Town of Oakville - Halton Region

Environmental Implementation Report and Functional Servicing Study (EIR/FSS) Sixteen Mile Creek Addendum #1 1st Submission

Prepared for:

Neatt (16 Mile Creek) Inc.

Prepared by:

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EXECUTIVE SUMMARY

An Environmental Implementation Report (EIR) and Functional Servicing Study (FSS) has been prepared for the Sixteen Mile Creek Subwatershed ES9 and the Neatt (16 Mile Creek) Inc. Lands (hereafter referred to as the 'Subject Lands'). A range of environmental and engineering matters are addressed as required by the Town of Oakville and Conservation Halton (CH) approved Scoped Terms of Reference (ToR) for the Subject Lands (**Appendix A**).

The purpose of the EIR is to characterize and analyze the natural heritage features and functions within the ES9 Subcatchment Area (i.e., north of Dundas Street and west of Neyagawa Boulevard), address the potential impacts of the proposed development application, including servicing requirements, on the nearby Natural Heritage System (NHS) and identify mitigative measures to be incorporated into development applications where needed.

The purpose of the FSS is to identify servicing requirements related to sanitary, water, stormwater management, roads and site grading.

Further, the purpose of both the EIR and FSS is to provide a link between the Town's North Oakville Creeks Subwatershed Study (NOCSS), the North Oakville East Secondary Plan (NOESP) and proposed Draft Plan submissions for development applications.

This EIR/FSS addresses requirements of the NOCSS and NOESP and ensures that the site characteristics are understood in sufficient detail to provide input to the preparation of a Draft Plan for the Subject Lands.

The following summarizes major findings and recommendations of this EIR/FSS.

EIR SUBCATCHMENT AREA AND FSS STUDY AREA

1. This EIR/FSS is prepared for the Subject Lands situated at the northwest corner of Dundas Street and Neyagawa Boulevard (**Figures 1.1 and 1.2**). The Subject Lands studied as part of this EIR/FSS encompass an area of approximately 3.73 hectares.

2. The 'EIR Subcatchment Area' is defined to be the Sixteen Mile Creek ES9 subcatchment as shown on **Figure 1.3** as well as the areas south of and including Dundas Street that are conveyed to the existing Riverbank Way Stormwater Management (SWM) pond. This area includes 0.62 ha of the OC-1 subcatchment which is proposed to be directed to ES9 under ultimate conditions.

3. The 'FSS Study Area' is defined to be the Subject Lands and the lands at 1039 Dundas Street (St. Peter and Paul Parish) and 1013 Dundas Street (Prime Envision Inc.) as shown on **Figure 1.3**.

4. Detailed 2018 LiDAR topographic mapping was used to refine the drainage boundaries for the ES9 Subcatchment and a survey was also completed for the existing Riverbank Way SWM Pond.

NATURAL HERITAGE SYSTEM FRAMEWORK

5. OPA 272, NOCSS and the NOCSS Addendum identify various environmental features to be protected and/or studied further during the EIR/FSS. As shown on Figure NOE3 from OPA 272, the Subject Lands do not include any Core Areas or Linkage Preserve Areas (LPAs). **Figure 2.1** presents the Subject Lands in relation to the Natural Heritage Framework as provided in NOCSS and the NOESP. **Section 2** provides further discussion on the NHS.

HYDROGEOLOGICAL ASSESSMENT

6. The scope of work completed for the hydrogeological component of the EIR/FSS involved comprehensive field investigations and desktop evaluations to characterize the geological and hydrogeological conditions in the Hydrogeologic Study Area (3056 Neyagawa Blvd and 1039 Dundas Steet West). The work included the installation of boreholes and groundwater observation wells to investigate the site-specific soil and groundwater conditions, aquifer parameter testing, water quality sampling, estimation of temporary groundwater flow rate during construction and assessment of permanent drainage requirements.

7. The Hydrogeologic Study Area slopes south towards Lake Ontario. Topographical relief is about 4.5 m, with the highest elevations (approximately 158.8 masl - metres above mean sea level) found in the east portion of the EIR Subcatchment Area. The lowest elevations (about 154.2 masl) are found in the west area of the subcatchment.

8. The stratigraphy comprises of silty clay till deposit, silty clay till and shale complex and shale bedrock. Shale bedrock of Queenston Formation was found at approximate depths ranging from 2.3 to 3.3 m below existing ground surface, corresponding to elevations varying from 152.2 to 157.0 masl.

9. The till and shale materials are considered as poor aquifers (aquitards), and the water yields are typically very low, and the groundwater quality is relatively poor. The local water well records (**Figure 3.2**) show that groundwater supplies for domestic and farm purposes generally tap the upper portions of the shale bedrock. The groundwater quality is relatively hard and mineralized with somewhat variable and elevated chloride from the shale. In general, however, the groundwater quality is within provincial water quality standards except for some metal elements. Higher concentrations of total metals are typically associated with suspended solids and can be reduced with water filtration. There is currently no municipal groundwater use, and no planned future groundwater use in the Hydrogeologic Study Area. The proposed development will be municipally serviced from Lake Ontario.

10. Surface water runoff occurs mainly as sheet flow and moves generally towards the Sixteen Mile Creek. There are no natural watercourses in the Hydrogeologic Study Area and storm runoff is conveyed via roadside ditches.

11. The groundwater movement flows generally towards the Sixteen Mile Creek which closely mimics the surface water flow pattern within the Hydrogeologic Study Area.

12. The groundwater levels vary seasonally and in response to precipitation events, with observed groundwater level changes in the range of about 148 to 157 masl. Water levels are generally highest in the spring and lower throughout the winter. The depth to the water table ranges from about 2.56 m to 6.3 m below grade in the Hydrogeologic Study Area.

13. It is interpreted that groundwater recharge conditions exist throughout most of the Hydrogeologic Study Area. The groundwater recharge and discharge volumes are limited due to limited precipitation infiltration capacity.

DRAFT PLAN

14. The Draft Plan includes three high-density residential blocks and three municipal roads. The Draft Plan of Subdivision is shown on **Figure 4.2.**

TRAIL PLANNING AND DESIGN

15. Figure 1 of the *North Oakville East Trails Plan* (2013) (**Figure 4.1**) shows a multi-use trail along the western portion of the EIR Subcatchment Area however, there are no trails shown on the Subject Lands.

STORMWATER MANAGEMENT

16. The ES9 drainage areas were used to set pre-development target release rates for on-site storage design for the 2-100 year storms based on the unit flow rates in NOCSS. Existing drainage patterns are shown on **Drawing 5.2**.

17. NOCSS Figure 7.4.6 identifies a conceptual stormwater management facility (ES5) on the lands west of the Subject Lands (St. Peter and Paul Parish lands).

18. As required by NOCSS and the approved ToR, alternative approaches to SWM have been identified and evaluated to assess and incorporate appropriate SWM practices in the development design to satisfy NOCSS SWM goals, objectives and targets. A range of at-source, conveyance and end-of-pipe measures have been assessed with the goal of providing the required quality, quantity and erosion controls while also minimizing the amount of municipal infrastructure.

19. The stormwater management analysis led to the recommendation that it would be appropriate to maximize the efficiency of the existing stormwater management pond located south of Dundas Street and north of Riverbank Way to provide the water quality, quantity and erosion controls for the remaining lands within the ES9 catchment area. This solution makes efficient use of existing infrastructure, thereby reducing long-term municipal maintenance and operations costs.

20. It is proposed that the outlet structure of the pond be retrofitted to provide Regional controls for the ES9 drainage area as well as for the areas south of, and including, Dundas Street that are currently tributary to the pond. A 900 mm orifice plate is proposed to be installed on top of the existing 1200 mm pipe. An emergency overflow spillway via high capacity catchbasin grates located 0.3 m above the Regional Storm water level will collect all flows into the existing 1200 mm pipe prior

to it spilling over the roadway. Refer to **Drawing 5.4** and **Appendix D** for catchbasin capacity calculation.

21. The reduction in outlet size results in a nominal increase in the water level of the Riverbank Way SWM Pond compared to existing conditions however, Conservation Halton has confirmed that the Regional water levels in the pond are not regulated (and as such the nominal increase does not result in regulated area extending on adjacent lands).

22. Controls to meet the required water quality, erosion control and quantity control for the 2-100 year storms set out in NOCSS for the developable lands will be provided onsite**.** A retrofit of the downstream SWM pond is proposed to meet the NOCSS targets for the Regional Storm. The conceptual design for the SWM pond retrofit is illustrated in **Figure 5.4**.

23. An evaluation of the hydrogeological conditions identified that soil materials in the subcatchment have low hydraulic conductivity and limited infiltration rates, and as such, are not considered suitable for the use of large, engineered facilities and constructed 'active' infiltration measures such as infiltration trenches, pervious storm pipe systems and infiltration pits.

24. Consideration was given to the incorporation of Low Impact Development (LID) measures in accordance with the Town's standards to retain the 25 mm event onsite. Design of the NHS within North Oakville has protected substantial areas and directed development away from environmentally sensitive lands. Many other LID measures are not compatible with the required densities and compact urban form. There are, however, some mitigation techniques proposed for use to increase the potential for post-development infiltration and mitigate the reductions in recharge that may occur with land development which include tree pits in the proposed right of ways (ROWs).

25. Compatible with the proposed urban form, the Subject Lands will be serviced by on-site storage tanks and storm sewers designed in accordance with Town of Oakville standards.

26. The conceptual major storm system is illustrated in **Drawing 5.2**.

27. Post-development subcatchment drainage areas within the Subject Lands will generally maintain pre-development areas.

28. Regional Storm controls are proposed and are provided in the downstream SWM pond through the upgrading of the existing outfall. It has been verified that there will be no impact to Dundas Street West as a result of this conveyance. In addition, it has been confirmed that there will be no impact on Riverbank Way or the residential lots adjacent to the existing SWM facility.

29. The erosion threshold for the EIR Subcatchment was assessed to determine an appropriate erosion threshold to inform the design of the SWM facility. It included determination of a theoretical critical erosion threshold, field verification of erosion thresholds, continuous hydrologic modeling of pre- and post-development flows and an assessment of potential geomorphic adjustments due to potential changes in the flow regime. Based on the erosion threshold assessment, it is recommended that:

a) A minimum of XX m^3/impervious hectare of extended detention should be provided (i.e., to ensure that 25mm rainfall is detained over a 24 to 48 hour period).

b) For all developing areas in the subcatchment, LID measures should be maximized to the extent feasible.

c) A monitoring plan should be developed at detailed design to assess channel adjustments within the reach downstream of the existing SWM pond.

30. The storm drainage designs for the Subject Lands have considered external lands outside of the Subject Lands but within the FSS Study Area (i.e., the properties to the west and southeast of the Subject Lands). Drainage from the Prime Envision Inc. lands (1013 Dundas Street) will be captured and conveyed to the proposed storm sewers within the Subject Lands. Drainage from the St. Peter and Paul Parish property (1039 Dundas Street) will drain south to the existing storm sewers on Dundas Street West. The general approach is that these lands will have independent stormwater controls subject to a future EIR/FSS Addenda.

31. There were no Hydrologic Features A or B identified in NOCSS within the Subject Lands. There is one Hydrologic Features B on the Trafalgar Lawn Cemetery lands (hereafter referred to as the 'cemetery lands'). This feature appears to be a man-made decorative pond with a fountain in it.

32. A detailed operations and maintenance manual for the SWM facilities and related infrastructure will be submitted at the time of detailed design in conformance with the Town of Oakville Standards and Specifications, the NOCSS and the SWMP Design Manual.

WATER BALANCE

33. Detailed water balance calculations using a monthly soil-moisture balance approach determined that under existing land use conditions, the groundwater recharge component across the Subject Lands will be about 4,991 mm/year. This estimate for groundwater recharge is consistent with previous studies done for the North Oakville area.

34. Construction of impervious surfaces such as roads, driveways, parking lots, and roofs can alter the natural water balance of a site. Monthly post-development water balance calculations for the Subject Lands based on the proposed development concept indicate that, if unmitigated, the development has the potential to reduce the pre-development recharge by approximately 89%.

35. The natural recharge volume is limited due to the low hydraulic conductivity of the surficial till soils. There are no surface water drainage features on the Subject Lands and runoff is mainly via surface flow towards roadside ditches and catchbasins. Therefore, the potential reduction in recharge related to land development is not expected to result in any significant changes to the overall groundwater flow patterns and no watercourses will be affected. To minimize potential development impacts to the water balance, and to address Town

requirements, LID measures, in the form of tree pits, are provided to in part make up the post-development recharge deficit.

PRELIMINARY GRADING PLAN

36. A preliminary grading plan has been prepared to identify preliminary grading requirements within the Subject Lands. **Drawing 5.5** presents preliminary grading information.

WASTEWATER SERVICING

37. The Area Servicing Plan (ASP) prepared by MMM, shows the Subject Lands as part of the area draining to sanitary node 6F which drains east along Sixteen Mile Drive.

38. The conceptual wastewater servicing scheme for the Subject Lands is illustrated in **Drawing 7.1**. The wastewater servicing scheme has been planned in accordance with the North Oakville East ASP and approved update. This includes sanitary sewers designed in accordance with Region of Halton standards and specifications.

WATER SERVICING

39. The Subject Lands are currently located within the subzone O3 of Halton's water distribution system. A 400 mm watermain is located on the east side of Neyagawa Boulevard which will service the Subject Lands.

40. The conceptual water servicing scheme for the Subject Lands is illustrated in **Drawing 7.2.** The water servicing scheme has been planned in accordance with the North Oakville East ASP. This includes a network of new local watermains designed in accordance with the Regional Municipality of Halton design criteria and MECP guidelines such that adequate pressures and fire flows are achieved.

ROADS

41. Through the Secondary Plan process, alternate road allowance design standards were proposed by the Town of Oakville. Updated road allowance designs for the various road types, including utility and sidewalk placements, are proposed to address the detailed requirements of the various stakeholders. Road cross-sections are included in on **Figures 8.1A, 8.1B** and **8.1C**.

42. Preliminary sidewalk locations are illustrated on **Drawing 4.3**.

CONSTRUCTION PRACTICES

43. An erosion and sediment control strategy will be implemented at the detailed design stage in accordance with Town of Oakville and Conservation Halton (CH) guidelines. All control measures will be installed prior to the start of earthworks in accordance with industry standards.

44. The groundwater conditions do not present significant constraints to construction. The overburden till material and shale bedrock demonstrates low hydraulic conductivity, indicating limited permeability across the site. However, certain locations, specifically monitoring wells BH1 and BH2 and BH3 (screened at the interface of overburden till and shale bedrock), exhibit relatively higher hydraulic conductivity compared to the other monitoring wells. These zones of higher conductivity are observed at shallow depths, approximately 1.5 to 7.1 metres below the existing ground surface. During detailed design, if dewatering above 50,000 L/day is anticipated, an Environmental Activity Sector Registry (EASR) registration can be made to support the required dewatering. Permanent dewatering is not permitted by the Town into public storm sewers and infrastructure. It is recommended that waterproofed foundations (e.g. bathtub design) be implemented. Best management practices will be used to prevent lowering of the water table (e.g., use of trench collars to prevent preferential groundwater flow along the permeable granular bedding material in the base of the service trenches).

45. A Geotechnical Report was prepared by DS Consultants Ltd. (DS, August 2023). Findings affecting construction design and practices are summarized in **Section 3** with the complete report in **Appendix E**.

MONITORING

46. NOCSS outlines the requirement to prepare monitoring programs for erosion and sediment control, stormwater management facilities, and monitoring of stormwater management works, municipal services and trails installed by a landowner within the Natural Heritage System. Principles for each of these monitoring programs, where applicable, are provided in **Section 10**.

47. An erosion and sediment control plan will be prepared prior to site earthworks in accordance with guidelines endorsed by Conservation Halton titled, Erosion and Sediment Control Guide for Urban Construction (TRCA, 2019). Specific details of an erosion and sediment control strategy will include the type and location of control measures to be implemented, timing of implementation, details of responsibilities for monitoring, reporting and maintenance needs.

48. Stormwater management facility monitoring details will be prepared in accordance with the Town of Oakville's *Stormwater Management Monitoring Guidelines, North of Dundas Street* (January 2012). A detailed monitoring program will be provided at the time of detailed design, including the estimated monitoring costs.

CONFORMITY WITH OPA 272 AND NOCSS

49. This EIR/FSS Addendum has been prepared in accordance with requirements set out in the approved Scoped EIR/FSS Addendum ToR (**Appendix A**) to ensure conformity with NOCSS technical recommendations.

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1 INTRODUCTION

1.1 Study Purpose

This Environmental Implementation Report and Functional Servicing Study (EIR and FSS) has been prepared in accordance with the requirements of the Town of Oakville Official Plan Amendment 272 (OPA 272) for a portion of the lands located in the North Oakville East Secondary Plan (NOESP) Area shown on **Figures 1.1 and 1.2**. This parcel of land is owned by Neatt (16 Mile Creek) Inc. and is referred to as the 'Subject Lands'. Detailed investigations were undertaken for the Subject Lands as well as to two external properties located adjacent to the Subject Lands (1013 and 1039 Dundas Street).

The Subject Lands are located north of Dundas Street, immediately west of Neyagawa Boulevard, and south of Sixteen Mile Drive. These lands encompass a gross area of approximately 3.73 ha. The EIR and FSS Study Area also includes 3.96 ha associated with St. Peter and Paul Parish (1039 Dundas Street) located to the west of the Subject Lands and 0.62 ha associated with Prime Envision Inc. (1013 Dundas Street) located to the southeast.

This EIR/FSS has been prepared to address OPA 272 policy requirements in support of the approval of a Draft Plan submission for the Subject Lands.

