Town of Oakville - Halton Region

Environmental Implementation Report and Functional Servicing Study Addendum East Sixteen Mile Creek (ES6) First Submission

Prepared for:

Argo Neyagawa Corporation

Prepared by:

Jennifer Lawrence and Associates Inc.
Trafalgar Engineering
GEO Morphix
Beacon Environmental
R. J. Burnside
DS Consultants
Korsiak Urban Planning

December 2023

EXECUTIVE SUMMARY

An Environmental Implementation Report (EIR) and Functional Servicing Study (FSS) Addendum has been prepared for the Sixteen Mile Creek Subwatershed ES6-West and the Argo Neyagawa Corporation 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 and hydrological features and functions within the northern portion of the ES6-West Subcatchment Area (i.e., north of Burnhamthorpe Road), address the potential impacts of the proposed Draft Plan of Subdivision for the Subject Lands, 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 Plans of Subdivision.

This EIR/FSS Addendum addresses requirements of the NOCSS and Secondary Plan (OPA 272) and ensures that the site characteristics are understood in sufficient detail to provide input to the preparation of the Draft Plan of Subdivision and identification of environmental and engineering draft plan conditions of approval for the Subject Lands.

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

EIR SUBCATCHMENT AREA AND FSS STUDY AREA

1. The findings of this EIR/FSS Addendum build upon the findings of the ES6-West Davis-Minardi EIR/FSS (Stonybrook Consulting, et.al., 2015). Where appropriate and necessary, findings from the Davis-Minardi EIR/FSS are included in this report for ease of reference.

2. This EIR/FSS Addendum is prepared for the Subject Lands situated at the northwest corner of Neyagawa and Burnhamthorpe Road (**Figure 1.1**). The Subject Lands studied as part of this EIR/FSS Addendum encompass an area of approximately 11.3 hectares.

3. The 'EIR Subcatchment Area' is defined to be the Sixteen Mile Creek ES6-West subcatchment, specifically that portion of the catchment north of Burnhamthorpe Road (**Figure 1.2**).

4. The 'FSS Study Area' is defined to be the Subject Lands (**Figure 1.3**).

5. Detailed 2018 LiDAR topographic mapping was used to refine the drainage boundaries for the ES6-West Subcatchment.

NATURAL HERITAGE SYSTEM FRAMEWORK

6. 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 portion of a Core Area, Linkage Preserve Area or stream corridor. Two Hydrologic Features B existed on the Subject Lands at the time of NOCSS however, only one remains fully on the landscape. **Figure 2.1** presents the Subject Lands in relation to the Natural Heritage Framework as provided in NOCSS and the NOESP. **Section 2.0** provides further discussion on the NHS.

HYDROGEOLOGICAL ASSESSMENT

7. The scope of work completed for the hydrogeological component of the EIR/FSS Addendum involved comprehensive field investigations and desktop evaluations to characterize the geological and hydrogeological conditions in the EIR Subcatchment Area. 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, monitoring of surface water flow conditions and detailed pre-development and post-development water balance assessments.

8. The EIR Subcatchment Area slopes to the southwest. Topographical relief is about 11 m, with the highest elevations (190 masl - metres above mean sea level) found in the northern portion of the EIR Subcatchment Area. The lowest elevations (179 masl) are found in the southwest area of the subcatchment at Burnhamthorpe Road.

9. The stratigraphy comprises a surficial layer of silty clay to clayey silt glacial till overburden sediments overlying shale bedrock of the Queenston Formation. The till ranges in thickness from about 7 m to 17 m, and the till is generally thickest in the areas of higher elevation in the northern part of the subcatchment and thins towards the south in the lower elevation areas. There are no discrete sand or silt layers identified in the EIR Subcatchment Area.

10. 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 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. There is currently no municipal groundwater use and no planned future groundwater use in the EIR Subcatchment Area. The proposed development will be municipally serviced from Lake Ontario.

11. Surface water runoff occurs mainly as sheet flow and moves generally towards the southwest. There are no natural watercourses in the EIR Subcatchment Area, but storm runoff is conveyed via roadside ditches. Flow monitoring stations were

established along ditches in keeping with previous studies and were almost always dry with only occasional minor flows recorded in response to precipitation and seasonal water runoff events.

12. The groundwater movement flows generally towards the south and southwest which closely mimics the surface water flow pattern within the EIR Subcatchment Area.

13. The groundwater levels vary seasonally, with observed groundwater level changes in the range of about 1.4 m to 4.6 m. Water levels are generally highest in the spring and lower throughout the summer and fall months. The depth to the water table ranges from about 0.04 m to 3.5 m below grade in the FSS Study Area.

14. It is interpreted that groundwater recharge conditions exist throughout most of the EIR Subcatchment Area. At a Hydrologic Feature B in the northern portion of the Subject Lands seasonal discharge conditions were observed in the pond (**Figure C-4-12, Appendix C-4**). The groundwater recharge and discharge volumes are very limited due to the low hydraulic conductivity of the surficial glacial till sediments.

DRAFT PLAN OF SUBDIVISION

15. The proposed Draft Plan of Subdivision includes medium and high-density. The proposed Official Plan Amendment will remove the employment overlay and permit mixed-use residential. The Draft Plan of Subdivision is shown on **Figure 4.2.**

TRAIL PLANNING AND DESIGN

16. The proposed trail system on the Subject Lands is presented conceptually on **Figure 4.3** and is consistent with Figure 1 of the *North Oakville East Trails Plan* (2013) (**Figure 4.4**).

STORMWATER MANAGEMENT

17. The pre-development drainage areas as established in the Davis-Minardi EIR/FSS were used to set pre-development target release rates for SWM facility design based on the unit flow rates in NOCSS. Existing drainage patterns are shown on **Figure 5.2**.

18. As required by NOCSS and the approved ToR, alternative approaches to stormwater management have been identified and evaluated to assess and incorporate appropriate Stormwater Management Practices (SWMP) 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.

19. An evaluation of the hydrogeological conditions identified that the clayey silt till and shale 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.

20. NOCSS recommendations for the ES6-West Subcatchment included one SWM pond located north of Burnhamthorpe Road. No other SWM ponds were proposed in this subcatchment due to existing land uses, road patterns, drainage conditions and sizes of developing areas. NOCSS noted that other Best Management Practices would be required to address SWM objectives and satisfy design criteria.

21. One end-of pipe SWM facility is proposed within the Subject Lands to meet water quality, phosphorus control, erosion control and quantity control requirements set out in NOCSS for the Subject Lands. The control of post development peak flows to NOCSS target flows for the 2 year to 100 year events is provided through a stormwater management (SWM) facility (wet pond) located at the southwest corner of the Subject Lands. The proposed pond is designed as an urban pond, per Town of Oakville guidelines, within retaining walls along those edges that are adjacent to higher density residential areas. An urban pond, in this location, is considered appropriate given the high density community and compatibility with the proposed urban form. The conceptual design for the SWM pond is illustrated in **Figure 5.6.** The pond will outlet to an extension of the storm sewer along Fourth Line and eventually outlet to the Fourth Line roadside ditch and ESM-F2 with an ultimate outlet of SMA-6.

22. An additional separate SWM facility will be required in the ES6-West Subcatchment for the remaining lands in the subcatchment that are generally west of Fourth Line. The location and type of stormwater management is subject to future study (by others).

23. In addition, consideration was given to the incorporation of Low Impact Development (LID) measures such as limiting imperviousness, the use of cisterns, rain gardens, permeable pavement in localized areas, bioswales and increased topsoil depths. 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 is 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. These include techniques to maximize the water availability in pervious areas such as designing grades to direct roof runoff towards lawns, use of side and rear yard swales and increased topsoil depths.

24. Compatible with the proposed urban form, the Subject Lands will be serviced by a conventional storm sewer system designed in accordance with Town of Oakville standards. Storm sewers will be sized using a 5 year return frequency and Town of Oakville IDF curves and direct runoff to the SWM facility for quantity and quality control.

25. Shallow storm sewers will be required due to relatively shallow outlet elevations. Sump pumps will be provided where the storm sewer is not sufficiently deep.

26. The conceptual major storm system is illustrated in **Figure 5.4**.

27. Post development subcatchment drainage areas within the Subject Lands have generally maintained pre-development areas. However, sub-area catchment

boundaries have been delineated to generally align with ownership boundaries and ROW delineations.

28. An evaluation of the need for Regional Storm controls in the ES6-West and ES6-East subcatchments was undertaken for interim and ultimate development conditions by the Davis-Minardi EIR/FSS. This included updating hydrology and hydraulic models to identify changes to flood levels through Stream Reaches SMA-6, SMA-4, SMA-3 and SMA-2 downstream of ES6-West and ES6-East subcatchments without Regional Storm controls in place. Implications of increased Regional Storm flood levels and velocities to road infrastructure and lands/uses along these stream reaches were identified in that EIR/FSS. For discussion on the complete review of downstream impacts, see Section 7.5 of the Davis-Minardi EIR/FSS. Based on the results of that evaluation, it was recommended that Regional Storm controls are not required in these subcatchments. As requested by the Town and CH, the model was re-assessed as part of this Addendum to confirm model assumptions and results.

29. The erosion threshold for the EIR Subcatchment was assessed by Geomorphic Solutions for the Davis-Minardi EIR/FSS and has been adopted for the purpose of this EIR/FSS Addendum. The purpose of that assessment was to determine an appropriate erosion threshold to inform the design of SWM facilities. 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, the Davis-Minardi EIR/FSS recommended that:

    a) For areas draining to the SMA-4 tributary, a minimum of 250 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) Small areas are to control runoff on a 'best-efforts' basis, whereby the minimum orifice size is set at the Town's guideline of 75mm (or greater where larger catchments permit). In the case of the Subject Lands, the 25mm rainfall event will be stored for 24 hours and released through a 75mm orifice in accordance with the Town's guidelines.

    c) For all developing areas in the subcatchments, Low Impact Development (LID) measures should be maximized to the extent feasible.

    d) A monitoring plan should be developed at detailed design to assess channel adjustments within stream reach SMA-4 due to changes in the flow regime.

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., 407 transitway and Highway 407 interchange lands, Burnhamthorpe Road – future Wiliam Halton Parkway). Drainage from the transitway and Highway 407 lands will be captured and conveyed to the adjacent municipal roads (Neyagawa or Fourth Line, subject to future studies). Drainage from Burnhamthorpe Road (future William Halton Parkway) will drain west. The general approach is that these lands will have independent stormwater controls subject to their EA studies.

31. There were two Hydrologic Features B identified in NOCSS in the ES6-West Subcatchment Area that is the focus of this EIR/FSS Addendum. The storage volume of the natural Hydrologic Features B is accommodated within the SWM pond. The storage volume of the anthropogenic Hydrologic Features B is not accommodated in the SWM pond as per the NOCSS mediation agreement.

32. A detailed operations and maintenance manual for the stormwater management 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 EIR Subcatchment Area will be about 54 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 EIR Subcatchment Area based on the proposed development concept indicate that, if unmitigated, the development has the potential to reduce the pre-development recharge by about 78%.

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 within stream corridors on the Subject Lands and runoff is mainly by sheet flow to roadside ditches. 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. Nevertheless, it is recommended to minimize potential development impacts to the water balance through the incorporation of LID measures where feasible into the development design to the extent possible 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. **Figure 5.7** presents preliminary grading information.

WASTEWATER SERVICING

37. The Area Servicing Plan (ASP) prepared by MMM Group on behalf of the North Oakville Community Builders Inc. (2011), show the Subject Lands as part of the Neyagawa Subtrunk drainage boundary which drains west to a future pumping station which then pumps wastewater back to the Neyagawa sanitary trunk.

38. The Region of Halton Water and Wastewater Master Plan Update shows the existing 525mm wastewater main located in Neyagawa Boulevard as the outlet for

the Subject Lands. The sanitary trunk outlets to the North Oakville Wastewater Pumping Station located within the Mattamy Preserve Phase 2 lands.

39. An ASP Update was prepared for the Subject Lands and submitted to the Region to support a gravity connection to the existing 450 mm diameter wastewater main adjacent to the Subject Lands on Burnhamthorpe Road, immediately west of Neyagawa Boulevard. This 450 mm diameter sewer outlets to the trunk sewer south on Neyagawa Boulevard.

40. The change in land use from employment area to residential area results in an increase in population representing a peak flow increase of 7 L/s (or roughly 1cm increase in flow depth) which is considered nominal.

41. The conceptual wastewater servicing scheme for the Subject Lands is illustrated in **Figure 7.1**. The wastewater servicing scheme has been planned in accordance with the North Oakville East Area Servicing Plan and approved update. This includes a network of local gravity sewers designed in accordance with Region of Halton standards and specifications.

WATER SERVICING

42. The Subject Lands are currently located within the subzone M4L pressure district of Halton's water distribution system. A 1200mm watermain has been constructed on Neyagawa Boulevard, with a branch connection provided to service the Subject Lands.

43. In accordance with the Region's Master Plan Update, the external watermains, pumps and booster station have been constructed and are functional to service the Subject Lands.

44. The conceptual water servicing scheme for the Subject Lands is illustrated in **Figure 7.2.** The water servicing scheme has been planned in accordance with the North Oakville East Area Servicing Plan. 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

45. Through the Secondary Plan process, alternate road allowance design standards were proposed by 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 **Appendix E**.

46. Preliminary sidewalk locations are illustrated in **Figure 4.3**.

CONSTRUCTION PRACTICES

47. An erosion and sediment control strategy will be implemented at the detailed design stage in accordance with Town of Oakville and Conservation Halton

guidelines. All silt control measures (fences, sediment basins, etc.) will be installed prior to start of earthworks construction in accordance with industry standards.

48. The groundwater conditions do not present significant constraints to construction. There may be areas where servicing may encounter locally high water table conditions, however, the till has relatively low hydraulic conductivity and no significant dewatering is anticipated to be required for construction. 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 (if required) may be supported by traditional weepers and subdrains as seepage volumes are expected to be low due to the low hydraulic conductivity of the overburden sediments. 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).

49. A Geotechnical Report was prepared by DS Consultants Ltd. (DS, July 2022). Findings affecting construction design and practices are summarized in **Section 9.1**.

MONITORING

50. 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 10.3**.

51. 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.

52. 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 for each facility at the time of detailed design, including the estimated monitoring costs.

CONFORMITY WITH OPA 272 AND NOCSS

53. This EIR/FSS Addendum has been prepared in accordance with requirements set out in the approved Scoped EIR/FSS Addendum ToR to ensure conformity with NOCSS technical recommendations.

