MILTON NORTH PORTA

Comprehensive Environmental and Servicing Study

VERSION 2 ▪ APRIL 2022

REPORT PREPARED FOR

ORLANDO

ORLANDO CORPORATION
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this report has been formatted for double-sided printing

CONTENTS

APPENDICES

FIGURES

Attached Figures

TABLES

1 INTRODUCTION

1.1 Overview

A Comprehensive Environmental and Servicing Study (Comprehensive Study) was prepared on behalf of Orlando Corporation (Orlando) for the proposed Milton North Porta employment lands in Milton, Ontario. The lands covered by the Comprehensive Study (also referred to herein as 'the Subject Lands' and 'North Porta') are generally located north of James Snow Parkway, west of Esquesing Line, south of No. 5 Side Road and east of the Canadian National Rail (CNR) (**Figure 1-1**). The study area includes properties that are owned by Orlando (referred to herein as 'the Orlando Lands') and other properties that were not participating in the development process at the time of the Comprehensive Study.

The technical studies described herein were prepared in support of land use planning approvals for the proposed industrial subdivisions. The Town of Milton (the Town), Conservation Halton (CH) and Halton Region (the Region) had requested the completion of the Comprehensive Study to conform with planning policies related to the alteration to watercourses and floodplains in the absence of an existing Subwatershed Study for the study area. The Comprehensive Study assesses the existing conditions and potential impacts of the proposed development with respect to the natural environment and ecological functions, hydrology, hydraulics, fluvial processes, erosion, and hydrogeology.

The Comprehensive Study team comprises of the following consultants retained by Orlando:

- TYLin International Canada Inc. (TYLin) (formerly The Municipal Infrastructure Group Ltd. or TMIG) (civil engineering).
- GEI Consultants (formerly Savanta Inc.) (natural heritage).
- GEO Morphix Ltd. (fluvial geomorphology).
- Palmer Environmental Consulting Group Inc. (Palmer) (hydrogeology).

1.2 Planned Development

The study area and ownership map for North Porta is shown on **Figure 1-1.** Proposed development consists of industrial/employment uses. The majority of the development plan is generally divided into four areas along property boundaries. Similarly, servicing plans were generally developed considering these property boundaries. The four parcel areas are as follows:

- **Parcel 1 (Orlando Lands – 8800 Boston Church Road)** – The development plan for this property includes three warehouse buildings, parking and driveways, minor landscaped areas, a stormwater management pond, and a conveyance swale along the western property boundary. There is also one existing residential lot on Boston Church Road adjacent to this property, and while there is no current development plan for this lot, the potential future development was included in this study. The Draft Plan of Subdivision for 8800 Boston Church Road is provided in **Appendix A**.
- **Parcel 2** – Non-participating property with future industrial/employment uses.
- **Parcel 3** – This non-participating property is located outside of the urban boundary area, but portions of the property are located outside of the Greenbelt Plan's "Protected Countryside" area. It has been included in this Comprehensive Study given its location within the Subject Lands, but the Comprehensive Study does not account for any future urban development on this property.
- **Parcel 4 (Orlando Lands – 8350 Esquesing Line)** – This property is the largest parcel within the Subject Lands and consists of two warehouse buildings, parking, driveways, landscaped areas, a channel block and a stormwater management pond. The development plan also includes a 24 m public right-of-way along the south property boundary that connects to James Snow Parkway and provides access and

servicing to the development. The Draft Plan of Subdivision for 8350 Esquesing Line is provided in **Appendix A**.

- **Parcel 5** – Small non-participating properties with future industrial/employment uses.

In addition, there are several other areas within the Subject Lands outside of the four main parcel areas described above. A hydro corridor is located within the southern portion of Subject Lands, parallel to and abutting the north side of James Snow Parkway. There is no proposed development within the hydro corridor, with the exception of a public road that connects James Snow Parkway to Parcel 4.

There are also rural residential uses within the Subject Lands along Boston Church Road, north of Parcel 4, and east of Esquesing Line. In general, the Comprehensive Study includes these areas because of their potential for future redevelopment, with the exception of stormwater management, which is assumed will be provided as on-site controls at the site plan level.

1.3 Land Use Planning Context

The majority of the Subject Lands were brought into the Town of Milton's Urban Area by Halton Region Official Plan Amendment No. 38 (ROPA 38) to accommodate employment growth to 2031. Subsequently, these lands were designated "Sustainable Halton Plan (SHP) Growth Area – Employment" and "Natural Heritage System" within the Urban Area through Milton's Official Plan Amendment 31 (OPA 31).

The Subject Lands are required to be part of a Secondary Plan prior to their development. Accordingly, a Town-initiated Official Plan Amendment has advanced and has been adopted by the Town of Milton (as of August 23, 2021) to logically bring the majority of the Subject Lands into the 'Milton 401 Industrial/Business Park Secondary Plan District'. The Town-initiated Official Plan Amendment (LOPA No. 67) was prepared collaboratively with the Town of Milton, the Region and CH and essentially adjusts the boundary of the 401 Industrial/Business Park Secondary Plan to include the North Porta lands and to assign land use designations to the North Porta lands to ensure orderly development in alignment with the goals and objectives of the Secondary Plan. The amendment also facilitates employment (industrial) growth by increasing Milton's employment land inventory in the shorter term. At the time of publication, LOPA No. 67 had been forwarded to the Region of Halton for final approval.

The current 2031 'Urban Area' limit for the Town of Milton traverses the Subject Lands and excludes a portion (or 'northern sliver') of the Subject Lands that are within the Province's "Provincially Significant Employment Zone" (PSEZ) area, and are outside of the Greenbelt Plan's "Protected Countryside" area. Accordingly, concurrent to the Town-initiated LOPA No. 67 process, privately initiated planning applications are being submitted to include both a Regional Official Plan Amendment ("ROPA") application and a Local Official Plan Amendment ("LOPA") application, which will bring the 'northern sliver' into the Regional and Local "Urban Areas" and into the Milton 401 Industrial/Business Park Secondary Plan.

Concurrently, privately-initiated Draft Plan of Subdivision and Zoning By-Law Amendment applications are being submitted to implement the Region of Halton objectives and policy directives for the entirety of the Subject Lands, and to implement Milton's concurrent Secondary Plan Amendment process. Specifically, these applications will seek to facilitate the development of the Subject Lands for industrial/employment uses, related stormwater management uses, natural heritage system protection areas and related road and road widening areas. The draft plans are included in **Appendix A**.

1.4 Comprehensive Study Scope and Approach

The Comprehensive Study provides the goals, objectives and targets that are to be achieved to support development. The Subject Lands for the Comprehensive Study includes the existing drainage areas contributing to and encompassing the proposed development areas for a total area of approximately 250 ha.

The Subject Lands are relatively small in area compared to other development areas within the Town previously assessed under Town-led subwatershed studies and Functional Servicing and Environmental Management Studies (FSEMS) in support of the Secondary Plan process. The Subject Lands are not included

within an existing FSEMS study area. Therefore, the scope of the Comprehensive Study is intended to replicate the high-level information and strategies provided within a Subwatershed Update Study (SUS) and FSEMS before continuing to more detailed functional servicing and ecological restoration that is typically provided within a developer-led Subwatershed Impact Study (SIS).

More specifically, the scope and approach of the Comprehensive Study is outlined as follows:

- The overall goals, objectives, and targets to support development within the Subject Lands are defined to provide a strategic management framework for natural heritage and water resources (**Section 2**).
- Baseline characterization studies for natural heritage, fluvial geomorphology, surface water and hydrology, and hydrogeology were completed for the Subject Lands (**Section 3**). Baseline characterization studies have been underway in the study area since 2016 by the Comprehensive Study team.
- The constraints and opportunities for development were defined through the results of the baseline characterization studies and field staking with CH (**Section 4**).
- High-level subwatershed management strategies with respect to natural heritage, natural hazards, water resources and stormwater management are outlined to address the overall goals, objectives, and targets for the development (**Section 5**). A high-level impact assessment is provided based on the above subwatershed management strategies (**Section 6**).
- A more detailed level of analysis and design was completed in a subwatershed management and functional servicing plan for the Orlando Lands (**Section 7**). This level of study was not completed for non-participating properties. The Orlando properties are referred to herein as 'the Orlando Lands' to differentiate from the larger North Porta area.
- The implementation strategy (**Section 8**) and monitoring and adaptive management plan (**Section 9**) provide the future studies, next steps and monitoring requirements for the proposed development.

1.5 Policy and Legislation Review

1.5.1 The Town of Milton's Official Plan

In August 2008, Milton Town Council adopted an amended plan to the original 1997 Official Plan (OP). The plan establishes the broad policy framework for managing the future growth and development in the Town.

The North Porta lands are located north of the original 401 Industrial Business Park Secondary Plan Area. These lands are designated industrial/business park areas to aid in achieving long-term economic goals for the Town, as per section C.2 within the OP.

Schedule A (Land Use Plan) depicts the North Porta lands as having the following land use designations: "Greenlands A Area" and "Agricultural Area". The Greenland A Area is found at the northeastern corner of the Parcel 4 lands where Sixteen Mile Creek cuts through the woodlot. Greenland A Areas are considered to be a "crucial part of the proposed greenlands open space system intended for the Urban Area" with a focus to encourage the protection, maintenance and enhancement of natural features. According to Section C.8.5.6 of the Official Plan, the boundary of Greenland A Areas can be refined dependent on the completion of a Subwatershed Impact Study.

Moreover, as shown on Schedule C.2.B (Milton 401 Industrial/Business Park Secondary Plan – Land Use Plan), the hydro-corridor is identified as an "Environmental Linkage Area" (**Figure 2**, **Appendix B1**).

As discussed in **Section 1.3**, the Town recently approved LOPA No. 67 which adds a portion of the Subject Lands to the 401 Industrial Business Park and designates them for industrial development.

1.5.2 The Halton Regional Official Plan

The Minister of Municipal Affairs and Housing modified and approved Halton Region Official Plan Amendment No. 38 (ROPA 38) on November 24, 2011. ROPA 38 was appealed at the Ontario Municipal Board (OMB) level and since then, the OMB has only approved certain policies. The current Office Consolidation of the

Official Plan (2018) is based on approvals of the Sustainable Halton amendments that occurred between 2014 and 2017.

As identified on Map 1 (Regional Structure) within the Official Plan, the North Porta lands have three land use designations: Agricultural Area, Regional Natural Heritage (RNHS) System, and Urban and Employment Areas. Portions of the RNHS are also part of the Greenbelt Natural Heritage System, which is further discussed in **Section 1.5.3** of this report. The RNHS corresponds with the woodland along the northern boundary of the North Porta lands, while the agricultural lands generally correspond with the existing land use area. A small area between the RNHS and the designated urban lands consists of agricultural areas.

As identified in Section 115.3 of the Regional Official Plan, the RNHS includes the following components:

Key Features, which include:

- Significant habitat of Endangered and Threatened species;
- Significant wetlands;
- Significant coastal wetlands;
- Significant woodlands;
- Significant valleylands;
- Significant wildlife habitat (SWH);
- Significant areas of natural and scientific interest (ANSIs);
- Fish habitat;
- Enhancements to Key Features including Centres for Biodiversity;
- Linkages;
- Buffers;
- Watercourses that are within a Conservation Authority Regulation Limit or that provide a linkage to a wetland or a significant woodland; and
- Wetlands other than those considered significant under Section 113.3(1)b.

Section 115.4 of the Regional Official Plan also indicates that the RNHS includes Escarpment Natural Area and Escarpment Protection Areas as identified in the Niagara Escarpment Plan, regulated floodplains, and parts of the agricultural system where the only Key Feature present is a Significant earth science ANSI.

Section 116.1 of the Regional Official Plan indicates that boundaries of the RNHS may be refined through a Subwatershed Study or an Environmental Impact Assessment.

Section 118.2(a) of the Regional Official Plan indicates that “development and site alteration are prohibited within significant wetlands, significant coastal wetlands, significant habitat of endangered and threatened species and fish habitat except in accordance with Provincial and Federal legislation and regulations”. Section 118.2(b) does not permit the alteration of any component of the RNHS “unless it has been demonstrated that there will be no negative impacts on the natural features and areas or their ecological functions”. Section 118.3 requires the completion of an Environmental Impact Study (EIS) to “demonstrate that the proposed development or site alteration will result in no negative impacts to that portion of the RNHS or unmapped Key Features affected by the development or site alteration by identifying components of the RNHS as listed in Section 115.3 and their associated ecological functions and assessing potential environmental impacts, requirements for impact avoidance and mitigation measures, and opportunities for enhancement”.

Section 139.3.7 of the Regional Official Plan will apply to this project since portions of the Greenbelt are located within the Subject Lands. Section 139.3.7 (1) prohibits “development or site alteration within the Key Features of the Greenbelt Natural Heritage System, except in accordance with policies of this Plan” and 139.3.7 (2) prohibits “development or site alteration on lands adjacent to the Key Features of the Greenbelt Natural Heritage System unless the proponent has evaluated the ecological functions of these lands through an Environmental Impact Assessment.”

Components of the Greenbelt NHS (discussed below within **Section 5.1.3**) and the RNHS create Halton’s Natural Heritage System.

1.5.3 The Greenbelt Plan

The Greenbelt Plan (2017) works to permanently protect environmentally sensitive areas, due to their ecological value, within the Golden Horseshoe. It is intended to enhance the natural landscapes by working to facilitate the connection of environmentally significant areas and reducing fragmentation of the landscape. Protection is offered also to permanent agricultural areas ensuring the permanency and sustainability of natural resources.

A woodlot located in the northeast corner of the Parcel 4 lands (outside of the development limit) is designated as Protected Countryside and part of the NHS within the Greenbelt Plan (**Figure 2, Appendix B1**).

As discussed in Section 4.1.1 of the Greenbelt Plan, proposals for non-agricultural uses must demonstrate the following (although it is noted that no development is proposed within the Greenbelt Plan area for this particular development):

- The use is appropriate for the location in a rural area;
- The type of water and sewer servicing proposed is appropriate for the type of use;
- There are no negative impacts on key natural heritage features and/or key hydrologic features or their functions; and
- There are no negative impacts on the biodiversity or connectivity of the Natural Heritage System.

As described within Section 3.2 of the Greenbelt Plan (2017), the Protected Countryside contains a Natural System composed of a NHS and a Water Resource System. The NHS includes core and linkage areas of the Protected Countryside with the highest concentration of sensitive and significant natural features and functions, while the Water Resource System is made up of both ground and surface water features, areas and their associated functions. The Natural System protects natural heritage, hydrologic and/or landform features (key hydrologic areas, key hydrologic features and key natural heritage features) that contribute to conserving Ontario's biodiversity and the ecological integrity of the Greenbelt itself.

The Greenbelt Plan (2017) contains policies to protect key hydrologic areas, key hydrologic features and key natural heritage features. These features and areas are listed below, although not all are present within the Subject Lands.

Key hydrologic areas include the following:

- Significant groundwater recharge areas;
- Highly vulnerable aquifers; and
- Significant surface water contribution areas.

Key hydrologic features include the following:

- Permanent and intermittent streams;
- Lakes (and their littoral zones);
- Seepage areas and springs; and
- Wetlands.

Key natural heritage features include the following:

- Habitat of Endangered and Threatened species;
- Fish habitat;
- Wetlands;
- Life science ANSIs;
- Significant valleylands;
- Significant woodlands;
- SWH (including habitat of special concern species);

- Sand barrens, savannahs and tallgrass prairies; and
- Alvars.

1.5.4 Conservation Halton

CH conducts reviews of planning processes associated with future development of properties within its jurisdictional boundaries. In addition, CH provides planning and technical advice to planning authorities to assist them in fulfilling their responsibilities regarding natural hazards, natural heritage and other relevant policy areas pursuant to the Planning Act 1990.

CH administers the Regulation of Development, Interference with Wetlands, Alterations to Shorelines and Watercourses permit process, under O. Reg. 162/06. Permission is required from CH for development in or adjacent to watercourses, rivers or stream valleys, or other natural hazards such as wetlands where the development could interfere with the hydrology of the area.

The following setbacks are prescribed within CH's Policies and Guidelines for the Administration of Ontario Regulation 162/06 and Land Use Planning (2006; November 2020 Consolidation) as follows:

- 15 m from stable top of major valley slope and 7.5 m from stable top of minor valley slope;
- 15 m from toe of any major valley slope and 7.5 m from toe of any minor valley slope;
- 30 m from bankfull channel of any coldwater/coolwater watercourse and warmwater sportfish watercourse and 15 m from bankfull channel of any warmwater baitfish watercourse;
- 15 m from flooding hazard;
- 30 m from provincially significant wetlands (PSWs) and wetlands greater than or equal to 2 ha in size or 15 m from non-provincially significant wetlands and less than 2 ha in size; and
- 15 m from meander belt allowance within an unconfined major valley system.

CH's Online Interactive Regulation Limit Mapping (2018a) identifies the following hazards within the Subject Lands: wetlands, floodplain, meander belt and stable top of bank.

Furthermore, the Interactive Regulation Limit Mapping depicts the headwater drainage feature (HDF) along the most eastern side of the Parcel 4 Lands and through the centre of Parcel 3 Lands as being within the Approximate Regulation Limit (ARL). All other drainage features delineated within the greater Subject Lands were outside of the ARL. In addition, Sixteen Mile Creek and four wetland pockets were identified as being within the ARL on Parcel 4. Refinement or adjustments to the ARL can be taken as a part of the permit application to demonstrate that the hazard and/or ecological feature limit differs from that shown on the interactive mapping.

1.5.5 Provincial Policy Statement and Associated Guideline Documents

The PPS (MMAH 2020) provides guidance on matters of provincial interest surrounding land use planning and development. It "supports improved land use planning and management, which contributes to a more effective and efficient land use planning system." The PPS is to be read in its entirety and land use planners and decision-makers need to consider all relevant policies and how they work together. The PPS (2020) came into effect May 1, 2020 and replaces the previous PPS issued April 30, 2014.

Section 2.1 of the PPS defines eight types of significant natural heritage features, as follows:

- Significant wetlands;
- Significant coastal wetlands;
- Significant woodlands;
- Significant valleylands;
- SWH;
- Fish habitat;
- Habitat of Endangered and Threatened species; and

- ANSIs.

Development and site alteration shall not be permitted in significant wetlands within Ecoregions 5E, 6E and 7E, or in significant coastal wetlands. Development and site alteration shall not be permitted in significant woodlands, significant valleylands, SWH or significant ANSIs, unless it is demonstrated that there will be no negative impacts on the natural features or their ecological functions.

Development and site alteration shall not be permitted in the habitat of Endangered and Threatened species or in fish habitat, except in accordance with provincial and federal requirements.

Section 3.1 of the PPS directs development away from areas of natural hazards as a preventative measure to protect public health and safety, and minimize cost, risks and social disruption over the long term. The policies identify specific natural hazards, including hazardous land adjacent to river and stream systems which are impacted by flooding hazards and/or erosion hazards, which are the most relevant to the North Porta Lands. Development shall generally be directed to areas outside of the aforementioned hazardous lands.

1.5.6 Ontario Endangered Species Act, 2007

The provincial Endangered Species Act 2007 (2021 Consolidation) was developed to:

- Identify species at risk, based upon best available science;
- Protect species at risk and their habitats and to promote the recovery of species at risk; and
- Promote stewardship activities that would support those protection and recovery efforts.

The ESA protects all Threatened, Endangered and Extirpated species listed on the Species at Risk in Ontario (SARO) list. These species are legally protected from harm or harassment and their associated habitats are legally protected from damage or destruction, as defined under the Endangered Species Act 2007.

1.5.7 Federal Fisheries Act 1985

Fisheries and Oceans Canada (DFO) administers the federal Fisheries Act, 1985, which defines fish habitat as “spawning grounds and other areas, including nursery, rearing, food supply and migration areas, on which fish depend directly or indirectly in order to carry out their life processes” (Subsection (2)1). The Fisheries Act, 1985 prohibits the death of fish by means other than fishing (Subsection 34.4 (1)) and the harmful alteration, disruption or destruction of fish habitat (HADD; Subsection 35. (1)). A HADD is defined as “any temporary or permanent change to fish habitat that directly or indirectly impairs the habitat’s capacity to support one or more life processes” (DFO 2019a).

Some projects may be eligible for exemption from the DFO review process, as specified under Step 3 of the DFO Fish and Fish Habitat Protection Program review process (DFO 2019b; e.g., clear-span bridges and bridge maintenance projects where DFO mitigation measures are applied, artificial waterbodies with no hydrological connection to occupied fish habitat, and projects that follow the Standards and Codes of Practice defined by DFO). All other projects or activities that have the potential to impact fish or fish habitat should be submitted to DFO through the “Request for Review” process. DFO will review the proposed project to determine whether there is potential to (1) impact an aquatic species at risk; (2) cause the death of fish; or (3) result in HADD of fish habitat. The death of fish by means other than fishing or a HADD of fish habitat can be authorized by DFO under paragraphs 34.4(2)(b) or 35(2)(b) of the Fisheries Act, 1985. Authorizations require the preparation and submission of an application package identifying the impacts on fish and fish habitat as well as the avoidance, mitigation and offsetting measures that will be implemented as well as any monitoring that is proposed.

1.5.8 Migratory Birds Convention Act

This federal legislation protects the nests and offspring of listed migratory bird species from destruction or disturbance. In its application, it requires best management practices (BMPs) to detect and avoid disturbance to active nests during development activities.

1.5.9 Fish and Wildlife Conservation Act

The Fish and Wildlife Conservation Act outlines management of fishing, hunting, and trapping activities to protect and manage wildlife. It also dictates the circumstances where wildlife may be kept in captivity, which is not appropriate for this development application. Should any trapping or fishing of wildlife in support of baseline, construction or post-construction activities be required, a permit issued by the Ministry of Northern Development, Mines, Natural Resources and Forestry (MNDMNRF) will be required.

1.6 Secondary Source Information Review

A considerable amount of information is available for the study area, including land use planning documents, on-line databases and other resources, and previous studies pertaining to the Sixteen Mile Creek watershed. The relevant information from these sources of background information is summarized in the following sections.

Savanta has relied, in part, upon supporting background information and previous site surveys/investigations to provide additional insight into the overall character of these Orlando Lands. Examples of these agencies and resources are:

- Ministry of Natural Resources and Forestry (MNRF) online resources including:
  - Land Information Ontario (LIO) Natural Features Mapping;
  - Natural Heritage Information Centre (NHIC) database;
- Species at Risk (SAR) website;
- MNRF, Aurora District Office;
- Conservation Halton;
- Town of Milton Official Plan (2008);
- Region of Halton Official Plan (2018); and
- Functional Stormwater and Environmental Management Strategy (FSEMS) – Highway 401 Industrial/Business Park Secondary Plan Area (Philips Engineering 2000).

The results of the background reference review are discussed in the following sections.

1.6.1 Land Information Ontario

Based on the MNRF (2016) LIO geographic database, three unnamed watercourses that are tributaries of Sixteen Mile Creek were identified on, or adjacent to, the Orlando Lands (**Figure 2, Appendix B1**).

No other known natural heritage features were identified on or adjacent to (i.e., within 120 m of) the Orlando Lands. The following natural heritage features were identified within the general vicinity of the Orlando Lands:

- Chudleigh Swamp, an Evaluated (non-provincially significant) Wetland, is located approximately 1.7 km northwest;
- Scotch Block Wetland Complex is found approximately 4.5 km northwest;
- Hilton Falls Complex Environmentally Sensitive Area is located approximately 3.9 km west-northwest; and
- Milton Heights Marsh is found approximately 3.1 km southwest.

1.6.2 The Natural Heritage Information Centre Database

The NHIC database (MNRF 2021) was searched for records of provincially significant plants, vegetation communities and wildlife on, and in the vicinity of, the Orlando Lands. The database provides occurrence data by 1 km^2 area squares, with two squares overlapping at least a portion of the Orlando Lands (17NJ8822 and 17NJ8922,). Within these squares the search revealed two records. The following records are considered as

current occurrences in this reporting and this information assisted in defining the search effort and target species for studies on and immediately adjacent to the Orlando Lands:

Species listed as Threatened or Endangered on the SARO list:

- Eastern Meadowlark (*Sturnella magna*) – Threatened;

Species of Conservation Concern (i.e., listed as Special Concern on the SARO list, or identified as an S1 to S3 species):

- Narrow-leaved Puccoon (*Lithospermum incisum*) – S1 (critically imperilled in Ontario).

Previously, four other atlas squares were available for the site; however, some of the data squares have since been removed from the publicly accessible NHIC website. Other species that were identified during previous NHIC searches included Carey's Sedge (*Carex careyana*) – S2 ranking (imperiled in Ontario) and Virginia Bluebells (*Mertensia virginica*) – S3 ranking (vulnerable in Ontario). All other species identified during earlier searches were considered historical (greater than 50 years old).

1.6.3 Ontario Breeding Bird Atlas

The Ontario Breeding Bird Atlas (OBBA) contains detailed information on the population and distribution status of birds in Ontario (Bird Studies Canada [BSC] et al. 2006). The data are presented on 100 km^2 area squares with two squares overlapping a portion of the Orlando Lands (17NJ82 and 17NJ92). It should be noted that the Orlando Lands are a small component of the overall bird atlas squares, and therefore it is unlikely that all bird species previously recorded within the atlas squares are found within the Orlando Lands. Habitat type, availability and size are all contributing factors in bird species presence and use.

A total of 131 species were recorded in the atlas squares that overlap with the Orlando Lands, with the following species of interest noted:

- Species listed as Threatened or Endangered on the SARO list:
  - Prothonotary Warbler (*Protonotaria citrea*) – Endangered;
  - Barn Swallow (*Hirundo rustica*) – Threatened;
  - Bobolink (*Dolichonyx oryzivorus*) – Threatened;
  - Bank Swallow (*Riparia riparia*) – Threatened; and
  - Chimney Swift (*Chaetura pelagica*) – Threatened;
- Species of Conservation Concern (i.e., listed as Special Concern on the SARO list, or identified as an S1-S3 species):
  - Eastern Wood-Pewee (*Contopus virens*) – Special Concern;
  - Wood Thrush (*Hylocichla mustelina*) – Special Concern;
  - Canada Warbler (*Cardellina canadensis*) – Special Concern;
  - Grasshopper Sparrow (*Ammodramus savannarum*) – Special Concern;
  - Red-headed Woodpecker (*Melanerpes erythrocephalus*) – Special Concern; and
  - Golden-winged Warbler (*Vermivora chrysoptera*) – Special Concern.

1.6.4 Ontario Reptile and Amphibian Atlas

The Ontario Reptile and Amphibian Atlas contains detailed information on the population and distribution status of Ontario herpetofauna (Ontario Nature 2018). The data are presented on 100 km^2 area squares with two squares overlapping a portion of the Orlando Lands (17NJ82 and 17NJ92). It should be noted that the Orlando Lands are a small component of the overall atlas square, and therefore it is unlikely that all herpetofauna species previously recorded within the atlas squares are found within the Orlando Lands. Habitat type, availability and size are all contributing factors in herpetofauna species presence and use.

A total of 27 reptile and amphibian species have been recorded in the atlas squares that overlap with the Orlando Lands, of which eight are salamander species, nine are frog and toad species, three are turtle species and seven are snake species. Of these species, the following species of interest are noted:

- Species listed as Threatened or Endangered on the SARO list:
  - Jefferson Salamander (*Ambystoma jeffersonianum*) – Endangered; and
  - Blanding's Turtle (*Emydoidea blandingii*) – Threatened.
- Species of Conservation Concern (i.e., listed as Special Concern on the SARO list, or identified as an S1-S3 species):
  - Snapping Turtle (*Chelydra serpentina*) – Special Concern; and
  - Eastern Ribbonsnake (*Thamnophis sauritus*) – Special Concern.

1.6.5 Ontario Butterfly and Moth Atlases

The Ontario Butterfly and Moth Atlases (Toronto Entomologists' Association 2018a; Toronto Entomologists' Association 2018b) contain detailed information on the population and distribution status of Ontario butterflies and moths. The data are presented on 100 km^2 area squares with a portion of two squares covering the Subject Lands (17NJ82 and 17NJ92). It should be noted that the Subject Lands are a small component of the overall atlas squares, and therefore it is unlikely that all butterfly and moth species previously recorded within the squares are found within the Subject Lands. Habitat type, availability and size are all contributing factors in butterfly and moth species presence and use.

A total of 69 species were recorded in the atlas squares that overlap with the Subject Lands. Of these species, two Species of Conservation Concern (i.e., listed as Special Concern on the SARO list, or identified as an S1 to S3 species) were noted: Monarch (*Danaus plexippus*) and West Virginia White (*Pieris virginiensis*), both ranked Special Concern in Ontario.

1.6.6 Fisheries and Oceans Canada

DFO (2019c) aquatic SAR distribution mapping was reviewed to identify any known occurrences of aquatic SAR, including fish and mussels, within the subwatershed where the Subject Lands are located. No aquatic SAR were identified as being present within the watercourses on or within 120 m of the Subject Lands.

The DFO (2019c) mapping identifies critical habitat (per the definition in the federal SAR Act; SARA) Silver Shiner (*Notropis photogensis*) as being present within the Middle Branch of Sixteen Mile Creek, a straight line distance of approximately 5 km downstream from the Subject Lands. Silver Shiner are listed as threatened on Schedule 1 of SARA and as threatened on the SARO list. The Ministry of Environment, Conservation and Parks (MECP) defines Silver Shiner general habitat based on three categories, of which all correspond to occupied reaches (MECP 2019). No contributing habitat definitions are provided.

The DFO (2019c) mapping identifies the unnamed tributary of the Middle Branch of Sixteen Mile Creek northeast of the Subject Lands as occupied habitat for Redside Dace (*Clinostomus elongatus*), which is listed as endangered on Schedule 1 of SARA and on the SARO list. The closest point of this watercourse is approximately 310 m from the northeast corner of the Subject Lands. The limit of habitat for this species in this watercourse is located approximately 3 km upstream from the confluence with the Middle Branch of Sixteen Mile Creek. Therefore, the watercourses flowing through the Subject Lands discharge approximately 3 km downstream from the identified limit of Redside Dace habitat and would not be considered contributing habitat, per section 29.1.1.v of O. Reg 242/08, given that they do not flow into habitat for Redside Dace. Further, as per **Section 1.6.7**, the MNRF did not identify Redside Dace as a potential SAR that should be considered during consultation completed as part of this CESS.

1.6.7 Ministry of Natural Resources and Forestry

Savanta submitted an Information Request Form (IRF) to the Aurora District MNRF on August 6, 2014 in support of the EIS for the proposed development. A response letter was received back on October 2, 2014

(**Appendix B3**). The MNRF noted records of Bobolink and Eastern Meadowlark, both listed as Threatened species in Ontario, on or within the vicinity of the Orlando Lands.

A second IRF was submitted to the MNRF on January 8, 2016 to obtain an updated list of SAR records for the area. A response letter was received on January 15, 2016 (**Appendix B3**) and the MNRF added the following SAR species:

- Eastern Milksnake (*Lampropeltis triangulum*) – previously Special Concern in Ontario;
- Bank Swallow – Threatened in Ontario;
- Barn Swallow – Threatened in Ontario;
- Butternut (*Juglans cinerea*) – Endangered in Ontario; and
- Little Brown Myotis (*Myotis lucifugus*) – Endangered in Ontario.

Since receiving the response letter from the MNRF, Eastern Milksnake has been down-listed and is no longer considered a SAR in Ontario. MECP (who now has jurisdiction over SAR and SAR habitat) are no longer responding to IRFs; rather, they are recommending that wildlife atlases are reviewed. Review of secondary source information is summarized within this section (Section 1.6).

The species list provided by the MNRF assisted in defining the search area and targeted species surveys on, and adjacent to, the Orlando Lands.

1.6.8 FSEMS Review

A review of the Highway 401 FSEMS (Philips Engineering 2000) was undertaken to understand the natural heritage features and functions that are known within the general vicinity of the Subject Lands. It should be noted that the Subject Lands are not included within the FSEMS Study Area, rather, they are located immediately north. No information specific to the Subject Lands was included within the FSEMS, except for a description of a portion of two aquatic features (N-3-A and N-3-B; discussed below).

As illustrated on FSEMS Figure 4 (see **Appendix A**), aquatic features N-3-A, N-3-B and N-5-A were identified immediately downstream of the Subject Lands. All features appear to be continuations of headwater drainage features that originate within the Subject Lands, where N-3-A flows through Parcels 1 and 2 (identified within this report as HDF R5), and N-3-B (identified within this report as HDF R1S1) and N-5-A (identified within this report as HDF R3S1) flow through Parcel 4. FSEMS Section 3.5 (Fisheries) identifies reach N-3-A as a “dry swale planted through with crops when examined”. The FSEMS has limited discussion on the feature characteristics of reach N-5-A (also identified as “Mansewood Tributary”) but states that the 401 Corridor Subwatershed Plan (Dillion Consulting 1999) found the lower portions of the reach had little to no flow. The FSEMS also indicates that fish community sampling identified five species within the Sixteen Mile Creek tributary that traverses the eastern portion of the Subject Lands: White Sucker (*Catostomus commersoni*), Common Shiner (*Luxilus cornutus*), Eastern Blacknose Dace (*Rhinichthys atratulus*), Creek Chub (*Semotilus atromaculatus*) and Brook Stickleback (*Culaea inconstans*). No description for N-3-B was provided, however this reach flows into EU-2-A, which was described as a “ditch/swale that was dry when examined”.

The FSEMS classifies the watercourses as high, medium or low constraint features based on their characteristics, flow, channel form and fish community. The constraint definitions from the FSEMS Section 3.5 are provided below:

> “A high constraint rating was applied to permanently flowing streams. Virtually all of these have diverse fish communities and well-defined channels with a range of substrates. Some reaches have trout populations; others have populations of at-risk species. Some reaches within these streams have been altered to the point where they provide little or no fish habitat, but these are included as a high-level constraint based on their potential or value as a migration route. Areas with a high constraint rating should be protected in, or restored to, a condition which is as close to their natural condition as feasible.
>
> A medium constraint rating was applied to intermittent streams which, based on the presence of a defined channel with sorted substrates, were thought to flow for extended periods. It is believed that many of the larger intermittent tributaries particularly those which are proximate to and accessible from the East and

Main Branches, provide spawning and nursery habitat in the spring for fish from the permanently flowing streams. Multiple fish species were found in some of these streams, despite habitat being confined to isolated pools at the time of sampling. The natural form and function should be maintained for watercourses assigned a medium constraint rating.

A low constraint rating was applied to watercourses which are ephemeral or intermittent, have either poorly defined channels with no clear sorting of substrate or no defined channels, and where in all cases but one, brook stickleback were the only fish species captured where isolated pools were present. These pools were almost always associated with road culverts. For these watercourses function should be maintained, but it is considered feasible to eliminate the channels themselves, if necessary".

FSEMS Table 3.9 identifies N-3-A as a green (low constraint) reach, EU-2-A as a blue (medium constraint) reach and N-5-A as a blue reach. Blue reaches must remain open however realignment is permitted, while green constraints may be enclosed with their functions replicated. Documentation of Redside Dace within the Northwest Tributary (reaches N-4-A and NW-2-G) was recorded within the FSEMS. These reaches are located on the western most watercourses identified within the FSEMS Study Area, which appear to have since been altered within the landscape (e.g., flow through recently developed landscape). This Redside Dace occurrence is in a different tributary than that identified previously in **Section 1.6.7** of this Comprehensive Study.

FSEMS Section 3.7 suggests that two evaluated wetlands comprised of swamp and/or marsh cover were evaluated using the Ontario Wetland Evaluation System (OWES) (3rd Edition, 1993) within the FSEMS Study Area. However, it does not specifically identify which wetland communities were evaluated, where these wetlands are located and if they were evaluated as significant wetlands. The FSEMS further suggests that no provincially significant woodlands are present within the FSEMS Study Area. Finally, FSEMS Section 3.7 suggests that a variety of bird, reptile, amphibian, mammal and butterfly species were recorded as part of the field surveys, however species-specific information and observational locations were not included in the documentation.

Key stormwater servicing and environmental management opportunities identified within the FSEMS Study Area (as discussed within FSEMS Section 3.8) include mitigation of thermal impacts to downstream cool-water species (including salmonid species), increasing infiltration capacity, flood control, enhancement of watercourses and installation of buffers to protect woodlots, riparian areas and other natural features. Other priorities were focused around linkage protection and enhancement within the actively managed agricultural fields and increasing habitat diversity, which was reduced due to extensive agricultural uses including historical grazing.

1.6.9 Natural Heritage Constraints Memo Review

A review of Dougan and Associates' Draft Natural Heritage Constraints Memo for Town Initiated Official Plan Amendment, Milton 401 Industrial/Business Park Secondary Plan – North Porta Lands (dated March 24, 2021) was conducted (a copy of the report is found within **Appendix A**). This memo completed a background and policy review and completed scoped roadside assessments to inform a preliminary natural heritage screen of the North Porta lands. The roadside assessment was conducted on March 10, 2021.

The following Key Features as part of the RNHS were identified within Orlando Lands (per Map 1):

- Polygon 1 – Designated a Wooded Area by MNRF, contains CH regulated wetlands, located within Greenbelt Plan Area (approximately 0.02 ha).
- Polygon 2 – Isolated wetland, appears to be meadow marsh community based on orthoimagery interpretation. Identified as CH regulated feature. Does not appear to be associated with HDF or watercourse (approximately 0.12 ha). Unable to confirm from roadside.
- Polygon 3 – Isolated feature that appears to be a meadow marsh community. Identified as CH regulated feature. Does not appear to be associated with a HDF or a watercourse. Unable to confirm from roadside.

