

APPENDIX

G

HYDROGEOLOGY REPORT



REGIONAL MUNICIPALITY OF HALTON

STEELES AVENUE CORRIDOR IMPROVEMENTS
CLASS ENVIRONMENTAL ASSESSMENT
(TREMAINE ROAD TO INDUSTRIAL DRIVE,
MILTON)
HYDROGEOLOGICAL ASSESSMENT

MAY 3, 2022





STEELES AVENUE
CORRIDOR
IMPROVEMENTS CLASS
ENVIRONMENTAL
ASSESSMENT
(TREMAINE ROAD TO
INDUSTRIAL ROAD,
MILTON)
HYDROGEOLOGICAL
ASSESSMENT

REGIONAL MUNICIPALITY OF HALTON

PROJECT NO.: 17M-00979-00
DATE: MAY 03, 2022

WSP

WSP.COM



The Regional Municipality of Halton
Address 1
Address 2

Attention:

Dear Madam/Sir:

Subject: Steeles Avenue Corridor Class Environmental Assessment (Tremaine Road to Industrial Road) - Hydrogeological Assessment Report

WSP Canada Group Limited is please to provide the following hydrogeological assessment report with respect to the ongoing Class Environmental Assessment for Steeles Avenue between Tremaine Road and Industrial Road, in Milton, Ontario. WSP understands that Halton Region wishes to undertake road improvements to improve traffic movement along this portion of Steeles Avenue while also maintaining

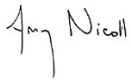
Yours sincerely,

A handwritten signature in grey ink that reads 'Peter van Driel'.

Peter vanDriel

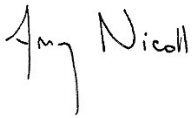
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cc:
WSP ref.: 17M-00979-00-451

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1 INTRODUCTION

The Regional Municipality of Halton (Halton Region) retained WSP Canada (WSP) to complete a hydrogeological assessment in support of the Municipal Class Environmental Assessment (MCEA) for Steeles Avenue improvements and widening from Tremaine Road to Industrial Drive. In addition to conducting Site Visits on December 1, 2017, and August 26, 2018, WSP reviewed the following reports while preparing this environmental assessment:

- 1) Earth Fx, February 2014. Tier 3 Water Budget and Local Area Risk Assessment for the Kelso and Campbellville Groundwater Municipal Systems Risk Assessment Report.
- 2) Ecoplans, a Member of MMM Group Limited, June 2013. Temporary Category 3 Permit to Take Water Application Hydrogeological Assessment. Tremaine Road Widening and Realignment from Main Street to Steeles Avenue, Milton, Ontario. Prepared for the Regional Municipality of Halton.
- 3) GHD, October 2013. Jannock Lands Restoration Plan, Milton Heights Landowner Group.
- 4) Halton Region, 2010. Vulnerability Analysis for the Milton and Campbellville Wellfields, Regional Municipality of Halton, Ontario.
- 5) Halton-Hamilton Source Protection Committee, July 2015. Assessment Report, Halton Region Source Protection Area. Approved by the Ontario Ministry of the Environment and Climate Change on August 5, 2015.
- 6) Milton Heights Neighbourhood Subwatershed Impact Study (AMEC et al., 2013);
- 7) MMM Group Limited's Contaminant Overview Study for Tremaine Road Permit-to-Take-Water (PTTW) from Steeles Avenue to No. 3 Side Road (2016) as a part of this project.
- 8) MMM Group Limited, July 2016. Category 3 PTTW, Tremaine Road Widening and Realignment from Steeles Avenue to No. 3 Side Road, Regional Municipality of Halton, Ontario;

Figure 1 highlights the extent of the study area, which includes an approximate five hundred meter buffer.

The proposed improvements to Steeles Avenue will generally include widening of the road from the existing two-lane rural cross-section to four lanes with urban cross-sections from Tremaine Road to Industrial Drive. Road improvements may include a grade separation and possible realignment of Steeles Avenue south of its current location, along with minor reconfiguration of lanes along the existing road alignment, modification of sidewalks and road shoulders, and landscaping. It is noted that the portion of Steeles Avenue east of Sixteen Mile Creek West Branch is currently being widened from two lanes to four lanes, by Fermar Construction, and this work has already included constructing a storm water management facility (wet pond) on the north side of Steeles Avenue west of Industrial Drive. The following background information is provided in appendices to this report:

- Standard conditions and limitations are provided in **Appendix A**;
- Site photographs taken on December 1, 2017, August 26, 2018, as well as from an airplane flyover (July 21, 2018), supplemented by images from Google Earth, are provided in **Appendix B**;
- Conceptual road alignment design drawings are provided in **Appendix C**;
- Laboratory certificates of analyses, for two water samples collected on December 1, 2017 (Sixteen Mile Creek West Branch and Tributary NW-1-E) are provided in **Appendix D**;
- Excerpts from the Milton Heights Neighborhood Subwatershed Impact Study (2013) are provided in **Appendix E**; and
- Ontario Ministry of the Environment, Conservation, and Parks (MECP) Water Well Records are provided in **Appendix F**.

In order to widen the road, several structures may need to be reconstructed or widened, including (from East to West):

- 1) A sediment basin may need to be altered, with twin culverts across Steeles Avenue, located immediately to the west of Industrial Drive, which directs the runoff in the intersection area to the Sixteen Mile Creek West Branch.
- 2) The Sixteen Mile Creek West Branch bridge, between Peru Road and Industrial Drive, will need to be reconstructed;
- 3) The NW-E-1 Tributary culvert, located immediately west of the Canadian Pacific Railway (CPR) crossing of Steeles Avenue, may need to be reconstructed;
- 4) The farm access road culvert crossing of an unnamed tributary to Sixteen Mile Creek. This channel runs along the north side of Steeles Avenue from new Tremaine Road to the CPR Railway. The farm culvert is located approximately 150m west of the CPR Railroad; and
- 5) A grade separation is proposed at the CPR Railway crossing of Steeles Avenue, which may or may not be on the existing alignment.

Road alignment options are being evaluated as part of the MCEA study. Two road alignment options are currently being evaluated, each with several grade separation sub-options. A preferred alternative has not been selected. The options are:

- 1) Option 1 – Widening on both sides of Steeles Avenue following the existing road alignment:
 - 1A Alignment at grade
 - 1B Alignment with an overpass over the CPR Railway crossing
 - 1C Alignment with an underpass below the CPR Railway crossing
- 2) Option 2 – Realign a portion of Steeles Avenue with a curve to the south in the vicinity of the CPR crossing:
 - 2B Alignment with an overpass over the CPR Railway crossing
 - 2C Alignment with an underpass below the CPR Railway crossing

The conceptual alignment options are presented in Appendix C.

Although the preferred road alignment option has not yet been selected, it is anticipated that both culverts will need to be replaced as part of this project, as well as the Sixteen Mile Creek bridge. Option 2 would require replacing the Sixteen Mile Creek Bridge, and the culvert for Tributary NW-1-E at a new location.

2 BACKGROUND

The study area is located within the City of Milton and the Region of Halton. The study area is also located within the Conservation Halton Authority (CH)'s jurisdiction, specifically the Sixteen Mile Creek watershed. Site photographs showing the general land use, physiography and topography are provided in **Appendix B**.

This section discusses the following studies and reports, which provide background information related to geology, hydrogeology, natural environments, and an overview environmental contamination, within the Steeles Avenue MCEA study area:

- AMEC et al., 2013. Milton Heights Neighbourhood Subwatershed Impact Study.
- GHD, October 2013. Jannock Lands Restoration Plan, Milton Heights Landowner Group.
- MMM Group Limited, 2016. Contaminant Overview Study (COC) for Tremaine Road PTTW from Steeles Avenue to No. 3 Side Road. Prepared for Halton Region.

2.1.1 MILTON HEIGHTS NEIGHBOURHOOD SUBWATERSHED IMPACT STUDY, AMEC, 2013

The Milton Heights Neighbourhood Subwatershed Impact Study (SIS) (AMEC et al., 2013), including Areas 1, 2 & 4, is a comprehensive study of existing environmental conditions and anticipated impacts of a proposed development north of Steeles Avenue. The SIS study area extends from Steeles Avenue (between the CPR Railway crossing to Peru Road) north to Highway 401, where it extends from Old Tremaine Road to Peru Road. The SIS study area overlaps a portion of the current Steeles Avenue MCEA study area north of Steeles Avenue, from the CPR Railway crossing to Peru Road. The southern portion of the study area, immediately north of Steeles Avenue, is part of the SIS Area 4.

The SIS provides a description of the geology hydrogeology, and surface water characteristics within this area. The hydrogeological study included a groundwater monitoring program, borehole logs, and completion of four schematic cross-sections through the study area. Cross-sections D-D' (eastern portion) and A-A' (southern portion) are within the current study area. Further descriptions of these cross-sections is found in section 2.6 of this report, and these hydrogeological cross sections are provided in **Appendix E**.

The SIS study includes mapping showing the locations of several watercourses within the Steeles Avenue MCEA study area, including Tributaries NW-1-E and the west branch of Sixteen Mile Creek.

2.1.2 JANNOCK LANDS RESTORATION PLAN, MILTON HEIGHTS LANDOWNER GROUP – DRAFT REPORT, GHD, OCTOBER 2013

The Jannock lands property, located west of the CPR Railway to Old Tremaine Road and north of Steeles Avenue, are proposed as compensation lands for habitat loss associated with the Milton Heights development. GHD (October 2013) was retained to prepare a restoration plan for wetlands within the Jannock Lands, and this report was reviewed. The Jannock Lands property is the site of a historical shale quarry and brickworks, whereby quarrying and site decommissioning left several large depressions on the property. The proposed restoration plan intends to enhance the variability and function of the natural ecosystem in two large depressions which have reverted to naturalized wetlands. All proposed works as per the Steeles Avenue MCEA avoid impacting high constraint features, and are intended to minimize grading requirements and impacts to existing drainage patterns.

The southern wetland (Wetland 1) is located approximately 350 m north of Steeles Avenue, between Old Tremaine Road and the CPR Railroad. The southern wetland lies within the Steeles Avenue MCEA study area, but will not be directly affected by the proposed works. The northern wetland (Wetland 2) is located approximately 700m north of Steeles Avenue, and lies north of the Steeles Avenue MCEA study area.

The Regional Municipality of Halton (Halton Region) has recently completed construction of a realignment for Tremaine Road between Steeles Avenue and No. 3 Side Road, which passes through the Jannock Lands property (MMM Group, May 2016). This new road passes immediately east of these two wetland features and the road has been carefully designed with engineered works to maintain the hydrology of these two wetland features, as well as minimize impact or changes to watercourses on the downstream side of the road. The new Tremaine Road includes a grade separation (underpass) at the CPR.

2.1.3 CONTAMINANT OVERVIEW STUDY FOR TREMAINE ROAD PTTW FROM STEELES AVENUE TO NO. 3 SIDE ROAD, 2016

A contaminant overview study was completed in support of the Permit to Take Water (PTTW) application for the realignment of Tremaine Road from Steeles Avenue to 3rd Sideroad in Milton, ON. This included a comprehensive environmental database search (EcoLog ERIS) of a study area which overlapped the western portion of the current study area for the Steeles Avenue MCEA, ending just west of the CPR Railway crossing. The query search results indicated that in this area (along Steeles Avenue, west of Peru Road), there is low risk of potential contaminants from the surrounding area that may pose an adverse concern to the environment during construction and dewatering.

It is noted that residential, commercial and industrial land uses are present along Steeles Avenue east of Peru Road, which pose moderate to higher environmental risks as relates to soil and groundwater impacts. There is also a moderate risk of encountering environmental contamination along the CPR railway due to leaks, spills, and use of creosote as a wood preserver for railroad ties.

2.1.4 VULNERABILITY ANALYSIS FOR THE MILTON AND CAMPBELLVILLE WELLFIELDS, 2010

The Vulnerability Analysis was completed to delineate the wellhead protection area for the Milton and Campbellville wellfield. This report includes detailed physiographic and geological mapping as well as regional stratigraphy and water balance information in the vicinity of the Site.

The Steeles Avenue MCEA Site is entirely in the Sixteen Mile Creek West Branch sub watershed. The report presents a stream hydrograph for Sixteen Mile Creek in Milton (near but not at the Steeles Avenue crossing within the Site), noting that there is a typical base flow around 0.25 to 0.5 cubic meters per second, but peak flows up to and occasionally exceeding 5 cubic meters per second. The flow in the Sixteen Mile Creek West Branch is moderated by the presence of the Kelso Dam, both to augment base flow and minimize peak flows. Figure 6.9 of the report (provided in **Appendix G**) suggests that in the area, precipitation landing on the ground reaches the water table relatively quickly, typically within five years, indicating moderate to high groundwater vulnerability, particularly west of Peru Road, where bedrock is interpreted to be close to ground surface. However the Site lies outside of the interpreted capture zone for any municipal groundwater production wells.