TABLE OF CONTENTS

ENVIRONMENTAL IMPLEMENTATION REPORT
AND FUNCTIONAL SERVICING STUDY ADDENDUM
SIXTEEN MILE CREEK SUBCATCHMENT ES6-WEST,
ARGO NEYAGAWA CORPORATION

CONTENTS

1		**INTRODUCTION**	**1**
	1.1	STUDY PURPOSE	1
	1.2	EIR SUBCATCHMENT AREA AND FSS STUDY AREA	2
	1.3	EIR/FSS STUDY OBJECTIVES	4
	1.4	STUDY TEAM	5
	1.5	PREVIOUS STUDIES, REPORTS AND PLANNING DOCUMENTS	5
2		**NATURAL HERITAGE SYSTEM FRAMEWORK**	**7**
	2.1	NATURAL HERITAGE SYSTEM COMPONENTS	7
	2.2	NATURAL HERITAGE	8
		2.2.1 ELC and Vegetation Inventory	9
		2.2.2 Breeding Bird Survey	11
		2.2.3 Amphibian Call Survey	12
		2.2.4 Turtle Survey	13
		2.2.5 Bat Habitat Assessment	14
		2.2.6 Incidental Wildlife	18
3		**GEOLOGY AND HYDROGEOLOGY**	**19**
	3.1	SCOPE OF WORK	19
	3.2	PHYSIOGRAPHY AND TOPOGRAPHY	21
	3.3	DRAINAGE	21
	3.4	CLIMATE	23
	3.5	GEOLOGY	23
		3.5.1 Stratigraphy	23
		3.5.2 Surficial Geology	24
		3.5.3 Bedrock Geology	24
	3.6	HYDROGEOLOGY	25
		3.6.1 Local Groundwater Use	25
		3.6.2 Hydraulic Conductivity	25
		3.6.3 Groundwater Levels	26
		3.6.4 Groundwater Flow Conditions	27
		3.6.5 Recharge and Discharge Conditions	28
	3.7	WATER QUALITY	28
		3.7.1 Groundwater Quality	28
		3.7.2 Surface Water Quality	29

TABLE OF CONTENTS

ENVIRONMENTAL IMPLEMENTATION REPORT
AND FUNCTIONAL SERVICING STUDY ADDENDUM
SIXTEEN MILE CREEK SUBCATCHMENT ES6-WEST,
ARGO NEYAGAWA CORPORATION

4		**LAND USE**	**31**
	4.1	GENERAL DESCRIPTION OF DRAFT PLAN	31
	4.2	TRAIL PLANNING	32
5		**GRADING, DRAINAGE AND STORMWATER MANAGEMENT**	**33**
	5.1	OPA 272 AND THE NOCSS RECOMMENDATIONS	33
	5.2	UPDATED SUBCATCHMENT BOUNDARIES	44
	5.3	PRE-DEVELOPMENT FLOWS AND DOWNSTREAM INFRASTRUCTURE CAPACITIES	44
		5.3.1 Pre-Development Flows	44
	5.4	STORMWATER MANAGEMENT PLAN SELECTION PROCESS	45
	5.5	REGIONAL STORM CONTROLS	47
	5.6	EROSION CONTROL ANALYSIS	51
	5.7	DRAINAGE AREAS AND PATTERNS	54
		5.7.1 Existing Conditions	54
		5.7.2 Post-Development Conditions	55
	5.8	CONVEYANCE OF MINOR SYSTEM FLOWS ON SUBJECT LANDS	56
	5.9	CONVEYANCE OF MAJOR STORM FLOWS ON SUBJECT LANDS	56
	5.10	STORMWATER MANAGEMENT ON SUBJECT LANDS	57
		5.10.1 Quality Treatment	57
		5.10.2 Quantity Treatment	57
	5.11	HYDROLOGIC FEATURES	58
	5.12	PRELIMINARY GRADING PLANS	59
6		**WATER BALANCE**	**61**
	6.1	COMPONENTS OF THE WATER BALANCE	61
	6.2	APPROACH AND METHODOLOGY	62
	6.3	COMPONENT VALUES	64
	6.4	PRE-DEVELOPMENT WATER BALANCE (EXISTING CONDITIONS)	65
	6.5	POTENTIAL DEVELOPMENT IMPACTS TO WATER BALANCE	66
	6.6	POST-DEVELOPMENT WATER BALANCE	66
	6.7	WATER BALANCE IMPACT ASSESSMENT	67
		6.7.1 Water Quantity	67
		6.7.2 Water Quality	67

TABLE OF CONTENTS

ENVIRONMENTAL IMPLEMENTATION REPORT AND FUNCTIONAL SERVICING STUDY ADDENDUM SIXTEEN MILE CREEK SUBCATCHMENT ES6-WEST, ARGO NEYAGAWA CORPORATION

		6.7.3 Private Services	68
	6.8	WATER BALANCE MITIGATION MEASURES	68
7		**WASTEWATER AND WATER SERVICING**	**71**
	7.1	NORTH OAKVILLE EAST – AREA SERVICING PLAN (ASP)	71
	7.2	WASTEWATER SERVICING	71
		7.2.1 Wastewater Design Criteria	71
		7.2.2 Existing Wastewater Services	72
		7.2.3 Proposed Wastewater Servicing	72
	7.3	WATER SERVICING	73
		7.3.1 Water Supply Design Criteria	73
		7.3.2 Pressure Zone Boundaries	73
		7.3.3 Existing Water Supply	74
		7.3.4 Proposed Water Servicing	74
8		**ROADS**	**75**
	8.1	ROAD ALLOWANCE DESIGN	75
	8.2	SIDEWALK DESIGN	75
9		**CONSTRUCTION PRACTICES**	**76**
	9.1	SUMMARY OF KEY GEOTECHNICAL FINDINGS	76
	9.2	EROSION AND SEDIMENT CONTROLS	77
	9.3	CONSTRUCTION PHASING	77
	9.4	DEWATERING REQUIREMENTS	77
	9.5	CONSTRUCTION BELOW WATER TABLE	78
	9.6	PRIVATE WATER WELLS	78
	9.7	WELL DECOMMISSIONING	79
10		**MONITORING PROGRAM**	**81**
	10.1	OPA 272 MONITORING REQUIREMENTS	81
	10.2	NOCSS MONITORING REQUIREMENTS	81
	10.3	PROPOSED MONITORING	83
		10.3.1 Erosion and Sediment Control	83
		10.3.2 Stormwater Management Facilities	83
11		**SUMMARY OF RECOMMENDATIONS**	**85**
	11.1	EIR/FSS ADDENDUM RECOMMENDATIONS	85

TABLE OF CONTENTS
ENVIRONMENTAL IMPLEMENTATION REPORT
AND FUNCTIONAL SERVICING STUDY ADDENDUM
SIXTEEN MILE CREEK SUBCATCHMENT ES6-WEST,
ARGO NEYAGAWA CORPORATION

12 REFERENCES 90

List of Figures and Drawings

Figure 1.1 Location Plan
Figure 1.2 Subcatchment Areas Within the Subject Lands
Figure 1.3 EIR Subcatchment Area and FSS Study Area
Figure 2.1 Natural Heritage Framework
Figure 3.1 Drilling and Monitoring Locations
Figure 3.2 Topography and Drainage
Figure 3.3 Surficial Geology
Figure 3.4 Bedrock Geology
Figure 3.5 Cross Section Locations
Figure 3.6 Schematic Cross Section A-A’
Figure 3.7 Schematic Cross Section B-B’
Figure 3.8 Interpreted Groundwater Flow
Figure 4.1 North Oakville Master Plan
Figure 4.2 Proposed Draft Plan of Subdivision
Figure 4.3 Pedestrian Circulation Plan
Figure 4.4 North Oakville Trails Plan
Figure 5.1 Stream and Culvert Locations
Figure 5.2 Existing Storm Drainage Pattern
Figure 5.3 Post Development Storm Drainage Pattern
Figure 5.4 Conceptual Storm Servicing
Figure 5.5 Sump Pump Detail
Figure 5.6 Conceptual Urban SWM Pond Block
Figure 5.7 Conceptual Grading Plan
Figure 7.1 Conceptual Wastewater Servicing
Figure 7.2 Conceptual Watermain Servicing

List of Tables

Table 1.1 Existing Subcatchment Areas and Subject Lands
Table 2.1 Dates of Field Investigations and Key Personnel
Table 2.2 2023 Breeding Amphibian Survey Details
Table 2.3 2023 Breeding Anuran Survey Results
Table 2.4 Basking Turtle Survey Details
Table 2.5 Basking Turtle Survey Results
Table 2.6 Acoustic Monitoring Results
Table 2.7 SAR Bat Species Calls During Roost Emergency Timing in June

TABLE OF CONTENTS

ENVIRONMENTAL IMPLEMENTATION REPORT
AND FUNCTIONAL SERVICING STUDY ADDENDUM
SIXTEEN MILE CREEK SUBCATCHMENT ES6-WEST,
ARGO NEYAGAWA CORPORATION

Table 5.1 North Oakville SWS Meeting the SWS Goals and Objectives
Table 5.2 Erosion Thresholds from Davis-Minardi EIR/FSS
Table 5.3 NOCSS Unit Flow Rates and Pre-Development Flows at Neyagawa Boulevard
Table 5.4 SWM Facility Release Rates and Storage Requirements
Table 6.1 Water Balance Land Use Categories
Table 6.2 Water Balance Component Values
Table 7.1 Summary of Zone Elevations
Table 7.2 Summary of Existing Watermains
Table 11.1 Summary of EIR/FSS Addendum Recommendations and Mitigative Measures

List of Appendices

Appendix A – EIR/FSS Scoped Terms of Reference

Appendix B – Natural Heritage
- Appendix B-1 Figures
- Appendix B-2 Species Lists
- Appendix B-3 Field Data Sheets

Appendix C – Hydrogeology
- Appendix C-1 Water Well Records
- Appendix C-2 Monitoring Well and Borehole Logs
- Appendix C-3 Hydraulic Conductivity Tests
- Appendix C-4 Groundwater Elevations
- Appendix C-5 Surface Water Flow
- Appendix C-6 Water Quality
- Appendix C-7 Water Balance

Appendix D - Stormwater Management
- Appendix D-1 Uncontrolled Regional Flow Assessment (GAWSER Update Memo)
- Appendix D-2 Stormwater Pond Calculations

Appendix E Town of Oakville Standard Road Cross Sections

Appendix F Geotechnical Investigation Report

Appendix G Water and Wastewater Servicing
- Appendix G-1 Area Servicing Plan Update
- Appendix G-2 Sanitary Design Sheets
- Appendix G-3 Pressure Zone Boundaries

1 INTRODUCTION

1.1 Study Purpose

This Environmental Implementation Report and Functional Servicing Study (EIR and FSS) Addendum 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 Area shown on **Figure 1.1**. This parcel of land is owned by Argo Neyagawa Corporation and is referred to as the 'Subject Lands'.

The Subject Lands are located north of Burnhamthorpe Road, immediately west of Neyagawa Boulevard, and east of Fourth Line. These lands encompass a gross area of approximately 11.3 ha.

This EIR/FSS Addendum has been prepared to address OPA 272 policy requirements in support of the approval of the Draft Plan of Subdivision 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 North Oakville East Secondary Plan (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").
- Argo Neyagawa Corporation is proposing a further Official Plan Amendment to redesignate the Subject Lands from Employment District to Neyagawa Urban Core, consistent with a preliminary review and draft Official Plan Amendments 326 and 45 completed by the Town of Oakville. Argo Neyagawa Corporation is proposing additional height to a maximum of 16 storeys.

The work completed as part of this EIR/FSS Addendum 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 Terms of Reference (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 of subdivision, 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 Addendum 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.

The approved *EIR/FSS for the East Sixteen Mile Creek Tributary Subcatchment ES6-West and the Davis-Minardi Lands* ("ES6-West EIR/FSS") is dated June 2015.

1.2 EIR Subcatchment Area and FSS Study Area

The Subject Lands lie within the East Sixteen Mile Creek Tributary subcatchment referred to as ES6-West.

The East Sixteen Mile Creek subcatchment ES6 is divided into two subcatchments, referred to as ES6-West and ES6-East, and shown on **Figures 1.2** and **1.3**. This

division of subcatchments is consistent with those outlined on Figure 7.4.2 from OPA 272 that delineates the extent of EIR Subcatchment for studies.

Neyagawa Boulevard forms the common boundary between these two subcatchments. Surface runoff from lands west of Neyagawa Boulevard flows generally southeasterly to outlet across Neyagawa Boulevard via stream reach SMA-6. Surface runoff from lands east of Neyagawa Boulevard flows generally southerly to outlet into Core 5 east Neyagawa Boulevard via stream reach SMA-6. Flows from these two subcatchments combine in stream reach SMA-6 just east of Neyagawa Boulevard. Lands downstream of this point lie with the ES7 subcatchment.

The limits of the EIR Subcatchment Area, adjacent subcatchments and the Subject Lands are shown on **Figure 1.2**. As discussed in **Section 5.2**, the EIR Subcatchment Area is 37.1 ha in size. **Table 1.1** notes the subcatchment draining the Subject Lands and the areas/percentages of the Subject Lands lying within each subcatchment.

Table 1.1 – Existing Subcatchment Areas and Subject Lands

Area	East Sixteen Mile Creek Tributary (ES6-West)	East Sixteen Mile Creek Tributary (ES7)	Total
Subject Lands (total landholding)	11.3 ha	0.00 ha	11.3 ha
% of Subject Lands in each subcatchment	100%	0%	100%

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 draft plans of subdivision. 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. With reference to this figure and direction from the ToR, the appropriate study areas for this EIR/FSS are:

- **EIR Subcatchment Area** is defined to be the East Sixteen Mile Creek Tributary subcatchment (ES6-West), focusing on the area west of Neyagawa Boulevard north of Burnhamthorpe Road as delineated in **Figures 1.2** and **1.3**; and,

- **FSS Study Area** is defined to be the lands owned by Argo Neyagawa Corporation west of Neyagawa Boulevard and north of Burnhamthorpe Road.

The EIR Subcatchment Areas and the FSS Study Area for the Subject Lands are shown on **Figure 1.3**. The Subject Lands cover approximately 31 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 Argo Neyagawa Corporation landholdings west of Neyagawa Boulevard;
- the "**FSS Study Area**" referring to the Subject Lands west of Neyagawa Boulevard and north of Burnhamthorpe Road;
- the "**EIR Subcatchment Area**" referring to the East Sixteen Mile Creek Tributary subcatchment (ES6-West) west of Neyagawa Boulevard and north of Burnhamthorpe Road; 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 King's Christian College and the Davis-Minardi lands to the south, rural residential to the west, and agricultural lands to the east. This EIR/FSS recognizes and incorporates where appropriate planning and servicing recommendations from the Davis-Minardi EIR/FSS. The location and extent of these adjacent lands are noted on **Figure 1.1**.

