strategy Master Plan Class Environmental Assessment Study, Vaughan Metropolitan Centre

The City's Metropolitan Secondary Plan was adopted by City Council September 7, 2010. The objectives of the City's Metropolitan Centre Secondary Plan are:

- To establish a distinct downtown containing a mix of uses, civic attractions and a critical mass of people as well as establish complete neighbourhoods containing a variety of housing types;
- Attract and accommodate a variety of employment uses;
- Attract a major institution of higher learning;
- Optimize existing and planned investments in rapid transit;
- Establish a hierarchical fine-grain grid network of streets and pathways;
- Develop a robust and remarkable open space system;
- Improve natural systems and functions;
- Ensure development incorporates green infrastructure and green building technologies, and;
- Ensure all development exhibits a high quality of urbanity, materials and design.

Currently, drainage from individual lots is accounted for through on-site controls in an effort to restrict the 100-year return period event to the 2-year post-development flow rate and rooftop controls have been previously implemented to control release rates to 42 l/s/ha. In addition to on-site controls, there are three (3) existing SWM ponds and a fourth pond which is under private ownership.

The recommended SWM strategy considered as part of the redevelopment of the Vaughan Metropolitan Centre is as follows:

- 100-year peak flow controlled to 2-year target flow at 80% imperviousness;
- Retention of 15 mm rainfall over the building footprint and landscaped areas;
- Traditional dual drainage system for Right of Way;
- Enlargement of Existing SWM facilities / construction of new SWM facility; and,
- Public Realm Low Impact Development (LID) Strategies.

1.4.4. City of Vaughan Stormwater Management Retrofit Study – Aquafor Beech Limited, November 2009

Many areas in the City were developed prior to SWM planning. As such, a strategy was developed to implement SWM quantity / quality and erosion control within existing urban areas in the City. The objective of the study was to prioritize retrofit opportunities to existing SWM ponds and outfalls based on ecological significance of receiving watercourse / stream, erosion control advantages, water quality control advantages and flood control considerations. After completing the assessment, a prioritization list was created with provides an overall priority ranking for each of the potential sites. This study focussed on the existing conditions within the City and did not account for future growth and development.

1.4.5. Hydrologic Study of Impacts on Flood Flows and Mitigation of Future Development in the Humber River – AMEC Environment & Infrastructure, June (Draft) 2012

This report is currently being completed for the TRCA and will provide guidance for flood flow mitigation throughout the Humber River Watershed. Given the scope of the analysis, the model for the overall Humber River is less detailed than that of Rainbow Creek; however, it is important for planning and regulation purposes that both models give similar results. To this end we have been working with AMEC, through the TRCA, to keep our methodology consistent with that used in the Humber River analysis. The models and methodology from the Humber River analysis were used as the base for the Rainbow Creek Hydrology model.

1.5. Problem and Opportunity Statement

1.5.1. Problem

The City is proceeding with the preparation of a City-Wide Storm Drainage / SWM MPCEA to complement the new OP which was adopted by Council in September 2010 and direct the required SWM infrastructure improvements to support the build-out of the new OP.

As part of the overall SWM MPCEA, the City is also undertaking an update study to the Rainbow Creek Master Plan. The TRCA has been working with the City to rehabilitate and enhance the environmental conditions of deteriorated streams in urbanized areas, including Rainbow Creek Watershed. The City is committed to developing and implementing a regeneration plan for the Rainbow Creek Watershed.

1.5.2. Opportunity

This project presents the opportunity to prepare a SWM planning and guidance document to support and direct development in compliance with the City's OP and policies of the TRCA to improve and determine the Best Management Practices (BMPs) for SWM as well as to support future intensification as mandated by the Province of Ontario.

The update to Rainbow Creek Master Plan Study presents the opportunity for regeneration that will not only improve the environmental conditions within the creek and valley system, but will provide reasonable protection against accelerated erosion rates and flooding while protecting municipal infrastructure and property.

1.6. Objectives of the Project

The project has been conducted in accordance with the Master Plan process as outlined in the Municipal Engineers Association Municipal Class Environmental Assessment document (October 2000, as amended in 2007 and 2011).

The objectives of the Storm Drainage / Stormwater Master Plan are described below:

- Identify storm drainage and SWM system requirements to support the Vaughan Consolidated Growth Management Strategy;
- Identify appropriate methods of accommodating post-development storm water runoff, water quality, erosion control and water balance for future development lands identified within the new OP and to meet the City’s overall growth projections;
- Identify SWM control strategies;
- Identify areas where more detailed subwatershed studies may be required;
- Establish computer models as required to support the selection of preferred servicing solutions;
- Establish a preferred and complete set of solutions capable of addressing the City’s storm drainage and SWM infrastructure needs to the year 2031 and in accordance with the phasing requirements noted above to 2051;
- Identify alternative infrastructure planning strategies by taking into account the treatment approach to stormwater and select the preferred alternative to meet the City’s growth needs;
- Review the City’s existing design criteria / standards and policies and recommended improvements and/or updates that will provide the basis for future infrastructure planning and design;
- Establish infrastructure phasing requirements / triggers and policies to facilitate each of the required Master Plan horizon years; and
- Undertake a comprehensive consultation program with all necessary stakeholders including public groups / agencies, York Region, TRCA and the development industry.

The objectives of the Rainbow Creek Master Drainage Plan update are described below:

- Recommend storm drainage plan and SWM criteria for Rainbow Creek and identify improvements required in the existing storm water collection system;

- Conduct necessary field work to identify alternative SWM measures that would cost-effectively improve the stormwater runoff quantity, quality, erosion potential and reduce future maintenance requirements and flooding;
- Select the preferred SWM and flood control alternative(s) to be considered for future phased implementation;
- Develop draft policies and SWM criteria to be applied to existing, new development and re-development in the Rainbow Creek Subwatershed to help achieve identified SWM targets;
- Establish / identify major and minor system drainage patterns in areas of future development and identify the number of ponds required and potential pond locations;
- Verify the need to propose flood remediation works for sites on Rainbow Creek as identified in 1989 MDP under existing, interim (2011) and full build out conditions of Rainbow Creek Watershed;
- Identify and evaluate other flood vulnerable sites within the City and make recommendations for flood remediation work;
- Evaluate the impact of upstream development on the existing erosion problems and identify stream restoration where required; and,
- Establish erosion levy to address existing and future erosion problems.

1.6.1.1 Objectives of the TRCA Stormwater Management Criteria

The SWM MPCEA study will be closely coordinated with the new TRCA SWM Criteria Document. The development of environmental design criteria is based on the interactions and cumulative effects which are often present with urban development. With respect to SWM, environmental design criteria are provided to:

- Prevent any increases in flood risk potential, which may include the need for Regional Storm controls;
- Maintain runoff volume, frequency, and duration from frequent storm events;
- Protect water quality;
- Preserve groundwater and base flow characteristics;
- Maintain feature specific water balance to protect natural heritage features and functions;
- Prevent undesirable geomorphic changes in the watercourse; and,
- Maintain an appropriate diversity of terrestrial and aquatic life and opportunities for human uses.

These objectives can be grouped into the following environmental design criteria which are common in SWM:

- Quantity Control (Flood Protection);
- Water Quality;
- Erosion Control; and,
- Water Balance (Groundwater Recharge and Protection of Natural Features).

1.6.1.2 Objectives of the Town's Official Plan Amendment Related to Stormwater Management

The New OPA was completed and adopted by City Council in September 2010, a component of the City's Consolidated Growth Management Strategy to a planning horizon of 2031. The new OP updates the City's community planning policies in a manner consistent with the principles of sustainability.

The policies of the OPA as it pertains to SWM are as follows:

- To recognize the value of stormwater as a resource and encourage the reuse of stormwater and snowmelt for on-site, non-potable uses, such as greywater systems and irrigation;
- To recognize SWM facilities as a functioning part of the City's natural water system and ecosystem. New development will employ SWM practices that are sensitive to the natural environment and natural heritage features;
- For all development, a treatment train approach to stormwater must be considered consisting of source controls (for example, green roofs, permeable paving, improved urban tree canopy), conveyance controls (for example, bioswales and permeable pipes), and end-of-pipe treatment (for example, wetlands and ponds);
- That new stormwater facilities shall be located outside of valley and stream corridors, unless approved by the City and the TRCA, and integrated into the design of the proposed development to positively contribute to the overall character of the development;
- To require new SWM facilities to be designed as local amenities while also providing a utilitarian function;
- To require that proposed SWM quality, quantity, erosion control and water balance for ground water and natural features be developed as part of a Master Environment and Servicing Plan in order to permit proper assessment of development impacts upon environmental features;
- To require that road, transit and other infrastructure projects that entail expansion of an existing service provide full SWM for new and existing infrastructure, where practically feasible;
- To require that stormwater be treated as close to the source as possible. Roof leaders will not be directly connected to the storm sewer system, in conformity with City policy. In highly sensitive subwatershed areas, alternative, innovative SWM approaches will be considered if such approaches will improve stormwater quality and quantity;
- To require the use of source controls in parking lots and other large paved surfaces such as oil / grit separators (OGS) where deemed necessary by the City;
- To encourage, where existing development has outdated or absent stormwater controls, stormwater retrofitting that to the greatest extent possible incorporates a treatment train approach with source, conveyance and end-of-pipe measures. These measures should provide water quality treatment, erosion control, flood control and address water balance objectives;
- To implement end-of-pipe stormwater retrofits as outlined in the City's SWM retrofit study (as updated);

- To require that all *significant development* provide post-development stormwater quantity control to pre-development levels for the 2- through 100-year storm events and stormwater quantity control in accordance with current guidelines in consultation with the TRCA. Should a subsequent TRCA-approved watershed hydrology study indicate that an alternative runoff control requirement is appropriate, alternative criteria may be established by the City in consultation with the TRCA;
- That all developments will undertake SWM on a volume control basis in order to provide peak flow control and to maintain pre-development water balance. In addition, the SWM strategy for all developments will strive to maintain recharge rates, flow paths and water quality to the extent possible. Particular emphasis will be placed on locations confirmed as significant recharge areas;
- To support the TRCA in establishing programs for ongoing monitoring of ambient conditions as part of the Regional Watershed Monitoring Program, including evaporation, stream flow, channel geomophology, groundwater levels, water quality and terrestrial communities and species to provide baseline data to facilitate an adaptive management approach; and,
- To work with the TRCA to monitor the effects of new development and redevelopment in *urban areas* on receiving watercourses and the hydrologic balance in order to apply adaptive management measures as necessary to maintain water balance and evaluate flooding on downstream flood vulnerable areas.

1.6.1.3 Objectives of Green Directions

Green Directions Vaughan is the City's Community Sustainability and Environmental Master Plan (CSEMP). It influences virtually all aspects of the City's operational and regulatory activities, including the growth management strategy. The plan establishes the principles of sustainability to be used in the development of other plans and master plans to achieve a healthy natural environment, vibrant communities and a strong economy.

Green Directions provides two (2) distinct functions:

1) It creates a series of sustainability action plans to guide the City’s operational and regulatory functions; and,
2) It acts as the City’s first Integrated Community Sustainability Plan.

There are six (6) key goals outlined in the plan:

1) To significantly reduce our use of natural resources and the amount of waste we generate;
2) To ensure sustainable development and redevelopment;
3) To ensure that Vaughan is a City where it is easy to get around with a low environmental impact;
4) To create a vibrant community where citizens, businesses and visitors thrive;
5) To be leaders in advocacy and education on sustainability issues; and,
6) To ensure a supportive system for the implementation of Green Directions.

1.7. Purpose of the Project File

The Project File documents the planning and design process that is followed and conclusions reached for the City's SWMMP EA Study. In accordance with the Municipal Class EA planning and design process, the problems and opportunities associated with this study were investigated and documented. Subsequently, a number of alternative solutions were identified and evaluated. This information was presented to stakeholders and the public through Technical Advisory Committees and Public Information Centres respectively. The Project File documents the EA process followed and is structure for ease of public review.

2.0 Planning Context and the EA Planning Process

2.1. Municipal Class EA

The Municipal Class EA (2007) planning and design process was followed for this project as it allows the City to meet the requirements of the Ontario Environmental Assessment Act (OEAA) for municipal infrastructure without having to either undertake an Individual Environmental Assessment or request a specific exemption for the project. The Class EA is a planning process approved under the OEAA for a class or group of undertakings including municipal infrastructure. Municipal projects included in the Class EA may be implemented without further approval under the OEAA, if the approved Class EA planning and design process is followed (**Figure 2-1**).