2.1.5 TIER 3 WATER BUDGET AND LOCAL AREA RISK ASSESSMENT FOR THE KELSO AND CAMPBELLVILLE GROUNDWATER MUNICIPAL SYSTEMS, 2014

This study built on the Vulnerability Analysis to provide a water balance / water budget for the region, which includes the Steeles Avenue MCEA study area. The study provides modeling results of the existing water budget as well as future water budgets given various development scenarios. The Site is not within any wellhead protection areas or groundwater capture zones for municipal water supply wells.

2.2 LAND USE

The study area includes both natural and urban areas. The eastern portion of the study area (from Industrial Road to Peru Road) includes low density residential, commercial, light industrial and naturalized areas (Sixteen Mile Creek West Branch corridor) and a conference center. West of Peru Road, the lands adjacent to Steeles Avenue are former agricultural or naturalized areas, with some properties zoned for future development. The Jannock Lands located north of Steeles Avenue and east of Old Tremaine Road were the site of a former quarry and brickworks, and are intended to be left in a natural state as well as providing passive outdoor recreation. The Niagara Escarpment lies immediately west of the study area, crossing the study area in a generally north-south direction. The Jannock Lands lie within the Niagara Escarpment Commission (NEC) regulated area. According to the Town of Milton (2015), the lands to the south of Steeles Avenue, west of the CPR tracks, and east of Tremaine Road, are not zoned for future development, and are zoned as agricultural at this time.

2.3 PHYSIOGRAPHY AND TOPOGRAPHY

As per Chapman and Putnam (1984), the Site includes three physiographic regions of Ontario, including the Niagara Escarpment, the South Slope, and the Peel Plain.

The western end of the study area lies at the base of the Niagara Escarpment, near an outlier of the Escarpment called the Milton Outlier. The Niagara Escarpment (Milton Outlier) ascends approximately 90 meters (m) over a distance of approximately 500 m just west of Tremaine Road at Steeles Avenue, whereby Steeles Avenue ascends this ridge, west of Tremaine Road. Photographs are provided in **Appendix B**. From Tremaine Road moving east, Steeles Avenue traverses an area of gently rolling hills, sloping gently down towards the Sixteen Mile Creek West Branch, which flows within a small incised valley (5-10 meters below surrounding table lands). Steeles Avenue spans the Sixteen Mile Creek West Branch approximately half way between Peru Road and Industrial Drive. East of Sixteen Mile Creek, Steeles Avenue ascends a gentle slope back up to the local tableland elevation (approximately 200 to 210 meters above mean sea level (m AMSL)). The topography within the eastern portion of the study area has been modified by roadworks, the construction of a sediment detention pond north of Steeles Avenue, and the CNR Railway crossings (The CNR crosses Steeles Avenue on an overpass east of Industrial Road). South of the study area, the former agricultural lands are composed of plains and gently rolling hills. There is a steady slope from west to east which is part of the lower slope of the Niagara Escarpment. Then, across the creek, there is a lesser slope back up to the local tableland elevation. Overall, the tableland generally slopes to the southeast, towards Lake Ontario.

2.4 GEOLOGY

As per Rand and Beacon (2013) and Earth Fx (February 2014), the geology in the Site-vicinity generally consists of Halton Till, a glacial till consisting of dense clayey silt to silty clay overlying shale bedrock (Queenston Formation). Within the eastern portion of the Site, there is a thin veneer of generally fine grained glaciolacustrine sediments, locally present atop the Halton Till, attributed to a prehistoric glacial lake (Lake Peel), which existed towards the end of the most recent (Laurentide) continental glaciation, approximately 11,000 years before present (Chapman and Putnam, 1984). Alluvial deposits are noted to be present along the Sixteen Mile Creek valley (Earth Fx, 2014) within the floodplain area.

To the west of the Site, the geology of the Niagara Escarpment includes a dolostone caprock (Amabel Formation) overlying several rock formations ranging from shale to sandstone to limestone / dolostone (Clinton-Cataract Group), within the Escarpment Slope. The lower slopes of the Niagara Escarpment are overlain by Halton Till,

however the Amabel Formation outcrops as a steep cliff, up to 30 meters high, at the brow of the Niagara Escarpment.

The Halton Till is the dominant near-surface stratum throughout much of the Site vicinity. As observed by WSP in the Site-vicinity, the Halton Till grades downward into the Queenston Formation bedrock (soft red-brown shale with harder grey siltstone and clay seams and occasional limestone seams). The upper portion of the Queenston Formation is highly weathered, making it difficult in some areas to distinguish the top of the bedrock from the overlying Halton Till. The Queenston Formation is regionally extensive, found throughout as the uppermost bedrock unit Halton Region below the Niagara Escarpment (Holysh, 1997).

In the Site-vicinity, the Queenston Shale bedrock elevation varies, such that it is close to the ground surface in the western portion of the study area, however is deeper (10 meters or more) east of the CPR crossing, and in the vicinity of Sixteen Mile Creek, as per Rand and Beacon (2013) (Geological cross sections provided in **Appendix E**). These cross sections indicate the presence of a bedrock valley in the vicinity of the current course of Sixteen Mile Creek, whereby there is a sandy unit five to ten meters below ground surface, between an upper and lower layer of clayey silt till (interpreted as Halton Till). Shale rock faces are exposed within the Jannock Lands property, west of the CPR, where the Queenston Shale is close to the general ground surface. Overburden thickness mapping indicates that a bedrock valley is present below the Sixteen Mile Creek West Branch through the study area (Earth Fx, April 2010).

2.5 REGIONAL HYDROGEOLOGY

The 2013 Milton Heights SIS study provides information on the hydrogeology of the Site-vicinity. This study identified four main hydrostratigraphic units in the Site-vicinity, which include:

- 1) Modern alluvial deposits on the Sixteen Mile Creek West Branch floodplain, which act as a surficial aquifer where present (Hewitt 1969);
- 2) Halton Till unit, comprised primarily of clayey silt till, with localized interbedded clay, silt, and sand glaciofluvial and glaciolacustrine deposits. Generally, the Halton Till functions as an aquitard (Holysh, 1997);
- 3) As per Rand and Beacon (2013), there are localized silt and sand layers present within the Halton Till, in particular within the interpreted bedrock valley below the Sixteen Mile Creek West Tributary. These sand lenses are interpreted to function as confined aquifers with groundwater yield related to the sedimentary nature of the aquifer sediments; and
- 4) Queenston Shale, whereby the upper, weathered portion of the shale acts as a poor aquifer, however present throughout Halton Region below the Niagara Escarpment (Holysh, 1997). The bedrock porosity is generally low due to compaction of the shale materials since its deposition, although groundwater does flow through fractures, joint and faults within the rock, which tend to become tighter with depth.

Groundwater recharge rates are generally low within the Steeles Avenue MCEA study limits due to the fine-grained nature of the Halton Till (Earth Fx, April 2010). In naturalized areas and fields, net groundwater recharge rates are generally 100-200 mm per year in areas covered by Halton Till (Conservation Halton, 2014). Recharge rates can be much higher on the escarpment where bedrock is near the ground surface. Recharge rates may also be higher within the Jannock Lands property due to historical alteration of the natural geology, including placement of earth fill materials, and exposure of shale bedrock, combined with wetlands which allow water to pool and potentially infiltrate (GHD, October 2013). Infiltration rates are generally lower in urban areas due to impervious surfaces (pavement and rooftops).

Table 2.5 Summary of Regional Hydraulic Conductivity (K) Measurements

GEOLOGICAL UNIT	HYDRAULIC CONDUCTIVITY (K)		
	GEOMETRIC MEAN (METERS/SECOND)	MAXIMUM K (METERS/SECOND)	MINIMUM K (METERS/SECOND)
Halton Till	1.7 x 10 ⁻⁸	4.8 x 10 ⁻⁵	7 x 10 ⁻¹⁰
Queenston Shale	7.9 x 10 ⁻⁷	3.2 x 10 ⁻⁵	1 x 10 ⁻⁸

Source : Halton Aquifer Management Plan, Phase 2 Report. Municipal Wellhead Protection Program - Technical Study. Steve Holysh. (April 1997)

2.6 SITE-SPECIFIC HYDROGEOLOGY

Available mapping and the presence of fire hydrants indicates that municipal water is available to the homes along Steeles Avenue and Peru Road. In those areas where servicing is available, residences may be using municipal water. However, many of the houses in the area are older and may have groundwater wells that are still in use. Well surveys will be required at detailed design to determine which residences are currently using private wells.

The Site overlies the southern portion of a deep bedrock valley (Earth Fx, April 2010, and Rand and Beacon, 2013). The northern limb of the valley is found north of the Site near No 5 Sideroad, and the southern limb of the valley is on the Jannock lands and extends across Steeles Avenue. In between, the valley is filled with impermeable till and confined sand layers (Rand and Beacon, 2013, refer to cross sections in **Appendix E**).

Mapping of static groundwater levels within the area indicates that shallow groundwater flow is from the west to the east towards Sixteen Mile Creek West Tributary, in the Steeles Avenue MCEA study limit, with some local contribution from the north side of Sixteen Mile Creek (Halton Region, 2010, and Rand and Beacon, 2013). Shallow groundwater flow is generally controlled by topography as the Halton Till limits downward infiltration. Limited artesian conditions are scattered throughout the region, and may be most pronounced along the lower portion of the escarpment slope, as well as in confined sand aquifers and the bedrock aquifer below the Sixteen Mile Creek West Branch valley.

The Milton Heights SIS (2013) includes site specific geological cross sections in the vicinity of the Steeles Avenue MCEA study area. The sections provide detailed mapping of the local stratigraphy and hydrogeological conditions. The two most relevant cross-sections are A-A' and D'D' (**Appendix E**).

Cross-section A-A' extends from northwest of the study area to approximately 25m south of the intersection of the CPR Railway crossing and Steeles Avenue. The surface elevation ranges from approximately 208 – 210 m AMSL north of Steeles Avenue and rises to approximately 215 m AMSL south of Steeles Avenue. The uppermost layer is till (Halton Till), which becomes thicker within the bedrock valley north of Steeles Avenue. South of Steeles Avenue is the southern limb of the bedrock valley which rises to approximately 10 m below the surface in this location. A thin sand lens (confined aquifer) is found within the till layer at an elevation of approximately 205-207 m AMSL north of Steeles Avenue. Slight artesian conditions were found just north of Steeles Avenue at Monitoring Well 06-02 (drilled by AMEC in 2006), likely associated with the confined sand aquifer.

Cross-section D-D' is located approximately 300 m north of Steeles Avenue between Peru Road and Old Tremaine Road. The escarpment in the west gives way to the till plain in the east. A sand lens is present at a depth of approximately 203 – 204 m AMSL. Slight artesian conditions were found at wells located along the lower escarpment slope (Monitoring Wells 06-07, 06-08 and 06-B D, completed in the Halton Till unit), with the most pronounced artesian condition at the bottom of the slope near the confluence of Tributaries NW-1-D and NW-1-E.

Based on the monitoring wells by AMEC and the Vulnerability Analysis, there is a high potential that construction dewatering will be required for the following works:

- a) Construction of any below ground works (culvert replacements and storm sewers) along Steeles Avenue from Tremaine Road to the CPR Railway, due to groundwater levels close to the ground surface;
- b) Construction of below-ground works required for any grade separation at the CPR, including more significant construction dewatering and long-term dewatering if an underpass option is selected; and
- c) Construction of below-ground works required for a replacement bridge structure for Steeles Avenue over the Sixteen Mile Creek West Tributary.

2.7 WATER QUALITY SAMPLING

On December 1, 2017, WSP sampled two surface water features within the study area. These water sampling locations are indicated on Figure 4 (Natural Features). The sampling sites included:

- 1) Sixteen Mile Creek West Branch underneath the existing Steeles Avenue Bridge. UTM Co-ordinates: Easting: 588668 m, Northing: 4818432 m.
- 2) Sixteen Mile Creek Tributary NW-1-E, at its confluence with the Unnamed Tributary to Sixteen Mile Creek. The sample was taken in a small pool area just north of Steeles Avenue and west (immediately upstream) of the CPR railroad culvert. UTM Co-ordinates: Easting: 588347 m, Northing: 4818017 m.