Polygons 2 and 3 were identified as potential regionally significant wetlands only if they make an important contribution to the RNHS. Polygon 1 was identified as a regionally significant woodland.

Several HDFs were identified within the North Porta lands that appeared to be intermittent with some sections that could be wet year-round. The memo indicated that Sixteen Mile Creek is located north of the North Porta lands, however portions of Sixteen Mile Creek are known within the north-east corner of the property.

Based on [candidate] available habitats, Dougan identified the following species may be present within the North Porta lands:

- Butternut – within the North Porta lands and adjacent lands
- Redside Dace – within adjacent lands only
- Wood Thrush – within adjacent lands only
- Snapping Turtle – within North Porta lands and adjacent lands
- Eastern Wood-Pewee – within adjacent lands only

A preliminary SWH analysis was completed and suggested 11 candidate SWH types may be present within the North Porta lands:

- Seasonal Concentration Areas of Animals
  - Bat Maternity Colonies – within adjacent lands only
  - Turtle Wintering Areas – within adjacent lands only
  - Reptile Hibernaculum – within North Porta lands and adjacent lands
  - Colonially Nesting Bird Breeding Habitat (Trees and Shrubs) - within adjacent lands only
- Specialized Habitat for Wildlife
  - Turtle Nesting Areas – within North Porta lands and adjacent lands
  - Seeps and Springs - within adjacent lands only
  - Amphibian Breeding Habitat (Woodland) - within adjacent lands only
  - Amphibian Breeding Habitat (Wetland) - within North Porta lands and adjacent lands
- Habitat for Species of Conservation Concern
  - Terrestrial Crayfish – within North Porta lands and adjacent lands
  - Special Concern and Rare Wildlife Species
    - Snapping Turtle – within North Porta lands and adjacent lands
    - Monarch – within North Porta lands and adjacent lands
    - Eastern Wood-Pewee – within North Porta lands and adjacent lands
    - Wood Thrush - within adjacent lands only
- Animal Movement Corridors
  - Amphibian Movement Corridors - within adjacent lands only

1.6.10 Sixteen Mile Creek Fisheries Review

A review of the Sixteen Mile Creek, Grindstone Creek and Supplemental Monitoring Report (CH 2011) indicated that a total of 30 fish species, ranging from warmwater to cold-water species, were captured throughout Sixteen Mile Creek in 2011. Figure 2 (Sixteen Mile Creek Fisheries Sampling Stations and Associated IBI Classification) depicts one station (SXM-349) on the Middle Branch of Sixteen Mile Creek (which runs through the northwest corner of the Subject Lands), approximately 1.6 km east of the Subject Lands. This station was identified as having a good index of biotic integrity. The following fish species were captured in 2011 at SXM-349:

- Creek Chub;
- Fantail Darter (*Etheostoma flabellare*);
- Johnny Darter (*Etheostoma nigrum*);
- Northern Hog Sucker (*Hypentelium nigricans*);

- Pumpkinseed (*Lepomis gibbosus*);
- Rainbow Darter (Etheostoma caeruleum);
- Rainbow Trout (*Oncorhynchus mykiss*);
- Stonecat (*Noturus flavus*); and
- White Sucker.

Rainbow Trout is not thought to be a permanent resident in Sixteen Mile Creek and its tributaries. During the spawning season, Rainbow Trout will enter Sixteen Mile Creek from Lake Ontario and migrate upstream. Juvenile Rainbow Trout will return back to Lake Ontario where they will remain until they reach sexual maturity and migrate upstream to riverine spawning habitats (Natural Resources Conservation Service; NRCS 2000).

No aquatic SAR were identified within the vicinity of the Subject Lands.

1.6.11 Conservation Halton Fisheries Data Request

Savanta submitted a data request to CH on November 12, 2021 in support of the CESS for the proposed development. A response letter was received back on January 21, 2022 (**Appendix B3**). One fisheries station (SXM-472) was noted on the Subject Lands and the following species were observed:

- Black Crappie (*Pomoxis nigromaculatus*)
- Creek Chub
- Pumpkinseed
- Rainbow Darter
- Northern Hog Sucker
- Johnny Darter
- Longnose Dace (*Rhinichthys cataractae*)
- Stonecat
- Fantail Darter
- Common Shiner (*Luxilus cornutus*)
- Western Blacknose Dace (*Rhinichthys obtusus*)

As noted within February 2, 2022 agency team meeting, these species are largely known within the main branch of Sixteen Mile Creek; however, some species are generalists and could be found within the Subject Lands (e.g., Creek Chub, Western Blacknose Dace). Given the seasonality of the watercourse associated with SXM-472, it is possible that this was a random occurrence during a larger flooding event; however, it is not expected that these species would typically reside within the seasonal agricultural watercourse within the Subject Lands.

2 GOALS, OBJECTIVES AND TARGETS

2.1 Overview

Goals, objectives and targets have been established for the North Porta lands at a sub-watershed level based on the most current information and approaches for sub-watershed level studies within the Town of Milton, specifically the recent South Milton Urban Expansion Area Subwatershed Study – Phase 2 / Phase 3 (Wood et al., 2021).

In general, these goals, objectives, and targets are up-to-date versions of those presented in the Sixteen Mile Creek Watershed Plan (1996) and the Sixteen Mile Creek, Areas 2 & 7 Subwatershed Update Study (SUS) (AMEC 2015), and respect current provincial, regional, local and conservation authority policies, regulations and guidelines.

The goals and objectives related to Natural Heritage, Natural Hazards, Water Resources and Stormwater Management are set out in the following sections.

2.2 Natural Heritage

Goal:

To protect, restore or, where appropriate, enhance the biodiversity, connectivity and ecological functions of the natural heritage features and areas throughout the Subject Lands for the long term.

Objectives:

- To ensure that natural heritage features and areas, associated with a refined RNHS, including their ecological and hydrologic functions, are protected from potential adverse impacts of development;
- To ensure that buffers, corridors and linkages between natural features and areas, surface water features and groundwater features are maintained, restored or, where possible, improved through the establishment of the natural heritage system;
- To establish development standards and land use controls that will ensure future development does not negatively impact the RNHS;
- To consider climate change mitigation and adaptation measures as part of the development of natural heritage management strategies;
- To establish a healthy and diverse RNHS that compliments and enhances the ecological functions of existing habitat types; and
- To develop integrated stormwater management plans to help manage water balance with the intent to maintain both hydrological and ecological function of features within the adjacent RNHS.

2.3 Natural Hazards

Goal:

To prevent, eliminate or minimize the risks to life and property caused by flooding and erosion hazards and not create new or aggravate existing hazards.

Objectives:

- To ensure new development does not increase the frequency and intensity of flooding, the rate of natural stream erosion or increase slope instability;
- To establish development standards, land use planning and engineering practices that ensure future development is located outside of, and appropriately setback from, flooding and erosion hazards;

- To ensure that new development, including infrastructure, incorporates appropriate mitigation measures in order to avoid adverse impacts to natural features and areas as it relates to natural hazards; and
- To consider climate change adaptation measures as part of the development of flooding and erosion management strategies.

2.4 Water Resources

Goal:

To protect, improve or restore the quality and quantity of water resources within, adjacent to and downstream of the Subject Lands, including their associated ecological and hydrologic / hydrogeologic functions.

Objectives:

- To ensure fluvial processes and stream morphology are maintained or improved to support important habitat attributes (pools, riffles, etc.), dynamic channel form and diversity which will contribute to maintaining a sustainable natural heritage system;
- To prevent nutrient enrichment and contamination of surface and groundwater resources from development and related activities;
- To ensure surface and groundwater features and their hydrologic functions are protected, improved or restored;
- To maintain important linkages and related functions among groundwater features, functional groundwater recharge, surface water features, hydrologic functions, and natural heritage features and areas;
- To consider climate change mitigation and adaptation measures as part of establishing management strategies; and
- To ensure that the riparian rights of downstream landowners is respected.

2.5 Stormwater Management

Goal:

To mitigate negative impacts related to the quality and quantity of stormwater within, adjacent to, and downstream of the Subject Lands.

Objectives:

- To maintain/enhance baseflow to the receiving regulated watercourses to mimic existing hydrologic function;
- To ensure that post- to pre-development peak flow control (as a minimum) achieves flood control objectives for all storm events (2 year to 100 year) and including the Regional Storm event;
- To ensure that stormwater runoff controls maintain or enhance existing flow-duration exceedance characteristics and other erosion indicators in the receiving regulated watercourses;
- To ensure that the treatment of runoff mitigates surface water quality impacts due to development in accordance with Ministry of the Environment, Conservation and Parks guidelines, to an *enhanced* standard;
- To mitigate thermal impacts from stormwater runoff to the extent possible;
- To consider Low Impact Development (LID), Green Infrastructure and BMPs to treat stormwater at its source; and
- To consider climate change mitigation and adaptation measures as part of establishing stormwater management strategies.

3 BASELINE INVENTORY

The consultant team completed studies on the Orlando Lands (i.e., Parcels 1 and 4) between 2015 and 2021, and this Comprehensive Study addresses those lands in detail. Parcels 2, 3 and 5 have not been subject to field data collection and will need to be addressed through future submissions by the development proponent for those lands. In general, these lands were included within this submission at the request of reviewing agencies as they are located within the larger North Porta area.

3.1 Natural Heritage

Ecological field investigations were completed on Parcels 1 and 4 to gather ecological data to assist in understanding the potential constraints to development. The following terrestrial surveys conducted on the Orlando Lands included:

- Amphibian call count surveys;
- Bat acoustic monitoring;
- Bat snag density survey;
- Botanical inventory and Ecological Land Classification (ELC);
- Breeding bird surveys;
- Insect surveys;
- Salamander cover board monitoring;
- Snake cover board monitoring and transects;
- Turtle nesting transects; and
- Winter wildlife surveys.

Field surveys were conducted on Parcels 1 and 4. The totality of the Parcels 1 and 4 were screened for habitat suitability and survey stations were added where potentially suitable habitat was identified. Some limited characterization of conditions was also documented from lands adjacent to Parcels 1 and 4. The Parcel 2 and 3 and 5 lands were not surveyed as those parcels occur outside of Orlando's current ownership limits.

Surveys conducted by Savanta ecologists through the course of this work are presented in the following sections and summarized in **Table 1** (**Appendix B2**). It is recognized that some of these surveys are considered out of date as they were conducted greater than five years ago. Through several technical discussions with the reviewing agencies, it was agreed that a site reconnaissance would be conducted to confirm that the present-day conditions within the Orlando Lands resemble the data collected during the below surveys. CH further clarified that no further amphibian fieldwork would be required within the Orlando Lands in support of the Comprehensive Study (see **Appendix B3** for email correspondence). Moreover, a survey of the hydro-corridor along James Snow Parkway was completed to inform whether any natural heritage features may be present. Additional discussion is presented below within **Section 3.1.10**.

It should be noted that the FSEMS suggests that a variety of bird, reptile, amphibian, mammal and butterfly species were recorded within as part of the field studies, however species-specific information and observational locations were not included in the documentation. Based on this, limited interpretation related to the FSEMS could be included within the below results section. No field investigations were completed by Dougan and Associates as part of their constraints analysis, therefore, no field data could be incorporated into the below results.

3.1.1 Vegetation and Botanical Inventory

Survey Methodology

Vegetation communities were first identified on aerial imagery and then verified in the field. Vegetation community types were confirmed, sampled and revised, if necessary, using the sampling protocol of the ELC

for Southern Ontario (Lee at al. 1998). ELC was completed to the finest level of resolution (Vegetation Type) where feasible. Species names generally follow nomenclature from the Flora Ontario – Integrated Botanical Information System (FOIBIS; Newmaster and Ragupathy 2012).

The provincial status of all plant species and vegetation communities is based on NHIC (2021). Identification of potentially sensitive native plant species is based on their assigned coefficient of conservatism (CC) value, as determined by Oldham et al. (1995). This CC value, ranging from 0 (low) to 10 (high), is based on a species' tolerance of disturbance and fidelity to a specific natural habitat. Species with a CC value of 9 or 10 generally exhibit a high degree of fidelity to a narrow range of habitat parameters.

Survey Results

Ecological Land Classification

Both Parcels 1 and 4 were assessed. The majority of the natural vegetation cover is found on the Parcel 4 lands, whereas it is more limited on the Parcel 1 lands. Natural vegetation cover within the Parcel 4 lands is limited to peripheral portions of forest and swamp associated with a wooded complex centred around Southcott Drive. The hydro corridor which are located immediately south of Parcel 4 were surveyed in 2021, and classified as actively managed agricultural. No natural vegetation communities were recorded within the hydro corridor.

ELC mapping of the Orlando Lands is shown on **Figure 5** (**Appendix B1**), with ELC interpreted through air photos on adjacent lands (within 120 m). ELC communities on adjacent non-participating parcels (Parcels 2, 3 and 5) were interpreted using aerial imagery and should be ground-truthed once access has been granted. A detailed list and description of ELC units is provided in **Table 2** (**Appendix B2**). Where duplicate ELC communities are present within the Subject Lands, unique identifiers were assigned to each community.

One provincially rare vegetation community was present: Red Maple – Conifer Organic Mixed Swamp (SWM5-1). This community type is ranked S3S4, indicating that it is considered provincially rare to uncommon (NHIC 2021). ELC delineation was reconfirmed during the site reconnaissance (as discussed below within **Section 3.1.10)**. The site reconnaissance found that no changes to the ELC delineation were warranted; the conditions observed during initial ELC surveys were consistent with 2021 community characterizations.

As illustrated within **Figure 2** (**Appendix B1**), the RNHS depicts several isolated features within the Parcel 4 agricultural lands. Our ELC surveys have confirmed that these features are not present as the agricultural fields are actively managed in these locations. Additional reconnaissance was conducted on May 4, 2021 and again with CH staff on June 4, 2021, which confirmed that these features are not wetland communities. Full details of the May 2021 reconnaissance are summarized within a technical brief that was provided to reviewing agencies. This technical brief is also included within **Appendix B6**. For clarity, while these vegetative communities were too small to initially classify as vegetative communities per the ELC guidelines, the Features 2 and 3 have been delineated as cultural meadow communities (CUM1-1). The characterization of Feature 1 supports the existing mapping of the feature as agricultural. Locations of Features 1, 2 and 3 are shown on **Figure 1** of **Appendix B6**. No other unmapped features were identified that could be identified as Key Features.

Vascular Plants

Botanical inventories completed on the Orlando Lands identified a total of 245 species of vascular plants. Of that number, 171 (or 70%) are native and 74 (or 30%) are exotic. A full species list is included in **Table 3** (**Appendix B2**).

The majority of the native species (91%) are ranked S5 (secure in Ontario). Fifteen species (9%) are ranked S4 (apparently secure in Ontario; NHIC 2021), while one species is ranked S2? and is discussed below. No regionally rare plants were observed, as per the Region's rarity rankings (Varga ed. 2005). None of the species recorded from the Orlando Lands had a CC value of 9 or 10.

Provincially rare species (SAR and S1-S3; NHIC 2021) observed included:

- Butternut – Eight individual trees were observed in the northeast corner of the Orlando Lands, in the SWM5-1 community near Esquesing Line.

Butternut is also a SAR, designated as Endangered in Ontario and Canada, and is subject to protection under the ESA (2021 Consolidation). A formal health assessment was not completed as these trees are greater than 50 m from the proposed development footprint (**Figure 5**, **Appendix B1**)**.**

Based on local Halton status, no regionally or locally rare vascular plants were observed.

Evaluated Wetlands/Other Wetlands

Chudleigh Swamp, located 1.7 km northwest of the Orlando Lands, is the closest evaluated wetland. Currently, this swamp is identified as "other," indicating that it is not provincially significant but may be locally significant. No PSWs were identified on, or in the vicinity of, the Orlando Lands as per the FSEMS (**Figure 2, Appendix B1**).

Invasive Species

The Orlando Lands contain a relatively low ratio of exotic plants to native plants given their proximity to the Town. Nonetheless, 10 of the exotic species observed have a weediness index of -3, indicating they have a high potential for invasiveness. One exotic plant that was observed is particularly concerning from a health and safety perspective: Giant Hogweed (*Heracleum mantegazzianum*). Numerous stems of this plant were observed between Sixteen Mile Creek and Esquesing Line. Control efforts are currently underway for this population by CH, as indicated by cautionary signs posted along Esquesing Line.

The Orlando Lands can be divided into two main areas based on the presence and threat of invasive species. In general, the abundance of exotic and invasive plants is highest in the open habitat types and lower in the treed communities.

The Old Field Meadow (CUM1-1) unit contains many exotic species, especially forage forbs and grasses, however, being small and located across the road, it does not pose a threat to the natural vegetation areas. Similarly, the Cattail Mineral Shallow Marsh (MAS2-1), which is dominated by two exotic species (Narrow-leaved Cattail; *Typha angustifolia* and Reed Canary Grass; *Phalaris arundinacea*), covers a small and isolated area.

The forest and treed swamp units on the Orlando Lands, in general, contain small to moderate amounts of invasive exotic plant species. In the Fresh-Moist Sugar Maple-Hardwood Deciduous Forest (FOD6-5) unit, Garlic Mustard (*Alliaria petiolata*) was only noted as rare. The two tableland swamp units (SWD3-3 and SWD4-5) had Garlic Mustard as "occasional", and Tartarian Honeysuckle (*Lonicera tatarica*), European Buckthorn (*Rhamnus cathartica*) and Moneywort (*Lysimachia nummularia*) as "rare." The valley slope unit FOM3-2 (Dry-Fresh Sugar Maple-Hemlock Mixed Forest) had Garlic Mustard present as "occasional." Down the slope, in the natural SWM5-1 (Red Maple-Conifer Organic Mixed Swamp) vegetation community, no invasive species were observed.

The following Category 1 invasive species were recorded within the Orlando Lands (Urban Forest Associates 2002):

- European Buckthorn;
- Canada Thistle (Cirsium arvense) – located within cultural meadows and along agricultural field edges;
- Garlic Mustard;
- Dame's Rocket (Hesperis matronalis) – present within FOD6-5 community;
- Tartarian Honeysuckle;
- Manitoba Maple (Acer negundo) – present in cultural areas such as residential, hedgerows and cultural meadows;

In addition, the following Category 2 invasive species were recorded (Urban Forest Associates 2002):

- Garden Bird's-Foot Trefoil (Lotus corniculatus) – present in cultural areas, such as residential, hedgerows and cultural meadows;
- White Sweet Clover (Melilotus albus) – present in cultural meadows and hedgerows;

- Tufted Vetch (Vicia cracca)– present in cultural meadows and hedgerows;
- Creeping Yellow Loosestrife (Lysimachia nummularia) – present in SWM5-1 and SWD4-5 communities;
- Moneywort (Lysimachia nummularia) – present within woodland; and
- Norway Maple (Acer platanoides) – located within woodland.

These species are identified within **Table 3** (**Appendix B2**).

3.1.2 Amphibian Call Count

Survey Methods

Three rounds of evening amphibian call count surveys (AMC) were completed in April, May and June 2015. Survey stations were first identified using a preliminary review of aerial photography and/or during earlier surveys. Stations were verified in the field to confirm the presence of suitable breeding habitat.

These surveys followed standard protocols outlined in the Great Lakes Marsh Monitoring Program (BSC 2003). Surveys were conducted on warm nights with little wind. Surveys commenced one half hour before dusk and ended before midnight. Visits were at least 15 days apart and as per protocols. The first occurred with a minimum nighttime air temperature of 5°C, the second visit with a minimum of 10°C and the third visit with a minimum of 17°C. If noise from plane, road traffic and/or trains was present, monitoring was delayed and began during a quiet period.

Each station was surveyed for three minutes and a three-level call category system was used to identify the level and type of frog activity.

The standard call levels are:

- Individual calls do not overlap and calling individuals can be discreetly counted;
- Calls of individuals sometimes overlap but number of individuals can still be estimated; and
- Overlap among calls seems continuous (full chorus) and a count estimate is impossible.

Anurans were recorded as within the station if they were within 100 m. All other species were recorded as incidental records heard outside the station.

Survey Results

AMC was conducted at six stations on the Orlando Lands in 2015. Station locations are illustrated on **Figure 6** (**Appendix B1**). All stations were surveyed in 2021 under appropriate round 1 and 2 timing windows. Species observations were similar to those identified during 2015 surveys. One additional station (G) was surveyed during the 2021 surveys; this station was not included within the 2015 surveys as it was determined to be unable to support amphibian breeding.

A cumulative total of four amphibian species were recorded during the AMC assessments. Detailed results of the AMC surveys are provided in **Table 4** (**Appendix B2**). All of the amphibian species are provincially ranked S5.

Based on local Halton status, no locally or regionally rare amphibians were observed.

3.1.3 Breeding Bird Survey

Survey Methods

Surveys were conducted following protocols set forth by the OBBA (Cadman et al., 2007), the Ontario Forest Bird Monitoring Program (Cadman et al. 1998) and the Marsh Monitoring Program (BSC 2006; BSC 2014).

Surveys were conducted between dawn and five hours after dawn with suitable wind conditions, no thick fog or precipitation (Cadman et al. 2007). Point count stations were located in various habitat types within the Orlando Lands and combined with area searches to help determine the presence, variety and abundance of bird species. Each point count station was surveyed for 10 minutes for birds within 100 m and outside 100 m.

All species recorded on a point count were mapped to provide specific spatial information and were observed for signs of breeding behaviour. Surveys were conducted at least 10 days apart.

Targeted surveys for SAR grassland species Bobolink and Eastern Meadowlark, listed as Threatened provincially and afforded protection under the ESA, were not conducted within the Orlando Lands as suitable habitat for these species was not present.

Both the NHIC (2021) database and the SARO list were reviewed to determine the current provincial status for each bird species.

Survey Results

A total of five point count stations were surveyed within the Orlando Lands. Point count stations were located within cultural meadow, swamp, and agricultural lands (**Figure 7, Appendix B1**). No point count stations were located along the offsite FOD/SWD communities as these communities will be retained and enhanced in place as part of the proposed site plan. These communities are also continuous with the existing woodland unit.

A total of 45 bird species were observed on the Orlando Lands. Of this total, seven species are confirmed, 16 are probable and 16 are possible breeders on the Orlando Lands. The remaining six bird species are considered non-breeders, flyovers or migrants. The observed breeding bird species are discussed in the sections below. All species observed on the Orlando Lands are listed in **Table 5** (**Appendix B2**).

A total of 39 (100%) of the confirmed, probable or possible breeders are provincially ranked S5, S4 or SNA (species not native to Ontario).

Probable breeding evidence was recorded for Barn Swallow, which is Threatened in Ontario and Canada. Although no nests were found during the survey, two pairs of Barn Swallows were observed on the Orlando Lands. One pair was documented in close proximity to a barn near point count station 1. This barn was not surveyed as there were horses in the paddock adjacent to the barn that precluded access to the structure. This barn has since been removed from the landscape; compensation habitat was provided in accordance with Ontario Regulation 242/08 section 23.5 in 2018. The second pair was observed in close proximity to an off-site barn near point count station 5. Both of these barns appear to be suitable structures for Barn Swallow nesting. Barn Swallow nesting habitat is shown on **Figure 7** (**Appendix B1**).

On November 29, 2018, the Orlando Lands were visited to assess Barn Swallow use in the large barn structure on the southeast residence/farm. A total of 69 Barn Swallow nests were observed in the beams of the main floor of the structure. Of these, 17 were determined to be used successfully in 2018. This was determined by intact, large amounts of droppings on the floor beneath the nests. These droppings accumulate during the time before fledging and do not typically persist more than 12 to 14 months on the ground. Many of the remaining nests were eroded with holes or were remnants of the former structure. Other nests were intact but did not have droppings underneath.

Confirmed breeding evidence was recorded in the woodlands at the north end of the Orlando Lands for Eastern Wood-Pewee, which is designated as Special Concern in Ontario and Canada. This species was present at point count stations 2, 3 and 4 during both survey rounds. A singing male was also recorded off-site near point count station 5 during survey round 2. Locations of Eastern Wood-Pewee within the Subject Lands are shown on **Figure 7** (**Appendix B1**).

No Bobolink or Eastern Meadowlark were recorded on the Orlando Lands; no breeding habitat is present for these species.

Based on local Halton status, one regionally rare bird species was also observed:

- Common Raven (Corvus corax). This observation was a flyover; no breeding evidence was recorded within the Subject Lands.

3.1.4 Insect Survey

Survey Methods

Insect surveys do not currently have a set protocol in Ontario. Species detection is dependent on repeated visits during the appropriate flight times for a given species in suitable habitat. Dragonflies and butterflies are conspicuous, easily observed and have plentiful resources to aid in identification of Ontario species and as a result, focus is on these groups during surveying.

Surveys were conducted between mid-morning and noon or late afternoon to sunset with mostly sunny skies, suitable low wind conditions, no thick fog or precipitation. Temperatures were between 22°C and 30°C such that insect activity was optimal. Area searches were placed within all habitats present within the Orlando Lands to help determine the presence, variety and abundance of insect species. In order to provide comprehensive coverage of all insect species flight periods, three survey periods were chosen:

- Early May to mid-June;
- Mid-June to mid-July; and
- Late July to late August.

Species were identified by confirmation in the field using binoculars and live capture and release. A hand lens (30X Leica) was used to identify certain species groups that require examination of specific anatomical features to ensure identification.

During insect surveys, vegetation and landscape features (i.e., watercourses) were assessed for potential presence of habitat for rare species (S1 to S3; NHIC 2021) and SAR.

Both the NHIC (2021) database and the SARO list were reviewed to determine the current provincial status for each insect species observed on the Orlando Lands.

Survey Results

Insect area searches were conducted within SWM5-1, MAM2-11 (Mixed Mineral Meadow Marsh), CUM1-1, MAS2-1 and along the periphery of agricultural lands as depicted in **Figure 8** (**Appendix B1**).

A total of 25 dragonfly and 26 butterfly species were observed within the Orlando Lands. The observed species are discussed in the sections below. All species observed on the Orlando Lands are listed in **Table 6** (**Appendix B2**).

A total of 50 (98%) of the species are provincially ranked S5, S4 or SNA. One insect species is considered provincially rare (S1-S3; NHIC 2021) and is discussed in the section below.

In addition, one SAR was observed on the Orlando Lands: Monarch (Special Concern in Ontario and Canada). A single Monarch was observed in flight along the edge of the soy field and SWD3-3 forest. Based on the timing of the survey (July 29, 2016), it is likely that this specimen was a migrant. Only a small host plant population (i.e., Common Milkweed; *Asclepias syriaca*) was noted on the Orlando Lands.

Based on local Halton status, two locally rare insect species were also observed, including:

- Tule Bluet (Enallagma carunculatum); and
- Grey comma (Polygonia progne).

No suitable habitat for Tule Bluet was recorded within the Subject Lands; however, suitable habitat for Gray Comma was identified. Gray Comma's were recorded within the woodland features; as they are typically found along the edges of deciduous and mixed forest habitats.

3.1.5 Turtle Nesting

Survey Methods

The turtle nesting survey occurred during the peak nesting period, which spans from late spring to early summer (late May to June). Candidate turtle nesting areas generally include shores/beaches of wetlands; lakes or rivers; gravel trails and driveways; and farm field margins with suitable substrate and aspect in relatively close proximity to core habitat (i.e., areas where turtles are observed basking). Potentially suitable nesting areas were searched for evidence of nesting, such as test nest dig sites, claw marks, turtle trails or

predated nests. Where potential habitat was noted, soil type mapping was reviewed for the presence of potentially suitable substrate. Data recorded at each potential nesting location included: nesting area size, % slope of the nesting area, % canopy cover over the nesting area, direction of orientation (e.g., east facing), location (coordinates), soil substrate, and distance from roadways.

Species-specific habitat preferences (COSEWIC 2008a) and the survey methods of the Ontario Ministry of Natural Resources (MNR; 2012a) and Toronto Zoo (Caverhill et al. 2011; Kula. 2011) were considered in the formulation of this survey protocol.

Survey Results

No evidence of turtle nesting was observed during the survey. Limited turtle basking habitat was identified within the Orlando Lands due to the absence of permanent pools, apart from the Middle Branch of Sixteen Mile Creek. The turtle nesting soil sampling core was taken within the vicinity of the Sixteen Mile Creek valleyland since this is adjacent to potential breeding/overwintering habitat for turtles in the watercourse. Only one survey was warranted within the Orlando Lands due to the agricultural nature of the property resulting in a lower survivability and likelihood of available nesting opportunities. This survey was completed to determine whether candidate nesting habitat was present on the Subject Lands. The site is dominated by silty clay loam soils that are moderately suitable for turtle nesting, however no south facing slopes were observed. The Orlando Lands are also actively managed as agricultural lands (row-crop); however, turtles could nest along the edge of the agricultural field adjacent to the natural heritage features and along roadsides (Esquesing and Boston Church Road). Locations of all survey transects are provided in **Figure 9** (**Appendix B1**) and survey results are provided in **Table 7** (**Appendix B2**).

3.1.6 Salamander Survey

No Ambystomid salamander trapping was warranted within swamp communities as these communities are located a distance from the proposed development and will be retained in place as they are located within the RNHS and Greenbelt. No Jefferson Salamander are known within the general vicinity of the Subject Lands as identified in the IRF by MNRF (see Appendix B3 and **Section 1.6.7**, above).

Survey Methods

Preliminary aerial photography review was completed to identify potentially suitable salamander habitat (upland forests with vernal pools). Surveys focused on cover board transects and wildlife road crossing transects. Cover board transects included searching natural cover, like logs and debris (carpeting, tarps) in addition to cover boards installed (12 in total). All objects were replaced as they were found to minimize disturbance.

Data recorded during salamander surveys included species observed and locations (UTM coordinates), air temperature, water temperature, survey start and end time, and weather conditions.

This survey methodology focuses on Eastern Red-backed Salamander (*Plethodon cinereus*) and Mole Salamanders (*Ambystoma* spp.) that are known to generally occur in the vicinity of the Orlando Lands. Survey methods are based on the joint Ecological Monitoring and Assessment Network (EMAN) and Parks Canada National Monitoring Protocol for Plethodontid Salamanders (Zorn et al. 2004).

Survey Results

Twelve cover boards and two wildlife road crossing transects were established on the Orlando Lands and adjacent roadways. Salamander cover board and road crossing transect locations are summarized on **Figure 10** (**Appendix B1**).

The SWD3-3 and SWD4-5 vegetation communities were found to be suitable habitat for Eastern Red-backed Salamanders. These polygons contained leaf litter and a high density of habitat features such as decomposing logs and woody debris. Soils were observed to be moist but not saturated under cover boards. In the SWM5-1 polygon, more saturated soils were observed along the western edge of the community. Soils in this area may have been too saturated to be suitable for Easter Red-backed Salamanders. The eastern edge of the

community associated with the watercourse lacked leaf litter and instead was populated with grasses. Canopy cover was also lacking in this community and may have contributed to unsuitable salamander habitat.

Despite survey effort, no salamander species were observed during these surveys. Detailed survey results are provided in **Table 8** (**Appendix B2**).

3.1.7 Snake Cover Board, Transects and Area Search

Survey Methods

Preliminary aerial photography review was completed to identify potentially suitable snake habitat (i.e., cultural meadow, disturbed meadow, wetland edges, cultural woodland, cultural savannah, rural residence and farm buildings).

Surveys focused on cover board transects, wildlife road crossing transects and general area searches.

Cover boards, which help detect more common snake species, were placed in the vicinity of several old standing structures associated with a farm homestead located west of Esquesing Line, which could provide candidate snake hibernacula opportunities(**Figure 9, Appendix B1**). Cover board transects included searching natural cover, like logs and debris (carpeting, tarps). All objects were replaced as they were found to reduce disturbance.

Transect surveys/area searches were conducted, which included scanning rocks/debris piles for basking snakes. These were completed along the Sixteen Mile Creek valleyland and existing RNHS, as well as along Esquesing Line and Boston Church Road. Survey effort was focused in areas with highest probability of detection; however, general searches were completed throughout the agricultural fields despite the absence of candidate hibernacula.

Snake surveys were conducted on mild spring mornings (minimum 8°C) and relatively cool autumn days (no greater than 25°C) between 8:00 and 14:00 hours, with sunny or overcast conditions. Data recorded during snake surveys included: species observed and locations (UTM coordinates), air temperature, survey start and end time, and weather conditions. Survey methods are based on MNR SAR protocols (2012b) and Toronto Zoo snake survey protocols (Caverhill et al. 2011).

Survey Results

2016 Results

Two reptile species were observed within the Orlando Lands: Eastern Gartersnake (*Thamnophis sirtalis*) and Eastern Milksnake. One Eastern Gartersnake was recorded along Esquesing Line, while one Eastern Gartersnake and one Eastern Milksnake were identified along Boston Church Road. Both species are listed as S5 or S4 (NHIC 2021). No snakes were recorded as part of the area and cover board search within the Subject Lands. Locations of all survey transects are provided in **Figure 9** (**Appendix B1**) and detailed survey results are provided in **Tables 9** and **10** (**Appendix B2**).

Minimal snake activity was observed on the Orlando Lands, resulting in no congregations of snakes being observed despite survey effort. As snake hibernacula is highly variable; it cannot be stated that no potentially suitable features exist on the Orlando Lands. However, the limited snake activity along with the largely agricultural landscape supports a lack of suitable snake hibernacula on the Orlando Lands.

2017 Results

Three cover boards were surveyed on the Orlando Lands over the course of 2017; these cover boards are the same cover boards that were deployed in 2016. Cover boards (CBs) 4 and 5 were unable to be located during 2017 assessments. No snakes were observed under the cover boards or within the general vicinity. In addition to cover board surveys, one area search was completed on the property around the barn structure along Esquesing Road. No snakes were observed within the search area despite survey effort. Detailed results of the snake surveys are provided in **Table 9** (**Appendix B2**).

Two wildlife road crossing transects were surveyed on, and adjacent to, the Orlando Lands along Esquesing Road and Boston Church Road. Four reptile species were recorded on the Orlando Lands including Snapping

Turtle, which is listed as Special Concern in Ontario. Three mammal and one bird species were also recorded, all of which are listed as S5 or S4 (NHIC 2021). A total of 13 Eastern Gartersnakes, one Dekay's Brownsake (*Storeria dekayi*) and one Red-bellied Snake (*Storeria occipitomaculata*) were recorded along Esquesing Line near the Sixteen Mile Creek watercourse crossing. Four Eastern Gartersnakes were recorded along Boston Church Road. Detailed results of the wildlife road crossing surveys are provided in **Table 10** (**Appendix B2**).

A total of 23 juvenile Snapping Turtles were found dead along Esquesing Road approximately 250 m north of the Parcel 4 lands. A nest search was completed; however, no nest was visible along the roadside. Since no suitable turtle nesting habitat was found on the Orlando Lands, it is anticipated that a Snapping Turtle dug her nest along or near Esquesing Road as this provided more suitable substrate and drainage.

Based on local Halton status, no locally or regionally rare reptiles were observed.

3.1.8 Bat Habitat and Acoustic

3.1.8.1 Bat Habitat Assessment

Survey Methods

On March 22, 2016, cavity tree density surveys were completed for the Orlando Lands, as cavity trees with snags are considered to be indicators of high-quality potential maternity roost habitat. Bat maternity colonies are considered to be a type of SWH. Further, four bat species listed as Endangered on the SARO list, Eastern Small-footed Myotis (*Myotis leibii*), Little Brown Myotis, Tri-coloured Bat (*Perimyotis subflavus*) and Northern Myotis (*Myotis septentrionalis*), are known to establish maternity roosts in trees, both within woodlands and hedgerows.

Bat habitat assessment survey methods were completed according to MNR survey guidelines as outlined in "Bats and Bat Habitats: Guidelines for Wind Power Projects" (MNR 2011).

Areas to be surveyed were determined through the use of aerial interpretation, ELC mapping of the Orlando Lands, and ground-truthing. Targeted ELC communities were deciduous forests (FOD), mixed-wood forests (FOM), deciduous swamp (SWD) and mixed-wood swamps (SWM). Surveys were conducted during the leaf-off period on a day when visibility was good. No hedgerows were surveyed as they are not considered Bat Maternity Roosting SWH nor SAR bat habitat.

Using the above criteria, two areas were identified to be searched on the Orlando Lands. One area included the western SWD3-3 community, while the second area included the SWD4-5, FOD6-5 and SWM5-1 communities.

ELC communities greater than 1 ha were surveyed using a plot-based approach, which consisted of randomly selecting 10 plots within the community. Each plot had a radius of 12.6 m (0.05 ha) and a GPS waypoint was recorded for each plot centre. Within each plot, all trees greater than or equal to 25 cm diameter-at-breast height (DBH) were visually inspected using binoculars to document any cavities that may or may not be present along the trunk or large branches. Each tree containing suitable cavities, or peeling bark preferred by the Tri-coloured Bat, had the following information recorded: UTM, species, DBH, approximate height, decay class, canopy cover, total number of cavities and height information for the top three cavities. Each tree was also photographed.

For all communities and hedgerows less than 1 ha, the entire community was surveyed using a transect approach, where transects were 5 m to 20 m apart (depending on visibility). These results were then used to assess the quality of the area to provide bat maternity roost habitat, with areas with >10 cavities/ha determined to provide the greatest potential bat maternity roost habitat in accordance with MNRF guidelines (2017).

Survey Results

The results of the habitat survey are presented in **Table 11** (**Appendix B2**) by area number and correspond with the bat snag locations shown on **Figure 3** (**Appendix B1**).