OPA 272 to the Town of Oakville Official Plan was approved by the Ontario Municipal Board on January 11, 2008. This OPA establishes the NOESP for the lands generally bounded by Dundas Street, Ninth Line, Highway 407 and Sixteen Mile Creek. The OPA includes land use designations and detailed policies establishing general development objectives to guide the future development of this area. It also sets out the prerequisites which must be met before any development can proceed. These include:

- Policy 7.8.3 a) requires that an Environmental Implementation Report (EIR) be prepared for each subcatchment area, in accordance with the directions established in the *North Oakville Creeks Subwatershed Study (NOCSS*) *Implementation Report* for each subcatchment area identified in Appendix 7.2.
- Policy 7.8.3.b) requires that a Functional Servicing Report (FSS) be completed. The FSS must include a preferred servicing plan based on an analysis of servicing requirements, in accordance with any approved Class Environmental Assessment Studies, Halton Transportation Master Plan and the Master Servicing Plan for the North Oakville East Planning Area and including:
    - i.) servicing design requirements;
    - ii.) preliminary sizing of water and wastewater infrastructure;
    - iii.) layout for roads and other transportation systems including transit and trails; and,

iv.) preliminary sizing and location of stormwater management facilities and integration with environmental features and development areas.

- Policy 7.8.3 a) iii) requires that Environmental Implementation Reports be prepared in accordance with Terms of Reference approved by the Town of Oakville (the "Town"), the Region of Halton (the "Region") and the applicant(s), in consultation with Conservation Halton ("CH").

The work completed as part of this EIR/FSS and documented in this report was guided by requirements set out in the Scoped EIR/FSS Terms of Reference (ToR) approved by the Town and Conservation Halton and is intended to satisfy the above policy requirements of OPA 272. A copy of the approved ToR is provided in **Appendix A**.

The purpose of the EIR is to characterize and analyze the natural heritage features and functions within the study area and to determine and address the potential impacts of a proposed development application, including servicing requirements, on the Natural Heritage System (NHS).

The purpose of the FSS is to identify servicing requirements related to roads, water supply, sanitary sewers, storm drainage, stormwater, and site grading. Further, the purpose of both the EIR and FSS is to provide a link between the Town's *North Oakville Creeks Subwatershed Study* (NOCSS) Management Report and Implementation Report, the NOESP, and the required planning approvals.

The EIR/FSS is intended to assist in the development of draft plans, address the requirements of the NOCSS and NOESP, and ensure that the site characteristics are understood in sufficient detail to provide the information necessary to process draft plans and identify conditions of approval.

As set out in the approved Scoped ToR, the EIR/FSS for the Subject Lands has been prepared as a joint report to fully integrate environmental and engineering recommendations to protect the function of the NHS and service the Subject Lands.

1.2 EIR Subcatchment Area and FSS Study Area

The majority of the Subject Lands lie within the East Sixteen Mile Creek Tributary subcatchment referred to as ES9. Under existing conditions, approximately 0.62 ha of the Subject Lands is located within subcatchment OC1. These lands will be conveyed to ES9 under the ultimate condition based on the existing ES9 drainage area flows. As a result, OC1 has not been studied as part of this EIR and FSS.

Surface runoff flows move generally towards the Sixteen Mile Creek. There are no natural watercourses in the EIR Subcatchment Area and storm runoff is conveyed via roadside ditches.

The limits of the EIR Subcatchment Area and the Subject Lands are shown on **Figure 1.3**. The EIR Subcatchment Area is 20.61 ha in size and includes the 0.62 ha currently

associated with OC1. **Table 1.1** notes the subcatchment draining the Subject Lands and the areas/percentages of the Subject Lands lying within the subcatchment.

Table 1.1 – Existing Subcatchment Areas and Subject Lands

Area	East Sixteen Mile Creek Tributary (ES9) (ha)	Percentage of Catchment Area
Subject Lands	3.73*	18%
St. Peter and Paul Parish	3.96	3%
Prime Envision Inc.	0.62	19%
Trafalgar Lawn Cemetery	4.64	23%
Dundas Street West	3.26	16%
Knox Presbyterian Church	0.54	3%
Existing Residences South of Dundas	2.53	12%
Riverbank Way SWM Pond	1.33	6%
	20.61**	100%

*Note - the 3.73 ha also includes the 0.62 ha currently within OC1 that will ultimately be conveyed to ES9

**Note - the original NOCSS drainage area (catchment ES9) to Dundas Street is 24.68 ha, but a portion of that area (approximately 6.4 ha) has been diverted to the North Park SWM facility.

The Scoped EIR/FSS ToR differentiate between the study area for the FSS and the subcatchment study area for the EIR. The EIR is to be completed on a subcatchment basis, while the FSS will address specific servicing requirements in support of the draft plans. The NOCSS provides direction to the preparation of EIRs including the delineation of EIR subcatchments. Figure 7.4.2 from the NOCSS Addendum illustrates EIR subcatchments.

The EIR Subcatchment Areas and the FSS Study Area for the Subject Lands are shown on **Figure 1.3**. The Subject Lands cover approximately 18% percent of the EIR Subcatchment Area.

This EIR/FSS consistently uses the following four terms when referring to various land areas:

- the "**Subject Lands**" referring to the Neatt (16 Mile Creek) Inc. landholdings west of Neyagawa Boulevard;

- the "**FSS Study Area**" referring to the Subject Lands west of Neyagawa Boulevard and north of Dundas Street as well as the St. Peter and Paul Parish and Prime Envision Inc. properties;
- the "**EIR Subcatchment Area**" referring to the East Sixteen Mile Creek Tributary subcatchment (ES9) west of Neyagawa Boulevard and north of Dundas Street and those lands south of Dundas Street that drain to the existing SWM pond upstream of Riverbank Way; and,
- the "**Study Areas**", referring to both the EIR Subcatchment Area and the FSS Study Area.

As required by the Scoped EIR/FSS ToR, land uses as proposed by the Town's Secondary Plan for lands adjacent to the FSS Study Area are recognized and considered in planning and servicing analyses. Lands immediately adjacent to the Subject Lands include the St. Peter and Paul Parish and Trafalgar Lawn Cemetery lands to the west, one rural residential property to the southeast, the Sixteen Mile Sports Complex to the north, commercial development to the east across Neyagawa Boulevard and residential development to the south across Dundas Street.

1.3 EIR/FSS Study Objectives

The objectives to be fulfilled by the EIR/FSS Addendum are set out in the approved Terms of Reference. They are:

- To demonstrate how the subwatershed requirements set out in the NOCSS Management Report (including targets), the Implementation Report, and Secondary Plan are being fulfilled in all proposed Draft Plans;
- To provide sufficient level of conceptual design to ensure that the various components of the NHS and infrastructure can be implemented as envisaged in the NOCSS and Secondary Plan and to ensure that the Draft Plans are consistent with this conceptual design;
- To ensure servicing requirements as determined in the FSS for the areas external to the Draft Plan are adequate;
- To identify details regarding any potential development constraints or conflicts and how they are to be resolved;
- To provide any further implementation details as needed;
- To streamline the Draft Plan approval process; and,
- To facilitate the preparation of Draft Plan conditions.

1.4 Study Team

A multidisciplinary study team has studied the environment and servicing of the Study Areas. The team and their responsibilities include:

- **Jennifer Lawrence and Associates Inc**. – Lead EIR consultant addressing study integration, team/study management, environmental planning and coordination of EIR/FSS report preparation;

- **Urbantech Consulting** – Lead FSS consultant addressing municipal servicing, stormwater management and site grading;
- **GEI Consultants** - addressing natural heritage;
- **DS Consultants Limited** – addressing geology and soils and hydrogeology;
- **GEO Morphix Ltd.** – addressing fluvial geomorphology and erosion
- **Urban Strategies Inc.** – addressing municipal planning matters and preparing the draft plan of subdivision.

1.5 Previous Studies, Reports and Planning Documents

The following approved studies/guidelines/documents were reviewed in preparation of this EIR/FSS Addendum. A complete listing of references is provided at the end of this report:

- Town of Oakville North Oakville Creeks Subwatershed Study, August 2006;
- Town of Oakville North Oakville Creeks Subwatershed Study Addendum, September 2007;
- Ontario Municipal Board Mediation Agreements, 2007;
- Town of Oakville Official Plan Amendment 272 (February 2008);
- Region of Halton Official Plan Amendments 25, 48 and 49;
- Ontario Municipal Board Minutes of Settlement, June 2006 and August 2007;
- Halton Water and Wastewater Master Plan Review, KMK Consultants Limited, October 2002 (Master Plan);
- South Halton Water and Wastewater Master Plan Update, Region of Halton, 2007 (Master Plan Update);
- North Park, Phases 1 and 2, Environmental Implementation Report and Functional Servicing Study, FINAL, Totten Sims Hubicki et al, May 2009
- North Oakville East Secondary Plan - Area Servicing Plan, Oakville Ontario, MMM Group, April 2011;
- North Oakville East Trails Plan - May 2013
- Stormwater Management Planning and Design Manual, Ministry of Environment, March 2003;
- Development Engineering Procedures and Guidelines Manual, Town of Oakville, September 2023;
- Stormwater Monitoring Guidelines North of Dundas Street, Town of Oakville, January 2012;
- Conservation Halton Guidelines for Stormwater Management Engineering Submissions, June 2024
- Water and Wastewater Linear Design Manual, Halton Region, October 2019; and,
- Erosion and Sediment Control Guide for Urban Construction, TRCA 2019.

2 NATURAL HERITAGE SYSTEM FRAMEWORK

2.1 Natural Heritage System Components

OPA 272, the NOCSS and the NOCSS Addendum provide policies and/or directions with respect to the protection and management of the North Oakville East Natural Heritage/Open Space System. The NOCSS is divided into four sections, which follow the four phases of a subwatershed management approach. They include Characterization, Analysis, Management Strategy and Implementation.

The Management Strategy outlines requirements with regard to lands restricted from development, lands with development limitations or constraints, stormwater management, input to land use policies and servicing requirements. The Implementation Plan outlines the implementation requirements for the recommended management strategy, studies needed in subsequent stages of the development process, environmental reporting requirements, agency responsibilities, and the approval process with the Town of Oakville, Halton Region and Conservation Halton (CH), and, where applicable, the MNRF, MECP and DFO.

The Natural Heritage System Area designation of OPA 272 is comprised of Core Preserve Areas, Linkage Preserve Areas, and High and Medium Constraint Stream Corridors. In addition to the High and Medium Constraint Stream Corridor, a number of other hydrological features have been identified in OPA 272, which are also part of the Natural Heritage component of the Natural Heritage and Open Space System to the extent they are maintained after development occurs.

The Subject Lands and the EIR Subcatchment Area do not support any Core Areas, Linkage Preserve Areas or Stream Corridors as identified in OPA 272, NOCSS and the NOCSS Addendum and there are no environmental features that require protection in-situ. Aerial photos suggest the presence of one Hydrologic Features B within the EIR Subcatchment Area, outside of the Subject Lands. Photos suggest that this is a decorative pond with fountains and is not a natural depression or feature. **Figure 2.1** illustrates this feature on a current aerial photograph base.

While there are no natural heritage features or linkages within the Subject Lands or EIR Subcatchment Area, a Core Preserve Area (Core 3) is located immediately west of the EIR Subcatchment Area (**Figure 2.1**). The adjacent Core Area 3 is associated with the main Sixteen Mile Creek valley; this area provides a linkage between the lands north of Highway 407 and south of Dundas Street and includes natural heritage features and associated buffers including the valleyland, woodlands and wetlands. Adjacent to Core 3, within the ES9 Catchment Area, is a cemetery. It is not anticipated that there will be any redevelopment of the cemetery lands. Further, given that the cemetery is actively

maintained and consists predominantly of mowed lawns, with some hedgerow communities, it is not anticipated that there are significant ecological functions within the cemetery lands that would warrant further assessment. As such, no site reconnaissance or ecological surveys were completed on these cemetery lands. Should the cemetery lands advance for development at some point in the future, an EIR/FSS Addendum would be required.

2.2 Natural Heritage

No components of the NHS were identified within the Subject Lands in NOCSS or within the adjacent non-participating properties of the FSS Study Area (St. Peter and Paul Parish and 1013 Dundas Street). Field investigations were undertaken by GEI between April 2024 to September 2024 to confirm existing conditions with respect to natural heritage and hydrological features and to screen for species at risk (SAR). The following studies were completed within the Subject Lands, 1039 Dundas Street and 1013 Dundas Street, referred to as the 'Ecological Study Area' in the sections below:

- Ecological Land Classification and Vegetation Inventory (summer and fall);
- Anthropogenic Structure Surveys (snake overwintering, bat habitat, and bird habitat);
- Treed Bat Habitat Assessment;
- Two rounds of Breeding Bird surveys; and,
- Three rounds of Amphibian Call Count surveys.

Survey details, including dates, times and weather conditions are summarized in **Table 1, Appendix B-2.**

2.2.1 Ecological Land Classification and Vegetation Inventory

2.2.1.1 Methods

Vegetation surveys were conducted on July 25 and September 16, 2024.

Ecological communities on the Subject Lands were mapped and described following the protocols of the Ecological Land Classification (ELC) System for Southern Ontario (Lee *et al.,* 1998). This involved delineating vegetation communities on aerial photos of the property and recording pertinent information on the community structure and composition.

A two season (summer, fall) vegetation survey was conducted for the Subject Lands in conjunction with ELC surveys, and all vegetation species observed during these surveys were recorded.

2.2.1.2 Findings

2.2.1.2.1 Ecological Land Classification

The Subject Lands are comprised largely of Dry-Moist Old Field Meadow (CUM1-1) and residential/disturbed areas (RES/DIST). Ecological communities include Mineral Cultural Thicket (CUT1), Coniferous Plantation (CUP3), and Hedgerows (HR).

The remaining Ecological Study Area consisted of disturbed areas (DIST), Hedgerows (HR), and Mineral Cultural Woodlands (CUW1). Additional communities include Dry-Moist Old Field Meadow (CUM1-1), Buckthorn Deciduous Shrub Thicket (THDM2-6), manicured lawn, and residential properties (RES).

Ecological communities are illustrated in **Figure 1, Appendix B-1** and described in **Table 2, Appendix B-2**. ELC data sheets are included in **Appendix B-3**.

Table 2.1. Ecological Land Classification Coverage

Subject Lands (3.74 ha)	
ELC Unit	**Coverage (%)**
HR	23%
RES/DIST	30%
CUM1-1	40%
CUT1	5%
CUP3	3%
Ecological Study Area (8.32 ha)	
ELC Unit	**Coverage (%)**
HR	11%
CUM1-1	18%
RES/DIST	34%
CUT1	2%
CUP3	2%
Lawn	14%
HR/THDM2-6	2%
DIST/CUM	5%
CUW1	11%

2.2.1.2.2 Flora

A total of 102 species of vascular plants were documented from the Ecological Study Area. Of this total, 48 (47%) are native, and 54 (53%) are introduced. A full species list is provided in **Table 3, Appendix B2**.

In terms of conservation status, the species recorded in the Ecological Study Area show a variety of rankings by the NHIC (2024):

- 2 species (4%) are ranked S1-S3 (critically imperiled to vulnerable);

- 6 species (13%) are ranked S4 (apparently secure);
- 40 species (83%) are ranked S5, indicating they are secure in Ontario.

One Butternut (*Juglans cinerea*) was observed to the west, and beyond 25m of, the Subject Lands as shown on **Figure 1, Appendix B1**. Butternut is considered endangered under the *Endangered Species Act* (2007), and provincially rare (S2?) under the NHIC rankings. This medium sized individual was located within the southwestern portion of the St. Peter and Paul Parish within the Ecological Study Area. When those lands advance for development, a subsequent DNA analysis could be undertaken to confirm potential hybridity. Butternut hybrids are not considered at risk and are not protected in Ontario.

2.2.2 Anthropogenic Structure Screening Assessment

2.2.2.1 Methods

Anthropogenic structures within the Ecological Study Area were visually assessed for their potential to provide species at risk (SAR) habitat as follows:

- **Bat Roosting Habitat:** Potential entry and exit points; bats will roost within structures where openings permit access. Four bat species are listed as endangered in Ontario: Eastern Small-footed Myotis (*Myotis leibii*), Little Brown Myotis (*Myotis lucifugus*), Northern Myotis (*Myotis septentrionalis*), and Tri-colored Bat (*Perimyotis subflavus*).
- **Chimney Swift (*Chaetura pelagica*) Nesting Habitat**: Chimneys may be used for nesting by Chimney Swift, listed as Threatened in Ontario. The species uses open uncapped chimneys without any modifications like ventilation or exhausts.
- **Barn Swallow (*Hirundo rustica*) Nesting Habitat:** Barn Swallow, listed as Special Concern in Ontario, will nest on walls or rafters, typically on the exterior of a structure under an overhang, or in the interior where access is available.
- **SAR Snake Hibernacula Habitat:** Species at risk snakes are known to overwinter below the frost level, including through cracks in foundations where present.

Features with the potential to provide habitat for SAR were recorded for future studies during appropriate seasonal conditions.

2.2.2.2 Findings

The following outlines the potential for anthropogenic structures within the Ecological Study Area to provide SAR habitat

- **SAR Bat Roosting Habitat:** Two (2) structures were identified as potential SAR bat roosting habitat and are shown on **Figure 2 (Appendix B-1).** The first structure (#1) is a residence located within the Subject Lands and the second structure (#2) is located on the adjacent property at 1013 Dundas Street. Structures identified to have potentially suitable habitat will require additional survey effort, referred to as Bat Exit Surveys, to confirm whether SAR bats are using these potential habitats. Both structures will require bat exit surveys to be completed in June prior to any planned removal.

- **Chimney Swift Habitat:** Anthropogenic structures with uncapped chimneys were present on the Subject Lands. As a result, further assessment was completed, as documented in **Section 2.2.3**.

- **Barn Swallow Habitat:** Suitable nesting habitats for Barn Swallow were not observed on the Subject Lands or within the remainder of the Ecological Study Area.

- **Snake Hibernacula:** No structures were identified that would support snake overwintering within the Subject Lands or within the remainder of the Ecological Study Area.

2.2.3 Bat Habitat Assessment

2.2.3.1 Methods

SAR bat maternal roosts are often associated with cavity trees and anthropogenic structures (discussed previously in **Section 2.2.1**).

Treed habitat assessments were undertaken within the Ecological Study Area in accordance with the MECP '*Species at Risk Bats Survey Note 2022*' guideline.

As per Step 1 of the MECP protocol '*Maternity Roost Surveys*' (undated), any coniferous, deciduous or mixed wooded ecosite that include trees at least 10 cm diameter at breast height (DBH) are considered candidate maternity roost habitat. Four habitats (Hedgerow HR, Residential RES, Hedgerow/Buckthorn Deciduous Shrub Thicket HR/THDM2-6, Dry-Moist Old Field Meadow CUM1-1) were included in the assessment.