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 and coordination of EIR/FSS report preparation;
- Trafalgar Engineering – Lead FSS consultant addressing municipal servicing, stormwater management and site grading;
- Beacon Environmental - addressing natural heritage;
- R. J. Burnside & Associates Limited – addressing hydrogeology;
- DS Consultants – addressing geology and soils;
- Korsiak Urban Planning – 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 Draft 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);
- Town of Oakville Official Plan Amendment 326 (April 27, 2022 draft);
- Town of Oakville Official Plan Amendment 45 (April 27, 2022 draft);
- Region of Halton Official Plan Amendments 25, 48 and 49;
- Ontario Municipal Board Minutes of Settlement, June 2006 and August 2007;
- Scoped Environmental Implementation Report and Functional Servicing Addendum Study Terms of Reference, February 2023;
- North Oakville East Subwatersheds Study, prepared for the North Oakville Landowners' Group, August 2004;
- 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 & 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 & Guidelines Manual, Town of Oakville, September 2023;
- Stormwater Monitoring Guidelines North of Dundas Street, Town of Oakville, January 2012;
- 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. With reference to Figure NOE3 from OPA 272 there were two Hydrologic Features B within the EIR Subcatchment Area, at the time of NOCSS, on the Subject Lands. **Figure 2.1**, Natural Heritage Framework, illustrates these features on a current aerial photograph base. The northern Hydrologic Features B remains as per the location as shown in NOCSS however, that portion of the southern Hydrologic Features B, that was originally on the non-participating landholding (501 Burnhamthorpe Road) was filled in by that landowner sometime around 2015. The northern portion of the southern Hydrologic Features B, where it extends onto the Subject Lands, remains however, as a result of the fill placement on 501 Burnhamthorpe Road, the drainage in the area has been altered, resulting in the creation of a wetland area on the Subject Lands where one did not exist at the time NOCSS was prepared.

Based on historical air photos from 1934 (**Figure B-2, Appendix B-1**), there was no natural wet area located in the area of the southern Hydrologic Features B. By 2002 (**Figure B-3, Appendix B-1**) a pond is visible straddling the two property lines. Finally, by 2015 (**Figure B-4, Appendix B-1**), the majority of the pond has been filled in by the landowner at 501 Burnhamthorpe Road, with a small wet area visible on the Subject Lands. As such, this southern Hydrologic Features B should be considered anthropogenic.

While there are no natural heritage features or linkages within the Subject Lands or EIR Subcatchment Area, a Core Preserve Area (Core 4), a Linkage Preserve Area (LPA) and two Hydrologic Features B are located immediately west of the EIR Subcatchment Area (**Figure 2.1**).

2.2 Natural Heritage

No components of the NHS were identified within the Subject Lands in NOCSS however, the report identified two small wetlands/ponds as Hydrologic Features B. Within the Subject Lands, one of these features is identified as a "Wetland Contributing to Hydrological Function" and the other is identified as "Pit/Depressional Storage Area" in NOCSS. Field investigations were undertaken by Beacon in 2022 and 2023 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:

- ELC and vegetation inventory
- Breeding bird survey
- Amphibian call survey
- Basking turtle survey
- Bat habitat assessment

Dates of field investigations and field personnel are summarized in **Table 2.1**

Table 2.1 – Dates of Field Investigations and Key Personnel

Survey Type	Dates of Surveys	Personnel/Surveyor
Ecological Land Classification and Flora Inventory	August 23 and September 30, 2022; May 12 and June 30, 2023	D. Westerhof
Breeding Bird Surveys	May 25, June 13 and June 27, 2023	N. Price
Anuran Surveys	April 10, May 24 and June 23, 2023	J. Skeath, A. Haney
Turtle Surveys	September 9 and 23, 2022; May 10, June 5 and June 11, 2023	N. Price
Snag Survey	April 3, 2023	A. Haney

2.2.1 ELC and Vegetation Inventory

2.2.1.1 Methods

Vegetation surveys were conducted on August 23 and September 30, 2022; and May 12 and June 30, 2023.

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 three season (spring, summer, fall) vegetation survey was conducted for the Subject Lands in conjunction with ELC surveys. A list was compiled of all flora species observed in conjunction with ELC surveys.

2.2.1.2 Findings

2.2.1.2.1 Ecological Land Classification

The Subject Lands are comprised largely of agricultural fields. Ecological communities within include hedgerows, meadow, thicket, and several small wetlands. Ecological communities are illustrated in **Appendix B-1** and described below. ELC data sheets are included in **Appendix B-3**.

ELC Unit 1: Dry-Moist Old Field Meadow (CUM1-1)

This community is dominated by common old field forbs and graminoids, including Smooth Brome Grass (*Bromus inermis*), Timothy (*Phleum pratensis*), Tall Goldenrod (*Solidago altissima*), Queen Anne's Lace (*Daucus carota*), and asters (*Symphyotrichum* spp.).

ELC Unit 2: Hedgerow (HE)

The Subject Lands supports two hedgerows. Both features are dominated by hawthorns (*Crataegus* spp.) and Common Buckthorn, with some Black Walnut (*Juglans nigra*). Ground covers include grasses, Enchanter's Nightshade (*Circaea canadensis*), Garlic Mustard (*Alliaria petiolata*), and Cleavers (*Galium aparine*).

ELC Unit 3: Cultural Woodland (CUW1)

This community consists of a fringe of Crack Willow (*Salix fragilis*) around a dug pond. The understory consists of Common Buckthorn and Gray Dogwood. Ground covers include Garlic Mustard, Cleavers, Enchanter's Nightshade, and Thicket Creeper.

ELC Unit 4: Cultural Thicket (CUT1)

This thicket community is dominated by invasive Common Buckthorn, with some hawthorns and Gray Dogwood. Ground covers include grasses, Wild Strawberry (*Fragaria virginiana*), Tall Goldenrod, and Thicket Creeper.

ELC Unit 5: Cattail Mineral Shallow Marsh (MAS2-1)

Two cattail marshes were identified within the EIR Subcatchment Area. Unit 5a occurs on the Subject Lands and corresponds with the remnant of the southern Hydrologic Features B. Unit 5b occurs west of Fourth Line. Both features are anthropogenic, resulting from excavation, and are dominated by Narrow-leaved Cattail, with lesser amounts of Reed Canary Grass, Panicled Aster, Common Reed (*Phragmites australis*), and Purple Loosestrife (*Lythrum salicaria*).

ELC Unit 6: Stonewort Submerged Shallow Aquatic (SAS1-3)

This small dug pond feature, which corresponds with the northern Hydrologic Features B, supports submergent aquatic vegetation, notably Stonewort algae (Chara sp.), Coontail (*Ceratophyllum demersum*), and watermilfoil (*Myriophyllum* sp.) The edge is fringed by emergent vegetation, notably Reed Canary Grass and Narrow-leaved Cattail.

ELC Unit 7: Mineral Meadow Marsh (MAM2)

This meadow marsh is dominated almost exclusively by the invasive Common Reed, with small amounts of Panicled Aster, Purple Loosestrife, Reed Canary Grass, and Field Horsetail.

ELC Unit 8: Shallow Aquatic (SA)

This small dug pond is fringed by willow trees (ELC Unit 3). It does not support any vegetation except for a few stems of Narrow-leaved Cattail. The feature holds water in the spring and is dry in the summer.

ELC Unit 9: Agriculture (AG)

Agricultural lands within the EIR Catchment Area consists of row crops.

ELC Unit 10: Anthropogenic (ANT)

Areas classified as anthropogenic include existing rural residences and associated lawns, buildings, and paved surfaces.

2.2.1.2.2 Flora

A total of 84 species of vascular plants were documented from the Subject Lands and accessible portions of the EIR Subcatchment Area (i.e., 4022 Fourth Line - the property at the northwest corner of Fourth Line and Burnhamthorpe Road). A list is provided in **Appendix B-2**. Of this total, 40 (48%) are native, and 44 (52%) are introduced. The majority of species are ranked S4 or S5 in Ontario by the NHIC. A rank of S4 denotes a

species that is apparently secure in the province, with many occurrences, while S5 indicates it is demonstrably common and secure in the province. Two species are considered uncommon in Halton Region: Coontail (*Ceratophylum demersum*) and Canada Plum (*Prunus nigra*).

2.2.2 Breeding Bird Survey

2.2.2.1 Methods

Three breeding bird surveys were conducted for the EIR Subcatchment Area on May 25, June 13, and June 27, 2023, in the mornings, with low to moderate winds (0-3 Beaufort scale), no precipitation, and with temperatures within 5^{o}C of the normal average temperature. The breeding bird community was surveyed using a roving type survey, in which all parts of the Subject Lands and 4022 Fourth Line were walked to within 50 m and all birds heard or observed and showing some inclination toward breeding were recorded as breeding species. Lands west of Fourth Line were surveyed from the roadside (see **Figure B-1, Appendix B-1**). All birds heard and seen were recorded in the location observed on an aerial photograph of the site.

A third breeding bird survey was conducted given the presence of grassland habitat, in accordance with MNRF guidance documents. This third survey is typically targeted for the detection of Bobolink (*Dolichonyx oryzivorus*) and/or Eastern Meadowlark (*Sturnella magna*).

2.2.2.2 Findings

A total of 28 species of breeding birds were observed from the EIR Subcatchment Area during the 2023 surveys (Appendix B-2). This level of avian diversity is reflective of the range of habitats present on the Subject Lands as discussed in preceding sections, with a dominance of open agricultural fields and residential areas, with smaller areas of marsh, shallow aquatic communities, cultural meadow, cultural thicket, cultural woodland and hedgerows.

The majority of breeding birds are common species regularly found in urbanizing areas of southern Ontario, including the most abundant in descending order: Red-winged Blackbird (*Agelaius phoeniceus*), Song Sparrow (*Melodia melospiza*), American Robin (*Turdus migratorius*), and American Goldfinch (*Spinus tristis*). Other species observed with multiple breeding territories included: Black-capped Chickadee (*Poecile atricapillus*), Northern Cardinal (*Cardinalis cardinalis),* and Yellow Warbler (*Setophaga petechia*).

Breeding species associated with the small, isolated wetland pockets on the Subject Lands (ELC units 6, 5a and 5b; **Figure B-1, Appendix B-1**) included common species such as : Mallard (*Anas platyrhynchos*), Common Yellowthroat (*Geothlyphis trichas*), Yellow Warbler and Willow Flycatcher (*Empidonax traillii*). Northern Rough-winged Swallow (*Stelgidopteryx serripennis*) was also observed foraging over the wetland community in the northern portion of the Subject Lands (ELC unit 6; **Figure B-1, Appendix B-1**). There were no marsh breeding bird species associated with the wetland communities located in the southwestern and southeastern portions of the Subject Lands (ELC units 7 and 8; **Figure B-1, Appendix B-1**).

A limited number of species typically associated with open woodlands or woodland edges were also recorded during the surveys: Black-capped Chickadee, Northern Flicker (*Colaptes auratus*), and Least Flycatcher (*Empidonax minimus*).

Species of open habitat were associated with the agricultural fields and meadow communities and included: Eastern Kingbird (*Tyrannus tyrannus*), Horned Lark (*Eremophila alpestris*), Field Sparrow (*Spizella pusilla*), and Savannah Sparrow (*Passerculus sandwichensis*).

Area-sensitive birds require larger tracts of suitable habitat in which to breed or have higher breeding success in larger areas of suitable habitat. Two such species were recorded: Least Flycatcher and Savannah Sparrow. Least Flycatcher typically breeds in semi open deciduous and mixed forests of all ages but will occasionally use shrubby fields and forest edges. One breeding territory of Least Flycatcher was recorded in a small tree grouping in the meadow community in the southwestern portion of the EIR Subcatchment Area, outside of the Subject Lands. The Savannah Sparrow is an inhabitant of open country or grassland habitat. Two distinct breeding territories were recorded during the surveys on the Subject Lands throughout the central agricultural field.

One species, Eastern Meadowlark (*Sturnella magna*), listed as threatened under the provincial ESA (2007), was recorded as a migrant during the first survey in late May. This species was recorded within the EIR Subcatchment Area in the meadow north of the Subject Lands. As this species was not recorded again on any of the following surveys, it is considered a late migrant rather than a breeding species. No other endangered or threatened bird species were recorded.

Barn Swallow (*Hirundo rustica*) is a species of special concern in Ontario and was observed foraging above the agricultural fields and meadows on the Subject Lands. Barn Swallow nest almost exclusively on human-made structures that are open such as open barns, under bridges and in culverts. A barn is present in the western portion of the EIR Subcatchment Area, but outside of the Subject Lands; therefore, it was not searched to confirm the presence of this species as it is outside of the proposed development limits.

No species ranked as S1 through S3 (Critically Imperiled through Vulnerable) by the province were present during the 2023 breeding season.

2.2.3 Amphibian Call Survey

2.2.3.1 Methods

Surveys were undertaken during the spring of 2023 to determine if the Subject Lands support breeding habitat for frogs and toads. Surveys were conducted following the Marsh Monitoring Protocol (Bird Studies Canada 2009). The surveys consisted of listening for calling anurans during the prime breeding period to determine presence and abundance.

The surveys involved visiting the site after dusk with minimum night-time air temperatures of at least 5°C for the first survey, 10°C for the second survey and 17°C for

the third survey. Areas that contained potential breeding amphibian habitat were surveyed from a distance that would enable calling amphibians to be heard. A total of four survey stations were established, including ELC Units 5a, 5b, 6, and 8 (**Figure B-1, Appendix B-1**). Survey details, including dates, times and weather conditions are summarized in **Table 2.2**.

Table 2.2 - 2023 Breeding Amphibian Survey Details

	Survey 1	Survey 2	Survey 3
Date	April 10	May 24	June 23
Start Time	20:30	22:00	22:15
Temperature (°C)	13	11	19
Wind Speed (Beaufort)	1	0	0
Cloud Cover (%)	0	0	100
Precipitation	None	None	Drizzle

Calling amphibians, if present, were identified to species and calling activity was assigned a code from the following options, which indicate increasing abundance:

- Code 0: No calls;
- Code 1: Individual calls do not overlap and calling individuals can be discretely counted;
- Code 2: Calls of individuals sometimes overlap, but numbers of individuals can still be estimated; and
- Code 3: Overlap among calls seems continuous (full chorus), and a count estimate is impossible.

2.2.3.2 Findings

Ponds and wetlands within the Subject Lands support several frog species in low abundance, including Spring Peeper, Chorus Frog, Gray Treefrog, and Green Frog. The results of the surveys are provided in **Table 2.3.**

Table 2.3 - 2023 Breeding Anuran Survey Results

ELC Unit	Survey Date		
	April 10	**May 20**	**June 23**
6	SPPE 2(6) CHRF 1(1)	0	GRTR 2(3) GRFR 1(2)
8	0	SPPE 1(3)	0
5a	SPPE 2(8)	SPPE 2(5)	0
5b	0	0	0

SPPE – Spring Peeper
CHRF – Chorus Frog
GRTR – Gray Treefrog
GRFR – Green Frog

2.2.4 Turtle Survey

Surveys for basking turtles were completed for the Subject Lands in the fall of 2022 and spring of 2023. Survey details are presented in **Table 2.4**. The shorelines of ponds and

wetlands were surveyed with binoculars for basking turtles. This method is considered to be one of the most effective methods of confirming the presence of turtles within suitable habitat (MNRF 2015). Basking surveys were completed on sunny days when air temperatures were above 10°C or on partially cloudy or slightly overcast days when the air temperatures were above 15°C and were higher than the water temperature (MNRF 2015). Surveys focused on ELC Unit 6 in the fall of 2022, as it was the only feature within the Subject Lands holding water at the time. ELC Units 6, 5a, 5b, and 8 were surveyed in spring 2023 when all four units were holding water.