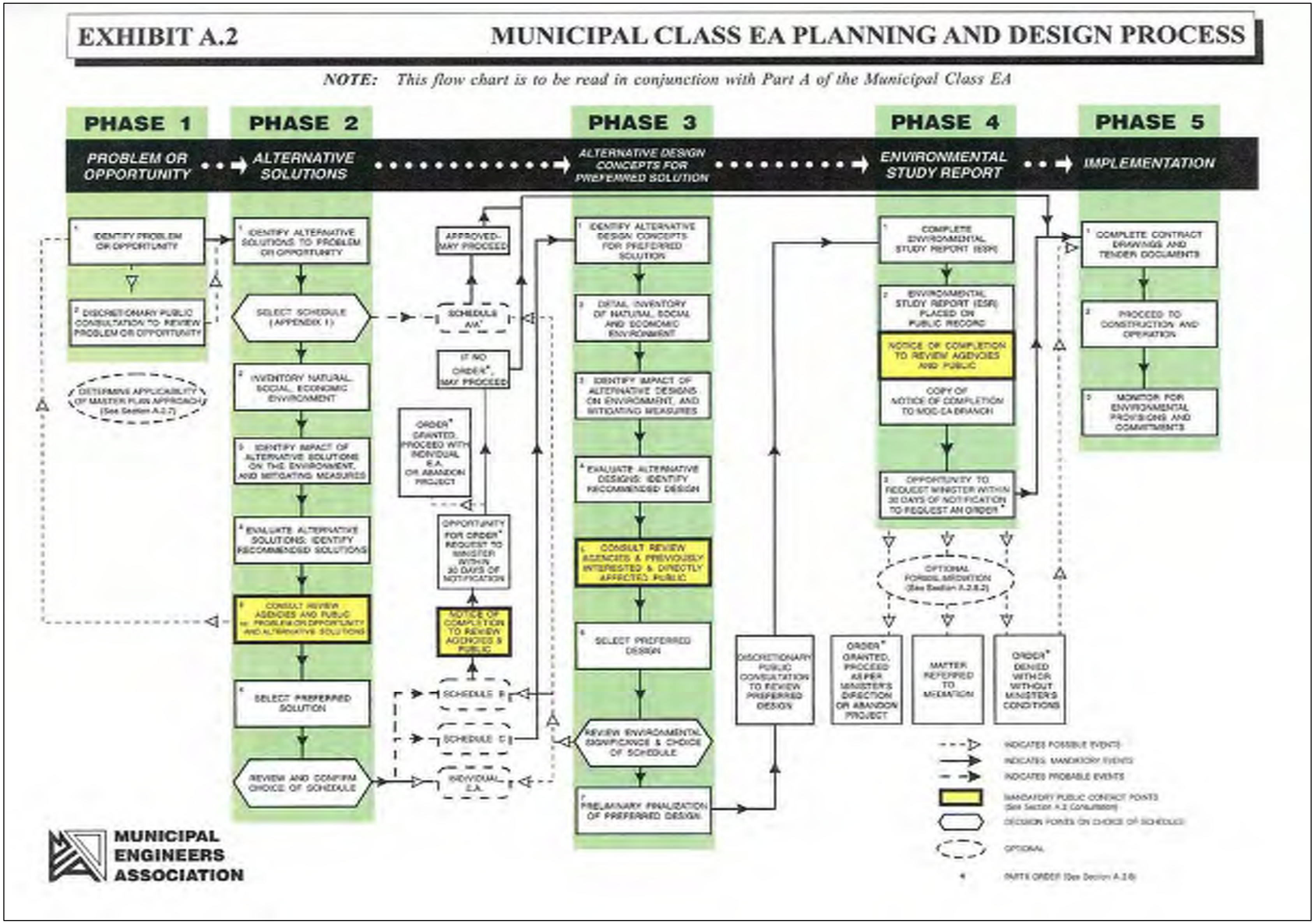


Figure 2-1 Municipal Class EA Process

2.1.1. Four (4) Project Schedules

Since projects undertaken by municipalities vary in their environmental effects, the Class EA classifies these projects into four (4) schedules according to their environmental significance:

1) **Schedule 'A'** – Projects are limited in scale, have minimal adverse effects and include the majority of municipal maintenance and operational activities. These projects are approved and may proceed directly to Phase 5 for implementation without following the other phases;
2) **Schedule 'A+'** – Projects are limited in scale and have minimal adverse effects. These projects are approved and may proceed directly to Phase 5 for implementation without following the other phases. However, the public is to be advised prior to project implementation, though there is no ability for the public to request a Part II Order;
3) **Schedule 'B'** – Projects have the potential for some adverse environmental effects. The municipality is required to undertake a screening process (Phases 1 and 2) involving mandatory contact with directly affected public and relevant review agencies to ensure that they are aware of the project and that their concerns are addressed. Schedule 'B' projects require that a Project File report be prepared and submitted for review by the public and review agencies. If there are no outstanding concerns, then the municipality may proceed to Phase 5 for implementation; and,
4) **Schedule 'C'** – Projects have the potential for significant environmental effects and must proceed under the full planning and documentation procedures specified in the Class EA Document (Phases 1 to 4). Schedule 'C' projects require that an Environmental Study Report be prepared and submitted for review by the public and review agencies. If there are no outstanding concerns, then the municipality may proceed to Phase 5 for implementation.

2.1.2. Master Plan Classification

As the Master Plan process does not fall into a specific schedule, they are specified as "long range plans which integrate infrastructure requirements for existing and future land use with environmental assessment planning principles. These plans examine an infrastructure system(s) or group of related projects in order to outline a framework for planning for subsequent projects and/or developments."

Section A.2.7 of the Municipal Class EA document states:

"At a minimum, Master Plans address Phase 1 and 2 of the Municipal Class EA process".

Since the City's SWMMP Class EA is a high level document relating to the future planning of SWM guidelines and principles, it is classified as a Master Plan project.

2.1.3. Master Plan EA Process

The following activities were carried out for this study.

2.1.3.1 Phase 1: Identify the Problem / Opportunity

This phase involves identifying the problem / opportunity to be addressed through the study and describes it in sufficient detail to lead to a clear problem / opportunity statement.

2.1.3.2 Phase 2: Identify and Evaluate Alternative Solutions to the Problem / Opportunity

This phase involves six (6) steps:

1) Identify reasonable alternative solutions to the problem / opportunity;
2) Prepare a general inventory of the existing natural, social and economic environments in which the project is to occur;
3) Identify the net positive and negative effects of each alternative solution, including mitigating measures;
4) Evaluate the alternative solutions;
5) Consult with review agencies and the public to solicit comment and input; and,
6) Select or confirm the preferred solution(s).

It is noted that the evaluation and selection of a preferred solution is on a development area basis and is subject to individual site specific analysis during later phases of the EA process. All preferred solutions are to be confirmed at the detailed design stage.

2.2. Public Consultation

In order to fulfill the requirements for a municipal class EA, two (2) Public Information Centers (PICs) were held on October 13, 2011 and June 27, 2012 at the City. **Section 9.0** describes the public consultation process in detail.

3.0 Existing Conditions

3.1. General

This chapter will summarize existing environmental conditions within the City. It should be noted that for the purpose of this study, existing environmental conditions were based on a review of existing information and documentation provided by the City, Conservation Authority and other sources. Further information on the characterization of existing environmental conditions can be found in the City's OP.

3.2. Natural Environment

3.2.1. Natural Heritage Network

Natural Heritage features referred to as "Core Features" in the City's OP are identified as wetlands, woodlands, valley and stream corridors, fish and wildlife habitat, significant, endangered and threatened species habitat, Environmentally Significant Areas, Areas of Natural and Scientific Interest, and key hydrological features within the Provincial Greenbelt and the Oak Ridges Moraine. The City's Natural Heritage Network is to be protected and enhanced as stated in the OP. Schedule 2 in the City's OP illustrates the Natural Heritage Network (NHN). Schedule 2 can be found in **Appendix A**.

The City is currently conducting a NHN Study which will assess the role of the existing NHN in maintaining elements of biodiversity and ecological functions for the longer term. Additionally, a GIS database of the NHN will be developed including its constituent parts and relevant attribute information to provide a clear and transparent rationale for the NHN, which can be used in the development applications process. Finally, a strategy to enhance the NHN to meet select ecosystem targets will be prepared.

3.2.2. Green Belt

The Province of Ontario's Greenbelt is approximately 728,000 ha which surrounds the Golden Horseshoe, which is the most populated area of Canada. The purpose of creating the Greenbelt was to protect specific environmentally sensitive land and farmlands from urban development and sprawl. Ontario's Greenbelt policy prevents widespread development or impacts associated with development from occurring within lands designated as protected countryside.

3.2.3. Oak Ridges Moraine

The Oak Ridges Moraine is one (1) of Southern Ontario's most distinct landscape features. It is an irregular ridge of sandy hills stretching from the Trent River to the Niagara Escarpment. The primary function of the moraine is sustaining the health of the watersheds and diversity of the species that are located within it. The Moraine acts as a recharge area for groundwater. Specific restrictions associated with development and other uses have been established in the Oakridge's Moraine Conservation Plan (ORMCP).

3.2.4. Natural Hazards

Natural hazards within the City include flood vulnerable areas, or areas with unstable slopes or erosion issues. These areas present a natural threat to human safety and the environment. Flooding risks generally occur around watercourses. The Provincial Policy Statement requires that development occur away from these areas. Permission for development or site alterations in these areas is regulated by the TRCA.

3.2.5. Environmentally Significant Areas

Environmentally Significant Areas (ESA) have been identified within the City. The TRCA considers an area environmentally sensitive based on a set of ecological criteria regarding the function as well as the importance and rarity of the features and/or species found in the area.

3.2.6. Aquatic Habitat

Both the Humber and Don River Watersheds provide habitat to a variety of aquatic species within the City. Management plans to preserve the existing aquatic habitats are detailed further in the Humber River Watershed Plan (2008) and the Don River Watershed Plan (2009).

The City (as with many other parts of Southern Ontario) is home to an endangered fish species known as Redside Dace. The Redside Dace is a cyprinid (minnow family) which is found in streams flowing into western Lake Ontario including tributaries of the Humber River.

In recent years, their populations have declined and as a result the species was uplisted to endangered in 2009 under Ontario's *Endangered Species Act, 2007* (ESA 2007). A recovery strategy has been developed including both long term and short term goals.

The long term goals include:

- Protecting existing healthy, self-sustaining populations and their habitats;
- Restoring degraded populations and habitats; and,
- Re-establish Redside Dace to sites of former distribution where feasible.

The short-term recovery goals include:

- Determine distribution and abundance of extant populations;
- Maintain the current geographical distribution and abundance of Redside Dace through habitat protection and other measures;
- Establish a long-term monitoring program to assess the status of Redside Dace and its habitats;
- Generate awareness regarding the significance of Redside Dace and protection and stewardship of its habitats; and,
- Rehabilitate degraded Redside Dace habitats and identify candidate locations for re-introductions.

There may be other constraints placed on development due to sensitive aquatic habitats. Developers should consult the most current watershed and Fisheries Management Plans for their sites receiving watercourse.

3.2.7. Aquifer Vulnerability

Aquifer vulnerability refers to an aquifer's susceptibility to contamination from both human and natural sources. The vulnerability of groundwater to contamination depends on soil types, water table elevation, contaminant concentration and the confined / unconfined nature of the aquifer. These areas need to be protected in order to reduce contamination and protect the groundwater. Measures to infiltrate stormwater that are in these areas require detailed studies to ensure that they are not impacting groundwater. Aquifer vulnerability sites within the City are located within the Oak Ridges Moraine and are illustrated in Schedule 6 in the OP under **Appendix A**.

3.2.8. Landform Conservation

Landform conservation is the protection through responsible land use of the landform, including its form, soils and biophysical process. The Oak Ridges Moraine contains various types of landform that impact the ecological and hydrological processes. During development, it is important to maintain significant landform features such as steep slopes, kames, kettles, ravines and ridges in their natural undisturbed form. These areas are identified under Schedule 7 of the OP located in **Appendix A.**

3.2.9. Special Policy Areas

Special Policy Areas are areas which have historically been developed within the regulatory floodplain. In general, development or re-development below the Regulatory Flood as determined by the TRCA is prohibited. A Special Policy Area has been identified in the Community of Woodbridge within the Humber River Watershed. In this area development is permitted within the floodplain; however, there are a number of conditions which must be met in order for development or re-development to occur in this area.

3.2.10. Wellhead Protection Zones

Wellhead Protection Areas are zones established by the Region of York that are in the vicinity of domestic water supply wells. They are in place to protect groundwater quality from degradations and to ensure sources of water are not compromised in the future as a result of land use decisions. These areas are displayed by *time-of-travel zones* which represent the travel time for groundwater to reach the municipal well.

Wellhead protection areas are based on time travel zones as follows:

- 100 metre pathogen zones around each wellhead; and,
- Time of travel zones of 0- to 2-years, 2-to 5-years, 5- to 10-years and 10- to 25-years.

As per the City's OP: "the storage or use of pathogen threats by new land uses, including the sitting and development of SWM ponds and rapid infiltration basins or columns, except for storage of manure or personal family use, is prohibited within the 100 metre pathogen zone around each municipal well and may be restricted within the 100 metres to 2-year time of travel zone".

3.2.11. Watercourses / Waterbodies

Significant watercourses within the City include the Humber River, Rainbow Creek (major tributary of the Humber), Don River, Black Creek and German Mill.

Aquatic communities as well as the regulatory floodplain, erosion and other natural channel process may be affected if there is an alternation or interference to the watercourse such as: straightening, diverting, realigning or altering the base flow.

3.2.12. Valley and Stream Corridors

Valley and Stream Corridors are valued landscape features that provide topographic and habitat diversity, act as corridor and linkages, and contain rich archaeological resources. Maintaining the integrity of these streams will foster the maintenance of the ecological health of the valley and surrounding land-based features.

The City has a number of significant valley systems the largest being formed by the Humber, East Humber and Don Rivers.

Development will be restricted within valley and stream corridors and the natural features and functions within these systems. Field investigations are recommended to determine location and appropriate top-of-bank boundary. The existing natural hazard areas and constraints can be found in **Figure 3-1**.