The results of the water quality analysis are included in Appendix D. All water quality results were within the acceptable range of Ontario Provincial Water Quality Objectives criteria, with the exception of higher iron (tested: 370 µg/L, criteria: 300 µg/L) and phosphorous (tested: 0.013 mg/L, criteria 0.01 mg/L) in Tributary NW-1-E.

3 SENSITIVE ENVIRONMENTAL FEATURES

3.1 EXISTING CONDITIONS

Provincial mapping of natural features in the site-vicinity are presented in **Figure 4**. Photographs taken during a site visit on December 1st, 2017, and August 26, 2018 are provided in **Appendix B**. The study area contains a variety of sensitive natural features, including several watercourses, wooded areas, escarpment rural areas and unevaluated wetlands. The 500m buffer area includes lands classified as escarpment natural area and escarpment protection area. These lands are located west of the proposed work area (west of Old Tremaine Road). Also within the buffer area but outside of the proposed work area (east of Bronte Street North) is an evaluated wetland along the West Branch of Sixteen Mile Creek corridor.

3.1.1 LOCAL WATERCOURSES AND NATURAL FEATURES:

- **Unnamed Tributary to Sixteen Mile Creek:** From Tremaine Road to approximately 230 m east, this creek has been realigned as a “naturalized ditch” as part of the Tremaine Road and Steeles Avenue intersection construction. From the end of the realignment to the CPR railway, the creek is a roadside ditch flowing east along the north side of Steeles Avenue. The channel crosses through a farm culvert approximately 150m west of the CPR Railway. This watercourse is classified as an intermittent warm-water creek.
- **Tributary NW-1-E to Sixteen Mile Creek:** This watercourse is classified as an intermittent warm water creek. The channel crosses Steeles Avenue through a culvert (estimated span 1 m) located west of the CPR Railway.
- **West Branch of Sixteen Mile Creek:** Within the study area the creek flows north to south across Steeles Avenue, through a bridge with an estimated span of 15-20 m. South of Steeles Avenue, the creek meanders to the east to its crossing with the CNR Railway. This creek is classified as a permanent cold-water watercourse.
- **Unevaluated Wetland 1:** Located on Tributary NW-1-E, immediately east of the CPR Railway and north of Steeles Avenue. The southern portion of this wetland may be intercepted by the proposed works under Options 1 and 2 if a grade separation is pursued.
- **Unevaluated Wetland 2:** Located on Tributary NW-1-D, east of the CPR Railway approximately 250 m north of Steeles Avenue. This wetland will not be directly affected by the proposed works.
- **Evaluated Wetland:** Located on Sixteen Mile Creek West Branch, east of Bronte Street North. This wetland will not be directly affected by the proposed works.
- **Escarpment Rural Area:** Located south of the CPR tracks south of Steeles Avenue. A small portion of this area overlaps the proposed works under Option 2. The Niagara Escarpment Plan (2017) describes these areas as follows:
“Escarpment Rural Areas are an essential component of the Escarpment corridor, including portions of the Escarpment and lands in its vicinity. They provide a buffer to the more ecologically sensitive areas of the Escarpment.”
- **Wooded areas:** Approximately five separate wooded areas of various sizes may be affected by the proposed works under Options 1 and 2.

3.1.2 MOECC WELL RECORDS

There are approximately 64 Ontario Ministry of the Environment, Conservation, and Parks (MECP) water well records (WWR) within the study area, over a time span of 1951 to 2016. Recorded well uses include water supply wells, test holes, monitoring wells, observation wells, and water well abandonments. These water well records indicated a depth to bedrock ranging from 0-23m below ground surface within the Site-vicinity. The locations of MECP WWRs are shown in **Figure 5** and a printout summary is provided in **Appendix F**.

The locations of surveyed domestic wells are also shown on **Figure 5**. This information was gathered as part of the hydrogeological assessment study for the Tremaine Road extension from Main Street to Steeles Avenue (Ecoplans, June 2013).

3.1.3 SURVEYED WATER WELLS

Ecoplans (June 2013) completed a Temporary Category 3 Permit to Take Water Application Hydrogeological Assessment, for Tremaine Road Widening and Realignment from Main Street to Steeles Avenue, Milton, Ontario. As part of this effort, Ecoplans surveyed private water wells within 500 meters of this section of Tremaine Road (now constructed), and much of the 2013 Tremaine Road well survey area overlaps with the study area for this EA for Steeles Avenue West. Ecoplans (June 2013) identified 13 private water supply wells on 13 private properties (residential and agricultural) along Tremaine Road south of Steeles Avenue, whereby 11 of these water wells were in use as domestic water supplies. Of these water supply wells, five were interpreted to be completed into the bedrock aquifer, three into overburden aquifers, and for the remaining five, it was not known if the wells were completed into overburden or bedrock aquifers. The well depths ranged from four meters deep to 30.5 meters deep. The locations of these wells are shown on **Figure 5**, and additional information about these water wells is summarized in **Appendix G**.

3.1.4 MOECC PERMITS TO TAKE WATER (PTTW), EASRS AND ECAS

There is one active MECP PTTW in the Site-vicinity (within 500 meters), which is for construction dewatering associated with construction of the new Tremaine Road between Steeles Avenue and No. 3 Side Road. MECP mapping indicates several approved EASRs and ECAs within the study area north of Steeles Avenue. Mapping of MECP PTTW, EASRs and ECAs are presented in **Figures 5 and 6**.

3.2 SOURCE WATER PROTECTION

The study area lies within the Halton Region Source Protection Area (SPA). Based on a review of the Halton Region SPA Assessment Report (2015) the study area includes the following:

- Figure 4.6: The study area is located within a lower-tier municipality. Sixteen Mile Creek West Branch is indicated to be a cold-water creek;
- Figure 5.8: The study area is located within an area with Moderate monthly surface water stresses, with 34% total water demand for the entire sub watershed;
- Figure 5.9: Annual groundwater stress is low, with 1% demand for the entire sub watershed;
- Figure 5.11: The Steeles Avenue study area is located within the Tier 3 Study Area;
- Figure 6.9: The intrinsic groundwater susceptibility index within the study area is Medium;
- Figure 6.10: The study area is not located within a Highly Vulnerable Aquifer;

- Figure 6.12: Significant Groundwater Recharge Area (SGRA): Within the study area, the Sixteen Mile Creek West Branch creek corridor (area of alluvial deposits) is classified as an SGRA along with several other smaller isolated pockets. Most of the study area is not an SGRA;
- Figure 6.13: Significant Groundwater Recharge Area Vulnerability: The portions of the study area classified as SGRAs are indicated to have Medium vulnerability; and
- Figure 7.1: Managed Land Map Wellhead Protection Areas.

Appendix F includes the figures listed above with the study area highlighted. The SPA Assessment Report indicates that areas located below the Niagara Escarpment, which includes the study area, typically have limited infiltration due to the presence of till and shale. The calculated groundwater recharge rate for areas below the escarpment was approximately 115 mm per year. Figure 6.12 indicates that only isolated portions of the study area are Significant Groundwater Recharge Areas (SGRAs).

The section of Steeles Avenue between Tremaine Road and Industrial Road does not pass through any municipal wellhead protection areas (WHPAs).

3.3 POTENTIAL SOURCES OF CONTAMINATION / AREAS REQUIRING DETAILED ENVIRONMENTAL ASSESSMENT DURING DETAILED DESIGN

3.3.1 POTENTIAL SOURCES OF CONTAMINATION

WSP carried out a site visit along Steeles Avenue on December 1, 2017, and completed a detailed review of aerial imagery, Google street view imagery, and conceptual designs for the Steeles Avenue improvements. Through these efforts, a list of potential sources of groundwater contamination was compiled, which are summarized in **Table 3.1**, which is included at the end of this report.

WSP identified a total of 11 areas of potential concern (APEC) ranking as either high to moderate. These include railway crossings, an industrial / commercial plaza and several industrial businesses. All of these APECs are listed in **Table 3.1**, including their ranking as high, moderate, or low potential concern.

WSP classifies areas of **high potential concern** as areas correspond to locations where land uses consist of commercial/industrial operations that could impact soil and/or groundwater quality within the Study Area, according to Ontario Regulation 153/04, as amended.

WSP classifies areas of **moderate potential concern** as locations where land uses consist of commercial/light industrial operations, suspected of using chemical compounds or performing activities that could impact soil and/or groundwater quality within the Study Area, according to Ontario Regulation 153/04 as amended.

All other areas indicate land use features considered to have a **low potential** for site contamination. These areas are generally classified as natural areas, open space or residential land use, which are not suspected of using chemical compounds harmful to the environment or human health.

For areas of both high and moderate potential concern, it is recommended that a soil contaminant investigation be carried out by a qualified environmental consultant to assess soil quality in support of property acquisition in areas within or in close proximity to the APECs with the moderate potential for contamination. This recommendation should be reviewed and refined during Detail Design.

3.3.2 AREAS REQUIRING DETAILED ENVIRONMENTAL ASSESSMENTS

Table 3.2 presents the need to carry out additional investigations related to hydrogeology and erosion and sediment control, within seven sub-regions of the Site, during the preliminary design and detailed design stages of the Project. Specifically, this table evaluates the need for specific types of investigations in each respective sub-area, including: Construction dewatering, requirement for in-water works, nearby environmentally sensitive areas, erosion and sediment control, private water supply wells, and potential environmental contamination. It is also interpreted that reconstruction and widening of this portion of Steeles Avenue may require relocation of existing overhead and buried utilities, including storm sewers, sanitary sewers, water mains, gas mains, electrical and telecommunications cables, potentially requiring construction dewatering. The specific need and requirements for additional hydrogeological investigations will be determined during the preliminary and detailed design phases of the project, in co-operation with other disciplines, based on the preferred alternative, as the project progresses.

Table 3.2 Areas Requiring Further Site Specific Hydrogeological Assessments

Aspect		Location Within Site						
		Steeles Ave. near Tremaine Rd. (toe of escarpment)	Unnamed Tributary north of Steeles Ave.	Tributary NW-1-E crossing	CPR Rail grade separation & associated creek works (all options)	Residences near Steeles Ave. and Peru Rd.	Sixteen Mile Creek West Branch crossing	Industrial properties, Industrial Rd. & Steeles Ave.
1	Areas where proposed works may require dewatering	✓	✓	✓	✓		✓	
2	Areas where proposed works may require in-water work		✓	✓	✓		✓	
3	Areas where proposed works may require a higher levels of effort for sediment and erosion control		✓	✓	✓		✓	
4	Areas where a natural feature lies within/ adjacent to construction footprint	✓	✓	✓	✓		✓	
5	Areas where residential water wells are or may be present	✓				✓	✓	
6	Areas where there is a higher likelihood of encountering soil or groundwater contamination, based on observed land use				✓			✓

4 SUMMARY

This report summarized the hydrogeological assessment completed by WSP in support of the environmental assessment (EA) for Steeles Avenue improvements and widening from Old Tremaine Road to Industrial Drive. The study area included the potential construction footprint and an additional buffer of approximately five hundred meters.

The proposed improvements to Steeles Avenue will generally include widening of the road from the existing two-lane rural cross-section to four lanes with urban cross-sections from Tremaine Road to Industrial Drive. Road improvements may include a grade separation and possible realignment of Steeles Avenue south of its current location, along with minor reconfiguration of lanes along the existing road alignment, modification of sidewalks and road shoulders, and landscaping. Creek crossings of Sixteen Mile Creek West Branch and Tributary NW-E-1 will also be affected.

Four main hydrostratigraphic units have been identified in the Site-vicinity, including:

- 1) Modern alluvial deposits on the Sixteen Mile Creek West Branch floodplain, which act as a surficial aquifer (Hewitt 1969);
- 2) Halton Till, including some clay and silt glaciolacustrine sediments, which functions as an aquitard;
- 3) Sand layers within the till, which function as localized aquifers; and
- 4) Queenston Shale, whereby the upper weathered portion hosts a regional aquifer.

The site is located at the base of the Niagara Escarpment (Milton Outlier). The shale bedrock is close to the ground surface under the western portion of the study area (Tremaine Road to the CPR) however the bedrock becomes deeper under the eastern portion of the study area (east of the CPR) where a bedrock valley is interpreted to be present (Earth Fx, April 2010, and Rand and Beacon, 2013).