Detailed bat snag surveys were undertaken in accordance with Step 2 of the MECP protocol on April 16, 2024, to determine the occurrence of snag trees. The survey was completed during leaf off, using a transect approach. Snag trees with characteristics favourable to Myotis species were considered. In addition, oak species with a DBH greater than 10 cm or maple species with a DBH greater than 25 cm were noted to consider habitat for Tri-colored Bat. All snag trees observed were provided a unique code and the following parameters were documented:

- Species;
- Location;
- Approximate tree height;
- Diameter at breast height;
- Number of cavities;
- Characteristics of cavity;
- Approximate height of cavities; and
- Tree condition.

2.2.3.2 Results

The treed bat habitat assessment confirmed eleven cavity trees that could provide potential SAR bat roost habitat. A detailed list is provided in **Table 4, Appendix B-2**, and the locations are shown in **Figure 2, Appendix B-1**. These cavity trees were isolated to anthropogenically influenced communities including hedgerows and cultural meadow which are unlikely to provide high quality bat habitat. High quality bat habitat is present within the local landscape associated with the Sixteen Mile Creek valley corridor (Core 3). As a result, the removal of the eleven cavity trees on the Subject Lands would have no impact on the overall habitat availability for endangered species of bats, and there is no requirement to engage with MECP. Regardless, it is recommended that all tree/native vegetation removals should occur outside of the active bat window (April 1 to September 30) when feasible.

2.2.4 Breeding Bird Survey

2.2.4.1 Methods

Two breeding bird surveys were conducted on June 1 and June 26, 2024, between dawn and five hours after dawn with suitable wind conditions, no thick fog or precipitation, and with temperatures between 11 and 12°C. Breeding bird surveys were conducted following protocols set forth by the Ontario Breeding Bird Atlas (Cadman et al. 2007) and the Ontario Forest Bird Monitoring Program (Cadman et al. 1998). Point count stations were surveyed for 10 minutes for birds within 100 m and outside 100 m. All species recorded on a point-count were mapped to provide specific spatial information and were observed for signs of breeding behaviour. Surveys were conducted at least 10 days apart.

2.2.4.2 Results

A total of 30 species of breeding birds were observed during the surveys. Of this total, three species are confirmed, eight are probable, and 12 are possible breeders. The remaining seven bird species are considered non-breeders, flyovers, or migrants. No additional species were observed. All species observed within the Ecological Study Area are listed in **Table 5** (**Appendix B-2**).

A total of 23 (100%) of the confirmed, probable, or possible breeders are provincially ranked S5 (common and secure), S4 (apparently common and secure) or SNA (species not native to Ontario). No bird species are considered provincially rare (S1-S3; NHIC 2024).

No Chimney Swifts were observed during these surveys; as Chimney Swift are easily detected when present, it is determined that they are not using the identified potentially suitable structures for nesting.

Up to three Barn Swallows were observed foraging during both rounds of surveys. However, as noted previously, no suitable breeding sites were observed, and no breeding evidence was obtained for Barn Swallow in the Ecological Study Area. As a result, the Ecological Study Area does not represent habitat under the *Endangered Species Act* and no further engagement with MECP is required.

2.2.5 Amphibian Call Survey

2.2.5.1 Methods

Wet areas were found along the hedgerow features during bat habitat assessments which were identified as potentially suitable amphibian habitat. Surveys were undertaken during May and June 2024 to determine if this area would support breeding habitat for frogs and toads.

One survey station location was subsequently identified through an assessment of orthophotography, existing vegetation communities and ground observations. This station was located within a hedgerow (HR), and water was present during the first two rounds of surveys. All calls heard within the survey station were recorded, as well as any call observations outside of the survey station, including on adjacent lands

Minimum night air temperatures at time of survey of 5°C, 10°C and 17°C were applied to each of the respective survey periods. The areas that contained potential breeding amphibian habitat was surveyed from a distance that would enable calling amphibians to be heard.

2.2.5.2 Results

No amphibians were heard calling within the Ecological Study Area during the three rounds of call count surveys (full results are provided in **Table 6, Appendix B-2**).

2.2.6 Incidental Wildlife Observations

All incidental wildlife observations are included within the Master Wildlife Table (**Table 7, Appendix B-2).** Incidental observations of Eastern Cottontail (*Sylvilagus floridanus*), Red Squirrel (*Sciurus vulgaris*) and Eastern Gray Squirrel (*Sciurus carolinensis*) were recorded.

2.2.7 Aquatic Habitat

As noted in the approved Terms of Reference, background information was to be used to document fish habitat downstream of the existing stormwater management (SWM) pond north of Riverbank Way.

The EIR catchment area is located within the Sixteen Mile Creek watershed and more specifically the West Branch subwatershed. Sixteen Mile Creek has headwaters originating from above the Niagara Escarpment which run through rural and urban land uses within the Towns of Halton Hills, Milton, Oakville, and the City of Mississauga before draining into Lake Ontario (Conservation Halton, 2024). The SWM pond south of the Subject Lands drains via pipe outlet into a tributary of Sixteen Mile Creek, which flows within a deeply incised valleyland identified as a major discharge area with seeps (Conservation Halton, 2024).

The West Branch subwatershed is described as providing more warmwater conditions than areas further upstream. This branch provides warmwater sport fish habitat and is

part of the migratory route for Rainbow Trout (*Oncorhynchus mykiss*) to and from the spawning grounds (Gore & Storrie Limited and Ecoplans Ltd., 1996). While the exact fish survey station locations are generally not available, fish species historically caught or observed within the West Branch of Sixteen Mile Creek between 1970s-1990s include: Coho Salmon (*Oncorhynchus kisutch*), Chinook Salmon (*Oncorhynchus tshawytscha*), Smallmouth Bass (*Micropterus dolomieu*), Rock Bass (*Ambloplites rupestris*), White Sucker (*Catostomus commersonii)*, Northern Hogsucker (*Hypentelium nigricans*), Carp (*Cyprinus carpio*), Stonecat (*Noturus flavus*), Brown Bullhead (*Ameiurus nebulosus*), Creek Chub (*Semotilus atromaculatus*), River Chub (*Nocomis micropogon*), Lake Chub (*Couesius plumbeus*), Common Shiner (*Luxilus cornutus*), Rosyface Shiner (*Notropis rubellus*), Rainbow Darter (*Etheostoma caeruleum*), Fantail Darter (*Etheostoma flabellare*), Longnose Dace (*Rhinichthys cataractae)*, Bluntnose Minnow (*Pimephales notatus*) and American Eel (*Anguilla rostrata*) (Gore & Storrie Limited and Ecoplans Ltd., 1996). . Habitat conditions within the West Branch of Sixteen Mile Creek are described as moderate to fast flowing, with the presence of riffle and pool habitats, filamentous algae and predominately cobble substrate with gravel and bare shale (Gore & Storrie Limited and Ecoplans Ltd., 1996).

3 GEOLOGY AND HYDROGEOLOGY

3.1 Scope of Work

The scope of work completed for the hydrogeological component of this report was designed to address the technical requirements as set out in the approved Scoped EIR/FSS ToR (**Appendix A**). Specifically, the hydrogeological work program was completed to:

- review the regional hydrogeological setting;
- characterize the local soil, groundwater, and surface water flow conditions;
- assess the local groundwater/surface water interactions and identify areas for recharge/discharge function protection;
- characterize the existing surface water and groundwater quality;
- calculate the pre- and post-development water balance conditions;
- identify hydrogeological opportunities and constraints to maintaining the water balance;
- provide information to support the identification of the type, location and size of infiltration or storage measures that may be feasible for use based on the geological and hydrogeological conditions;
- evaluate opportunities for augmenting groundwater infiltration through appropriate and practical Best Management Practices (BMPs) to balance, or at least in part, make up the post-development infiltration deficit; and
- identify potential construction constraints related to the hydrogeological conditions.

The detailed scope of work included:

1. Review of MECP water supply well records and available geotechnical reports for the Hydrogeologic Study Area plus 500m radius to assess the regional hydrogeological setting and soil conditions. A listing of these water supply well records is provided in **Appendix C-1**.

2. The installation of boreholes (BH) and groundwater monitoring wells (MW) in the Hydrogeologic Study Area and review of the available geotechnical borehole and monitoring well records from the Hydrogeologic Study Area plus 500m radius to investigate the local soil and groundwater conditions. The borehole and monitoring well locations on the Hydrogeologic Study Area are shown on **Figure 3.1,** and copies of the borehole logs and well construction details are provided in **Appendix C-2**.

3. Completion of detailed soil descriptions for monitoring wells and review of borehole logs and grain size analyses for monitoring wells and boreholes completed by DS Consultants (DS). Single well response tests conducted by DS were also

evaluated and all data were reviewed to characterize the surficial sediments and estimate the hydraulic conductivity of the soils encountered. Copies of hydraulic conductivity testing results are included in **Appendix C-3**.

4. Monitoring of groundwater levels in the wells on the Hydrogeologic Study Area to measure the depth to the water table and the groundwater seasonal fluctuations. For this study, manual water level monitoring was completed from October 2023 through September 2024 to track four seasons of groundwater variations. The groundwater monitoring data are summarized in **Appendix C-4**. Hydrographs for each of the monitoring locations also are provided in **Appendix C-4**.

5. Collection of a groundwater sample from monitoring well BH23-6 to characterize the groundwater quality. The groundwater sample was submitted to a qualified laboratory for analyses of general quality indicators (e.g., pH, hardness, conductivity), basic ions (including chloride and nitrate) and selected metals. The groundwater quality data are summarized in **Appendix C-5**.

6. Pre-development water balance calculations (based on existing land use conditions) and post-development water balance calculations (based on the proposed development concept) for the Subject Lands to assess the potential impacts of development on the local water resources. The local climate data and detailed monthly water balance calculations are provided in **Appendix C-6.**

3.2 Physiography and Topography

The Hydrogeologic Study Area lies within Till Plains (Drumlinized) physiographic region of Southern Ontario (as per OGS Earth). Quaternary geology characterized by Halton Till predominately consists of silt to silty clay matrix, high in carbonate content and clast poor deposits of Pleistocene. The surficial geology of the Hydrogeologic Study Area has been mapped as Till and consists of clay to silt-textured till derived from glaciolacustrine deposits or shale.

The land surface across the Hydrogeologic Study Area slopes south towards Lake Ontario. Analysis of the detailed topography in the Hydrogeologic Study Area shows the highest elevations (up to 159.8 masl - metres above mean sea level) are found at the east portion of the subcatchment. There is a maximum relief amplitude across the Hydrogeologic Study Area of about 4.5 m, with the lowest elevations (154.2 masl) found in the west area of the subcatchment.

3.3 Drainage

The drainage area and EIR subcatchment boundary is shown on **Figure 3.1**. The Hydrogeologic Study Area generally drain surface water runoff towards Sixteen Mile Creek. Surface flows are directed via roadside ditches.

3.3.1 Watercourse Conditions

There are no permanent watercourses in the Hydrogeologic Study Area. Surface water runoff is directed overland to roadside ditches and swales along Neyagawa Boulevard and Dundas Street West.

3.3.2 Hydrologic Features

Hydrologic Features A are defined in NOCSS to be hydrological features located within Blue or Red Streams. There are no Hydrologic Features A within the EIR Subcatchment Area.

Hydrologic features not associated with the NHS, are referred to as Hydrologic Features B. There are no Hydrologic Features B located on the Subject Lands. There is one Hydrologic Features B within the EIR Subcatchment Area on the cemetery lands; however, air photos would suggest that this is a decorative pond with fountains and is not a natural depression or feature (**Figure 2.1**).

3.4 Climate

The reported long-term average annual precipitation for the period between 1981 and 2010 for the North Oakville area is 897.1 mm based on data from the Environment Canada Royal Botanical Garden monitoring station (Station 6153301 - 43º17'30''N, 79º54'30''W, elevation 102 masl). Average monthly records of precipitation and temperature from this station have been used for the water balance calculations in this study (refer to **Section 6** and **Appendix C-6**).

3.5 Geology

3.5.1 Stratigraphy

The MECP maintains a database that provides geological records of water supply wells drilled in the province. A list of the available MECP water well records for local private wells is provided in **Appendix C-1** and the well locations are plotted on **Figure 3.2**. It is noted that the well locations listed in the MECP records are approximations only and may not be representative of the precise well location in the field. Along with site-specific geological information obtained from geotechnical boreholes and groundwater monitoring wells drilled within the Hydrogeologic Study Area , these MECP records provide geology data that have been used to help assess the regional stratigraphy.

To illustrate the geological conditions, a schematic cross-section through the Hydrogeologic Study Area was prepared. The cross-section location is shown on **Figure 3.1** and the interpreted cross-section is shown on **Figure 3.5**. The cross-sections illustrate

stratigraphic profile of the Hydrogeologic Study Area, showing the sequence and thicknesses of various subsurface materials encountered, including topsoil and fill materials, silty clay till, a silty clay till/shale complex, and underlying shale bedrock.

3.5.2 Surficial Geology

Surficial geology mapping published by the Ontario Geological Survey shows that the Hydrogeologic Study Area is covered by Till deposit consists of clay to silt-textured till derived from glaciolacustrine deposits or shale (**Figure 3.3**). Detailed geological work in the North Oakville East area by Eyles & Eyles (2003) identified two layers of glacial till materials: an upper silt-rich till referred to as the Wildfield till, and a lower coarser-grained till referred to as the Halton till. The Halton till generally occurs north of Burnhamthorpe Road and is not continuous throughout the North Oakville area so that in most places, the Wildfield till directly overlies the shale bedrock.

In 2023, a hydrogeological study and geotechnical investigation of the Hydrogeologic Study Area involved the drilling of twenty-one boreholes to depths ranging from 1.4 to 18.8 m to determine the engineering properties of the surficial soils for residential subdivision construction. Ten of the boreholes were equipped as groundwater monitoring wells. The borehole locations are shown on **Figure 3.1** and a copy of the borehole and monitoring well logs is provided in **Appendix C-2**.

The borehole drilling records show a varied subsurface profile with layers of topsoil, fill materials, granular material, silty clay till, and shale bedrock. The overburden sediments are described as a combination of topsoil, granular fill, clayey silt to silty clay fill with organics, and silty clay till deposits.

The till thickness encountered in the boreholes ranged from about 0.8 m to 1.5 m thick (**Appendix C-2**). The cross-section (**Figure 3.4**) shows that the till ranges from 1.6 m to 3.1 m across the Hydrogeologic Study Area.

3.5.3 Bedrock Geology

The Hydrogeologic Study Area is underlain by shale bedrock of the Queenston Formation. This late-Ordovician aged bedrock consists of relatively soft, friable shale containing thin (< 30 cm) interbeds of fine sandstone and siltstone. The bedrock generally slopes towards the southeast, with the highest bedrock elevation of about 157.0 masl and the lowest elevation of 152.2 masl (**Figure 3.4**).

Across the Hydrogeologic Study Area, the bedrock is encountered at depths ranging from about 2.3 m to 3.3 m of ground surface (refer to borehole logs in **Appendix C-2**).

3.6 Hydrogeology

3.6.1 Local Groundwater Use

In the North Oakville area there are no high-yielding or extensive water supply aquifers reflecting the lack of coarse-grained sand and gravels and the relatively thin, glacial till overburden. A review of the MECP water well records (**Appendix C-1**) indicates that local supply wells generally tap the upper portions of the Queenston shale bedrock. The low hydraulic conductivity till and shale materials are considered as relatively poor aquifers (aquitards), and the local water yields are typically quite low (less than 0.3 L/s).

Municipal water supplies for the Town of Oakville are obtained from Lake Ontario and the proposed development will be municipally serviced. In the long term, it is anticipated that the entire North Oakville area will be on lake-based municipal supplies. There is no proposed groundwater use for the development area (refer to **Section 7** for Water Servicing Details).

It is noted that there may be continued interim use of groundwater for local private wells in the areas surrounding the proposed development. It is important that the development does not disrupt these local water supplies and monitoring of the local supply wells before, during and after construction will be required (refer to **Section 10** for details of the proposed monitoring of local private water supply wells still in use during development).

3.6.2 Hydraulic Conductivity

The hydraulic conductivity (ability of the material to transmit water) of the silty clay till overburden material is low, and was estimated in the NOCSS to be less than 1×10^{-6} cm/sec. This estimate was based on soil grain-size analyses of samples. It is noted, however, that physical conditions such as the degree of weathering and fracturing may affect the overall hydraulic conductivity of the overburden till layer.

In order to assess the in-situ hydraulic conductivity of the overburden, Single Well Response Tests (SWRTs) tests were completed in June and July 2023. Tests completed at shallow groundwater monitoring wells screened in the silty clay till overburden sediments) as well as monitoring wells screen in the shale bedrock resulted in hydraulic conductivity ranging from 9.65×10^{-7} cm/sec at BH23-4 to 1.46×10^{-3} cm/sec at BH2 (refer to **Appendix C-3**). Monitoring wells BH23-4 and BH2 were screened in the shale bedrock and weathered shale complex. The overburden till material and shale bedrock demonstrates low hydraulic conductivity, indicating limited permeability across the site. However, certain locations, specifically monitoring wells BH1 and BH2 and BH3 (screened at the interface of overburden till and shale bedrock), exhibit relatively higher hydraulic conductivity compared to the other monitoring wells. These zones of higher conductivity are observed at shallow depths, approximately 1.5 to 7.1 meters below the existing ground surface.

3.6.3 Groundwater Levels

Since October 2023, groundwater levels have been measured on a monthly basis in monitoring wells (**Appendix C-4).** Hydrographs for each well location are provided in **Appendix C-4**.

This study includes one years' worth of data obtained from October 2023 to September 2024.

The groundwater monitoring data show the following (refer to **Figure 3.1** for the monitoring locations and the hydrographs in **Appendix C-4**):

- Groundwater levels vary seasonally, with water levels generally highest in the spring and lowering throughout the fall and winter months. The general trend at most locations shows levels low in winter followed by a rise in water level through the spring. Following the spring rise there was a gradual decline in levels from late spring to early fall. Seasonal variation in the monitoring wells ranged from 148 masl to 157 masl.