3.2.13. Stormwater Management Plan

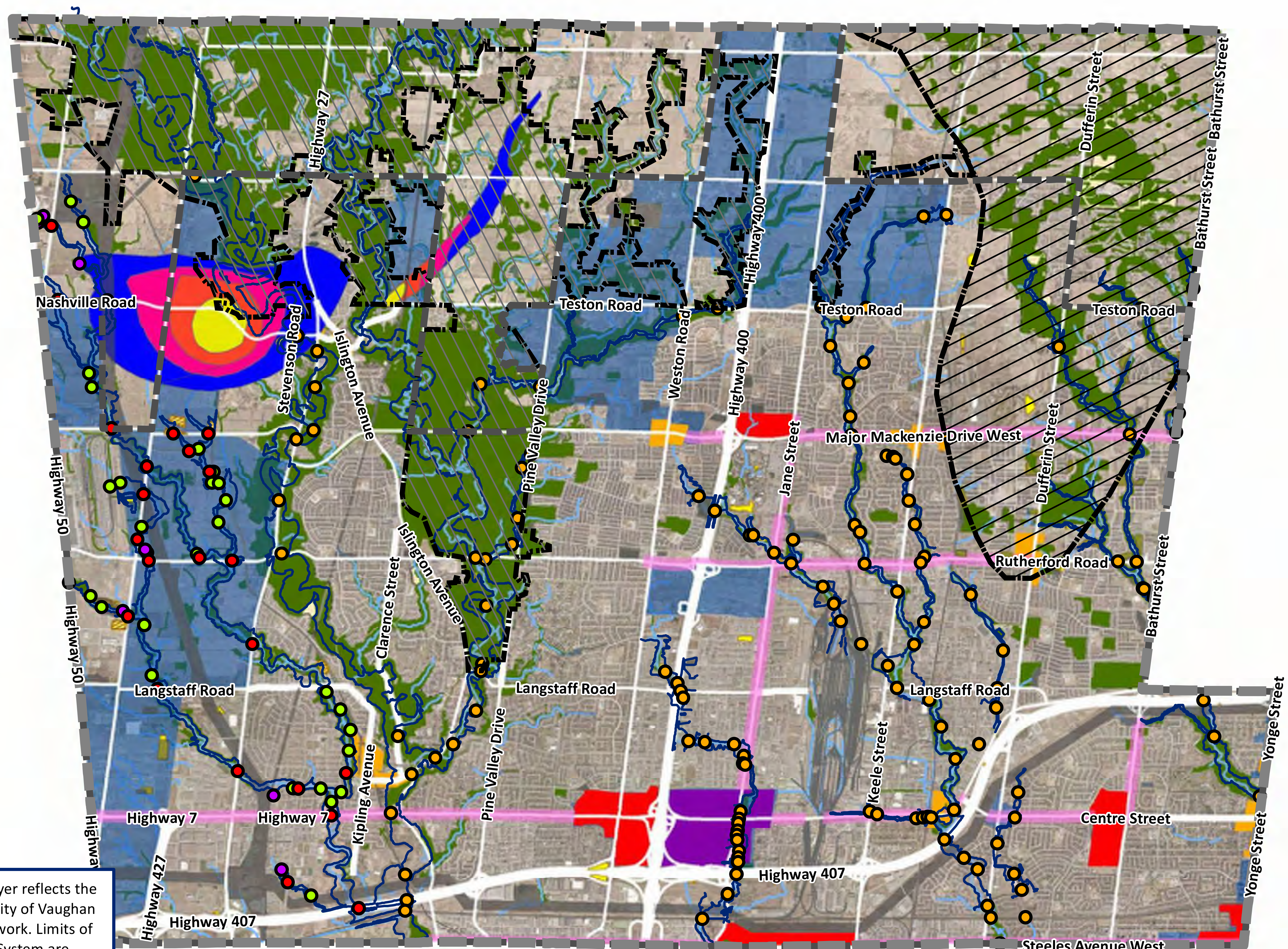
The SWM plan is designed to reduce flooding and minimize hazards under the major storm event and address issues such as water quality and erosion protection for smaller more frequent storm events. The SWM plan should address the impacts of urban development on water quality and quantity, erosion, sedimentation and hydrological characteristics, and will be based on the criteria established by the City, the TRCA, and the MOE.

In general, the following guidelines will be followed:

- Post-development peak flows for all events from the site will be controlled to pre-development levels or specified unit flow rates for certain tributaries of the Don and Humber River Watersheds;
- Stormwater quality control will be implemented to Enhanced Protection Levels as outlined in the MOE SWMP Manual (2003);
- Infiltration of site runoff will be utilized in order to assist in maintaining (where practically feasible) predevelopment water balance and infiltration rates;
- SWM practices will comply with the criteria specified by the City, Region of York, TRCA and MOE;
- Developers should consult with both the TRCA and the MNR as to any additional studies and site constraints that should be addressed as part of the site plan, and;
- The City's NHN Study should be used in future SWM planning.

As projects move forward into more detailed design stages it is important to note that all relevant environmental policies of the day must be adhered to. For example, the TRCA's Valley and Stream policies may be updated. It is also important to note that the MNR should be consulted to determine if the site or receiving waters are habitats for endangered species. This list of threatened and endangered species is a continually evolving document and should be consulted prior to moving forward with site design.

Natural Hazard Areas and Constraints



Note: Natural Area layer reflects the core features of the City of Vaughan Natural Heritage Network. Limits of the Natural Heritage System are conceptual at this stage and have not been established at the site level.

Legend

- Municipal Boundary
- Urban Boundary
- Green Belt Plan Area
- Oak Ridges Moraine Plan Area
- TRCA Existing Floodlines
- Watercourse
- Flood Vulnerable Areas

Rainbow Creek

- Flood Vulnerable Roads
- Flood Vulnerable Structures
- Flood Vulnerable Areas
- Approved Ponds
- Existing Ponds
- Natural Areas
- Intensification Corridors
- Vaughan Metropolitan Centre
- Primary Centres
- Local Centres
- Growth Areas
- Infrastructure and Utilities
- TRCA ESA

Wellhead Protection

- 2 Years
- 5 Years
- 10 Years
- 25 Years

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Stormwater Management Master Plan
November 2013

Natural Hazard Areas and Constraints Map

SCALE 1:75,000
0 250 500 1,000 1,500 2,000 Meters

FIGURE
3-1

3.3. Socio-Economic Environment

3.3.1. Existing Land Use and Zoning

The existing land use for this study has been determined using the City's zoning By-law and the most recent aerial photography. The By-law divides the City into zones and in each zone permits specific uses of land, buildings and structures.

The City encompasses a mix of land uses including natural areas, parks, private open spaces, agricultural areas, rural and urban residential areas, employment, mixed use and institutional.

A detailed discussion of existing and future land use is provided in **Section 4.0**.

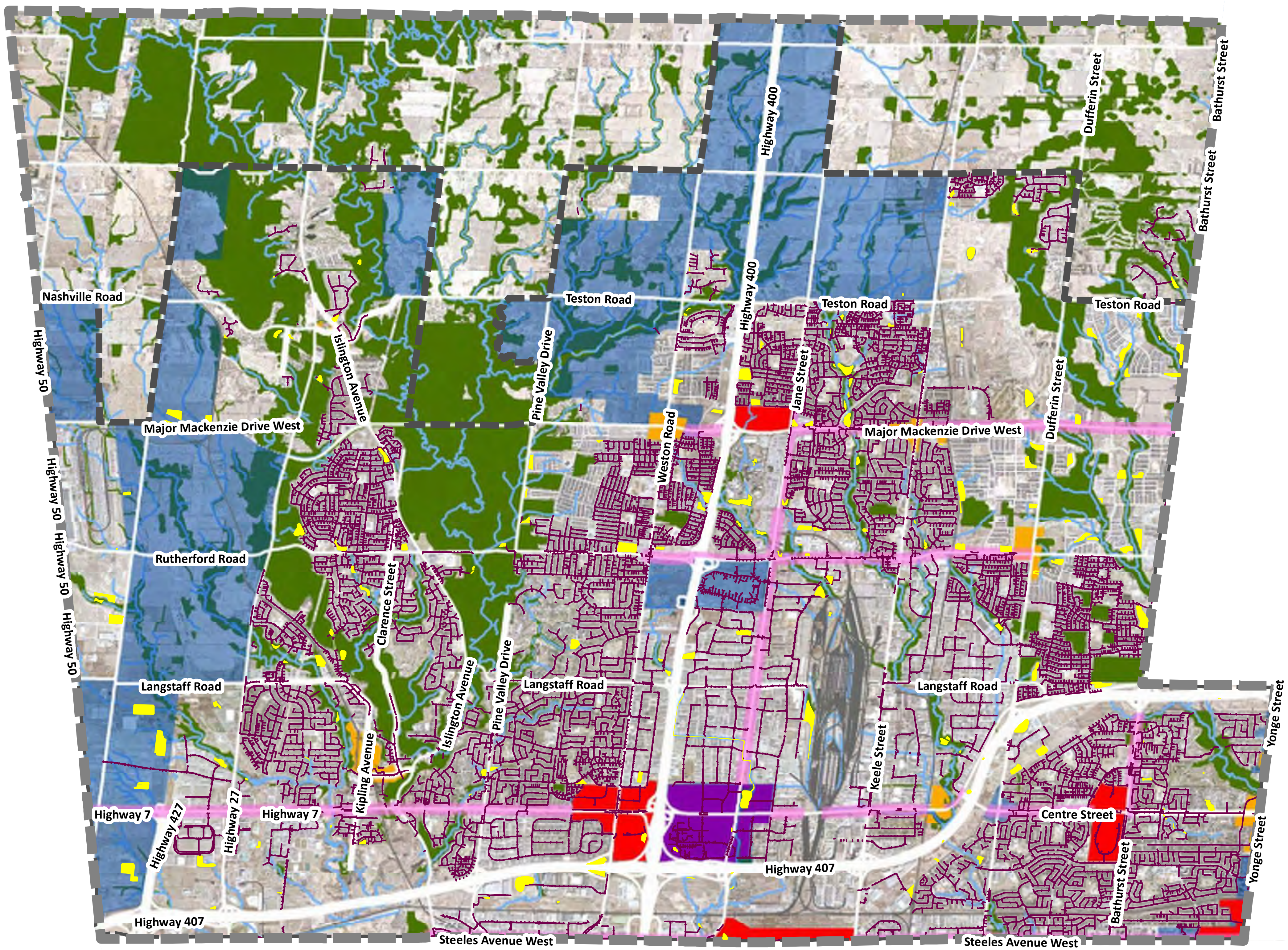
3.4. Municipal Infrastructure

3.4.1. Inventory of Stormwater Management Facilities

The inventory of Stormwater Management Facilities (SWMF) within the City was conducted in 2004. A total of 53 facilities were surveyed of which 25 are dry ponds and 28 are wet ponds, hybrid ponds or wetlands. A System Wide Maintenance Software (SWMSoft) was designed to provide easy access to all the drawings, reports, pictures, inspections and maintenance information about each facility and component. Each of the facilities that were inventoried were input into SWMSoft as a method for the City to keep its SWMF cost-effective and operating properly, within the guidelines and with the minimum amount of liability. Since 2004, the City has continued to update this database with SWMF information as it becomes available.

In addition to the public infrastructure, there are a number of privately owned SWMF's as well as on-site SWM controls, within the City which are not accounted for in the SWMSoft database. It is recommended that as part of the review and approvals process for future development, that the City includes all privately owned SWMF / controls in the SWM Soft database. **Figure 3-2** illustrates all SWMF within the urban boundary.

Existing Stormwater Management Facilities



Legend

- Municipal Boundary
- Urban Boundary
- Watercourse
- Existing SWM Ponds
- Storm Sewers
- Natural Areas
- Intensification Corridors
- Vaughan Metropolitan Centre
- Primary Centres
- Local Centres
- Growth Areas

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Stormwater Management Master Plan
November 2013

Stormwater Network Map

SCALE 1:75,000
0 245 490 980 1,470 1,960 Meters

FIGURE
3-2

3.4.2. Transportation Network

The transportation network as described in the City's OP will serve as the framework on which to build and enhance other movement networks, including walking, cycling and transit. There are four (4) categories which form the street network each serving a different purpose:

1) **Provincial Highways** – Limited access freeways that accommodate a high volume of traffic, support rapid and local transit but exclude pedestrian and bicycle use;
2) **Arterial Streets** – Formed from the concession block grid and provides the overall structure to the street network;
3) **Collector Streets** – Major and Minor collector streets typically have a maximum of four (4) through-lanes and two (2) lanes, respectively. They can support local transit, pedestrian and bicycle facilities; and,
4) **Local Streets** – Low traffic volumes and a maximum of two (2) lanes. They accommodate pedestrians and cyclists, and may support community-oriented transit, where required.

The City's Transportation Master Plan will define the road and public transit infrastructure, and other initiatives, which are needed to accommodate the population and employment growth that will result from the implementation of the Growth Management Strategy.

3.4.3. Municipal and Private Services

The source of the City's municipal drinking water is Lake Ontario and is imported through adjacent regions. It is supplied by York Region and distributed by the City.

Wastewater is collected by a large network of wastewater pipes and a series of wastewater treatment plants.

A region of Vaughan known as the "countryside" is dependant on well water and on-site wastewater treatment. The countryside is defined as lands outside the urban boundary which land uses include Natural Area, Agricultural and Rural residential.