Groundwater recharge rates are generally low within the Steeles Avenue MCEA study limits due to the fine-grained nature of the Halton Till (Earth Fx, April 2010). In naturalized areas and fields, net groundwater recharge rates are generally 100-200 mm per year in areas covered by Halton Till (Earth Fx, February 2014). Recharge rates can be higher on the escarpment where bedrock is near the ground surface. Infiltration rates are generally lower in urban areas due to impervious surfaces (pavement and rooftops).

Shallow groundwater is interpreted to flow from the west to the east towards Sixteen Mile Creek West Tributary, in the Steeles Avenue MCEA study limit, with some local contribution from the north side of Sixteen Mile Creek (Earth Fx, April 2010). This interpretation is supported by groundwater monitoring as discussed in Rand and Beacon (2013). Shallow groundwater flow is generally controlled by topography, noting that the Halton Till limits downward infiltration. As per Rand and Beacon (2013), there are select areas where groundwater has been found to be under artesian conditions, within the Halton Till unit (east of Tremaine Road at the toe of the slope of the Niagara Escarpment), as well as in deeper sand units and potentially the bedrock aquifer, beneath the Sixteen Mile Creek valley.

Based on available water level monitoring information, there is a high potential that construction dewatering will be required to build proposed road improvements for Steeles Avenue and associated below-ground infrastructure, in the following areas:

- a) Construction of any below ground works (culvert replacements and storm sewers) along Steeles Avenue from Tremaine Road to the CPR Railway, due to groundwater levels close to the ground surface;
- b) Construction of below-ground works required for any grade separation at the CPR, including more significant construction dewatering and long-term dewatering if an underpass option is selected; and
- c) Construction of below-ground works required for a replacement bridge structure for Steeles Avenue over the Sixteen Mile Creek West Tributary.

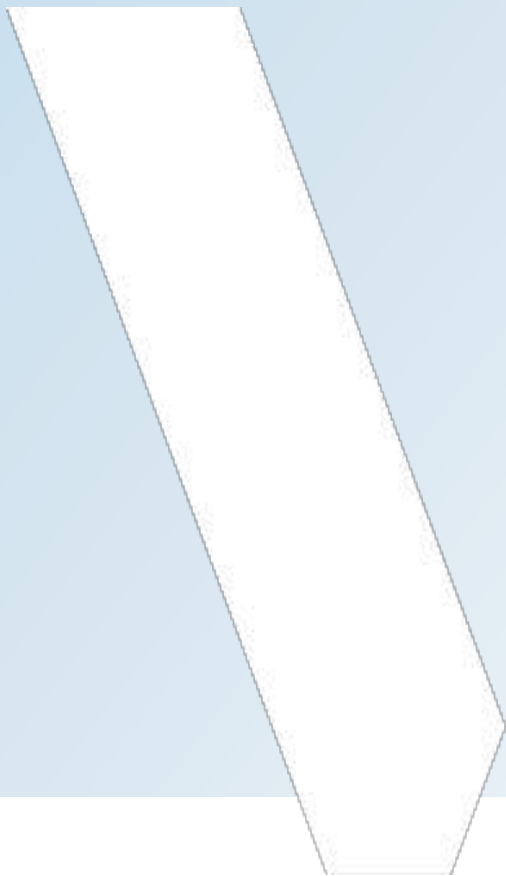
WSP identified a total of 11 areas of potential environmental concern (APEC) for soil contamination ranking as either high or moderate concern. Areas requiring detailed environmental assessment were also identified, and include the unnamed tributary north of Steeles Avenue, the Tributary NW-1-E crossing, the CPR Rail grade separation, older residences within the Site which may have wells, the Sixteen Mile Creek West Branch crossing, and the industrial properties on Peru Road and Steeles Avenue.

WSP notes that municipal water servicing is available along Steeles Avenue within eastern portions of the study area, as far west as Peru Road, and water servicing continues north along Peru Road, based on the presence of fire hydrants in these areas. It is nonetheless possible that older homes and businesses in these area may still have and use private water supply wells. The residential homes and farms along Tremaine Road south of Steeles Avenue were found to rely on private services (water wells and septic systems) as per Ecoplans (June 2013).

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TABLES



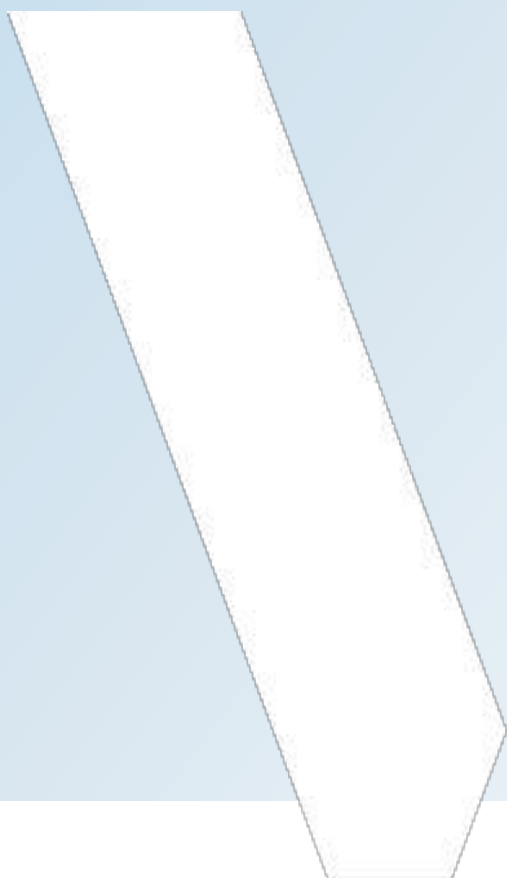
POTENTIAL SOURCES OF SOIL AND GROUNDWATER CONTAMINATION
STEELES AVENUE CLASS ENVIRONMENTAL ASSESSMENT FROM TREMAINE ROAD TO INDUSTRIAL ROAD
REGIONAL MUNICIPALITY OF HALTON, ONTARIO

Potential sources of contamination

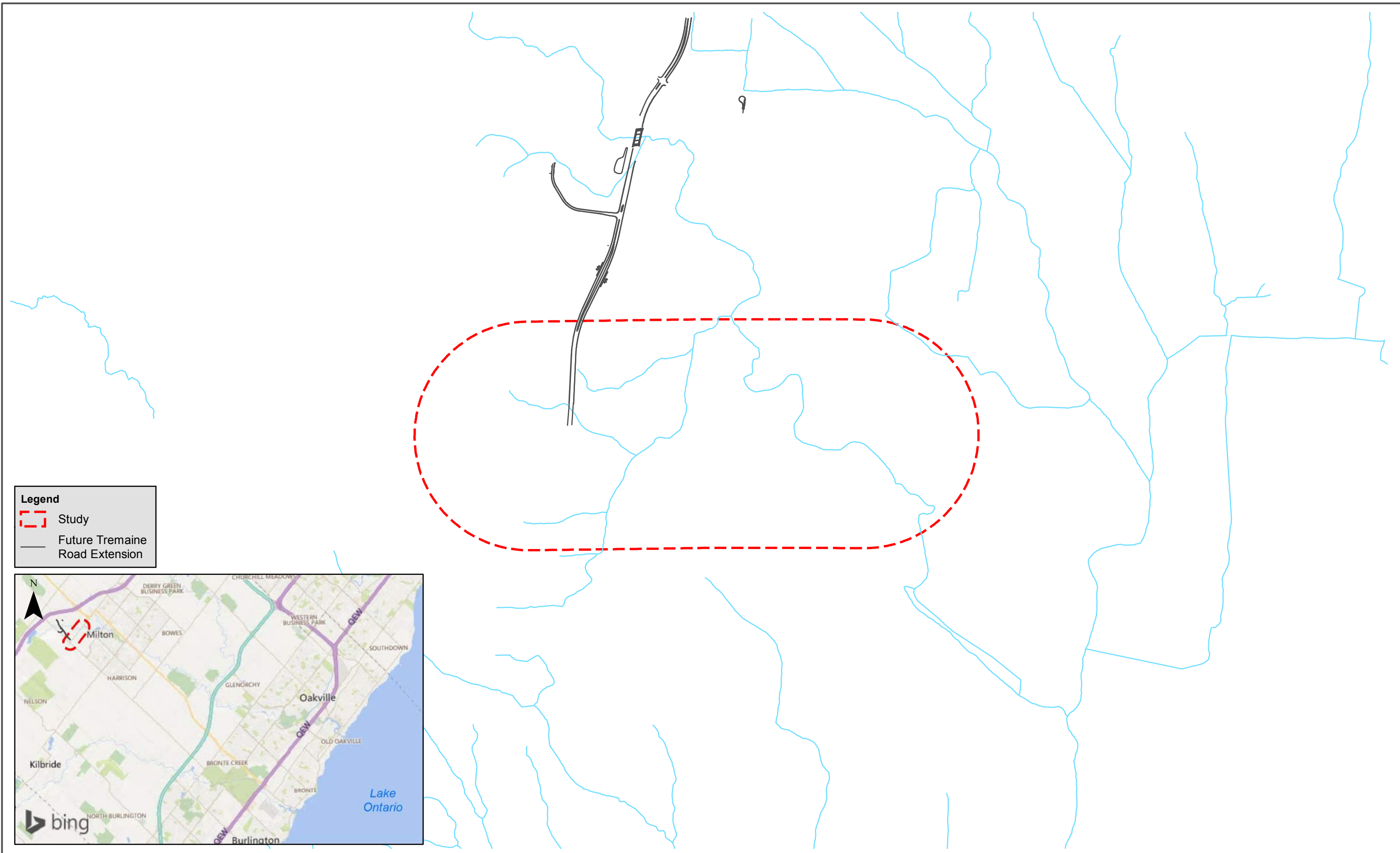
Feature #	Feature Name	Location Description	NAD 83 Easting	NAD 83 Northing	Contaminant Risk Ranking	Likelihood of encountering environmental impacts during construction	Existing Environmental Concerns
1	Primary electrical supply	3163 Steeles Ave West	43°30'45"	79°54'16"	Moderate	Low: private property outside of construction footprint	Stockpiles on site may include equipment which held oil or contain PCBs.
2	Historic brickworks, Jannock Lands	Lot 2, Con. 7, Nassagaweya and Lot 2, Con. 1, Esquesing	43°30'31"	79°54'53"	Moderate	Low: Site lies north of construction area.	Buried brick and metal rubble, elevated metals in groundwater, recently dumped garbage
3	CPR rail	Steeles Avenue west of Peru Road	43°30'36"	79°54'21"	Moderate	Moderate: Within construction footprint, however very localized to the railroad tracks.	Potential local soil contamination due to historical leaks, spills, and creosote railway ties.
4	CNR rail	Steeles Avenue east of Industrial Drive	43°30'58"	79°53'58"	Moderate	Low: Site lies immediately east of construction limit, and is very localized to the railroad tracks.	Potential local soil contamination due to historical leaks, spills, and creosote railway ties.
5	405 Industrial Cr. Complex	405 Industrial Dr., Milton	43°30'59"	79°54'01"	Moderate	Low: private property outside of construction footprint	Connect Conveyor Belts, Inc., Atlantic Bearing & Drives and other businesses may store oil or other potential contaminants on site. No outdoor storage areas visible in satellite photo.
6	PDS Welding	410 Industrial Dr	43°30'57"	79°54'06"	Moderate	Low: private property outside of construction footprint	May store oil or other potential contaminants on site. Vehicles stored on site in satellite image.
7	Various businesses along Industrial Road	Industrial Drive north of Steeles Avenue	varies	varies	Moderate	Low: private property outside of construction footprint	Various trucking, shipping, and other businesses. Old vehicles and / or outdoor storage of oil or other contaminants may be present.
8	Older homes along Steeles Avenue	Steeles Avenue, east of CN Railway & Old Tremaine Road south of Steeles Ave	varies	varies	Low	Low: if present, located on private property outside of construction footprint	Potential presence of oil heating tanks (above or below ground) in older homes.
9	Old water wells	Study area	varies	varies	Low	Moderate: Old water wells may be located within construction footprint.	Potential presence of unused wells or improperly decommissioned wells within the construction footprint and/or adjacent study area. Greater likelihood of finding such wells in the vicinity of homes located along Steeles Avenue and Peru Road. These wells could provide a direct connection from the surface to the water table.