Table 2.4 - Basking Turtle Survey Details

	Survey 1	Survey 2	Survey 3	Survey 4	Survey 5
Date	Sept 9, 2022	Sept 23, 2022	April 10, 2023	May 5, 2023	May 11, 2023
Start time	8:50	11:30	12:45	12:30	8:00
End time	9:30	12:20	14:00	14:30	10:15
Temperature (ºC)	17	12	14	11	12
Wind speed (Beaufort)	0-1	2-3	3	1	1
Cloud cover (%)	0	0	0	40	60
Precipitation	None	None	None	None	None

2.2.4.1 Findings

The results of the basking turtle surveys are summarized below in **Table 2.5**. One turtle species, Midland Painted Turtle (*Chrysemys picta marginata*), was observed at two locations (ELC Units 6 and 5a), which correspond with the northern and southern Hydrologic Features B, respectively.

Table 2.5 - Basking Turtle Survey Results

ELC Unit	Survey Date				
	Sept 9, 2022	**Sept 23, 2022**	**April 10, 2023**	**May 5, 2023**	**May 11, 2023**
6	8 MIPA	10 MIPA	4 MIPA	7 MIPA	6 MIPA
8	Not surveyed	Not surveyed	-	-	-
5a	Not surveyed	Not surveyed	-	2 MIPA	2 MIPA
5b	Not surveyed	Not surveyed	-	-	-

MIPA=Midland Painted Turtle

2.2.5 Bat Habitat Assessment

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*). These species over-winter in caves and mines. Maternal roosts are often associated with cavity trees and sometimes old buildings (e.g., attics).

2.2.5.1 Methods

A bat habitat assessment was undertaken within the Subject Lands in accordance with the MECP updated '*Species at Risk Bats Survey Note 2022*' guideline for woodlands.

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. The cultural woodland (ELC Unit 3), though very small, was included in the assessment.

Detailed bat snag surveys were undertaken on April 3, 2023, to determine the occurrence of snag trees. Step 2 of the MECP protocol requires forest communities less than 0.5 ha to be surveyed in their entirety using transects. The CUW1 is less than 0.5 ha; therefore, it was surveyed in its entirety following Step 2 of the protocol. The survey was completed during leaf off, and under suitable conditions (i.e., no precipitation, not immediately following heavy snowfall). 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.

CUW1 is a small community comprised largely of Crack Willow which surrounds a small dug pond (ELC Unit 3, **Figure B-1, Appendix B-1**). A snag survey of this area was conducted on April 3, 2023, which confirmed the presence of four cavity trees that represent potential maternity roost habitat.

Acoustic monitoring for bats was conducted from May 31 to June 12, 2023. Following the MECP protocol, this deployment period provided at least ten nights of data recorded under suitable weather conditions (air temperature ≥10°C, low winds, and minimal precipitation). One monitoring station was established within the CUW1 (**Figure B-1, Appendix B-1**). The monitoring location was selected based on the area being considered for future development, the range of the acoustic monitor, and location of potential roost trees.

At the acoustic monitoring location an SM4BAT passive monitor equipped with a SMM-U2 ultrasonic microphone was installed. The microphone was oriented to optimize the echolocation detections. The monitor was programmed to record during triggered events each night for a period of six hours beginning at sunset. A 12dB gain setting, was selected based on the SMM-U2 microphone and the surrounding habitat and proximity to potential roost trees. The unit was programmed to record in full spectrum with a 256

kHz sample rate. The high pass filter was set to 16 kHz to eliminate low frequency noise but to still capture the lowest frequency bat calls (i.e., Hoary Bat [*Lasiurus cinereus*]). The trigger level was set to +18SNR with a 0.5 second minimum call duration trigger. All files were recorded as full spectrum in .WAV format.

Recordings from the monitor were analyzed using Kaleidoscope Pro software. A combination of auto-identification and manual analysis was applied to call files to make species determinations. All unclassified files (No ID Files) were manually reviewed for call frequency to determine if unclassified calls fell within the 40 kHz Myotis species and Tri-Colored Bat range. If the call did not fall within the approximate 40 kHz range, it was not analyzed further as it is likely not an endangered species of bat. Furthermore, a random selection of noise files was reviewed to ensure that the batch filters functioned as intended.

2.2.5.2 Findings

The results of the acoustic analysis are summarized in **Tables 2.6** and **2.7** and indicate the occurrence of seven species: Big Brown Bat (*Eptesicus fuscus*), Eastern Red Bat (*Lasiurus borealis*), Hoary Bat, Silver-haired Bat (*Lasionycteris noctivagans*), Little Brown Myotis, Eastern Small-footed Myotis and Northern Myotis. Additionally, unidentified Myotis species were recorded. As the call spectrograms of all three Myotis species have overlapping characteristics, it can sometimes be difficult to differentiate between them and therefore they are assigned to "unidentified Myotis". Of the species detected, three are listed as endangered under the provincial ESA: Little Brown Myotis Eastern Small-footed Myotis and Northern Myotis. Recordings of these regulated species and unidentified Myotis species were subjected to further detailed analysis to determine whether they corresponded with roost emergence times (8:30 pm to 10:30 pm) (**Table 2.7**).

Table 2.6 - Acoustic Monitoring Results*

Detector #	Number of Call Files*								
	Big Brown Bat	Eastern Red Bat	Hoary Bat	Silver-haired Bat	Little Brown Myotis	Eastern Small-footed Myotis	Northern Myotis	Myotis species	Total
67	212	2	25	5	124	122	8	67	565

*The number of call files does not represent the number of bats as multiple calls can be recorded from a single bat.
Non-SAR bat files represent auto-identification only and have not been manually reviewed whereas SAR bat files have been manually reviewed to make species determinations.

Table 2.7 - SAR Bat Species Calls During Roost Emergence Timing in June*

Detector #	Date	Number of Little Brown Myotis Calls	Number of Eastern Small-footed Myotis Calls	Number of Northern Myotis Calls	Number of Unidentified Myotis Species Calls
67	May 31, 2023	39	7	0	15
	June 1, 2023	1	39	6	11
	June 2, 2023	3	16	0	2
	June 3, 2023	21	1	0	6
	June 4, 2023	12	0	1	2
	June 5, 2023	18	11	0	11
	June 6, 2023	23	0	0	5
	June 7, 2023	2	3	1	1
	June 9, 2023	1	8	0	1
	June 10, 2023	0	5	0	0
Total	**-**	**120**	**90**	**8**	**54**

*The number of call files does not represent the number of bats as multiple calls can be recorded from a single bat

Little Brown Myotis was recorded during roost emergence (**Table 2.6**). A total of 120 Little Brown Myotis calls were recorded during roost emergence times over the 13-day monitoring period. These calls were recorded over nine separate nights during the monitoring period. On nights with multiple recordings, the calls were recorded within five minutes of each other suggesting that either one or a few individuals were active in the area and calling repeatedly during this time. The low number of Little Brown Myotis calls recorded during roost emergence times in June, the spread of calls over the monitoring period and low number of trees with typical Myotis roost characteristics suggest that the wooded features on the Subject Lands within the immediate vicinity of the detector do not provide maternity roost habitat for Little Brown Myotis. Rather, based on the data analysis, it is Beacon's opinion that the small cultural woodland and surrounding area within the Subject Lands provides foraging or flyover habitat for Little Brown Myotis.

Northern Myotis was recorded during roost emergence times (**Table 2.6**). A total of eight Northern Myotis calls were recorded during roost emergence times over the 13-day monitoring period. These calls were recorded over three separate nights during the monitoring period. Only one of these nights had multiple recordings and the calls were recorded within five minutes of each other suggesting that either one or a few individuals were active in the area and calling repeatedly during this time. The very low number of Northern Myotis calls recorded during the roost emergence timing in June, the spread of calls over the monitoring period and low number of trees with typical Myotis roost characteristics suggest that the wooded features on the Subject Lands within the immediate vicinity of the detector do not provide maternity roost habitat for Northern Myotis. Beacon is of the opinion that the wooded habitat on the Subject Lands, particularly around detector 67 provides foraging or flyover habitat for this species.

Eastern Small-footed Myotis was recorded during roost emergence times (**Table 2.6**). A total of 90 Eastern Small-footed Myotis calls were recorded during roost emergence times over the 13-day monitoring period. These calls were recorded over eight separate nights during the monitoring period. On nights with multiple recordings, the calls were

recorded within five minutes of each other suggesting that either one or a few individuals were active in the area and calling repeatedly during this time. Eastern Small-footed Myotis typically roost in crevices in cliffs and talus slopes (Humphrey 2017), which are not present within the Subject Lands. Beacon is therefore of the opinion that the wooded habitat on the Subject Lands, particularly that around Detector 67 provides foraging or flyover habitat for Eastern Small-footed Myotis.

In summary, the calling activity associated with SAR bats within the Subject Lands is consistent with foraging and flyover activity rather than maternity roosting behaviour.

2.2.6 Incidental Wildlife

2.2.6.1 Methods

Wildlife observed outside of the targeted studies were noted as incidental observations.

2.2.6.2 Findings

Mammal species documented from the Subject Lands included Eastern Cottontail (*Sylvilagus flordinaus*) and Gray Squirrel (*Sciurus carolinensis).* Evidence of White-tailed Deer (*Odocoileus virginianus*) and Eastern Coyote (*Canis latrans*) was also observed. Other common mammal species that are likely present on and adjacent to the Subject Lands include Raccoon (*Proycon lotor*), Striped Skunk (*Mephitis mephitis*) and/or Red Fox (*Vulpes vulpes*).

3 GEOLOGY AND HYDROGEOLOGY

3.1 Scope of Work

The scope of work completed for the hydrogeological component of this Addendum was designed to address the technical requirements as set out in the approved Scoped EIR/FSS ToR (**Appendix A-1**). 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 Ministry of Environment, Conservation and Parks (MECP) water supply well records and available geotechnical reports for the EIR Subcatchment Area 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), groundwater monitoring wells (MW) and shallow drive-point piezometers (PZ) on the Subject Lands and review of the available geotechnical borehole and monitoring well records from the Subject Lands and surrounding subcatchment areas to investigate the local soil and groundwater conditions. The borehole and monitoring well locations 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 completed by Burnside 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 grain-size analyses and hydraulic conductivity testing results are included in **Appendix C-3**.

4. Monitoring of groundwater levels in the wells and piezometers on the Subject Lands to measure the depth to the water table and assess the horizontal and vertical groundwater flow conditions. For this study, manual water level monitoring was completed from October 2022 through September 2023 to track four seasons of groundwater variations. Monitoring is on-going to verify the results of the first year of monitoring. In addition to the manually recorded groundwater levels, two automatic water level recorders (dataloggers) have been installed in monitoring wells MW22-1A and MW22-13 (**Figure 3.1**) to record detailed and continuous water level measurements. The groundwater monitoring data are summarized in **Table C-4-1** in **Appendix C-4**. Hydrographs for each of the monitoring locations also are provided in **Appendix C-4**.

5. Monitoring of surface water flow monthly at four road culvert locations surrounding the EIR Addendum Subcatchment Area. These included ESM-F3 along Fourth Line and ESM-B6, ESM-B7 and ESM-B8 along Burnhamthorpe Road. The culvert locations are shown on **Figure 3.1** Flow, when present, was estimated using a stream area - velocity method. The surface water flow data are summarized in **Table C-5-1, Appendix C-5**.

6. Collection of a groundwater sample from MW22-1 to characterize the groundwater quality. A surface water sample was not collected as sufficient flows were not available. 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 **Table C-6-1** in **Appendix C-6**.

7. 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 EIR Subcatchment Area 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-7.**

3.2 Physiography and Topography

The ES6-West subcatchment is located on the south slope of the Trafalgar Moraine, a 'till moraine' mapped by Chapman and Putnam (1951, 1984) and, more recently, by the Ontario Geological Survey (Barnett, 1992a). The Trafalgar Moraine consists of a belt of gently undulating topography extending across the North Oakville area. Highway 407 generally marks the crest of the Trafalgar Moraine between Sixteen Mile Creek and Trafalgar Road. The crest of the Moraine forms the regional surface water divide with all subcatchment areas on the south slope draining towards the south.

The land surface across the ES6-West Subcatchment Area slopes to the south and southwest and is characterized by an undulating till surface. Analysis of the detailed topography in the subcatchment shows the highest elevations (up to 190 masl - metres above mean sea level) are found at the northern portion of the subcatchment (**Figure 3.2**). There is a maximum relief amplitude across the EIR Subcatchment Area of about 11 m, with the lowest elevations (179 masl) found in the southeast area of the subcatchment at Burnhamthorpe Road. (**Figure 3.2**).

3.3 Drainage

The drainage area is shown on **Figure 3.2**. The EIR subcatchment boundary is also shown and extends from Highway 407 at its northern extremity to Burnhamthorpe Road in the south. The western boundary coincides with the ES6-West boundary along the western and eastern extremities. The Subject Lands generally drain southwest towards Fourth Line . Surface flows are directed below Fourth Line through a series of culverts. A portion of the Subject Lands then drains through the King's Christian College lands to the south. The other portion of the Subject Lands drain south through the ditches along Fourth Line.

3.3.1 Watercourse Conditions

There are no permanent watercourses in the EIR Subcatchment Area. Surface water runoff is directed overland via a series of drainage swales through farm fields and along roadside ditches along Fourth Line and Burnhamthorpe Road. The observations and monitoring data for the drainage swales across the EIR Subcatchment Area confirm that the swales are ephemeral and have a surface water conveyance function. Surface water flows were observed at four road culvert locations along Fourth Line (ESM-F3) and Burnhamthorpe Road (ESM-B6 to ESM-B8; **Figure 3.2**). **Table C-5-1** in **Appendix C-5** summarizes the data recorded during this study.

The monitoring data show the culverts are mostly dry with standing water or minimal flow (too low to be measured) recorded even during spring conditions. The only flow

recorded during the period of review was noted during spring conditions at ESM-B6 in April 2023 (**Table C-5-1**, **Appendix C-5**). The absence of flow in the swales and at the culverts confirms that these areas are ephemeral, with a conveyance function related to precipitation and seasonal water runoff events.

Surface water in the Fourth Line ditch flows southwards to join the roadside ditch along Burnhamthorpe Road.

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 two Hydrologic Features B (northern and southern) and one dug-out pond within the EIR Subcatchment Area (**Figure 3.2**). The northern Hydrologic Features B is a small pond located in a depression at the northern end of the Subject Lands and the southern Hydrologic Features B is the remnant of a larger pond feature, a portion of which was filled by the neighbouring landowner (501 Burnhamthorpe Road). The dug-out pond was identified as an artificial pond in NOCCS (2006) and is also located along the south-eastern edge of the EIR Subcatchment Area (**Figure 3.2**).

At the southern Hydrologic Feature B, a drive-point piezometer (PZ1) was installed. The data from this location (**Figure C-4-11** in **Appendix C-4**) shows that water levels are always below grade and occasionally the piezometer is dry during dry periods. These data are interpreted as indicating that the feature is not supported by groundwater discharge but is a result of surface water that is ponded in the area due to the blockage of the drainage that gradually infiltrates over time. Our review of conditions and historic air photos indicates that the blockage of drainage occurred as a result of fill being placed on the neighbouring property to the south.