In parallel with this study, the City is undertaking the City-Wide Water / Wastewater Master Plan which will optimize the efficiency of the City's current infrastructure, and identify where and how additional capacity may be provided to address the needs of new development areas, as well as redevelopment and intensification within the built boundary. The ability of the City's existing water and wastewater distribution / collection systems to service growth will ultimately rely on the capacities of the Region of York's major trunk water and sewer systems.

3.4.4. Utility Corridors

The City has two (2) high voltage electricity transmission lines with the associated distribution facilities, including: 1) that runs along the western edge of the City; and, 2) that follows the Highway 407 corridor. The TransCanada natural gas pipeline also crosses the City south of Kirby Road, and includes a compressor station west of Weston Road.

3.4.5. Summary of Environmental Conditions

The existing environmental conditions as described in **Section 4.0** provide a general characterisation of the existing conditions within the City. Reference should be made to TRCA watershed plans and subwatershed studies for detailed information and evaluations on a watershed and subwatershed basis. In addition, reference should be made to the City's OP which provides further existing information from a planning perspective. The City is currently conducting a NHN Study which will further characterise the existing natural heritage network throughout the City.

4.0 Existing and Proposed Land Use

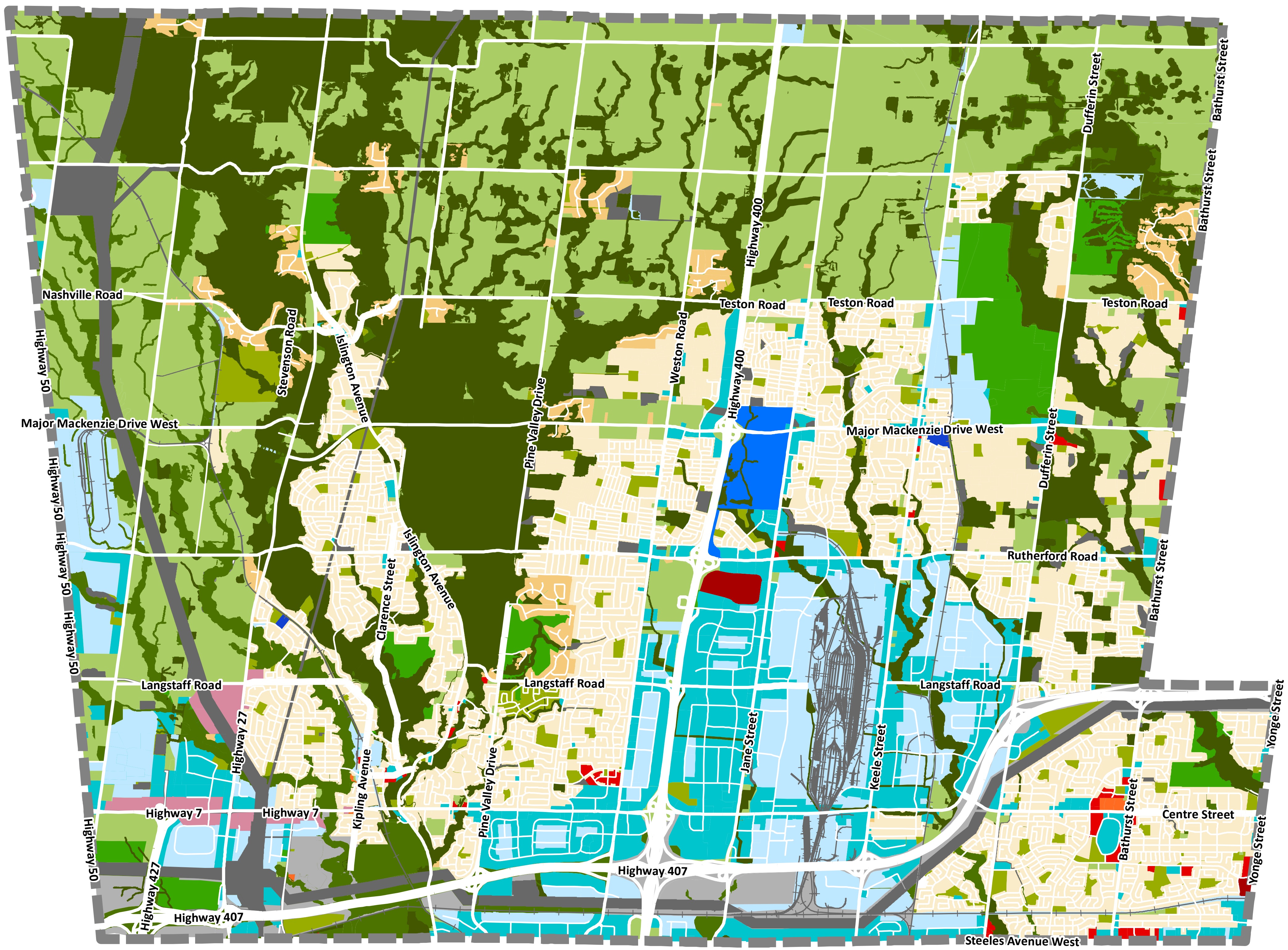
4.1. Existing Land Use

The existing land use within the City is comprised of low-rise residential, low-rise mixed-use, mid-rise residential, mid-rise mixed-use, high-rise residential, community and employment commercial mixed-use and new community areas. 40% of the City is protected as Green / Open Space: Natural Areas and Countryside which is comprised of the following land use designations: Oak Ridges Moraine, Greenbelt, Natural Areas, Parks, Private Open Spaces, Agricultural, and Rural. The specific land use for each of the Secondary Plan Areas and intensification corridors will be elaborated upon in the following sections. **Figure 4-1** illustrates the existing land use within the urban boundary.

4.2. Future Land Use

The population within the City is expected to increase from 250,000 residents in 2006 to 415,000 residents by 2031. Employment during the same time period is expected to from increase from 160,000 to 265,000 people. 20% of the City has been designated as Employment Area to support economic and job growth. Similar to existing conditions, the proposed land use in the City will consist of Natural Areas, Park, Private Open Spaces, Agricultural, Rural Residential, Low-Rise Residential, Low-Rise Mixed-Use, Mid-Rise Residential, Mid-Rise Mixed-Use, High-Rise Residential, High-Rise Mixed-Use, Downtown Mixed-Use, General Employment, Prestige Employment, Theme Park and Entertainment, and Major Institutional. **Figure 4-2** illustrates the projected future land use in the City in the year 2031.

Existing Land Use



Legend

Municipal Boundary

Existing Land Use

- Infrastructure and Utilities
- Natural Areas
- Natural Areas
- Parks
- Private Open Space
- Agricultural
- Rural Residential
- Low-Rise Residential
- Mid-Rise Residential
- Mid-Rise Mixed-Use
- High-Rise Residential
- High-Rise Mixed-Use
- General Employment
- Prestige Employment
- Major Institutional
- Theme Park and Entertainment
- Parkway Belt West Lands

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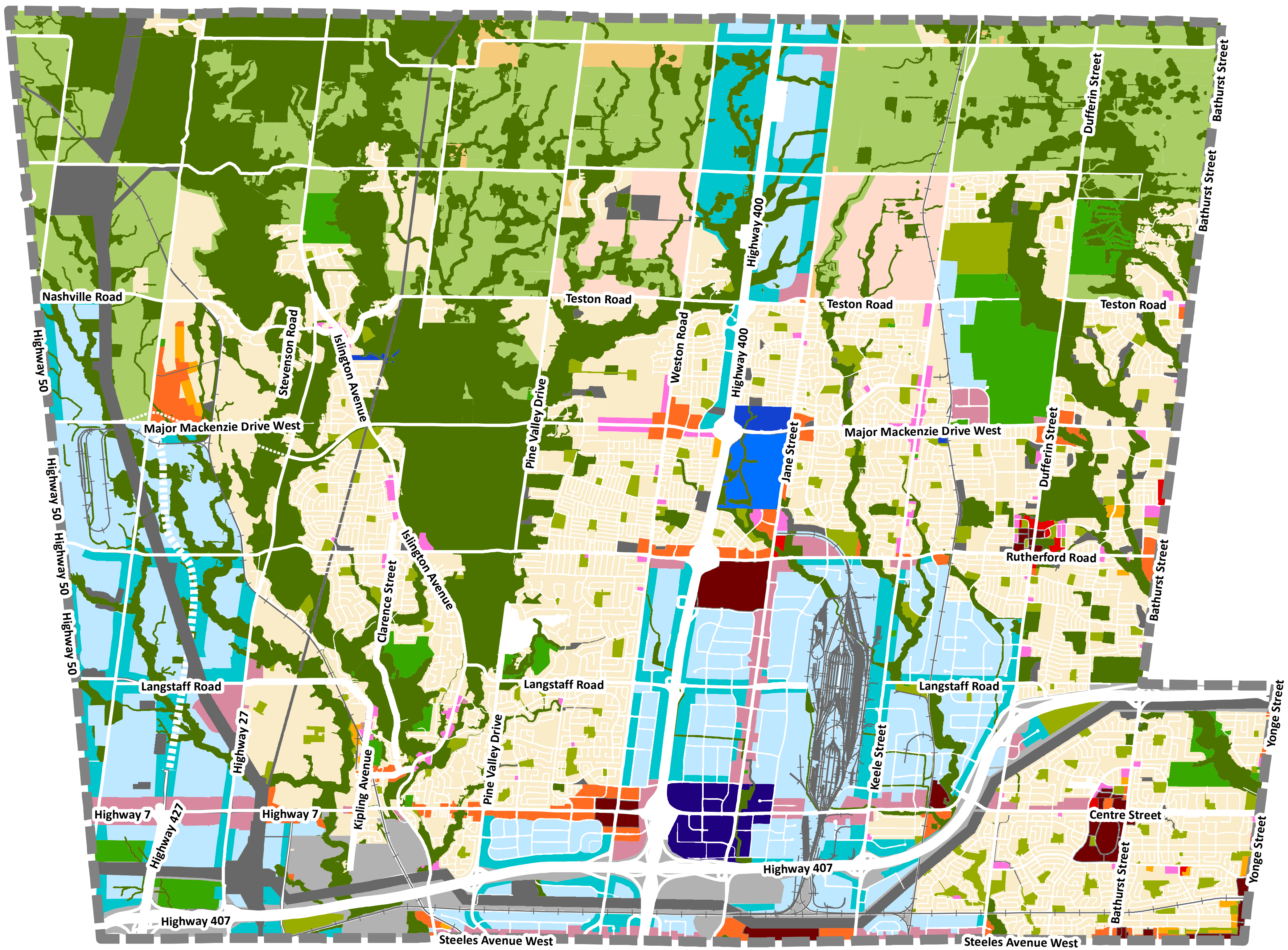
Existing Land Use Map

SCALE 1:75,000

FIGURE 4-1

2031 Projected Land Use



Legend

Municipal Boundary

2031 Land Use

- Agriculture
- Commercial Mixed Use
- Downtown Mixed Use
- General Employment
- High-Rise Mixed Use
- High-Rise Residential
- Low-Rise Mixed Use
- Low-Rise Residential
- Major Institutional
- Mid-Rise Mixed Use
- Mid-Rise Residential
- Natural Areas
- New Community Areas
- Parks
- Parkway Belt West Lands
- Prestige Employment
- Private Open Spaces
- Rural Residential
- Theme Park and Entertainment
- Infrastructure and Utilities

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November 2013

2031 Projected Land Use

SCALE 1:75,000
0 230 460 920 1,380 1,840 Meters

FIGURE
4-2

5.0 Development of Alternatives

5.1. General

In order to identify the solution that best encompasses the study's principles, goals and objectives, a list of alternatives was generated. The alternatives consider both existing and future land uses within the City's existing urban areas as well as un-developed lands.

The approach for developing and evaluating alternatives is consistent with the requirements of the planning and design process for Master Planning projects described in the Municipal Class EA (Municipal Engineers Association, June 2000). It involves reviewing Phase 1 work (i.e. Identification of the Problem) and undertaking Phase 2 (i.e. Establishing Existing Conditions, Identification of a Long List of Alternatives, Development and Assessment of Alternative Management Strategies, and Selection of a Preferred Strategy). Additionally, consultation with stakeholders is a necessary step in the process.

5.2. Overview of Alternatives

A range of alternative solutions was developed in order to address the identified problems and opportunities. The alternatives identified for evaluation are summarized in the following three (3) categories:

1) Do nothing;
2) Lot level / at source / conveyance controls; and,
3) End-of-pipe measures.

In certain cases, lot level / at source / conveyance controls may be feasible to be used with end-of-pipe measures in an integrated SWM approach. For example, in employment areas storage can be provided at the lot level prior to discharging to a SWM pond, in order to reduce the size requirement of said pond. The feasibility of combining lot level and end-of-pipe measures will be assessed where applicable.

5.2.1. Do Nothing

Although the "Do nothing" alternative does not address the Problem / Opportunity Statement, the Class EA document mandates its consideration in all Class EA's as a means of providing a benchmark for evaluating the other alternative solutions.

5.2.2. Lot Level / At Source / Conveyance Controls

This alternative involves physical measures that are located at the beginning of the drainage system; generally on private property. Source controls will reduce stormwater runoff generated from impervious surfaces that occur mostly in urban areas. Source controls can be used in a variety of different land uses such as residential, industrial and commercial. Source controls can be retrofitted into existing areas and implemented into proposed urban areas.