FIGURES

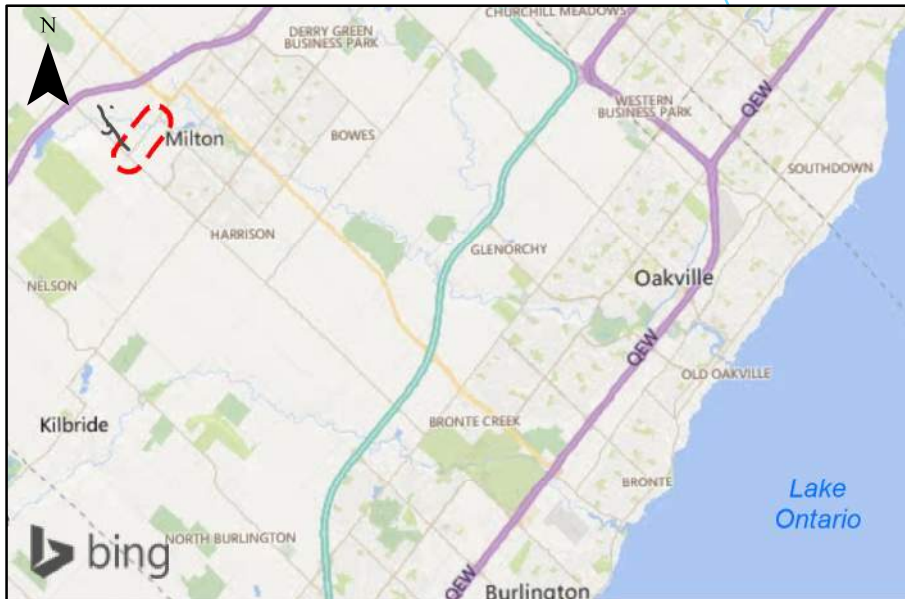


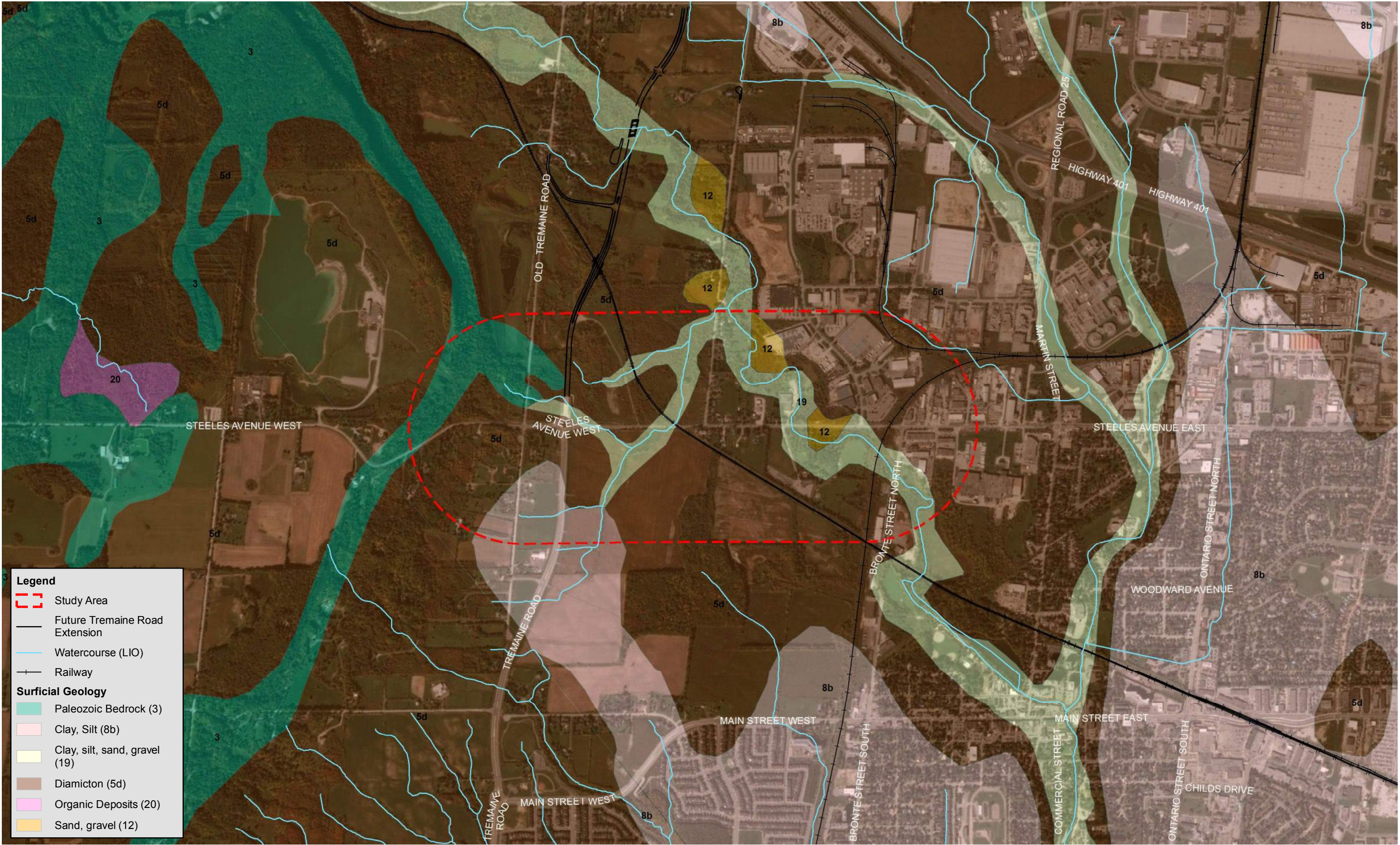
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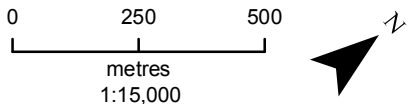
Legend

- Study
- Future Tremaine Road Extension

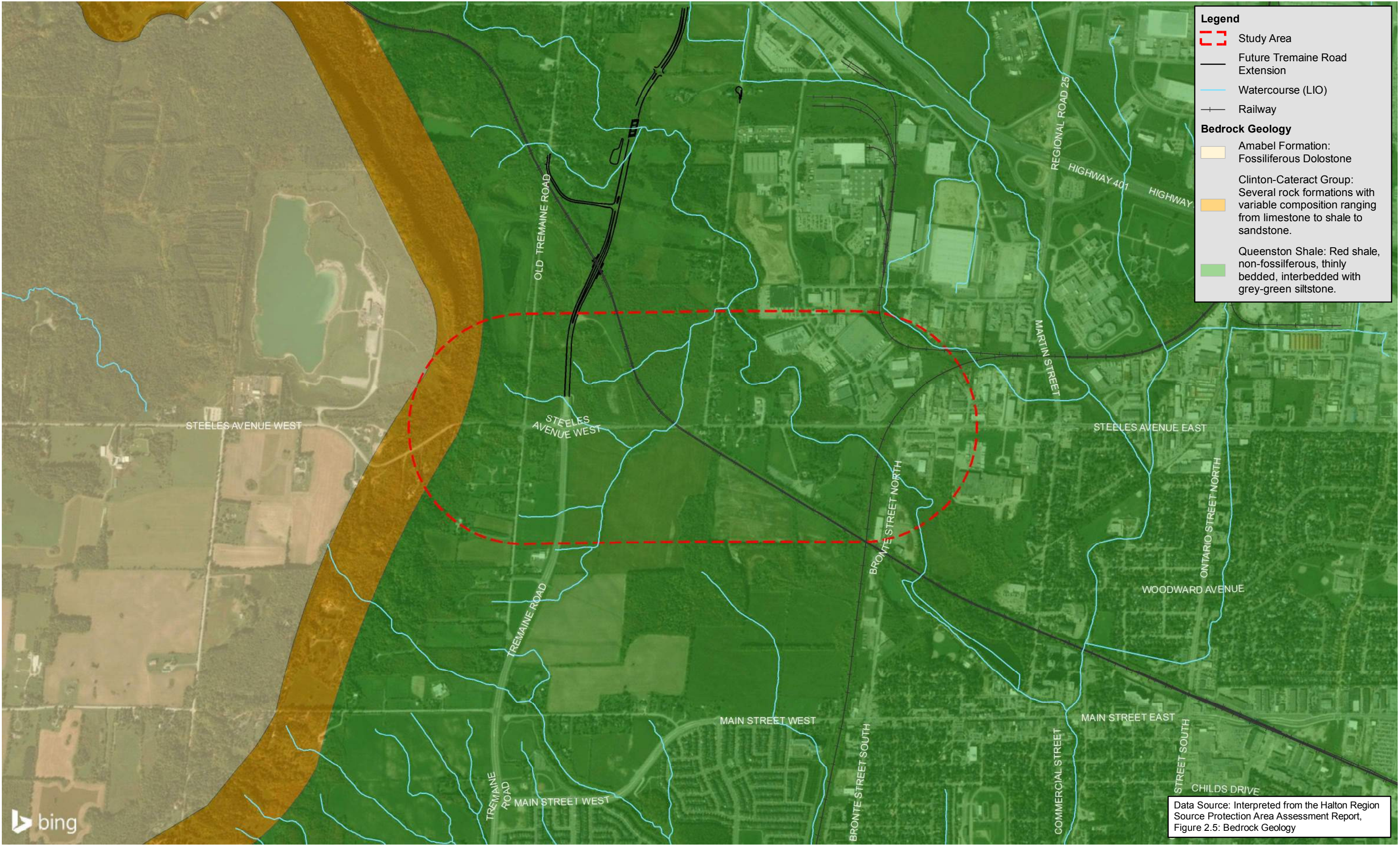




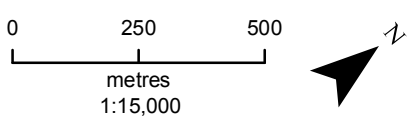
STEELES AVENUE - HYDROGEOLOGICAL ASSESSMENT
Surficial Geology



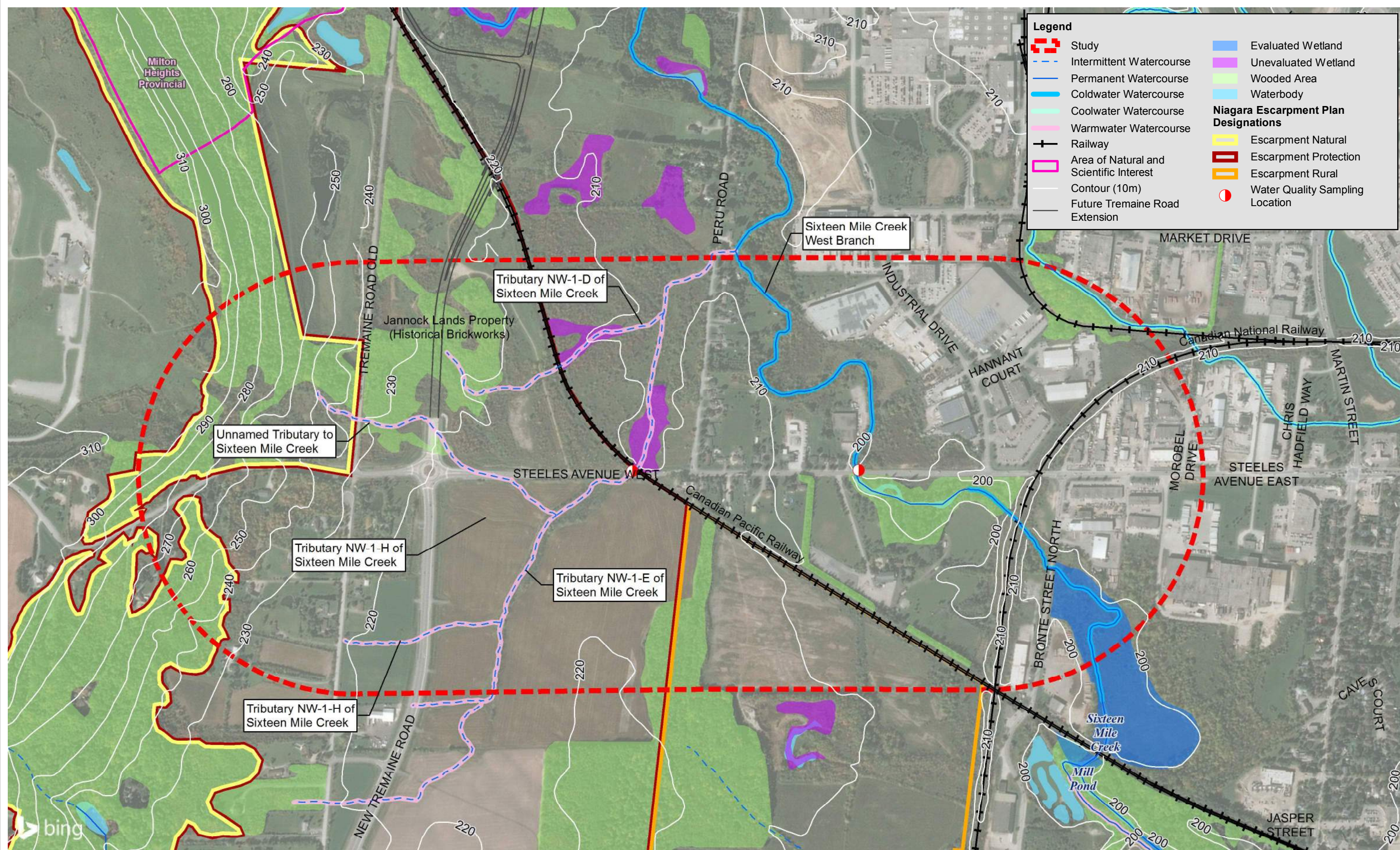
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Project No: 17M-00979-00
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STEELES AVENUE - HYDROGEOLOGICAL ASSESSMENT
Bedrock Geology