The SWD3-3 vegetation community was determined to be candidate SWH for bat maternity colonies based on suitable habitat criteria provided by MNRF (2015; >10 cavity trees per hectare with a minimum DBH of 25

cm). Given that suitable maternity roost habitat was identified within the SWD3-3 community, surveys were conducted to confirm the presence/absence of SAR bats on the Orlando Lands, and if bat species are using the habitat within this community (as discussed below within **Section 3.1.8.2**).

3.1.8.2 Bat Acoustic Monitoring

Survey Methods

Acoustic monitoring surveys to detect bat species within the Orlando Lands were carried out on June 8 and 27, 2016. Surveys were completed using handheld acoustic detectors (i.e., EchoMeter Touch by Wildlife Acoustics).

The acoustic field program was developed using a combination of professional experience and best available guidance provided by MNRF. These surveys were conducted prior to MNRF Guelph District releasing their Bat and Bat Habitat Surveys of Treed Habitats (2017) guidance document; it is also our understanding that this guidance has not been formally accepted by the rest of the MNRF. These surveys were the best available guidelines at the time of conducting the surveys. No additional field investigations are warranted given that the woodlots will be retained and enhanced in place with the proposed site plan.

Bat species can be identified using sonographic characteristics from calls used by bats to echolocate. These ultrasonic calls can be detected, recorded, and analyzed by biologists trained in bat sonogram interpretation to reasonably predict the species of bats present. All ultrasonic recordings were filtered to eliminate recordings with high levels of noise or with no bat calls, and then further analyzed using SonoBat's auto-classification. Any calls with a positive identification were manually vetted by a wildlife ecologist with training in bat species identification by sonogram.

Active mobile acoustic surveys consisted of walking transects and stopping at 10-minute point count stations using Wildlife Acoustics' EchoMeter Touch (EMT) devices to record bat activity. Survey sites were selected based on aerial interpretation, ELC vegetation community types, and ground-truthing for suitable bat micro-habitat such as clusters of large diameter (>25 cm DBH) trees with peeling bark and cavities, along the edges of woodlands. No hedgerows were surveyed as they are not considered Bat Maternity Roosting SWH nor SAR bat habitat.

Surveys were conducted between sunset and sunrise when temperatures were >10°C with low winds and no precipitation (**Figure 3, Appendix B1**). In addition, the EMT microphone was elevated approximately 2 m above the ground to reduce background noise during transect walks and at point count stations.

Survey Results

During acoustic surveys, three bat species were confirmed to be present on the Orlando Lands: Big Brown Bat (*Eptesicus fuscus*), Hoary Bat (*Lasiurus cinereus*), and Eastern Red Bat (*Lasiurus borealis*). Over two evening surveys, 15 low frequency calls and two high frequency call were recorded, with a cumulative total of 17 passes by all species. Of these, a total of six calls were confirmed to be Big Brown Bat, three calls were confirmed to be Hoary Bat and two calls were confirmed to be Eastern Red Bat. The remaining two high frequency calls were not identifiable to species and did not have 40K Myotis characteristics. No confirmed Endangered Myotis species were recorded on Orlando Lands.

The results of acoustic monitoring surveys conducted on the Orlando Lands are summarized in **Table 12** (**Appendix B2**).

Based on local Halton status, no locally or regionally rare bats were observed.

3.1.8.3 Bat Exit Surveys

Survey Methods

In accordance with protocols provided by MECP (2018), anthropogenic structures that have potential to be used as maternity roosts by bats were monitored through exit surveys combined with acoustic monitoring equipment to identify bats to the species level. The bat exit surveys and data analysis were conducted by qualified biologists with experience in bat identification and monitoring. All structures were pre-screened ahead

of the first site visit to understand whether any bat exits may be present (e.g., cracks in roofing, shed openings, uncapped chimneys). A total of five structures were pre-screened within the Parcel 4 lands, including a residence, one barn structure and three sheds/storage facilities, of which only two structures (an old barn and active residence) were determined to require bat exit surveys. The pre-screen was completed to understand where exit points could be (e.g., peak of roof, vents near roofline, chimneys). Full access was granted within some of the shed structures where visual observations could confirm that no bats were roosting within the structure. Where potential exit points were documented and investigations within the structures was not possible and/or the interior of structures could not be fully screened (e.g., drop ceilings), acoustic monitoring was completed.

Prior to sunset, surveyors were placed at all possible exit points with a hand-held heterodyne bat detector (Wildlife Acoustic EMT2 Pro). The hand-held heterodyne bat detector was set between 40 to 45 kHz to pick up SAR bat species and were recording in full spectrum.

The exit surveys began at sunset and continued to be monitored for 1.5 hours. Each structure was monitored twice under appropriate weather conditions (temperature above 15C, no rain, and low wind).

Survey Results

The barn and existing residential dwelling were surveyed to understand whether bats were using these structures to support maternity roosting. No SAR bats were observed leaving or entering the residential structure during the two evenings of surveys. Since no SAR bats were recorded leaving or entering the structures, it can be concluded that the two structures do not provide maternity roosting habitat for SAR bats. These survey results are valid for a period of one year (i.e., until June 2022), after which point bat exit surveys should be redone to ensure that SAR bats have not moved into these structures in subsequent roosting periods.

3.1.9 Winter Wildlife

Survey Methods

Winter wildlife surveys were conducted along transects throughout the Orlando Lands, as depicted in **Figure 4** (**Appendix B1**). Transect locations were determined through inspection of orthophotography, vegetation communities and ground observation, and were distributed across the Orlando Lands to ensure that the ecological variability on the Orlando Lands was adequately sampled. Surveys were concentrated along existing access routes, trails, habitat edges, hedgerows and streams where habitat was safely accessible by snowshoe. Transects were established within each vegetation community type and long transects were divided into segments to allow for more refined tracking of observation locations.

When possible, fieldwork was conducted at least 12 to 24 hours after moderate (i.e., <15 cm accumulation in 24 hours) snowfall. Fieldwork was conducted 24 to 48 hours after large snow events (i.e., >15 cm accumulation in 24 hours). Specifically, surveys were conducted in February 2015 following an overnight snow event, and within 12 hours of a snow event in February 2016. Wildlife tracks were recorded within 2-3 m on either side of each transect and all other evidence of wildlife (e.g., scat, browse, nests, hibernacula, etc.) was recorded. “Trails” are defined as numerous overlapping tracks that are difficult to discern from one another, which creates a trail system. In many cases, trails are used by several different wildlife species.

The Significant Wildlife Habitat Technical Guide (MNR 2000) and the Resources Inventory Standards Committee (RISC; n.d.) species inventory methods manual were used as guidance documents for the survey methodology.

Survey Results

2015 Results

The Orlando Lands are generally well used by common mammal species, such as Red Fox (*Vulpes vulpes*), Coyote (*Canis latrans*) and Eastern Gray Squirrel (*Sciurus carolinensis*). Evidence of use by a Beaver (*Castor canadensis*) was observed along transect 11, where chewed tree trunks were found along the banks of Sixteen Mile Creek. No fresh Beaver tracks, scat, dams or huts were found in the vicinity of the transect. Beavers do

not hibernate, and their activities are generally restricted to travelling beneath the ice between their lodge and underwater food reserves during the winter. No defined wildlife trails were observed. Detailed survey results are provided in **Table 13** (**Appendix B2**).

2016 Results

General habitat use was identified for common mammal species, such as Red Fox, Meadow Vole (*Microtus pennsylvanicus*), Eastern Gray Squirrel, Eastern Cottontail (*Sylvilagus floridanus*) and Coyote. No defined wildlife trails were observed.

Sixteen Mile Creek, the SWM5 vegetation community and the agricultural fields were heavily used by a variety of wildlife. Two defined Red Fox and Eastern Cottontail trails were observed near transect 10. Detailed survey results can be found on **Table 13** (**Appendix B2**).

Based on local Halton status, no locally or regionally rare species were observed.

3.1.10 2021 Site Reconnaissance

Survey Methods

Savanta staff were on site to conduct several site reconnaissance throughout 2021 (**Table 1, Appendix B2**). During site reconnaissance, the Orlando Lands were surveyed to determine whether existing conditions matched previously documented conditions. In addition to this, the hydro-corridor immediately south of the Orlando Lands were also surveyed to understand whether any natural heritage features may be present within the hydro corridor.

Survey Results

The conditions observed and recorded throughout Savanta's targeted fieldwork program are consistent with previous assessments of existing conditions. The Orlando Lands continue to be actively managed agricultural fields, with several seasonally wet HDFs. No new features were observed within the Orlando Lands.

Within the hydro-corridor, the lands consisted of actively managed agricultural fields. No natural or cultural vegetative communities were identified. The downstream component of HDF R1S1 and HDF R2S1 were identified within the hydro-corridor (discussed further below within **Section 3.2.2**). HDF R1S1 converged into HDF R2S1 to form one flow path under James Snow Parkway via a culvert. While both reaches were dry throughout the hydro-corridor, 7.5 cm of standing water was documented at the culvert.

3.2 Aquatic Ecology

Several watercourses and a number of headwater drainage features are present on the Orlando Lands. The following sections describe the inventory work completed on these features including aquatic habitat assessment, fish observations and headwater drainage feature assessment. In addition, information from background studies (as described in **Section** Error! Reference source not found.) is also integrated into this s ection to provide an overall characterization of the aquatic ecology of these features.

3.2.1 Watercourses

Two watercourses are present on the Orlando Lands; the Middle Branch of Sixteen Mile Creek located in the northeast corner and a tributary of Sixteen Mile Creek (also referred to herein as R3S1), which runs through the central portion of Parcel 4. These watercourses are shown on **Figure 11** (**Appendix B1**). Aquatic habitat and the fish community in each watercourse are discussed in the following sections. Watercourse constraint rankings are discussed in **Section 4.2.1.**

3.2.1.1 Middle Branch of Sixteen Mile Creek

3.2.1.1.1 Aquatic Habitat

The Middle Branch of Sixteen Mile Creek originates approximately 9 km north of the Orlando Lands and joins with the Middle East Branch of Sixteen Mile Creek around Sixth Line and Trafalgar Road (approximately 8.2 km downstream from the Orlando Lands).

No specific aquatic habitat investigations were completed in this watercourse, given that it is located in the Greenbelt, well outside the proposed development footprint and no impacts on the features are expected. Based on general observations, the watercourse is permanently flowing, meandering natural channel running within a well-defined valleyland. Groundwater seepage from the banks has been observed in several locations along the reach. As noted during the fluvial geomorphological assessment, the reach on the Orlando Lands contains primarily run and pool morphology with some riffles, and has an average bankfull width of 7.9 m and average bankfull depth of 0.83 m. Substrate in riffles ranges from sand to boulder, while in pools, substrate ranges from sand to cobble. Instream habitat consists of larger boulders, abundant large woody debris, undercut banks (up to 1.25 m in depth) and overhanging vegetation. Woody debris in the channel consists of a mix of downed trees, overhanging branches and leaning trunks from riparian trees and shrubs and a beaver dam crossing the channel. Riparian vegetation consists of a relatively dense mix of ground cover, shrubs and trees, with banks generally well vegetated. Riparian trees do appear to provide some shading of the channel, but the canopy is relatively open over the watercourse.

Based on the aquatic habitat present, this watercourse reach is expected to provide habitat suitable to facilitate completion of numerous life history functions for the resident and potentially migrant fish community of the area (as discussed in (**Section 3.2.1.1.2**). Life history functions provided for by the available habitat likely include spawning (e.g., in gravelly area for nest-builders such as Creek Chub), nursery (in lower velocity pools and around large woody debris and other instream cover), foraging and overwintering (in pools, including the area influenced by the beaver dam and deeper runs). Rainbow Trout migrating into Sixteen Mile Creek from Lake Ontario could potentially use gravel and small cobble dominated areas for spawning purposes. The mid-reach beaver dam may provide a partial barrier to free movement of fish throughout the reach, but movement is expected to be able to continue during high flow periods or via leakage through the structure.

3.2.1.1.2 Fish Community

Given that this watercourse is located in the Greenbelt well outside the proposed development footprint, and that existing fish community data is available from the CH Long-Term Ecological Monitoring Program, no fish community investigations were undertaken in the watercourse. As discussed previously in **Section 1.6.10**, the fish assemblage in this watercourse is dominated by cool to warm water, generally riverine fish species. As discussed in CH (2011), the following fish species were captured in 2011 at monitoring station SXM-349, located approximately 1.8 km downstream from the Orlando Lands:

- Creek Chub;
- Fantail Darter;
- Johnny Darter;
- Northern Hog Sucker;
- Pumpkinseed;
- Rainbow Darter;
- Rainbow Trout;
- Stonecat; and
- White Sucker.

The fish community Index of Biotic Integrity was determined to be Good, based on the 2011 results, which was an improvement from the Fair condition assessed in 2007 to 2009 (CH 2011). Rainbow Trout is not thought to be a permanent resident in Sixteen Mile Creek and its tributaries. During the spawning season, Rainbow Trout will enter Sixteen Mile Creek from Lake Ontario and migrate upstream, where they have been captured in the Middle Branch as far upstream as the Scotch Block Dam, which is located approximately 5 km

upstream from the Orlando Lands (CH 2011). Juvenile Rainbow Trout will return back to Lake Ontario where they will remain until they reach sexual maturity and migrate upstream to riverine spawning habitats (Natural Resources Conservation Service; NRCS 2000). No aquatic SAR were identified in this watercourse within the vicinity of the Orlando Lands.

CH also completes benthic invertebrate sampling at monitoring station SXM-349. In 2011, overall water quality, based on benthic invertebrate community metrics, was determined to be unimpaired at this station (CH 2011).

3.2.1.2 Tributary of Middle Sixteen Mile Creek (R3S1)

3.2.1.2.1 Aquatic Habitat

This watercourse originates from agricultural field run-off approximately 950 m north of the Orlando Lands. It appears to be channelized through the agricultural field in Parcel 3 south of 5 Sideroad before entering the woodland just north of the Orlando Lands. After flowing out of the woodland at the northern Orlando Lands boundary, the watercourse flows for approximately 1.1 km in an easterly direction through the active agricultural fields, where it exhibits evidence of historic channelization and is highly altered as a result of agricultural practices. The watercourse leaves the Orlando Lands via a culvert under Esquesing Line where it flows through a mix of rural residential, agricultural and natural areas before draining into the Middle Branch of Sixteen Mile Creek approximately 2.3 km downstream from the Orlando Lands. The overall catchment area for the watercourse is 139.5 ha.

The watercourse is comprised of one main reach (R3S1) on the Orlando Lands and is supported by a number of headwater drainage tributaries. As discussed in **Section 3.5.2**, R3S1 receives seasonal groundwater discharge, however the remainder of the time it is supported through surface water contributions. The downstream reaches towards Esquesing Line do not receive groundwater discharge and are solely supported by surface water. A detailed aquatic habitat assessment was completed in this watercourse on the Orlando Lands. In addition, although the feature is designated as a watercourse, aquatic habitat data was also collected on the feature using the HDFA protocol (CVC and TRCA 2014). The methodology and results of the detailed aquatic habitat assessment are provided in the sections below. The results of the aquatic habitat investigations completed using the HDFA data collection protocol are also described below, while the methodology is discussed in **Section 3.2.2**. Additional descriptions of the morphological characteristics of this watercourse are provided in **Section 3.3**.

Aquatic Habitat Assessment Survey Methods

The Aquatic Habitat Assessment consisted of a detailed visual survey of existing instream and riparian habitat conditions along and adjacent to a portion of the watercourse running through the Orlando Lands. The assessment took note of any of the following features:

- Hydrology (e.g., flowing or standing water)
- General watercourse morphology (e.g., riffle, run, pools)
- Wetted width and depth (at time of survey)
- Bed and bank substrate
- Instream habitat (e.g., woody debris, aquatic vegetation, undercut banks)
- Presence of obstructions to fish movement (e.g., culverts, debris dams)
- Evidence of groundwater inputs (e.g., seeps or springs, iron flocculation/staining)
- Riparian habitat.

A photographic record of habitat conditions on and adjacent to the Orlando Lands was collected during the assessment (see **Appendix B7** for representative photos).

Survey Results

One aquatic habitat station (AHS1) was completed within R3S1 (**Figure 11, Appendix B1**). This station was selected as it provided a representative snapshot of the reach. AHS1 was total of 40 m in length and was selected in accordance with OSAP's reach selection guidelines (S1 M1). This survey was conducted within

48 hours of a rain event in an effort to characterize this intermittent feature while it was holding water. The feature was dry upon assessment; no water was documented throughout the entire reach; however, saturated soils were recorded within portions of the reach. No anthropogenic inputs (e.g., culverts, SWM outlets) were documented within the reach to suggest alteration to stream hydrology.

AHS1 is a seasonally wet defined channel that receives seasonal inputs from upstream wooded and wetland features. The feature conveys flow through actively managed agricultural fields (row-crop; corn) and likely receives some overland flows from adjacent areas. AHS1 contained limited habitat morphology, as it was 100% run habitat. No other fish habitat features/structures (e.g., large woody debris, undercut banks, riffles), were documented within the reach.

Mean bankfull width was measured at 3.45 m with a bankfull depth measured at 0.34 m. Bed and bank substrates within AHS1 consisted of silty clay. No evidence of erosion or depositional features were recorded within AHS1. Both banks appeared stable, however cropped vegetation was recorded right up to the edge of the feature. A small isolated patch of meadow habitat was recorded midstream, and contained Asters (*Asteraceae* sp.), Goldenrods (*Solidago* sp.), Teasel (*Dipsacus* sp.), Vetch (*Vicia* sp.), Timothy Grass (*Phleum pratense*) and Queen Anne's Lace (*Daucus carota*). No instream vegetation was recorded throughout the majority of AHS1, except for a small patch of Reed Canary Grass at the upstream extent of the reach. Minimal cover (<30%) was recorded within the feature, as no riparian shrubs or trees were recorded within proximity to AHS1 to provide canopy cover.

Downstream of AHS1 within the east-west hedgerow, a damaged culvert was recorded which could limit the movement of fish into the upper portions of the feature. No other migratory obstructions were recorded within or nearby the reach to suggest that fish would be unable to pass through the reach during wet conditions.

Observations Made Using HDFA Protocol

R3S1 consists of an intermittent natural defined channel that was flowing during the first round, had standing water during the second round and was dry by the third round. During the second-round assessment, small, isolated pools with no downstream connection were observed within the lower portions of the reach. Algal growth was present within these pools. This feature flows from off-site wooded features through an agricultural landscape before exiting the site through a culvert under Esquesing Road. The feature is incised with obvious bed sorting and instream erosion.

Seasonal (early spring) fish habitat was present throughout the feature including riffles, runs and pools. Feature width was measured at 5 m and wetted width at 1.2 m during the assessment in April 2018. Water depths during the first round varied between 10 cm and 23 cm. Flow velocity calculations obtained during the first-round assessment ranged from 0.11 m/s to 0.18 m/s. While no fish species were observed during 2018 surveys, 12-15 fish, identified as possible Western Blacknose Dace (*Rhinichthys obtusus*) were visually observed by a Savanta fisheries biologist within this reach during the HDFA survey conducted on April 16, 2015. The fish were observed in the reach between 155 m and 670 m upstream from the Esquesing Line culvert. Based on these observations, the feature has been confirmed as providing seasonal direct fish habitat. The presence of seasonal riffles, runs and pools may permit a range of spring life history functions to be completed (e.g., reproduction, foraging) for baitfish species, although the intermittent flow regime may impair the reproductive function of the watercourse, particularly during dry years. Water temperature within the isolated standing pools during the second-round assessment was 26°C, suggesting that the feature could only support tolerant warm-water fish species. Given that the feature is intermittent and dries up in the summer, any fish using the feature on a seasonal basis must move back downstream to summer refuge habitat (off the Orlando Lands) or they would perish as the watercourse dries up.

These observations are consistent with a medium constraint watercourse as discussed further within **Section 4.2.1.2**.

3.2.1.2.2 Fish Community

As per the Terms of Reference (Savanta 2016), fish community sampling was required within HDFs to determine the presence/absence of fish within features. As discussed in **Section 3.2.1.2.1**, the presence of fish was confirmed in the feature in spring 2015. Given the intermittent flow regime, this watercourse appears to be capable of providing only seasonal direct fish habitat, given that it has been observed to dry out in the

summer and there are no permanent refuge locations on the Orlando Lands. Therefore, seasonal presence of fish appears to be the result of upstream early spring movements from further downstream refuge areas in this watercourse, or potentially in the Middle Branch of Sixteen Mile Creek. Depending on the flow regime in any given year, the watercourse may facilitate spring reproductive activities, providing spawning, incubation, hatching and downstream movement occur prior to drying out of the feature.

3.2.2 Headwater Drainage Features

Survey Methods

Potential HDFs on the Orlando Lands were assessed using the Credit Valley Conservation/Toronto Region and Conservation Authority (CVC/TRCA) 2014 "Evaluation, Classification and Management of Headwater Drainage Features Guidelines" (herein referred to as the HDFA Guidelines). These guidelines provide a standardized means of identifying and assessing the value of HDFs and identifying long-term management recommendations to protect or maintain the important ecological or biophysical functions provided by HDFs in a developing landscape.

HDFA surveys were conducted on the Orlando Lands in 2015 and were updated in 2018. This Comprehensive Study will focus on the updated 2018 data. Per the requirements of the HDFA Guidelines, Savanta completed site visits to assess HDFs on the Orlando Lands on the following dates:

- Round 1 – April 13 and 27, 2018;
- Round 2 – May 30, 2018; and
- Round 3 – August 15, 2018.

During the first site visit, all areas of the Orlando Lands were walked to identify potential HDFs. Each HDF observed was separated into specific reaches, per the guidance on reach delineation in the HDFA Guidelines, and data collection was completed for each reach based on Ontario Stream Assessment Protocols (OSAP) for Unconstrained Headwater Sampling, Section 4: Module 11 (Stanfield ed. 2017). Sampling of each reach was then completed in accordance with OSAP protocols.

Following completion of the three survey rounds, the collected data were used to classify each HDF, based on the HDFA Guideline hierarchy.

The locations of the HDFs are shown on **Figure 11** in **Appendix B1**, and additional details can be found in **Table 14** in **Appendix B2.**

Survey Results

Each HDF, including a discussion on fish species observations and potential fish habitat, is provided in the following sections. Management recommendations are provided in **Section 5.3.1**.

Feature R1 and Associated Tributary Features

Feature R1 is located within the southwestern portion of the Parcel 4 lands. This feature drains in a southeasterly direction towards the adjacent transmission line corridor and is comprised of two main reaches (R1S1 and R1S2) and one tributary feature (R1S1a). This feature has a total catchment area of approximately 61.0 ha in size. The feature appears to ultimately outlet into a stormwater management pond (SWM) downstream within an industrial site.

Reach R1S1 is an ephemeral swale feature that conveys flows from R1S2 (wetland) through agricultural fields and into an off-site channelized feature within the transmission line corridor. As discussed further within **Section 3.5.2.2,** R1S1 is solely supported through surface water contributions. R1S1 was flowing during the first-round assessment. The majority of the reach was dry during the second-round assessment, with the exception of a few isolated pools that had no downstream connection. The feature itself does not provide direct fish habitat, but it does contribute flows to downstream watercourses providing fish habitat by way of a SWM pond draining an industrial area south of James Snow Parkway. Based on an analysis of aerial imagery, R1S1 appears to flow into R2S1 off-site before entering an industrial area to the south. Substantial sediment deposits (31 mm to 50 mm) were recorded during the first-round assessment, as well as instream bank

erosion. The feature and wetted widths were measured at 1.78 m and 0.69 m, respectively, during the first-round assessment. Hydraulic head measured during the first round was 2 mm in height.

Feature R1S2 is a swamp wetland vegetation community (SWD3-3) that was holding water during the first-round assessment and was dry by the second round. Discharge from the wetland enters R1S1 through the agricultural field. Site assessments that were completed prior to the first-round survey documented R1S2 flowing into R1S1. No springs or seeps were observed during HDFA surveys and no fish or fish habitat were observed. The estimated feature and wetted widths are both approximately 30 m. Minimal sediment deposits were observed within the feature. No amphibian breeding was observed in the wetland.

Feature R1S1A is an ephemeral swale that originates in the agricultural field and flows into R1S1. The feature was flowing during the first-round assessment and was dry by the second round. Extensive (>80 mm) sediment deposits were recorded during the first-round assessment. The feature was documented as having extreme roughness (>60%) attributed to the previous year's crop (i.e., corn). The feature does not provide direct fish habitat. Feature and wetted width measurements during the first round were 1.7 m and 0.32 m, respectively.

Feature R2 and Associated Tributary Features

Feature R2 is located along the approximate mid-point of the Parcel 4 property and flows in a southerly direction towards the adjacent hydro-corridor. It is comprised of one main reach (R2S1) and several associated tributary features.

R2S1 is an ephemeral channelized feature that conveys flows from agricultural fields into an off-site channelized feature, before flowing into a SWM pond via the industrial area located south of the Orlando Lands. The feature has been historically straightened to accommodate agricultural practices and is located along the edge of the agricultural field. The feature is showing signs of a slight meander beginning to occur within the channelized banks. R2S1 was flowing during the first-round assessment. Isolated pockets of standing water were observed during the second-round survey and the feature was dry by the third round. Standing water observed within R2S1 had no downstream connection and had persisted as a result of coverage provided by Cattails (*Typha* sp.). This feature does not provide direct fish habitat, but indirectly contributes flows to downstream watercourses. Extensive sedimentation (>80 mm) was observed within the feature during the first-round assessment. Feature and wetted widths were measured at 3.4 m and 0.77 m, respectively.

R2S1A is an ephemeral swale feature that had standing water during the first-round assessment and was dry by the second-round assessment. The feature originates in the agricultural field (corn) and flows southeast into R2S1. Extreme feature roughness (>60%) was documented within the feature as a result of the adjacent corn field. Extensive sediment deposition and instream bank erosion was also documented. Feature and wetted width measurements during the first round were 1 m and 0.39 m, respectively. No fish or fish habitat were observed within the feature.

R2S1B is an ephemeral swale feature that contained standing water during the first-round assessment and was dry by the second-round assessment. The feature originates in the agricultural field (corn) and flows southwest into R2S1. Substantial sediment deposition was recorded within the feature. No fish or fish habitat were observed. Feature and wetted width measurements during the first-round assessment were 1.04 m and 0.44 m, respectively.

R2S1C is a swale feature within the agricultural field that had standing water during the first-round assessment and was dry by the second round. R2S1C connects an upstream undefined feature (area of localized pooling; R2S1D) to a downstream HDF (i.e., R2S1); however, flowing water conditions were not observed within this feature. No fish or fish habitat were observed during the assessments. Feature and wetted width measurements during the first round were 3.92 m and 1.0 m, respectively.

R2S1D is an undefined feature (localized pooling within an agricultural field) that had standing water during first and second round assessments and was dry by the third-round survey. No downstream flows were observed, and no fish or fish habitat were identified. Feature and wetted widths both measured at 13 m. No aquatic vegetation was present within R2S1D.

HDF Tributaries of Watercourse R3S1

R3S1A is an ephemeral swale feature that originates in the agricultural field near the edge of the adjacent woodland, and flows southeast into R3S1. No hydrological connection with the adjacent woodland/wetland (SWD4-5) was observed during the HDFA in 2018, although it is possible that during high flow periods, some drainage from the woodland enters this feature. No fish were observed during the assessments. Instream erosion was prevalent throughout the feature, with extensive sediment deposits (>80 mm) identified at several locations. Substrate sorting was starting to occur within the feature with some gravel substrates documented sporadically, causing downstream erosion and scour pools. Feature width and wetted width measurements during first round assessments were 0.78 m and 0.40 m, respectively. Water depth was measured at 2 cm.

R3S1B is an ephemeral swale feature that contained standing water during the first-round assessment and was dry by the second round. The feature originates in the middle of the agricultural field and flows north into R3S1. The feature was documented as having extreme feature roughness (>60%) as the swale flows through remnant stalks of the previous year's crop. No fish or fish habitat were identified within the feature. Feature and wetted widths were measured at 0.75 m and 0.44 m, respectively. Water depth was measured at 3 cm during the first-round assessment.

R3S1C is an ephemeral swale feature originating in the agricultural field and flowing north into R3S1. The feature had standing water during the first-round assessment and was dry by the second-round survey. Water depth within the standing water was measured at 4 cm depth. Minimal sediment deposition (<5 mm) was recorded within the feature, with no valley sediment transport identified. The swale flowed through debris from the previous year's crop and was therefore identified as having extreme feature roughness. No fish or fish habitat were identified within the swale.

R3S1D is an ephemeral swale feature that flows along the boundary of the woodlot/wetland/residential hedgerow and the agricultural field. The feature is fed by R3S1E and R3S1F and flows northeast into R3S1. The feature was flowing during the first-round assessment and was dry by the second-round assessment. Substantial sediment deposition was recorded within the feature (31-50 mm). Minimal feature roughness was observed as the feature was largely bare. No fish or fish habitat were found within the feature. Feature and wetted widths measured at 1.3 m and 0.25 m, respectively, during the first-round assessment with water depth measuring at 2 cm depth.

R3S1E is an ephemeral swale feature that had standing water during the first-round assessment and was dry by the second-round assessment. This feature originates in the agricultural field and flows northeast into R3S1D. Similar to R3S1D, R3S1E flows adjacent to the residential hedgerow that connects wooded features on the Orlando Lands; however, the feature itself flows through the agricultural field. The water depth of the standing water was measured at 2 cm depth. Extensive sediment deposition was recorded within the feature. The feature roughness was identified as moderate (10 to 40%). Feature and wetted widths were measured at 0.60 m and 0.20 m, respectively. No fish or fish habitat were identified within the feature.

R3S1F is an ephemeral swale feature that had standing water during the first-round assessment and was dry by the second-round assessment. The feature originates in the agricultural field and flows north into R3S1D. Feature and wetted widths were measured at 0.80 m and 0.12 m, respectively, with a water depth of 4 cm. Extreme feature roughness was documented within the feature. No fish or fish habitat were recorded.

R3S1G is an ephemeral undefined feature that contained standing water during the first-round assessment. The feature is located within the floodplain of R3S1 and connects R3S1H (upstream HDF) to R3S1. The feature flows through the agricultural field and was identified as having extreme feature roughness due to last year's crop. No fish or fish habitat were identified within the feature. Feature and wetted widths both measured at 10 m during first round assessments; water depth was measured at 10 cm.

R3S1H is an ephemeral channelized feature along the edge of agricultural fields that receives contributions from R3S1I, although it originates in the agricultural field. The feature flows northeast into R3S1G. Standing water was documented throughout the entire feature during the first-round assessment and isolated, small pockets of standing water were identified during the second-round survey within cattail stands. It is anticipated that the cattails shaded the standing water pool thereby reducing evaporation potential. The upstream and downstream portions of the reach were dry during the second-round assessment. No downstream flow was observed, and extreme roughness was documented within the feature due to the extensive dominance of cattails. Feature and wetted widths during the first-round assessment measured at 3.7 m and 0.20 m,

respectively. Wetted width during the second-round assessment measured at 0.43 m, with water depths ranging from 3 cm to 4 cm. Water temperature during the second-round assessment was 26°C. No fish or fish habitat were documented within the feature.

R3S1I is an ephemeral swale feature that had standing water during the first-round assessment and was dry by the second round. The feature originates in the agricultural field and is fed by R3S1H. No fish or fish habitat were documented within the feature. Feature and wetted widths were measured at 1.28 m and 0.38 m, respectively. Water depth was measured at 4 cm.

Feature R4

This feature consists of one reach in the northeastern corner of the Parcel 1 lands. R4S1 is an ephemeral undefined feature that contained standing water during the first-round assessment and was dry by the second-round assessment. This undefined feature flowed through the agricultural field from a culvert along 5 Sideroad and into a roadside ditch along Boston Church Road. The most upstream extent of the feature had instream erosion due to increased topographic relief before leveling out. Feature and wetted widths measured at 3.64 m (upstream) and 0.77 m (downstream) during the first-round assessment. No fish or fish habitat were observed within the feature. The feature had extreme feature roughness from previous agricultural crops.

Feature R5 and Associated Tributary Features

This feature is located on the western portion of the Parcel 1 lands and flows in a southerly direction. It consists of three main reaches (R5S0, R5S1 and R5S2) and one tributary reach.

R5S0 is an ephemeral channelized feature that receives flows from R5S1 and directs flows around the edge of an abandoned horse track and into another channelized feature before exiting the Orlando Lands into other agricultural lands to the south. Through aerial photo interpretation, it appears that the feature continues through the agricultural field (potentially with some degree of alteration) downstream into a culvert under James Snow Parkway. From there, flows are likely piped underneath the industrial area before discharging into a stormwater management pond. The feature was supporting substantial flows during the first-round assessment and was dry by the second-round survey. No fish or fish habitat were identified within the feature. Feature and wetted width measurements during the first round were 2.2 m and 1.5 m, respectively. Water depth during first round was measured at 10 cm. Extensive sediment deposition was recorded within the feature. Algal growth was prevalent throughout the feature.

R5S1 is an ephemeral swale feature that had substantial flow during the first-round assessment and was dry by the second round. The feature is fed by R5S2 (roadside ditch) and receives some inputs from the off-site train track ditch at the upstream and midstream extent before flowing southeast across the Orlando Lands into R5S0. R5S1 occurs within a lower topographic elevation than the train track ditch; therefore, flows are naturally draining into the feature. No fish or fish habitat were documented within the feature. The feature had extensive sediment deposition, with rilling identified throughout the feature. Feature and wetted widths during first-round assessments were measured at 0.69 m and 0.49 m, respectively. Water depth ranged from 7 cm to 11 cm during the first round. One velocity measurement taken during the first-round assessment found flows were moving at approximately 0.064 m/s. The feature had high roughness, making it difficult to obtain multiple flow measurements.

R5S2 is an ephemeral roadside ditch along 5 Sideroad that had standing water during the first-round assessment and was dry by the second-round survey. The feature does not receive contributions from upstream features/culverts. No fish or fish habitat were observed within the feature. The feature and wetted widths measured at 1.75 m and 0.74 m, respectively. Substantial deposition and moderate feature roughness were recorded within the feature.

R5S0A is an ephemeral undefined feature that originates in the middle of the abandoned horse track (now cropped). This feature flows through the agricultural field before flowing through a culvert and into R5S0. The feature was flowing during the first-round assessment and was dry by the second-round assessment. Extensive sediment deposition was recorded during the first-round assessment, with high feature roughness from last-year's crop. Feature and wetted widths were both measured at 8.0 m during the first-round assessment. No fish or fish habitat were found within the feature.

Feature R6 and Associated Tributary Features

Feature R6 (also identified as SMC-Trib-01) consists of two reaches on the Parcel 4 lands that flow towards Boston Church Road. As discussed within **Section 3.5.2.2**, R6S1/R6S0 are solely supported through surface water contributions and are not connected to the water table. The total catchment is approximately 43.6 ha in size.

R6S0 is an ephemeral swale feature that receives flows from R6S1 (via a culvert under the horse track) and flows into a roadside ditch along Boston Church Road. The feature was flowing during the first round and was dry by the second-round assessment. The swale flows through a meadow community, with some cattails observed at the downstream extent where water was stagnant within the roadside ditch. The feature has extreme feature roughness as it flows through a meadow community. Minimal sediment deposition was recorded within the feature. Feature and wetted widths were measured at 0.35 m and 0.17 m, respectively. No fish or fish habitat was observed.

R6S1 is an ephemeral excavated ditch around the edge of the former horse track that had standing water within isolated pockets during the first and second-round (spring) assessments. No flow was observed within the feature at any point. The feature was removed from the landscape between second and third-round (summer) assessments as part of agricultural land uses, however, it is assumed that this feature would be dry in the summer since the majority of the feature was dry during second round assessments. There was no downstream connection as R6S0 was dry by the second round. Standing water was present within the channelized feature as it was densely vegetated with cattails and had little to no open space to allow for evaporation. The feature originates on the inside curve of the horse track and flows into R6S0 byway of a culvert. The culvert appeared to be laterally crushed and may constrain upstream flows. During the first-round assessment, feature and wetted width measurements were both 1.23 m. Wetted width was measured in the second round at 0.62 m. Water depth was measured at 15 cm depth during the first round and ranged between 5-6 cm during the second round. Minimal sediment deposition was recorded within the feature. No fish or fish habitat were present within the feature.

3.3 Fluvial Geomorphology

As outlined in **Section 3.2.1**, there are two main watercourse features within the Subject Lands: the Middle Branch of Sixteen Mile Creek and a tributary of Sixteen Mile Creek. The Middle Branch of Sixteen Mile Creek (referred to herein as SM1) is situated within the northeast corner of the site, and the tributary of Sixteen Mile Creek (referred to as R3S1) transects the central portion of Parcel 4. Channel morphology and existing conditions for each feature are outlined below. Rapid and detailed geomorphological field assessments were completed for the features between 2015 and 2021. Meander belt width delineation was also completed for each feature to characterize the existing erosion hazard extent. A summary of the fluvial geomorphological assessment is provided below, and a detailed overview of the assessment is provided in **Appendix C**.