Lot level / at source / conveyance control measures include:

5.2.2.1 Roof Downspout Disconnection

Simple downspout disconnection involves directing flow from roof downspouts to a pervious area that drains away from the building or residence. This prevents stormwater from directly entering the storm sewer system or flowing across a "connected impervious surface, such as a driveway, that drains to a storm sewer. Simple downspout disconnection requires a minimum flow path length of 5 metres across a pervious area.

When the infiltration rate of the soil in the pervious area is less than 15 mm/hr (i.e. hydraulic conductivity of less than 1x10^{-6} cm/s), the area should be tilled to a depth of 300 mm and amended with compost to achieve an organic content in the range of 8 to 15% by weight or 30 to 40% by volume.

5.2.2.2 Bioretention

As a stormwater filter and infiltration practice, bioretention temporarily stores, treats and infiltrates runoff. Depending on native soil infiltration rate and physical constraints, the system may be designed without an underdrain for full infiltration, with an underdrain for partial infiltration, or with an impermeable liner and underdrain for filtration only, which can also be referred to as a biofilter. The primary component of a bioretention system is the filter bed which is a mixture of sand, fines and organic material. Other important elements of bioretention systems include a mulch ground cover and plants adapted to the conditions of bioretention system, including a flood / drought cycle and higher levels of pollutants. Pre-treatment, such as a settling forebay, vegetated filter strip, or stone diaphragm, often precedes the bioretention system to remove particles that would otherwise clog the filter bed. Bioretention is designed to capture small storm events or the water quality storage requirement. An overflow bypass is required to pass large storm events.

Bioretention systems can be adapted to fit into many different development contexts and provides a convenient area for snow storage and treatment. In a low density development, it might have a soft edge and gentle slopes, while a high density application might have a hard edge with vertical slopes.

5.2.2.3 Green Roofs (i.e. Roof Gardens)

Green roofs, also known as "living roofs" or "rooftop gardens", consist of a thin layer of vegetation and growing medium installed on top of a conventional flat or sloped roof. Green roofs are publicized for their benefits to cities, as they improve energy efficiency, reduce urban heat island effects, and create greenspace for passive recreation or aesthetic enjoyment. From a water resources perspective, they are attractive for their water balance, and peak flow control benefits. From a hydrologic perspective, the green roof acts like a lawn or meadow by storing rainwater in the growing medium and ponding areas. Excess rainfall enters underdrains and overflow points and is conveyed in the building drainage system. After the storm, a large portion of the stored water is evapotranspirated by the plants, evaporates or slowly drains away.

5.2.2.4 Soakaway Pits, Infiltration Trenches and Chambers

On sites suitable for underground stormwater infiltration practices, there are a variety of facility design options to consider, such as soakaway pits, infiltration trenches and infiltration chambers.

Soakaway pits are rectangular or circular excavations lined with geotextile fabric and filled with clean granular stone or other void forming material, which receives runoff from a perforated pipe inlet and allow it to infiltrate into the native soil. They typically service individual lots and receive only roof and walkway runoff but can also be designed to receive overflows from rainwater harvesting systems. Soakaway pits can also be referred to as infiltration galleries or dry wells.

Infiltration trenches are rectangular trenches lined with geotextile fabric and filled with clean granular stone or other void forming material. Like soakaway pits, they typically service an individual lot and receive only roof and walkway runoff. This design variation on soakaway pits is well suited to sites where available space for infiltration is limited to narrow strips of land between buildings or properties, or along road rights-of-way. They can also be referred to as infiltration galleries or linear soakaway pits.

Infiltration chambers are another design variation on soakaway pits. They include a range of proprietary manufactured modular structures installed underground, typically under parking or landscaped areas. They create large void spaces for temporary storage of stormwater runoff and allowing it to infiltrate into the underlying native soil. These structures typically have open bottoms, perforated side walls and optional underlying granular stone reservoirs. They can be installed individually, in series, or in bed configurations. With adequate pre-treatment they can infiltrate roof, walkway, parking lot and road runoff. Due to the large volume of underground void space they create and the modular nature of their design, they are well suited to sites where available space for other types of BMPs is limited, or where it is desirable for the facility to have little or no surface footprint (e.g., high density development contexts).

5.2.2.5 Permeable Pavement

Permeable pavements, an alternative to traditional impervious pavement, allow stormwater to drain through them and into a stone reservoir where it is infiltrated into the underlying native soil or temporarily detained. They can be used for low traffic roads, parking lots, driveways, pedestrian plazas and walkways. Permeable pavement is ideal for sites with limited space for other surface stormwater BMPs. Depending on the native soils and physical constraints, the system may be designed with no underdrain for full infiltration, with an underdrain for partial infiltration, or with an impermeable liner and underdrain for a filtration only practice. Permeable paving allows for filtration, storage, or infiltration of runoff, and can reduce surface stormwater flows compared to traditional impervious paving surfaces like concrete and asphalt.

5.2.2.6 Rainwater Harvesting (i.e. Rain Barrels, Cisterns, etc.)

Rainwater harvesting is the process of intercepting, conveying and storing rainfall for future use. Harvesting rainwater for domestic uses has been practiced in rural Ontario for well over a century. Interest in adapting this practice to urban areas is increasing as it provides combined benefits of conserving potable water and reducing stormwater runoff. When harvested rainwater is used to irrigate landscaped areas, the water is either evapotranspirated by vegetation or infiltrated into the soil, thereby helping to maintain the pre-development water balance.

5.2.2.7 Rooftop Storage

Buildings which have flat roof tops can be used to store or “pond” stormwater during a rainfall event. Stormwater quantity control can be achieved by restricting the flow to roof drains.

This will attenuate the flow and result in rooftop ponding. Once capacity becomes available downstream, the ponded water will be discharged slowly to the storm sewers.

5.2.2.8 Surface / Parking Lot Storage

There are opportunities to store stormwater on the surface or parking lot of a site depending on the grading associated with the development. Flows can be attenuated by installing flow restrictor devices such as orifice controls in the downstream system which will lead to ponding on the surface. Once capacity becomes available downstream, the ponded water will be discharged slowly into the storm sewers.

5.2.2.9 Underground Storage

Underground storage can be implemented as oversized pipes, underground tanks, cisterns or manufactured modular structures installed underground, typically under parking or landscaped areas, for temporary storage of stormwater runoff. Flows are attenuated by installing a flow restrictor downstream of the storage chamber. Stored water will discharge slowly into the downstream system once capacity becomes available.

5.2.2.10 Grassed Swales

Grassed swales are vegetated open channels designed to convey, treat and attenuate stormwater runoff (also referred to as enhanced vegetated swales). Check dams and vegetation in the swale slows the water to allow sedimentation, filtration through the root zone and soil matrix, evapotranspiration, and infiltration into the underlying native soil. Simple grassed channels or ditches have long been used for stormwater conveyance, particularly for roadway drainage.

Grassed swales incorporate design features such as modified geometry and check dams that improve the contaminant removal and runoff reduction functions of simple grassed channel and roadside ditch designs. A dry swale is a design variation that incorporates an engineered soil media bed and optional perforated pipe underdrain system. Grassed swales are not capable of providing the same water balance and water quality benefits as dry swales, as they lack the engineered soil media and storage capacity of that best management practice.

5.2.2.11 Perforated Pipe Systems

Perforated pipe systems can be thought of as long infiltration trenches or linear soakaway pits that are designed for both conveyance and infiltration of stormwater runoff. They are underground stormwater conveyance systems designed to attenuate runoff volume and thereby, reduce contaminant loads to receiving waters. They are composed of perforated pipes installed in gently sloping granular stone beds that are lined with geotextile fabric that allow infiltration of runoff into the gravel bed and underlying native soil while it is being conveyed from source areas or other BMPs to an end-of-pipe facility or receiving waterbody. Perforated pipe systems can be used in place of conventional storm sewer pipes where topography, water table depth, and runoff quality conditions are suitable. They are suitable for treating runoff from roofs, walkways, parking lots and low to medium traffic roads, with adequate pre-treatment. A design variation can include perforated catchbasins, where the catchbasin sump is perforated to allow runoff to infiltrate into the underlying native soil.

Perforated pipe systems can also be referred to as pervious pipe systems, exfiltration systems, clean water collector systems and percolation drainage systems.

5.2.2.12 Vegetated Filter Strips

Vegetated filter strips (i.e. buffer strips and grassed filter strips) are gently sloping, densely vegetated areas that treat runoff as sheet flow from adjacent impervious areas. They function by slowing runoff velocity and filtering out suspended sediment and associated pollutants, and by providing some infiltration into underlying soils. Originally used as an agricultural treatment practice, filter strips have evolved into an urban SWM practice. Vegetation may be comprised of a variety of trees, shrubs and native plants to add aesthetic value as well as water quality benefits. With proper design and maintenance, filter strips can provide relatively high pollutant removal. Maintaining sheet flow into the filter strip through the use of a level spreading device is essential.

5.2.2.13 Oil / Grit Separator Units

OGS Units are manufactured mechanical structures consisting of one or more underground chambers. The purpose of an OGS unit is to remove sediment, debris and separate oil from stormwater. They are effective at capturing particulate matter and hydrocarbons from small areas, typically less than 5 ha, which are highly impervious. OGS units are integrated with the storm sewer network and are typically installed in storm manholes. A flow bypass weir is often included in the design of OGS units so that low flows enter the unit, and more intense flows from larger more infrequent storm events will be bypassed. The purpose of the bypass is to reduce the potential for contaminants to be re-suspended in the stormwater. Their effectiveness at treating stormwater varies based on the model and jurisdiction. The TRCA requires that OGS units be used as part of an integrated treatment train approach for SWM.

5.2.3. End-of-Pipe Measures

This alternative consists of managing stormwater at the end of a storm sewer system prior to discharging to a stream. They usually consist of man-made measures such as stormwater ponds or constructed wetlands. This alternative would look at opportunities for retrofit of existing ponds, or the construction of additional ponds. BMPs would still be recommended for sites out letting to end-of-pipe facilities.

Stormwater Management Ponds (i.e. Wet Ponds)

Wet ponds are the most common end-of-pipe SWMF employed in Ontario. They are less land-intensive than wetland systems and are normally reliable in operation, especially during adverse conditions (e.g., winter / spring).

This reliability can be attributed to:

- Performance does not depend on soil characteristics;
- The permanent pool minimizes re-suspension;
- The permanent pool minimizes blockage of the outlet; and,
- The permanent pool provides extended settling.

Wet ponds can be designed to efficiently provide for water quality, erosion and quantity control, reducing the need for multiple end-of-pipe facilities. Wet ponds can be designed with extensive landscaping and associated recreational amenities, contributing to the character of the community and enhancing its marketability.

One drawback of wet ponds is their thermal impacts to receiving watercourses. Surface water warms during the day, and the water discharged from wet ponds is often warmer than the downstream watercourses. As such, in areas where wet ponds are proposed and coldwater fisheries are present, it is recommended that thermal mitigation strategies be implemented. These may include bottom draw outlet pipes, cooling trenches, and sufficient vegetation around the pond's perimeter.

As with all SWM facilities, wet ponds require regular inspection and maintenance to function as designed.

5.2.3.1 Dry Ponds

Dry ponds have no permanent pool of water. They can be effectively used for erosion control and flood control; however, the removal of stormwater contaminants in these facilities is purely a function of the detention time in the pond. For a 24 hour retention period, this normally means a lower contaminant removal than a wet facility as the inter-event settling does not occur. Higher levels of sediment removal may occur with longer detention times, however; achieving this for smaller drainage areas can be difficult due to orifice size considerations. There is no documented performance monitoring data for dry ponds with longer detention times, however; and re-suspension of settled material remains a concern. As such, the use of dry ponds (for water quality control) remains largely restricted to retrofits, where temperature is not an overriding concern, and situations where other more effective SWMP types are infeasible. Dry ponds may be used as part of an overall treatment train approach.

5.2.3.2 Constructed Wetlands

The constructed wetland is one of the preferred end-of-pipe SWM facilities for water quality enhancement. Wetlands are normally more land-intensive than wet ponds because of their shallower depth (both in the permanent pool and in the active storage zone). They are suitable for providing the storage needed for erosion control purposes, but will generally be limited in their quantity (i.e. flood) control role because of the restrictions on active storage depth.

Benefits of constructed wetlands are similar to wet ponds and include:

- Performance does not depend on soil characteristics;
- The permanent pool minimizes re-suspension;
- The permanent pool minimizes blockage of the outlet;
- Biological removal of pollutants occurs (including phosphorus); and,
- The permanent pool provides extended settling.

6.0 Development and Assessment of Alternative Solutions

The Project Team considered various SWM alternatives for the purposes of servicing, on a functional level, the approved Secondary Plan Areas. The study had also investigated strategies for servicing of future Secondary Planning Areas identified in the OPA as well as the proposed intensification corridors. Details of the evaluations are appended to this volume of the report as **Appendix B** and in the Functional SWM Plans in **Volume II**.

6.1. General

The development of Alternative SWM Strategies is necessary in order to determine the effectiveness of each strategy with respect to protecting, enhancing and restoring the natural resources of the watersheds located within the City under existing and plan land use changes.