Date: September 2018
Project No: 17M-00979-00
Figure No: 3

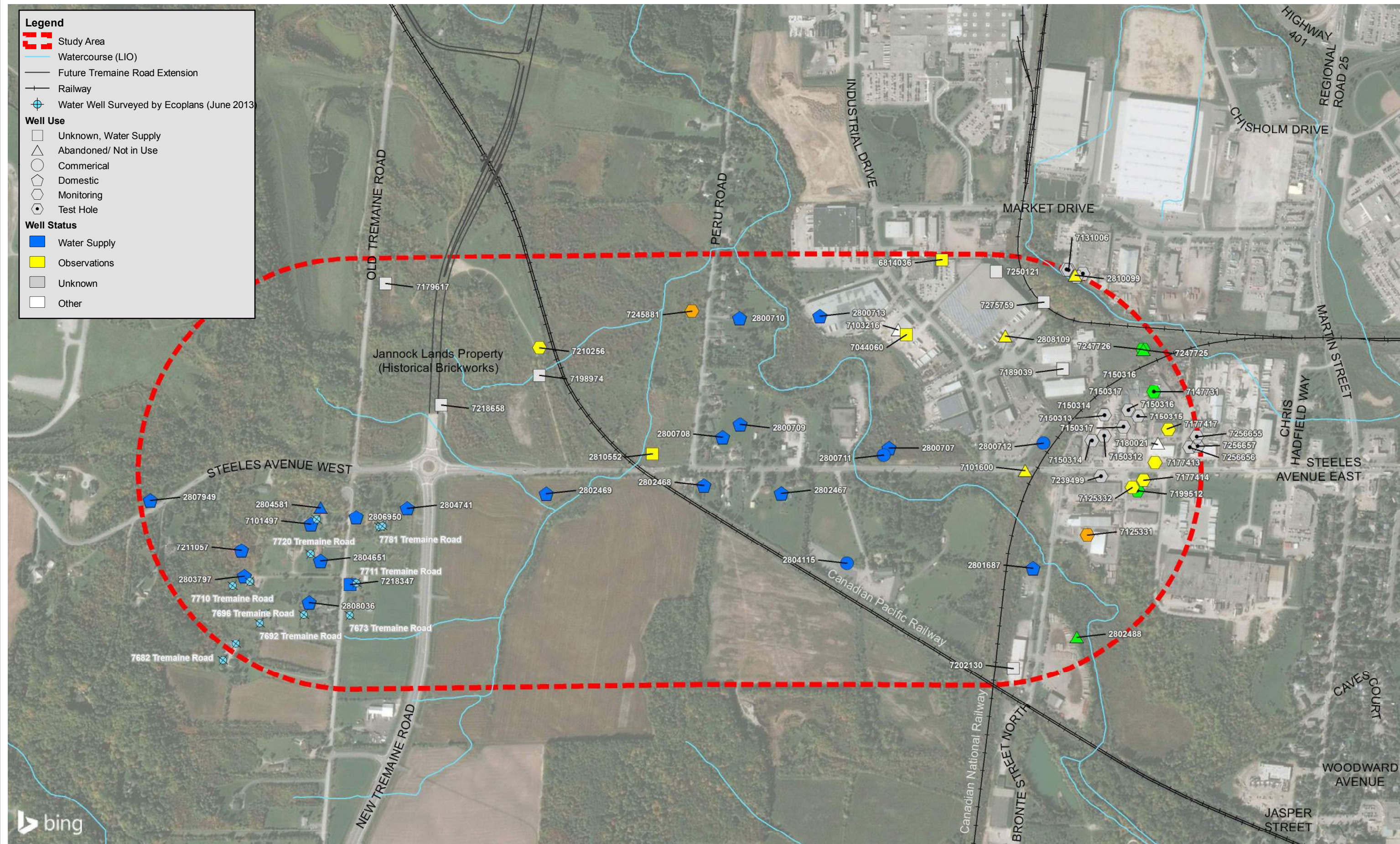


STEELES AVENUE - HYDROGEOLOGICAL ASSESSMENT **Natural Features**

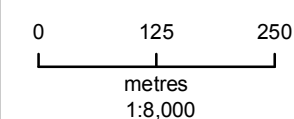
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STEELES AVENUE - HYDROGEOLOGICAL ASSESSMENT MECP Water Well Record



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Project No: 17M-00979-00
Figure No: 5

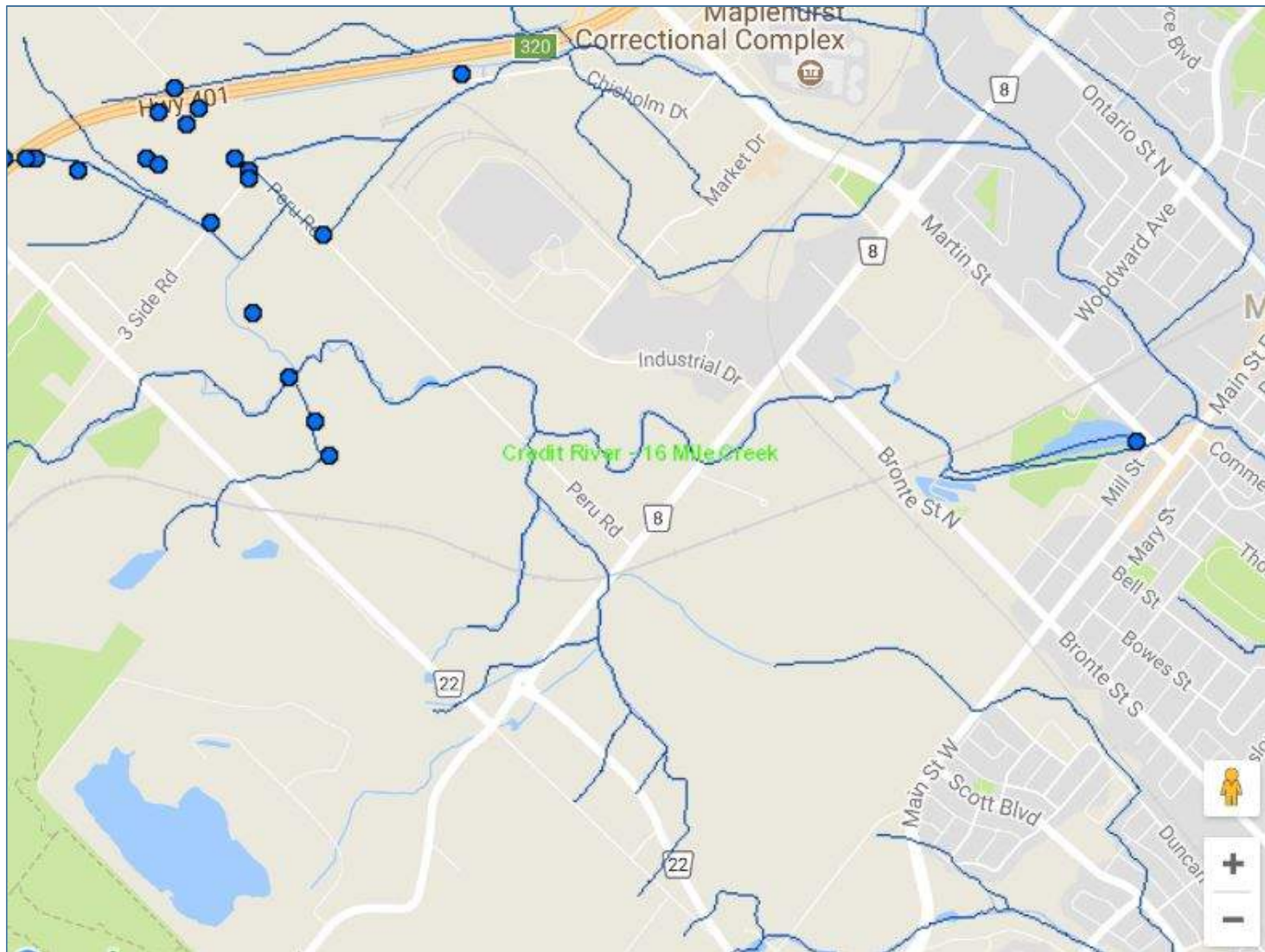


Figure 6: PTTW Records in Site-vicinity

17M-00979-00 Steeles Avenue EA – Hydrogeological Assessment
Source: MOECC Interactive Map

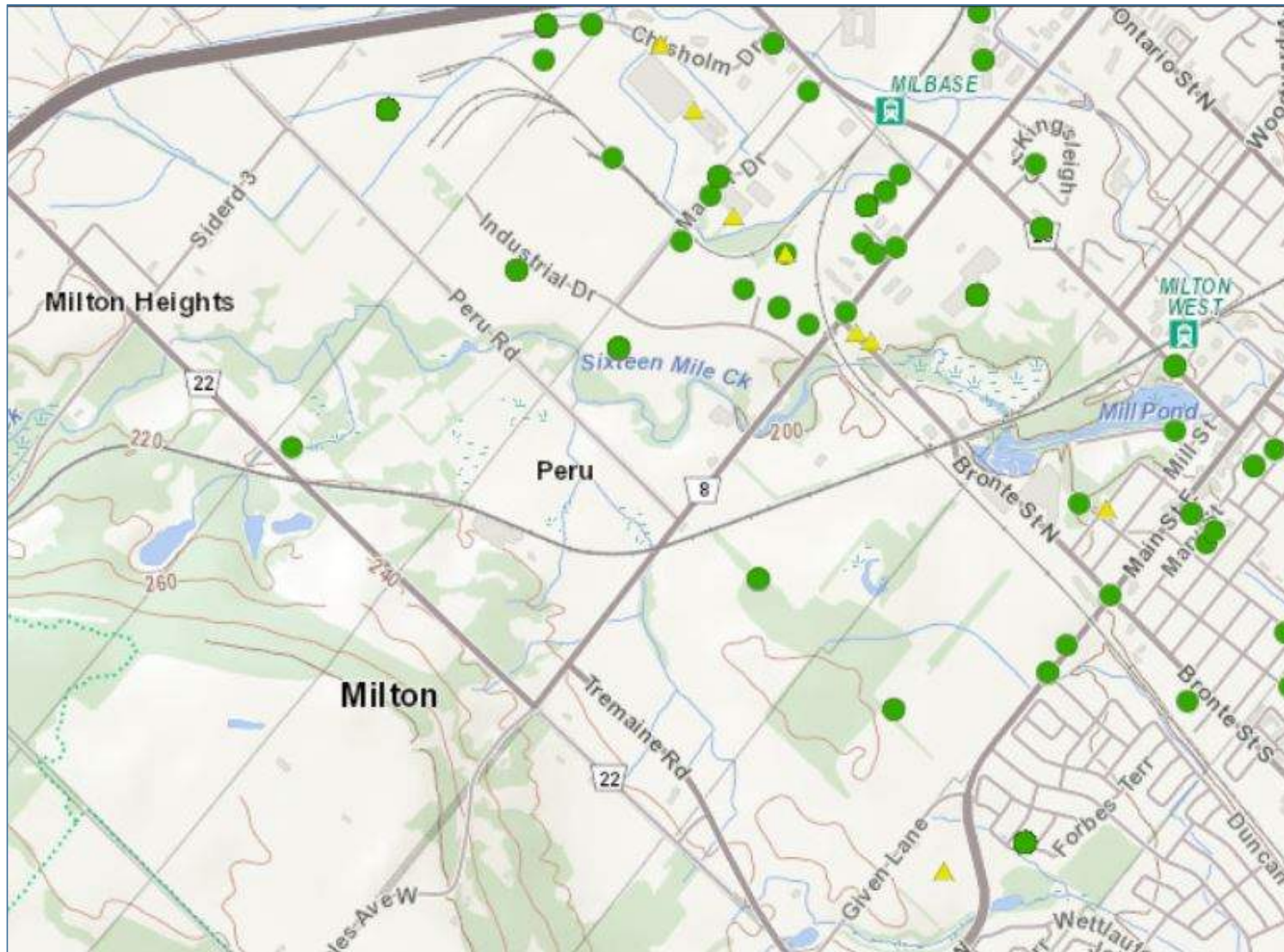


Figure 7: ECA and EASR Records in Site-vicinity

17M-00979-00 Steeles Avenue EA – Hydrogeological Assessment
Source: MOECC Interactive Map

APPENDIX

A STANDARD LIMITATIONS



STANDARD LIMITATIONS

This Report was prepared for the Client, solely for their exclusive use to provide an Assessment of current environmental conditions in association with the Site. WSP will not be responsible for any use of this report by any other party, for any decisions to be made based on it, or for the consequences thereof, unless written reliance is granted by WSP.