3.3.1 Rapid Geomorphological Field Assessments

Rapid geomorphological assessments wer completed for the main watercourses on participating properties based on standard field protocols. Given the extent of headwater drainage features on site, the rapid geomorphological assessment was limited to reach **SM1** and **R3S1** within the Orlando lands. An additional rapid assessment was completed for reach **R3S0C** on the tributary of Sixteen Mile Creek, downstream of **R3S1** and east of the Orlando lands, to inform the subsequent erosion assessment. The assessment included the following components:

- Characterization of stream form, process, and evolution using the Rapid Geomorphological Assessment (RGA) (MOE, 2003; VANR, 2007)
- Assessment of the ecological function of the watercourses using the Rapid Stream Assessment Technique (RSAT) (Galli, 1996)
- Instream estimates of bankfull channel dimensions
- Observations of channel bed and bank material composition and structure

- Habitat sketch maps based on Newson and Newson (2000) outlining channel substrate type, flow patterns, geomorphological units (e.g., riffle, run, pool), and riparian vegetation

Middle Sixteen Mile Creek (SM1) flows in a southeastern direction across the northern corner of the property. The Middle Sixteen Mile Creek in this location is a mixed-load meandering channel, with a low gradient that sits within a wide valley system. The channel flows through an established and continuous riparian buffer zone that extends greater than 10 times the channel width and contains predominately grasses and deciduous trees. The average bankfull width and depth were 7.9 m and 0.83 m, respectively. The average wetted width and depth at the time of the assessment were 6.1 m and 0.49 m, respectively. Bank angles ranged from 30 to 60 degrees. Bank materials consisted of clay and silt. Bed materials in pools ranged from sand to cobble, while bed materials in riffles ranged from sand to boulder. A high density of woody debris was also observed in the channel. General channel characteristics for SM1 based on the rapid geomorphological assessment are summarized below in **Table 3-1**. Photographs and rapid geomorphological field sheets (e.g., RGA/RSAT) are also provided in **Appendix C**.

The tributary of Sixteen Mile Creek R3S1 originates north of the Subject Lands and then flows through agricultural fields in Parcel 3. From here, it then enters the woodland immediately north of Parcel 4. The feature then flows diagonally through the central portion of Parcel 4 to a culvert at Esquesing Line. The tributary confluences with the Middle Branch of Sixteen Mile Creek approximately 2.3 km downstream of the Subject Lands. Within Parcel 4, the channel is a single thread, low-gradient channel that sits with an unconfined system. There is evidence of historic channelization along the length of the watercourse, and as such, the feature can be considered highly altered because of adjacent agricultural practices. Artificial ditching has resulted in a large bankfull channel in several locations; however, observations collected on site show that there is a smaller, low-flow channel nested within the larger ditch footprint. Average bankfull width and depth of the ditched feature were 3.77 m and 0.20 m, respectively. The low-flow channel nested within the larger feature had an average width in the range of 1.0-1.5 m. Bank angles ranged from 30 to 60 degrees. Bank materials consisted of clay and silt. Bed materials ranged from clay/silt to small gravels.

It should be noted that R3S1 was initially assessed as a Headwater Drainage Feature, as outlined in Section 3.2.2. Given that HDF assessments are completed over three separate rounds between April and August, this approach provided a comprehensive review of the feature during a range of conditions. Erosion was evident along the reach through each site visit; however, the three visits indicated that surface flow conditions are minimal through the summer months. As such, most of the observed erosion is likely a result of spring freshet flows. In the summer months, the reach is heavily vegetated with extreme vegetation encroachment through the channel. General channel characteristics for R3S1 based on the rapid geomorphological assessment are summarized below in Table 3-1. Photographs and rapid geomorphological field sheets (e.g., RGA/RSAT) are also provided in Appendix C. Reach R3S0C of the tributary of Sixteen Mile Creek flows through a grassy corridor east of the Orlando properties. The reach is characterized as a low-gradient, meandering, suspended-load dominated channel. Riparian vegetation consists of grasses with occasional mature trees on the northern banks. The average bankfull width and depth are 1.75 m and 0.27 m, respectively. The bank materials throughout the reach are a cohesive silty-clay, and bed materials range from compact, cohesive silty-clay to small gravel. General channel characteristics for R3S0C based on the rapid geomorphological assessment are summarized below in **Table 3-1**. Photographs and rapid geomorphological field sheets (e.g., RGA/RSAT) are also provided in **Appendix C**.

Table 3-1 Rapid Geomorphological Assessment Observations

Watercourse Reach	Average Bankfull Channel Width (m)	Average Bankfull Channel Depth (m)	Substrate		Riparian Conditions	Notes
			Riffle	Pool		
SM1	7.9	0.8	Sand to boulder	Sand to cobble; coarse materials embedded	Continuous vegetation coverage; deciduous trees and grasses	Meandering channel, undercutting on outer meander banks; deposition on point bars
R3S1	3.77	0.2	Substrate ranged from clay/silt to small gravels (sediment sorting observed); poorly defined morphological features (riffles/pools)		Limited to no riparian coverage; agricultural crops up to edge of channel	Straight channel; heavily modified by past ditching practices; nested low-flow channel observed
R3S0C	1.75	0.46	Uniform substrate throughout; predominantly clay; some small gravels	Continuous, wide, grasses and occasional trees	Fairly entrenched, frequent meandering, undercutting common, poorly defined geomorphic units	

3.3.2 Detailed Geomorphological Field Assessment

To accommodate the proposed development on site, a channel realignment has been proposed for Reach R3S1 (as described in later sections of this report). Given that the feature is well-defined and provides ephemeral flows to downstream reaches, a detailed geomorphological assessment was completed in support of the proposed realignment. Downstream of the Orlando lands, an additional detailed geomorphological assessment was completed on reach R3S0C to inform the erosion sensitivity analysis in support of the proposed stormwater management plan (**Section 6.2**).

Obtaining detailed geomorphological measurements and observations allows for a more complete characterization of channel geometry, flow, and sediment characteristics. The data obtained are used to make well informed decisions with regards to channel characteristics applied in natural channel design and erosion mitigation in the interest of maintaining or improving channel conditions with regards to stability and fluvial function.

The detailed geomorphological assessment included a substantial portion of the reach within the Subject Lands. The results of the detailed assessments are provided in **Table 3-2,** and comprehensive summaries is included in **Appendix C**. The following activities were completed as part of the detailed assessment:

- Longitudinal profile along the channel centre line to determine an existing gradient for the feature
- Eight representative cross-sectional channel surveys to determine average bankfull channel dimensions
- Detailed instream measurements at each cross-section including bankfull geometry, riparian conditions, bank material, bank height/angle, and bank root density
- Bed material sampling for gradation analysis

Table 3-2 Detailed Assessment Results for R3S1 and R3S0C

Channel Parameter	Results by Reach	
	R3S1	R3S0C
Measured		
Average bankfull channel width (m)	3.77	1.75
Average bankfull channel depth (m)	0.20	0.46
Average cross-sectional area (m^2)	0.75	0.46
Bankfull channel gradient (%)	0.47	0.67
D_{50} (mm)	<2.0	<2.0
D_{84} (mm)	16.0	18.8
Manning's n roughness coefficient	0.050	0.038
Computed		
Bankfull discharge (m^3/s)*	0.35	0.43
Average bankfull velocity (m/s)	0.47	0.90
Unit stream power at bankfull discharge (W/m^2)	4.32	16.01
Tractive force at bankfull (N/m^2)	9.22	17.78
Critical shear stress (N/m^2)**	1.46	1.46
Flow competency for D_{50} (m/s)***	0.27	0.27
Flow competency for D_{84} (m/s)***	0.71	0.76

** Based on Manning's equation*
*** Based on Sheilds diagram from Miller et a. (1997)*
**** Based on Komar (1987)*

3.3.3 Meander Belt Width Assessment

A meander belt width assessment was completed for the Middle Branch of Sixteen Mile Creek (SM1) and the tributary of Sixteen Mile Creek (R3S1) within the Subject Lands. Development activities are not proposed in the vicinity of SM1. It should also be noted that the erosion hazard outlined for R3S1 is associated with the existing watercourse feature. Erosion hazards associated with the proposed realigned watercourse for R3S1 are addressed as part of the channel design outlined in **Section 7.3.1**. As such, the meander belt width assessment outlined here is provided for characterization purposes only.

Most watercourses in southern Ontario have a natural tendency to develop and maintain a meandering planform, provided there are no topographical constraints. A meander belt width assessment estimates the lateral extent that a meandering channel has historically occupied and will likely occupy in the future. This assessment is therefore useful for determining the potential hazard to proposed activities in the vicinity of a stream.

When defining the meander belt width for a creek system, the TRCA (2004) and Ministry of Natural Resources and Forestry (MNRF) protocol treat unconfined and confined systems differently. Unconfined systems are those with poorly defined valleys or slopes well-outside where the channel could realistically migrate. Confined systems are those where the watercourse is contained within a defined valley, where a valley wall contact is possible.

Based on the field observations and a review of the historical and recent aerial images, Middle Sixteen Mile Creek (SM1) is situated within a densely vegetated and wide floodplain. Defined valley walls were not observed in the vicinity of the creek, which indicates that the system is unconfined and free to migrate across

the floodplain. The tributary Sixteen Mile Creek (R3S1) is also situated within an agricultural field and unconfined valley setting. As such, the erosion hazard for both can be defined by the channel's meander belt width.

Meander belt widths for both watercourses are outlined in Error! Reference source not found. below, and a d etailed summary of the meander belt width assessment is provided in **Appendix C**.

Table 3-3 Existing Meander Belt Widths for SM1 and R3S1

Reach	Meander Belt Width (m)			Proposed Meander Belt Width (m)
	Largest Meander Amplitude (m)	**Williams - Width (1986)	ᵀ TRCA (2004)	
SM1	33*	62	45	**62**
R3S1	No visible meanders	22	24	**24**

* Largest meander amplitude measured upstream of Reach SM1 in 2016 imagery
**Includes 20% factor of safety
ᵀ 1 standard error (~8 m) for factor of safety assuming no changes in post-development hydrology

3.4 Surface Water and Hydrology

3.4.1 Drainage

The topography of the site is generally flat, with gently sloping terrain in some areas. The major watercourse and valley feature in the vicinity of the site is Middle Sixteen Mile Creek, located north of the Subject Lands, flowing from west to east. A small portion of the study area, located at the northeast corner of Parcel 4, directly discharges to Middle Sixteen Mile Creek, but it is not proposed for development and thus generally excluded from analysis and discussion in this Comprehensive Study.

The remaining watercourse on the site is a tributary of Middle Sixteen Mile Creek, referred to as R3S1 as described in **Section 3.2.1.2**. Several headwater drainage features are also located within the Subject Lands and were described in **Section 3.2.2**. R3S1 and the headwater drainage features are intermittent or ephemeral and mostly convey surface water flows from the agricultural area towards the south and east. In addition, roadside ditches along No. 5 Side Road, Boston Church Road and Esquesing Line and carry flows from the Subject Lands.

The existing conditions drainage areas associated with Tributary of Sixteen Mile Creek (R3S1) and the main headwater drainage features are summarized in **Section 3.2.2** and on **Figure D3-1 (Appendix D)**. The drainage areas were used in the existing conditions hydrologic model described in **Section 3.4.5**.

From a hydrologic perspective, the predominant land use within the Subject Lands is agricultural, with the exception of some wooded areas between Boston Church Road and Esquesing Line and some scattered rural residential land. A hydro corridor is located along the southern portion of the Subject Lands (parallel to James Snow Parkway). In the areas surrounding the Subject Lands, the predominant land use is also agricultural for lands to the north and east, as well as estate lot residential land uses to the north. The areas west and south of the Subject Lands area are industrial.

Table 3-4 Drainage Areas

Watercourse or Headwater Drainage Feature	Hydrologic Subcatchment Areas	Drainage Area (ha)	Outlet Node in Hydrologic Model
Tributary of Middle Sixteen Mile Creek (R3S1) at downstream boundary of Subject Lands	101-1 through 101-8	135.96	OF-101
R1S1 / R2S1 at James Snow Parkway	102-1, 102-2, 102-3, and 101-4	65.21	OF-102
R5S0 at James Snow Parkway	103-1, 103-2, 103-3, and 103-4	48.83	OF-103
Southwest corner of Subject Lands	104-1	4.84	OF-104

3.4.2 Existing Stream Lengths and Drainage Density

There are several subcatchments that drain the Subject Lands as noted above. Drainage density is a measure of the degree of dissection of the drainage basin. It is defined as the ratio of the total channel length over the drainage area of the basin and is usually expressed in units of km/km^2. The drainage density increases as the average area between adjacent channels decreases. Drainage density depends on precipitation rate, the permeability of the surface materials, the resistance to erosion, and the degree of vegetation cover (Knighton, 1998; Bridge, 2003). Drainage density generally decreases with distance downstream from the headwaters, but is relatively lower (i.e., less than 10 km/km^2) in temperate regions due to greater vegetation cover and runoff (Bridge, 2003).

Drainage density was determined for each drainage feature subcatchment based on the watercourse layer obtained from Ministry of Natural Resources and Forestry (MNRF) and subcatchment mapping outlined in **Section 3.4.1** above.

Table 3-5 Drainage Densities for Drainage Feature Subcatchments

Watercourse or Headwater Drainage Feature	Existing Stream Length* (km)	Drainage Area (km^2)	Existing Drainage Density (km/km^2)
Tributary of Middle Sixteen Mile Creek (R3S1) at downstream boundary of Subject Lands	4.088	1.36	3.01
R1S1 / R2S1 at James Snow Parkway	2.008	0.65	3.09
R5S0 at James Snow Parkway	1.369	0.49	2.80

** Existing stream lengths account for all headwater drainage features reviewed on Orlando Lands, including those characterized as No Management Required (i.e., feature removal is permitted; no requirement to replicate feature form or function)*

Although drainage density is acknowledged as a requirement of the Terms of Reference, a function-based approach was used to address low-order tributaries consistent with recent studies in the Town of Milton (i.e., the CVC/TRCA Protocols for Headwater Drainage Features Assessments). Drainage density does not provide information regarding the function of low-order feature, which is typically replicated through stormwater management measures such as low impact development techniques, as appropriate. Nevertheless, pre- to post-stream lengths were reviewed as part of the CESS as outlined in **Section 6.2.1**.

3.4.3 Existing Stormwater Management

There are no existing stormwater management (SWM) facilities within the Subject Lands. Runoff is conveyed through watercourses or drains in agricultural areas and road side ditches and culverts along No. 5 Side Road, Boston Church Road, and Esquesing Line. An inventory of culvert crossings is shown on **Figure D3-1** and summarized in **Appendix D2**.

R1S1, R2S1 and R5S0 discharge south to urban areas of Milton. R1S1 and R2S1 drain to a large SWM pond located about 800 m downstream within an industrial area. R5S0 is conveyed across James Snow Parkway through a set of culverts and discharges into the storm sewer system through a catchbasin located south of the road, before continuing to stormwater management facilities north of Highway 401. Conversely, R3S1 drains in an eastern direction through agricultural lands as an open channel to its confluence with Middle Sixteen Mile Creek. However, two off-line facilities treating runoff from relatively recent developments (in Halton Hills) discharge to R3S1 a short distance upstream of 5th Line.

To date, the Town of Milton has not been able to locate complete information for the downstream stormwater management facilities (treatment area characteristics, rating curves, etc.). Additional information on these facilities will be presented in subsequent versions of this report if and when the materials are located and provided by the Town of Milton.

3.4.4 Surface Water Monitoring

Baseline water quality and quantity monitoring was established in 2021 and consisted of continuous water level and temperature monitoring, as well as discrete water quality sampling. Four (4) monitoring locations were established throughout the Subject Lands to assess baseline water quality and hydrology of site drainage features. The stream flow data collected at the monitoring stations also provide a method to validate the existing conditions hydrologic model for the Subject Lands (additional discussion is provided in **Section 3.4.5**). The monitoring sites are shown on **Figure 4-2** with additional information presented in **Appendix C-2**.

MN1 and MN2 are located on the north side of James Snow Parkway. MN1 is west of Boston Church Road along the R5 tributary, and MN2 is east of Boston Church Road along the R1/R2 tributary. Both drainage features flow in a southerly direction through agricultural fields before draining to culverts along James Snow Parkway. At both monitoring sites, the drainage feature is narrow with heavy vegetation encroachment. Flow is intermittent, and both sites have been predominantly dry since the onset of monitoring.

MN3 is located on the west side of Esquesing Line at the downstream extent of R3S1 within the Orlando Lands. Immediately upstream of the monitoring site, the channel is poorly defined. The monitoring location has remained dry under baseflow conditions, and limited flow has been recorded during storm events.

A fourth site (MN4) was also established along the west side of Esquesing Line at the crossing location of the Middle Branch of Sixteen Mile Creek. The watercourse in this location is large with perennial flow.

The monitoring activities outlined above were initiated in spring 2021 and is ongoing. Monitoring to date has included the following activities at each site:

- Continuous water level and temperature monitoring
  - Water level and water temperature data is collected at 15-minute intervals using an Onset U20 pressure and temperature sensor
  - An additional temperature and pressure logger was installed on site to collect atmospheric pressure and air temperature, which provide reference data for continuous water level and water temperature measurements
- Discrete water quality spot sampling
  - Spot measurements include water temperature, water depth, turbidity, dissolved oxygen, and hydraulic conductivity
  - Additional water quality sampling completed for Total Suspended Solids (TSS) for a minimum of seven precipitation events (4 wet, 3 dry) to capture a range of flow conditions throughout the monitoring period (samples to be analyzed by an accredited laboratory)

- Daily rainfall measurements acquired from a GEO Morphix weather station located in Milton. Additional rainfall data was received from CH for rain gauges at Kelso Dam (about 5 km southwest of the Subject Lands) and Scotch Block Dam (about 4 km northwest of the Subject Lands) for the period between June and November 2021.
- Hydrological monitoring cross-sections were established at each monitoring site to assist in calibrating discharge. Cross-sections were surveyed and velocity measurements are collected during a range of flow conditions to develop a stage-discharge curve for each drainage feature.

To date, the presence of water / flow has been limited at MN1, MN2 and MN3 within the Subject Lands due to the intermittent nature of the drainage features. A total of four stream flow measurements were taken after rainfall events in 2021, where observed flow rates at three out of four measurements were relatively low (10 L/s or less at MN1, MN2 and MN3). A single, relatively high flow rate was measured on December 6, 2021. The stage-discharge relationships at the monitoring stations are considered preliminary at this time, and its (limited) application to validate hydrologic modelling is discussed in **Section 3.4.5.2**.

The continuous water level measurements collected with dataloggers in 2021 confirmed the intermittent flow patterns. The summer rainfall events (higher intensity, short duration) generally produced short water level and flow responses before returning to no flow / dry conditions. In the fall, rainfall events were generally lower intensity and longer in duration, which produced corresponding responses in water levels, and more sustained flows between rainfall events.

3.4.5 Hydrologic Analysis

Existing conditions hydrologic analysis was previously completed by the Town for the Sixteen Mile Creek Watershed, which included the subwatersheds downstream of the Subject Lands. The model is understood to be a continuous hydrologic model in HSP-F (Hydrological Simulation Program – FORTRAN). In consultation with the Town, the Comprehensive Study developed a continuous hydrologic model using PCSWMM specifically for analysis and design within the Subject Lands. A frequency analysis on the PCSWMM model results with the Milton continuous dataset was done to determine the discharge rates for each return period. The results of the PCSWMM analysis in the Comprehensive Study will be verified using the Town's current HSP-F modelling as part of the Town's review of the Comprehensive Study.

The Comprehensive Study's PCSWMM model includes the drainage area for the Subject Lands, which includes the Tributary of Sixteen Mile Creek and the headwater drainage features up to outlets at James Snow Parkway at the downstream boundary of the Subject Lands.

3.4.5.1 Hydrologic Modelling Scenarios and Parameters

From a hydrologic perspective, the predominant land use within the Subject Lands is agricultural, with the exception of wooded areas between Boston Church Road and Esquesing Line and some scattered rural residential land. A hydro corridor is located along the southern portion of the Subject Lands (parallel to James Snow Parkway). In the areas surrounding the Subject Lands, the predominant land use is also agricultural for lands to the north and east, as well as estate lot residential land uses to the north. The areas west and south of the Subject Lands area are industrial.

According to the Ontario Geologic Survey (OGS, 2010), the study area is located on the Peel Plain physiographic region and contains surficial deposits of fine-textured till derived from glaciolacustrine deposits, containing predominately clay and silt. Site specific surficial geological conditions were determined through a the hydrogeological investigation completed by Palmer (2021) (**Section 3.5** and **Appendix E**). The results of the borehole investigations were generally consistent with the regional OGS surficial geology mapping with the majority of the site being made up of clay and silt.

To facilitate a review of the drainage conditions as it currently exists, a hydrologic model of the study area was developed using PCSWMM software (supplemented by ArcGIS analysis). In general, the steps to develop the existing conditions model included:

- GIS analysis of the Digital Elevation Model (DEM) from LiDAR data to identify streamlines (i.e. flow paths) through the study area, and to delineate sub-catchment areas appropriately (including external upstream areas) contributing to flow in each part of the system.
- Developing suitable modelling parameters for sub-catchments; based on imperviousness, slope, soil type, etc.
- Determining/obtaining suitable precipitation records for continuous simulation.
- Validation of the model using preliminary flow monitoring data and existing reference models.

A base model was developed for existing conditions, from which refinements were considered through the validation/verification process described further below. Development of the base model required the selection of parameters based on best practice approaches and suitable engineering judgement to ensure that the numerical model is sensible, robust and representative of the physical realities it is simulating. The model parameters are provided in **Appendix D2**, and summarized below:

- Manning's n for subcatchment pervious areas set to be 0.25, per typical values for naturally vegetated areas.
- Manning's n for subcatchment impervious areas set to be 0.013, per typical values for asphalt pavement.
- Subcatchment imperviousness was estimated using an imperviousness shapefile created from satellite imagery.
    - Subcatchment mean slope was extracted from the DEM using GIS spatial analyst zonal statistics tool.
    - Drying time of seven (7) days was assumed.
    - Catchment length was manually measured for each catchment.
    - Roughness values of 0.035 for main channel flow areas (assuming vegetated channel) and 0.05 for the floodplain were applied to all natural channel routing elements.
    - Depression storage used to calculate volume of rainfall intercepted (or "lost") to surface depression storage. Defined using standard values of 2 mm and 5 mm for impervious and pervious surfaces, respectively.
- Subcatchment infiltration losses were simulated using Modified Green Ampt equations. The input parameters required are the initial moisture deficit the soil, the soil's hydraulic conductivity, and the suction head at the wetting front. Green Ampt is a physically based infiltration model, which is slightly different from simpler conceptual infiltration models such as the SCS-CN and considered more suitable for continuous simulation modelling.

  As shown on the surficial geology (**Appendix E, Figure 2**), there are two predominant soil types in the study area. Following a sensitivity analysis, the following parameters were assigned to the soil parameters and spatially weighted within each subcatchment.

Table 3-6 Green Ampt Infiltration Parameters

Surficial Geology	Wetting Front Soil Suction Head (mm)	Saturated Hydraulic Conductivity (mm/h)	Initial Deficit (Fraction)
Glaciolacustrine Deposits	250	5	0.26
Halton Till	290	0.51	0.23

Green Ampt parameters from PCSWMM lookup tables and Conservation Halton Table B.6 (refer to Appendix D for reference values).

Continuous simulation and frequency analysis was completed to determine the 2-year to the 100-year return period peak flow rates, similar to the Town's continuous hydrologic model. The 42-year (1962 to 2003) rainfall and temperature record used in the simulation was provided by the Town and is consistent with the current

modelling for the Sixteen Mile Creek Watershed. The rainfall record was based on hourly precipitation data from Burlington RBG Station from 1962 to 1995 and from Pearson Airport Station from 1996 to 2003, according to the Sixteen Mile Creek, Areas 2 and 7 Subwatershed Update Study (AMEC, 2015).

Event based simulation was completed to assess the Regulatory flow for watercourses and stormwater management facilities. The Regional storm is the largest storm on record that could potentially reoccur over the watershed. Within Conservation Halton's jurisdiction, the Regional Storm is Hurricane Hazel. This storm consisted of 73 mm of rainfall over a 36 hour period, followed by 212 mm over the final 12 hours of the storm. The storm was represented in the hydrologic model as a constant intensity of approximately 2 mm/hr for 36 hours, followed by the hourly rainfall intensities from the Conservation Halton Guidelines for Stormwater Management Engineering Submissions (November 2021). The 100-year storm was also modelled (event-based simulation) to determine whether the 100-year storm is greater than the Regional storm (see Appendix D2). The Regional Storm (Hurricane Hazel) was confirmed to be the Regulatory storm for the Subject Lands.

3.4.5.2 Model Validation

It was recognized that a validation exercise for the peak flows generated from the base existing conditions PCSWMM model would provide additional certainty. Thus, the base existing conditions model results were compared to field flow monitoring data (collected thus far) and other sources of modelled peak flow data.

Flow monitoring at four locations was completed by Geo Morphix from June 3, 2021, to December 9, 2021 (**Section 3.4.4**), three of which are located within the hydrology model area. Discharge at each of the stations was measured on four occasions during the above monitoring period and preliminary stage-discharge relationships were calculated, recognizing that the results are preliminary due to the limited monitoring data to date.

Rainfall records at two nearby Conservation Halton rain gauge stations (Scotch Block Dam and Kelso Dam) were reviewed and compared. Both rain gauges are approximately equal in distance (about 6 km) from the centre of the study area. It was determined that the Scotch Block Dam station rainfall data would be used for analyzing and comparing flow monitoring data due to greater consistency between recorded rainfall and response in water levels at the monitoring stations.

Within the monitoring period, there were a variety of rain event intensities and durations, of which, three events were selected for the model validation analysis (**Table 3-7**). The first two events were short duration events with higher intensity storms and the third event had a longer duration with a larger total amount of rainfall. Storms with longer duration and steady rainfall allow for significant infiltration, thus the model parameters related to pervious areas and infiltration influence the results, which is of interest for the existing conditions.

Table 3-7 Model Validation Rainfall Events

Event	Start Date	End Date	Rainfall Total (mm)	Rainfall Duration (hours)
1	24/07/2021	24/07/2021	41	2
2	14/09/2021	14/09/2021	27	2
3	21/09/2021	23/09/2021	70	47

The limited number of flow events captured in 2021 are not considered sufficient to be relied upon for model calibration. Based on discussions with Town staff and Wood (March 10, 2022), it was agreed that the hydrologic model input parameters were to be calculated using industry standard practices based on site-specific topographic and geological conditions, and the observed flow data is to be used to verify the reasonableness of the resulting hydrologic model output. Flows generated from the PCSWMM model at the stream monitoring locations were compared with the calculated flows from the stage-discharge relationships and recorded water level hydrographs for the three selected events (**Table 3-8**). **Appendix A2** includes

additional results / discussion regarding base model refinement and correspondence with the Town prior to Version 2 of the Comprehensive Study.

Table 3-8 Observed versus Modelled Discharge Rates

Monitoring Station	PCSWMM Node	Location	Comments
MN1	OF103	R5S0 at James Snow Parkway (west of Boston Church Road)	Flows from the model are higher than observed values. Note that the field data logger did not record a water level response for Event 2 (September 14-15, 2021)
MN2	OF102	R1S1 at James Snow Parkway (between Esquesing Line and Boston Church Road)	Model slightly overestimates peak flows compared to observed value for Events 1 and 2. Model slightly underestimates peak flows for longer duration Event 3.
MN3	J1-2	R3S1 at Esquesing Line	Model slightly overestimates peak flows compared to observed value for Events 1 and 2. Very good correlation for longer duration Event 3.

In addition to validation against observed data, the PCSWMM model results were also compared against flows from both the Derry Green (Amec, 2015) and Highway 401 (Philips, 2000) Functional Stormwater and Environmental Management Studies (FSMES). Flow rates for 2- to 100-year events for similar sized catchments with similar land-use characteristics were extracted from the Derry Green and Highway 401 FSEMSs and summarized on a per hectare basis (**Table 3-9**).

The Comprehensive Study PCSWMM modelled peak flow rates were slightly lower compared to the Derry Green FSEMS and the Highway 401 FSEMS. Given that the PCSWMM model, in some cases, overestimated flows compared to observed values and underestimated flows compared to both existing studies, a calibration exercise is not recommended on the basis that there is inherent uncertainty in both validation methods.

In particular, the field monitoring data would benefit from additional discharge measurements in 2022 to provide greater certainty to the stage-discharge relationships at the monitoring stations. Calibration of the base model with field monitoring data at this point would not result in additional certainty for the model results.

That said, the base model had reasonable agreement with the rainfall events selected for the model validation analysis. With that, the subcatchment parameters used for the base model are considered sufficient to set stormwater management targets for the subject lands at this stage.

Table 3-9 Comparison of Peak Flow Rates Per Hectare

Model / Study	Unit Peak Flow Rates ($m^3/s/ha$)					
	2-yr	5-yr	10-yr	20-yr	50-yr	100-yr
Derry Green FSEMS	0.009	0.013	0.019	0.023	0.028	0.035
Highway 401 FSEMS	0.004	0.007	0.009	0.012	0.016	0.019
Comprehensive Study	0.002	0.005	0.006	0.011	0.012	0.015

3.4.5.3 Existing Conditions Peak Flow Rates

As mentioned previously, the purpose of this model is to determine peak flow rates leaving the site under existing conditions to inform future development SWM targets. The existing conditions peak flow rates at the downstream outlets of the Subject Lands is provided in **Table 3-10**, while the peak flow rates for use in the R3S1 hydraulic model is provided in **Table 3-11**.

Table 3-10 Existing Conditions Peak Flow Rates

Location (Flow Node)	Drainage Area (ha)	Peak Flow Rates (m^3/s)						
		2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	Regional Storm
Tributary of Middle Sixteen Mile Creek (R3S1) at downstream boundary of Subject Lands (OF-101)	135.96	0.22	0.62	0.83	1.39	1.74	1.86	7.92
R1S1 / R2S1 at James Snow Parkway (OF-102)	65.21	0.23	0.44	0.63	0.86	1.01	1.12	4.14
R5S0 at James Snow Parkway (OF-103)	48.83	0.09	0.19	0.30	0.50	0.59	0.64	2.84
Southwest corner of Subject Lands (OF-104)	4.84	0.04	0.10	0.13	0.17	0.17	0.22	0.51

Table 3-11 Existing Conditions Peak Flow Rates Used in R3S1 Hydraulic Model

Key Hydraulic Flow Node Location (PCSWMM Node)	HEC-RAS River Station	Flow Rate (m^3/s)						
		2-year	5-year	10-year	25-year	50-year	100-year	Regional Storm
Upstream limit of Tributary to Sixteen Mile Creek (R3S1) at No. 5 Side Road (J1-4)	4400	0.12	0.27	0.33	0.37	0.41	0.49	1.48
Tributary to Sixteen Mile Creek (R3S1) at southern limit of Parcel 3 (J1-3)	4000	0.21	0.49	0.62	0.91	1.06	1.18	5.06
Tributary to Sixteen Mile Creek (R3S1) within Parcel 4, 200 m downstream of northern property limit (J1-1)	3500	0.25	0.67	0.88	1.48	1.81	1.93	8.03
150m downstream of Esquesing Line (OF-101)	2300	0.22	0.62	0.83	1.39	1.74	1.86	7.92

3.4.6 Hydraulic Analysis and Flood Plain Mapping

The existing conditions Regulatory hydraulic model for Tributary to Sixteen Mile Creek (R3S1) was provided by CH in November 2017. The CH model included a 2013 update for a portion of the channel that was realigned for the construction of James Snow Parkway, which is located immediately downstream of the Subject Lands. The CH existing conditions model was reviewed and updated as described below. Additional results are provided in **Appendix D3**.

The CH existing conditions hydraulic model and Regulatory Floodplain within the Subject Lands for R3S1 was updated with the hydrologic peak flow rates from the Comprehensive Study's PCSWMM model. **Table 3-12** is a summary of the key HEC-RAS river stations within the Subject Lands along with a comparison of Regulatory Storm peak flow rates from the CH HEC-RAS model and the Comprehensive Study PCSWMM model (**Section 3.4.5**). In general, the PCSWMM modelled Regulatory peak flow rates were lower compared to the CH Regulatory flow rates. As noted by CH, the CH Regulatory flow rates were derived by the Index Flow Method and may be conservative, and it appears the flow rates were also conservatively applied to the river stations at the upstream reaches of R3S1 (e.g., 8.07 m^3/s at RS 4400 with a drainage area of about 10 ha). However, the existing conditions peak flow rates are closely aligned for the reach within Parcel 4 (RS 3500).

The following information was used to update CH's existing hydraulic model for R3S1:

- The CH model geometry was used to represent the existing conditions for R3S1. Model cross-sections were not updated with detailed topography from the Orlando Lands (Parcel 4). Topography to generate the updated existing conditions Regulatory floodline was obtained from CH and it closely resembles the CH model geometry.
- The Esquesing Line culvert specifications were updated. A review of the existing conditions model determined a discrepancy between the culvert specifications in the model and the site reconnaissance and topographic survey results. The existing conditions model used a single 600 mm CSP culvert, which was updated to be twin 450 mm CSP culverts, as observed in field investigations for this study.
- The CH model parameters were reviewed and determined to be reflective of site conditions and within the range of typical hydraulic modelling best practices, and thus were unchanged in the existing conditions model update.

Table 3-12 Hydraulic Model Flow Rates for Tributary of Sixteen Mile Creek (R3S1)

Location	HEC-RAS River Station	Regulatory Storm Flow Rate (m^3/s) (CH Model)	Existing Conditions Regulatory Storm Flow Rate (m^3/s) (TYLin Model)
Upstream limit of Tributary to Sixteen Mile Creek (R3S1) at No. 5 Side Road	4400	8.07	1.48
Tributary to Sixteen Mile Creek (R3S1) at southern limit of Parcel 3	4000	8.07	5.06
Tributary to Sixteen Mile Creek (R3S1) within Parcel 4, 200 m downstream of northern property limit	3500	8.87	8.03
150m downstream of Esquesing Line	2300	12.36	7.92

Figure D3-2 in Appendix D illustrates the existing conditions HEC-RAS model cross-section plan and the updated flood extents based on Regional Storm peak flow rates from the Comprehensive Study's PCSWMM

model. The updated floodplain is mostly similar to the CH floodplain except for reduced flooding extents at the upstream reaches of R3S1 and around the Esquesing Line culvert.

The riparian storage available within the Tributary to Sixteen Mile Creek was modelled using a modified geometry file that is specifically set up for this purpose. The riparian storage was modelled by removing crossing structures from the existing conditions model. The existing riparian storage (**Table 3-13**) was compared with proposed conditions riparian storage (in the re-aligned portions of the tributary described in later sections of the Comprehensive Study) to ensure that proposed works do not adversely affect downstream areas. The comparison between existing and proposed conditions is discussed in **Section 7.3.1.2**.

Table 3-13 Existing Conditions Riparian Storage in R3S1

Scenario	Riparian Storage in R3S1 from RS 3700 to RS 2513.932 (Esquesing Line) (1000 m^3)						
	2-year	5-year	10-year	25-year	50-year	100-year	Regional Storm
Existing Condition	0.90	1.86	2.30	3.48	4.12	4.37	16.26

CH also maintains hydraulic modelling and flood plain mapping for the Middle Sixteen Mile Creek, located to the north and east of the planned development area. A review of CH's regulation mapping indicated that the Regulatory flood plain associated with Middle Sixteen Mile Creek is contained well below the top of the valley embankments and does not govern the Regulation Limit for the Subject Lands.

In late 2021, CH initiated a Flood Hazard Mapping Study for Sixteen Mile Creek that will generate updated flood hazard mapping for the watershed. Flood hazard limits may be subject to change in the future and will be reflected in future regulatory decisions and approvals.

3.5 Hydrogeology

Palmer has completed a hydrogeological investigation for the Subject Lands, and water balance for the Orlando Lands. The hydrogeological investigation includes a summary of the geology and hydrogeology, groundwater flow, soil permeability, in-situ soil percolation rates, hydrologic function of targeted wetlands and watercourses, and defines the overall pre-development water balance for the Orlando Lands and establishes infiltration targets for the post-development condition.

3.5.1 Regional Geology and Hydrogeology

3.5.1.1 Physiography

The site is situated primarily within the Peel Plain physiographic region, with a small section in the northwest corner located within the South Slope physiographic region (Chapman and Putnam, 1984). The Peel Plain covers a large portion of Halton, Peel, and York Regions, and is characterized by the presence of a thin veneer of glaciolacustrine silt and clay, overlying clay till. Localized surficial deposits of glaciolacustrine sand are also present within this physiographic region. The topography of the Peel Plain is generally level to gently rolling.

The South Slope physiographic region (Chapman and Putnam, 1984), which forms a horseshoe shape around the Peel Plain, is located immediately north and west of the project site boundary. The region is characterized by predominately clay till soils derived from former glacial lakes. In the Region, the South Slope begins on the south side of the Niagara Escarpment and slopes downwards towards the Peel Plain. The topography of the area is gently rolling with numerous drumlins oriented upslope.

3.5.1.2 Surficial Geology

Hydrostratigraphic units can be subdivided into two distinct groups based on their ability to allow groundwater movement. An aquifer is classically defined as a layer of soil that is permeable enough to permit a usable supply of water to be extracted. An aquitard is a layer of soil that inhibits groundwater movement due to its low permeability. Shallow groundwater flow within the analysis area is influenced by three (3) key hydrostratigraphic units: glaciolacustrine silt and clay aquitard, the Halton Till aquitard, and localized interstadial sand aquifer(s).

A surficial ***glaciolacustrine silt and clay*** was identified in OGS surficial geology mapping as being present over the study area, and is comprised of silt and clay with minor sand and gravel, and interbedded silt and clay and gritty, pebbly flow till and rainout deposits. Generally, this unit has a low permeability, and therefore forms a thin surficial aquitard that inhibits horizontal groundwater flow and recharge.