For the purposes of the SWM MPCEA, a SWM Strategy was defined as a set of BMPs which when implemented collectively, will attempt to address impacts associated with change in land uses within the watersheds. The land uses under consideration are located throughout the City, however, this study had focused on future and approved Secondary Plan Areas as well as proposed intensification corridors as these are the main development areas considered in the City's growth management plan.

The assessment was undertaken using modelling results for the specific growth areas as well as taking into account various factors such as technical, natural, social / cultural, and economic criteria which are defined to further develop specific components of the Alternative Strategies.

The approach used for developing and evaluating alternatives is, where appropriate, consistent with the planning and design process for Master Planning projects as described in the Class EA document.

6.2. Development of Alternative Stormwater Management Strategies

The assessment of existing conditions suggests that the Alternative Management Strategies, if they are to be effective, must deal with impacts associated with the existing and proposed land uses. A total of three (3) alternative SWM strategies have been considered. The three (3) alternatives are as follows:

1) Do Nothing;
2) At Source / Lot-Level / Conveyance Controls; and,
3) End-of-Pipe Controls.

6.2.1. Do Nothing

The "Do Nothing" alternative would involve development proceeding as planned however, there would be no SWM strategy proposed for future development. This alternative does not require any action from the City nor the development community and there will be no immediate financial impacts. However, by not providing any form of SWM, costs may be incurred by the public and/or private in the case of damages resulting from an extreme storm event. This alternative must be considered as part of the Class EA. This approach typically would not meet the environmental objectives of the City's SWM Policies and Practices.

6.2.2. At Source / Lot Level / Conveyance Controls

This alternative involves the implementation of various "small scale" controls for water quantity, water quality, water balance and erosion control.

These may include but are not limited to the following:

- Surface / Parking lot Storage (Quantity);
- Roof top Storage (Quantity);
- Underground / Superpipe Storage (Quantity);
- Cisterns (Quantity, Water Balance, Erosion);
- Green Roofs (Quantity, Water Balance);
- Infiltration Trenches (Water Balance, Erosion);
- Rain Gardens (Quality, Water Balance, Erosion);
- Swales (Quality, Erosion);
- Filter Strips (Quality, Water Balance, Erosion);
- Permeable Pavement (Quality, Water Balance, Erosion); and,
- OGS Units (Quality).

Small scale controls also known as BMP or LID may not be feasible in all areas. The applicability of these technologies / methods will depend on the proposed land use, local soil conditions and available space for implementation. A discussion of which BMPs / LIDs are applicable for a given Secondary Plan Area can be found in the individual Functional Servicing Reports for the individual Secondary Plan Areas and intensification corridors.

6.2.3. End-of-Pipe Controls

This alternative involves the implementation of traditional SWM ponds or other end-of-pipe methods for water quantity, water quality, and erosion control.

6.2.4. Low Impact Development

When devising a SWM plan for a site or larger development LID strategies should be included in addition to the three (3) alternative solutions presented in this study. The use of LID strategies will augment water quality, help maintain water the sites water balance, help to mitigate erosion by reducing the volume of runoff leaving the site and may reduce the size of end-of-pipe facilities. LID measures should be considered as lot level and multi-lot level controls and should be implemented as part of a treatment train approach for SWM management.

6.2.5. Development of Evaluation Categories and Criteria

Evaluation criteria were developed to reflect the definition of "environment" provided in the OEAA and the specific circumstances associated with this project.

Table 6.1 shows the different evaluation criteria considered for each alternative.

Table 6.1 – Evaluation Criteria

Technical
Ability to provide quantity control and flood protection
Ability to provide stormwater quality control
Ability to improve water balance
Ability to mitigate against erosion to receiving water courses
Natural Environment
Potential impacts to aquatic habitat
Potential impacts to terrestrial habitats
Potential impacts to natural features
Potential impacts to species of concern
Social / Cultural Environment
Potential impacts on public health and safety
Potential impacts to private property
Potential impacts to public property
Potential impacts to built and cultural heritage landscape
Potential impacts to archeological resources
Economic Environment
Capital costs
Property acquisitions, permit costs
Operation and maintenance costs
Risk management

It is noted that the evaluation criteria was applied on an individual Secondary Plan basis where the key aspects of the alternative SWM strategies could be effectively applied.

The preferred alternatives for each Secondary Plan Area are based on existing site constraints and the feasibility of implementing SWM improvements to each area.

6.3. Model Development

This section describes the modeling approach utilised to analyse the existing conditions and preferred SWM strategy for the approved and future Secondary Plan Areas.

The hydrologic model used for the functional stormwater servicing analysis was Visual OTTHYMO Version 2.4. This modelling software allows users to model the storm effects and define the hydrologic input parameters of a given site area.

The main modelling inputs used are described below:

- **STANDHYD Command**:
  - An area input command mainly used for urban areas; and,
  - Impervious area input parameters may be assigned to this command.
- **NASHYD Command**:
  - An area input command mainly used for rural or natural areas.
- **ADDHYD Command**:
  - An input command used to add two (2) areas together.
- **ROUTE RESERVOIR Command**:
  - A command used to represent a SWMF or control device; and,
  - The user inputs a rating curve to represent the storage-discharge relationship of the SWMF.

Model Results can be found in the Volume II of the MCEA within the Functional Servicing Plans.

7.0 Evaluation of Alternatives for Approved Secondary Plans

This section describes in greater detail the evaluation process undertaken for the Approved Secondary Plan Areas within the City. These areas were a primary focus of the SWM Master Plan. Much more detail in the evaluation and modelling undertaken for these areas is described in Volume II of the SWMMP where the Functional SWM Plans for these and other areas are detailed.

Three (3) general alternatives were considered for each Secondary Plan Areas: do nothing, lot level controls, and end-of-pipe controls. However, in certain areas where the proposed development form would allow for both lot level and end-of-pipe controls (treatment train), a fourth option was considered for the Secondary Plan Area.

7.1. Yonge-Steeles Secondary Plan Area (North and South)

The Yonge-Steeles Secondary Plan Area is an existing developed area located within Thornhill neighbourhood of the City. Existing land use in the area consists of low-rise employment, medium density mid-rise residential, industrial pockets in the vicinity of the CN Rail line, as well as low density residential land uses.

The proposed development includes significant intensification for the area and will consist of a combination of high-rise, mid-rise and low-rise mixed-use, low-rise and mid-rise residential, parks, and private open spaces. **Figure 7-1** illustrates the location of the Secondary Plan Area and the proposed land uses. The following scenarios were considered when determining the preferred SWM solution for the Secondary Plan Area.

7.1.1. Alternative 1: Do Nothing

This alternative considers no SWM for the proposed redevelopment area. The northern component of the Yonge-Steeles Secondary Plan Area (corner of Steeles Avenue West and Yonge Street) will have a negative impact on the Study Area as the overall imperviousness increases under post-development conditions. If no SWM measures are implemented, this will potentially lead to an increased risk in flooding, decrease in water quality and an increase in downstream erosion in the West Don River. Additionally, with no SWM measures in place there is the potential to impact natural features, terrestrial / aquatic habitat as well as public and private properties.

The South Study Area will meet the quantity control requirements for the site, as the overall imperviousness decreases during posted development conditions; however, there may be the possibility of degraded water quality if no SWM for quality control is implemented. Although there are no costs associated with this alternative as there are no SWM measures proposed, the cost of doing nothing will increase the risk of potential issues related to flooding, water quality and erosion.

7.1.2. Alternative 2: At Source / Lot Level Controls

Implementation of at source / lot level SWM controls for both the North and South Study Areas will provide some quantity control, improve water quality, and reduce downstream erosion. There will be an overall improvement in the surrounding natural environment, and the social and cultural impacts will be minimized by implementing various SWM techniques. The costs associated with at source / lot level Controls are not as significant compared to end-of-pipe facilities as there is typically no major construction activities required.

7.1.3. Alternative 3: End-of-Pipe Controls

End-of-pipe SWM controls will meet all the necessary requirements for the Study Area by providing quantity control, quality control, and erosion protection in a single centralised facility. However as a standalone solution, end-of-pipe controls are not preferred methods for addressing the water balance criteria. End-of-pipe SWM Facilities will be able to mitigate impacts on the surrounding natural environment and minimize impacts both public and private properties. One (1) of the major drawbacks of this alternative for this particular Secondary Plan is that SWM ponds would be difficult to implement as the Secondary Plan Area is located in an existing high density urban area. Additionally, there are significant capital and maintenance costs associated with the construction of end-of-pipe facilities within this plan area.

APPENDIX

C

REGIONAL GEOLOGICAL CROSS SECTIONS PREPARED BY THE TORONTO AND REGION CONSERVATION AUTHORITY

APPENDIX C – Excerpts from TRCA (2008) – Geology of the Humber River Watershed, and TRCA (2009c) - Geology of the Don River Watershed

Figure C-1: Generalized Geological Sequence in York Region South of the Oak Ridges Moraine.

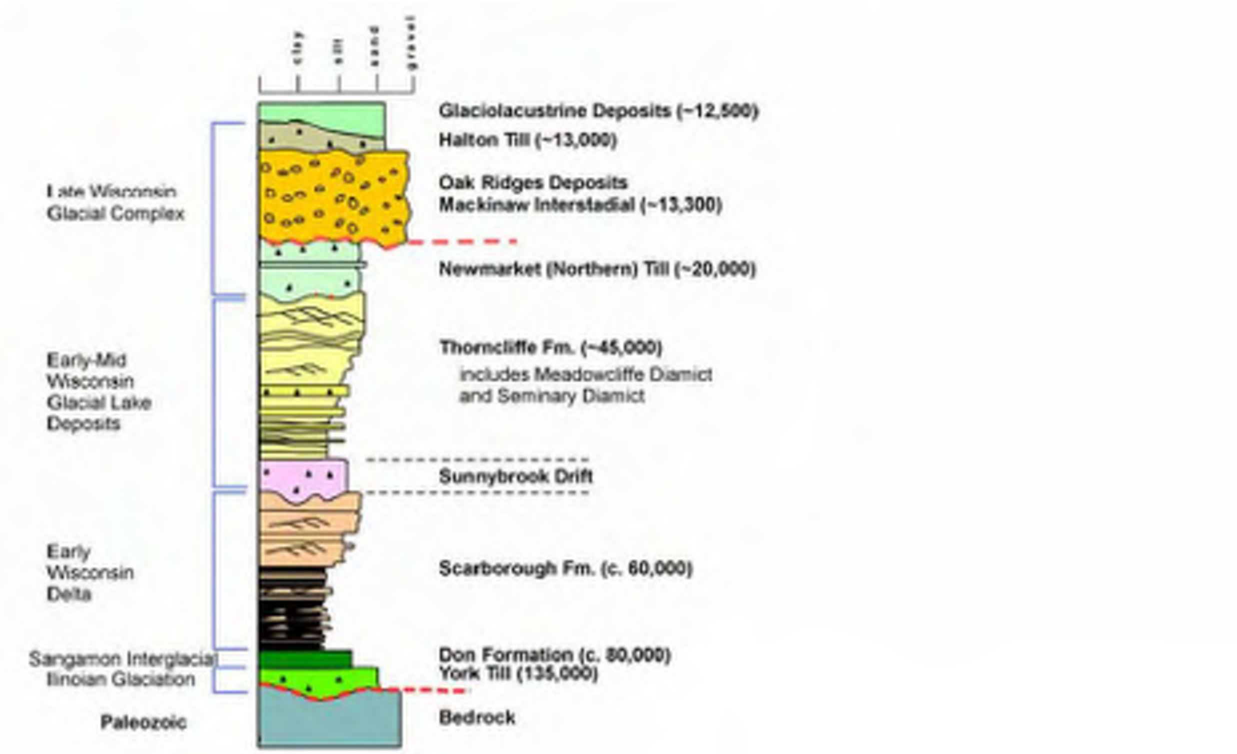
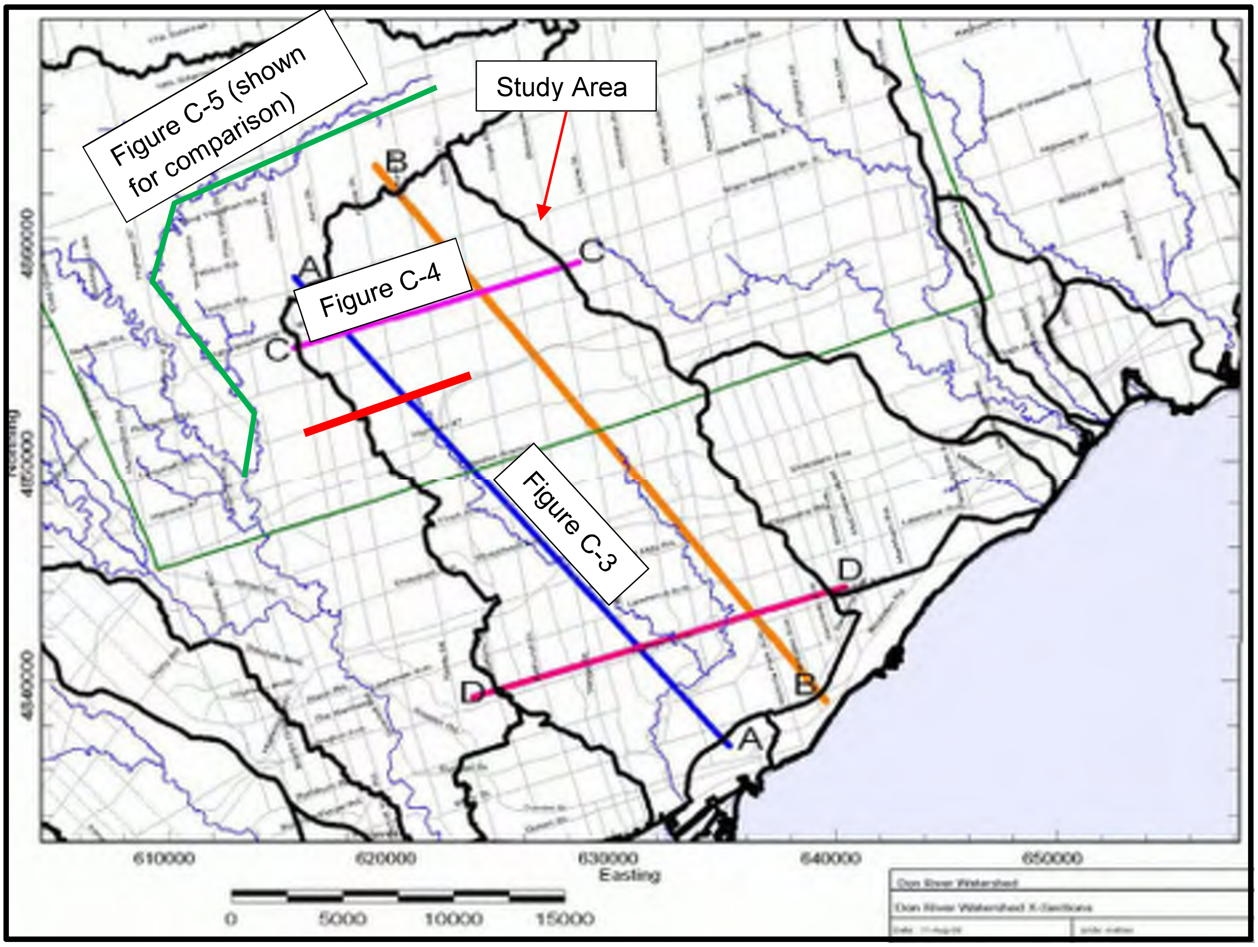