The northern Hydrologic Feature B is in a depression at the northern extent of the Subject Lands. This feature was instrumented with a drive-point piezometer (PZ2) and a staff gauge located in the water. The water level hydrograph for this location (**Figure C-4-12** in **Appendix C-4**) shows groundwater gradually increasing over time and rising to above grade in the spring of 2023. During the above grade period, the groundwater level is consistent with the recorded surface water level of the pond. These data are interpreted to indicate that there is potential for seasonal groundwater discharge conditions to the pond and that pond water levels may be sustained during high groundwater conditions by groundwater discharge.

3.3.3 Artificial Pond

The artificial pond was recognized by NOCSS 2006 and is located in the southeastern section of the Subject Lands (see **Figure 3.2**). NOCSS did not record the pond as a Hydrologic Feature. As part of this study, a drive-point piezometer was installed in this area. The hydrograph for this location (**Figure C-4-13** in **Appendix C-4**) shows a gradual increase in groundwater levels over the spring with above grade water table during the groundwater high. Conditions recorded during the fall of 2022 suggest that the piezometer goes dry during extended dry periods. These data are interpreted to indicate that the pond is a recharge feature that stores surface water which recharges groundwater generally, however during periods of high water table, the pond likely interacts with groundwater and groundwater discharge likely supports the pond during high groundwater conditions. The seasonal variation in water level at the pond is noted to be in the region of 1 m water for infiltration into the underlying sediments and gives the feature a seasonal recharge function that will also help to support the high water table.

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 3.5**. 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 EIR Subcatchment Area, these MECP records provide geology data that have been used to help assess the regional stratigraphy.

To illustrate the geological conditions, schematic cross-sections through the EIR Subcatchment Area were prepared. The cross-section locations are shown on **Figure 3.5** and the interpreted cross-sections are shown on **Figures 3.6 and 3.7**. The cross-

sections illustrate the basic stratigraphy typical of the North Oakville area, with glacial till overburden sediments overlying shale bedrock.

3.5.2 Surficial Geology

Surficial geology mapping published by the Ontario Geological Survey shows that the EIR Subcatchment Area is covered by glacial till (**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 June 2022, a hydrogeological study and geotechnical investigation of the FSS Study Area involved the drilling of 48 boreholes to depths ranging from 12.3 m to 17.0 m to determine the engineering properties of the surficial soils for residential subdivision construction. Six of the boreholes were equipped as groundwater monitoring wells. The borehole locations are shown on **Figure 3.5** and a copy of the geotechnical report with the borehole and monitoring well logs is provided in **Appendix F**. Copies of the monitoring well logs are also provided in **Appendix C-2**.

The borehole drilling records show a layer of organic topsoil ranging in thickness from 20 cm to 25 cm overlies glacial till overburden sediments which extend to a till shale complex overlying shale bedrock. The overburden sediments are described as silty clay to silty clay till interbeds sandy silt to silty sand till.

The till thickness encountered in the boreholes ranged from about 9.1 m to 16.9 m thick (**Appendix C-2**). The cross-sections (**Figures 3.6 and 3.7**) shows that the till ranges from 12 m to 15 m across the Subject Lands.

3.5.3 Bedrock Geology

As shown on **Figure 3.4**, the EIR Subcatchment 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 south, with the highest bedrock elevation of about 171 masl (MECP well 2802214) and the lowest elevation of 166 masl (**Figures 3.6 and 3.7**).

Across the FSS Study Area, the bedrock is encountered at depths ranging from about 12 m to 17 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 7.3** 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 9.6** 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 very low, and was estimated in the NOCSS to be less than 3×10^{-7} cm/sec. This estimate was based on soil grain-size analyses of till 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 in the FSS Study Area, six bail-down tests were completed by DS in June 2022. Tests completed at MW22-1A, MW22-2, MW22-12 and MW22-14 (shallow groundwater monitoring wells screened in the silty clay till overburden sediments) resulted in hydraulic conductivity ranging from 4.4×10^{-5} cm/sec at MW22-12 to 5.2×10^{-6} cm/sec at MW22-14 (refer to **Appendix C-3**). Monitoring wells MW22-1B and MW22-9 were screened in the overburden and shale complex. The hydraulic conductivity in these locations is in the order of 2.1×10^{-4} cm/sec at MW22-1B and 1.3×10^{-6} cm/sec at MW22-9 (**Appendix C-3**).

Tests for hydraulic conductivity of the shale bedrock were not completed as none of the monitoring wells were installed in the shale bedrock. From previous studies, it is noted

that the shale hydraulic conductivity tends to be controlled by fracturing and horizontal bedding planes and the weathered layer at the top of the bedrock is generally expected to have the highest hydraulic conductivity. The North Oakville East Subwatersheds Study (NOMI, 2004) notes that the hydraulic conductivity of the upper weathered part of the shale is in the order of 1×10^{-5} cm/sec.

3.6.3 Groundwater Levels

Since September 2022, groundwater levels across the FSS Study Area have been measured on a monthly basis in monitoring wells and piezometers (**Table C-4-1**, **Appendix C-4**). Hydrographs for each well and piezometer location are provided on **Figures C-4-1** through C**-4-13** in **Appendix C-4**. In addition to the manual water level measurements recorded at each location, two automatic water level recorders were installed in October 2022 at MW22-1A and MW22-13 to record continuous water levels. The datalogger hydrographs are presented on **Figures C-4-1** and **C-4-7** in **Appendix C-4**.

This study includes data obtained from September 2022 to September 2023. Monitoring is on-going to confirm the results of the first year of monitoring.

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 summer and fall months. The general trend at most locations shows levels low in late fall of 2002 followed by a rise in water level through the spring of 2023. 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 1.4 m to 4.6 m.

- The groundwater levels in MW22-13 took over two months to stabilize after the installation of this well (Figure C-4-7; **Appendix C-4**). This long recovery period (6 months) illustrates how very low the hydraulic conductivity is within the dense surficial till soils in some areas (refer to **Section 3.5.4** for discussion of hydraulic conductivity). A similar delay in stabilization is interpreted to have occurred at MW22-11 (**Figure C-4-5, Appendix C-4**).

- The depth to the water table generally ranges from about 0.2 m to 5.3 m below grade within the surficial till in the Subject Lands (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.

- The detailed water level measurements provided by the datalogger in MW22- 13 do not show a direct or rapid response relationship between the water table elevation and precipitation (**Figure C-4-7, Appendix C-4**). This is consistent with the very low hydraulic conductivity of the surface soils in the FSS Study Area (refer to **Section 3.5.4**). The datalogger in MW22-1A however did capture a water table response to precipitation events (**Figure C-4-1**). At the piezometer locations, water levels tend to be seasonally at or close to grade during spring and groundwater high conditions. Seasonal groundwater discharge has been interpreted to occur at PZ2 and PZ3 locations. At the PZ1 location, the water level in the piezometer varies by about 0.5 m and is seasonally close to grade. The piezometer was dry October 2022 to January 2023 (**Figure C-4-11**, **Appendix C-4**). At the PZ2 location, the water levels in the piezometer were lower than the surface water level in the pond from February to April 2023 and water levels being similar or above the surface water levels from May to September (**Figure C-4-12, Appendix C-4**). It is interpreted that the water table will intersect ground level in this area and that discharge gradients may occur during seasonal groundwater high conditions when the pond is supported by groundwater. It is anticipated that the actual groundwater flux in this area will be very low i.e., the rate of groundwater flow is limited by the low hydraulic conductivity of the surficial sediments.

- At PZ3 the water levels increased from January to May 2023 then decreased during the summer months. Surface water levels at the piezometer were similar to groundwater in April and May, then decreased to below the groundwater levels May to August indicating discharge conditions. (**Figure C-4-13, Appendix C-4**). The potential groundwater seepage volumes will be low due to the low hydraulic conductivity soils.

3.6.4 Groundwater Flow Conditions

Groundwater elevation data from July 2023 are shown on **Figure 3.8**. The interpreted groundwater elevation contours for the EIR Subcatchment Area are shown on **Figure 3.8** 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, groundwater gradients and surface water feature elevations where appropriate.

The groundwater elevation contours indicate that the groundwater movement is generally towards the south and southwest across the subcatchment (**Figure 3.8**). 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 tributary and main river valleys located to the south and west of the EIR Subcatchment 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 lower areas within the EIR Subcatchment Area and that hydrological features may seasonally demonstrate groundwater / surface water interactions. There are no permanent surface water features across the Subject Lands and no contributions to baseflow are expected.

3.6.5 Recharge and Discharge Conditions

Recharge conditions (i.e., downward gradients) occur throughout most of the EIR Subcatchment Area. The vertical and horizontal hydraulic gradients suggest that the surface water that infiltrates and recharges to the water table in the northern portion of the subcatchment will move southwards across the EIR Subcatchment Area in the direction of groundwater flow (**Figure 3.8**). 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.

There are times when seasonally high groundwater levels intersect the ground surface in the topographically lower areas, and minor seasonal discharge gradients have been recorded in the northern Hydrologic Features B, although no discharge seepage to surface or baseflow contributions have been observed (refer to **Sections 3.3.2 and 3.3.3**).

3.7 Water Quality

3.7.1 Groundwater Quality

The local groundwater quality is considered to be relatively 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 in June 2022 from MW1 (MW22-1A (DS, 2022) and from the water quality data available from surrounding studies, including work on the Davis Minardi lands (as reported in the *David Minardi EIR/FSS*).

MW22-1A is screened in clayey silt till (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 **Table C-6-1**, **Appendix C-6** and the Halton Region sewer use by-law guideline/standards are also listed with the data for comparison.

There were no exceedances for the tested parameters compared to the Halton Region Sewer Use By-Law (refer to **Table C-6-1, Appendix C-6**).

3.7.2 Surface Water Quality

Due to the absence of surface water flow within the roadside ditches for the period of monitoring, no surface water sample was obtained and hence no analysis of background surface water characteristics was possible.

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:

- Four (4) Medium Density Residential Condominium Blocks, totaling 5.6 ha, to consist of dual frontage, rear-lane, and back-to-back townhouse dwellings;
- One 1.64 ha Mixed Use Block, anticipated to consist of rear-lane townhouse dwellings, back-to-back townhouse dwellings with underground parking, and mid- to high-rise mixed-use buildings;
- One 0.9 ha Stormwater Management Block;
- A 0.12 ha Trail Block;
- A 1.25 ha Transitway Block and associated 0.42 ha Buffer Block; and
- 19 m and 17 m public rights-of-way.

The adjacent land uses can be summarized as follows:

- To the West: - Rural Residential
- To the North: - Highway 407
- To the East: - Agricultural
- To the South - King's Christian College and Davis-Minardi development

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; however, the Subject Lands do contain two Hydrologic Features B (ELC Units 5a and 6). These features have not been identified for protection in OPA 272; however, mitigation is required to replicate their hydrologic functions if the features are natural and not anthropogenic.

All hydrological features will be removed to accommodate the proposed development and the storage functions of the natural features (i.e., non-anthropogenic) will be provided in the extended storage component of a SWM pond.

Field investigations conducted by Beacon confirmed that both wetland features support small populations of frogs and Midland Painted Turtles. To mitigate impacts on these species, prior to removal of these wetland features, it is recommended that a Wildlife Collection Permit be obtained from the MNRF to safely relocate any frogs or turtles to a suitable habitat location.

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, though potential nesting habitat for Barn Swallow is associated with buildings within the EIR Subcatchment Area west of Fourth Line.

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. Beacon recommends that during the peak period of bird nesting, no vegetation clearing or disturbance to nesting bird habitat occur – i.e., between May 16 and July 15. In the shoulder seasons of April 1 to May 15, and July 16 to August 31, Beacon suggests that vegetation clearing could occur, but only after an ecologist with appropriate avian knowledge has surveyed the area to confirm lack of nesting. If nesting activity is detected, then vegetation clearing (in an area around the nest) must wait until nesting has concluded.

With respect to habitat for endangered bats, Beacon recommends consultation with MECP prior to site alteration to ensure the proposed development is in conformity with the *Endangered Species Act*.

4.2 Trail Planning

Within the Subject Lands, the Town's Trails Master Plan shows a Major Trail along the southern limit of the transitway (**Figure 4.4**). Along the perimeter of the EIR Subcatchment Area, on the west side of Fourth Line, the Master Plan identifies a Major Trail along the eastern limit of Core 4. This EIR/FSS Addendum provides information pertaining to the trail on the Subject Lands while a future EIR/FSS Addendum, for the lands west of Fourth Line, will need to address the trail along the edge of Core 4.

The off-road Major Trail in proximity to the transitway will be accommodated through a 4 metre wide block on the draft plan of subdivision, between the transitway buffer and medium density residential development.

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 as well as recommendations that were made within the downstream Davis-Minardi EIR/FSS.

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.

*Reproduced from NOCSS

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

Target Setting

Goals	Objectives	Targets
	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 5.7** of this EIR/FSS addresses drainage boundaries and present target peak flows respectively for East Sixteen Mile Creek Subcatchment ES6-West at Neyagawa Boulevard. Through this Addendum, the subcatchment boundaries were reviewed and determined to still be accurate.

- **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 with the Subject Lands (presented on NOCSS Figure 6.3.15 and OPA 272 Figure NOE 3). NOCSS identified two Hydrologic Features B within the Subject Lands.

As part of this Addendum, more detailed field surveys and topographic mapping was completed of the Subject Lands which included a bathymetric survey of the northern Hydrologic Features B. Given that this feature is likely natural and not anthropogenic, the bathymetric survey was used to establish the storage volume of the feature. The northern Hydrologic Features B is estimated to have a storage volume of 1,050 cu.m., which has been incorporated into the SWM facility.

The remnant portion of the southern Hydrologic Features B is the remains of a dug pond. As such, there is no need to replicate the storage function of this feature in the SWM pond.

The dug pond in the southeastern section of the Subject Lands was not picked up in the 2023 topographic survey and, given that the feature was not identified as a Hydrologic Features B, there is no need to replicate its storage function.

- **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.

  An erosion analysis was prepared as part of the approved Davis-Minardi EIR/FSS and the findings have been incorporated into this Addendum.

Table 5.2 – Erosion Thresholds from Davis-Minardi EIR/FSS

Parameter	Reach SMA-1	Reach SMA-2	Reach SMA-4
Critical Discharge (m^3/sec)	1.6	0.77	0.04
Critical Velocity (m/sec)	1.7	1.7	0.26

- **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 ES6-West 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 ES6-West 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 6.0 of this EIR/FSS Addendum addresses post development water balance issues.

- **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 ES6-West subcatchment located north of Burnhamthorpe Road on the non-participating landholdings adjacent to the Subject Lands.

- **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 5.4 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. In 2007, detailed LiDAR topographic mapping was obtained by Rady-Pentek Edward Surveyors to refine the drainage boundaries for each subcatchment and have more detailed mapping available for engineering design. Using the LiDAR mapping and DEM, the culvert inventory and review of engineering drawings along major roads, existing subcatchment drainage boundaries were delineated and compared to the NOCSS drainage area boundary for the ES6-West Subcatchment Area, as part of the Davis-Minardi EIR/FSS. That analysis concluded that based on more current data and interpretation, the total area of ES6-West is approximately 2.2 ha larger than the area shown in NOCSS (NOCSS area = 34.9 ha; Davis-Minardi EIR area = 37.1 ha). The change in drainage area is 6.2 percent of the NOCSS drainage area. Since this change is small, NOCSS unit flow rates remain valid. The updated pre-development drainage area was used for the Davis—Minardi EIR/FSS analysis, which has been carried through into this Addendum.