The ***Halton Till*** is a clayey silt to silty clay textured till unit representing the final advance of ice at the end of the Wisconsinan glaciations. Locally the Halton Till can exceed 15 to 30 m in areas west of Brampton. It has a predominantly silty clay to silt matrix and contains isolated lenses of laminated sand, silt, and clay. Regionally the unit acts as a surficial aquitard, with hydraulic conductivities ranging from about 10^{-10} to 10^{-6} m/s (Interim Waste Authority, 1994). The low bulk permeability acts to inhibit local groundwater recharge and reducing the exposure of underlying aquifers to contamination (Sharp et al., 1996). Groundwater flow within till soils is typically downwards towards more permeable, confined aquifer units. The water table is expected to be fairly shallow in the clay rich till soils, and perched water table conditions may form because of the poorly drained nature of the soil.

In this area of Milton, ***interstadial sand*** aquifer deposits are occasionally present within the Halton Till. These coarse-grained sediments (deposited between periods of glacial till deposition) of silt, sand and gravel generally extend in finger-like protrusions southwards towards Lake Ontario. Where the overlying Halton Till is thin, gravel pits have historically been established to extract aggregate from this unit. These deposits have the capacity to act as small confined aquifers and may provide localized groundwater discharge to natural features.

3.5.2 Site Geology and Hydrogeology

Specific surficial geological conditions on the site were determined through a borehole drilling program completed by Palmer staff. Twelve boreholes (MW1 – MW12) were drilled during two separate events, one from July 14 - 15, 2015, and the second from March 27 – 28, 2018. Monitoring well installation details are summarized in **Table 3-14**. The boreholes in 2015 were drilled by Pontil Drilling, and in 2018 were drilled by Drilltech Drilling Ltd., under the supervision of Palmer staff. Borehole depths ranged from 5.1 metres below ground surface (mbgs) to 12.2 mbgs. Drilling methodologies using a combination of hollow stem and solid stem auger methods, and soil samples were collected using a 0.61 m long split spoon. The location of each borehole is presented in **Figure 1, Appendix E,** and borehole logs are presented in **Appendix E**. Two hydrostratigraphic cross sections were created based on borehole drilling investigation results. Cross section locations are from A-A' and B-B' (**Figure 2, Appendix E**) and are provided in **Figure 3 and Figure 4, Appendix E**.

Table 3-14 Borehole and Monitoring Well Installation Details

Borehole ID	Ground Elevation (masl)[1]	Year of Installation	Stick Up (m)	Total Depth (mbgs)	Screened Depth (mbgs)	Screened Geology
MW1	217.0	2015	0.83	9.8	7.6 – 9.1	Silty Sand
MW2	212.9	2015	0.97	6.8	3.1 – 6.1	Silty Sand Till
MW3	216.1	2015	0.89	6.8	3.1 – 6.1	Silty Sand Till
MW4	217.4	2015	0.97	5.1	1.5 – 4.5	Silt to Silty Sand
MW5	219.5	2015	1.00	6.7	2.1 – 5.1	Clayey Silt Till
MW6	220.1	2015	0.88	6.7	3.1 – 6.1	Clayey Silt Till
MW7	214.8	2018	0.63	12.2	4.9 – 6.4	Silt
MW8	217.8	2018	0.89	8.2	6.4 – 7.9	Sand
MW10	216.3	2018	0.70	6.7	3.1 – 6.1	Clayey Silt
MW11	220.8	2018	0.72	8.2	5.8 – 7.3	Silty Clay Till
MW12	219.8	2018	0.66	7.3	5.8 – 7.3	Silt to Silty Sand

[1]Ground elevation values approximated from topographical survey (TMIG, 2014)

3.5.2.1 Groundwater Levels and Flow

Groundwater and surface water monitoring was designed to characterize groundwater level and groundwater/ surface water interactions on the site. In addition, the existing drainage features and wetlands within the site were specifically instrumented to assess the hydrogeological flow regimes and to provide hydrogeological input into the proposed channel realignment. Manual monitoring of groundwater and surface water levels was completed in approximate monthly intervals from June 2015 to May 2016, and quarterly from November 2017 to June 2020. Select monitoring wells (MW1, MW2, MW3, MW4, and MW10) were instrumented with dataloggers to obtained continuous hourly water level data in the vicinity of the proposed channel realignment and future stormwater mitigation facilities (i.e., LIDs).

Groundwater levels measured across the site range from 7.00 meters below ground surface (mbgs) at MW1 (January 22, 2018) to 0.05 mbgs at MW5 (March 26, 2016). A summary of the manual water levels at each monitoring well is provided in **Table 3-15**, and the logger and manual water level data are plotted on **Figure 5, Appendix E**. Groundwater levels measured in April and May of 2017 and 2018 are representative of seasonal highs due to the spring freshet. It is important to note however that groundwater levels fluctuate seasonally in response to precipitation and can vary with the total annual precipitation volumes.

The seasonal high groundwater level elevations collected in May 2018 were utilized to construct a groundwater equipotential map and determine the direction of groundwater flow (**Figure 6, Appendix E**). At this time, groundwater elevations ranged from 210.44 meters above sea level (masl) at MW1 to 219.72 masl at MW6. Groundwater flow is strongly influenced by the presence of Middle Sixteen Mile Creek, and the dominant groundwater flow direction is to the north/ northeast towards the river valley and associated wetland features

near MP2 (**Figure 6, Appendix E**). The water table ranges by approximately 8.7 m from the southwest side of the site to the northeast side, with an overall horizontal gradient of 0.0058 m/m.

The monitoring results confirm that the dominant groundwater flow direction does not match the surface water catchment areas for the intermittent and ephemeral tributaries or the wetland features (**Figure 6, Appendix E**). This result suggests that these features are primarily supported by surface water run-off and not by groundwater discharge.

Groundwater levels along the alignment of R3S1 was monitored using MW4, MW3, and MW2. Based on the monitoring results, groundwater levels below the tributaries range from 3.99 mbgs at MW3 (December 2017) to 0.12 mbgs at MW2 (June 2020), or between an elevation of 211.57 masl at MW2 (December 2017) and 217.24 masl at MW4 (June 2020). High groundwater elevations measured at MW4 in the spring indicate that this feature receives seasonal groundwater discharge originating from the shallow lens of interstadial silt and sand identified at this borehole.

3.5.2.2 Hydrogeological Assessment of Natural Features

Key drainage features and wetland communities identified on the site were instrumented with MPs in order to characterize groundwater or surface water contributions to each feature (**Figure 1, Appendix E**). Targeted wetlands were selected based on Ecological Land Classification (ELC) mapping of the site completed by Savanta (**Figure 4-1**). Surface water and groundwater levels collected at each MP were used to assess the magnitude of groundwater recharge or discharge at each location, and results are summarized in **Table 3-16**. Plots of the water levels within these features are shown on **Figures 7 – 21, Appendix E**.

MP1 was installed within Middle Sixteen Mile Creek. Based on the monitoring results, the hydraulic gradient is generally positive (i.e., groundwater discharge), but seasonally can be negative (i.e., groundwater recharge) in the late fall and winter. This is a major watercourse that controls groundwater flow in the area, and surface water was present within the feature throughout the monitoring period. This MP was destroyed during bridge rehabilitation construction in August 2018.

MP2s, MP2d, and MP2(new) are installed within a mixed swamp wetland feature (SWM5-1) in the northeast corner of the site within the Middle Sixteen Mile Creek valley. MP2s displayed a neutral to slightly negative hydraulic gradient throughout the monitoring period, whereas the gradients at MP2d and MP2(new) were neutral to positive. The measurements made at MP2d and MP2(new) are likely more representative of the hydraulic characteristics of the marsh wetland community as they are screened below the layer of organic material that was encountered to 0.9 mbgs (based on the results of shallow hand auger excavations in June 2015). This suggests that groundwater discharge is occurring at this location, which is consistent with the presence of thick organic material, the presence of surface water in all months except May 2016, December 2017, and January 2018, and the direction of groundwater flow towards this location (**Figure 6, Appendix E**). This is also demonstrated within the hydrostratigraphic cross section through the wetland (**Figures 3 and 4, Appendix E**), which shows the wetland intersects a lower interstadial silt and sand unit providing discharge to the feature.

MP3 is within a mineral deciduous swamp wetland community within a woodlot (SWD4-5) along the northern boundary of the site. Based on the surface water and groundwater monitoring, the hydraulic gradient was strongly negative, neutral, or dry at all monitoring events. This indicates that this feature is fed through precipitation and surface water runoff, which is consistent with a swamp community, the presence of low permeability Halton Till sediments, and direction of groundwater flow (**Figure 6, Appendix E**).

MP4, SP1, MP9, and MP11 are installed within the intermittent drainage feature (R3S1) within Parcel 4. In general, the hydraulic gradients measured at each of these MPs were negative, indicative of groundwater recharge. However, positive gradients were measured in the MPs in May and April during the spring freshet, as well as following a small melt event in February 2018. This suggests the seasonal occurrence of groundwater discharge following significant precipitation or freshet events. This observation is further supported by the direction of groundwater flow (**Figure 6, Appendix E**), which shows that groundwater is directed towards the tributary in the spring between the location of MW4 and MW8. Within this reach, there may be a hydraulic connection to the confined sand lenses observed in the Halton Till at MW3, MW4, and MW8.

MP5 is installed within a swamp wetland community (SWD3-3) near the headwaters of the central ephemeral drainage channel (R1S2). The hydraulic gradients measured within this wetland were generally negative, indicative of a swamp wetland, with the exception of positive gradients noted in March, April, and May 2016, April and May 2018, and April and June 2019. This indicates this wetland is likely supported through seasonal, shallow groundwater discharge during the spring freshet, and is supported by surface water runoff for the remainder of the year.

MP6 and MP8 are installed within the southwestern most drainage feature (R5S1 and R5S0) on the west side of Boston Church Road. All hydraulic gradients measured at these locations were negative, neutral, or dry. This indicated that these drainage channels are ephemeral and supported through surface water runoff and are not connected to the water table.

MP7 is within a mineral meadow marsh wetland (MAM2-11) along Boston Church Road. The hydraulic gradients measured were each neutral to slightly negative, indicating that this feature is supported through precipitation and surface water runoff creating long periods of standing water. This is consistent with the surficial geology and groundwater flow direction in this area. This MP was destroyed in August 2018.

MP10 is installed within the central drainage feature within the site (R2S1) (**Figure 1, Appendix E**). The hydraulic gradients measured at this MP were negative or dry, indicative of groundwater recharge. The monitoring results support the conclusion that this drainage feature is ephemeral, which is consistent with the presence of low permeability Halton Till and fine grained glaciolacustrine deposits in this area, as well as direction of groundwater flow.

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Table 3-15 Groundwater Level Monitoring Data

Monitoring Well ID	Ground Elevation[1] (masl)	Units	Groundwater Level																					
			20-Jul-2015	13-Aug-2015	21-Sep-2015	18-Nov-2015	22-Dec-2015	19-Jan-2016	26-Mar-2016	30-Apr-2016	24-May-2016	18-Dec-2017	22-Jan-2018	27-Feb-2018	29-Mar-2018	9-Apr-2018	29-May-2018	28-Aug-2018	28-Jan-2019	1-Apr-2019	6-Jun-2019	8-Aug-2019	24-Oct-2019	20-Mar-2020	8-Jun-2020
MW1	217	mbgs	6.59	6.71	6.87	6.9	6.91	6.82	6.6	6.48	6.57	6.99	7	6.82	6.8	6.73	6.56	6.79	6.66	6.67	6.39	6.62	5.95	6.36	6.62
		masl	210.41	210.29	210.13	210.1	210.09	210.18	210.4	210.52	210.43	210.01	210	210.18	210.2	210.27	210.44	210.21	210.34	210.33	210.61	210.38	211.05	210.64	210.38
MW2	212.9	mbgs	0.47	0.79	1.1	1.11	1.03	0.64	0.26	0.3	0.49	1.33	1.15	0.59	0.68	0.49	0.48	0.93	0.55	0.45	0.18	0.62	1.12	0.12	0.64
		masl	212.43	212.11	211.8	211.79	211.87	212.26	212.64	212.6	212.41	211.57	211.75	212.31	212.22	212.41	212.42	211.97	212.35	212.45	212.72	212.28	211.78	212.78	212.26
MW3	216.1	mbgs	3.03	3.38	3.7	3.77	3.71	3.32	2.91	2.85	3.07	3.99	3.89	3.3	3.32	3.16	3.04	3.54	3.19	3.12	2.77	3.18	3.74	2.51	3.18
		masl	213.07	212.72	212.4	212.33	212.39	212.78	213.19	213.25	213.03	212.11	212.21	212.8	212.78	212.94	213.06	212.56	212.91	212.98	213.33	212.92	212.36	213.59	212.92
MW4	217.4	mbgs	0.82	1.69	2.45	1.81	1.47	1.36	0.66	0.35	0.34	3.17	2.43	1.43	1.49	1.17	0.56	2.12	1.45	0.31	0.2	1.6	3.16	0.16	0.72
		masl	216.58	215.71	214.95	215.59	215.93	216.04	216.74	217.05	217.06	214.23	214.97	215.97	215.91	216.23	216.84	215.28	215.96	217.09	217.2	215.8	214.24	217.24	216.68
MW5	219.5	mbgs	0.57	1.18	1.61	1.29	1	0.43	0.05	0.36	0.54	2.1	0.7	0.1	0.48	0.24	0.48	1.09	0.57	0.13	0.03	0.78	1.5	0.02	0.62
		masl	218.93	218.32	217.89	218.21	218.5	219.07	219.45	219.14	218.96	217.4	218.8	219.4	219.02	219.26	219.02	218.41	218.93	219.37	219.47	218.72	218	219.48	218.88
MW6	220.1	mbgs	0.74	1.17	1.67	0.95	0.82	0.52	0.54	0.46	0.71	2.47	1.36	0.56	0.57	0.41	0.38	0.61	0.68	0.21	0.27	0.65	1.31	0.14	0.67
		masl	219.36	218.93	218.43	219.15	219.28	219.58	219.56	219.64	219.39	217.63	218.74	219.54	219.53	219.69	219.72	219.49	219.42	219.89	219.83	219.45	218.79	219.96	219.43
MW7	214.8	mbgs	*Monitoring Well installed March 2018*												1.84	1.38	1.65	2.38	1.75	1.26	1.32	1.86	2.63	1.12	1.93
		masl													212.96	213.42	213.15	212.42	213.05	213.54	213.48	212.94	212.17	213.68	212.87
MW8	217.8	mbgs	*Monitoring Well installed March 2018*												5.35	5.14	4.67	5.11	4.94	4.85	4.02	4.56	5.33	3.73	3.77
		masl													212.45	212.66	213.13	212.69	212.86	212.95	213.78	213.24	212.47	214.07	214.03
MW9	215.5	mbgs	*Monitoring Well installed March 2018*												8.822	2.14	0.65	1.02	0.76	0.9	0.47	0.67	1.3	0.46	0.75
		masl													206.682	213.36	214.85	214.48	214.74	214.6	215.03	214.83	214.2	215.04	214.75
MW10	216.3	mbgs	*Monitoring Well installed March 2018*												1.77	1.56	1.52	2.175	1.3	1.28	0.92	1.71	3.16	0.8	1.57
		masl													214.48	214.69	214.73	214.075	214.95	214.97	215.33	214.54	213.09	215.45	214.68
MW11	220.8	mbgs	*Monitoring Well installed March 2018*												4.552	1.34	1.255	1.7	1.57	1.3	0.99	1.31	2.01	0.98	1.4
		masl													216.252	219.46	219.55	219.1	219.23	219.5	219.81	219.49	218.79	219.82	219.4
MW12	219.8	mbgs	*Monitoring Well installed March 2018*												0.99	0.52	0.635	1.44	0.79	0.61	0.37	0.88	1.75	0.21	-
		masl													218.76	219.23	219.12	218.31	218.96	219.14	219.38	218.87	218	219.54	-

Table 3-16 Mini-Piezometer Water Levels and Hydraulic Gradients

MP ID	Depth of Screen (m)	Measurement	Units	18-Jun-2015	20-Jul-2015	13-Aug-2015	21-Sep-2015	18-Nov-2015	22-Dec-2015	19-Jan-2016	26-Mar-2016	30-Apr-2016	24-May-2016	18-Dec-2017	22-Jan-2018	27-Feb-2018	29-Mar-2018	9-Apr-2018	29-May-2018	28-Aug-2018	28-Jan-2019	1-Apr-2019	6-Jun-2019	8-Aug-2019	24-Oct-2019	20-Mar-2020	8-Jun-2020
MP1	0.67	GW Level	mags	-0.691	0.03	0.18	-0.03	0.1	0.17	0.45	0.32	0.17	0.22	0.12	0.17	0.71	0.09	0.25	0.12	*MP destroyed*							
		SW Level	mags	0.15	0.07	0.01	0	0.05	0.09	0.52	0.52	0.16	0.1	0.14	0.64	0.63	0.06	0.195	0.07								
		Hydraulic Gradient	**-**	***-1.251***	***-0.06***	***0.25***	***-0.04***	***0.07***	***0.12***	***-0.1***	***-0.3***	***0.01***	***0.18***	***-0.03***	***-0.7***	***0.12***	***0.04***	***0.08***	***0.07***								
MP2s	0.64	GW Level	mags	0.08	0.23	0.24	0.26	0.25	0.23	0.26	-0.07	-0.19	0.2	0.11	0.09	-0.04	0.04	0	-0.19	0.12	0.11	dry	0.03	0.08	0.12	-0.07	-0.19
		SW Level	mags	0.225	0.25	0.24	0.26	0.25	0.22	0.25	0.21	0.2	dry	dry	dry	0.08	0	0.1	0.05	0.1	dry	0.03	0.03	0.05	0.22	0.16	0.14
		Hydraulic Gradient	**-**	***-0.23***	***-0.03***	***0***	***0***	***0***	***0.02***	***0.02***	***-0.44***	***-0.61***	**-**	**-**	**-**	***-0.19***	***0.06***	***-0.16***	***-0.38***	***0.03***	**-**	***-0.05***	***0***	***0.05***	***-0.16***	***-0.36***	***-0.52***
MP2d	1.76	GW Level	mags	-2.081	0.17	0.16	0.15	0.12	-0.01	0.14	0.18	0.19	0.17	0.07	0.05	0.08	-0.12	-0.15	0.17	0.135	0.13	0.11	0.14	0.11	0.09	-0.12	-0.14
		SW Level	mags	0.045	0.06	0.06	0.08	0.06	0.07	0.09	0.05	0.04	dry	dry	dry	0	0.01	0.02	0.01	0.01	dry	0	0.01	0	0.01	0	0.02
		Hydraulic Gradient	**-**	***-1.211***	***0.06***	***0.06***	***0.04***	***0.03***	***-0.05***	***0.03***	***0.07***	***0.09***	**-**	**-**	**-**	***0.05***	***-0.07***	***-0.1***	***0.09***	***0.07***	**-**	***0.07***	***0.09***	***0.07***	***0.06***	***-0.05***	***-0.02***
MP2 (new)	1.06	GW Level	mags	MP installed December 2017										dry	0.03	0.05	-0.04	-0.01	0.09	0.1	0.13	0.08	0.17	0.09	dry	-0.07	0.13
		SW Level	mags											dry	dry	0	0.02	0.03	0.02	0.02	dry	0	0.01	0.01	0	0	0.02
		Hydraulic Gradient	**-**											**-**	**-**	***0.05***	***-0.06***	***-0.04***	***0.07***	***0.08***	**-**	***0.09***	***0.16***	***0.07***	**-**	***-0.02***	***0.06***
MP3	0.86	GW Level	mags	-0.8	-0.57	-0.54	-0.52	dry	dry	-0.25	0.19	-0.07	-0.13	dry	-0.22	-0.25	-0.5	-0.23	-0.27	dry	-0.56	-0.24	0.13	-0.52	dry	dry	dry
		SW Level	mags	0.02	0.12	dry	dry	dry	dry	0.12	0.19	0.14	dry	dry	dry	0.13	0.15	0.14	dry	dry	dry	dry	0.15	dry	dry	dry	dry
		Hydraulic Gradient	**-**	***-0.95***	***-0.8***	**-**	**-**	**-**	**-**	***-0.43***	***0***	***-0.24***	**-**	**-**	**-**	***-0.44***	***-0.76***	***-0.43***	**-**	**-**	**-**	***-0.16***	***-0.02***	**-**	**-**	**-**	**-**
MP4	0.85	GW Level	mags	-1.211	-0.35	-0.82	-1.16	-0.52	-0.27	-0.09	-0.17	0.16	0.39	-0.32	-0.12	0.14	-0.01	0.1	-0.07	dry	0.1	0.2	0.02	dry	dry	-0.06	-0.37
		SW Level	mags	0.065	0.03	dry	dry	0.01	0.05	0.22	0.18	dry	dry	dry	0.08	0.12	0.03	0.07	dry	dry	0.16	0.2	0.07	dry	dry	0.09	dry
		Hydraulic Gradient	**-**	***-1.501***	***-0.45***	**-**	**-**	***-0.62***	***-0.38***	***-0.36***	***-0.41***	**-**	**-**	**-**	***-0.24***	***0.02***	***-0.05***	***0.04***	**-**	**-**	***-0.07***	***0***	***-0.06***	**-**	**-**	***-0.18***	**-**
MP4 (new)	0.88	GW Level	mags	MP installed December 2017										dry	-0.33	0.09	-0.02	0.07	-0.04	dry	0.07	0.08	0.02	dry	dry	0.01	-0.52
		SW Level	mags											0	0.08	0.15	0.03	0.05	dry	dry	0.22	0.19	0.07	dry	dry	dry	dry
		Hydraulic Gradient	**-**											**-**	***-0.47***	***-0.07***	***-0.06***	***0.02***	**-**	**-**	***-0.18***	***-0.13***	***-0.06***	**-**	**-**	**-**	**-**
MP5	0.91	GW Level	mags	-0.861	-0.57	-1.09	-1.25	-1.21	-1.21	-1.01	0.14	0.22	0.03	-1.24	-0.89	0.02	0.03	0.085	-0.02	dry	-0.03	0.14	0.1	dry	dry	0.1	dry
		SW Level	mags	-0.02	0.02	dry	dry	dry	dry	0.02	0.09	0.07	dry	dry	dry	0.08	0.04	0.06	-0.08	dry	0.1	0.11	0.09	dry	dry	0.1	dry
		Hydraulic Gradient	**-**	***-0.92***	***-0.65***	**-**	**-**	**-**	**-**	***-1.13***	***0.05***	***0.16***	**-**	**-**	**-**	***-0.07***	***-0.01***	***0.03***	***0.07***	**-**	***-0.14***	***0.03***	***0.01***	**-**	**-**	***0***	**-**
MP6	0.85	GW Level	mags	MP installed August 2015		-0.6	-0.96	-0.57	-1.07	-0.16	-0.23	0.05	0.24	-0.37	-0.22	-0.05	-0.04	0.03	0.21	-0.16	-0.03	0.09	0.19	-0.01	-1.08	0	0.04
		SW Level	mags			dry	dry	-0.02	0.05	0.14	0.06	0.03	dry	dry	0.07	0.01	0.01	0.03	dry	dry	0.13	0.03	dry	dry	dry	0.03	dry
		Hydraulic Gradient	**-**			**-**	**-**	***-0.65***	***-1.32***	***-0.35***	***-0.34***	***0.02***	**-**	**-**	***-0.34***	***-0.07***	***-0.06***	***0***	**-**	**-**	***-0.19***	***0.07***	***0.25***	**-**	**-**	***-0.04***	**-**
MP7	0.85	GW Level	mags	MP installed December 2017										-1.31	0.28	0.12	0.04	0.08	-0.06	MP Removed							
		SW Level	mags											dry	dry	0.1	0.04	0.08	0								
		Hydraulic Gradient	**-**											**-**	**-**	***0.02***	***0***	***0***	***-0.07***								
MP8	0.76	GW Level	mags	MP installed December 2017										-1.221	-0.47	-0.04	-0.12	0.09	0.06	-0.33	0.17	0.13	0.1	-0.45	-1.09	-0.42	-0.11
		SW Level	mags											dry	0.11	0.1	0.08	0.11	dry	dry	0.14	0.15	0.12	dry	dry	0.19	dry
		Hydraulic Gradient	**-**											**-**	***-0.76***	***-0.18***	***-0.26***	***-0.03***	**-**	**-**	***0.04***	***-0.03***	***-0.03***	**-**	**-**	***-0.8***	**-**
MP9	0.31	GW Level	mags	MP installed December 2017										-0.25	-0.05	0.14	0.16	0.33	0.55	0.16	0.3	0.39	0.54	0.19	-0.49	-0.19	0.29
		SW Level	mags											0.13	0.4	0.36	0.3	0.32	0.33	dry	0.5	0.43	0.33	0.28	dry	0.37	dry
		Hydraulic Gradient	**-**											***-1.23***	***-1.45***	***-0.71***	***-0.45***	***0.03***	***0.71***	**-**	***-0.65***	***-0.13***	***0.68***	**-**	**-**	***-1.81***	**-**
MP10	0.57	GW Level	mags	MP installed December 2017										dry	-0.05	0.16	-0.98	0.04	-0.54	-0.18	-0.55	0.2	0.13	-0.19	-0.85	0.02	-0.02
		SW Level	mags											dry	0.05	0.04	0.01	0.04	dry	dry	0.1	0.06	0.04	dry	dry	0.07	dry
		Hydraulic Gradient	**-**											**-**	***-0.18***	***0.21***	***-1.74***	***0***	**-**	**-**	***-1.14***	***0.25***	***0.16***	**-**	**-**	***-0.09***	**-**
MP11	0.63	GW Level	mags	MP installed December 2017										dry	-0.07	0.3	0.01	0.22	0.15	-0.17	0.21	0.26	0.11	-0.57	-0.76	0.09	-0.29
		SW Level	mags											dry	0.1	0.15	0.04	0.13	dry	dry	dry	0.28	0.15	dry	dry	0.21	dry
		Hydraulic Gradient	**-**											**-**	***-0.27***	***0.24***	***-0.05***	***0.14***	**-**	**-**	**-**	***-0.03***	***-0.06***	**-**	**-**	***-0.19***	**-**
SP1	0.98	GW Level	mags	-0.12	-0.24	-0.45	-0.61	0.06	0.09	0.31	0.01	-0.28	-0.1	0.15	0.09	0.09	0.06	0.07	0.06	-0.34	0.3	0.05	0.24	-0.57	-0.66	-0.2	-0.27
		SW Level	mags	0.17	dry	dry	dry	0.06	0.18	0.28	0.34	0.19	dry	0.15	dry	0.08	0.18	0.23	0.07	dry	0.43	0.42	0.235	dry	dry	0.04	dry
		Hydraulic Gradient	**-**	***-0.3***	**-**	**-**	**-**	***0***	***-0.09***	***0.03***	***-0.34***	***-0.48***	**-**	***0***	**-**	***0.01***	***-0.12***	***-0.16***	***-0.01***	**-**	***-0.13***	***-0.38***	***0.01***	**-**	**-**	***-0.24***	**-**

3.5.3 Hydraulic Conductivity

Single well response tests (i.e., slug tests) were completed at each monitoring well to determine the hydraulic conductivity (K) of the hydrostratigraphic unit surrounding the well screen. Slug testing consisted of both rising head (RH) and falling head (FH) tests, which act to create a head change through the insertion (FH Test) or removal (RH Test) of a 1-m long slug

Based on the results of the single well response testing, the geometric mean hydraulic conductivity of the silty clay Halton Till is approximately $9.7x10^{-7}$ m/sec, and ranges from $4.7x10^{-8}$ m/sec to $8.0x10^{-6}$ m/sec. This is within the accepted range of hydraulic conductivity of between 10^{-10} m/sec and 10^{-6} m/sec for Halton Till soils (Interim Waste Authority, 1994). The variability of the k values within the till are a result of the heterogeneity of the soils, which range from dense silty sand till, to fine grained seams of glaciolacustrine silty sand and silty clay soils. The k values measured within the interstadial silty sand soils have a geometric mean of $5.7x10^{-6}$ m/sec. The measured values range from $3.0x10^{-7}$ m/sec to $5.1x10^{-5}$ m/sec. The results are summarized in **Table 5, Appendix E**.

3.5.4 Infiltration Testing

Infiltration tests were planned and conducted with consideration of the Low Impact Development (LID) Stormwater Management Planning and Design Guide, Appendix C – Site Evaluation and Soil Testing Protocol for Stormwater Infiltration (TRCA/CVC, 2010). Six locations (IT1 – IT6) were selected to provide good spatial distribution through the proposed landscaped areas. Infiltration test locations are shown on **Figure 1, Appendix E**. Infiltration testing was completed using a Guelph Permeameter (GP), which can be used to calculate the field saturated hydraulic conductivity (K_{fs}) of the shallow subsurface.

The infiltration rate of the shallow soils ranged between 12.9 and 22.5 mm/hour, with an average rate of 16.2 mm/hour. A summary of the infiltration tests is presented in **Table 3-17**. Note that any selected LID measures should be designed to take into consideration the low permeability silt and clay composition of the surficial soils. Infiltration trenches, vegetated swales, bioretention areas, and the application of topsoil can all be effective strategies in low permeability soils to increase infiltration. It is expected that the use of infiltration trenches should be effective in most areas, as the groundwater table elevation is typically greater than 1 m below ground surface. During the spring freshet in May 2018, the measured water table ranged from 6.56 mbgs (MW1) to 0.38 mbgs (MW6). Infiltration trenches generally require approximately 1 m of separation between the base of the trench and the top of the seasonally high water table.

Higher infiltration values are expected in the units of interstadial sand and silt identified at the northeast corner of the Orlando Lands found approximately 1.5 – 3.0 mbgs near MW1, MW3, and MW8 (**Figure 4, Appendix E**). The hydraulic conductivity of the sands near MW1 and MW8 range from 6.0×10^{-6} to 3.8×10^{-5} m/s which correlates to percolation rates ranging from 74 to 122 mm/hour. The water table in this area ranges from 2.5 to 7.0 mbgs, making a 1 m separation between the invert of an LID and the water table easily achievable. Based on the percolation rates and the depth of the water table, this area would be an optimal location for infiltration-based LIDs.

Table 3-17 Summary of Infiltration Testing

Site ID	Soil Description	Total Depth (cm)	Applied Change in Hydraulic Head (H) (cm)	Steady State Rate of Change (r) (cm/min)	Kfs (m/sec)	Infiltration Rate (mm/hour)
IT1	0 – 15 cm: brown disturbed soils 15 – 90 cm: brown clay, some silt, trace sand, moist	90	10	0.05	$9.0x10^{-9}$	13.1
IT2	0 – 30 cm: brown disturbed soils 30 – 73 cm: brown to red silty clay, some fine sand, dry and non-cohesive	73	10	0.15	$5.0x10^{-8}$	20.7
IT3	0 – 50 cm: light brown fine sand and silt, some clay, dry and non-cohesive	50	20	0.05	$8.6x10^{-9}$	12.9
IT4	0 – 15 cm: brown disturbed soils 15 – 82 cm: light brown/red clay with silt, moist, slightly cohesive	82	10	0.05	$9.0x10^{-9}$	13.1
IT5	0 – 90 cm: brown clayey silt with some sand, moist	90	10	0.075	$1.4x10^{-8}$	14.6
IT6	0 – 77 cm: brown clay and silt and fine sand, dry and non-cohesive	77	10	0.375	$6.8x10^{-8}$	22.5
MW1	Interstadial Sand and Silt	7.6 – 9.1 (mbgs)	N/A	N/A	$3.8x10^{-5}$	122.5
MW8	Interstadial Sand and Silt	6.4 – 7.9 (mbgs)	N/A	N/A	$6.0x10^{-6}$	74.0

3.5.5 Groundwater Chemistry

Groundwater chemistry samples were collected on August 14, 2015 from two monitoring wells, MW1 and MW5, and analyzed for a suite of water quality parameters including turbidity, total dissolved solids (TDS), pH, dissolved metals, cations and anions. A summary table of the groundwater analysis results is presented on **Table 7, Appendix E**. Results were compared against Ontario Drinking Water Standards (ODWS) and the Provincial Water Quality Objectives (PWQO). The results show the sample from MW1 exceeded PWQO standards in colour and hardness, and the sample from MW5 exceeded PWQO in colour, turbidity, metals and exceeded ODWS in sodium. These results are typical for raw groundwater samples collected in the area and do not show any adverse impacts from historical agricultural use on the Orlando Lands.

3.5.6 Source Water Protection

In October 2017, a Source Water Protection Plan was completed that encompasses the Halton Region Source Protection Area (HHSPC, 2017). The Source Water Protection Plan identifies three main regulatory factors under the *Clean Water Act (2006)* relating to local hydrogeology to consider for site development: Significant Groundwater Recharge Areas (SGRAs), Highly Vulnerable Aquifers (HVAs), and Wellhead Protection Areas (WHPAs).

Based on available MECP Source Protection Information mapping, the Subject Lands are approximately 3.5 km from the nearest WHPAs associated with the Kelso Municipal Supply Well Field and are outside of designated WHPA-Q1 and WHPA-Q2 recharge management areas. The Subject Lands also not within any designated HVA or SGRA areas **(Appendix E).** Overall, no restrictions to land use or mitigative actions were identified based on Source Water Protection policies

3.5.7 Water Balance

3.5.7.1 Methodology

A pre-development water budget was calculated over the Orlando Lands using a monthly soil-moisture balance approach as described in Thornthwaite and Mather (1957). Long term climate data were obtained from the nearest meteorological station to the study area, the Georgetown WWTP (43^0 38' 24" N, 79^0 52' 45" W) which is approximately 10 km from the Orlando Lands, over the 30-year duration from 1981 to 2010. The average available water surplus, which is the water available for infiltration and runoff, was calculated by subtracting the average annual evapotranspiration from the average annual precipitation. A soil moisture retention value of 250 mm was utilized to represent the clay and silt textured till and agricultural land cover at the site and in areas where forest cover is the dominant vegetation cover, a soil moisture retention of 400 mm was utilized.

The resulting annual water surplus was then partitioned using infiltration coefficients based on MOEE (1995) and modified based on site specific conditions. This approach takes into consideration three factors: topography/slope, soil type, and land cover, which are summed to provide a representative infiltration factor for the area. A summary of the infiltration factors for each descriptor used in the water balance assessment are provided in **Table 3-18**. The total average annual infiltration over pervious areas was then calculated by multiplying the applicable water surplus value by the sum of the three individual factors. A summary of the surplus values calculated for each soil moisture retention over the Orlando Lands is provided in **Table 3-19**.

3.5.7.2 Parcel Based Water Balance Results

The calculated actual ET (or AET) based on the Thornthwaite and Mather monthly water balance model is approximately 486 mm/year, or approximately 55% of the total annual precipitation (**Table 3-19**). The actual evapotranspiration is calculated based on a potential ET (or PET) and soil-moisture storage withdrawal. Monthly PET is estimated using monthly temperature data and is defined as a water loss from a homogeneous vegetation covered area that never lacks water (Thornthwaite, 1948; Mather, 1978). The calculated PET for the study area is 593 mm/year, or about 68% of the total precipitation. In general, there is a soil moisture deficit of 107 mm/year.

The estimated water surplus within the Subject Lands was calculated using the soil moisture retention value for agricultural land cover and silty clay geology, and is approximately 392 mm/year. The water surplus has two components: a runoff component which occurs when the soil moisture capacity is exceeded leading to overland flow, and an infiltration component.

The pre-development infiltration for Parcel 1 was calculated to be 41,581 m^3/yr. The pre-development infiltration for Parcel 4 was calculated to be 152,001 m^3/yr. Combined, both parcels have a total pre-development infiltration of 193,582 m^3/yr (**Table 3-20**).