Figure C-2: Locations of Geological Cross Section Prepared by TRCA (2009).



APPENDIX C – Excerpts from TRCA (2008) – Geology of the Humber River Watershed, and TRCA (2009c) - Geology of the Don River Watershed

Figure C-3: Generalized Geological Cross Section along the West Don River.

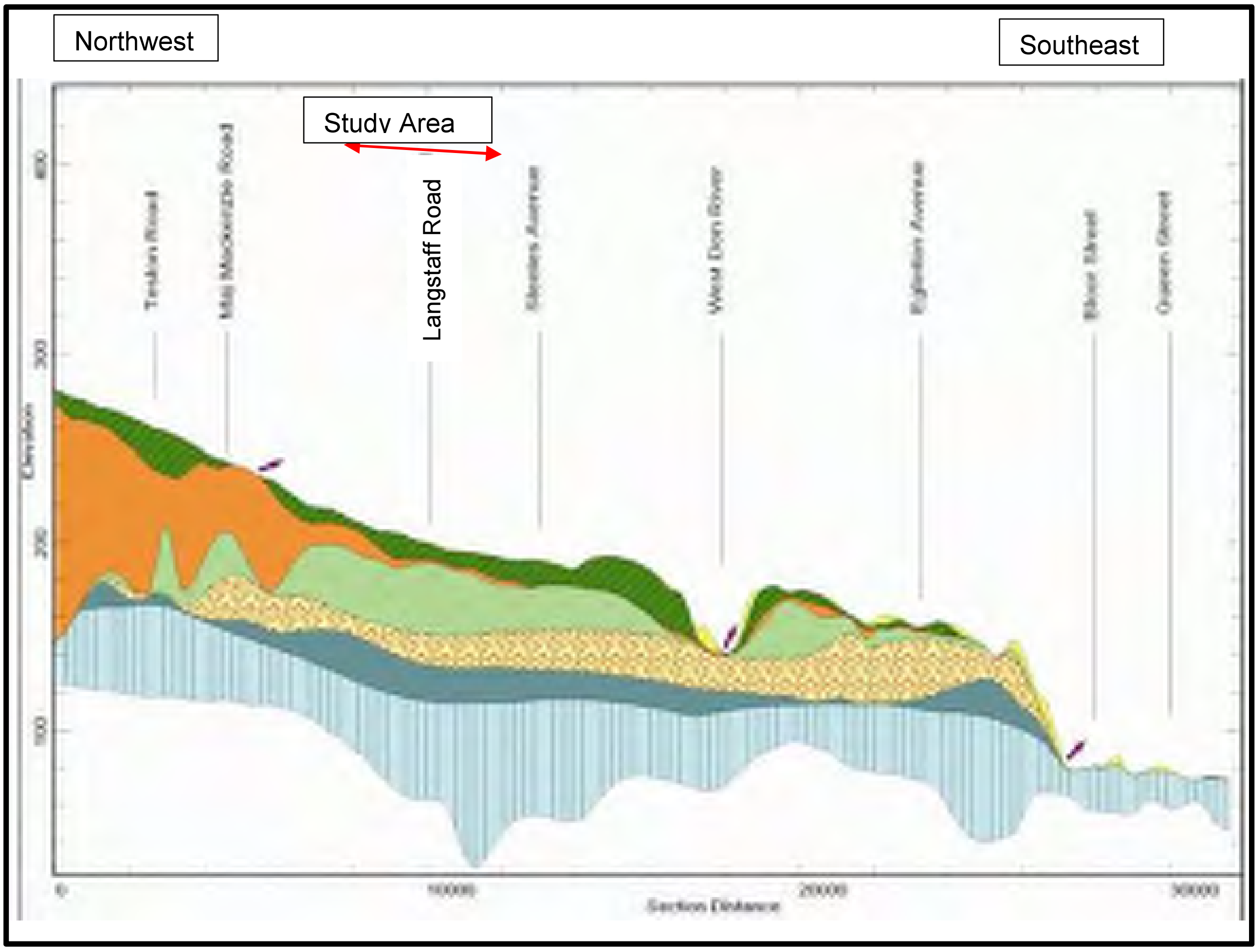


Figure C-4: Generalized Geological Cross Section along Major MacKenzie Drive.

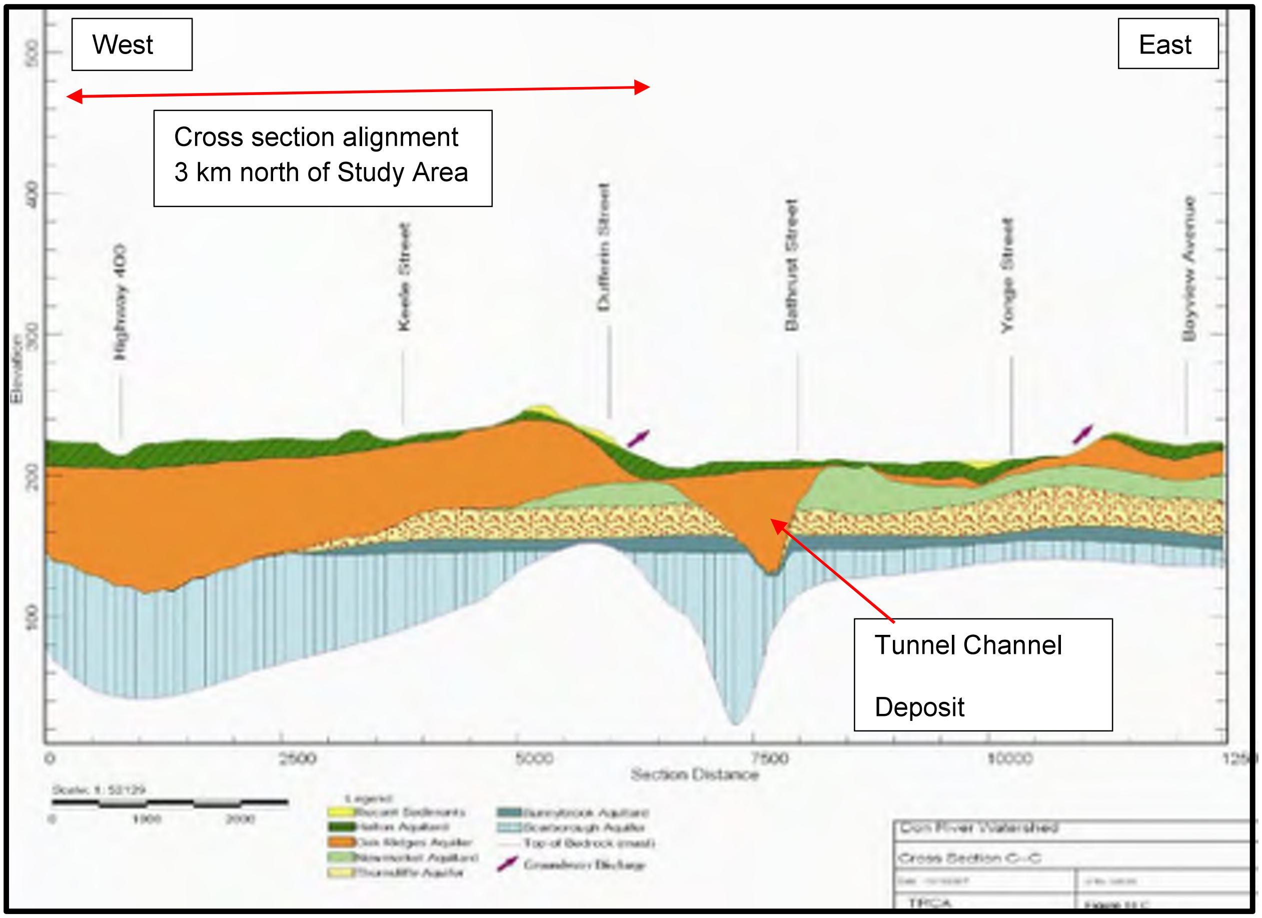
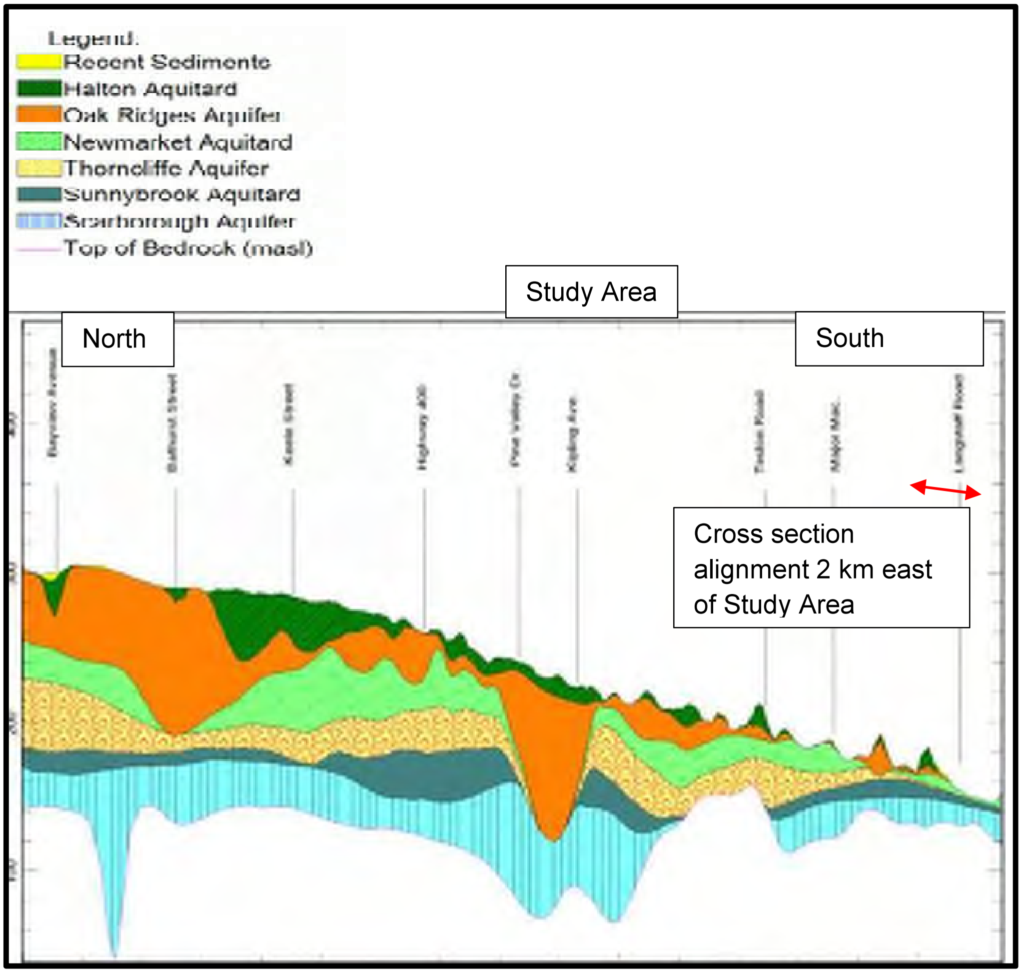


Figure C-5: Generalized Geological Cross Section along the East Humber River (from TRCA, 2008).