- The depth to the water table generally ranges from about 2.56 m to 6.3 m below grade within the overburden and shale bedrock in the Hydrogeologic Study Area (ground elevations are shown on the hydrographs in **Appendix C-4**). Water table is interpreted to be closer to surface in low lying areas and near surface runoff swales and further from surface in the upland areas.

3.6.4 Groundwater Flow Conditions

Groundwater elevation data from April 2024 are shown on **Figure 3.5**. The interpreted groundwater elevation contours for the Hydrogeologic Study Area are shown on **Figure 3.5** along with arrows to illustrate the shallow groundwater flow directions. The groundwater contour lines were drawn using basic hydrogeological principles. Water levels in the local observation wells were used and were incorporated into the larger regional flow mapping. This mapping considered water level monitoring data, topographic elevation data and groundwater gradients where appropriate.

The groundwater elevation contours indicate that the groundwater movement is generally towards the west across the subcatchment (**Figure 3.5**). Regionally, the groundwater flow pattern is interpreted to be influenced by more regional topographical conditions in the area, with flow generally moving towards the deeply incised Sixteen Mile Creek valley located to the west of the Hydrogeologic Study Area.

As described in **Section 3.6.3**, the depth to the water table varies with topography and seasonal conditions. The groundwater rises and falls within the overburden materials and the groundwater monitoring has demonstrated that groundwater is relatively shallow in the topographically higher areas within the Hydrogeologic Study Area. There are no

permanent surface water features across the Hydrogeologic Study Area and no contributions to baseflow are expected.

3.6.5 Recharge and Discharge Conditions

According to the geology, it is expected that downward conditions (i.e., low gradients) occur throughout most of the Hydrogeologic Study Area. The low hydraulic gradients suggest that the surface water may intend to run off rather than infiltrate. It is likely that recharge to the water table and groundwater movement throughout the area is predominantly controlled by fracturing within the till and upper weathered shale.

3.6.6 Groundwater Quality

The local groundwater quality is considered to be poor in terms of drinking water supplies. Singer (2003) indicates that the groundwater from the Queenston Formation shale is characterized as being hard to very hard with excessive levels of sodium and chloride being common. Sulphate concentrations may also vary between 18 and 1,220 mg/L. The highly variable concentrations may reflect the shale chemistry, and this is expected to impact the water quality of the overlying overburden sediments.

Background groundwater quality has been characterized based on a sample collected from BH23-6 on June 27, 2023.

Monitoring well BH23-6 is screened in shale bedrock (refer to well log in **Appendix C-2**). The sample was analyzed for Halton Region sewer use guideline parameters which includes general metals, inorganics and VOCs. The groundwater chemistry results from the analytical laboratory are summarized in **Appendix C-5** and the Halton Region sewer use by-law guideline/standards are also listed with the data for comparison.

There were exceedances for the tested parameters compared to the Halton Region Sewer Use By-Law (refer to **Appendix C-5**).

4 LAND USE

4.1 General Description of Draft Plan

The location of the Subject Lands in relation to the North Oakville Master Plan is shown on **Figure 4.1**. The proposed draft plan is shown on **Figure 4.2** and consists of:

- 3 residential apartment blocks (Blocks 1, 2 and 3)
- 3 public roads (Streets A, B and C).

The adjacent land uses can be summarized as follows:

- To the West: - Institutional land uses (church, cemetery), Sixteen Mile Creek valley and associated NHS)
- To the North: - Community Park, Arena and Open Space
- To the East: - Commercial Uses/Urban Core
- To the South - Low-Density Residential

Neither the EIR Subcatchment Area nor the Subject Lands support any Core Areas, Linkages, or High/Moderate Constraint Drainage Features as identified through NOCSS or OPA 272. The Hydrologic Features B identified on the cemetery lands has not been identified for protection in OPA 272; however, given its location within an existing cemetery, it is assumed that this feature will persist on the landscape.

The proposed development will result in the removal of habitat for a small number of birds that are common to rural and suburban areas. No significant wildlife species (rare, special concern, threatened or endangered) were found to be breeding with the Subject Lands.

To prevent direct impacts on breeding birds, removal of vegetation should be conducted when birds are not actively nesting. The federal *Migratory Birds Convention Act* (1994) protects the nests, eggs and young of most bird species from harm or destruction. Environment Canada considers the general nesting period of breeding birds in southern Ontario to be between late March and the end of August. This includes times at the beginning and end of the season when only a few species might be nesting. The broad bird nesting season in southern Ontario is April 1 to August 31.

With respect to endangered bats, GEI recommends that no vegetation clearing or stripping occur between the bat active window from April 1st to September 30th. In addition, bat exit surveys are required prior to structure removals, as described in Section 2.2.1.

4.2 Trail Planning

Within the Subject Lands, the Town's Trails Master Plan shows a Major Trail along the western boundary of the subcatchment along the Sixteen Mile Creek valley, immediately north of the Subject Lands in the Community Park, and immediately east of the Subject Lands along Neyagawa Boulevard (**Figure 4.4**). There are no trails shown on the Subject Lands.

5 GRADING, DRAINAGE AND STORMWATER MANAGEMENT

5.1 OPA 272 and the NOCSS Recommendations

Preparation of the Stormwater Management Plan for the Subject Lands has been guided by OPA 272 and the NOCSS recommendations.

OPA 272 policy 7.4.5 states that, "*The management of water resources within the North Oakville East Planning Area shall be undertaken in accordance with the directions established in the North Oakville Creeks Subwatershed Study. No amendments to the Secondary Plan shall be required to implement the recommendations of the Subwatershed Study or for changes to the number or location of stormwater management facilities in accordance with the policies of Section 7.6.2.2 a) of this Plan*".

Section 6.0 of the NOCSS presents the recommended Management Strategy for North Oakville. It includes strategies for natural heritage protection, stormwater management, terrestrial and wetland resources management, riparian corridor management, rehabilitation plans, remediation plans and monitoring. The goals, objectives, and targets of the Management Strategy are set out in NOCSS Section 6.2.

The recommended NOCSS Management Strategy addresses the development of an approach to stormwater management that will, "…*protect and enhance environmental characteristics through managing stormwater response and conveyance processes*". The water resource related goals, objectives and targets from the Management Strategy are presented in **Table 5.1**.

The NOCSS Section 6.3.6 discusses the Stormwater Management component of the Management Strategy. It includes discussion on hydrology, peak flow control, hydrogeology, water quality, fisheries protection, low impact development, source pollution protection and various types of SWM measures.

Table 5.1*
NORTH OAKVILLE SUBWATERSHED STUDY
Meeting the Subwatershed Goals & Objectives

Target Setting

Goals	Objectives	Targets
1. To minimize the threat to life and destruction of property and natural resources from flooding, and preserve (or re-establish, where possible) natural floodplain hydrologic functions.	1.1 To ensure that runoff from developing and urbanized areas is controlled such that it does not increase the frequency and intensity of flooding at the risk of threatening life and property.	• Maintain existing peak discharge rates for all design events, particularly high flows. • Target discharge rates required for each catchment (unit area). • Stream reach floodplain storage targets to protect existing floodplain storage. • Remove flood potential at identified locations within the study area. • Delineate floodplains to provide development limits. • Restrict development in the floodplains as per Provincial and CA policies.
	1.2 To adopt appropriate land use controls and development standards to prevent development in natural flood hazard and erosion hazard areas.	• Delineate floodplains to provide development limits. • Restrict development in the floodplains as per Provincial and CA policies. • Delineate meander belt and erosion setback to be applied on all streams designated to be left as open watercourse (providing erosion protection). • Apply valley wall setback standard (slope plus top of valley setback). • Develop stormwater management plan to replicate flow-frequency-duration from existing conditions. • Meet threshold tractive force targets. • Use Distributed Runoff Control (DRC) approach.

Table 5.1*
NORTH OAKVILLE SUBWATERSHED STUDY
Meeting the Subwatershed Goals & Objectives

Target Setting

Goals	Objectives	Targets
*Reproduced from NOCSS		
	1.3 To ensure that new development incorporates the most appropriate development form and mitigation measures necessary to optimize compatibility with natural features and their associated functions.	• Aquatic protection based upon resident fish community and existing aquatic habitat conditions. • Achieve MOE 'enhanced' level of SWM protection (80% TSS Removal) for all reaches of streams supporting resident redside dace populations (14 Mile and Morrison Creeks). • For all other stream reaches, achieve 'normal' level of SWM protection (70% TSS removal) to adequately protect aquatic habitat and resident fish. Note that 'enhanced' protection of these streams will be required for reasons not directly related to aquatic habitat and resident fish. (see Section 2.2 regarding Phosphorus loadings).
2. To restore, protect, and enhance water quality and associated aquatic resources and water supplies for watercourses, including their associated hydrologic and hydrogeologic functions, within the subwatershed areas.	2.1 Protect stream morphological and fluvial character; restore, where appropriate and feasible, sinuosity; maintain physical habitat attributes (e.g. pools and riffles), diversity and fluvial processes (e.g. bedload transport and energy reduction through sinuosity); and prevent increase in erosions and deposition, through maintenance of hydrological regime.	• Streams that displayed a high sensitivity to change and have a well-developed geomorphic form and function. • Streams that exhibited some sensitivity to change and geomorphic function with a moderate degree of form. • Streams that lacked a defined form but still had a geomorphic function such as sediment transport, flow conveyance, and connectivity to other features.

Table 5.1*
NORTH OAKVILLE SUBWATERSHED STUDY
Meeting the Subwatershed Goals & Objectives

Target Setting

Goals	Objectives	Targets
	2.2 To prevent the accelerated enrichment of streams and contamination of waterways from runoff containing nutrients, pathogenic organisms, organic substances, and heavy metals and toxic substances.	• Control to current nutrient levels in the streams to mitigate the potential increases in nutrients and associated impacts on algae growth. • The potential increase in suspended solids and associated urban pollutants. • The level of chloride and potential increase. • The need to manage stream temperature for fisheries protection.
	2.3 To maintain or restore a natural vegetative canopy along streams where required to ensure that mid-summer stream temperatures do not exceed tolerance limits of desirable aquatic organisms.	• Maintain existing riparian vegetation associated with watercourses where feasible. • Active restoration of riparian zones with native plantings, in cases where watercourse modifications/alterations require permitting/authorization.
	2.4 To minimize the disturbance of the streambed and prevent streambank erosion and, where practical, to restore eroding streambanks to a natural or stable condition.	• Targets as outlined in Objectives 2.1 and 2.2.
	2.5 To restore, rehabilitate, or enhance water quality and associated resources through the implementation of appropriate Best Management Practices on the land.	• Targets for surface water as outlined in Objective 2.2. • For groundwater, target of no detrimental change in existing groundwater quality.

Table 5.1*
NORTH OAKVILLE SUBWATERSHED STUDY
Meeting the Subwatershed Goals & Objectives

Target Setting

Goals	Objectives	Targets
	2.6 To ensure that hydrogeologic functions are preserved and maintained and take full advantage of stream and groundwater discharge/baseflow enhancement opportunities.	• Maintaining groundwater supplies for existing residents while development and servicing proceed. • Keeping changes in the depth to the local water table to within the seasonal fluctuations normally experienced. • Maintaining the groundwater contribution to stream health (groundwater quantity and quality), where it currently exists.
	2.7 To maintain and enhance the aquatic habitat.	• The targets relating to biodiversity for Fourteen Mile, Morrison, and Joshua's Creeks should be that the biodiversity of the fish community be, at a minimum, maintained at existing levels and increased if possible. • Identify stream corridors for protection. • Fluvial geomorphology/erosion control targets under Objective 2.1. • Water quality targets under Objective 2.2. • Designate reaches which support redside dace populations as "no touch" areas where stream sections cannot be relocated. • Enhanced level of stormwater quality control for Fourteen Mile and Morrison Creeks. • Retain wetlands associated with streams if possible and incorporate into drainage system.

Table 5.1*
NORTH OAKVILLE SUBWATERSHED STUDY
Meeting the Subwatershed Goals & Objectives

Target Setting

Goals	Objectives	Targets
	2.8 To minimize disturbance of wetlands, preserving and/or enhancing the habitat and functions they provide.	• Minimize the fragmentation of wetlands. • Maintain the function of all wetlands associated with watercourses. • Maintain the function and structure of wetlands within woodlands.
	2.9 Provide appropriate buffers to wetlands, watercourses, and valley lands to maintain or enhance their biological health and meet objectives of long-term sustainability of these features.	• Establish appropriate feature-specific buffers for protection of natural habitats.
3. To restore, protect, develop, and enhance the Natural Heritage, historic cultural, recreational, and visual amenities of rural and urban stream corridors.	3.1 To ensure that environmental resource constraints are fully considered in establishing land use patterns in the subwatershed.	• Minimize the fragmentation of woodlands. • Maintain the function of all woodlands that are >200m in width (i.e., provide potential interior conditions). • Maintain the function of woodlands associated with watercourses.
	3.2 To ensure that existing wildlife linkages are preserved and that opportunities for improving these linkages are considered/implemented as part of any future development.	• Minimize the discontinuities in linkages (especially >20m). • Linkages to be 100m wide. • Allow for linkages to habitats or other linkages located outside the study area (for example Sixteen Mile Creek valley and Bronte Creek).

Table 5.1*
NORTH OAKVILLE SUBWATERSHED STUDY
Meeting the Subwatershed Goals & Objectives

Target Setting

Goals	Objectives	Targets
	3.3 To retain, preserve, or maintain Natural Heritage Features (i.e., open space and visual amenities) in urban and rural areas by establishing and maintaining greenbelts along stream corridors and adjacent natural areas and maintaining linkages between these areas.	• See discussions under Objectives 2.8, 3.1, and 3.2.
	3.4 To ensure that development in the stream corridor is consistent with the historical and cultural character of the surroundings and reflects the need to protect visual amenities.	• Presence of visual and historic amenities through the subwatershed and Secondary Planning Processes.
	3.5 To ensure that the recreational and fisheries potential of a stream corridor are developed to the fullest extent practicable.	• See discussion under objectives 1.3, 2.3, and 2.7.

The NOCSS Management Strategy makes the following recommendations regarding the design of SWM systems in support of development in North Oakville:

- **Peak Flow Control** – The NOCSS recommends that SWM systems be designed to control post development peak flows to target unit flow rates presented in NOCSS Table 7.4.1 for the 2 year to 100 year events and the Regional Storm. The Addendum further notes that future land use applications may carry out an investigation of the potential increase to flood risk to confirm if Regional Storm controls are necessary. It states that this analysis is to include the assessment of the increase in risk to life and to private, municipal, regional, provincial and federal property under Regional Storm conditions. The Regional Storm assessment was completed; it is outlined in **Section 5.5**.

  No new hydrologic modelling of existing conditions in the subcatchment is necessary to establish existing conditions target peak flows, however, the NOCSS notes that more accurate topographic information is required to define subcatchment boundaries. Target peak flows for the full range of events are to be calculated at the EIR/FSS stage on the basis of updated subcatchment boundaries. **Section 5.2** of this EIR/FSS addresses drainage boundaries and presents target peak flows for East Sixteen Mile Creek Subcatchment ES9 at Dundas Street. Through this report, the subcatchment boundaries were reviewed and minor updates were made to the boundary adjacent to Sixteen Mile Creek.

- **Role of Topographic Depressions/Hydrologic Features A and B** – The NOCSS Analysis Report and Management Strategy address the hydrologic function of terrestrial features (woodlands, wetlands) and stream riparian corridors in the formulation of the recommended Natural Heritage System and SWM System. These reports also identified numerous topographic depressions across the landscape in North Oakville. The NOCSS GAWSER hydrologic model accounted for the storage function of these topographic depressions in the simulation of existing conditions peak flows and the setting of target unit flow rates for SWM facility design. The NOCSS Addendum recommends that the storage functions of these depressions be confirmed through the completion of the EIR/FSS when more detailed topographic information would be available.

  Some topographic depressions that are wetland or pond features were noted to be Hydrologic Features A and B. Wetlands or ponds that were located online or within the stream corridor of a Medium or High Constraint Stream, were defined to be a Hydrologic Feature A; others were defined to be Hydrologic Features B.

  The NOCSS recommended that the form and function of Hydrologic Features A be carefully considered as part of the EIR studies. If relocating these features, the form and function must be maintained. There are no Hydrologic Features A within the EIR Subcatchment Area.

With respect to Hydrologic Features B, the NOCSS notes that their preservation is encouraged but not required. If they are proposed for removal, the active storage volume of these features, if they are natural features and not anthropogenic, must be addressed as part of SWM facility design.

In accordance with NOCSS Addendum requirements, this EIR/FSS Addendum has completed field reconnaissance to identify the presence of Hydrologic Features B located within the EIR subcatchment area (presented on NOCSS Figure 6.3.15 and OPA 272 Figure NOE 3). NOCSS identified no Hydrologic Features B within the Subject Lands and none were identified through the field surveys. As noted earlier, there is one Hydrologic Features B (a decorative pond) located within the cemetery lands.

- **Erosion Control** – The NOCSS identifies the need to complete erosion threshold and erosion control analyses as part of an EIR/FSS so that existing channel erosion or aggradation is not exacerbated by development. The recommended approach to erosion threshold analyses is set out in the NOCSS Addendum.

- **Water Quality Control** – The NOCSS recommendations for water quality control focus on the management of phosphorus, suspended solids, chloride, dissolved oxygen and temperature. The focus on these water quality parameters is, "… *intended to provide controls to the meet the objective of not permitting further enrichment of the streams (i.e., nutrient control), fisheries protection and overall water quality protection*". It further notes that SWM systems are to be designed to meet targets set out in NOCSS Section 6.0 and outlined in NOCSS Table 6.2.1.

  With respect to each of these water quality parameters, NOCSS recommendations specific to East Sixteen Mile Creek ES9 Subcatchment Area are:

  - Provide Enhanced Level of water quality protection. This level of control provides for the removal of 80% of suspended solids, will meet the target of no net increase in Phosphorus loading and will provide the recommended control for overall water quality protection. No further analysis of Phosphorus loading is necessary.

  - Dissolved Oxygen and temperature recommendations apply to other subcatchments, not to the ES9 subcatchment.

  - Chloride recommendations relate to the Town's management of salt applications and do not require any further analyses in the EIR/FSS.