Table 3-18 Infiltration Factors

Area Description	Infiltration Factor Value
SOIL TYPE	
Till: Clay to silt-textured till (derived from glaciolacustrine deposits or shale)	0.10
Fine textured glaciolacustrine deposits: silt and clay, minor sand and gravel	0.10
TOPOGRAPHY/SLOPE	
2.5% slope	0.15
PRE-DEVELOPMENT LAND COVER	
Agriculture	0.10
Forested	0.15
OVERALL INFILTRATION COEFFICIENTS FOR SITE	
Silty Clay/ 2.5% slope/ agricultural	0.35
Silty Clay/ 2.5% slope/ forested	0.40

Table 3-19 Surplus Calculation

	WATER BALANCE	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	YEAR
Soil Moisture Retention = 250 mm	Precipitation (P)	67.8	60	57.2	76.5	79.3	74.8	73.5	79.3	86.2	68.3	88.5	65.9	877.3
	Temperature (T)	-6.3	-5.2	-0.9	6	12.3	17.4	20	19	14.8	8.4	2.8	-2.9	7
	Potential Evapotranspiration (PET)	0	0	0	32	77	112	132	115	77	38	10	0	593
	P-PET	68	60	57	45	2	-37	-58	-36	10	30	78	66	285
	Change in Soil Moisture Storage	0	0	0	-80	-35	-22	-11	9	24	30	25	0	-60
	Soil Moisture Storage	250	250	250	170	135	113	102	111	135	165	190	250	-
	Actual Evapotranspiration (AET)	0	0	0	32	77	97	85	70	77	38	10	0	486
	Soil Moisture Deficit (mm)	0	0	0	0	0	15	47	45	0	0	0	0	107
	Surplus (P-AET)	**68**	**60**	**57**	**45**	**2**	**-22**	**-11**	**9**	**10**	**30**	**78**	**66**	**391.7**

Soil Moisture Retention = 400 mm	Precipitation (P)	67.8	60	57.2	76.5	79.3	74.8	73.5	79.3	86.2	68.3	88.5	65.9	877.3
	Temperature (T)	-6.3	-5.2	-0.9	6	12.3	17.4	20	19	14.8	8.4	2.8	-2.9	7.1
	Potential Evapotranspiration (PET)	0	0	0	32	77	112	132	115	77	38	10	0	593
	P-PET	68	60	57	45	2	-37	-58	-36	10	30	78	66	285
	Change in Soil Moisture Storage	0	0	0	-31	-40	-27	-15	13	0	35	26	0	-39
	Soil Moisture Storage	400	400	400	369	329	302	287	300	329	364	390	400	-
	Actual Evapotranspiration (AET)	0	0	0	32	77	102	89	66	77	38	10	0	491
	Soil Moisture Deficit (mm)	0	0	0	0	0	10	43	49	0	0	0	0	102
	Surplus (P-AET)	**68**	**60**	**57**	**45**	**2**	**-27**	**-15**	**13**	**10**	**30**	**78**	**66**	**386.7**

Table 3-20 Pre-Development Water Balance (Future Development Parcels)

Parcel	Surficial Geology	Vegetation	Total (ha)	Water Surplus on Vegetated Pervious Areas (m/year)	Runoff Coefficient	Infiltration Coefficient	Total Runoff Volume (m^3/year)	Total Infiltration Volume (m^3/year)
1	Silty Clay	Agriculture	30.3	0.392	0.65	0.35	77,222	41,581
4	Silty Clay	Agriculture	89.53	0.392	0.65	0.35	227,948	122,741
	Silty Clay	Forested	16.6	0.392	0.55	0.45	35,762	29,260
Total	**-**	**-**	**136.5**	**-**	**-**	**-**	**340,932**	**193,582**

4 CONSTRAINTS AND OPPORTUNITIES

The information collected through the background review and baseline inventories has been synthesized and compared against the goals, objectives and targets to establish the key opportunity and constraints for the study area. These are documented in the following sections.

4.1 Natural Heritage Features Analysis and Significance

As identified in Section 115.3 of the Regional Official Plan, the RNHS includes the following components:

Key Features, which include:

- Significant habitat of Endangered and Threatened species;
- Significant wetlands;
- Significant coastal wetlands;
- Significant woodlands;
- Significant valleylands;
- SWH;
- ANSIs;
- Fish habitat;
- Enhancements to Key Features including Centres for Biodiversity;
- Linkages;
- Buffers;
- Watercourses that are within a Conservation Authority Regulation Limit or that provide a linkage to a wetland or a significant woodland; and
- Wetlands other than those considered significant under Section 113.3(1)b.

The Key Features include those natural features and areas identified in the PPS (MMAH 2020) while the other components of the RNHS represent the systems-based approach to natural heritage system planning.

The presence/absence of these RNHS components on the Subject Lands are discussed in the subsequent sections. The Natural Heritage Reference Manual (NHRM; MNR 2010), the Town of Milton Official Plan (2008) and the Region of Halton Official Plan (2018) were referenced to assess the potential significance of the natural areas, and their associated forms and functions on the landscape.

The FSEMS (2000) provided limited discussion on the presence of natural heritage features within the FSEMS Study Area and did not provide species or community specific information to determine where sensitive features may be located. As a result, they have not been included within this discussion and the analysis below is based solely on the data collected to inform this Comprehensive Study.

Where significant natural heritage features are present on the Subject Lands (**Figure 4-1 and Figure 12, Appendix B1**), their sensitivities are discussed.

4.1.1 Key Features

4.1.1.1 Habitat of Endangered and Threatened Species

SAR and their habitats are considered provincially sensitive information. The survey methods, results, and potential impacts to SAR species and their habitats will be submitted to the MECP through the Information Gathering Form (IGF) process or a similar process. Due to the sensitive nature of this information, all correspondence and precise location-related information will remain with the MECP. One Endangered species and one Threatened species were recorded within the Subject Lands and are discussed below. As discussed

in **Section 1.6.7**, Redside Dace are not known to be present within or downstream from the watercourses on the Orlando Lands and therefore, these watercourses do not provide contributing habitat, per the definition in O.Reg. 242/08. Although Silver Shiner were identified in the Middle Branch of Sixteen Mile Creek approximately 5 km (straight line distance) downstream from the watercourses on the Orlando Lands, given the distance from these confirmed populations, Silver Shiner are not considered further in this impact assessment. However, the mitigation measures identified to protect fish and fish habitat on and adjacent to the Orlando Lands will also protect downstream Silver Shiner populations.

Butternut

Butternut is listed as Endangered in Ontario and Canada. A total of eight individuals were recorded on the Orlando Lands. No formal Butternut health assessment was completed as these specimens occur >50 m from the proposed development. The MNRF Recovery Strategy (2013) does not identify the critical habitat of Butternut, due to the diversity of suitable habitats occupied by this species, with the expectation that an appropriate level of habitat protection will be applied for the recovery of the species. Impacts to this species will be addressed under specific assessment by MECP through the SAR IGF process or a similar process.

Barn Swallow

Barn Swallow are listed as Threatened in Ontario and Canada. Two confirmed nesting locations were identified on the Orlando Lands during targeted Barn Swallow nesting surveys. One confirmed nesting location was removed from the landscape, after registration with the MNRF through their Notice of Activity Form, due to a public health and safety risk. A replacement habitat structure has been erected within 1 km of the removed structure, following requirements set out under O. Reg. 242/08 Section 23.5. Impacts to the remaining Barn Swallow population will be addressed under specific assessment by the MECP through the SAR IGF process, or a similar process.

Draft Natural Heritage Constraints Memo (Dougan & Associates)

Dougan and Associates prepared a Draft Natural Heritage Constraints Memo for the Orlando Lands (dated March 24, 2021) which identified the following candidate threatened and endangered species based on candidate habitat availability within or adjacent to the Orlando Lands:

- Butternut – within the Orlando Lands and adjacent lands
- Redside Dace – within adjacent lands only

As previously discussed within **Section 1.6.7**, Redside Dace are not currently known within the Middle Tributary of Sixteen Mile Creek. Based on targeted field surveys, Butternut individuals were recorded within the Orlando Lands.

4.1.1.2 Significant Wetlands

Within Ontario, significant wetlands are identified by the MNRF or by their designates. Other evaluated or unevaluated wetlands may be identified for conservation by the municipality or the conservation authority. Section 268 of the Region's OP provides the definition for PSWs as "wetlands so classified by the Ministry of Natural Resources based on the Ontario Wetland Evaluation System [OWES] 2013 Southern Manual, as amended from time to time". There are no PSWs identified within or adjacent to the Orlando Lands as part of the FSEMS on adjacent lands.

The Chudleigh Swamp evaluated (other) wetland is located approximately 1.7 km northwest of the Orlando Lands. This feature is not considered provincially significant; however, it may be considered regionally or locally significant.

Non-Provincially Significant Wetland Units

A total of three wetland community types (meadow marsh, shallow marsh and deciduous swamp) are found on the Orlando Lands. Within these wetlands, a total of five ELC communities were identified:

- Mixed Mineral Meadow Marsh (MAM2-11);

- Cattail Mineral Shallow Marsh (MAS2-1);
- Red Maple-Conifer Organic Mixed Swamp (SWM5-1);
- Swamp Maple Mineral Deciduous Swamp (SWD3-3); and
- Hickory Mineral Deciduous Swamp (SWD4-5).

The SWM5-1 ELC community (also identified as Mixed Swamp Wetland – MP2) is ranked as an S3S4 (rare to uncommon/apparently secure – vulnerable) community. The above-noted wetland community types present on the Orlando Lands are unevaluated. As discussed within **Section 3.5.2.2**, SWM5-1 vegetation community is fed by both groundwater discharge and surface runoff, SWD3-3 vegetation community receives seasonal groundwater contributions, and SWD4-5 and MAM2-11 vegetation communities are fed solely through surface water contributions and precipitation events.

Section 276.5 of the Region's OP defines Significant Wetlands as:

- for lands within the Niagara Escarpment Plan Area, PWSs and wetlands as defined in the Niagara Escarpment Plan that make an important ecological contribution to the RNHS;
- for lands within the Greenbelt Plan Area but outside the Niagara Escarpment Area, PWSs and wetlands as defined in the Greenbelt Plan;
- for lands within the RNHS but outside the Greenbelt Plan Area, PWSs and wetlands that make an important ecological contribution to the RNHS; and
- outside the RNHS, PWSs.

All of the above-noted wetlands, with the exception of the MAM2-11 and MAS2-1 vegetation communities, are located within the Greenbelt Planning Area (Protected Countryside) but outside of the Niagara Escarpment Area. Therefore, all wetlands (except for MAM2-11 and MAS2-1) are considered to be Significant Wetlands, as defined in the Region's OP (2018). The MAM2-11 and MAS2-1 vegetation communities are located outside of the Greenbelt Plan Area and the RNHS, and are not PSWs, therefore, they do not qualify as significant wetlands per the Region's OP definition. This is illustrated on **Figure 12** (**Appendix B1**).

These wetlands are located on the west side of Boston Church Road and appear to be hydrologically and terrestrially disconnected from the adjacent RNHS. The MAM2-11 and MAS2-1 vegetation communities are associated with HDF R6, which conveys flows from actively managed agricultural fields within the Parcel 1 lands into the roadside ditch that flows along the western side of Boston Church Road. This HDF reach does not flow into the RNHS (as shown on **Figure 11**, **Appendix B1**). These wetlands are not hydrologically connected to the RNHS on the eastern side of Boston Church Road. Moreover, no wildlife passages (e.g., culverts) were identified along Boston Church Road within the general vicinity of the wetlands that could support abiotic and biotic movement of matter/materials into the RNHS. These wetlands do not provide an important contribution to the overall RNHS as they are common wetland communities with limited native diversity. No amphibians were recorded using these wetland communities (as shown within **Table 4**, **Appendix B2**) and it is likely that these wetlands contribute limited ecological functions in comparison to the existing SWD communities on the Parcel 4 lands to the overall RNHS.

Moreover, the RNHS depicts several isolated features within the Parcel 4 agricultural lands (**Figure 2, Appendix B1**). The Comprehensive Study's ELC surveys and site reconnaissance have confirmed that these features are not present as the agricultural fields are actively managed in these locations (as discussed above within **Section 3.1**).

4.1.1.3 Significant Coastal Wetlands

Similarly, to significant wetlands, the MNRF or their designates identify significant coastal wetlands present on the landscape. Coastal wetlands are identified under the NHRM (MNR 2010) as:

> a) any wetland that is located on one of the Great Lakes or their connecting channels (Lake St. Clair, St. Mary's, St. Clair, Detroit, Niagara and St. Lawrence Rivers); or

b) any other wetland that is on a tributary to any of the above-specified water bodies and lies, either wholly or in part, downstream of a line located two km upstream of the 1:100-year floodline (plus wave run-up) of the large water body to which the tributary is connected.

No significant coastal wetlands are identified on the Orlando Lands.

4.1.1.4 Significant Woodlands

Significant woodlands are identified by the planning authority using criteria established by the MNRF. Under the NHRM (MNR 2010), woodlands are defined as:

> ...treed areas that provide environmental and economic benefits to both the private landowner and the general public, such as erosion prevention, hydrological and nutrient cycling, provision of clean air and the long-term storage of carbon, provision of wildlife habitat, outdoor recreational opportunities, and the sustainable harvest of a wide range of woodland products. Woodlands include treed areas, woodlots or forested areas and vary in their level of significance at the local, regional and provincial levels.

The Halton Region Official Plan (2018; Section 295) definition of a woodland states that:

> Woodland means land with at least: 1000 trees of any size per ha, or 750 trees over 5cm in diameter per ha, or 500 trees over 12 cm in diameter per ha, or 250 trees over 20 cm in diameter per ha but does not include an active cultivated fruit or nut orchard, a Christmas tree plantation, a plantation certified by the Region, a tree nursery, or a narrow linear strip of trees that defines a laneway or a boundary between fields. For the purpose of this definition, all measurements of the trees are to be taken at 1.37 m from the ground and trees in regenerating fields must have achieved that height to be counted.

The Halton Region Official Plan (2018; Section 277) defines significant woodlands as:

> Significant Woodland means a Woodland 0.5 ha or larger determined through a Watershed Management Plan, a Subwatershed Study or a site-specific Environmental Impact Assessment to meet one or more of the four following criteria:
>
> - 277(1) the Woodland contains forest patches over 99 years old;
> - 277(2) the patch size of the Woodland is 2 ha or larger if it is located in the Urban Area, or 4 ha or larger if it is located outside the Urban Area but below the Escarpment Brow, or 10 ha or larger if it is located outside the Urban Area but above the Escarpment Brow;
> - 277(3) the Woodland has an interior core area of 4 ha or larger, measured 100 m from the edge; or
> - 277(4) the Woodland is wholly or partially within 50 m of a major creek or certain headwater creek or within 150 m of the Escarpment Brow.

In accordance with the above-noted definitions, natural treed communities (Coniferous Forest; FOC, FOM, FOD, Coniferous Swamp; SWC, SWM, SWD) and cultural forest/plantation communities (Cultural Woodland; CUW, Cultural Plantation; CUP) are considered woodlands (i.e., meet the Forestry Act,1990 woodland density requirements). Woodland patches are considered part of the same continuous woodland if they are within 20 m of each other.

Woodlands on the Orlando Lands have been examined and mapped in terms of ELC vegetation community types. Patch sizes were measured, and each patch was considered in terms of the presence of other indicators of potential significance.

One significant woodland was identified on the Orlando Lands given that the total contiguous area exceeds 4 ha in size, provides interior forest habitat, hosts a portion of Sixteen Mile Creek (Middle East Branch) (**Figure 12, Appendix B1**) and is part of a defined RNHS (**Figure 2, Appendix B1**). This feature is also located within Protected Countryside designated lands of the Greenbelt Planning Area.

Draft Natural Heritage Constraints Memo (Dougan & Associates)

Dougan and Associates prepared a Draft Natural Heritage Constraints Memo for the Orlando Lands (dated March 24, 2021) which identified the woodlands as regionally significant.

4.1.1.5 Significant Valleylands

Significant valleylands are defined and designated by the planning authority. General guidelines for determining significance of these features are presented in the NHRM (MNR 2010) for Policy 2.1 of the PPS. Recommended criteria for designating significant valleylands include prominence as a distinctive landform, degree of naturalness, and importance of its ecological functions, restoration potential and historical and cultural values.

Both the Town and the Regional Official Plans do not provide detailed criteria for the evaluation of significant valleylands. CH's Policies and Guidelines for Administration of O. Reg. 162/06 and Land Use Planning Policy Document (2006) defers identification of significant valleyland features to analysis under the NHRM (MNR 2010).

The NHRM (MNR 2010) was reviewed to understand whether the valleyland associated with Sixteen Mile Creek meets significance criteria within the landscape. While limited information is available regarding the physiography of the valleyland, this feature has been assessed as a candidate significant valleyland as it hosts a permanent watercourse, provides habitat for Endangered species and supports a Rare Vegetation Community Type (SWM5-1; S3S4). Candidate significant valleyland limits are illustrated on **Figure 12** (**Appendix B1**).

4.1.1.6 Significant Wildlife Habitat

SWH is one of the more complex natural heritage features to identify and evaluate. There are several provincial documents that discuss identifying and evaluating SWH including the NHRM (MNR 2010), the Significant Wildlife Habitat Technical Guide (MNR 2000), and the SWH Ecoregion Criterion Schedule (MNRF 2015). The Orlando Lands are located in Ecoregion 7E and were therefore assessed using the 7E Criterion Schedule (MNRF 2015).

There are four general types of SWH:

- Seasonal concentration areas;
- Rare or specialized habitats;
- Habitat for species of conservation concern; and
- Animal movement corridors.

General descriptions of these types of SWH are provided in the following sections.

Seasonal Concentration Areas

Seasonal concentration areas are those sites where large numbers of a species gather together at one time of the year, or where several species congregate. Seasonal concentration areas include deer yards; wintering sites for snakes, bats, raptors and turtles; waterfowl staging and molting areas, bird nesting colonies, shorebird staging areas, and migratory stopover areas for passerines or butterflies. Only the best examples of these concentration areas are usually designated as SWH.

Rare or Specialized Habitats

Rare and specialized habitat are two separate components. Rare habitats are those with vegetation communities that are considered rare in the province. SRANKS are rarity rankings applied to species at the 'state', or in Canada at the provincial level, and are part of a system developed under the auspices of the Nature Conservancy (Arlington, VA). Generally, community types with SRANKS of S1 to S3 (extremely rare to rare-uncommon in Ontario), as defined by the NHIC (2021), could qualify. It is to be assumed that these habitats are at risk and that they are also likely to support additional wildlife species that are considered significant. Specialized habitats are microhabitats that are critical to some wildlife species. The NHRM (MNR

2010) defines specialized habitats as those that provide for species with highly specific habitat requirements, areas with exceptionally high species diversity or community diversity, and areas that provide habitat that greatly enhances species' survival.

Habitat for Species of Conservation Concern

Species of conservation concern include those that are provincially rare (S1 to S3), provincially historic records (SH) and Special Concern species. Several specialized wildlife habitats are also included in this SWH category, including Terrestrial Crayfish habitat, and significant breeding bird habitats for marsh, open country and early successional bird species.

Habitats of species of conservation concern do not include habitats of Endangered or Threatened species as identified by the ESA (2021 Consolidation). Endangered and Threatened species are discussed in **Section 4.1.1.1**.

Animal Movement Corridors

Animal movement corridors are areas that are traditionally used by wildlife to move from one habitat to another. This is usually in response to different seasonal habitat requirements, including areas used by amphibians between breeding and summer/overwintering habitats, called amphibian movement corridors.

Dougan's Draft Natural Heritage Constraints Memo

Dougan and Associates prepared a Draft Natural Heritage Constraints Memo for the Orlando Lands (dated March 24, 2021) identified 11 candidate SWH types that may be present:

- Seasonal Concentration Areas of Animals
  - Bat Maternity Colonies – within adjacent lands only
  - Turtle Wintering Areas – within adjacent lands only
  - Reptile Hibernaculum – within Orlando Lands and adjacent lands
  - Colonially Nesting Bird Breeding Habitat (Trees and Shrubs) - within adjacent lands only
- Specialized Habitat for Wildlife
  - Turtle Nesting Areas – within Orlando Lands and adjacent lands
  - Seeps and Springs - within adjacent lands only
  - Amphibian Breeding Habitat (Woodland) - within adjacent lands only
  - Amphibian Breeding Habitat (Wetland) - within Orlando Lands and adjacent lands
- Habitat for Species of Conservation Concern
  - Terrestrial Crayfish – within Orlando Lands and adjacent lands
- Special Concern and Rare Wildlife Species
  - Snapping Turtle – within Orlando Lands and adjacent lands
  - Monarch – within Orlando Lands and adjacent lands
  - Eastern Wood-Pewee – within Subject Lands and adjacent lands
  - Wood Thrush - within adjacent lands only
- Animal Movement Corridors
  - Amphibian Movement Corridors - within adjacent lands only

Table 15 (**Appendix B1**) discusses all types of SWH relevant to the Subject Lands based on ecological data collected between 2014 and 2021. The SWH analysis only considers data collected by Savanta during ecological inventories on Parcels 1 and 4.

The following SHW types are confirmed to be or may be present on the Parcel 1 and 4 Subject Lands:

- Candidate Bat Maternity Colonies within woodland features;

- Candidate Turtle Overwintering Habitat within Sixteen Mile Creek;
- Candidate Habitat for Species of Conservation Concern (Snapping Turtle) within Sixteen Mile Creek;
- Candidate Woodland Amphibian Breeding Habitat (offsite – AMC D);
- Candidate Terrestrial Crayfish Habitat (within SWD communities);
- Rare Vegetation Type – S3S4 Red Maple – Conifer Organic Mixed Swamp (SWM5-1); and
- Habitat for Species of Conservation Concern (Eastern Wood-Pewee).

Bat Maternity Colonies were determined to be candidate based on the limited number of surveys completed.

Candidate Woodland Amphibian Breeding Habitat was found on adjacent lands at AMC D (**Figure 4, Appendix B1**), as species abundance criteria was met; however, habitat criteria could not be confirmed. Since this property is on adjacent lands (non-participating), it will not be considered in the impact assessment.

All other candidate SWH types identified by Dougan and Associates within the Draft Natural Heritage Constraints Memo were confirmed not to be present based on absence of ELC communities, habitat availability, significant wildlife indicator species not being present and/or abundance criteria not met.

4.1.1.7 Significant Areas of Natural and Scientific Interest

No ANSIs were identified on, or within the general vicinity of, the Subject Lands.

4.1.1.8 Fish Habitat

Fish habitat, as defined in the federal Fisheries Act, 1985, c. F-14, means “spawning grounds and nursery, rearing, food supply, and migration areas on which fish depend directly or indirectly in order to carry out their life processes.” Fish, as defined in S.2 of the Fisheries Act, 1985, c. F-14, includes “parts of fish, shellfish, crustaceans, marine animals and any parts of shellfish, crustaceans or marine animals, and the eggs, sperm, spawn, larvae, spat and juvenile stages of fish, shellfish, crustaceans and marine animals.”

A portion of the Middle Branch of Sixteen Mile Creek is found along the northeast portion of Parcel 4 lands. Sixteen Mile Creek is considered to be a regulated watercourse by CH. Aquatic data collected from a sampling station downstream from the Subject Lands (SXM-349) was discussed in the Sixteen Mile Creek, Grindstone Creek and Supplemental Monitoring report (CH 2011) and showed that the reach is generally dominated by a cool to warm-water, riverine fish assemblage. This watercourse provides permanent, direct fish habitat and is expected to support the full range of life history requirements for resident riverine species. It also supports migratory Rainbow Trout which enter Sixteen Mile Creek from Lake Ontario. As discussed within **Section 3.5.2.2**, Sixteen Mile Creek received seasonal groundwater discharge, however during some portions of the year (late fall and winter months) it supports groundwater recharge.

The watercourse on the Orlando Lands (R3S1) provides seasonal direct fish habitat, as documented during the 2015 HDFA. The feature is intermittent and therefore, does not provide any permanent habitat for fish and there are no permanent refuge areas present on the Orlando Lands. All other HDFs were assessed as contributing (indirect) fish habitat or no fish habitat, as discussed within **Section 5.3.1**. As discussed within **Section 3.5.2.2**, R3S1 receives seasonal groundwater discharge, however R1S1 and R6S1/R6S0 are solely supported through surface water contributions.

Therefore, both Sixteen Mile Creek and R3S1 (**Figure 12, Appendix B1**) provide direct fish habitat and some HDFs that provide contributing functions (I.e., ephemeral flow conveyance) provide indirect fish habitat.

4.1.2 Other Components of the RNHS

4.1.2.1 Enhancements to Key Features

RNHS mapping on Map 1G of the Regional Official Plan does not specifically distinguish Enhancements to Key Features from linkages and buffers. The existing ROPA 38 RNHS mapping depicts the agricultural lands within the Greenbelt on the Orlando Lands as being within the RNHS and these appear to be outside of Key

Features, Linkages and Buffers and therefore, these locations will be considered as potential enhancement areas for the purposes of this assessment.

4.1.2.2 Linkages

RNHS mapping on Map 1G of the Regional Official Plan does not specifically distinguish Linkages from Enhancements to Key Features and buffers and those linkages/buffers/enhancements to Prime Agricultural Areas in NHS. The Regional Official Plan defines a linkage as “an area intended to provide connectivity supporting a range of community and ecosystem processes enabling plants and animals to move between Key Features over multiple generations”. Furthermore, linkages are discussed within Halton Region’s Natural Heritage System Definition and Implementation document (North-South Environmental Inc. 2009). Regional linkages are identified as features that are between 300 to 400 m in width, whereas, local linkages range from 60 to 100 m wide.

Based on Halton Region’s OP definition, watercourse R3S1 could potentially be considered a linkage, since it links the upstream woodlands with downstream (offsite) Key Features. Currently there is limited vegetated riparian buffer given the existing agricultural nature of the Subject Lands, therefore, this would qualify as a local linkage.

The other ephemeral HDFs on the Orlando Lands do not meet this linkage criteria and are, therefore, not considered to be Linkages. However, RNHS mapping appears to depict HDF reach R3S1a as a Linkage in the RNHS (**Figure 12, Appendix B1**). Although this feature, which was identified as a Mitigation HDF, does not appear to provide linkage functions under current conditions, it will be considered in the impact assessment.

The Town of Milton’s OP also identifies the hydro-corridor as an environmental linkage area (as illustrated on **Figure 2**, **Appendix B1)**. While there are no natural heritage features present within the hydro-corridor, it is likely that this hydro-corridor allows for terrestrial species movement east-west across the property. This linkage would also be considered a local linkage given the size of the hydro-corridor (less than 300 m wide).

Finally, the existing NHS associated with Sixteen Mile Creek would be considered a regional linkage as it is greater than 300 m wide within the Subject Lands. The agricultural fields immediately south of the existing NHS identified within Map 1G of the Regional Official Plan are identified as Prime Agricultural Areas in NHS Enhancements/Linkages/Buffers.

4.1.2.3 Buffers

RNHS mapping on Map 1G depicts buffers around the woodlands and wetlands on the north side of Parcel 4 as well as a buffer along watercourse R3S1.

Natural feature buffers are addressed **Section 5.1** and in the impact assessment **Section 6** of this Comprehensive Study, since they are identified as a mitigation tool to prevent negative impacts on Key Features in the RNHS. Proposed buffers are depicted on **Figure 12** (**Appendix B1**).

Existing RNHS mapping on Map 1G depicts buffers from key natural heritage features located immediately east of Boston Church Road as extending across the road onto the properties to the west (Parcels 1 and 2). Given the presence of Boston Church Road adjacent to the key natural heritage features, no buffer west of the road is required to protect the features. Based on the road allowances shown on LIO, Boston Church Road and its associated allowance is approximately 20 m wide. As discussed within Table 7-2 of the NHRM (2010), maintained public roads create an edge to natural heritage features even if the opening is not wider than 20 m. Therefore, no buffers for these features are shown west of Boston Church Road in **Figure 12** (**Appendix B1**) and these areas should be removed from the existing RNHS mapping.

The agricultural fields immediately south of the existing NHS identified within Map 1G of the Regional Official Plan are identified as Prime Agricultural Areas in NHS Enhancements/Linkages/Buffers.

4.1.2.4 Watercourses within Conservation Authority Regulation Limit or that Provide Linkage

CH online mapping indicates that watercourse R3S1 and the Middle Branch of Sixteen Mile Creek are regulated watercourses located within the regulation limit; therefore, these features are considered to be components of the RNHS (**Figure 12, Appendix B1**). The HDFs that are tributary to R3S1 are not identified as regulated watercourses on CH online mapping and they are not associated with flooding and erosion hazards. Therefore, these HDFs are not considered to be a component of the RNHS.

HDF R1 is identified as a "hydrologic connection" and not a regulated watercourse on CH's online mapping. As discussed in **Section 3.2.2**, this feature is an ephemerally flowing HDF and should not be considered a watercourse. Although it originates in a wetland on the Orlando Lands, it does not provide a linkage, given that, after it flows off the Orlando Lands, it runs through an industrial area and into a SWM pond. Therefore, this feature and its tributary HDFs are not considered to be a component of the RNHS.

The HDFs identified on Parcel 1 of the Orlando Lands are also not identified as regulated watercourses and are outside of the mapped CH regulation limit. Therefore, these features are not considered to be components of the RNHS.

4.1.2.5 Wetlands Other than Those Considered Significant

As discussed in **Section 4.1.1.2**, all wetlands except for the MAM2-11 and MAS2-1 on Parcel 1, are considered to be Significant Wetlands for the purposes of this assessment.

Therefore, the MAM2-11 and MAS2-1 on Parcel 1 (**Figure 12, Appendix B1**) meet the criteria to be a wetland other than those considered significant, and are therefore, part of the RNHS.

4.1.2.6 Escarpment Natural Areas and Escarpment Protection Areas

The Orlando Lands are not located within the Niagara Escarpment Plan area. Therefore, this component of the RNHS is absent.

4.1.2.7 Regulated Floodplains

CH regulates the floodplains associated with the Tributary SMC-R3S1 as well as the main Middle Sixteen Mile Creek. Refer to **Section 3.4.6** and **Figure 12** (**Appendix B1**) for information regarding the regulatory floodplains associated with these features.

4.1.2.8 Agricultural Areas with Only Earth Science ANSIs

No Earth Science ANSIs were identified on or within the general vicinity of, the Orlando Lands. Therefore, this component of the RNHS is absent.

4.2 Watercourses and Headwater Drainage Features

4.2.1 Watercourses

There are two watercourses on the Orlando Lands; the Middle Branch of Sixteen Mile Creek in the northeastern corner (within the Greenbelt) and the Tributary of the Middle Branch of Sixteen Mile Creek (R3S1) that runs through the agricultural field in Parcel 4.

The Highway 401 FSEMS (Phillips Engineering 2000) classified watercourses within the FSEMS study area as high, medium or low constraint features based on their characteristics, flow, channel form and fish community. The constraint definitions from the FSEMS Section 3.5 are provided below:

> *"A high constraint rating was applied to permanently flowing streams. Virtually all of these have diverse fish communities and well-defined channels with a range of substrates. Some reaches have trout populations; others have populations of at-risk species. Some reaches within these streams have been altered to the point where they provide little or no fish habitat, but these are included as a high-level*

constraint based on their potential or value as a migration route. Areas with a high constraint rating should be protected in, or restored to, a condition which is as close to their natural condition as feasible.

A medium constraint rating was applied to intermittent streams which, based on the presence of a defined channel with sorted substrates, were thought to flow for extended periods. It is believed that many of the larger intermittent tributaries particularly those which are proximate to and accessible from the East and Main Branches, provide spawning and nursery habitat in the spring for fish from the permanently flowing streams. Multiple fish species were found in some of these streams, despite habitat being confined to isolated pools at the time of sampling. The natural form and function should be maintained for watercourses assigned a medium constraint rating.

A low constraint rating was applied to watercourses which are ephemeral or intermittent, have either poorly defined channels with no clear sorting of substrate or no defined channels, and where in all cases but one, brook stickleback were the only fish species captured where isolated pools were present. These pools were almost always associated with road culverts. For these watercourses function should be maintained, but it is considered feasible to eliminate the channels themselves, if necessary".

This classification system is generally similar to the system that has been used in other subwatershed studies in Milton (e.g., for the Boyne and Derry Green Secondary Plan Areas). However, more recent studies (e.g., Milton Phase 4) have used a slightly revised watercourse classification that only includes High and Medium constraint ratings with the former Low constraint rating replaced by the Headwater Drainage Feature Assessment protocol classification system (CVC/TRCA 2014).

For the purposes of this Comprehensive Study, the FSEMS constraint rating system for High and Medium constraint features was applied to the watercourses on the Orlando Lands. As described in Section 4.3.2, the HDFA protocol (CVC/TRCA 2014) was applied to HDFs on the Orlando Lands to identify management recommendations for those non-watercourse features.

The following sections discuss the recommended constraint rating for each of the watercourses on the Orlando Lands. Potential opportunities associated with each watercourse are also discussed.

4.2.1.1 Middle Branch of Sixteen Mile Creek

In accordance with the FSEMS rating system (Phillips Engineering, 2000), the portion of this watercourse on the Orlando Lands has been assigned a High Constraint rating on the basis of the following characteristics:

- Permanent flow;
- Well-defined channel morphology with a range of habitat characteristics;
- Relatively diverse, resident fish population with a Good Index of Biotic Integrity rating (CH, 2011), with use by migratory Rainbow Trout;
- Located within a well-defined valley; and
- Located within the Greenbelt NHS.

The High Constraint rating indicates that this watercourse should be protected in its current form and condition with no negative impacts occurring as a result of development.

4.2.1.2 Tributary of Sixteen Mile Creek (R3S1)

In accordance with the FSEMS rating system (Phillips Engineering, 2000), the portion of this watercourse on the Orlando Lands has been assigned a Medium Constraint rating on the basis of the following characteristics:

- Intermittent flow (typically dries up by late spring/early summer);
- Some substrate sorting and morphological development;
- Seasonal fish habitat;
- Lack of functional riparian habitat (I.e., active agricultural in most riparian areas); and

- High level of alteration and functional impairment as a result of long-history of agricultural use, including historical channelization and riparian alterations.

The Medium Constraint rating recognizes that the watercourse provides important biophysical and ecological functions (flow conveyance, aquatic habitat, erosion and sedimentation processes) but as an intermittently flowing system with high degree of alteration due to land use, it is does not warrant protection in place. Under the Medium Constraint rating system applied in other areas of Milton, watercourse alterations are typically permitted, while ensuring that the important functional attributes are maintained or enhanced.

As discussed in **Section 3.3**, this watercourse was identified as being heavily impacted by historical modifications. The current degraded conditions of this watercourse as a result of the long-history of agricultural land use on the property, provide an opportunity for substantial improvement in the form and function of the feature. The opportunity exists to realign the watercourse on the Orlando Lands (Parcel 4) to facilitate the proposed development while also benefiting the feature.

4.2.2 Headwater Drainage Features

Part 2 of the HDFA Guidelines (CVC/TRCA 2014) provides an approach to classify HDFs by providing a step-by-step characterization of specific functions that may be associated with the features assessed, including hydrology, riparian function and provision of fish or terrestrial habitat. **Table 14 (Appendix B2)** highlights the key components of this analysis based on the three rounds of HDFA completed in 2018. Incidental fish data collected during the 2015 HDFA surveys further informed classification and management recommendations.

Part 3 of the HDFA Guidelines (CVC/TRCA 2014) provides guidance on linking the characteristics and functions of features to specific management recommendations that may be applied to those features. To assist, the HDFA Guidelines include Figure 2: “Flowing Chart Providing Direction on Management Options.” The flow chart depicts various decision points associated with hydrology, fish habitat, riparian vegetation and terrestrial habitat, and ultimately leads the user to an appropriate management recommendation for each HDF segment. Management recommendations are outlined in **Section 5.3.1** and can include the following:

- Protection;
- Conservation;
- Mitigation;
- Maintain Recharge;
- Maintain/Replicate Terrestrial Linkage; or
- No Management Required.

The HDFs and associated management recommendations are presented on **Figure 11 (Appendix B1)**.

4.3 Groundwater Recharge and Discharge

While balancing the pre-to-post development water budget is not a requirement of the Orlando lands based on Source Water Protection, mitigation measures should be considered to maintain groundwater infiltration and discharge. As briefly discussed in **Section 4.1.1.2**, a mixed swamp wetland, SWM5-1, is located in the northeast corner of Parcel 4 within the valleyland associated with Sixteen Mile Creek – Middle East Branch. Based on long term monitoring of the feature (**Table 3-14**), SWM5-1 is a groundwater supported wetland feature that primarily relies on groundwater infiltration from a discrete area within the 30 m buffer adjacent to the feature and extending west to the proposed infiltration-based LID locations. This wetland community is a regionally significant wetland that supports various flora and fauna, including breeding amphibians. These communities are also slower to recover from hydrologic changes (TRCA 2017). Maintaining infiltration across the Orlando Lands and to this feature can be achieved using LID measures. The use of LID measures is recommended as part of the overall stormwater management plan to match pre-development conditions.

Specific LID design recommendations are provided in **Section 7.4.4**. As stated in *Low Impact Development Stormwater Management Planning and Design Guide Version 1.0* (2010) by CVC and TRCA,

> *"Developing stormwater management plans requires an understanding of the depth to water table, depth to bedrock, native soil infiltration rates, estimated annual groundwater recharge rates, locations of significant groundwater recharge and discharge, groundwater flow patterns and the characteristics of the aquifers and aquitards that underlay the area" (TRCA and CVC, 2010).*

For sites with deep water table conditions and high permeability soils, LID practices can significantly improve infiltration and groundwater recharge to maintain the groundwater characteristics of the underlying aquifer. However, for sites with low permeability soils and high water table conditions, the amount of infiltration is limited by the saturated hydraulic conductivity of the soil or percolation rate (i.e., the rate at which water can infiltrate). Infiltration trenches, vegetated swales, and bioretention areas can all be effective in low permeability soils to increase infiltration

5 SUBWATERSHED MANAGEMENT STRATEGIES

The existing conditions inventories, opportunities and constraints analysis and all relevant policy and guideline documents have been synthesized to establish appropriate management strategies for the study area.

In developing the strategies, it is recognized that the lands have been included in Milton's urban boundary and are designated for employment uses in the Town and Region's Official Plans. The strategies accept that there will be urban development in the study area, and attempt balance the economic, social and natural environments within and beyond the study area.

This section presents the strategies and direction for how they are to be realized. **Figure 5-1** provides an overview of the development constraints for the Subject Lands. Specific mitigation and enhancement measures needed to implement the management strategies for the planned development on the Orlando Lands are documented in **Section 7**.

5.1 Natural Heritage

The management strategy for this Comprehensive Study was developed to provide guidance for the future management of the Subject Lands. The guidance provided reflects the goal and objectives outlined within **Section 4.1** of this report.

Management strategies for retained significant natural heritage features on and adjacent to the Orlando Lands primarily relate to the protection of the existing form and function of features to ensure Regional NHS requirements (as identified in the Region of Halton Official Plan) are met. As defined within section 3.0 of the NHRM (MNR 2010), an NHS is "an ecologically based delineation of nature and natural function...[they] encompass or incorporate natural features, functions and linkages (also referred to as "corridors) as component parts within them and across the landscape". The NHRM identifies several planning concerns to the natural environment related to anthropogenic development/land-use changes within Ontario. Specifically, the following concerns are discussed in Table 3-1 of the NHRM:

- Landscape fragmentation;
- Biodiversity;
- Climate change;
- Ecosystem health and healthy communities;
- Ecosystem services; and
- Planning process efficiencies.