5.3 Pre-Development Flows and Downstream Infrastructure Capacities

5.3.1 Pre-Development Flows

The NOCSS established target unit peak flows for the 2 year to 100 year events and the Regional Storm using the GAWSER model. It is also noted that further modelling of existing conditions target flows is not required at the EIR/FSS stage. In accordance with NOCSS recommendations, NOCSS unit flow rates have been used, along with the updated pre-development drainage areas based on updated mapping to calculate pre-development peak flows at Neyagawa Boulevard for East Sixteen Mile Creek Subcatchment 6 West (ES6-West). NOCSS unit flow rates and the resulting pre-development flows ES6-West are summarized in **Table 5.3.**

Table 5.3
NOCSS Unit Flow Rates and Pre-development Flows at Neyagawa Boulevard

Return Period (years)	East Sixteen Mile Creek, ES6-West Subcatchment	
	Unit Flow Rates ($m^3/s/ha$)	Pre-Development Flow Rates (m^3/s) ESM-NG3[1] (37.1ha)[2]
2	0.004	0.1484
5	0.007	0.2597
10	0.009	0.3339
25	0.012	0.4452
50	0.014	0.5194

Return Period (years)	East Sixteen Mile Creek, ES6-West Subcatchment	
	Unit Flow Rates ($m^3/s/ha$)	Pre-Development Flow Rates (m^3/s) ESM-NG3[1] (37.1ha)[2]
100	0.016	0.5936
Regional	0.044	1.6324

[1] Refer to **Figure 5.1** for culvert locations
[2] Drainage area ES6-West to culvert ESM-NG3 is delineated on **Figure 5.1**.

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

5.4 Stormwater Management Plan Selection Process

As required by NOCSS and the Scoped EIR/FSS Addendum ToR, alternative approaches to stormwater management have been identified and evaluated to assess and incorporate appropriate Stormwater Management Practices (SWMP) 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 stormwater management 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 5.1** 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 SWMPs 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 blocks and roads with an overall density higher than traditional single family housing developments. 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 the housing form, 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 increasing the depth of topsoil to 20 cm (8"). Limited opportunities include disconnected roof leaders, and grassed swales in side yard and rear yard areas, bioswales in parking lots, and rooftop and parking lot storage, as appropriate. 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 Subwatershed 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 to clayey silt till soils having a low infiltration potential. As such, 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. The preparation of a Homeowner's Manual is recommended to provide information to new homeowners on reduced fertilizer/pesticide use, alternate lawn practices, rain gardens, rain barrels and pet litter control. The Town of Oakville's "*Living Green: Oakville's Guide to Environmental Stewardship*" (2010) may be used for this purpose.

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 stormwater management targets include the control of peak flows to predevelopment 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."

An evaluation of the need for Regional Storm controls in the ES6-West and ES6-East subcatchments was undertaken by Stantec Consulting as part of the Davis-Minardi EIR/FSS. Their analyses addressed three scenarios:

- **Existing** conditions in Subcatchments ES6-West and ES6-East;
- **Ultimate** development conditions in Subcatchment ES6-West and ES6-East; and,
- **Interim** development conditions where only the David-Minardi North lands are developed and all other subcatchment areas are existing conditions.

Hydrology and hydraulics models were prepared to establish uncontrolled Regional Storm flows and water levels in stream reaches SMA-6, SMA-4, SMA-3 and SMA-2 downstream of the ES6-West and ES6-East subcatchments for each scenario. Changes in flows, water levels, velocities, areas flooded and culvert capacities under both proposed scenarios were assessed and compared to existing conditions to determine impacts to downstream areas. As outlined in Appendix F-1 of the Davis-Minardi EIR/FSS, Stantec Consulting conclusions are outlined below.

<u>Under existing conditions</u>:

- Existing flows were established and presented in the January 19, 2012 submission and remain unchanged

- The existing conditions hydraulic model was updated with current topographic information on the Town's Depot site west of Neyagawa Blvd. As requested by CH and the Town, a ground survey was completed by Rady-Pentek & Edward Surveying Ltd. (R-PE) on April 14, 2015 to fill in a portion of mapping that had been prepared by J. D. Barnes during the preparation of the Site Plan for the Depot site but could not be found to include in the existing hydraulic model. The elevations of the revised existing conditions floodlines do not substantially differ from the existing conditions model prepared and submitted on January 19, 2012. There are two locations where the plotting of the floodline has been modified. They are between Cross Sections 101.0 and 102.0, and at the south Neyagawa Blvd culvert. In both cases, plotting was modified to more accurately reflect the location of the floodlines. The revised existing conditions floodline is presented on Drawings 1 to 4, Appendix F-1 of the Davis-Minardi EIR/FSS.

Under ultimate development conditions:

- Hydrology for ultimate development conditions was presented in the December 2012 submission. The December 2012 uncontrolled GAWSER model was updated to ensure equivalent approaches were used for the calculation of travel times and soil zone percentages to those used in the NOCSS modeling. This resulted in uncontrolled flows less than the December 2012 flows.

- Regional Storm water levels in Stream reaches SMA-6, SMA-4, SMA-3 and SMA-2 vary from -0.66m to +0.43m compared to existing conditions. There would be increases to the Regional Storm floodplain throughout the core areas (sections 247 to 232), however the floodplain would remain contained within the Core (Core 5) that will ultimately be public lands.

- Culvert upgrades at ESM-NG2 and ESM-NG3 were identified to accommodate uncontrolled Regional Storm flows without overtopping of the road at two locations. Proposed culvert improvements were discussed with the Region of Halton through their Environmental Assessment process for Neyagawa Blvd improvements. As part of the uncontrolled Regional Storm assessment, the 60% design work completed by the Region of Halton consultants was assessed as it differed from the results of the initial Regional Storm assessment. It confirmed that with the proposed Region of Halton culvert upgrades, uncontrolled Regional Storm flows would not overtop the road. New culvert sizes are outlined in Appendix F-1.

- Small changes in water levels (-0.25m to +0.34m) are predicted during the Regional Storm on the Region's closed landfill site. The Region advised that they had no concerns with the December 2012 submissions with respect to the closed landfill site and in particular regarding increased flood levels and regulatory burden. See Appendix F-2 of the Davis-Minardi EIR/FSS. Since receipt of their comments, the latest update to hydrology and water level changes from the uncontrolled Regional Storm flows resulted in a decrease in flows and decrease in estimated water levels increases on the landfill site. Hence, it is not expected that the recent update would change the Region's position on impacts to the closed landfill site.

- The Town and CH requested confirmation that flood increases in the vicinity of the landfill site would not increase risk of landfill or leachate release into the environment. At the Region's suggestion, Genivar was contacted (the Region's monitoring consultants for the landfill site). As outlined in their email dated September 20, 2013, they advised that there are no anticipated issues arising for the landfill site due to the proposed changes in floodlines. See Appendix F-3 of the Davis-Minardi EIR/FSS.

- Flow over the Trafalgar Lawn Cemetery access road would increase from 0.27m^3/s to 5.6m^3/s; depth of overtopping would increase from 0.07m to 0.34m during the Regional Storm. No increases would be expected during all return period storm events. Stantec Consulting concluded that regular passenger vehicles and emergency vehicles could safely pass through these depths based on guidance from the MNR Flood Technical Guide. The Regional Storm increases in flow and depth of overtopping are less than previously reported due to changes in hydrology resulting from changes in time to peak.

- A structural review of the culvert at the north end of the Trafalgar Lawn Cemetery was completed by G. D. Jewell Engineering Inc. in March 2013. See Appendix F-4 of the Davis-Minardi EIR/FSS for their letter dated April 3, 2013. They were requested to review the condition of the existing culvert accessing the north portion of the Cemetery. Based on a visual review of the structure, they made a number of observations regarding the culvert, retaining walls, adjacent valley embankments and banks of the watercourse, erosion, etc. They concluded that the culvert is generally in poor condition with severe deformations at the inlet, outlet and along the length of the culvert. Erosion and scour undermining retaining walls and wingwalls were also noted. They recommended that the culvert be replaced and the wingwalls, retaining wall and erosion protection be repaired or replaced.

  DSEL discussed the results of this review with the Town and Conservation Halton on April 15, 2013. It was their opinion that this culvert is at risk during existing storm events and upstream controls are in place to reduce post development flows to existing levels up to the 100 year event. The replacement of this culvert (that should occur regardless of upstream development) would alleviate any concerns regardless of current or future flow conditions. Replacement design should accommodate uncontrolled Regional Storm peak flows.

- Flood levels would increase within the Town's Depot site from existing conditions by 0.15m to 0.34m dependent on location. Under existing conditions, based on the updated topographic mapping, the Regional Storm flood line is 3m north of the new curb (see cross sections 111.6 and 111.8). The ultimate conditions uncontrolled Regional Storm water level at these locations is 1m north of the new curb. Therefore, under existing and ultimate conditions, Regional Storm flows would not enter the parking lot. Freeboard of 0.14m to 0.28m is provided.

- The increase in flood hazards along Stream Reaches SMA-6, SMA-4, SMA-3 and SMA-2 is considered to be minimal and/or is contained within public lands. Based on this assessment, the control of upstream Regional Storm flows in all developing areas in this subcatchment is not proposed. Based on the small change in the floodline on the Town's Depot site, no works are proposed to raise the curb (as previously discussed with the Town and CH).

Under interim development conditions:

- The largest increase in Regional Storm peak flow of 0.81% occurs within the furthest downstream reach SMA-2 and is considered to be negligible. Due to the minor changes in flows resulting from this, hydraulic modeling was not updated as the resulting water level changes are expected to be negligible and any increases in water levels would be within modeling error.

- Based on this assessment, the development of just Davis Minardi North lands (without Regional Storm controls) will have negligible impact on flooding on downstream stream reaches SMA-2, SMA-3, SMA-4 and SMA-6. No off-site works are required under interim conditions.

Based on these analyses, no Regional Storm controls were recommended for implementation in the ES6 subcatchment as a result of the Davis-Minardi EIR/FSS findings.

As requested by Town and CH, the modelling was reviewed as part of this Addendum to confirm the recommendations are still valid. A summary of the analysis is included in **Appendix D-1** and confirm no Regional Storm controls are recommended.

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 analysis that currently applies to the ES6-West catchment was completed and approved as part of the EIR/FSS completed for North Park and identified a location along Stream Reach SMA-4 as being the most sensitive erosion threshold for upstream areas. The SMA-4 tributary is downstream of the confluence of SMA-6 and SMA-5 tributaries of Sixteen Mile Creek and conveys drainage from a considerably larger area than the Subject Lands. This includes drainage from ES6-West and ES6-East subcatchments as well as some Core 5 drainage to Stream Reach SMA-5. As noted in the North Park EIR and discussed in **Section 5.1**, the erosion threshold for Reach SMA-4 upstream of Neyagawa Boulevard has a critical depth of 0.04m, a critical velocity of 0.26 m/sec and critical discharge of 0.04 m^3/sec.

The erosion threshold for the EIR Subcatchment was re-assessed by Geomorphic Solutions as part of the Davis-Minardi EIR/FSS (refer to Appendix G-2 of the Davis-Minardi EIR/FSS). The purpose of that assessment was to determine an appropriate erosion threshold to inform the design of SWM facilities within the ES6 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. A summary of the report findings, as described in the Davis-Minardi EIR/FSS include:

- Reaches SMA-3, SMA-4 and SMA-6 showed signs of erosion and instability resulting in a Rapid Geomorphic Assessment (RGA) rating of 'in transition/stress'.

- A theoretical erosion threshold of 0.040 m^3/s was determined for SMA-4 in the North Park EIR (2009) and was confirmed through an additional detailed survey. Critical depth and critical velocity were found to be slightly different than the North Park EIR with values of 0.09m and 0.33m/s.

- An additional theoretical erosion threshold was determined in upstream Reach SMA-6 to confirm the erosion sensitivity. This threshold was estimated as 0.068 m^3/s for a typical cross section at the critical shear stress for entrainment.

- Field verification was conducted to determine the appropriateness of the theoretical erosion thresholds. Flows observed to date indicate that the theoretical erosion thresholds are likely conservative.

- There is concern that restricting the system to the erosion threshold at SMA-4 may cause increased deposition in other reaches, particularly SMA-6, which could reduce channel definition. Given the isolation of SMA-4 within the forested area, it may be preferable to allow an increase in erosion through this reach to maintain the integrity of the rest of the system.

- Field verification confirmed that the erosion threshold at SMA-4 falls between 0.043 m^3/s and 0.091 m^3/s. The lower end of this range is approximately 10% higher than the calculated threshold. It is recommended that the threshold could be lifted as much a 20% higher than the calculated threshold of 0.040 m^3/s, to 0.048 m^3/s, without adverse impacts given the field observations. A higher erosion threshold will also limit potential increased deposition in other reaches.

- The use of an erosion threshold of 0.048 m^3/s is recommended for SMA-4 (20% above the theoretical value) based on the field observations. A 'best effort' was made to confirm the appropriateness of this threshold through field verification. More than a dozen field visits were conducted. This threshold should be considered as conservative value.

- Continuous hydrologic modelling indicated that the post-development time of exceedance of the erosion threshold at Reach SMA-4 was more than two times greater than pre- development exceedance. Mitigating this exceedance through

SWM facility design is limited due the minimum recommended orifice size of 75 mm.

- The increase in exceedance time was due to elongation of the falling limb of the hydrograph where flows were greater than the erosion threshold but less than bankfull. Peak flows were similar for both pre- and post-development scenarios.

- The geomorphic adjustment as a result of the increase in exceedance time will likely include:

    → Widening and downcutting within Reach SMA-4 (these processes are already occurring and will likely only be accelerated);

    → Winnowing of fines and increased transport of sediment through SMA-4;

    → Deposition of the increased bedload within the low gradient wet meadow at the downstream end of SMA-4;

    → Limited effect downstream of SMA-4 on the stream health, including channel form and function, the aquatic environment and natural heritage function of the watercourse;

    → Limited to no increase in impact on the form and function of the riparian woodland at SMA-4 and SMA-6 given that the increase in discharge will mostly be at levels below the bankfull discharge and there was already evidence of overland flow through portions of the woodland.

- Geomorphic adjustment within SMA-4 could be reduced by discharging a portion of the flows downstream of the sensitive reach. This would require discharging to the low gradient wet meadow downstream of the Neyagawa Boulevard as indicated by photograph location 15 in Appendix G-2 of the Davis-Minardi EIR/FSS.

- A monitoring plan should be developed at detailed design to assess channel adjustments within SMA-4 due to changes in the flow regime. For further discussion on this monitoring plan, see Section 12.3.4 of the Davis-Minardi EIR/FSS.