- **Infiltration** - The NOCSS notes that the management of groundwater resources focuses on the management of the hydrologic cycle. For groundwater, the overall goal was stated to be, "*to maintain infiltration as close to current levels as possible*". It further notes that the soils in North Oakville are, "… *poorly permeable, resulting*

in little infiltration" and "*infiltration targets are very difficult to meet*". As such, best efforts are to be made to address maintenance of groundwater recharge.

Section 6.6 of this EIR/FSS addresses post development water balance.

- **SWM Facility Numbers/Locations** – The NOCSS completed a preliminary assessment of the required numbers and locations of SWM ponds to meet the SWM design criteria. It presented preliminary locations for ponds in each subcatchment in North Oakville East. This preliminary analysis identified one SWM pond in the ES9 subcatchment, located approximately on the cemetery lands. Of note, NOCSS anticipated that a portion of the land to the north of the Subject Lands (i.e., the Town parkland and arena) would drain to the SWM pond however, through the design of the Town lands, a separate SWM facility was constructed that outlets to Sixteen Mile Creek further to the north (Subcatchment ES8) and a portion of the Town lands drain to Subcatchment OC-1.

- **Evaluation of SWM Measures, LIDs and Source Pollution Prevention** – While NOCSS identifies the requirement for end-of-pipe SWM facilities for water quality and quantity control, it also recommends that consideration be given to alternative management measures to meet the SWM objectives and targets. In this regard, the NOCSS discusses alternative low impact development (LID) techniques, various source pollution protection programs and alternative SWM practices to be considered.

  Section 6.8 discusses the evaluation of alternative SWM and LID measures.

5.2 Updated Subcatchment Boundaries

The NOCSS identified drainage boundaries based on the best topographic information of the day. The majority of the EIR and FSS Study Areas are located within Subcatchment ES9 which was originally established to have area of 24.68 ha. Subcatchment ES9 drains south to Dundas Street where the flows are collected by existing pipes and are then directed to the existing SWM pond on Riverbank Way.

Subsequent to the completion of the NOCSS, the North Park EIR/FSS was undertaken in support of the Sixteen Mile Sports Complex. As part of that study approximately 6.43 ha was diverted from Subcatchment ES9 to Subcatchment ES8.

In addition to the diversion noted above, the topography associated with the remaining ES9 lands has been reviewed. This review revealed that the portion of the Trafalgar Lawn Cemetery adjacent to Sixteen Mile Creek flows directly to the watercourse rather than to Dundas Street and Subcatchment ES9 as identified in the NOCSS. The existing drainage areas as well as the existing contours are shown on **Drawing 5.2**.

5.3 Pre-Development Flows

As indicated in **Section 5.2** above, changes to the NOCSS modelling were made based on upstream changes in land use as well as updated topography. The NOCSS established target unit peak flows for the 2 year to 100 year events and the Regional Storm using the GAWSER model at node 2140, ESM9. The GAWSER model associated with ESM9 has been updated and the original NOCSS unit flow rates and the updated rates are provided in **Table 5.2.**

Table 5.2 Original NOCSS Unit Flow Rates and Updated Flow Rates

	East Sixteen Mile Creek, ES9 Subcatchment – Node 2140			
Area (ha)	**24.68**		**15.64**	
Return Period (years)	**Original NOCSS Flow Rate (m^3/s)**	**Unit Flow Rates ($m^3/s/ha$)**	**Updated ESM9 Flow Rates (m^3/s)**	**Unit Flow Rates ($m^3/s/ha$)**
25 mm	0.12	0.0048	0.137	0.0088
2	0.26	0.0105	0.286	0.018
5	0.40	0.0162	0.414	0.027
10	0.48	0.0194	0.490	0.031
25	0.60	0.0243	0.595	0.038
50	0.68	0.00276	0.670	0.043
100	0.76	0.0308	0.746	0.048
Regional	1.55	0.063	1.143	0.073

The resulting pre-development flows for ES9 are summarized in **Table 5.3** below.

Table 5.3 Updated Unit Flow Rates and Predevelopment Flows

Return Period (years)	**East Sixteen Mile Creek, ES9 Subcatchment**				
	Updated ESM9 Flow Rates (m^3/s)	**Unit Flow Rates ($m^3/s/ha$)**	**Pre-Development Flow Rates (m^3/s)**		
			Subject Lands (3.11 ha)	**St. Peter & Paul Parish (3.96 ha)**	**Prime Envision Inc. (0.62 ha)**
25 mm	0.137	0.0088	0.027	0.035	0.0054
2	0.286	0.018	0.057	0.073	0.011
5	0.414	0.027	0.082	0.105	0.016
10	0.490	0.031	0.097	0.124	0.019
25	0.595	0.038	0.118	0.151	0.024
50	0.670	0.043	0.133	0.170	0.027
100	0.746	0.048	0.148	0.189	0.030
Regional	1.143	0.073	0.227	0.290	0.045

[1] Refer to **Drawing 5.3** for culvert locations and drainage areas. Only areas proposed to be developed have been included as having a target flow rate

These pre-development flows have been used for setting allowable release rates for return period storms from the subcatchment at Dundas Street. These unit flow rates were used to establish allowable release rates for urban runoff from the EIR Subcatchment Area up to Dundas Street and have been subsequently modified, as noted in **Section 5.6**, to address erosion threshold requirements.

The NOCSS GAWSER model has also been extended to include Riverbank Way SWM pond as well as the tributary drainage areas (Node 3013). **Table 5.4** below outlines the existing conditions flows from the Riverbank Way SWM pond.

Table 5.4 Pre-Development Flows – Riverbank Way SWM Pond

Return Period (years)	Node 3013 Flow Rates (m^3/s)
25 mm	0.156
2	0.342
5	0.511
10	0.615
25	0.768
50	0.869
100	0.971
Regional	1.546

5.4 Stormwater Management Plan Selection Process

As required by NOCSS and the Scoped EIR/FSS Addendum ToR, alternative approaches to SWM have been identified and evaluated to assess and incorporate appropriate SWM practices in the development design to satisfy NOCSS SWM goals, objectives and targets.

Stormwater management practices are specific planning and technical measures, which are implemented to manage the quantity and quality of urban runoff. The SWM measures specifically required to manage urban runoff and mitigate potential drainage impacts can be grouped into three main categories:

1) Lot level, or source control measures (i.e., reduced lot grades, roof drainage control or storage, porous pavements, rain gardens, grassed swales, etc.);
2) Infiltration measures (i.e., infiltration basins and trenches, exfiltration pipes or porous pavement, etc.); and,
3) End-of-pipe measures (i.e., underground storage facilities, detention wet ponds or wetlands, oil/grit separators, etc.).

In reviewing these options for inclusion in the proposed SWM Plan, these alternatives were evaluated on the basis of capabilities, limitations and physical constraints associated with their implementation. This included the following factors:

- Their ability to meet SWM goals, objectives and targets discussed in **Section 5.3** and listed in **Table 5.1**;
- Suitability of soils and groundwater conditions;
- Site topography and size of contributing drainage areas;
- Compatibility with urban form and natural features; and
- Municipal servicing requirements.

The evaluation of alternative SWM measures has made use of guidelines in the *MOE Stormwater Management Planning and Design Manual, March 2003, (*referred to here as the *MOE SWMP Design Manual)* and has considered the practical feasibility of implementing alternative LID techniques.

LID is a comprehensive land planning and engineering design approach, the goals of which include preserving natural heritage areas and managing stormwater to minimize increases in surface flow and pollutants. The LID approach combines planning with micro-management techniques to reach these goals. Many of the SWM practices outlined above are considered types of LID measures.

The NOCSS identified examples of LID to include conservation of natural features, reducing impervious areas, bioretention areas, rain gardens, green roofs, use of rain barrels and cisterns, vegetated filter strips and permeable pavements.

The proposed development will introduce impervious areas in the form of residential development and underground parking with an overall density that is 4.24 times the gross site area (5.54 net of conveyances for public roads and road widenings). The proposed urban form, as set out in OPA 272, combines the protection of large tracts of lands in the NHS along with higher density development in the remaining areas for development. In this regard, the NOCSS and OPA 272 provide for the retention and enhancement of significant environmental areas and features to maintain and enhance the existing environmental functions and linkages throughout North Oakville. Core Preserve Areas, Linkage Preserve Areas, High and Medium Constraint Stream Corridors combine to provide a large, connected NHS covering 603 ha or 27% ha of North Oakville East; all development is confined to areas outside of the NHS. This approach results in more compact forms of development with generally smaller lots, higher density residential products and reduced setbacks. The reduced building setbacks result in relatively small yard surfaces limiting the practical feasibility of at-source measures. Depending on groundwater levels and soil hydraulic conductivity, there may be some opportunities to introduce lot level controls to address stormwater quantity and quality. One opportunity that will assist with increasing infiltration and evapotranspiration and reducing runoff

volumes is increased topsoil. There are other, more limited, opportunities for green roofs and rainwater harvesting. The ability to implement these or other measures on other unit types must be assessed at the detailed design based on the building form, building setbacks, location of impervious surfaces, and ability to direct flows away from areas where there is the potential for icing problems.

From a conveyance perspective, the density of development required in OPA 272 is not compatible with the use of rural road cross sections with ditch/swale systems. In all areas, urban road cross sections are proposed compatible with higher density housing forms proposed in OPA 272 and Town standards.

With respect to the LID measure of "reduced impervious areas", as discussed above, the implementation of the NHS has resulted in a more compact built form on lands outside the NHS. This is achieved through higher density residential product and reduced building setbacks. As a result, the total development is confined to a smaller footprint. While the total building coverage may not be reduced, the amount of road required to serve the development is reduced. As such, the total impervious area associated with the roads has been reduced.

In addition to the proposed urban form, the hydrogeological analyses completed for the EIR Subcatchment Area provide important considerations to the selection of effective SWM measures. Consistent with the findings of the NOCSS, the analyses conclude that the surficial soils at the Subject Lands are characterized by silty clay till soils expected to have a low infiltration potential. As such, large-scale constructed infiltration facilities are not considered feasible or effective for stormwater management on the Subject Lands.

With respect to Source Pollution Prevention, the NOCSS identifies a number of source pollution prevention measures including reduced fertilizer and pesticide use, alternate lawn practices, pet litter control, street cleaning, salt management, and sewer use by-law enforcement. Many of these measures are the municipalities' responsibility. Given the intended condominium development, the preparation of a Homeowner's Manual is not recommended however, if the Town wishes, the Town of Oakville's "*Living Green: Oakville's Guide to Environmental Stewardship*" (2010) could be shared with condo owners.

5.5 Regional Storm Controls

Policy 7.4.13.2 of OPA 272 states, "*The North Oakville Creeks Subwatershed Study recommends that stormwater targets include control of the peak flow to predevelopment levels for various return periods, including the Regional Storm. Through the land development application process, an investigation of the potential increase to flood risk may be carried out to confirm if Regional Storm controls are necessary, in accordance with the directions established in the North Oakville Creeks Subwatershed Study*."

The NOCSS recommends that SWM targets include the control of peak flows to pre-development levels for the 2 year to 100 year return period events and the Regional Storm. However, it also states that, "*The flow targets represent existing conditions peak flows for the full range of design events (2 year to Regional Storm). This is provided as a peak flow target to prevent the increase in flow potential to private property along receiving watercourses. In cases, such as Sixteen Mile Creek, where the floodplain is contained within a well-defined, publicly owned valley system, consideration can be given to not controlling peak flows under Regional Storm conditions, as long as flood potential is not increasing on private property. Control of lesser events is still required to protect local flow regime characteristics of the outlet. If considered, this will require evaluation at the EIR stage.*"

In the case of Subcatchment ES9, as the flows are not being conveyed directly to Sixteen Mile Creek, but rather across Dundas Street and to a less defined tributary, Regional Storm controls are required.

The GAWSER model for NOCSS identified a Regional flow of 2.07 m^3/s at the Riverbank Way SWM pond based on the original ES9 drainage area as well as the areas south of, and including, Dundas Street that are tributary to the pond. Refer to **Appendix D** for the GAWSER modelling.

5.6 Erosion Control Analysis

The NOCSS identifies the need to complete erosion threshold and erosion control analyses as part of the EIR/FSS so that existing channel erosion or aggradation is not exacerbated by development.

The erosion threshold for the EIR Subcatchment was completed by GEO Morphix. The purpose of the assessment was to determine an appropriate erosion threshold to inform the design of the SWM facility retrofit within the ES9 Subcatchment Area. It included determination of a theoretical critical erosion threshold, field verification of erosion thresholds, continuous hydrologic modeling of pre- and post-development flows and an assessment of potential geomorphic adjustments due to potential changes in the flow regime.

Results from the assessment indicate the proposed stormwater management strategy effectively manages potential erosion concerns associated with the subject development. A summary of the key findings of the assessment are provided below:

- A detailed geomorphological assessment was completed along what was determined to be the most erosion-sensitive reach along the receiving watercourse (i.e., SMCT-3);

- An erosion threshold, expressed as a critical discharge, of 0.069 m3/s was defined for Reach SMCT-3;
- Continuous hydrology results from a site-wide continuous hydrological simulation model were used to calculate pre- and post-development erosion exceedance indices;
- Modeling results demonstrated a moderate decrease in erosion potential within the subject reach; and,
- An analysis of pre- and post-development flow conditions confirmed the average annual peak flow under proposed conditions is expected to remain over the defined erosion threshold, thus maintaining sediment mobilizing events throughout the year.

A detailed Geomorphological and Erosion Assessment report is provided in **Appendix G**.

The continuous hydrologic analysis that provided input to the erosion threshold analyses was completed in GAWSER by Urbantech as part of this study.

In the case of the developable lands within the study area, the 25mm rainfall event will be retained on site in accordance with the Town's guidelines.

Additional information on the facility sizing and operating characteristics for the SWM facility is provided under **Section 5.10**.

LID measures are discussed in **Section 6.8**.

5.7 Drainage Areas and Patterns

5.7.1 Existing Conditions

The Subject Lands are located at the eastern limit of the ES9 Subcatchment Area.

No external drainage areas are conveyed through the Subject Lands. Flows from ES9 drain south towards Dundas Street West where they are picked up in storm laterals and are conveyed to the existing Riverbank Way SWM Pond located on the south side of Dundas Street West.

A portion of the Subject Lands (0.62 ha) outlet to the east to Subcatchment OC1 via Neyagawa Boulevard.

Refer to **Figures 5.1 and 5.2** for further details.

5.7.2 Post-Development Conditions

For ultimate post-development conditions, this report assumes that all lands within the ES9 Subcatchment are developed for urban land uses, with the exception of the cemetery lands. See **Drawing 5.3** for the post-development drainage areas and proposed treatment facilities. A brief outline of post-development conditions within the ES9 Subcatchment Area is outlined below:

- The entirety of the Subject Lands, including the 0.62 ha currently tributary to OC1, will be controlled for the 2 to 100-year storms on site and conveyed south to the existing 525 mm storm lateral on Dundas Street West.

- Controlled flows from the 0.62 ha Prime Envision Inc. property will be conveyed North through the Subject Lands.

- Controlled flows from the St. Peter and Paul Parish property will be controlled and directed to the existing 600 mm storm lateral on Dundas Street West. External drainage from the existing cemetery and community centre (1 ha) will be maintained through the Parish lands.

- Flows from the Trafalgar Lawn Cemetery will continue uncontrolled to the existing 750 mm storm lateral.

5.8 Conveyance of Minor System Flows on Subject Lands

The Subject Lands as well as the external developable areas will be serviced by a conventional storm sewer system designed in accordance with Town of Oakville standards, and general industry practise. The storm sewers will be sized using a 5 year return frequency and Town of Oakville IDF curves. Within the Subject Lands, oversized pipes will be provided in order to control the roads to NOCSS targets.

On-site quantity, quality and erosion control will be provided within the residential development blocks.

All storm flows will be directed south to the existing Riverbank Way SWM Pond, where Regional Storm control will be provided.

The conceptual storm servicing scheme is illustrated in **Drawing 5.3.**

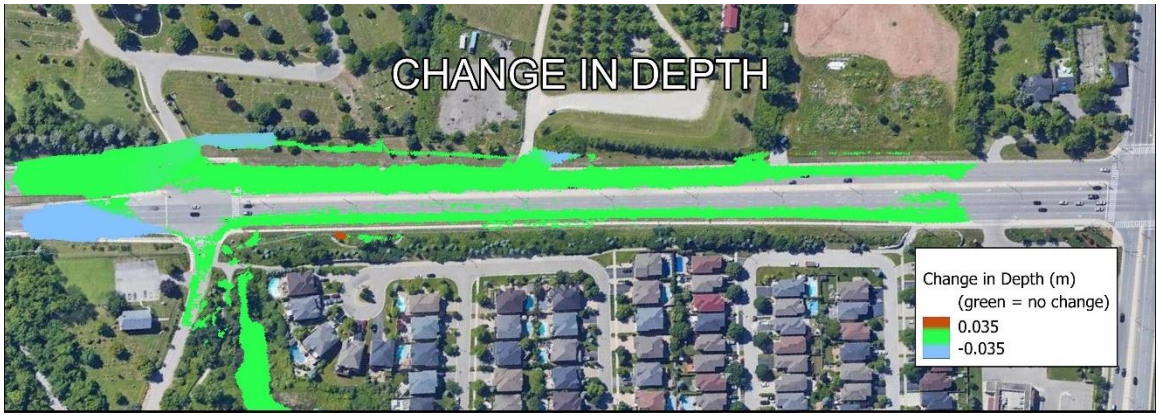
5.9 Conveyance of Major Storm Flows on Subject Lands

A continuous overland flow route has been provided through the FSS Study Area in order to safely convey major system flows in excess of the minor system up to the 100 year event. The excess flows will be contained within the right-of-way. For all classes of roads,

the product of depth of water (m) at the gutter times the velocity of flow (m/s) shall not exceed 0.65m^2/s. 100-year capture is proposed on-site in order to control flows to NOCSS targets. Similar to existing conditions, Regional Storm overland flow in excess of the storm lateral capacity will be directed to Dundas Street West and ultimately the existing Riverbank Way SWM Pond.