The Report summarizes WSP's review of available data in accordance with the principal components of the stated regulations, standards and guidelines and the scope, terms and conditions of the contract or proposal to which the Assignment was conducted. No other warranties are either expressed or implied with respect to the professional services provided under the terms of the contract or proposal and represented in this Report. Conditions may exist which were not detected given the nature of the inquiry WSP was retained to undertake with respect to the Site. Additional environmental studies and actions may be recommended.

The Report is based on data and information collected at the time of this Assessment, as stated in the Report. Site use or conditions change and the information and conclusions in the Report may no longer apply following the date of this Report. If any conditions become apparent that differ significantly from that presented in this Report, we request that we be notified to reassess the conclusions and recommendations provided herein. WSP disclaims any obligation to update this Report for conditions that may be identified after the date of this Report; however, WSP reserves the right to amend or supplement this report based on additional information, documentation or evidence.

In evaluating the Site, WSP has relied in good faith on information provided by others, as noted in the Report. WSP has assumed that the information provided is correct and WSP assumes no responsibility for the accuracy, completeness or workmanship of any such information.

The Report is intended to be used in its entirety. No excerpts may be taken to be representative of the findings in the assessment.

The conclusions are based on the Site conditions observed by WSP at the time the work was performed and may include information obtained at specific testing and/or sampling locations. It is recognized that overall conditions can only be extrapolated to an undefined limited area around these testing and sampling locations. The conditions that WSP interprets to exist between testing and sampling points may differ from those that actually exist. The accuracy of any extrapolation and interpretation beyond the sampling locations will depend on natural conditions, the history of Site development and changes through construction and other activities. In addition, analysis has been carried out for the identified chemical and physical parameters only, and it should not be inferred that other chemical species or physical conditions are not present. WSP cannot warrant against undiscovered environmental liabilities or adverse impacts off-Site.

The conclusions presented in this Report are based on Work undertaken by trained professional and technical staff and the reasonable and professional interpretation of the information considered. Conclusions presented in this report should not be construed as legal advice. WSP makes no other representations whatsoever, including those concerning the legal significance of its findings, or as to other legal matters touched on in the Report, including, but not limited to, ownership of any property, or the application of any law to the findings of the Assessment.

APPENDIX

B

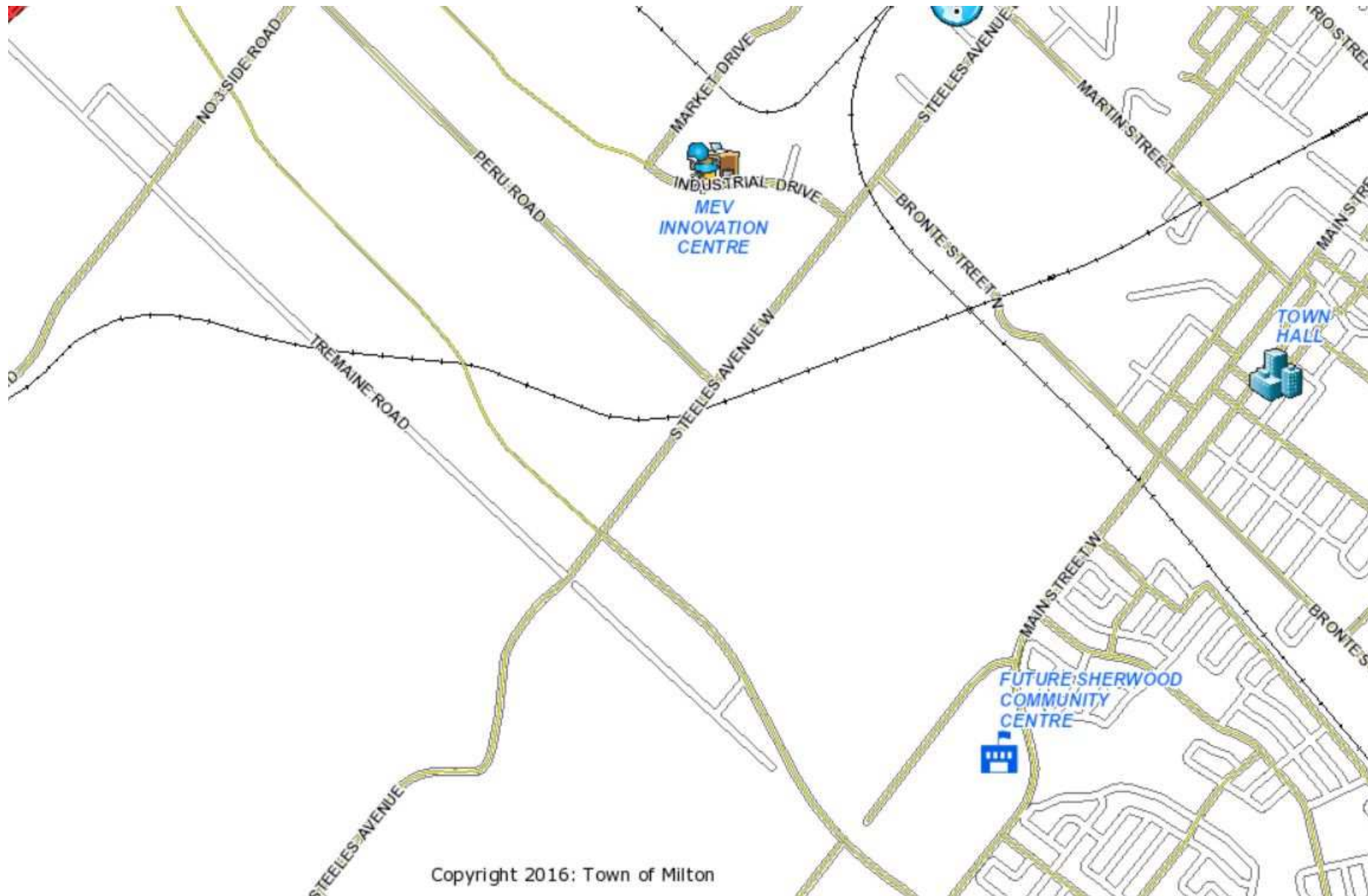
SITE

PHOTOGRAPHS

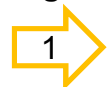
Site Photographs

Steeles Avenue EA (Tremaine Road to Industrial Road)

Hydrogeological Assessment



Legend:



Photograph location



Feature of interest



Creek name and flow direction



Local area map (subsequent pages)

Site Photographs **Steeles Avenue EA (Tremaine Road to Industrial Road)** **Hydrogeological Assessment**



Map #1: Steeles Avenue, from west of Old Tremaine Road to east of the new Tremaine Road.
 Source: Milton Maps – www.maps.milton.ca.

Site Photographs
Steeles Avenue EA (Tremaine Road to Industrial Road)
Hydrogeological Assessment



Photograph 1: Steeles Avenue and Tremaine Road intersection, looking east, Sept. 2016. Source: Google Street View.

Site Photographs

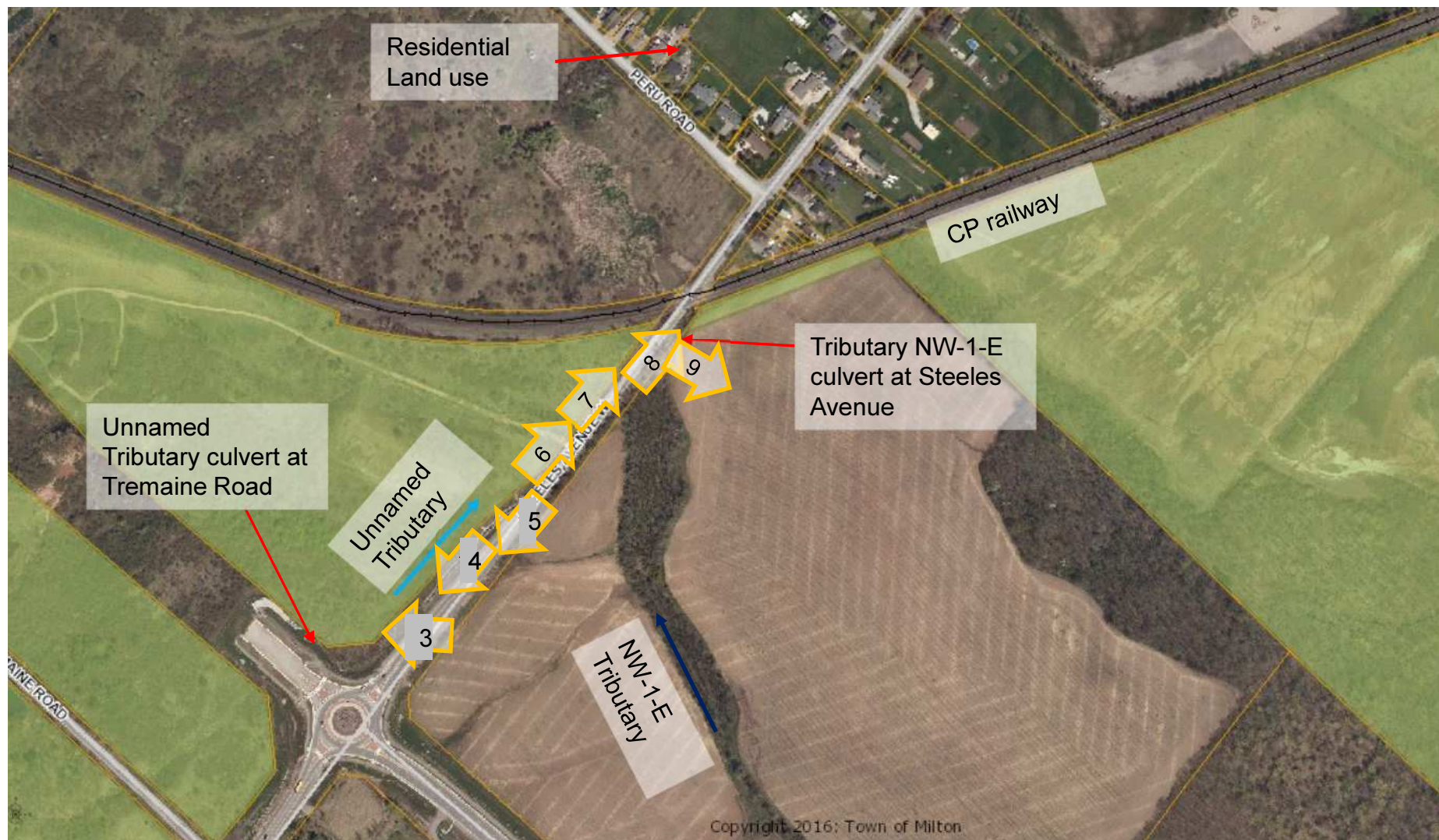
Steeles Avenue EA (Tremaine Road to Industrial Road)

Hydrogeological Assessment



Photograph 2: Steeles Avenue and Tremaine Road intersection, looking east, Sept. 2016. Source: Google Street View.

Site Photographs **Steeles Avenue EA (Tremaine Road to Industrial Road)** **Hydrogeological Assessment**



Map #2: Steeles Avenue, from Tremaine Road to Peru Road. Source: Milton Maps – www.maps.milton.ca.

Site Photographs **Steeles Avenue EA (Tremaine Road to Industrial Road)** **Hydrogeological Assessment**



Photograph 3: View of Tremaine Road from Steeles Avenue, looking northwest, Dec. 1, 2017. Source: WSP site visit.