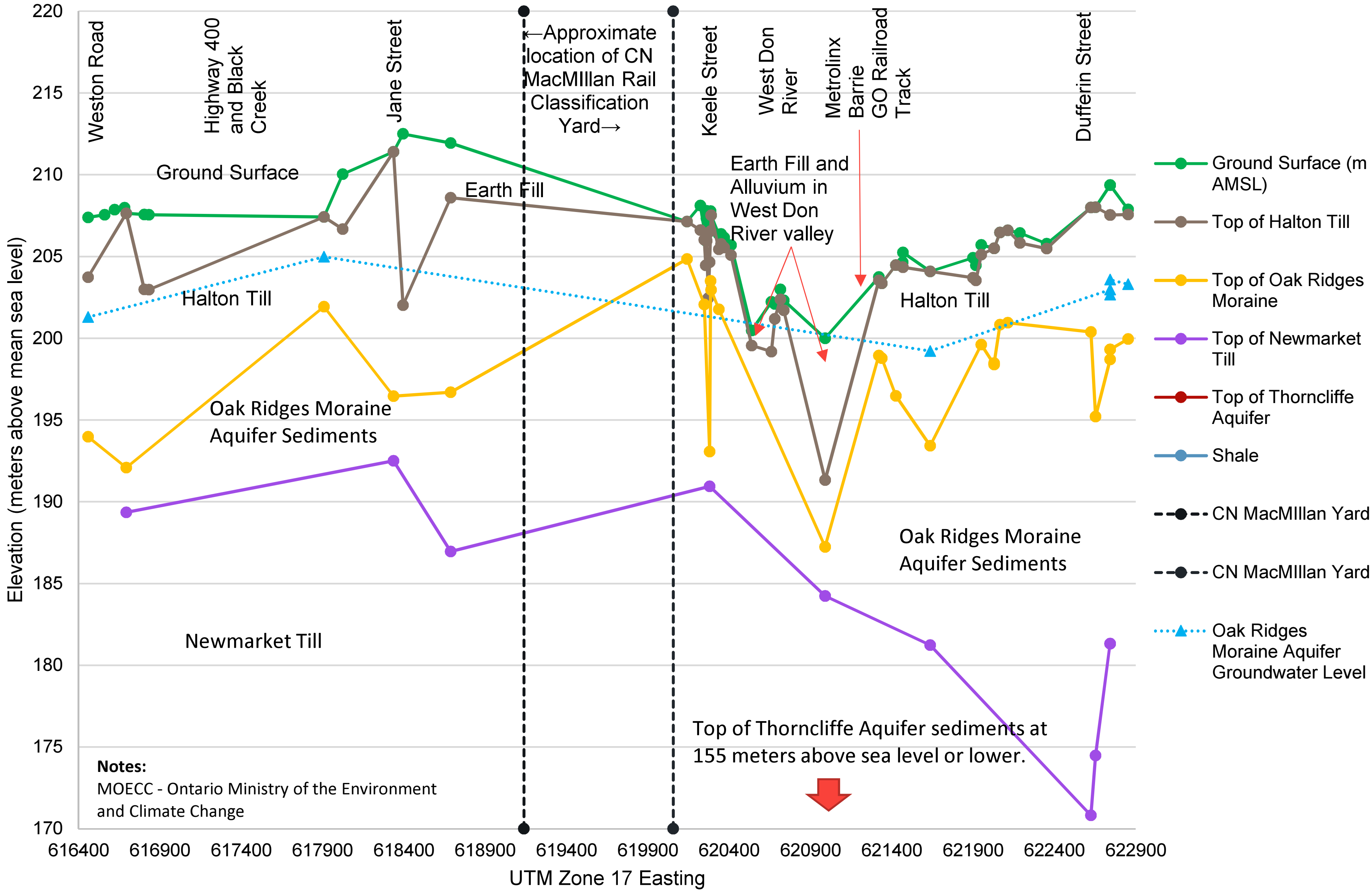


APPENDIX

D

INTERPRETED GEOLOGICAL CROSS SECTION ALONG LANGSTAFF ROAD PREPARED USING MOECC WELL RECORDS

Interpreted Geolological Cross Section along Langstaff Road between Weston Road and Highway 7 based on MOECC Water Well Records



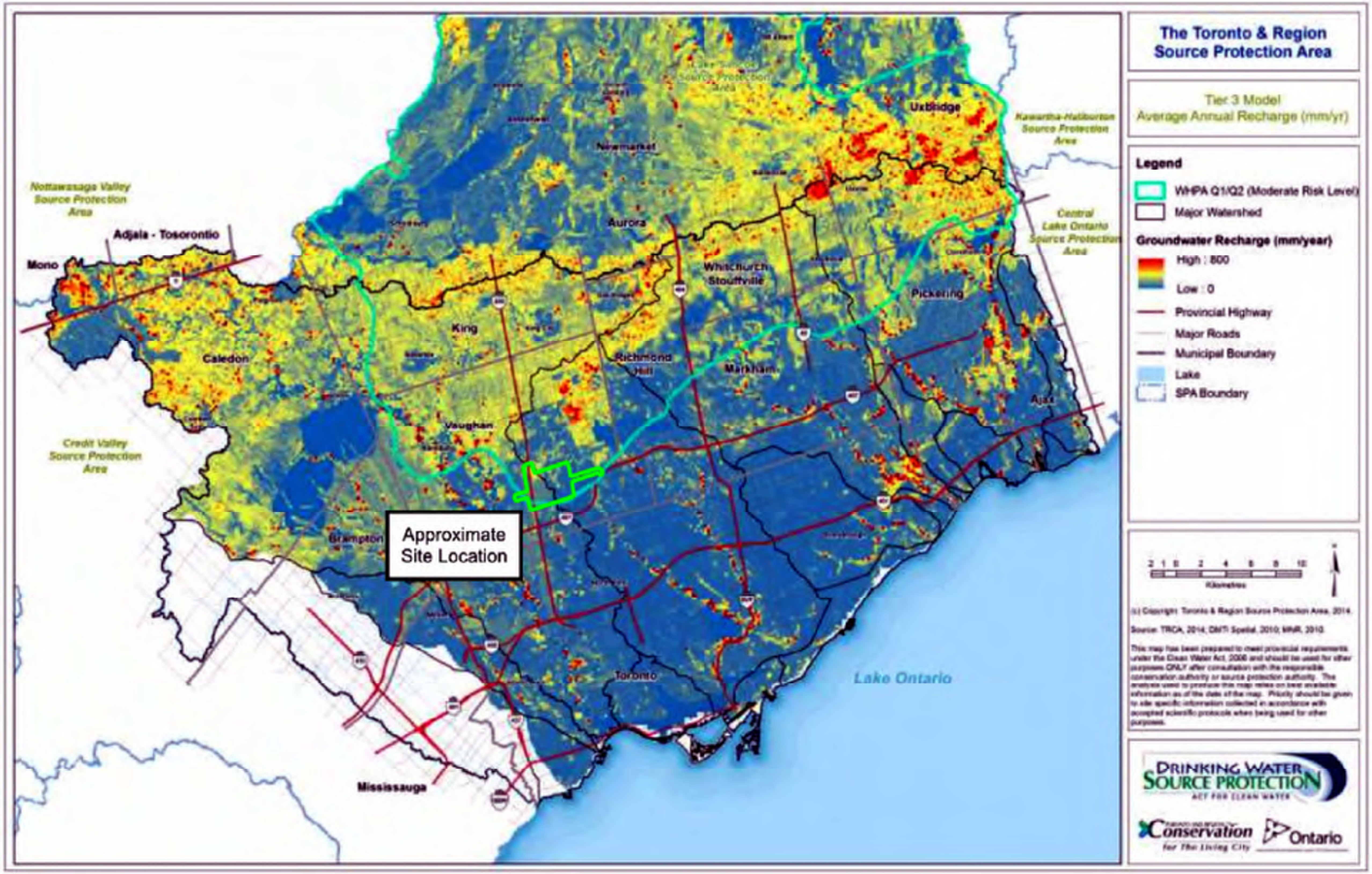
Notes:
MOECC - Ontario Ministry of the Environment and Climate Change

Wsp Ref. 16M-

APPENDIX

E

TORONTO AND REGION SOURCE PROTECTION AREA SOURCE PROTECTION FIGURES



Scale: As Shown

wsp

HYDROGEOLOGICAL ASSESSMENT
LANGSTAFF ROAD SCHEDULE "C" MUNICIPAL CLASS ENIRONMENTAL ASSESSMENT
VAUGHAN, ONTARIO

GROUNDWATER RECHARGE

DATE:
DECEMBER 2017

PROJECT:
16M-01457-01

APPENDIX
E-1

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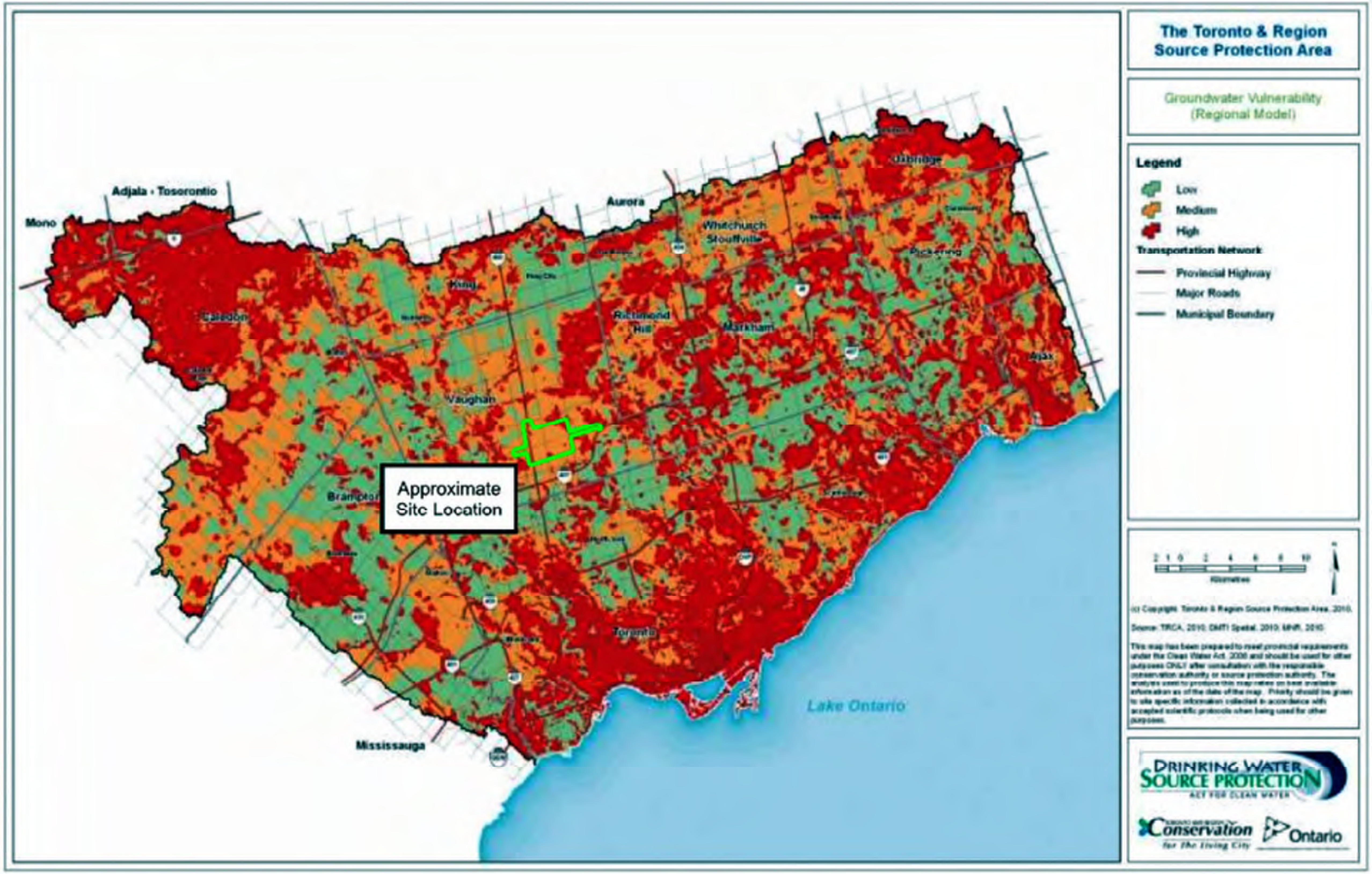

Scale: As Shown

WSP	HYDROGEOLOGICAL ASSESSMENT LANGSTAFF ROAD SCHEDULE "C" MUNICIPAL CLASS ENIRONMENTAL ASSESSMENT VAUGHAN, ONTARIO **GROUNDWATER VULNERABILITY**	DATE: DECEMBER 2017 PROJECT: 16M-01457-01	APPENDIX E-2

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APPENDIX

F

ENVIRONMENTAL ACTIVITY SECTOR REGISTRY AND ENVIRONMENTAL COMPLIANCE APPROVAL LOCATIONS

EASR and ECA Approvals Locations
Langstaff Road between Weston Road to Highway 7
Hydrogeological Assessment

Legend:

Environmental Activity Sector Registry (EASR) Approval

Environmental Compliance Approval (ECA)

WSP Ref. 16M-01457-01

Data Source:http://www.gisapplication.lrc.gov.on.ca/AccessEnvironment/IndexAccEnv.html?viewer=AccessEnvironment.AE&locale=en-US