Should the major system flow exceed the conveyance capacity of any given road, the storm sewer will be sized to accommodate the excess flows such that the road capacity is not exceeded. The conceptual major storm system is illustrated with flow arrows on **Drawing 5.3.**

The HEC-RAS 2D model was used to assess the flow depths along Dundas Street under Regional Storm conditions for both existing and proposed scenarios. Under existing conditions, the Regional Storm flows from the lands north of Dundas Street are not entirely conveyed by the storm sewer system. This analysis assumes no Regional flow is captured into the storm sewer and represents the worst case scenario conditions (all Regional Storm flows discharge to Dundas Street ROW with no upstream storage or diversions). The evaluation focused on verifying compliance with the Town's allowable criteria, which set a maximum depth-velocity product (D x V) of 0.65 m^2/s and a maximum depth limit of 0.15 m above the road crown. These criteria aim to ensure safe conditions for roadway users and emergency vehicles by preventing excessive water accumulation and flow velocity.



As shown in the results in **Appendix D,** the Regional flow is confined to the outer lanes in both the existing and proposed conditions, with no encroachment above the crown of the road. This flow confinement ensures that the central portion of the roadway remains unobstructed, posing no risk to emergency vehicles. In the existing condition, the maximum D x V value was 0.1 m²/s, while the proposed condition showed a maximum of 0.24 m²/s. Similarly, the maximum depth was typically 5 to 14 cm along the gutter under both existing and proposed conditions, indicating that there are no changes to flow dynamics or public safety. There are some sag areas at the west side of Dundas Street which fill to 30 cm or higher under existing and proposed conditions; however, these areas would not fill to this extent when CB capture is considered.

The assessment also considered conformance with the draft CH Spill Policy, which emphasize maintaining safe access routes during flood conditions. The results confirm that the proposed modifications meet these spill policy requirements, ensuring that

emergency vehicle routes remain passable and safe. The figures above illustrate the D x V distribution and flow depth under existing and proposed scenarios, highlighting the hydraulic performance improvements and confirming adherence to Town standards and CH draft policies.

The HEC-RAS 2D model is included in **Appendix D**.

5.10 Stormwater Management on Subject Lands

The stormwater management for the Subject Lands will provide stormwater quality and quantity treatment with an existing SWM pond located south of the Subject Lands (referred to as the Riverbank Way SWM Pond). See **Section 5.1** for the NOCSS criteria used to design the quality and quantity treatment measures. The proposed SWM controls are designed based on an inflow area of 7.69 ha consisting of the Subject Lands, the Prime Envision Inc. lands and the St. Peter and Paul Parish lands.

5.10.1 Quality Treatment

Although the Subject Lands and the adjacent properties currently drain to the Riverbank Way SWM Pond, the pond was not sized to provide quality control for these lands. Stormwater quality treatment for the Subject Lands and the adjacent lands will be provided within on-site treatment trains to achieve 80% TSS removal. The proposed treatment train may consist of a combination of treatment devices including, but not limited to, OGS devices, CB Shields, and LIDs.

A sample treatment train for the Subject Lands includes:

Subject Lands (Blocks 1 - 3)

- Proposed OGS within blocks (60% TSS removal, EFO-6 for Block 3 and EFO-8 for Blocks 1 and 2)
- Proposed OGS within the downstream ROW (60% TSS removal, size to be verified by manufacturer during detailed design)
- Total TSS Removal = 0.6 + (1 - 0.6) x 0.6 = 84%

Subject Lands (Proposed ROW)

- Proposed CB Shields within ROW (50% TSS removal)
- Proposed OGS within ROW (60% TSS removal, size to be verified by manufacturer during detailed design)
- Total TSS Removal = 0.5 + (1 - 0.5) x 0.6 = 80%

OGS sizing reports are provided in **Appendix D.**

Specifics of the treatment train will be determined as part of detailed design based on building form and building setbacks.

5.10.2 Quantity Treatment – 2-Year to 100-Year

Quantity control will be provided on-site through the use of storage tanks and oversized pipes which are sized for events up to, and including, the 100-year storm. Release rates for the storage facility are governed by erosion control requirements and the NOCSS release rates. See **Tables 5.5 to 5.11** below, for the SWM facility release rates and storage requirements.

The GAWSER model, as well as the post development schematic, are included in **Appendix D.**

Table 5.5 SWM Release Rates and Storage Requirements – Block 1 – GAWSER 3032

Component	Target Release Rate (1) (m^3/s)	Used Storage (m^3)	Simulated Outflow (m^3/s)
2-year/24-hour Chicago	0.015	264	0.007
5-year/24-hour Chicago	0.021	341	0.012
10-year/24-hour Chicago	0.025	385	0.015
25-year/24-hour Chicago	0.031	453	0.019
50-year/24-hour Chicago	0.035	498	0.021
100-year/24-hour Chicago	0.039	548	0.023
Regional	0.059	*	0.108

(1) Target release rates determined based on the existing conditions area to ES9 outlined in **Section 5.3**.
*Regional flows are uncontrolled

Table 5.6 SWM Release Rates and Storage Requirements – Block 2 – GAWSER 3031

Component	Target Release Rate (1) (m^3/s)	Used Storage (m^3)	Simulated Outflow (m^3/s)
2-year/24-hour Chicago	0.017	301	0.009
5-year/24-hour Chicago	0.025	392	0.014
10-year/24-hour Chicago	0.029	446	0.017
25-year/24-hour Chicago	0.035	529	0.021
50-year/24-hour Chicago	0.040	580	0.024
100-year/24-hour Chicago	0.044	637	0.027
Regional	0.068	*	0.125

(1) Target release rates determined based on the existing conditions area to ES9 outlined in **Section 5.3**.
*Regional flows are uncontrolled

Table 5.7 SWM Release Rates and Storage Requirements – Block 3 – GAWSER 3034

Component	Target Release Rate [1] (m^3/s)	Used Storage (m^3)	Simulated Outflow (m^3/s)
2-year/24-hour Chicago	0.011	202	0.006
5-year/24-hour Chicago	0.016	266	0.009
10-year/24-hour Chicago	0.019	302	0.011
25-year/24-hour Chicago	0.024	358	0.014
50-year/24-hour Chicago	0.027	393	0.016
100-year/24-hour Chicago	0.030	429	0.018
Regional	0.045	*	0.084

(1) Target release rates determined based on the existing conditions area to ES9 outlined in **Section 5.3**.
*Regional flows are uncontrolled

Table 5.8 SWM Release Rates and Storage Requirements – Proposed Road – GAWSER 3030

Component	Target Release Rate [1] (m^3/s)	Used Storage (m^3)	Simulated Outflow (m^3/s)
2-year/24-hour Chicago	0.013	223	0.038
5-year/24-hour Chicago	0.019	293	0.057
10-year/24-hour Chicago	0.022	337	0.067
25-year/24-hour Chicago	0.027	403	0.084
50-year/24-hour Chicago	0.031	443	0.094
100-year/24-hour Chicago	0.034	488	0.106
Regional	0.052	*	0.480

(1) Target release rates determined based on the existing conditions area to ES9 outlined in **Section 5.3**.
*Regional flows are uncontrolled

Table 5.9 SWM Release Rates and Storage Requirements - St. Peter & Paul Parish – GAWSER 3036

Component	Target Release Rate [1] (m^3/s)	Used Storage (m^3)	Simulated Outflow (m^3/s)
2-year/24-hour Chicago	0.035	981	0.041
5-year/24-hour Chicago	0.073	1279	0.062
10-year/24-hour Chicago	0.105	1444	0.076
25-year/24-hour Chicago	0.124	1704	0.094
50-year/24-hour Chicago	0.151	1872	0.105

Component	Target Release Rate (1) (m^3/s)	Used Storage (m^3)	Simulated Outflow (m^3/s)
100-year/24-hour Chicago	0.170	2052	0.119
Regional	0.189	*	0.439

(1) Target release rates determined based on the existing conditions area to ES9 outlined in **Section 5.3**.
*Regional flows are uncontrolled

Table 5.10 SWM Release Rates and Storage Requirements – Prime Envision Inc. – GAWSER 3033

Component	Target Release Rate (1) (m^3/s)	Used Storage (m^3)	Simulated Outflow (m^3/s)
2-year/24-hour Chicago	0.011	154	0.006
5-year/24-hour Chicago	0.016	202	0.009
10-year/24-hour Chicago	0.019	230	0.011
25-year/24-hour Chicago	0.024	274	0.013
50-year/24-hour Chicago	0.027	301	0.015
100-year/24-hour Chicago	0.030	331	0.017
Regional	0.045	*	0.069

(1) Target release rates determined based on the existing conditions area to ES9 outlined in **Section 5.3**.
*Regional flows are uncontrolled

The total post development flows for all areas tributary to ES9 have been compared to updated NOCSS flows at the same location (2140 in the GAWSER model). As shown in **Table 5.11** below, with the proposed storm controls in place the NOCSS flows at ES9 are not exceeded for the 2 to 100-year storm events.

Table 5.11 Flow Comparison at ES9

Component	Updated ES9 Flows (m^3/s)	Proposed Flows to ES9 (m^3/s)
25 mm Event	0.137	0.12
2-year/24-hour Chicago	0.286	0.23
5-year/24-hour Chicago	0.414	0.33
10-year/24-hour Chicago	0.490	0.39
25-year/24-hour Chicago	0.595	0.47
50-year/24-hour Chicago	0.670	0.52
100-year/24-hour Chicago	0.746	0.59
Regional	1.143	1.559*

*Note Regional flows are controlled downstream at the Riverbank Way SWM Pond.

To be conservative, storage has been sized assuming no on-site 25 mm retention. Storage sizes will be refined further as part of the functional/detailed design process.

In addition to the updated NOCSS on-site control, it has been verified that there is no increase in flows leaving the Riverbank Way SWM Pond and no change in hydrograph timing as a result of the proposed development. **Table 5.12** outlines the existing and proposed flows from the SWM pond to the Sixteen Mile Creek tributary.

Table 5.12 Riverbank Way SWM Pond
Pre and Post Development Release Rates

Component	Pre-Development Outflows (m^3/s)	Post-Development Outflows (m^3/s)
Extended Detention	0.16	0.15
2-year/24-hour Chicago	0.34	0.31
5-year/24-hour Chicago	0.51	0.44
10-year/24-hour Chicago	0.62	0.53
25-year/24-hour Chicago	0.77	0.66
50-year/24-hour Chicago	0.87	0.75
100-year/24-hour Chicago	0.97	0.84

5.10.1 Regional Storm Controls - Riverbank Way SWM Pond

As outlined earlier in this report, OPA 272 policy 7.4.5 states that, "*The management of water resources within the North Oakville East Planning Area shall be undertaken in accordance with the directions established in the North Oakville Creeks Subwatershed Study. No amendments to the Secondary Plan shall be required to implement the recommendations of the Subwatershed Study or for changes to the number or location of stormwater management facilities in accordance with the policies of Section 7.6.2.2 a) of this Plan*". The proposed approach to stormwater management within the FSS Study Area is to utilize and maximize the efficiency of, the existing Riverbank Way SWM Pond south of Dundas Street. As such, the use of the existing pond is in-keeping with the NOCSS SWM direction and does not require an amendment to the Secondary Plan.

As noted in **Section 5.9**, uncontrolled Regional flows will continue to be conveyed to Dundas Street West and will outlet into the Riverbank Way SWM Pond. When the pond was built, it was not designed with quantity control and currently has a 1200 mm diameter outlet pipe. The pond outlets to a tributary of Sixteen Mile Creek located downstream of Riverbank Way. As outlined in **Section 5.6,** the Regional Storm target flow is 2.07 m^3/s based on the original NOCSS areas to ES9 and the Riverbank Way SWM pond drainage areas.

As part of the approved scoped EIR/FSS ToR, CH requires that it be demonstrated how the Riverbank Way SWM pond can operate as a regulatory control facility in keeping with

CH's guidelines. This section outlines how this is achieved with respect to emergency flows, freeboard, storm staking and tailwater.

It is proposed that the outlet structure of the pond be retrofitted to provide Regional controls for the ES9 drainage area as well as for the areas south of, and including, Dundas Street that are currently tributary to the pond. A 900 mm orifice plate is proposed to be installed on top of the existing 1200 mm pipe. An emergency overflow spillway via high capacity catchbasin grates located 0.3 m above the Regional Storm water level will collect all flows into the existing 1200 mm pipe prior to it spilling over the roadway. Refer to **Drawing 5.4** and **Appendix D** for catchbasin capacity calculation.

Although the reduction in outlet size results in a nominal increase in the water level compared to existing conditions, CH has confirmed that the Regional water levels in the pond are not regulated (and as such the nominal increase does not result in regulated area extending on adjacent lands) and the proposed water level is fully contained within the existing storm pond block. The lowest lot line adjacent to the pond is located the northeast corner of the pond and is 147.75 m, which is 1.67 m higher than the proposed water level. The spill point to the Riverbank Way ROW is 147.15m so the water will not flow overland in the event of the Regional Storm. By restricting the flows with a 900 mm orifice the flows are significantly less than existing conditions as well as matching the target derived from the NOCSS GAWSER model.

Table 5.13 Riverbank Way SWM Pond

Parameter	Original NOCSS Areas Target	Post Development
GAWSER Node	3013	3013
Area (ha)	29.08	20.61
Outlet Size (mm)	1200	900
Regional Flow (m^3/s)	2.07	1.93
Required Volume (m^3)	1,644	1,750
Water Surface Elevation (m)	146.06	146.08

Refer to **Appendix D** for the GAWSER model results.

As the pond is not designed for any storms aside from the Regional event there is no concern regarding back to back storms as no extended detention is proposed.

A preliminary HEC-RAS model has been prepared to verify the extent of tailwater acting on the existing outlet pipe to the Sixteen Mile Creek tributary. The reach in the model extends from the existing outlet from Riverbank Way to approximately where the tributary joins the main branch of Sixteen Mile Creek. Cross sections have been defined based on LiDAR data for the area and a manning's roughness of 0.035 was used for the channel and 0.08 for the banks as the tributary is highly vegetated. As the tributary has a steep slope, a normal depth boundary condition was used.

Under NOCSS existing conditions, it was determined in GAWSER that a Regional flow of 2.77 m^3/s would be applied to the Riverbank Way SWM Pond outlet (XS 1019) and 4.54 m^3/s at the downstream Valley Forest Way SWM Pond (XS 1010) to account for all the flows in the tributary. This resulted in a water level of 143.51m in the tributary downstream of Riverbank Way, which is 34 cm below the existing outfall of 143.85 m. Under the proposed condition, a Regional flow of 2.64 m^3/s would be applied to the Riverbank Way SWM Pond outlet (XS 1019) and 4.41 m^3/s at the downstream Valley Forest Way SWM Pond (XS 1010) which corresponds to a water level of 143.5 m downstream of Riverbank Way. Therefore, tailwater does not need to be applied to the pond outlet during existing or proposed conditions. Refer to **Appendix D** for the HEC-RAS results.

Table 5.14 HEC-RAS Model Inputs

Location	HECRAS XS	GAWSER Node	Drainage Area (ha)	Existing Flow (m^3/s)	Proposed Flow (m^3/s)
Valley Forest Way SWM Pond*	1019	3210	Ex. 36.36 Pr. 27.89	2.77	2.64
Tributary Upstream of Main Creek	1010	3111	Ex. 54.49 Pr. 46.02	4.54	4.41

*Location of Valley Forest Way SWM Pond is shown on **Figure 1.3**.

Table 5.15 HEC-RAS Model Water Levels

	Existing		Proposed		Difference W.S. Elev (m)
River Sta	Q Total (m^3/s)	W.S. Elev (m)	Q Total (m^3/s)	W.S. Elev (m)	
1019	2.77	143.51	2.64	143.5	-0.01
1018	2.77	142.9	2.64	142.9	0
1017	2.77	142.34	2.64	142.34	0
1016	2.77	141.75	2.64	141.74	-0.01
1015	2.77	141.23	2.64	141.22	-0.01
1014	2.77	141.01	2.64	141.01	0
1013	2.77	140.67	2.64	140.67	0
1012	2.77	139.92	2.64	139.91	-0.01
1011	2.77	139.72	2.64	139.71	-0.01
1010	4.54	139.22	4.41	139.21	-0.01
1009	4.54	138.58	4.41	138.57	-0.01
1008	4.54	138.02	4.41	138.01	-0.01
1007	4.54	137.5	4.41	137.5	0
1006	4.54	136.6	4.41	136.59	-0.01
1005	4.54	135.52	4.41	135.51	-0.01

	Existing		Proposed		Difference W.S. Elev (m)
River Sta	Q Total (m^3/s)	W.S. Elev (m)	Q Total (m^3/s)	W.S. Elev (m)	
1004	4.54	134.06	4.41	134.05	-0.01
1003	4.54	132.6	4.41	132.59	-0.01
1002	4.54	131.95	4.41	131.94	-0.01
1001	4.54	131.75	4.41	131.74	-0.01
1000	4.54	130.31	4.41	130.31	0

5.11 Hydrologic Features

As discussed in **Section 2.1**, there is one Hydrologic Features B within the EIR Subcatchment Area. If natural Hydrologic Features B are modified or removed, the storage volume of the depressional areas is to be maintained. The NOCSS Addendum Section 7.4.4.1 provides procedures on how to demonstrate that topographical depression storage is preserved, where necessary. As noted earlier, the Hydrologic Features B is a man-made pond within the cemetery lands. Given the location of the pond within the cemetery, it has been assumed that this feature will not be removed however, even if it were removed, the pond is not a natural feature and, as such, would not need to be accommodated in the SWM facility.

5.12 Preliminary Grading Plans

A preliminary grading plan has been prepared for the Subject Lands based on the engineering constraints identified above. The conceptual grading is illustrated in **Drawing 5.5.** Grading details are consistent with Town Standards.

6 WATER BALANCE

To assess potential land development impacts on the groundwater conditions within the Subject Lands, a water balance analysis has been completed to determine the pre-development recharge volumes (based on existing land use conditions) and the post-development recharge volumes that would be expected based on the proposed land use plan.