Additional information on the erosion threshold analyses was provided to CH via email from GHD on July 24, 2013. This information is provided in Appendix G-3 of the Davis-Minardi EIR/FSS.

The hydrologic analysis that provided input to the erosion threshold analyses was completed by the Sernas Group as part of the EIR/FSS for the ES6-East Subcatchment

and the Westerkirk Lands (Sernas Group) considering a variety of stormwater management scenarios. Based on the reported erosion rate for SMA-4, an erosion threshold analysis was completed using the QUALHYMO continuous hydrologic model. Several scenarios were examined with all SWM facilities providing the same unit release rates per contributing area and erosion control storage.

The ES6-West Subcatchment Area has four drainage subareas as a result of the ownership structure, road patterns, development timing and existing land use conditions. These drainage areas consist of lands west of the Fourth Line ROW which are owned by non-participating owners, and there is no known schedule for the development of these lands. Kings Christian College, which is a developed property, and aside from additions to the school, or changes to sports facilities, it is not anticipated to change its current land use. The current Subject Lands and the original Davis-Minardi lands. These four subareas are relatively small and with the restrictive overall release rates for erosion control dictated by the erosion threshold at SMA-4 extremely small control orifice sizes would be required, much less than the Town of Oakville guideline of 75mm diameter or greater.

Based on the erosion threshold assessment noted above, for the smaller subareas, it has been recommended that the subcatchments draining to the SMA-4 tributary control runoff on a 'best-efforts' basis, whereby the minimum orifice size is set at the Town's guideline of 75mm (or greater where larger catchments permit). In the case of the Subject Lands, the 25mm rainfall event will be stored for 31 hours and released through a 115 mm orifice in accordance with the Town's guidelines.

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

For other facilities, a minimum of 250 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). As well, LID measures should be maximized to the extent feasible within all developing areas in the EIR Subcatchment. For the Subject Lands, the use of increased topsoil depth, roof leaders discharging to pervious areas and similar LIDs should be explored at detailed design.

5.7 Drainage Areas and Patterns

5.7.1 Existing Conditions

The Subject Lands are located at the upstream end of the ES6-West Subcatchment Area. There are minor external drainage sources that drain through the Subject Lands as illustrated on **Figure 5.2**. A portion of the Subject Lands outlet south to an existing culvert under Burnhamthorpe Road (future William Halton Parkway), and then through

the King's Christian College (KCC) School site. The west portion of the Subject Lands are conveyed south in roadside ditches along Fourth Line and discharge into the upper limit reach of SMA-6. A brief outline of external flows to the Subject Lands is provided below.

Developable Lands to West:
The future developable lands west of Fourth Line are conveyed south in roadside ditches along Fourth Line and discharge into the upper limit reach of SMA-6.

Burnhamthorpe Road (future William Halton Parkway):
Currently, the Region is undertaking re-construction of Burnhamthorpe Road (future William Halton Parkway) that goes east-west and is directly south of the Subject Lands. Based on the review of design drawings for this project, drainage is managed within the road and outlets south to Fourth Line.

Neyagawa Boulevard:
Approximately half of the Neyagawa Boulevard right-of-way, and a section of the Highway 407 exit ramp, drain to roadside ditches which ultimately discharge to SMA-6 at the upstream side of culvert ESM-NG3 (**Figure 5.1**).

5.7.2 Post-Development Conditions

Through this Addendum, most of the developable land within the ES6 West catchment has either been completed or is within the Subject Lands. There is a portion of land within the ES6 West catchment area, west of Fourth Line, that will be part of a future development and subject to a further addendum/study. This report assumes independent drainage area delineation to allow for independent development timing in the future. See **Figure 5.3** for the post-development drainage areas and proposed treatment facilities.

Developable Lands to West:
The developable lands west of Fourth Line generally drain south and are at a lower elevation than the Subject Lands. This area will provide independent stormwater treatment systems as illustrated in **Figure 5.3** This concept will be subject to future study to determine the appropriate facility type, size and location. All end of pipe facilities may outlet to the proposed storm sewer on Fourth Line, or the existing ditch along Fourth Line, both of which discharge at the upper limit of reach SMA-6.

Burnhamthorpe Road (future William Halton Parkway):
This portion of William Halton Parkway (WHP) is currently under construction through Halton Region. Drainage from William Halton Parkway is independent to the Subject Lands and should follow the stormwater management criteria as per the approved EA for the Regional road project.

MTO Transitway:
Within the Subject Lands, the 407 Transitway is proposed along the northern boundary. Based on the stormwater management design presented in the EA documents for the transitway, the transitway will provide independent stormwater management.

Neyagawa Boulevard:
Neyagawa Boulevard is urbanized and will provide independent stormwater management.

5.8 Conveyance of Minor System Flows on Subject Lands

The Subject Lands 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.

All storm flows will be directed to the stormwater facility, on the Subject Lands, where the runoff will be treated for erosion, quality and quantity control.

The conceptual storm servicing scheme is illustrated in **Figure 5.4***.*

Gravity house connections will not be provided where the storm sewer is not sufficiently deep or where the storm sewer will be subject to elevated water levels during infrequent storms. In these locations, sump pumps will be provided within the residential units. In all such cases, the sump pump must lift the foundation drainage above the critical hydraulic gradeline to prevent water from backing up into the unit. A typical sump pump detail is provided in **Figure 5.5***.* To the extent practical, sump pumps will discharge to grassed areas. In some areas where icing of walkways is a concern, or for other nuisance or safety reasons, sump pumps will discharge to the storm sewer as it is not feasible to direct sump pump outflows directly to grade.

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 $0.65 m^2/s$. All overland flow routes will be directed to the SWM Pond to be treated for water quantity, quality and erosion control. The major system flows will be attenuated in this facility to achieve the allowable erosion control release rates and 2 year to 100 year release rates as defined by the NOCSS. 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 in **Figure 5.4***.*

5.10 Stormwater Management on Subject Lands

The Subject Lands will provide stormwater quality and quantity treatment with a stormwater management wet pond built in the southwest corner of the Subject Lands. See **Section 5.1** for the NOCSS criteria used to design the quality and quantity treatment measures. The proposed stormwater management controls are designed based on an inflow area of 10.2 ha consisting of the Subject Lands minus the 407 Transitway block but includes the holdout property. As discussed above, the 407 Transitway block and adjacent municipal roads will have independent stormwater controls as required, subject to future studies.

The proposed SWM facility is contemplated as an urban pond, per Town of Oakville guidelines, with retaining walls proposed along those edges that are adjacent to higher density residential areas. An urban pond is appropriate in this location given the higher density development and the proposed urban form. Further details will be provided at subsequent planning application stages.

5.10.1 Quality Treatment

Stormwater quality treatment for the Subject Lands will be provided within the SWM pond as illustrated in **Figure 5.6**. The permanent pool and extended detention are designed to provide 'enhanced' level or SWM protection (80% TSS removal) per the Ministry's Stormwater Management Planning and Design Manual. Preliminary sizing calculations outlining removal efficiency in accordance with 'enhanced' treatment requirements is included in **Appendix D-2.**

5.10.2 Quantity Treatment

Quantity control will be provided with an end of pipe SWM pond sized for events up to, and including, the 100-year storm. Regional Storm quantity control is not proposed, as described in **Section 5.5**. Release rates for the storage facility are governed by erosion control requirements and the NOCSS release rates. See **Table 5.4**, below, for the SWM facility release rates and storage requirements. The proposed pond will accept drainage from the Subject Lands totaling 10.2 ha with an average imperviousness of 85%.

Preliminary modeling results are included in **Appendix D-2**. The preliminary stage-storage-discharge curve is provided in **Appendix D-2**.

Table 5.4 - SWM Facility Release Rates and Storage Requirements

Component	Unit Release Rate [1] ($m^3/s/ha$)	Target Release Rate [2] (m^3/s)	Simulated Inflow (m^3/s)	Used Storage (m^3)	Simulated Outflow (m^3/s)
Extended Detention [3]	N/A	N/A	0.639	857	0.011
2yr/24hr Chicago	0.004	0.041	1.727	2 518	0.021
5yr/24hr Chicago	0.007	0.071	2.563	3 310	0.053
10yr/24hr Chicago	0.009	0.092	3.128	3 918	0.080
25yr/24hr Chicago	0.012	0.122	3.883	4 739	0.116
50yr/24hr Chicago	0.014	0.142	4.416	5 280	0.139
100yr/24hr Chicago	0.016	0.163	4.937	5 880	0.163
Regional [4]	0.044	N/A	N/A	N/A	N/A

(1) Unit release rates as per the "Revised Target Unit Area Peak Flow Rate 07.06.27" table for East Sixteen Mile Creek.
(2) Target release rate based on post-development drainage area of 10.2 ha (85% imperviousness) to SWM Pond.
(3) Required extended detention volume based on the runoff volume of the 25 mm storm, with a 24-hour drawdown time; no quality control provided.
(4) No Regional quantity control provided.

The SWM pond will be constructed within the Subject Lands as illustrated on **Figure 5.6**. The pond will outlet to an extension of the storm sewer along Fourth Line and discharge to the upper limit of SMA-6.

5.11 Hydrologic Features

As discussed in **Section 3.3.2**, there are two Hydrologic Features B and one dug pond within the EIR Subcatchment Area. These features provide depressional storage, and 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.

Detailed topographic mapping completed of the Subject Lands encompassing the Hydrologic Features B, including a bathymetric survey of the northern hydrologic feature. As noted earlier, only the northern Hydrologic Features B is a natural feature and, as such, only the storage associated with this feature needs to be accommodated in the SWM facility. Hydrologic Feature B North is estimated to have a storage volume of 1,050 cu.m.

The proposed SWM pond has an active storage volume of 5,900 cu.m. which is greater than the storage volume of the northern Hydrologic Features B.

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 **Figure 5.7.** Grading details are consistent with Town Standards.

6 WATER BALANCE

In order to assess potential land development impacts on the groundwater conditions within the EIR Subcatchment Area, 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 893 mm based on long-term data (1981 – 2010) from the Environment Canada Burlington Royal Botanical Gardens (RBG) station (Station 6153300 - 43º16.8'N, 79º52.8'W, elevation 102.1 masl).

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 relatively low hydraulic conductivity till and shale that are found in the EIR Subcatchment Area 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 EIR Subcatchment Area 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 100 mm was used for the EIR Subcatchment Area to represent the silty clay soils and predominantly short-rooted vegetation (grassy open space and farm field areas) and a soil moisture storage capacity of 200 mm was used for longer-rooted vegetation, i.e., the wooded areas. **Table C-7-1** (for 100 mm retention) and **Table C-7-2** (for 200 mm retention) in **Appendix C-7** detail 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 EIR Subcatchment Area 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 C-7-1 and C-7-2** in **Appendix C-7**.

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 EIR Subcatchment Area is underlain by relatively low hydraulic conductivity glacial till, fracturing likely improves the recharge capabilities (refer to **Section 3.6.3**). 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. Therefore, this estimate

has been used in this study also to calculate the direct and indirect runoff components in the water balance for the EIR Subcatchment Area (refer to **Table C-7-1**, **Appendix C-7**).

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 6 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.	High Density Residential	0.88	90
2.	Medium Density Residential	6.94	85
3.	407 Transitway and Buffer*	1.65	20
4.	Trail	0.12	60
5.	Stormwater Management Block	0.90	80
6.	Roads	1.38	100
	Total Area	**11.87**	

*MTO will need to undertake SWM and water balance on their own lands

6.3 Component Values

The detailed monthly calculations of the water balance components are provided on **Table C-6-1** and C**-6-2** in **Appendix C-6**. The calculations show that a water surplus is generally available from November to May. 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 (**Table C-7-1** and C**-7-2**, **Appendix C-7**). A summary of these values is provided in **Table 6.2.**

Table 6.2 Water Balance Component Values

Water Balance Component	Agricultural/ Open Space	Woodlots
Average Precipitation	897 mm/year	897 mm/year
Actual Evapotranspiration	591 mm/year	626 mm/year
Water Surplus	306 mm/year	271 mm/year
Total Infiltration	107 mm/year	122 mm/year
Direct Runoff	199 mm/year	149 mm/year
Recharge (deep infiltration)	54 mm/year	61 mm/year
Interflow (indirect runoff)	54 mm/year	61 mm/year
Total Runoff	252 mm/year	210 mm/year

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 EIR Subcatchment Area are presented in **Table C-7-3** in **Appendix C-7**. As summarized on **Table C-7-3,** the total area of the subcatchment is 11.87 ha. The total pre-development groundwater recharge volume for the subcatchment is calculated to be about 6,400 m^3/year (**Table C-6-3**, **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 20% of precipitation and leakage through pavement was not considered. The water balance calculation of the potential water surplus for impervious areas (718 mm/year) is shown at the bottom of **Table C-7-1 in Appendix C-7.**

6.6 Post-Development Water Balance

The proposed draft plan is shown on **Figure 4.2**. As described in **Section 6.2**, the EIR Subcatchment Area 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 C-7-3, Appendix C-7**). 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 recharge will be about 1,430 m^3/year. As noted in **Section 6.4**, 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 recharge to the groundwater regime of about 78% with no mitigation strategies and full urban development of the EIR Subcatchment Area (**Table C-7-3, Appendix C-7**).

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.**

The natural recharge conditions in the subcatchment are limited due to the low hydraulic conductivity of the surficial till soils. Monitoring conducted as part of the Davis-Minardi EIR/FSS showed that the surface water flows in the ES6-West watercourse are intermittent and groundwater discharge does not make a major contribution to the flows throughout most of the EIR Subcatchment Area (the primary function of the downstream watercourses is surface water conveyance). There is only a small area south of the Davis-Minardi FSS Study Area in Core 5 where the water table seasonally comes to surface and groundwater discharge to the watercourse may occur.

The predicted decreases in recharge across the EIR Subcatchment Area suggest that, without mitigation, the developed subcatchment area will continue to receive about 22% 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. Any potential changes to the groundwater quality are not expected to influence conditions in surface water features given the limited discharge conditions.

6.7.3 Private Services

The proposed development within the FSS Study Area will be serviced by municipal water supply and wastewater services. 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 some existing groundwater supply wells and septic systems within the EIR Subcatchment Area, however, 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

As noted in **Section 5.4**, 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 collars or clay plugs to provide barriers to flow and prevent groundwater flow along granular bedding material. There are no significant enhancement opportunities for groundwater recharge in the EIR Subcatchment Area. The relatively low hydraulic conductivity of the surficial till and shale 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 generally 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.

For the Subject Lands, techniques such as designing grades to direct roof runoff towards pervious areas (e.g., lawns, side and rear yard swales) and increasing topsoil thickness throughout the development will be implemented where possible.

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 system 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.

Trafalgar Engineering prepared an ASP Update to address the change in sanitary outlet for the Subject Lands that was accepted by the Region. The ASP Update and Regional acceptance is provided in **Appendix G-1**.