Healthy and resilient NHSs are sustained through thoughtful land and resource management. These are typically created, maintained and enhanced through carefully planned urbanized land-uses that incorporate BMPs (e.g., invasive management, stormwater infrastructure) within a self-organizing natural ecosystem. As previously discussed within **Section 2**, the goal is "to *protect, restore or, where appropriate, enhance the biodiversity, connectivity and ecological functions of the natural heritage features and areas throughout the Study Area for the long term".* The following objectives were defined to guide the Comprehensive Study:

- To ensure that natural heritage features and areas, associated with a refined RNHS, including their ecological and hydrologic functions, are protected from potential adverse impacts of development;
- To ensure that buffers, corridors and linkages between natural features and areas, surface water features and groundwater features are maintained, restored or, where possible, improved through the establishment of the natural heritage system;
- To establish development standards and land use controls that will ensure future development does not negatively impact the RNHS;

- To consider climate change mitigation and adaptation measures as part of the development of natural heritage management strategies;
- To establish a healthy and diverse RNHS that compliments and enhances the ecological functions of existing habitat types;
- To develop integrated stormwater management plans to help manage water balance with the intent to maintain both hydrological and ecological function of features within the adjacent RNHS.

Based on the guiding goal and objectives defined above, the following environmental management strategies are proposed:

- Identify and classify natural heritage features and assess their significance in accordance with criteria established by either the Federal Government (e.g., *Federal Fisheries Act*), the Province (e.g., *Endangered Species Act*, SWH), the Region (ROP), the Town (Town OP) and CH (e.g., Ontario Regulation 162/06);
- The key objective of the CESS is to achieve an ecological "net gain" through the development of the RNHS in terms of the extent, quality and resiliency of natural heritage features and functions within the RNHS;
- Ensure that significant natural corridors and wildlife linkages are identified, protected or enhanced through the development of the RNHS;
- All natural heritage features that are identified as significant (as defined above within bullet #1) should be protected from adverse impacts of development and/or enhanced within the RNHS;
- The Comprehensive Study will define minimum standards for protection and linkage of these natural heritage features. These standards should be incorporated into future Addenda to the Comprehensive Study for non-participating properties (e.g., Parcels 2 and 5);
- Other non-significant features should be integrated into the RNHS, where feasible. Should non-significant features be proposed for removal, mitigative measures (e.g., habitat creation) may be required in accordance with planning policies (e.g., ROP). Salvages (flora and fauna) should be considered;
- A healthy and diverse RNHS should be created that compliments and enhances existing ecological features and functions (e.g., linkages) within the landscape;
- Stormwater management facilities should generally be integrated outside of the RNHS, except where tie-in connections or facility spillways are located;
- SISs for non-participating properties will refine the RNHS following site-specific detailed ecological inventories; and
- The Comprehensive Study will define monitoring and mitigation measures that consider pre, during and post construction, as well as an adaptive management framework for the RNHS.

5.1.1 Buffer Requirements

Vegetative buffers (sometimes referred to as vegetation protection zones; VPZs or allowances) are important for protecting and enhancing existing natural heritage features within the landscape. Buffers will aid in mitigating against potential adverse environmental impacts to natural heritage features and functions resulting from adjacent site alteration and/or development. Vegetated buffers act as a vegetated physical separation between the built-environment and the natural environment. **Table 5-1** below illustrates the vegetative buffer requirements, which are consistent with municipal and CH's policies.

Table 5-1 Vegetative Buffer Requirements

Natural Heritage Features	Vegetative Buffer Requirement/ Allowances (in metres)
Significant Woodlands	30 m from staked dripline
Significant Valleylands	15 m from staked top of bank
Provincially Significant Wetlands	30 m from staked wetland
Regionally Significant Wetlands	30 m from staked wetland
Non-Regionally Significant Wetlands	15 m from staked wetland for wetlands that are less than 2 ha in size OR 30 m from staked wetlands for wetlands that are greater than 2 ha in size
Fish Habitat	30 m from bankfull channel for any coldwater/coolwater watercourse and warmwater sportfish watercourse OR 15 m from bankfull channel for any warmwater baitfish watercourse
Significant Wildlife Habitat	To be assessed on a case-by-case basis by an ecologist/biologist
Key Natural Heritage Features in the Greenbelt NHS	30 m from the feature limit

All natural heritage features and their associated vegetated buffers should be incorporated into the RNHS. The greatest ecological buffer on the natural heritage features is the guiding constraint when forming the RNHS. A constraints and opportunities figure should be created to define the development limit to ensure adequate protection of the RNHS.

Setback Requirements within the Orlando Lands (Parcels 1 and 4)

The PPS (MMAH 2020) defines the important natural heritage features to consider in terms of impact assessment at a provincial level, while the Regional Official Plan identifies those components of the systems-based RNHS that need to be addressed. Accordingly, as per Section 118.3 of the Regional Official Plan, this study must "demonstrate that the proposed development or site alteration will result in no negative impacts to that portion of the RNHS or unmapped Key Features affected by the development or site alteration.

The following RNHS components were considered for impact avoidance, mitigation and/or potential offsets.

- Key Features
- Habitat of Endangered and Threatened species;
- Significant wetlands (SWD3-3, SWD4-5, SWD5-1);
- Significant woodlands;
- Candidate significant valleylands;
- SWH;
  - Candidate Bat Maternity Colonies Habitat;
  - Candidate Turtle Overwintering Habitat;
  - Candidate Habitat for Species of Conservation Concern (Snapping Turtle);

- Candidate Terrestrial Crayfish Habitat;
- Rare Vegetation Types; and
- Habitat for Species of Conservation Concern (Eastern Wood-Pewee);

- Fish habitat;
- Other RNHS components
- Enhancements to Key Features;
- Linkages;
- Buffers;
- Watercourses within Conservation Authority Regulation Limit;
- Wetlands other than those considered significant (MAM2-11 and MAS2-1); and
- Regulated floodplains.

The impact assessment will also address potential impacts to natural heritage features designated within the Greenbelt Planning Area (Protected Countryside), and Regionally and Locally Important Species (i.e., Gray comma).

Figure 12 (**Appendix B1**) depicts all components of the RNHS (excluding buffers, which will be addressed in **Section 7**) within the Orlando Lands.

The RNHS within the Orlando Lands includes the following features and associated buffers/allowances:

- Significant woodlands – 30 m vegetated buffer;
- Regionally significant wetlands – 30 m vegetated buffers; and
- Realigned channel (R3S1) – 15 m allowance from the greater hazard (Regulatory floodline and/or stable top of slope) and 6 m access allowance, on both sides of the realigned channel.

Sixteen Mile Creek is located well within the RNHS and is far removed from development activities (**Figure 13, Appendix B1)**. The 6 m access allowance has been incorporated into the 15 m allowance from the floodline/stable top of slope, and does not overlap the 30 m vegetated buffers for woodlands or wetlands.

A 30 m vegetated buffer from the RNHS was determined based on requirements under the Greenbelt Plan (2017), Section 3.2.5, Subsection 4. Within this Section it states that the minimum vegetation protection zone from wetlands, fish habitat, permanent and intermittent streams and significant woodlands (among other features) within the Greenbelt Plan area shall be a minimum of 30 m measured from the outside boundary of the key natural heritage feature or key hydrologic feature.

As previously discussed in **Section 4.1.2.3**, the existing RNHS mapping in Map 1G of the Regional Official Plan identifies buffers from key natural heritage features as extending across Boston Church Road. However, where roads run adjacent to key natural heritage features, buffers on the opposite side of the road are not required to protect the ecological form and function of the feature. Therefore, 30 m buffers have not been extended over Boston Church Road from these key natural heritage features. While these natural features are located in the Greenbelt Plan area, Boston Church Road represents the limit of the Urban Area to the west and as such, the Greenbelt NHS policy directives regarding mandatory minimum 30 m vegetated buffers do not apply west of Boston Church Road (I.e., in the Urban Area).

5.2 Natural Hazards

The management strategies and actions for the goal, objectives and targets related to natural hazards include the following:

- Develop floodline mapping, meander belt widths, and long-term stable top of slope (desktop assessment) as part of the Comprehensive Study to refine hazard limit definition.

- Provide post-to-pre development flood control for all events up to the 100 year storm, identify Regional Storm flow management measures based on a risk management approach, and provide erosion controls to reduce critical flow exceedance at key locations along receiving watercourses. Guidance on future locations and form of flood controls are generally set by the Comprehensive Study.
- Develop watercourse and stormwater management plans for the future development to mitigate adverse impacts.
- Develop stormwater management plans which incorporate measures to address increased risk due to climate change and/or allows for adaptive management.

The management strategies and actions for natural hazards largely overlap with the management strategies for water resources and stormwater management and are described in **Sections 5.3** and **5.4**, respectively.

5.3 Water Resources

The management strategies and actions for the goal, objectives and targets related to water resources include the following:

- Provide final management recommendations for watercourses and HDFs, recognizing that not all HDFs require protection (i.e., “No Management Required” features may be removed, “Mitigation” features may be removed while ensuring their hydrological function is maintained).
- Managing post-development stormwater volumes and flow rates to mitigate any potential impacts on erosion in the downstream receiving watercourses.
- Maintaining groundwater recharge to preserve or enhance the function of groundwater and surface-water supported natural systems.
- Provide stormwater quality treatment for infiltrated surface water.
- Achieving Enhanced water quality treatment of storm runoff to protect or enhance downstream water quality.
- Incorporating climate change mitigation and adaptation in the design of stormwater management systems.
- Develop stormwater management and drainage plan which respects the rights of downstream landowners.

Several of the management strategies and actions for water resources largely overlap with the management strategies for stormwater management and are thus described in **Section 5.4**. Watercourse and HDF management recommendations are discussed in the following section.

5.3.1 Watercourse and HDF Management Recommendations

The watercourse constraints were outlined in **Section 4.2**, whereby high and medium constraint watercourses and HDFs were identified within the Subject Lands. High-level watercourse and HDF management recommendations are provided for each type of watercourse constraint.

The Middle Branch of Sixteen Mile Creek was assigned a High Constraint rating. This watercourse should be protected in its current form and condition with no negative impacts occurring as a result of development.

The Tributary of Sixteen Mile Creek was assigned a Medium Constraint rating. The following high-level recommendations are provided for the management of this watercourse, including any proposed alterations to the watercourse, (i.e., realignment):

- The physical form and function of the channel should be restored to a more natural condition;
- Watercourse length should generally be maintained;
- Seasonal groundwater contributions to the watercourse should be maintained;
- Channel morphological functions should be improved, including the connection with the floodplain;

- Aquatic habitat should be enhanced through the use of natural channel design to incorporate a range of diverse habitat conditions;
- Riparian habitat form and function should be enhanced through design and vegetation plantings;
- Natural hazards (I.e., meander belt and floodplain) should be appropriately addressed through any realignment; and
- Wildlife habitat, including function as a potential linkage, should be enhanced.

Part 3 of the HDFA Guidelines (CVC/TRCA 2014) provides guidance on linking the characteristics and functions of features to specific management recommendations that may be applied to those features. To assist, the HDFA Guidelines include Figure 2: "Flowing Chart Providing Direction on Management Options." The flow chart depicts various decision points associated with hydrology, fish habitat, riparian vegetation and terrestrial habitat, and ultimately leads the user to an appropriate management recommendation for each HDF segment. The resulting management recommendations for each management classification (from the HDFA Guidelines) are as follows:

- Conservation
  - Maintain, relocate and/or enhance drainage feature and its riparian corridor zone;
  - If catchment drainage had been previously removed or will be removed due to diversion of stormwater flows, restore lost functions through enhanced lot level controls (i.e., restore original catchment using clean roof drainage), where feasible;
  - Maintain or replace on-site flows using mitigation measures and/or wetland creation, if necessary;
  - Maintain or replace external flows;
  - Use natural channel design techniques to maintain or enhance overall productivity of the reach; and/or
  - Drainage feature must connect to downstream.
- Mitigation
  - Replicate or enhance functions through enhanced lot level conveyance measures, such as well-vegetated swales (herbaceous, shrub and tree material) to mimic online wet vegetation pockets or replicate through constructed wetland features connected to downstream reaches;
  - Replicate on-site flow and outlet flows at the top end of the system to maintain feature functions within vegetated swales, bioswales, etc. If catchment drainage has been previously removed due to diversion of stormwater flows, restore lost functions through enhanced lot level controls (i.e., restore original catchment using clean roof drainage); and
  - Replication functions by lot level conveyance measures (e.g., vegetated swales) connected to the RNHS, as feasible, and/or by LID stormwater options.
- No Management Required
  - Confirmed that there are no features and/or functions associated with HDFs and/or there are no connections downstream. These features are generally characterized by lack of flow, evidence of cultivation, furrowing, presence of a seasonal crop and lack of natural vegetation. No management recommendations required.

The final management recommendations may differ from the CVC/TRCA HDF Guideline outcomes based on on-site specific rationale. The final management recommendations for each HDF within the Orlando Lands are shown on **Figure 11** in **Appendix B1** and **Table 14** in **Appendix B2**.

5.4 Stormwater Management

The stormwater management strategy has been developed in accordance with all relevant provincial, regional, local and conservation authority policies and guidelines, and addresses the goals, objectives and targets established in **Section 2** of this Comprehensive Study. These include:

- Controlling post-development peak flow rates to or below existing levels to mitigate any potential impacts on downstream flood hazards.
- Managing post-development stormwater volumes and flow rates to mitigate any potential impacts on erosion in the downstream receiving watercourses
- Achieving Enhanced water quality treatment of storm runoff to protect or enhance downstream water quality
- Protecting or improving temperature regimes in the downstream receiving watercourses through thermal mitigation of storm runoff
- Maintaining or enhancing baseflow in downstream receiving watercourses
- Maintaining groundwater recharge to preserve or enhance the function of groundwater and surface-water supported natural systems
- Incorporating climate change mitigation and adaptation in the design of stormwater management systems

5.4.1 Stormwater Management Approach

As part of the preliminary design process, a review of potential stormwater management practices (SWMPs) that could be incorporated into the proposed development design was completed. A treatment train approach was adopted, considering lot-level, conveyance and end-of-pipe stormwater management practices.

Opportunities to strategically incorporate LID approaches have been considered in developing the stormwater management strategy for the North Porta lands. An LID measures feasibility matrix is provided in **Appendix D**, which summarizes a number of LID measures for consideration, along with an evaluation of each LID measure. However, these measures generally require more detailed analysis of site-specific conditions to establish applicability and effectiveness, and thus will be explored further at the detailed design stage.

5.4.1.1 Lot Level Control Measures

Within the context of the stormwater management objectives described in **Section 7.4.1**, lot level controls can be used to supplement end-of-pipe controls. The details of the proposed lot level control measures will be explored during the detailed design stage. Note that the hydrologic modelling for the study area excludes lot-level controls to size the end-of-pipe facilities. There is considerable justification for inclusion of lot-level controls in the hydrologic models for the continuous simulations and SWM facility sizing for up to the 100 year return period control. However provincial guidelines recommend against considering most human-made peak flow controls in hydrologic models for the Regulatory event. As the Regulatory flood event generally governs the size of the end-of-pipe facilities, they have not been considered in the hydrologic modelling at this time.

Regardless, potential lot level controls are described as follows:

- Roof-top storage – The large roof area of warehouse buildings can be used to capture rainfall and release it at a controlled discharge rate to encourage evapotranspiration and reduce peak flow rates to end-of-pipe facilities.
- Parking lot storage – The large asphalt areas within industrial site plans can be graded to capture rainfall (to a maximum depth of 0.3m). Orifice plates or tubes placed within the storm sewer system are used to release the stormwater from the surface at a controlled release rate to the end-of-pipe facilities.
- Below ground storage – underground storage tanks, oversized storm sewers and/or infiltration systems can be placed below the asphalt and / or landscape areas to attenuate storm flows and, in some cases, encourage infiltration.
- Increased topsoil – Increasing the topsoil within landscaped areas allows for greater on-site retention of stormwater within the topsoil layer and further encourage both infiltration and evapotranspiration. Up to 300 mm topsoil depth is recommended for landscaped portions of the site. The document “Preserving and Restoring Healthy Soil: Best Practices for Urban Construction” (TRCA, 2012) should be referenced during detailed design such that reasonable soil management practices can be implemented during construction.

- Reduced lot grading – This approach applies flatter grades across the property to slow down runoff and further encourage both infiltration and evapotranspiration. Lot grading will be implemented in accordance with Town standards.

Other control measures such as rain gardens, buffer strips and bio-retention areas will also be explored at the detailed design stage.

5.4.1.2 Conveyance Measures

The preliminary lot-level grading and servicing investigations assumed that stormwater runoff will be conveyed to the end-of-pipe facilities via traditional minor and major drainage systems. During detailed design, Town staff will be consulted to determine if and where more innovative stormwater conveyance measures could be applied, such as enhanced vegetated swales, bio-retention swales, enhanced street tree pits, etc. These conveyance measures could further reduce peak flow rates and runoff volumes and improve water quality.

5.4.1.3 End-of-Pipe Measures

End-of-pipe measures receive stormwater runoff from the conveyance system and are designed to attenuate peak flows and improve water quality through the detention and slow release of stormwater runoff. The implementation of end-of-pipe facilities offer a number of significant practical benefits in terms of providing municipal control, ease of maintenance, ability to serve large drainage areas, and a high degree of effectiveness in runoff management, as required for mitigation of flooding, erosion and water quality impacts. Moreover, it is recognized that end-of-pipe facilities represent the most reliable and efficient means of achieving stormwater quantity control. End-of-pipe facility techniques, including wet ponds, wetlands and hybrid systems, have been considered for the study area, as follows:

Wetlands

The constructed wetland is one of the preferred end-of-pipe SWM facilities for water quality enhancement. Wetlands are normally more land-intensive than wet ponds because of their shallower depths (both in permanent pool and in active storage zone). They are suitable for providing the storage needed for erosion control purposes but will generally be limited in their quantity (i.e., flood) control role because of the restrictions on active storage depth. Wetland facilities are not preferred within the North Porta lands for the following reasons:

- The potential for nuisance species (i.e., mosquitoes) due to shallow permanent pool depth;
- The potential to increase downstream water temperatures in in the receiving drainage systems due to shallow permanent pool depth; and
- The extensive land area required to provide water quantity control for the Regional Storm event due to the maximum active depth of 1 m.

Hybrid Wet Pond/Wetland Systems

Hybrid wet pond / wetland systems consist simply of a wet pond element and a wetland element. The system provides for the deep water component which will be least impacted by winter/spring conditions and the wetland component which provides enhanced biological removal during the summer months. In terms of land requirements, it falls between the amounts needed for wet ponds and constructed wetlands. Hybrid facilities are not preferred within the North Porta lands for the following reasons:

- Although Hybrid facilities introduce deeper pools at the forebay and outlet (which aids in thermal mitigation), the potential for nuisance species (i.e., mosquitoes) is still present in the shallower permanent pool depths of the wetland component; and
- Active storage depth restrictions apply to Hybrid systems, therefore the land area required to provide water quantity control for the Regional Storm event are 1.5 times more than Wet Pond requirements.

Wet Ponds

Wet Ponds are the most common end-of-pipe SWM facility employed in Ontario. They are less land-intensive than wetland systems and are normally reliable in operation, especially during adverse conditions (e.g., winter/spring). Wet Ponds can be designed to efficiently provide for water quality, erosion and quantity control, reducing the need for multiple end-of-pipe facilities. Wet Ponds can be designed with extensive landscaping and associated recreational amenities, contributing to the character of the community. Wet Pond facilities are the preferred SWM facility within the North Porta lands for a number of reasons:

- Wet Ponds are preferred over Wetlands under current Town of Milton standards, as they are generally recognized to reduce the number of nuisance species (i.e., mosquitoes) due to the deeper permanent pool.
- Relative to constructed wetlands, Wet Ponds maintain a much deeper pool of water. The use of bottom draw outlets enables the facility to empty the extended detention storage volume by drawing cooler water from the base of the permanent pool thus providing thermal mitigation.
- Wet Ponds are the least land-intensive SWM facilities as they can be designed to depths up to 3 m, thus providing water quantity control for the Regional Storm event within a smaller footprint.

5.4.2 Proposed Conditions Hydrologic Analysis

The hydrologic model scenario developed for post-development conditions informed the stormwater management and watercourse management. The ultimate post-development conditions were modelled with stormwater controls to assess the effectiveness of the proposed stormwater management strategy. Hydrologic modelling results are discussed in **Section 6.3**. Additional details of modelling results of the proposed conditions model are provided in **Appendix D**.

In general, the PCSWMM continuous simulation model created for the existing conditions hydrologic analysis was modified to model the proposed conditions (increased imperviousness) and SWM water quantity and erosion control criteria in post-development conditions. Proposed conditions drainage areas are shown on **Figure D5-1 in Appendix D**.

Drainage areas and imperviousness were modified according to future industrial development within the Subject Lands at Parcels 1 through 4, which contain the areas with the greatest development potential. The proposed conditions imperviousness was assumed to be 100% for roof areas and 85% for non-roof areas. For Parcel 2, the imperviousness was assumed to be 85% for industrial development. The proposed conditions model did not include lot-level controls for the Comprehensive Study.

The proposed conditions hydrologic model scenario was used to size the proposed end-of-pipe SWM facilities at Parcel 1, 2 and 4. For quantity control, the SWM facilities were sized to provide enough storage to control post-development peak flow rates to pre-development targets for all storm events up to the Regional Storm. Continuous simulation and event frequency analysis was used to model the 2-year to 100-year return period events and Hurricane Hazel event-based simulation was used for the Regional Storm, consistent with the existing conditions model (**Section 3.4.5.1**).

Erosion control storage for Parcel 4 was sized used the hydrologic model. The continuous simulation for existing conditions was used to establish the baseline conditions for erosion risk (based on the erosion threshold described in **Section 5.4.3.2**.). The erosion controls were designed / modelled such that the cumulative hours exceedance duration and cumulative effective work under the proposed conditions continuous simulation with erosion control were acceptable compared to the existing conditions. The downstream erosion assessment is further described in **Section 6.2.2**.

Erosion control storage for Parcels 1 and 2 were modelled based on criteria established in the Highway 401 FSEMS, as described in **Section 5.4.3.2**.

5.4.3 Stormwater Management Criteria

5.4.3.1 Water Quantity Control

Quantity control from the SWM facilities is required to control peak flow rates from post-development conditions to existing conditions to mitigate potential impacts on downstream flood hazards. Peak flow control will be applied for a full range of storm events up to and including the Regional Storm, consistent with the objectives and findings of the Sixteen Mile Creek, Areas 2 and 7, SUS and FSEMS for Derry Green Business Park area (downstream of the Subject Lands).

Results of the existing conditions hydrologic model provide the post-development flow targets for each storm event downstream of the three main development parcels (**Section 3.4.5**). These allowable discharge rates were used in the proposed conditions hydrologic model (**Section 5.4.2**) to establish the required volume at each proposed SWM pond, and calculated the unitary water quantity storage requirements to compare with other studies within the Town of Milton (**Table 5-2 and Table 5-3**).

Unitary discharge and storage rates for the Subject Lands were driven by the site-specific hydrologic modelling that provided the target discharge rates at the downstream extents of the study area. The continuous hydrologic modelling to date indicates that very large extended detention storage volumes (and very long drawdown times) are needed to mitigate the impacts the development (including flow diversion) on erosion and increased peak flows. The unitary storage requirements are greater than those required in other areas of Milton.

In particular, Parcels 1 and 2 included a drainage area diversion (increase of 13 ha), and existing conditions peak flow targets for the 2-year to 25-year return period events were relatively low, which resulted in large cumulative storage volumes. Parcel 4 includes a drainage area diversion (increase of 33 ha) that contributed to a higher than usual erosion control volume and subsequent cumulative storage volumes above the erosion control volume. In later design stages, the hydrologic model will be further validated / refined with additional field measured stream flow data along with further refinements of the SWM strategies for the North Porta Lands.

Table 5-2 Stormwater Management Facility Sizing Criteria

Development Area	Storage Component	Unitary Discharge ($m^3/s/ha$)	Cumulative Storage Required (m^3 per imp ha)
Parcel 4 (Discharge to Tributary of Sixteen Mile Creek – R3S1)	Erosion Control / Extended Detention	0.00068	925
	25-year	0.00074	1002
	100-year	0.00084	1406
	Regional	0.041	2195
Parcels 1 and 2 (Discharge to stormwater management system downstream of James Snow Parkway)	Erosion Control / Extended Detention	0.0012	229
	25-year	0.0025	902
	100-year	0.0032	1117
	Regional	0.052	2372

Table 5-3 Unitary Stormwater Management Facility Sizing Criteria in Other Areas of Milton

Study (Development Area)	Storage Component	Unitary Discharge ($m^3/s/ha$)	Cumulative Storage Required (m^3 per imp ha)
Derry Green FSEMS (Applicable to most areas of Derry Green)	Erosion Control / Extended Detention	0.0011	300
	25-year	0.0130	550
	100-year	0.0211	685
	Regional	Not specified	Not specified
Highway 401 FSEMS (Area north of Highway 401)	Erosion Control / Extended Detention	0.0012	229
	25-year	0.0124	277
	100-year	0.0177	366
	Regional	Not specified	Not specified
Highway 401 FSEMS (East Area discharge to Tributary of Sixteen Mile Creek, i.e,. downstream of R3S1)	Erosion Control / Extended Detention	0.00103	520
	25-year	Not specified	Not specified
	100-year	Not specified	870
	Regional	Not specified	Not specified

5.4.3.2 Erosion Control

Post-development stormwater flow rates are to be managed to mitigate potential erosion impacts on the downstream receiving watercourses. For Parcels 1 and 2, the downstream receiving watercourse (downstream reaches of R5S0) is relatively short and will be realigned for future development at Parcels 1 and 2. The approach is to complete the realignment for both Parcels 1 and 2 to mitigate erosion impacts at the existing drainage feature. R5S0 within the hydro corridor will not be realigned, but erosion protection is proposed for the relative short (200 m) length of swale before the watercourse terminates at James Snow Parkway and enters the existing piped stormwater management system to the south. This approach acknowledges that permissions for proposed works in Parcel 2 (non-participant) and the hydro corridor will be required. The proposed erosion protection for R5S0 through the hydro corridor is described in **Section 7.3.2.2** and **Appendix C**.

For Parcel 4, proposed erosion control criteria applicable to stormwater discharge to the Tributary of Sixteen Mile Creek (from development on Parcel 4) are based on the local erosion threshold flow rate within the tributary between Esquesing Line and Fifth Line.

The erosion threshold for the Tributary of Sixteen Mile Creek was determined at sub-reach R3S0C, upstream of 5th Line, and was primarily informed by detailed field work completed on August 25, 2021 (**Figure 4-2**). The previously completed fieldwork for Tributary of Sixteen Mile Creek within Parcel 4 and the previously established erosion threshold for Reach A from the Town of Halton Hills 401 Corridor Integrated Planning Project (Dillon, 2000) were also considered for comparison purposes.

An erosion threshold is quantified based on the bed and bank materials and local channel geometry, in the form of a critical discharge. Theoretically, above this discharge, entrainment and transport of sediment can occur. To determine this discharge, the velocity, U is calculated at various depths for a representative cross section until the average velocity in the cross section slightly exceeds the critical velocity of the bed material. The velocity is determined using a Manning's approach, where the Manning's n value is visually estimated

through a method described by Acrement and Schneider (1989) or calculated using Limerino's (1970) approach. The velocity is mathematically represented as:

$$U = \frac{1}{n} d^{2/3} S^{1/2}$$

where, d is depth of water, S is channel slope, and n is the Manning's roughness coefficient. The visual approach (Acrement and Schneider, 1989) was adopted for determining the Manning's roughness coefficient.

For the bank materials, following Chow (1959) in a simplified cross section, 75% of the bed shear stress acts on the channel banks. In a similar approach, the depth of flow is increased until the shear stress acting on the banks exceeds the resisting shear strength of the bank materials.

The results of the erosion threshold analysis are presented in **Table 5-5.** The erosion threshold established for reach R3S0C is 0.118 m^3/s, based on a critical velocity of 0.61 m/s acting on the alluvial clayey silt bed material (Julien, 1998). Using a drainage area of 173.4 ha obtained from the Ontario Flow Assessment Tool, the unitary erosion threshold for R3S0C is 0.00068 $m^3/s/ha$. These values are in close agreement with the unitary erosion threshold previously established for R3S1 upstream, as well as the average unitary erosion threshold of 0.00050 $m^3/s/ha$ from the Town of Halton Hills 401 Corridor Integrated Planning Project (Dillon, 2000). Additional information on the erosion threshold assessment is provided in **Appendix C**.

The erosion control storage requirements for Parcel 4 were assessed using the hydrologic model (PCSWMM) and continuous simulation of existing and proposed conditions described in **Sections 5.4.2 and 6.2.2**.

Table 5-4 Erosion Threshold Analysis for Tributary of Sixteen Mile Creek Reach R3S0C

Channel Parameter	Results
Measured	
Average bankfull width (m)	1.75
Average bankfull depth (m)	0.46
Channel gradient (%)	0.67
D_{50} (mm)	<2
D_{84} (mm)	18.8
Manning's n roughness coefficient	0.038
Bankfull discharge (m^3/s)	0.43
Bankfull velocity (m/s)	0.90
Bed Material Erosion Threshold	
Bed Material	Alluvial clayey silt
Critical Velocity (m/s)	0.61*
Apparent shear stress acting on bed (N/m)	11.58
Critical discharge (m^3/s)	0.118
Bank Material Erosion Threshold	
Bed Material	Silty clay loam
Critical Velocity (m/s)	0.53**
Apparent shear stress acting on banks (N/m)	11.40
Critical discharge (m^3/s)	0.261
Limiting critical discharge (m^3/s)	**0.118**
Unitary erosion threshold ($m^3/s/ha$)* **	**0.00068**

**Criteria adopted for Alluvial Silt (Julien, 1998)*
***Criteria adopted for Silty Loam (Fischenich, 2001)*
****Determined using drainage area of 173.4 ha*

Table 5-5 Stormwater Management Facility Sizing Criteria for Erosion Control

Development Area	Unitary Volume (m^3 per impervious ha)	Unitary Discharge ($m^3/s/ha$)
Parcel 4 (Discharge to Tributary of Sixteen Mile Creek – R3S1)	925	0.00068 (based on predevelopment drainage area)
Parcels 1 and 2 (Discharge to stormwater management system downstream of James Snow Parkway)	229 (Note 1)	0.0012 (Note 1)

1. Erosion control criteria from Highway 401 FSEMS for areas north of Highway 401 (Philips, 2000)

5.4.3.3 Water Quality Control

Proposed water quality control criteria for all facilities was based on the Enhanced Level criteria as established by the MOE SWM Planning and Design Manual (MOE, 2003), which defines the storage volume within each type of SWM facility. The enhanced water quality storage requirements are presented in **Table 5-6**.

Table 5-6 Enhanced Water Quality Storage Requirements (MOE, 2003)

Protection Level	SWMP Type	Storage Volume (m^3/ha for Impervious Levels)			
		35%	***55%***	***70%***	***85%***
Enhanced Protection (80% TSS Removal)	Wetlands	80	105	120	140
	Wet Ponds	140	190	225	250
	Hybrid Wet Ponds / Wetlands	110	150	175	195

Note: Of the specified storage volume for wet facilities, 40 m^3/ha is extended detention

5.4.3.4 Thermal Mitigation

If not mitigated, water discharged from stormwater management facilities during the summer months can be much warmer than the water in the receiving drainage systems, potentially impacting the aquatic habitat and species in the downstream receiving systems.

The stormwater management strategy includes the use of wet detention ponds for end-of-pipe controls. As mentioned in **Section 5.4.1.3**, wet ponds maintain a deeper pool of water relative to constructed wetlands or hybrid facilities. When combined with bottom-draw outlets that empty the extended detention storage volume by drawing cooler water from the base of the permanent pool, wet ponds can be effective in mitigating thermal impacts.

Other thermal mitigation measures will be considered during subsequent design phases, and will consider the latest research from the STEP program as well as data from current monitoring programs for recent development in the Town of Milton. These additional measures include:

- Creating a 3 m deep permanent pool area in the vicinity of the bottom draw intake to create a zone of deeper, cooler water. If possible, the volume of the deeper pool should be equivalent to the runoff volume from a 5 mm storm, and the total permanent pool volume below a depth of 1.5 m should be equivalent to the runoff volume from a 10 mm storm.
- Orienting SWM ponds in a north-south direction.
- Configuring SWM ponds with large length-to-width ratios (preferably ≥ 5:1).
- Selecting plants to maximize shading of the SWM facility, particularly along the south and west edges.
- Constructing cooling trenches at the SWM pond outlets (within the receiving channel corridors).
- Installing shade plantings at the storm outfall.
- Maximizing infiltration of storm runoff (upstream of the SWM facility) to the extent feasible, ideally in areas close to the channel corridors to allow the infiltrated water to emerge as groundwater discharge in the surrounding watercourses.

5.4.3.5 Water Balance

The proposed development is to maintain pre-development recharge by providing infiltration to mitigate the reduction in infiltration in the post-development condition. Management of rooftop drainage to infiltration-based LIDs should be sufficient in meeting pre-development infiltration targets.

6 IMPACT ASSESSMENT

The planned development in the Subject Lands was documented in **Section 1.2** and generally consists of large warehouse buildings with associated parking (for the Orlando Lands). The Subject Lands are divided into five parcels where the three large parcels (Parcels 1, 2 and 4) will each include a SWM pond. The conceptual development plan for Orlando Lands is shown on **Figure 5-2**, and draft plans of subdivision for Parcels 1 and 4 are included in in **Appendix A**. No development is proposed within the hydro corridor along the southern extent of the North Porta lands, except to provide public road access from Parcel 4 to James Snow Parkway.

Parcel 1 contains a total of three warehouse facilities and a SWM pond facility on the southwestern portion of the property. A conveyance swale (replacing HDFs R5S1 and R5S0) is also found along the western Subject Land boundary adjacent to the railway. There are three existing residential dwellings located on the Parcel 1 property; the conceptual plan does not propose removal of these features at this time. Two small wetland units are proposed for removal from the landscape to accommodate development (discussed in further detail in **Section 7.2.2**).

Parcel 4 consists of three warehouse buildings with a SWM pond located on the southeastern corner of the Subject Lands and a realigned channel (Tributary R3S1) along the northern woodlot. This parcel also includes a 24 m public right of way that will provide additional access and servicing to the parcel through a connection to James Snow Parkway. R1S1 will be removed from the landscape, and instead flows will be supplemented by roof drainage to downstream habitats. Flows from the SWD3-3 vegetation community will be redirected through a conveyance swale into the realigned R3S1 channel, as discussed further in **Section 7.2.2.3.4**.

Parcels 2 and 5 (i.e., lands not owned by Orlando) have been included as future industrial/employment land uses. Parcel 2 is located west of Boston Church Road and south of Parcel 1, and Parcel 5 is immediately east of Esquesing Road. The proposed development on Parcel 2 would include a SWM pond at the southwestern corner, adjacent to Boston Church Road. This parcel also (potentially) includes a conveyance swale along the west and south boundary to convey flows downstream and offsite. This conveyance swale would potentially replace a HDF identified in a preliminary manner through aerial interpretation on adjacent lands.

Additional features found on the Subject Lands include the transmission line corridor to the south of Parcels 2, 4 and 5 and north of James Snow Parkway, and scattered residential dwellings, which were assumed to remain as rural residential.

The potential impacts of the planned development on the natural heritage systems and groundwater and surface water systems through the study area are discussed in the following sections. Where appropriate, the assessment evaluates the impacts of the planned employment development with and without implementation of the management strategies to confirm the importance and effectiveness of the recommended mitigation measures. More information on the management strategies to be implemented on the Orlando Lands can be found in **Section 7.**

6.1 Natural Heritage

This Comprehensive Study presents and discusses the natural heritage features and associated functions that occur on, and/or adjacent to, the Orlando Lands, and in particular Parcels 1 and 4. Findings in this report should be considered to be preliminary with respect to Parcels 2, 3 and 5. Further impact assessments should be completed on non-participating parcels following detailed evaluation of on-site ecological features and functions.

The Comprehensive Study assesses the potential effects on these natural heritage features and functions that could occur over various periods of time (short-term or long-term) following the implementation and construction of the proposed development. The Comprehensive Study also identifies planning, design and construction practices that are recommended to maintain, and where possible, improve or restore the health, diversity and size of natural heritage features on and adjacent to the Orlando Lands.

The preliminary assessment of impacts is detailed in **Table 16** (**Appendix B2**). That table outlines impacts associated with site alteration and construction by the proposed development (**Figure 14, Appendix B1**). **Table 16** also provides a summary of the natural heritage features and their associated functions, as well as their significance and sensitivity within the landscape. Impactors are identified along with potential effects without any form of mitigation. Impact avoidance, mitigation and/or restoration measures are identified along with predicted net effects. Recommended monitoring strategies are provided to assess the effectiveness of mitigation measures. Key points outlined within the impact assessment table are discussed in the following sections.

All enhancement and restoration opportunities will consider general principles provided FSEMS Section 3.8 (2000).