6.1 Components of the Water Balance

A water balance is an accounting of the water resources within a given area. As a concept, the water balance is relatively simple and may be estimated from the following equation:

$$P = S + R + I + ET$$

where:
- P = precipitation
- S = change in groundwater storage
- R = surface water runoff
- I = infiltration
- ET = evapotranspiration/evaporation

The components of the water balance vary in space and time and depend on climatic conditions as well as the soil and land cover conditions (e.g., rainfall intensity, land slope, soil hydraulic conductivity and vegetation). Runoff, for example, occurs particularly during periods of snowmelt when the ground is frozen, or during intense rainfall events. Precise measurement of some of the water balance components is difficult and as such, approximations and simplifications are made to characterize the water balance of a study area. Field observations of the drainage conditions, land cover and soil types, groundwater levels and local climatic records are important input considerations for the water balance calculations.

The water balance components are discussed below:

Precipitation (P) The average annual precipitation for the area is 897.3 mm based on long-term data (1981 – 2010) from the Hamilton RBG climate station.

Storage (S) Although there are groundwater storage gains and losses on a short-term basis, the net change in groundwater storage on a long-term basis is assumed to be zero so this term is dropped from the equation.

Evapotranspiration (ET) Evapotranspiration varies based on the land surface cover (e.g., type of vegetation, soil moisture conditions, impervious surfaces, etc.). Potential evapotranspiration (PET) refers to the water loss from a vegetated surface to the

atmosphere under conditions of an unlimited water supply. The actual rate of evapotranspiration (AET) is generally less than the PET under dry conditions (e.g., during the summer when there is a soil moisture deficit). The mean annual ET has been calculated for this study using a monthly soil-moisture balance approach considering the local climate conditions.

Water Surplus (R + I) The difference between the mean annual P and the mean annual ET is referred to as the water surplus. Part of the water surplus travels across the surface of the soil as surface or overland runoff (R) and the remainder infiltrates the surficial soil (I).

Infiltration is comprised of two components: shallow infiltration that migrates laterally through the topsoil profile and discharges to surface at some short time following cessation of precipitation and a deeper infiltration that reaches the water table. The shallow infiltration component may be referred to as interflow or throughflow and the deeper component may be referred to as percolation, deep infiltration or net recharge. The interflow moves relatively quickly and often re-emerges locally as seepage at the ground surface. Typically, the horizontal hydraulic conductivity of the soil profile tends to be higher than the vertical hydraulic conductivity, aiding the lateral interflow movement. Fracture patterns in the bedrock found in the Subject Lands are also interpreted to affect the vertical and lateral water movement.

Interflow is more closely associated with runoff (because of its relatively short residence time) than with baseflow which is fed by groundwater (net recharge). As such, the interflow is considered an “indirect” component of runoff, as opposed to the “direct” component of surface runoff that occurs across the ground surface during precipitation or snowmelt events. The ability to precisely distinguish interflow from direct runoff or baseflow is a not a simple task. This is related to the complexity of subsurface geological and hydrogeological environments. Because of this, there has been a lack of adoption of a standard separation or partitioning method and therefore, interflow and direct surface (overland) flow are often considered together as the total runoff component.

6.2 Approach and Methodology

The analytical approach to calculate a water balance for the Subject Lands involved monthly soil-moisture balance calculations to determine the actual evapotranspiration and the corresponding water surplus components. A soil-moisture balance approach assumes that soils do not release water as “potential recharge” while a soil moisture deficit exists. During wetter periods, any excess of precipitation over evapotranspiration first goes to restore soil moisture. Once the soil moisture deficit is overcome, any further excess water can then pass through the soil as infiltration and either become interflow (indirect runoff) or recharge (deep infiltration).

The water holding capacity of the surficial soils depends on the types of soil as well as the type of vegetation and rooting depths. A soil moisture storage capacity of 200 mm was used for the Subject Lands to represent the clay loam soils and moderately-rooted vegetation and a soil moisture storage capacity of 250 mm was used for pasture and shrub vegetation. **Table 2**, **Appendix C-6** details the monthly potential evapotranspiration calculations accounting for latitude and climate, and then calculate the actual evapotranspiration and water surplus components of the water balance based on the monthly precipitation and soil moisture conditions.

The infiltration and runoff volumes for the Subject Lands were then assessed for the pre-development (based on the existing land use) and post-development (based on the proposed development concept plan) conditions. The MOE SWMP Design Manual (2003) methodology for calculating total infiltration based on topography, soil type and land cover was used, and a corresponding runoff component was calculated for both pre- and post-development conditions. The monthly water balance component calculations are summarized on **Tables 2 – 4**, **Appendix C-6**.

As noted in **Section 6.1,** the infiltration component will also divide into shallow interflow and deeper groundwater recharge components. Although, as noted in **Section 6.1**, there is no specific methodology for calculating this division of flow and few studies have attempted to quantify this value with any degree of precision, reasonable estimates can be made based on the nature of the surficial soils. For soils underlain by very permeable sand, it is considered that the interflow component would likely approach 0% with most of the infiltrating water recharging the water table. For soils underlain by very low hydraulic conductivity sediments, the interflow component would likely approach 100%, with very little water being able to go deep and most of the water infiltrating into the topsoil just seeping along the topsoil/till contact to re-emerge locally at surface. High water table conditions also seasonally limit the infiltration of surface water and result in higher direct runoff contributions to the watercourses.

Although the topsoil in the Subject Lands is underlain by relatively low hydraulic conductivity glacial till, fracturing likely improves the recharge capabilities (refer to **Section 3.6.2**). In water balance analyses completed for the North Oakville East Subwatersheds Study (NOMI, 2004), an interflow component estimate of 50% was used in the soil moisture balance calculations and this was found to correlate well with numerical modelling results of the regional groundwater flow.

The calculated water balance components are used to assess the pre-development water balance volumes based on the existing land use characteristics. Then a post-development water balance scenario is calculated based on the proposed land development plan. This analysis assumes no mitigation strategies or use of best management or LID practices for stormwater management and infiltration to represent a ‘worst-case scenario’ of the potential impacts of urban land development on the existing water balance. For the purposes of these water balance calculations, the post-

development land uses have been broken down into pervious (clay loam) and impervious (site development) land use categories and assigned an average percentage of imperviousness as summarized in **Table 6.1**.

Table 6.1 Water Balance Land Use Categories

	LAND USE CATEGORY	TOTAL AREA (ha)	% IMPERVIOUSNESS
1.	Right of Way	0.87	73
2.	High Density Residential	2.86	100
	Total Area	3.73	94

6.3 Component Values

The detailed monthly calculations of the water balance components are provided on **Tables 3** and **4**, **Appendix C-6**. The calculations show that the proposed development will produce a decrease in annual evapotranspiration, a reduction in annual infiltration and an increase in annual runoff. The monthly water balance calculations illustrate how infiltration occurs during periods when there is sufficient water available to overcome the soil moisture storage requirements.

The monthly calculations are summed to provide estimates of the annual water balance component values (**Tables 2 - 4**, **Appendix C-6**). A summary of these values is provided in **Table 6.2.**

Table 6.2 Water Balance Component Values

Water Balance Component	Agricultural/ Open Space (mm/year)	Pasture and Shrub (mm/year)
Average Precipitation	897.3	897.3
Actual Evapotranspiration	581	590
Water Surplus	316	307
Total Infiltration	190	184
Total Runoff	127	123

It is acknowledged that the infiltration and runoff values presented in **Table 6.2** are estimates. Single values are used for the water balance calculations, but it is important to understand that infiltration rates are directly dependent upon the hydraulic conductivity of the surficial soils, and this may vary over several orders of magnitude. As such, the margins of error for calculated infiltration rates are large. The margins of error are recognized, but for the purposes of this assessment, the numbers used in the water

balance calculations are all considered reasonable estimates based on the site-specific conditions and anticipated post-development conditions. It is noted further that the estimates for groundwater recharge (deep infiltration to the water table) are consistent with the previous subwatershed studies done for the area, including the NOCSS (2006) and NOMI (2004) studies, and a comprehensive hydrogeological study of aquifers throughout the Region of Halton that included groundwater flow modeling by Holysh (1995).

6.4 Pre-Development Water Balance (Existing Conditions)

The pre-development water balance calculations for the Subject Lands are presented in **Table 2**, **Appendix C-6**. As summarized on **Table 2,** the total area of the subcatchment is 3.73 ha. The total pre-development groundwater infiltration volume for the subcatchment is calculated to be about 4,991 m^3/year (**Table 2**, **Appendix C-6**). It is noted that the numerical calculations are based on estimated average component values and assumed consistent soil and drainage conditions across the subwatershed. The calculated numbers are considered as reasonable representations of the magnitude of the recharge volume, not the precise volume that occurs in the subwatershed.

6.5 Potential Development Impacts to Water Balance

Development of an area affects the natural water balance. The most significant difference is the addition of impervious surfaces as a type of surface cover (e.g., roads, parking lots, driveways, and rooftops). Impervious surfaces prevent infiltration of water into the soils and the removal of the vegetation removes the evapotranspiration component of the natural water balance. There is still an evaporation component from impervious surfaces as well as some losses of water through infiltration because of cracks, however, this is relatively minor (estimated to be 10% to 20% of precipitation) compared to the evapotranspiration component that occurs with vegetation (65% to 70% of precipitation) in this area. So, the net effect of the construction of impervious surfaces is that most of the precipitation that falls onto impervious surfaces becomes surplus water and direct runoff.

For the purposes of the water balance calculations in this study, a maximum evaporative loss from impervious surfaces was estimated at 15 % of precipitation and leakage through pavement is assumed to be 0 mm/year. The water balance calculation of the potential water surplus for impervious areas (247 mm/year) is shown at the bottom of **Table 3, Appendix C-6.**

6.6 Post-Development Water Balance

The proposed draft plan is shown on **Figure 4.2**. As described in **Section 6.2**, the Subjected Lands has been broken down into proposed land use areas and each land use

has been assigned an average percentage of imperviousness as summarized in **Table 6.1**. These data have been used to calculate the potential post-development groundwater recharge volume assuming no mitigation techniques are in place (**Table 3, Appendix C-6**). These calculations are presented as a 'worst-case scenario' of potential development impacts to the local groundwater conditions.

Based on the proposed land use analysis, the total post-development infiltration will be about 1,354 m^3/year. The calculated number is considered as a reasonable representation of the magnitude of the recharge volume and not the precise volume that will occur in the subwatershed. Comparatively, however, these calculated volumes show that there is potential for a decrease in infiltration to the groundwater regime of about 73% with no mitigation strategies and full urban development of the Subject Lands (**Table 3, Appendix C-6**).

6.7 Water Balance Impact Assessment

6.7.1 Water Quantity

The increases in surface water runoff that will occur with urban development are typically addressed through the use of appropriate stormwater management techniques and best management practices (BMPs) to control the runoff volumes. Details of the proposed storm water management plans for the FSS Study Area are provided in **Section 5.4.**

The natural recharge conditions in the subcatchment are limited due to the low hydraulic conductivity of the surficial soils.

The predicted decreases in recharge across the Subject Lands suggest that, without mitigation, the developed subcatchment area will continue to receive about 11% of the current amount of average annual recharge (refer to **Section 6.6**). In addition to the loss of recharge, the construction of buried services below the water table has the potential to capture and redirect groundwater flow through more permeable fill materials typically placed in the base of excavated trenches. Groundwater may also infiltrate into joints in storm sewers and manholes. Over the long term, these impacts can lower the groundwater table across the subcatchment.

It is recommended to minimize potential development impacts to the water table through the use of stormwater BMP and LID measures to ensure the post-development groundwater recharge is maintained as close to the pre-development recharge as possible. Techniques to maximize the water availability in pervious areas such as designing grades to direct roof runoff towards lawns, side and rear yard swales, boulevards, bioswales, and other pervious areas throughout the development where possible can increase infiltration in developed areas. Water balance mitigation measures

are discussed in **Section 6.8**. Mitigation strategies to prevent water table lowering due to servicing are discussed in **Section 9.5**.

6.7.2 Water Quality

Depending on land use, runoff from urban developments may contain a variety of dilute contaminants such as suspended solids, chloride from road salt, oil and grease, metals, pesticide residues, bacteria and viruses. Except for the dissolved constituents such as nitrogen and salt, most contaminants are attenuated by filtration during groundwater transport through the soils, and therefore, the potential for effects on local groundwater quality from infiltration in the urban areas is expected to be limited.

6.7.3 Private Services

The proposed development within the FSS Study Area will be serviced by municipal water. Therefore, there will be no impact on the water balance and local groundwater or surface water quantity and quality conditions related to any on-site groundwater supply pumping or disposal of septic effluent. There are nine historic records of existing groundwater supply wells (seven domestic wells, one public supply well and one irrigation well) within the Hydrogeologic Study Area plus 500m radius. It is anticipated that all of these systems will be decommissioned or removed during the development process. Further discussion on interim monitoring and decommissioning of any active private wells is provided in **Section 9.6**.

6.8 Water Balance Mitigation Measures

LID techniques to minimize urban development impacts on the water balance will be incorporated into the development design. Services will be constructed to prevent redirection of flow and overall lowering of the water table (refer to **Section 9.5**). This will involve the use of trench plugs to provide barriers to flow and prevent groundwater flow along granular bedding material. There are no significant enhancement opportunities for groundwater recharge on the Subject Lands. The limited hydraulic conductivity of the surficial soil materials limit infiltration potential, and as such, the use of large, engineered facilities and constructed ‘active’ infiltration measures such as infiltration trenches, pervious storm pipe systems and infiltration pits are not considered suitable for the development.

There are however, as outlined in the MOE SWMP Design Manual (2003), several other techniques that can be used to increase the potential for post-development infiltration and mitigate the reductions in recharge that occur with urban land development. Techniques to maximize the water availability for infiltration such as designing grades to direct roof runoff towards pervious areas throughout the development where possible and increasing topsoil thickness to help to retain infiltration can increase recharge in developed areas and reduce the volume of runoff directed to stormwater management facilities. Incorporating

such stormwater management techniques into development design can help to minimize development impacts to the water balance by reducing the post-development groundwater recharge deficit. It is noted, however, that choosing such LID options in unsuitable soils can lead to undesirable wet soil conditions and possible water ponding at grade.

Incorporation of other LID SWM practices into the community design can be considered to manage stormwater to minimize the runoff and increase the potential for infiltration through the use of various design techniques. The NOCSS identified examples of LID including bioretention areas, rain gardens, green roofs, use of rain barrels and cisterns, vegetated filter strips and permeable pavements.

In addition to meeting water balance requirements, the Town of Oakville also requires that the 25 mm event be retained onsite. For the 3.73 ha development area related to 3056 Neyagawa Boulevard this equates to a retention volume of 932.5 m^3, which is a larger retention requirement than maintaining the pre to post water balance.

Flows from 0.55 ha will be directed to the pervious portions of the boulevard (0.24 ha) in the public R.O.W. Through the use of tree pits (18.6 m^3), the 25 mm event from the 0.55 ha area (138.9 m^3) will be able to be retained onsite. The remaining 793.6 m^3 of storage will be achieved within the blocks as follows:

- Block 1 – 269.2 m^3
- Block 2 – 313.6 m^3
- Block 3 – 210.9 m^3

As there are limited options within the site for onsite retention due to the extent of the underground parking, potential retention options include the following:

LID Measure	**Notes**
Landscaped Areas	The planting media (including landscape above parking garage) within the proposed development will retain rainwater and provide the opportunity for evapotranspiration.
Green Roofs	The benefits of green roofs could be attenuation of flows, filtration and increased water available for evapotranspiration. Proposed green roofs, if any, will be specified during detailed design.
Rainwater Harvesting - Irrigation	Rainwater is collected in the sump of the storage tank and used for irrigation for the proposed landscaped areas and planters.
Rainwater Harvesting – Mechanical Uses	Water that is not able to be used for irrigation could be used for other mechanical re-use measures. Mechanical uses may include mechanical cooling towers / HVAC, greywater toilet systems within the commercial spaces, and decorative uses. Exact use will be determined with the mechanical consultant as the design advances.

7 WASTEWATER AND WATER SERVICING

7.1 North Oakville East – Area Servicing Plan (ASP)

In support of the NOESP, on behalf of the North Oakville Community Builders Inc. (NOCBI), the *Area Servicing Plan* (ASP) for North Oakville East was prepared by MMM Group (April 2011). The ASP is intended to satisfy the Secondary Plan requirement for a Master Servicing Plan.

The ASP provides a conceptual framework for the extension and development of water and wastewater systems to the NOESP. The proposed water and wastewater servicing strategies outlined in this EIR/FSS Addendum have been prepared in accordance with the strategies put forth in the ASP.

7.2 Wastewater Servicing

7.2.1 Wastewater Design Criteria

Wastewater infrastructure will be designed in accordance with the latest Region of Halton design standard and specifications, as follows:

Sewer Design Criteria

➢ Average Dry Weather Flow	275 litres per capita per day
➢ Infiltration	286 litres per second per hectare
➢ Peaking Factor	Harmon Formula

Population Criteria

➢ High Density	1.835 people / unit (per Halton Region DC study where unit counts are available)
➢ High Density	1000 persons / hectare (for future / external lands)

7.2.2 Existing Wastewater Services

An existing 600mm diameter trunk sewer is located on Neyagawa Boulevard and Sixteen Mile Drive. This trunk has been designed to convey flows from the lands to the north and west of the Subject Lands to the North Oakville East Pump Station located further to the east, north of Dundas Street at Towne Boulevard. Flows are pumped from this location to a 2400mm diameter wastewater main located at Dundas Street and Third Line. In accordance with the Master Plan, the existing 2400mm diameter trunk main is proposed

to function as the ultimate outlet for all lands located within the North Oakville East Secondary Plan.

There is an existing 250mm sanitary sewer on Neyagawa Boulevard and 750mm twin forcemain on Dundas Street West.

The location of the existing wastewater main is illustrated in **Drawing 7.1.**

7.2.3 Proposed Wastewater Servicing

The Subject Lands will be serviced by a network of local gravity sewers designed in accordance with Region of Halton standards and specifications.

The local sewers will convey flows into the existing 600mm diameter trunk wastewater main constructed within Sixteen Mile Drive east of Neyagawa Boulevard. The Region's Master Plan previously contemplated a sewage pumping station for this area. Based on the detailed grading and servicing, the Subject Lands can be serviced by gravity. A future sewage pumping station will be necessary to serve the future development to the west.

Proposed infrastructure is also sized to accommodate future adjacent developments for which no concept plans are currently available. A population of 1000 persons per hectare for these external lands has been assumed. The sanitary design sheet is provided in **Appendix F**.