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

➢ Single Family	55 persons / hectare
➢ Semi – detached	100 persons / hectare
➢ Apartments	285 persons / hectare
➢ Community Services	40 persons / hectare
➢ Light Commercial Areas	90 persons / hectare

7.2.2 Existing Wastewater Services

An existing 450 mm diameter sanitary sewer is located within Burnhamthorpe Road (future William Halton Parkway) that will act as the outlet for these lands. This sewer outlets to the Neyagawa Boulevard 525mm diameter sanitary trunk sewer. The sanitary trunk outlets to the North Oakville Wastewater Pumping Station located within the Mattamy Preserve Phase 2 lands. The pumping station is complete and there are no wastewater servicing constraints for the Subject Lands.

The location of the existing wastewater main is illustrated in **Figure 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 an existing regional wastewater main within Burnhamthorpe Road (future William Halton Parkway). This design differs from the wastewater outlet as identified in the ASP for these lands. An ASP Update, prepared by Trafalgar Engineering, was submitted to the Region in March 2023 in support of this revision to which the Region provided clearance. Refer to **Appendix G-1** for the Update Memo and Regional clearance.

The ASP contemplated the Subject Lands as employment lands with a population of approximately 391 persons (at 43 ppha). The proposed change in land designation to mixed-use residential has an increased population (approximately 1,514 persons based on Region of Halton design criteria). The change in land use results in a peak flow increase of approximately 7 L/s. The sanitary design sheet from the ASP was recreated to assess the impacts of this nominal increase. The change in land use results in a 1 cm increase in flow depth to the downstream section of trunk sewer on Neyagawa Boulevard which is considered nominal. Refer to **Appendix G-2** for updated design sheets.

Wastewater servicing for lands that are west of the Subject Lands can be independently serviced through future wastewater infrastructure on Fourth Line consistent with the ASP.

The conceptual wastewater servicing scheme is illustrated in **Figure 7.1**.

The final wastewater servicing scheme will be completed as part of the *Water and Wastewater Servicing Report* at the detailed design stage, in consultation with the Region of Halton.

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	2.00
Commercial	2.00

Population Criteria

➢ Single Family	55 persons / hectare
➢ Semi – detached	100 persons / hectare
➢ Townhouse	135 persons / hectare
➢ Apartments	285 persons / hectare
➢ Community Services	40 persons / hectare
➢ Light Commercial Areas	90 persons / hectare

7.3.2 Pressure Zone Boundaries

The Subject Lands are located within the Zone 4 district of Halton's water distribution system. A summary of the zone elevations is provided in **Table 7.1** below:

Table 7.1 - Summary of Zone Elevations

Zone	Lower Elevation (m)	Upper Elevation (m)
4	167	182

Through correspondence with Regional staff, it was identified that Zone 4 is currently undergoing a zone realignment. Currently the Subject Lands are within subzone M4L. In the future, the Subject Lands will transition to a TWL of 250m. Refer to material provided in **Appendix G-3** for interim and future zone boundaries as provided by the Region.

At the time of development, if service pressures exceed 80psi, pressure reducing valves at the units may be required.

7.3.3 Existing Water Supply

Existing watermains are currently available in the vicinity of the lands as shown in **Table 7.2** below:

Table 7.2 - Summary of Existing Watermains

Street	Size (mm)	Location	Zone
Burnhamthorpe Road West (WHP)	300	Between Fourth Line and Neyagawa Boulevard	4

A 300mm diameter PVC watermain is located south of the Subject Lands and is located on Burnhamthorpe Road (future William Halton Parkway) between Fourth Line and Neyagawa Boulevard. It is connected to the 1200 mm diameter CPP watermain on Neyagawa Boulevard at the intersection of Burnhamthorpe Road and Neyagawa Boulevard.

The existing watermains are illustrated in **Figure 7.2.**

7.3.4 Proposed Water Servicing

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

Local watermains (150 mm, 200 mm and 300 mm diameter) will be provided throughout the Subject Lands. The proposed watermains to service the Subject Lands will connect to an existing 300 mm diameter watermain on Burnhamthorpe road in two locations to provide a looped system. The concepts envisioned in the ASP, including conceptual servicing of lands within the EIR Subcatchment Area, have been accommodated in the proposed servicing scheme. The conceptual watermain servicing concept is illustrated in **Figure 7.2**.

Final watermain sizing and pressure zone boundary limits will be completed as part of the *Water and Wastewater Report, in consultation with the Region of Halton* at the detailed design stage based on the actual development characteristics.

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 in order to reflect the detailed requirements of the many stakeholders whose infrastructure is located within the road allowance. The proposed road allowances which are currently proposed are illustrated in **Appendix E.**

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 **Figure 4.3**. The NOCSS contemplated sidewalks generally being provided on both sides of all streets but did provide conditions for exceptions to permitting only one sidewalk for some local roads.

It should be noted that the reduction in sidewalks results in reduced storm runoff generation due to the reduced imperviousness in the road allowance. Furthermore, the long term maintenance costs for Town of Oakville will be reduced due a reduction in the length of sidewalk which will require repair, replacement and snow clearing.

9 CONSTRUCTION PRACTICES

9.1 Summary of Key Geotechnical Findings

A complete geotechnical report was completed by DS Consultants for the Subject Lands. It is provided in **Appendix F.**

The key geotechnical findings are summarized as follows:

- Beneath a topsoil/organic layer, fill (re-worked/weathered/disturbed native material) consisting of clayey silt and sand materials were detected at some locations and at the surface of the remaining boreholes extending to approximate depths varying from 0.8 to 2.1 m. Brown to grey deposits consisting of silty clay to silty clay till interbeds sandy silt to silty sand till extended below the fill to the underlying silt till/shale complex and shale bedrock in all the boreholes, to approximate depths ranging from 10.7 to 16.9 m.

- Below the silt till in all the borehole locations, except Borehole BH22-14, at approximate depths ranging from 10.7 to 16.9m and extending to approximate depths ranging from 12.2 to 16.9m, a deposit of clayey silt and sandy silt till / shale complex was found overlying shale bedrock. This deposit generally consisted of clayey silt till/sandy silt till mixed with highly weathered shale.

- Shale bedrock of Queenston Formation was encountered at BH22-1B, BH22-2, BH22-11 and BH22-14 at approximate depths of 15.2, 12.2, 15.3 and 13.5m, respectively, below the existing grade, corresponding to approximate Elevations ranging from 171.7 to 165.7m.

- The topsoil is void of engineering properties and must be removed prior to any construction. Diligent control of the stripping operation will be necessary to prevent overstripping and to ensure satisfactory removal.

- The weathered zone generally extends to a depth of ± 0.7m from the prevailing ground surface.

- Perimeter subdrains and dampproofing of the foundation walls will be required for foundation wall construction. The subdrains should be shielded by a fabric filter to prevent blockage by silting.

- A Class ‘B’ bedding, consisting of compacted 20-mm Crusher-Run (graded) Limestone, is recommended for the construction of underground services.

- The till contains shale debris, cobbles and boulders. Extra effort and a properly equipped backhoe will be required for excavation. Rock slabs larger than 15cm are not suitable for structural backfill.

- The sound natural soil is suitable for normal spread and strip footing construction. Due to the presence of topsoil and weathered soil, the footing subgrade must be inspected by a geotechnical engineer, or a geotechnical technician under the supervision of a geotechnical engineer, or a building inspector who has geotechnical background, to ensure that the condition of the subgrade is compatible with the design of the foundations.

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,
- use of the permanent ponds as a temporary silt basins during site construction activities,
- 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

No construction phasing is required which is considered non-standard under this application. The general approach is summarized as follow:

General

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

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. As such, no significant high-volume dewatering is anticipated to be required for construction excavations. 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 domestic 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.

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, which applies to the period prior to the assumption of the facilities by the Town. 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 to be assumed by the Town of Oakville will be monitored by the owner for design conformance and hydraulic performance. 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 Argo Neyagawa Corporation 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 previously approved Davis-Minardi EIR/FSS, the Town's NOCSS Management and Implementation Report, 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 ES6-West Subcatchment north of Burnhamthorpe Road and builds on the findings of the ES6 EIR/FSS prepared for Davis-Minardi. The proposed Argo Neyagawa Corporation draft plan lies entirely within the ES-6 West Tributary subcatchment.	1.2
Draft Plan of Subdivision	The proposed Draft Plan (**Figure 4.2**) illustrates the proposed residential development plan.	4.0
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. The Davis-Minardi EIR/FSS assessed the total area of subcatchment ES6-West is approximately 2.2ha larger than the area shown in NOCSS (NOCSS area=34.9ha; EIR area=37.1ha). This change is minor and as such, the NOCSS target unit flow rates apply. This Addendum confirmed through the review of updated topography for the Subject Lands, that the Davis-Minardi subcatchment delineation remains valid.	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 are two Hydrologic Features B within the Subject Lands that will be removed, and the storage component of the northern Hydrologic Features B is addressed through the SWM pond. Field investigations conducted by Beacon confirmed that both small wetland features on the Subject Lands support small populations of frogs and Midland Painted Turtles. To mitigate impacts on these species, prior to removal of these features, it is recommended that a Wildlife Collection Permit be obtained from the MNRF to safely relocate any frogs or turtles to a suitable habitat location. With respect to habitat for endangered bats, Beacon recommends consultation with MECP prior to site alteration to ensure the proposed development is in conformity with the *Endangered Species Act*.	2.0
Trail System	The *North Oakville East Trails Plan* (2013) (**Figure 4.4**) shows a Major Trail along the southern limit of the Transitway. This trail has been accommodated in the draft plan - see **Figure 4.3**.	4.2
Target Flows	NOCSS target peak flows are appropriate for SWM design and were applied to determine target outflow rates for the proposed SWM facility for the 2 year to 100 year events.	5.3
Regional Storm Controls	An evaluation of the need for Regional Storm controls in the ES6-West and ES6-East subcatchments was undertaken as part of the Davis-Minardi EIR. This included updating hydrology and hydraulic models to identify changes to flood levels through Stream Reaches SMA-6, SMA-4, SMA-3 and SMA-2 downstream of ES6-West and ES6-East subcatchments	5.5

Topic	Recommendations	Report Section for Further Details
	without Regional Storm controls in place. Implications of increased Regional Storm flood levels and velocities to road infrastructure and lands/uses along these stream reaches were identified. Based on the results of that evaluation, recommendations were made for no Regional Storm controls in these subcatchments. Trafalgar Engineering has reviewed the modelling and has confirmed that this recommendation remains appropriate for the Subject Lands.	
Erosion Threshold Analysis	The erosion threshold for the EIR Subcatchment was assessed as part of the Davis-Minardi EIR/FSS. The recommendations from that erosion threshold analysis have been carried forward into this Addendum.	5.6
SWM Facilities	One SWM pond will be provided for the Subject Lands in the form of an end of pipe wet pond. 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, other LID measures have been recommended including techniques such as designing grades to direct roof runoff towards lawns, side and rear yard swales and increased topsoil depths to improve the potential for water storage and infiltration. 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.	5.4 and 6.8
Sanitary Servicing	An existing 525mm sanitary sewer is located within Neyagawa Boulevard that will act as the outlet for these lands. The sanitary trunk outlets to the North Oakville Wastewater Pumping Station located within the Mattamy Preserve Phase 2 lands. The wastewater servicing concept is shown on **Figure 7.1**.	7.2
Water Servicing	A 1200mm watermain has been constructed on Neyagawa Boulevard, with a 300 mm diameter branch connection provided to service the Subject Lands. The conceptual watermain servicing concept is illustrated in **Figure 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	9.7

Topic	Recommendations	Report Section for Further Details
	have been located and properly decommissioned by a licensed water well contractor according to Ontario Regulation 903.	

12 REFERENCES

Chapman, L.J. and Putnam, D.F, 1984; The Physiography of Southern Ontario, Third *Edition, Ontario Geological Survey Special Volume 2, 270 p.*

Conservation Halton, November 26, 2020, Conservation Halton's Policies and Guidelines for the Administration of Ontario Regulation 162/06.

Environment Canada Climate Records.

Eyles, C.H. and Eyles, N. March 2003. Investigation of the Geology and Origin of the Trafalgar Moraine: North Oakville Study Area.

Funk, G. 1979, Geology and Water Resources of the East and Middle Oakville Creeks.

Holysh, S. 1995. Halton Aquifer Management Plan. Phase I Report: Background Hydrogeology. Regional Municipality of Halton.

Humphrey, C. 2017. Recovery Strategy for the Eastern Small-footed Myotis (*Myotis leibii*) in Ontario. Ontario Recovery Strategy Series. Prepared for the Ontario Ministry of Natural Resources and Forestry, Peterborough, Ontario. vii +76 pp.

KMK Consultants Limited, October 2002 (Master Plan), Halton Water and Wastewater Master Plan Review.

Ministry of the Environment, Conservation and Parks. Undated.
Species at Risk Bats Survey Note 2022.

Ministry of the Environment, Conservation and Parks. Undated.
Maternity Roost Surveys.

Ministry of Environment, March 2003 (SWMP Design Manual), Stormwater Management Planning and Design Manual.

MMM Group, June 2008, North Oakville East Secondary Plan - Area Servicing Plan, Oakville Ontario;

North Oakville East Subwatersheds Study, prepared for the North Oakville Landowners' Group, August 2004.

Ontario Ministry of the Environment, Stormwater Management Planning & Design Manual, 2003.

Ontario Ministry of the Environment, Water Well Records.

Ontario Ministry of the Environment, Water Resources Branch, HD Representative Drainage Basin (Water Resources Report 12).

Ontario Municipal Board Minutes of Settlement, June 2006 and August 2007.

Ontario Municipal Board Mediation Agreements, 2007.

Ragab, R., P. Rosier, A. Dixon, J. Bromley and J.D. Cooper, Centre for Ecology and Hydrology; Experimental study of water fluxes in a residential area: 2. Road infiltration, runoff and evaporation. Hydrological Processes, Hydrol. Process. 17, 2423-2437, 2003 (published online in Wiley InterScience)

Region of Halton, February 2001 (updated 2007), Design Criteria, Contract Specifications and Standard Drawings.

Region of Halton, 2007 (Master Plan Update), South Halton Water and Wastewater Master Plan Update.

Stantec, et. al., August 2004. North Oakville East Subwatersheds Study, Prepared for the North Oakville East Landowners.

Thornthwaite, C.W. and Mather, J.R., 1957; Instructions and Tables for Computing Potential Evapotranspiration and Water Balance; Dextel Institute of Technology, Publications in Climatology Volume X Number 3.

Town of Oakville, North Oakville Subwatersheds Studies East of 16 Mile Creek, Characterization Report, Totten Sims Hubicki et.al., August 2006.

Town of Oakville North Oakville Creeks Subwatershed Study Addendum (Draft), September 2007.

Town of Oakville Official Plan Amendment 272, August 2007.

Town of Oakville, North Park, Phases 1 & 2, Environmental Implementation Report and Functional Servicing Study, FINAL, Totten Sims Hubicki et al, August 2008.

Town of Oakville, September 2012, Development Engineering Procedures & Guidelines Manual.

Town of Oakville, May 2013, North Oakville East Trails Plan.

Town of Oakville, Stormwater Monitoring Guidelines North of Dundas Street, Operations Maintenance and Monitoring of Stormwater Management Ponds, Development Engineering Department, January 2012