Site Photographs **Steeles Avenue EA (Tremaine Road to Industrial Road)** **Hydrogeological Assessment**



Photograph 4: Unnamed Tributary north of Steeles Avenue, looking west, Dec. 1, 2017. Source: WSP site visit.

Site Photographs **Steeles Avenue EA (Tremaine Road to Industrial Road)** **Hydrogeological Assessment**



Photograph 5: Steeles Avenue looking west toward Old Tremaine Road and the Niagara Escarpment, Dec. 1, 2017.

Site Photographs **Steeles Avenue EA (Tremaine Road to Industrial Road)** **Hydrogeological Assessment**



Photograph 6: North side of Steeles Avenue looking east toward CP Rail crossing, Dec. 1, 2017. Source: WSP site visit.

Site Photographs **Steeles Avenue EA (Tremaine Road to Industrial Road)** **Hydrogeological Assessment**



Photograph 7: Steeles Avenue looking east toward Peru Road, Dec. 1, 2017. Source: WSP site visit.

Site Photographs
Steeles Avenue EA (Tremaine Road to Industrial Road)
Hydrogeological Assessment



Photograph 8: Steeles Avenue looking east toward the CPR Rail crossing, Dec. 1, 2017. Source: WSP site visit.

Site Photographs
Steeles Avenue EA (Tremaine Road to Industrial Road)
Hydrogeological Assessment



Photograph 9: Agricultural area south of Steeles Avenue, Dec. 1, 2017. Source: WSP site visit.

Site Photographs **Steeles Avenue EA (Tremaine Road to Industrial Road)** **Hydrogeological Assessment**



Map #3: Steeles Avenue, at the CP Railway crossing. Source: Milton Maps – www.maps.milton.ca.

Site Photographs
Steeles Avenue EA (Tremaine Road to Industrial Road)
Hydrogeological Assessment



Photograph 10: Confluence of Unnamed Tributary and NW1-E Tributary, north of Steeles Ave and immediately west of CP Rail crossing, Dec. 1, 2017. Source: WSP site visit.

Site Photographs
Steeles Avenue EA (Tremaine Road to Industrial Road)
Hydrogeological Assessment



Photograph 11: Outfall of NW1-E Tributary culvert crossing of Steeles Ave, north side of Steeles Ave, Dec. 1, 2017. Source: WSP site visit.

Site Photographs
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Photograph 12: Unnamed Tributary culvert below side road, looking west, Dec. 1, 2017. Source: WSP site visit.

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Photograph 13: Side road under construction north of Steeles Ave, Dec. 1, 2017. Source: WSP site visit.

Site Photographs **Steeles Avenue EA (Tremaine Road to Industrial Road)** **Hydrogeological Assessment**



Photograph 14: South side of CP Railway crossing at Steeles Ave, Dec. 1, 2017. Source: WSP site visit.

Site Photographs **Steeles Avenue EA (Tremaine Road to Industrial Road)** **Hydrogeological Assessment**

Light industrial land use



Map #3: Steeles Avenue, from Peru Road to Industrial Drive, showing photograph locations from December 1, 2017. Source: Milton Maps – www.maps.milton.ca.

Site Photographs
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Photograph 15: View north of Peru Road at intersection with Steeles Avenue, Dec. 1, 2017. Source: WSP

Site Photographs **Steeles Avenue EA (Tremaine Road to Industrial Road)** **Hydrogeological Assessment**



Photograph 16: North ditch along Steeles Avenue east of the CPR tracks, looking east, Dec. 1, 2017. Source: WSP

Site Photographs
Steeles Avenue EA (Tremaine Road to Industrial Road)
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Photograph 17: View east along Steeles Avenue toward Sixteen Mile Creek West Branch valley, Dec. 1, 2017. Source: WSP

Site Photographs **Steeles Avenue EA (Tremaine Road to Industrial Road)** **Hydrogeological Assessment**



Photograph 18: View east along Sixteen Mile Creek bridge, Dec. 1, 2017. Source: WSP

Site Photographs
Steeles Avenue EA (Tremaine Road to Industrial Road)
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Photograph 19: View south of Steeles Avenue of drainage ditches flowing toward Sixteen Mile Creek West Branch, Dec. 1, 2017. Source: WSP

Site Photographs
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Photograph 20: View north of Sixteen Mile Creek bridge, Dec. 1, 2017. Source: WSP

Site Photographs
Steeles Avenue EA (Tremaine Road to Industrial Road)
Hydrogeological Assessment



Photograph 21: North face of Sixteen Mile Creek bridge, Dec. 1, 2017. Source: WSP

Site Photographs
Steeles Avenue EA (Tremaine Road to Industrial Road)
Hydrogeological Assessment



Photograph 22: View south of Sixteen Mile Creek bridge, Dec. 1, 2017. Source: WSP

Site Photographs **Steeles Avenue EA (Tremaine Road to Industrial Road)** **Hydrogeological Assessment**



Photograph 23: SWM pond north of Steeles Avenue, looking east, Dec. 1, 2017. Source: WSP

Site Photographs **Steeles Avenue EA (Tremaine Road to Industrial Road)** **Hydrogeological Assessment**



Photograph 24: SWM pond and drainage culvert looking east, Dec. 1, 2017. Source: WSP

Site Photographs
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Photograph 25: SWM pond and drainage culvert, looking west, Dec. 1, 2017. Source: WSP

Site Photographs
Steeles Avenue EA (Tremaine Road to Industrial Road)
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Photograph 26: Intersection of Industrial Road and Steeles Avenue looking east, Dec. 1, 2017. Source: WSP

Site Photographs **Steeles Avenue EA (Tremaine Road to Industrial Road)** **Hydrogeological Assessment**



Photograph 27: Intersection of Industrial Road and Steeles Avenue looking west, Dec. 1, 2017. Source: WSP

Site Photographs Steeles Avenue EA (Tremaine Road to Industrial Road) Hydrogeological Assessment



Photograph 28: **View of drainage ditch leading to SWM pond. View west along north side of Steeles Avenue**, Dec. 1, 2017. Source: WSP

Site Photographs **Steeles Avenue EA (Tremaine Road to Industrial Road)** **Hydrogeological Assessment**



Photograph 29: **Aerial Photograph of Steeles Avenue EA study area, July 21, 2018, looking southwest.**
 Source: WSP. Pilot: Max Salman.

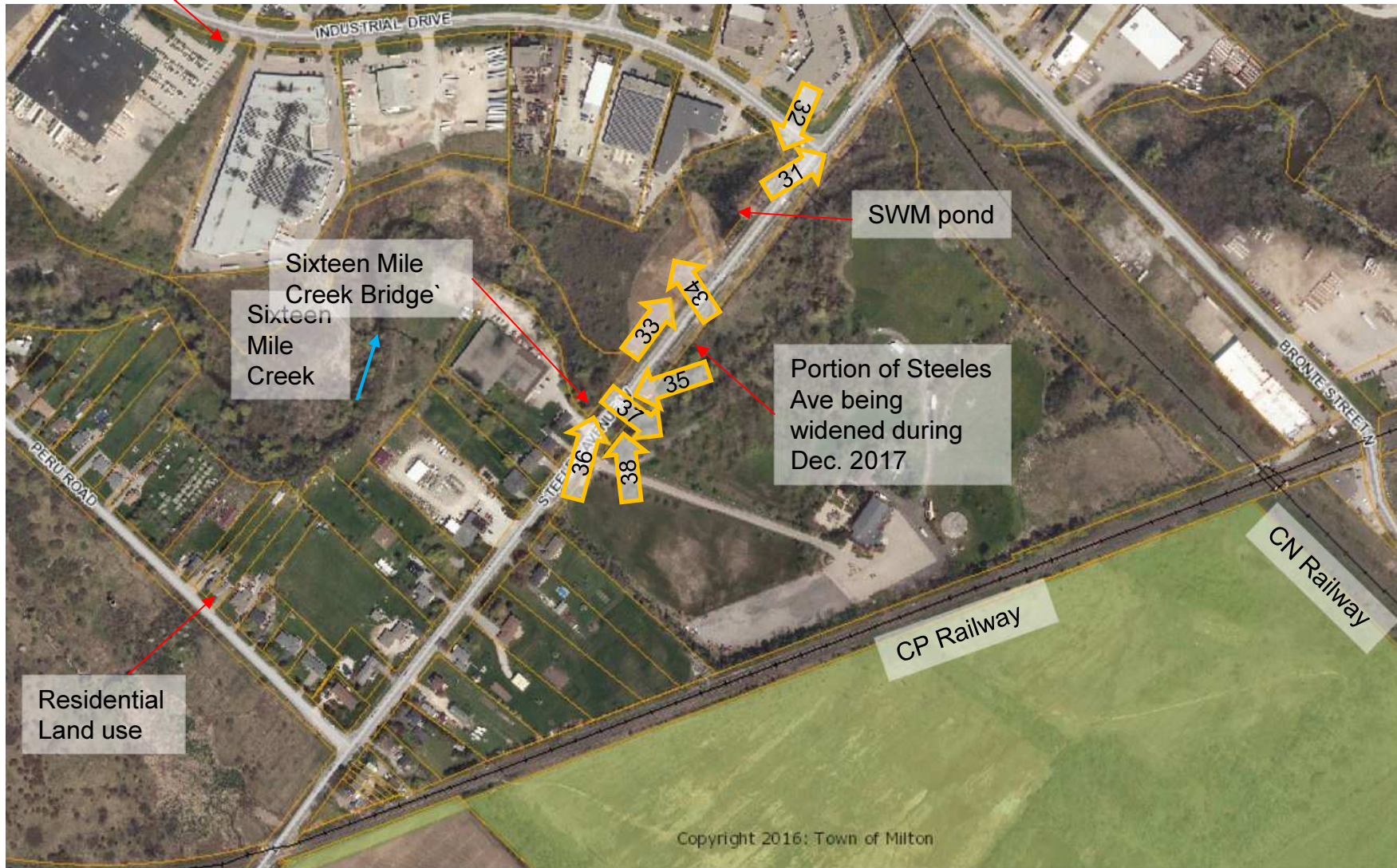
Site Photographs **Steeles Avenue EA (Tremaine Road to Industrial Road)** **Hydrogeological Assessment**



Photograph 30: **Aerial Photograph of Steeles Avenue EA study area, July 21, 2018, looking southwest.**
 Source: WSP. Pilot: Max Salman.

Site Photographs Steeles Avenue EA (Tremaine Road to Industrial Road) Hydrogeological Assessment

Light industrial land use



Map #4: Steeles Avenue, from Peru Road to Industrial Drive, showing photograph locations from August 26, 2018. Source: Milton Maps – www.maps.milton.ca.

Site Photographs
Steeles Avenue EA (Tremaine Road to Industrial Road)
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Photograph 31: Looking east at the intersection of Steeles Avenue and Industrial Road, August 26, 2018. Source: WSP

Site Photographs **Steeles Avenue EA (Tremaine Road to Industrial Road)** **Hydrogeological Assessment**



Photograph 32: **View along Steeles Avenue looking west from Industrial Road**, August 26, 2018. Source: WSP

Site Photographs Steeles Avenue EA (Tremaine Road to Industrial Road) Hydrogeological Assessment



Photograph 33: **View along Steeles Avenue east of the Sixteen Mile Creek bridge**, looking east, August 26, 2018.
 Source: WSP

Site Photographs **Steeles Avenue EA (Tremaine Road to Industrial Road)** **Hydrogeological Assessment**



Photograph 34: Detail view of stormwater management ponds on the north side of Steeles Avenue east of the Sixteen Mile Creek bridge, looking east, August 26, 2018. Source: WSP

Site Photographs
Steeles Avenue EA (Tremaine Road to Industrial Road)
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Photograph 35: **View of the Steeles Avenue bridge over Sixteen Mile Creek**, August 26, 2018. Source: WSP

Site Photographs
Steeles Avenue EA (Tremaine Road to Industrial Road)
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Photograph 36: **View of the Steeles Avenue bridge over Sixteen Mile Creek**, looking east, August 26, 2018. Source: WSP

Site Photographs
Steeles Avenue EA (Tremaine Road to Industrial Road)
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Photograph 37: **View of Sixteen Mile Creek, looking south from the Steeles Avenue bridge, August 26, 2018.**
Source: WSP

Site Photographs
Steeles Avenue EA (Tremaine Road to Industrial Road)
Hydrogeological Assessment



Photograph 38: View of the Steeles Avenue Bridge over Sixteen Mile Creek, showing the south side of the bridge, August 26, 2018. Source: WSP