The wastewater servicing plan is illustrated in **Drawing 7.1.**

7.3 Water Servicing

7.3.1 Water Supply Design Criteria

Water servicing for the Subject Lands will be designed in accordance with the latest Region of Halton standards and specifications such that adequate pressures and fire flows are achieved. Water design flows will be designed with the following criteria:

Water Design Criteria

➢ Average Daily Demand	275 litres per capita
➢ Maximum Daily Demand Peaking Factor	2.25
➢ Maximum Hourly Demand Peaking Factor	
Residential	4.00
Community Services	2.25
Commercial	2.25

Population Criteria

➢ High Density	1.835 people / unit (per Halton Region DC study where unit counts are available)
➢ High Density	1000 persons / hectare (for future / external lands)

7.3.2 Pressure Zone Boundaries

The Subject Lands are located within the Zone O3 pressure district of Halton's water distribution system.

A summary of the zone elevations is provided in **Table 7.1** below. The FSS Study Area elevations range from 160m to 156m.

Table 7.1 Summary of Zone Elevations

Zone	Lower Elevation (m)	Upper Elevation (m)
O3	127.58	163.99

7.3.3 Existing Water Supply

Existing watermains are currently available in the vicinity of the lands as shown in **Table 7.2**. A 1200mm diameter watermain is located on Neyagawa Boulevard and Dundas Street, and a 400mm diameter watermain is located on Neyagawa Boulevard adjacent to the Subject Lands. The existing watermains are illustrated in **Drawing 7.2.**

Table 7.2 Summary of Existing Watermains

Street Name	Size (mm)	Location	Zone
Neyagawa Boulevard	400	North of Dundas Street	O3
Neyagawa Boulevard	1200	North of Dundas Street	O3
Dundas Street West	1200	West of Neyagawa Boulevard	O3

7.3.4 Proposed Water Servicing

The Subject Lands will be serviced by a network of local watermains designed in accordance with the Regional Municipality of Halton design criteria and MECP guidelines.

Watermain sizing, hydrant flow testing, and pressure zone boundary analysis will be completed for the site at a later date further along in the design process. A 300mm watermain is proposed along Sixteen Mile Drive, to connect into the existing 400mm watermain along Neyagawa Boulevard with a chamber per Region of Halton standards. Watermains are proposed along the internal roads of the Subject Lands, and will loop into the proposed watermain extension on Sixteen Mile Drive. Fire and domestic connections will be provided to each block, per Regional standards. Connections for the two adjacent external future developments have been accounted for in the design of the Subject Lands. Concept plans for these two properties are not available at this time. As such, these connections will be sized for the future developments based on the best available information at the time of detailed design.

Detailed water modelling and hydrant testing to confirm fire flows will be completed at a later date.

The conceptual watermain servicing is illustrated in **Drawing 7.2**.

8 ROADS

There are no proposed road crossings of the NHS in the EIR Subcatchment. As such, this report section deals only with road allowance design and sidewalk design.

8.1 Road Allowance Design

Through the Secondary Plan process, alternate road allowance design standards were proposed by the Town of Oakville. The road allowance design was undertaken to establish preliminary right-of-way widths for the various road types.

Since the time of the Secondary Plan, the road allowance design has continued to evolve to reflect the detailed requirements of the many stakeholders whose infrastructure is located within the road allowance. The proposed road allowances are illustrated in **Figures 8.1A, 8.1B and 8.1C.**

The draft plan reflects road allowance widths in general conformance with the Secondary Plan widths.

8.2 Sidewalk Design

The preliminary sidewalk locations are illustrated in **Drawing 4.3**. Sidewalks are proposed on both sides of the road in accordance with the NOESP.

9 CONSTRUCTION PRACTICES

9.1 Summary of Key Geotechnical Findings

A preliminary geotechnical report was completed by DS Consultants for the Subject Lands (**Appendix E)**.

The key geotechnical findings are summarized as follows:

- Below the surficial materials, i.e., topsoil, asphaltic concrete, granular fill and fill materials, the Subject Lands is underlain by silty clay glacial till which extends to the till/shale complex transition zone to the bedrock and/or the bedrock surface. The bedrock is shale of the Queenston Formation and was encountered at approximate depths ranging from 2.3 to 3.3 m (Elevations 152.2 and 157.0 m) below existing ground surface. Short-term stabilized ground water levels measured in the monitoring wells ranged from depths of 2.5 to 13.1 m (Elevation 141.8 to 157.1 m) below existing ground surface and as documented in the geotechnical investigation report.
- Based on the borehole findings, the proposed buildings with 4 levels of underground parking can be supported by conventional spread and strip footings and raft foundations founded on sound shale bedrock.
- Excavation of the overburden will be relatively straightforward; however, obstructions and boulders should be expected. Excavation of the shale can be carried out using the heaviest available single tooth ripper equipment. The limestone beds are frequent and may overlay the shale bedrock surface at some locations. It will be necessary to utilize jackhammer type equipment to “open” the limestone layers for the ripper. The short-term groundwater levels measured in the installed monitoring wells ranged from depths of 2.5 to 13.1 m (Elevation 141.8 to 157.1 m) below existing ground surface. Dewatering will be required prior to any excavations below the groundwater table. Groundwater is expected in shale bedrock through the fractures which will also require dewatering.

9.2 Erosion and Sediment Controls

An erosion and sediment control strategy will be prepared and implemented in accordance with the ”*Erosion and Sediment Control Guide for Urban Construction”* (TRCA 2019) prior to any earthworks or grading activities on the Subject Lands. The erosion and sediment control strategy will include the following:

- methods for constructing SWM and environmental features in the dry;
- methods to stabilize disturbed areas to minimize transfer of sediment;
- stone mud mat at all construction entrances;

- regular inspection of the erosion and sediment control devices; and,
- removal and disposal of the erosion and sediment control devices after the site has been stabilized.

9.3 Construction Phasing

The general approach to construction is summarized as follow:

General

- Install all silt control measures (fences, sediment basins, etc.) as required.
- Commence earthworks in accordance with industry standards.

Refer to **Drawing 9.1** for the preliminary phasing plan.

9.4 Dewatering Requirements

Dewatering may be required where sewer trench grades and excavations encounter groundwater. There are no significant shallow aquifers in the development area and the till and shale materials have relatively low hydraulic conductivity except for localized high conductive zones at the intersection of till deposits and shale bedrock (these zones of higher conductivity are observed at shallow depths, approximately 1.5 to 7.1 metres below the existing ground surface specifically at the locations of monitoring well BH1, BH2 and BH3). It is noted however, that should the construction contractor need to pump at rates exceeding 50,000 L/day, registration on the Environmental Activity Sector Registry (EASR) for construction dewatering will be required from the MECP. A report with the dewatering calculations and proposed monitoring and contingency plan would be required.

9.5 Construction Below Water Table

The construction of buried services below the water table has the potential to capture and redirect groundwater flow through more permeable fill materials placed in the base of excavated trenches. Services below the water table will be constructed to prevent redirection of flow and overall lowering of the water table. This will involve the use of anti-seepage collars or clay plugs surrounding the pipes to provide barriers to flow to prevent groundwater flow along granular bedding and erosion of the backfill materials.

9.6 Private Water Wells

The proposed development will be municipally serviced and therefore, in the long term, it is expected that any existing water supply wells in the area will no longer be used. In the interim, however, it is important to ensure that construction does not adversely affect local groundwater supplies while the private water supply wells are still in use.

Based on the MECP water well records, there were thirty-one (31) water wells within a 500 m radius of the Subject Lands. All wells were noted as monitoring/test holes or not in use except for seven (7) records for domestic use purposes, one (1) well recorded as public supply and one (1) well listed for irrigation purposes.

Typically, the Region of Halton requires a survey of the static water level and water quality in all active water supply wells within 500 m of the planned construction area. As such, it will be necessary to complete a house-to-house survey to determine well locations and specific uses of local groundwater supply wells in the area. For any active and accessible water supply wells, the water levels will be measured at each well location during non-pumping conditions prior to the commencement of site construction activities, and a water sample will be collected at each well for analysis of background water quality. The water analysis will include general water quality indicator parameters including chloride, nitrate, turbidity and e-coli. The recommended monitoring program for the local private wells includes quarterly water level measurements throughout the site construction period (if the wells remain in use). At the end of the construction period, a water sample will again be collected from each of the monitored supply wells to confirm the post-development water quality.

9.7 Well Decommissioning

Prior to construction, it will be necessary to ensure that all inactive water supply wells within the development footprint have been located and properly decommissioned by a licensed water well contractor according to Ontario Regulation 903. In addition, all groundwater monitoring wells installed for this study must be decommissioned in accordance with provincial regulations prior to or during the site development, unless they are maintained throughout the construction for monitoring purposes.

10 MONITORING PROGRAM

10.1 OPA 272 Monitoring Requirements

Policy 7.9.5.2 of OPA 272 requires that an annual monitoring program be completed as follows:

> *A program shall be established by the Town in consultation with the Region of Halton and Conservation Halton to monitor the development in the Planning Area on an annual basis. The monitoring program shall be in accordance with directions established in the North Oakville Creeks Subwatershed Study and shall also consider such factors as:*
>
> *a) relationship and level of population and employment growth;*
>
> *b) supply of existing lots and number of building permits granted;*
>
> *c) the general achievement of housing mix targets;*
>
> *d) the functioning of stormwater management facilities to ensure they are constructed and operate as designed,*
>
> *e) stream alterations/relocations to ensure that natural channel designs were implemented and operate as designed;*
>
> *f) erosion and operation of sediment controls during construction;*
>
> *g) utilization of wastewater treatment and water supply system capacity; and,*
>
> *h) development application status.*

10.2 NOCSS Monitoring Requirements

NOCSS includes monitoring requirements for:

- erosion and sediment control,
- stormwater management facilities,
- monitoring of modified streams, and
- monitoring of stormwater management works, municipal services and trails installed by a landowner within the Natural Heritage System.

With respect to the above monitoring components, the principles of monitoring for which the landowners are responsible include the following, as set out in OMB monitoring mediation agreement dated July 27, 2007.

Erosion and Sediment Control (ESC)

1. An ESC plan will be required to be submitted to the Town of Oakville. The plan must be reviewed and approved by the Town prior to any clearing and grading.

2. The ESC requirements will follow applicable approved guidelines and bylaws in effect at the time of development. Deliverables will include a site alteration design report, an existing site conditions survey plan, an ESC plan, and a schedule of monitoring and reporting.

3. The ESC plan will include inspection, sampling for total suspended solids at all outlets from the site and reporting of results.

4. Remedial action to correct deficiencies of erosion and sediment control practices and facilities may be required based on either inspection or sampling results.

Stormwater Management Facilities

1. SWM facilities constructed in the conveyance system and at the end-of-pipe will be included in the monitoring program however, given that the Riverbank Way SWM pond is already owned by the Town, the required monitoring period will be determined in consultation with Town staff. The monitoring plan will include monitoring of the receiving system for the effectiveness of the stormwater management facilities at the location of the outfall for the purpose of water quality monitoring, and at a location or locations to be determined through the EIR for the purpose of erosion control. Monitoring will follow applicable approved guidelines in effect at the time of development. The current form of these guidelines is the *Town's Stormwater Monitoring Guidelines, North of Dundas Street* (January 2012). Monitoring requirements will be reflected in subdivision agreements.

2. Privately owned SWM facilities are not included in this mediation document and will be subject to site specific requirements at the time of application.

3. All SWM facilities to be assumed by the Town will be monitored by the owner for design conformance, maintenance of function and hydraulic performance. Monitoring and reporting requirements are to be reviewed and approved by the Town.

4. Facilities with water quality function(s) will be monitored by the owner for performance in meeting the specific pond design target for total suspended solids (80% removal). Total phosphorus and temperature sampling will also be required.

5. Facilities subject to *Ontario Water Resources Act* approval may be required to do additional monitoring as a condition of the Environmental Compliance Approval.

10.3 Proposed Monitoring

Consistent with the monitoring principles set out above, the following monitoring will be undertaken by the landowners.

10.3.1 Erosion and Sediment Control

Section 9.2 discusses the need for an erosion and sediment control strategy in accordance with TRCA guidelines and sets out typical components of the strategy. The TRCA Guideline will be applied to site construction plans at the detailed design stage to identify specific details of an erosion and sediment control strategy including the type and location of control measures to be implemented, timing of implementation, details of responsibilities for monitoring, reporting and maintenance needs. Deliverables will include a site alteration design report, an existing site conditions survey plan, an ESC plan, and a schedule of monitoring and reporting.

10.3.2 Stormwater Management Facilities

Stormwater management facilities will be monitored by the owner for design conformance and hydraulic performance for a period to be agreed to with the Town. Monitoring and reporting requirements are to be reviewed and approved by Town of Oakville and CH.

All monitoring will be prepared in accordance with the *Stormwater Monitoring Guidelines North of Dundas Street* (January 2012).

A detailed monitoring program will be provided for the SWM facility at the time of detailed design.

The cost of the monitoring will be estimated at the time of detailed design and will be included in the detailed monitoring program.

11 SUMMARY OF RECOMMENDATIONS

11.1 EIR/FSS Addendum Recommendations

This EIR/FSS Addendum identifies and characterizes the natural heritage features and functions within the Study Areas and recommends measures to mitigate any potential impacts of the proposed development application and associated servicing requirements on the NHS within the East Sixteen Mile Creek subcatchment. It also identifies servicing requirements related to roads, water supply, storm drainage, storm water management, sanitary sewage and site grading. The EIR/FSS Addendum provides a link between the Town's NOCSS Management and Implementation Report and the NOESP and the required planning approvals for the Subject Lands. **Table 11.1** summarizes main report findings and recommendations and notes the Section(s) of this report that can be referenced for more details.

Table 11.1 – Summary of EIR/FSS Addendum Recommendations and Mitigative Measures

Topic	Recommendations	Report Section for Further Details
Areas Studied	In accordance with OPA 272 requirements, a portion of the East Sixteen Mile Creek subcatchment has been studied in this EIR/FSS. The EIR Subcatchment Area encompasses that portion of ES9 Subcatchment north of Dundas Street and west of Neyagawa Boulevard. The proposed Neatt (16 Mile Creek) Inc. draft plan lies almost entirely within the ES9 Tributary subcatchment with the northeastern corner being in the OC1 Tributary subcatchment.	1.2
Draft Plan	The proposed Draft Plan (**Figure 4.2**) illustrates the proposed development plan.	4.1
Subcatchment Drainage Boundaries	As required by NOCSS, the subcatchment drainage boundaries have been confirmed through the review of additional, more detailed topographic work and field investigations.	5.2
NHS Framework and Associated Components	There are no components of the NHS on the Subject Lands or within the EIR Subcatchment Area. There is one Hydrologic Features B on the cemetery lands, which appears to be a man-made ornamental pond with a fountain in it. Field investigations conducted by GEI confirmed that no significant wildlife species (rare, special concern, threatened or endangered) were found to be breeding with the Subject Lands. However, bat exit surveys should be completed prior to removal of any structures. To mitigate impacts on wildlife species, and to ensure compliance with the *Migratory Birds Convention Act* and the *Endangered Species Act*, it is recommended that no vegetation clearing or stripping occur between April 1 and September 30 where feasible. One potential endangered species (Butternut) was identified on the St. Peter and Paul Parish lands, outside of, and beyond 25m of, the Subject Lands. When those lands advance for development, a DNA analysis should be undertaken to determine whether the tree is a hybrid and, if so, it would not be considered endangered.	2.0
Trail System	The *North Oakville East Trails Plan* (2013) (**Figure 4.4**) shows a multi-use trail along the eastern limit of the Sixteen Mile Creek valley on lands owned by the cemetery. A trail is also present immediately north and east of the Subject Lands in the Community Park and along Neyagawa Boulevard, respectively. There are no trails on the Subject Lands.	4.2
Target Flows	NOCSS target peak flows associated with ESM9 are appropriate for SWM design and were applied to determine target outflow rates for the proposed SWM facilities for the 2 year to 100 year as well as Regional events.	5.10
Regional Storm Controls	Regional controls are to be provided in the existing Riverbank Way SWM pond based on the ESM9 unit flow rate for the original ESM9 area as well as existing areas south of, and including, Dundas Street East that is tributary to the pond.	5.10.1

Topic	Recommendations	Report Section for Further Details
Erosion Threshold Analysis	An erosion threshold assessment was completed downstream of the existing SWM pond outfall. An erosion threshold, expressed as a critical discharge, of 0.069 m3/s was defined for Reach SMCT-3.	5.6
SWM Facilities	The existing SWM pond, south of Dundas Street has been re-designed to provide Regional control for the original 32.34 ha area based on NOCSS ESM9 targets. Information on the facility sizing and operating characteristics is provided in **Section 5.10.**	5.10
LID Measures	LID options have been evaluated. Large scale infiltration measures are not feasible due to the urban form of the proposed development and surficial soil characteristics; however, infiltration capability of the tree pits within the municipal right-of-way have been accounted for and the remainder of the 25mm event will be retained within tanks in each building. Specific measures are to be addressed at detailed design (for the Subject Lands) and as part of further studies for other areas in the EIR Subcatchment.	6.8
Sanitary Servicing	The proposed sanitary sewer on Sixteen Mile Drive will act as the outlet for these lands. The sanitary sewer outlets to the existing sewer on Neyagawa Boulevard. The wastewater servicing concept is shown on **Drawing 7.1**.	7.2
Water Servicing	A 300 mm watermain is proposed on Sixteen Mile Drive to service the Subject Lands. The conceptual watermain servicing concept is illustrated in **Drawing 7.2**.	7.3
Erosion and Sediment Controls	Controls are to be implemented prior to construction and remain in working condition for the duration of construction activity. Erosion and Sediment Control plans are to be submitted and approved by the Town of Oakville and Conservation Halton.	9.2
Construction Below Water Table	Services below the water table will be constructed to prevent lowering and redirection of groundwater flow.	9.5
Private Well Monitoring	Requirements for a survey of the static water level and water quality in all active water supply wells within 500m of the planned construction area are recommended.	9.6
Well Decommissioning	Prior to construction, it will be necessary to ensure that all inactive water supply wells within the development footprint have been located and properly decommissioned by a licensed water well contractor according to Ontario Regulation 903.	9.7

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