6.1.1 Summary of Predicted Direct and Indirect Effects

This impact assessment is based upon the proposed development plan and supporting engineering details (as discussed within subsequent sections; **Sections 6.2, 6.3 and 6.4**). This section addresses potential impacts, avoidance, mitigation and/or restoration on those components of the RNHS located within or adjacent to the proposed areas of development and site alteration.

6.1.2 Habitat for Endangered and Threatened Species

As discussed previously, SAR and their habitats are protected under the ESA (2021 Consolidation) Subsections 9 and 10. Potential direct and indirect impacts associated with development and site alteration will be disclosed and discussed with the MECP. A brief summary is provided below.

No removal of Butternut individuals is proposed, rather these will be retained and protected in place through the establishment of the RNHS. No negative impacts to Butternut stems are predicted as a result of the proposed site plan being located >50 m from all stems.

A Notice of Activity Form will be submitted to the MECP for the remaining barn structure located off Esquesing Line that has been identified as Barn Swallow habitat. Removal of the structure and compensation through the provincial SAR Fund will be provided in accordance with O. Reg. 830/21. No negative impacts are predicted to Barn Swallows as a result of the conditional exemption provided under O. Reg. 830/21.

No negative impacts are predicted to SAR.

6.1.3 Significant Wetlands

A total of five wetlands are present on the Orlando Lands including:

- Mixed Mineral Meadow Marsh (MAM2-11);
- Cattail Mineral Shallow Marsh (MAS2-1);
- Red Maple-Conifer Organic Mixed Swamp (SWM5-1);
- Swamp Maple Mineral Deciduous Swamp (SWD3-3); and
- Hickory Mineral Deciduous Swamp (SWD4-5).

Although these wetlands have not been evaluated under the OWES, the SWM5-1, SWD3-3 and SWD4-5 have been identified as Regionally Significant Wetlands, based on the definition in the Regional Official Plan (see **Section 4.1.1.2**). The remaining two wetlands (MAM2-11 and MAS2-1) do not meet the significance criteria in the Regional Official Plan and are therefore addressed in **Section 4.1.2.5** (Wetlands other than those considered significant).

All Regionally Significant Wetland communities will be retained on the landscape with a minimum 30 m vegetated buffer from the wetland boundary to the adjacent development limits. Grading near the upstream limit of the proposed realignment of channel R3S1 is required to facilitate the connection of the enhanced swale (discussed further within subsequent paragraphs) and transition from the existing channel to the

realigned channel inlet. This grading will be completed within actively managed agricultural fields and will be revegetated following grading works. Due to the existing nature of the area proposed for grading, no negative impact is predicted to the retained Regionally Significant Wetlands, rather the establishment of the vegetative buffer will enhance existing wetland functions. No direct impacts on Regionally Significant Wetlands are expected due to development on the Orlando Lands. No site alteration, temporary work zone, development, storage or long-term access is proposed on the north side of the channel; except, where required by CH within the 6 m access allowance. This access allowance is located outside of the 30 m setback from the regionally significant wetlands. The allowance will be vegetated with native species seed mix and will only be used in situations where repairs to the realigned channel are required by CH.

Native species plantings (shrubs and trees) within the buffers will assist in enhancing the wetlands relative to existing agricultural activities, which occur in close proximity to wetland boundaries. Plantings of native thorny species such as Raspberry (*Rubus* sp.) within the buffers will discourage public access into the retained wetland communities. A detailed restoration plan will be developed during the detailed design stage and will incorporate native species from Seed Zone 34. The Guidelines for Landscaping and Rehabilitation Plans (CH 2021) will be considered during detailed restoration planning. Further conceptual discussion on restoration plantings is discussed within **Section 7.2** of this report.

The existing water balance of the SWD3-3 wetland community in the western portion of Parcel 4 likely depends on ephemeral discharge of flow into the HDF located downstream. In order to maintain this discharge, while facilitating development on the Orlando Lands, this HDF is proposed to be realigned adjacent and partially within the 30 m wetland buffer, running east to discharge to the realigned R3S1 corridor. The realigned swale (also referred to as the “green swale” or “bioswale”) will be designed to convey discharge from the SWD3-3 wetland in the same manner as the current HDF does in order to avoid any changes in wetland hydrology due to outflow conditions. Consideration to the design of the green swale is discussed within **Section 7.3.2.1.**

The green swale will be designed as a flow conveyance feature that will be naturalized with no long-term maintenance requirements. This green swale will be constructed within existing actively managed agricultural fields; therefore, no negative impacts are predicted as a result of the construction and establishment of the green swale partially within the 30 m vegetative buffer. Through discussions with reviewing agencies, the location of the green swale has been refined. The green swale was moved outside of the 30 m vegetated buffer, where feasible. The green swale is located within the 30 m buffer only where warranted to maintain connections at the upstream and downstream ends of the green swale, and where warranted to contain the Regulatory flood plain and associated buffers within the proposed NHS system. Additional justification is provided in **Section 7.3.2.1.** No hydrological impacts on the SWD3-3 wetland are expected to occur (as further discussed within **Section 6.4.4**). The location of the green swale is shown on **Figures 13 and 15** (**Appendix B1**) and conceptual design is shown on **Figure D7-9** in **Appendix D1**.

Where the realigned swale is located within the 30 m wetland buffer, temporary disturbance within the buffer (which is currently in active agricultural production) will occur to construct the swale. In these locations where the green swale is located within the buffer, the swale will be generally located in the outer 15 m of the buffer and the temporary construction disturbance area (which will be located in the existing agricultural land adjacent to the wetland) will be minimized to the extent possible. Following construction, the green swale will be vegetated with a native seed mix. No long-term maintenance of this green swale is intended; rather, this is a natural feature to facilitate the flows from one natural heritage feature (regionally significant wetland) into another natural feature (realigned channel). The purpose of this green swale is not to support or convey anthropogenic flows.

No impacts on the rooting zone of trees in the wetland area expected due to excavation of the shallow conveyance swale at the outer limit of the 30 m buffer. BMPs (as discussed below) will be implemented during construction of the swale in the buffer to prevent indirect effects on the adjacent wetland. Once the swale is constructed, the buffer will be planted as per the ultimate detailed restoration plan. The swale will function as part of the buffer and no negative impacts on the wetland are expected as a result of swale construction and long-term presence.

As discussed within **Section 3.5.2.2** and **Section 4.3**, the SWM5-1 vegetation community in the northeast corner of Parcel 4 is supported by shallow groundwater discharge from sand and silt units primarily within the

30 m buffer, but that extend towards the proposed LID locations on the west side of the realigned channel. Groundwater discharge to the feature is anticipated to be maintained and/or supplemented through the implementation of LID measures within the Parcel 4 development to balance overall infiltration volumes. Supplementary targeted drilling will be conducted at the proposed LID locations to ensure soils are suitable to infiltrate water. Based on borehole logs completed by Terrapex (**Appendix A1**), both the realigned channel and the created wetland will not intercept permeable sand and silt units near the LID locations, and therefore will not be accepting water that was infiltrated through the proposed LIDs. Further discussion on the created wetland is provided within **Section 7.2**.

Other swamp communities (SWD3-3 and SWD4-5) are surface water supported and surface water runoff volumes are not anticipated to be impacted by development as the wetland's catchments are located outside of the development footprint. Based on the above-noted information, feature-based water balance was not required for retained wetland communities based on the retainment of their surface catchment areas and/or the maintenance of groundwater inputs through LID strategies. This is further discussed within **Section 6.4.4**.

Potential indirect impacts on Significant Wetlands associated with stormwater runoff will be addressed through the implementation of the proposed Erosion and Sediment Control (ESC) plan outlined in **Section 8.4** and informed by the ESC Guide for Urban Construction (TRCA 2019). Installation of ESC measures along the outer edge of the vegetated buffers (or the limit of any ground disturbance associated with swale construction) will ensure that wetlands are protected and will limit disturbance caused by development through ground disturbance and dislodgement of sediment.

In order to mitigate the potential for adverse effects on wetlands due to potential accidental spills during construction, it is recommended that appropriate spill prevention and response measures (e.g., material handling and storage protocols, mitigation measures (e.g., spill kits on-site), monitoring measures and spill response procedures) (i.e., emergency contact procedures, including Spills Action Centre, and response measures including containment and clean-up) be in place and implemented and necessary during construction. Implementation of an effective spill prevention and response plan is anticipated to be largely effective in preventing adverse effects on wetlands due to accidental spills during construction.

With the implementation of these mitigation measures, no negative impacts to Significant Wetlands and their associated functions are expected.

6.1.4 Significant Woodlands

The Orlando Lands contain 12.8 ha of significant woodlands within the Greenbelt Planning Area (designated Protected Countryside) on the Parcel 4 lands. The development plan respects all woodlands on the Orlando Lands through avoidance; no removals of the woodlands will occur to accommodate development.

A minimum of a 30 m vegetated buffer will be maintained along the limit of the woodland vegetation community boundary on the Orlando Lands (the vegetated buffer from these features on Parcel 4 does not cross over Boston Church Road to constrain development in Parcels 1 or 2 as the presence of the road negates the need for any additional buffer on the opposite side of the road from the feature). As previously indicated, the creation of a green swale (as discussed above within **Section 6.1.3**) is required to convey flows out of the regionally significant wetland (SWD3-3) into the realigned channel to maintain the wetland's hydroperiod. A portion of the green swale is proposed within the 30 m buffer; however, the green swale will be created within existing agricultural fields and will be naturalized and incorporated into the vegetative buffer. Where feasible, the green swale has been removed from the 30 m buffer; however, a portion of the green swale needed to be located within the buffer near the realigned channel to avoid impacts to the regional floodline (as discussed above within **Section 6.1.3**). No negative impacts to the significant woodlands as a result of the installation and establishment of the green swale are predicted as this will be incorporated and naturalized as part of the RNHS buffer. No long-term maintenance of the green swale is required.

Indirect effects that could occur from the proposed development may also include wildlife disturbance because of increased human access, and construction-related impacts from on-site grading and other machinery (e.g., soil compaction, introduction of invasive species, stress/dieback). Avoidance and mitigation methods have been developed to prevent and/or minimize negative effects on significant woodlands, including:

- Creation of a minimum 30 m wide vegetation buffer to enhance the RNHS;
- Planting of native thorny shrub plant material to discourage pedestrian access into the woodland and buffer;
- Direct new lighting away from the RNHS to avoid impacts to wildlife activity within the woodland; and
- Installation of tree protection fencing and ESC measures to eliminate excess disturbance from vegetation removals, ground disturbance and dislodgement of sediment.

Lighting requirements will follow the Town's standards. With the implementation of these mitigation measures, no negative impacts to significant woodlands are anticipated.

6.1.5 Candidate Significant Valleylands

The valleyland associated with Sixteen Mile Creek – Middle East Branch was identified as a candidate significant valleyland. Only a small portion of the valleyland is found on the Orlando Lands in the northeast portion of the Parcel 4 lands within the Greenbelt Planning Area (Protected Countryside). The valleyland supports a permanent watercourse feature and associated warm-water fisheries, provides habitat for Endangered species and hosts a Rare Vegetation Community Type (SWM5-1 – S3S4).

The form and function of Sixteen Mile Creek will not be disturbed or directly affected by development as the conceptual plan illustrates that the development is removed from the significant valley. No development will occur near staked top of bank (**Figure 13, Appendix B1**), as the valleyland is located within the eastern portion of the RNHS.

Avoidance and mitigation measures suggested within significant woodlands (**Section 6.1.4**) will also protect the candidate significant valleyland and ensure that excess disturbance and sediment dislodgement is minimized.

No negative impacts are anticipated following the implementation of these mitigation measures given that the candidate significant valleylands occur outside of the proposed development footprint.

6.1.6 Significant Wildlife Habitat

Confirmed SWH on the Orlando Lands includes Rare Vegetation Habitat Type and Habitat for Species of Conservation Concern (i.e., Eastern Wood-Pewee). Additionally, Candidate Bat Maternity Colonies Habitat, Candidate Terrestrial Crayfish Habitat; Candidate Species of Conservation Concern (Snapping Turtle) and Candidate Turtle Overwintering Habitat was identified on the Orlando Lands. All SWH types identified as present or potentially present on the Orlando Lands are associated with the Greenbelt Planning Area (Protected Countryside) or significant woodlands and will be protected from direct impacts through avoidance.

As discussed above, a minimum of a 30 m vegetated buffer consisting of native thorny plant material and other native shrubs and trees will be installed between the development footprint and the natural heritage feature limits. No removals of SWH will occur on the landscape, and therefore, no impacts to habitat are predicted.

However, some wildlife will be susceptible to short-term and long-term effects. Noise from construction activities may result in wildlife avoidance of the edges abutting active work areas during the construction period. Where feasible, construction activities should be timed outside of the nighttime and early morning periods during the bat and bird breeding seasons (April 1 to September 31). Some localized movement of wildlife out of these edge areas may still occur during the construction phase. The wildlife in this area are expected to have generally adjusted to the existing urban level of background noise and interference associated with existing industrial development south of the Orlando Lands, the railway along the western Subject Land boundary and the adjacent major arterial roadway (James Snow Parkway).

With the implementation of mitigation measures, no negative impacts to SWH are predicted.

6.1.7 Fish Habitat

A portion of Sixteen Mile Creek – Middle Branch is found along the northeastern portion of the Parcel 4 lands. Fisheries data suggest that this permanent watercourse supports cool and warm-water fisheries, however one cold-water fish is known to frequent these features during spawning season (Rainbow Trout). This watercourse feature is found deep within the Greenbelt Protected Countryside planning area and is located greater than 100 m away from site alteration and development. This feature will be protected from development and site alteration through avoidance. As discussed in **Section 6.4.4**, no impacts on groundwater discharge to Sixteen Mile Creek – Middle Branch is expected as a result of the proposed development.

A total of 18 HDFs, comprised of 25 separate reaches, were identified during HDFAs. One reach (R3S1) was found to provide seasonal direct fish habitat, while some of the other features may provide contributing functions (e.g., ephemeral flow and allochthonous material conveyance) to downstream fish habitats. No permanently flowing HDFs were found on the Orlando Lands. As discussed within **Section 3.5.2.2**, R3S1 receives seasonal groundwater discharge, however R1S1 and R6S1/R6S0 are solely supported through surface water contributions. No HDFAs were completed on the Parcel 2 and 3 lands as these parcels are non-participating landowners.

Realignment of R3S1 using natural channel design will occur along the Greenbelt Protected Countryside boundary to accommodate development and outside of the 30 m vegetative buffer to the retained significant woodlands and/or regionally significant wetlands. GEO Morphix's conceptual designs (as discussed within **Section 7.3.1**) indicate the total linear distance of the corridor will be 1,110 m long, with a realigned channel length of 1,370 m (net increase of 220 m). It is recommended that the realignment be completed when the feature is dry or at low flow conditions, to reduce potential for adverse effects and potential impact on fish communities. R3S1 was assessed as Conservation under the HDFA Guidelines (CVC/TRCA 2014), and therefore must be retained on the landscape. As discussed within **Section 6.4.5**, the proposed realigned channel is anticipated to maintain existing seasonal groundwater discharge into the feature. Through the realignment of this feature, enhanced wildlife habitat opportunities will be available within the corridor. A net gain of fish habitat is predicted within the realigned channel through the creation of enhanced fisheries habitat, increased riparian cover and stabilization of banks that will reduce erosion and sediment loading from the floodplain. This realignment will also provide additional habitat and buffering capacity to the existing significant areas (Greenbelt Protected Countryside, significant woodlands, significant valleylands, Sixteen Mile Creek – Middle Branch) through the additional naturalized area. Wildlife enhancement structures will be defined within the Natural Heritage Design Brief, as discussed within **Section 7.2**.

The removal of R1S1 will occur to accommodate development, however, flows from R1S2 (SWD3-3 vegetation community) will be diverted through a diversion channel into the new realigned channel (R3S1). The reach of this HDF downstream from the Orlando Lands appears to consist of an open channelized feature within an industrial area, discharging to a SWM Pond approximately 800 m downstream, which eventually discharges to Sixteen Mile Creek, although the discharge channel is largely enclosed. As this feature is located off-site, the fish habitat potential is unknown, although based on the industrial nature of the surrounding land use and enclosure of the channel downstream from the SWM outlet, the fisheries habitat value may be impacted. To avoid any potential impacts on downstream fish habitat, downstream hydrological contributions to this feature from R1S1 will be maintained by directing clean water from Parcel 4 into existing flow paths downstream of the development within the transmission line corridor (as discussed within **Section 7.4**). As noted in **Section 6.2.2,** erosion in the portion of the channel downstream from the Orlando Lands is not anticipated to be a concern based on the armoured nature of the channel. Provided surface water balance to this feature is generally maintained through use of clean roof runoff, no net negative impact on any potential downstream fish habitat is anticipated to occur.

HDFs R5S1 and R5S0 will be realigned to flow adjacent to the railway throughout all of Parcel 1 and the southern portions of Parcel 2 and 3. Both of these features provided indirect fish habitat. HDFA Guidelines (CVC/TRCA 2014) assessed both features as Mitigation, which allows for the realignment (or replication and removal) of these features, so long as its functions are replicated (i.e., flow conveyance and contribution of allochthonous materials to downstream habitats). R5S1 will generally be found within a similar configuration to existing conditions. Enhancement opportunities are available within these conveyance swales to ensure

that they are continuing to provide allochthonous material to downstream fisheries habitats. Realignment of these features should be completed in the dry, or at a minimum, of low flow conditions.

Construction and realignment of HDFs on the landscape should be completed outside of the warm-water spawning window (March 15 to July 15) to limit additional impacts to downstream fish and fish habitats.

A total of three SWM ponds are proposed within the North Porta lands (**Figure 13, Appendix B1**); each parcel contains at least one SWM pond. The primary SWM pond on the Parcel 4 lands will outlet to an existing culvert structure at Esquesing Road, which connects off-site to Sixteen Mile Creek. A SWM facility on Parcel 2 will discharge to a conveyance swale aligned along the west and south edges of the parcel. It is expected that a future SWM pond for Parcel 2 (non-participating owner) would be located immediately north of the hydro corridor and discharge to drainage feature R5, which is piped downstream of James Snow Parkway.

Conveyance swales will have the same tie-in and outlet connection to existing hydrologic connections, therefore no downstream fisheries will be starved of flow. Conveyance swales adjacent to the railway will have a vegetated berm to separate the feature from drainage off the railway to reduce excessive contaminated runoff into these features.

No access was provided to Parcels 2 and 3 (i.e., adjacent lands owned by others), however, an HDF was observed (i.e., through aerial photograph interpretation) flowing northwest to southeast of the agricultural field. A Mitigation management recommendation has been assumed (to be conservative; subject to change as Parcels 2 is assessed in detail). This would require that the hydrological and contributing fish habitat functions be retained, however it may be realigned. This feature has been proposed for realignment as a conveyance swale.

Outlet structures from SWM facilities will ensure the following (as further discussed within **Section 7.4**):

- Adequate release rates based off of design of orifices and weirs;
- Bottom-draw outlet (3 m) to minimize water temperature input to receiving conveyance swales and watercourses; and
- Riparian vegetation at pond outlet to aid in natural attenuation and soil stabilization during larger flow events.

No grading issues were identified within the development plan. Grading in support of the realigned channel will occur outside of the staked RNHS buffer, with the exception of limited grading at the interface of the proposed realigned channel, existing channel and proposed green swale (refer to **Section 6.1.3**).

Additional potential indirect effects on fish habitat downstream that could occur from the proposed development include:

- Impaired fish habitat and/or negative impacts on aquatic biota (e.g., fish and benthic invertebrates), including deteriorated health or mortality, due to erosion and sediment from site alteration and development;
- Mortality or health impacts due to accidental spills of toxic materials during or post-construction;
- Alterations in water quality due to pumping and discharge of pumped water during construction;
- Alterations in watercourse water balance (e.g., timing and volume of flows) and associated negative impacts on fish habitat functions; and
- Long-term impairment of watercourse quality (including chemical contaminants, suspended solids and temperature) due to surface runoff from the proposed development.

The following key avoidance and mitigation measures have been developed to prevent or minimize negative effects on fish and fish habitat relating to the potential indirect effects addressed above. Key avoidance and mitigation measures to be implemented include:

- Preparation and implementation of an ESC plan with associated mitigation measures to minimize the potential for negative impacts (i.e., silt fencing);

- Preparation and implementation of a spill prevention and response plan to prevent or minimize the potential for spills of potentially toxic materials during construction;
- If pumping of groundwater or accumulated surface water from excavations is required, water will be appropriately treated (e.g., in a sediment filtration bag) prior to discharge, with erosion protection at the discharge (if required);
- Implementation of 15 m vegetated setbacks from the meander belt of the realigned channel to the development limit;
- Complete channel realignment when the channel is dry (if feasible) and outside of the warmwater fisheries window (March 15 to July 15). If construction must occur when the feature contains water, a fish and wildlife salvage will be completed; and
- Installation of plant material (shrubs and trees) within vegetated buffer zones to further enhance and strengthen riparian functionality (e.g., enhance stormwater runoff control and management, enhance soil stability, shading and increased allochthonous inputs).

Overall net positive effects on fish and fish habitat through the restoration and enhancement works to reduce sediment loading and increase wildlife habitat. Long-term aquatic monitoring, including fish habitat, fish community and geomorphic stability, within the realigned channel is recommended to ensure that the natural channel is functioning as designed. Specific monitoring requirements will be determined during the detailed design phase.

6.1.8 Enhancements to Key Features

The RNHS mapping (Map 1G) appears to depict a Key Feature Enhancement area within the Greenbelt Plan protected countryside area on the Orlando Lands. This area is not associated with any existing Key Feature, buffer or linkage and is therefore interpreted to be a proposed Enhancement to Key Feature in the RNHS.

This area is located in the Greenbelt Plan area and is outside the development limit. Therefore, no impacts to the area will occur as a result of the proposed development. As will be discussed further in **Section 7.2.2.3.2**, a wetland is proposed for construction in this area to mitigate removal of a wetland in Parcel 1.

The constructed wetland will be located between the Key Features and their associated vegetated buffer to the north and the realigned watercourse corridor to the south. The wetland is expected to function as part of the overall RNHS unit in this area to provide a complex mix of vegetation communities and wildlife habitat. The presence of the constructed wetland will enhancement the adjacent Key Features by providing a contiguous natural area and stronger linkage to the adjacent watercourse corridor, relative to the existing agricultural activities that occur in this location.

Therefore, the proposed wetland enhancement is considered to be consistent with the goal of enhancement areas in the RNHS. As discussed below within **Section 7.2**, wetlands will be replicated at a 1:1 ratio. The existing wetland communities include monocultural stands of Reed-Canary Grass with limited native plant diversity. The new created wetland adjacent to the RNHS will provide increased native plant diversity. The created wetland will be fed by upstream surface water runoff, direct precipitation, and potentially from the realigned channel if needed. It is not expected to encounter any sand and silt units, and therefore will not be intercepting any water infiltrated that is intended to support SWM5-1. The created wetland area is illustrated on **Figure 13** (**Appendix B1**). No negative impacts are predicted as a result of the proposed development.

6.1.9 Linkages

The RNHS mapping (Map 1G of the Regional Official Plan) appears to depict a Linkage along HDF reach R3S1A, since this HDF appears to extend between the main watercourse (R3S1) and the woodland/wetland to the north. Under existing conditions, the HDF is an ephemeral swale that is ploughed through and cropped over on an annual basis and therefore, it does not current provide any linkage function. Moreover, the Town of Milton's 401 Industrial/Business Park Secondary Plan Schedule C.2.B indicated an Environmental Linkage Area associated with the hydro corridor (**Figure 2**, **Appendix B1**). As previously discussed within **Section**

4.1.2.2 of this report, two local linkages and one regional linkage were identified within the Subject Lands. The local linkages are associated with the existing hydro-corridor and the main watercourse (R3S1). The regional linkage is associated with the existing RNHS along Sixteen Mile Creek.

No development is proposed in the area currently mapped in the RNHS as a linkage. However, site alteration, in the form of the realigned watercourse and constructed wetland mitigation area will occur within and in the vicinity of this linkage area. Post-development, this area will consist of a contiguous, vegetated RNHS composed of the existing woodland/wetland and associated vegetated buffer, the constructed wetland and the realigned watercourse corridor. The entire area will be RNHS and as a result, no specific linkage will be required to connect any Key Features in this area.

Aside from this minor linkage, the Greenbelt Plan area associated with Sixteen Mile Creek provides the main linkage on the landscape. No negative impacts to the linkage function of this corridor area expected. The existing R3S1 regulated watercourse reach may also provide some minor linkage function under current conditions, since serves to link the woodland/wetland to the north to off-site (downstream) Key Features, although it is highly altered due to agricultural activities. Following completion of channel realignment activities, the linkage function of this watercourse is expected to be enhanced due to protection of a vegetated corridor. Through the vegetative buffers along the retained RNHS and the realigned watercourse, this linkage will be merged into the existing regional linkage to create a more robust linkage connection within the landscape. This will also work to create additional interior habitats.

A crescent road is proposed within the hydro corridor (**Figure 14**, **Appendix B1**) to gain access into the Parcel 4 properties from James Snow Parkway. No natural heritage features were identified within the actively managed hydro corridor, however the downstream extent of HDFs R1S1 and R2S1 are located within the hydro corridor (as discussed within **Section 3.1.10**). This linkage is also identified as a local linkage given that the hydro corridor could permit some terrestrial movement. As previously discussed above within **Section 6.1.7**, the removal of HDF R1S1 is proposed with flows being diverted into the realigned channel via a green swale. Moreover, the removal of HDF R2S1 within the Orlando Lands is proposed with additional clean flows from Parcel 4 conveyed into the retained portions of HDF R2S1 within the hydro corridor. HDF R2S1 provides indirect fish habitat contributions (i.e., flows and allochthonous materials) to downstream fisheries. While it is likely that the hydro corridor may act as an east-west linkage for terrestrial species (likely larger mammals and birds) within the landscape, no natural heritage features are located west of the Orlando Lands within the hydro corridor, rather development (industrial buildings) associated with the 401 Industrial Business Park are located immediately adjacent to the corridor. Moreover, the Sixteen Mile Creek corridor, located north of the hydro corridor, would be preferential for wildlife movement in comparison to this hydro corridor with several existing road crossings (Boston Church Road and Esquesing Line). As a result, it is predicted that the movement of wildlife within the hydro corridor would be relatively limited, and ultimately would not be impacted as a result of the construction of the two road sections crossing the hydro corridor. Wildlife passages (box culverts measuring 1.2 m high and 3.3 m wide) will be installed under both road sections within the hydro corridor to facilitate the movement of small to medium sized mammals, amphibians and reptiles. No HDFs or watercourses will be located within the hydro corridor, therefore, consideration of fish passage is not required for these road crossings. The terrestrial wildlife crossings will be designed in accordance with CH's Road Ecology guidelines (2018c) and will have an openness ratio of 0.1.

Overall, no negative impacts on linkages are expected to occur as a result of development on the Orlando Lands.

6.1.10 Buffers

Proposed buffers and allowances are depicted on **Figure 5-1** and **Figure 13 (Appendix B1)**. This includes buffers and allowances from Significant Wetlands (30 m), Significant Woodlands (30 m), Significant Valleyland (15 m) and the realigned watercourse (15 m from the greater of the top of slope or proposed Regulatory floodline, and 6 m access allowance).

Significant Woodland and Significant Wetland buffers are generally the same as those depicted on the existing RNHS mapping (Map 1G), except where current mapping depicts the buffers as crossing over Boston Church

Road. As previously discussed, buffers on the opposite side of the road from the feature are not warranted from an ecological perspective. Therefore, these buffers depicted on Map 1G are not proposed, nor depicted on **Figure 13** (**Appendix B1**).

The existing RNHS includes a 30 m buffer adjacent to watercourse R3S1. As part of the proposed R3S1 realignment, a 15 m allowance from the greater of the top of slope or proposed Regulatory floodline is provided. The distance between the outer edge of the 15 m allowance on the development side of the channel to the realigned low flow channel (located within the valley floor of the channel) is a minimum of 20 m (where the channel meanders close to the south valley wall). This distance between the proposed edge of development and the low flow channel exceeds the minimum 15 m vegetative buffer from bankfull channel from warmwater baitfish watercourses.

The 15 m allowance on the north side of the proposed realigned R3S1 channel has overlap within the 30 m buffer from the existing RNHS where the woodland bends and at the realigned channel tie-in. Per discussions with the Region on July 22, 2021 and as detailed within email correspondence from H. Ireland (**Appendix B3**), an opportunity to overlap the 30 m setback from the Greenbelt and existing RNHS with the CH regulatory allowance from the realigned channel (15 m setback) may be permitted provided that all site alteration, significant grading works and long-term maintenance occur outside of the 30 m buffer. No construction, storage, development, significant grading or long-term access is required on the north side of the channel, except for the construction of the created wetland unit, eliminating the requirement for additional setbacks from the 30 m vegetated buffer to the RNHS and the buffer to the realigned channel.

The 6 m access allowance on both sides of the channel is provided within the 15 m allowance but does not have any overlap with the 30 m buffer from the RNHS.

Comments received from CH on the first submission suggested that a 30 m warmwater sportfish setback was required as a result of the fisheries data presented within **Section 1.6.1.1** of this report. As discussed within **Section 1.6.1.1.**, it is unlikely that these warmwater sportfish were recorded within the seasonally flowing watercourse R3S1. During the February 2, 2022 meeting, CH and Savanta agreed that other ecological buffers incorporated within the realigned channel (e.g., 15 m allowance from top of slope / floodplain, 30 m setback from staked NHS limit) was sufficient.

Given the proposed enhancements to overall watercourse form and function, including vegetation planting within the realigned corridor, as well as other mitigation to prevent negative impacts on the realigned watercourse (i.e., stormwater management measures to prevent direct surface runoff from the impermeable areas of the proposed development), a 15 m allowance from the top of slope / floodline is considered sufficient to protect the form and function of the realigned feature.

All proposed buffer areas are currently within active agricultural fields and are therefore highly disturbed. Native species plantings (shrubs and trees) within the buffers will assist in enhancing the features relative to existing agricultural activities, which occur in close proximity to existing feature boundaries. Plantings of native thorny species such as Raspberry within the buffers will discourage public access into the natural heritage features. A detailed buffer restoration plan will be developed during the detailed design stage and will incorporate native species from Seed Zone 34. The Guidelines for Landscaping and Rehabilitation Plans (CH 2021) will be considered during detailed restoration planning.

6.1.11 Watercourses within Conservation Authority Regulation Limit

No negative impacts on the Middle Branch of Sixteen Mile Creek in the northern portion of the Orlando Lands are expected. The Regulation Limit for the watercourse is located approximately 70 m from the limit of the proposed development (at the nearest point, along the proposed realigned R3S1 in Parcel 4). As discussed in **Section 6.4.4**, water balance to the wetlands associated with the watercourse are expected to be maintained through site-wide LID measures.

The R3S1 regulated watercourse reach will be realigned (as outlined in **Section 7.3.1** and detailed in **Appendix C**). Aside from temporary disturbance during realignment activities, the long-term form and function of the watercourse are expected to be enhanced as a result of realignment using natural channel design

principles and vegetation restoration throughout the realigned corridor. Therefore, no long-term negative impacts are expected. BMPs will be implemented during the realignment process to maintain downstream functions. Mitigation measures will be implemented to prevent indirect impacts on the watercourse during construction (e.g., erosion and sedimentation) and during the long-term site operation (e.g., stormwater management measures).

No negative impacts are predicted as a result of the proposed development.

6.1.12 Wetlands Other than Those Considered Significant

Two of the wetlands on the Orlando Lands (both of which are located in Parcel 1) do not meet the Regional Official Plan wetland significance criteria (as discussed above within **Section 4.1.1.2)** and are, therefore, considered to be "Wetlands Other than Those Considered Significant", which are still a component of the RNHS. These two wetland communities did not meet the criteria outlined under Section 276.5 of the Regional Official Plan; as these wetlands do not provide an important ecological contribution to the larger RNHS given the low flora diversity recorded within the features, its proximity to Boston Church Road and no wildlife were recorded within the feature.

Removal of these two wetland communities on the Parcel 1 lands [MAS2-1 (0.55 ha) and MAM2-11 (0.06 ha)] is proposed, as shown on **Figure 13** (**Appendix B1**). Neither wetland unit provides breeding amphibian habitat due to absence or low water levels. Features are disturbed and are located along Boston Church Road adjacent to residential and agricultural land uses.

Wetland compensation locations were considered within the Orlando Lands. It was determined that replication near the retained RNHS was the best location for the wetland replication to create a more robust, ecologically complex system. It was determined based on a water availability assessment that the created wetlands should be located within the vicinity of the realigned watercourse to convey seasonal and storm event flows into the feature.

Various wetland compensation areas were considered along the northern side of the realigned watercourse; locations south of the realigned watercourse were determined to be less ideal due to their immediate location adjacent to the proposed development, which could be impacted from the adjacent development (e.g., increased wildlife-human interactions, potential for informal trails through the wetlands to get to the realigned watercourse). Three polygons along the northern portion of the realigned channel were identified for potential wetland creation (as shown on **Figure 14, Appendix B1)**.

A total of 0.61 ha of wetland habitat is proposed for removal. Polygon 1 was too small to host all of the wetland compensation and still accommodate the required buffers from key natural heritage and hydrologic features. Polygons 2 and 3 were not able to host the entire wetland compensation area outside of the Protected Countryside Area; however, the totality of the wetland compensation area could be hosted within a combination of areas inside and outside of the Greenbelt Planning Area. As discussed within Section 3.2.2.3 of the Greenbelt Plan (2017), new development or site alteration within the NHS has to demonstrate the following:

- "There will be no negative impacts on key natural features or key hydrologic features and their functions;
- Connectivity along the system and between key natural heritage features and key hydrologic features located within 240 metres of each other will be maintained, or where possible, enhanced for the movement of native plants and animals across the landscape; and
- The removal of other natural features not identified as key natural heritage features and key hydrologic features should be avoided. Such features should be incorporated into the planning and design of the proposed use wherever possible".

As discussed throughout **Section 6** of this CESS, no negative impacts to key natural heritage or hydrologic features and their associated functions are expected as a result of the proposed development and/or construction of the created wetland. Polygons 2 and 3 would be further connecting the natural system and key natural and hydrologic features within the landscape. No removal of natural features is required to construct

the wetland compensation area, rather, revegetation of the actively managed agricultural field is proposed to incorporate this area into the RNHS.

It was determined that Polygon 2 was the most appropriate wetland compensation area as it is surrounded by retained RNHS; whereas Polygon 3 is adjacent to a residential dwelling (offsite) and Esquesing Road. Wetland compensation within portions of Polygon 2 will encourage wildlife movement between the existing RNHS and the created realigned watercourse. There is some flexibility within Polygon 2 for the location of the created wetland to be adjusted, should it be determined with reviewing agencies in detailed design that the shape or location of the wetland would function better in a different orientation.

Mitigation in the form of wetland replacement will occur at a 1:1 ratio within the tableland area between the realigned channel corridor and the retained woodland buffer, partially within the Protected Countryside boundary (**Figure 13, Appendix B1**). This location allows for an increased connection and communication between the realigned channel and the existing RNHS. The proposed created wetland area (0.61 ha) may provide additional breeding habitat for amphibians within the RNHS, such as American Toad (*Anaxyrus americanus*), Gray Treefrog (*Hyla versicolor*), Spring Peeper (*Pseudacris crucifer*) and Northern Leopard Frog (*Lithobates pipiens*), depending on site hydrology. Wetland pools will not be designed to provide overwintering habitat for these species due to the limited availability of water (i.e., a minimum of 1.5 m deep permanent pool would be required). The proposed wetland area will also be planted with a variety of native nectaring plants to provide increased nectaring potential throughout spring into early fall. Restoration design specifics and a monitoring plan will be developed during the detailed design phase and described within the Natural Heritage Design Brief. Detailed hydroperiod modelling will be completed to inform the ultimate ELC community; the targeted ELC community for the created wetland is discussed **within Section 7.2.2.3.1** of this report.

Based on current soil types and proximity to the realigned channel, a combination of grading and/or redirecting of water (via vegetated swale) from the channel into the created wetland will ensure that a sufficient hydroperiod for the targeted community is maintained. Detailed water balance modelling will be undertaken during further design stages to establish the hydroperiod in the wetland. If the hydroperiod can be supported exclusively by runoff from the wetland catchment area (extending north of Polygon 2), the wetland will be located north of the channel corridor and outside of the 6 m access allowance on the north side of the channel (refer to **Section 6.1.10**). If additional water from R3S1 is needed to achieve the desired hydroperiod and targeted community, the wetland would need to be located within the flood plain of the realigned R3S1. In this case, the 6 m maintenance allowance associated with R3S1 would be provided to the north of a locally widened channel corridor to contain the wetland and flood plain. In all scenarios, the created wetland area will be located outside of the 30 m setback from all key natural and hydrologic features, and the 6 m maintenance allowance associated with R3S1 will also be fully outside of the 30 m setback. CH will be consulted during the development of this plan to ensure that design expectations are met.

Two different mitigation strategies are proposed to avoid negative impacts associated with the removals of these wetlands:

1. Opportunities for phasing the wetland removal and creation will be considered. Where feasible, the wetlands will be created within the Parcel 4 lands (when the realigned R3S1 is constructed) before the removal of the wetlands from the Parcel 1 lands; and
2. A wildlife salvage will be coordinated ahead of the wetland removal to ensure that all wildlife using the existing wetlands are captured and relocated.

Based on the proposed wetland restoration plan, no negative impacts on wetlands other than those considered significant are expected to occur as a result of the proposed development.

6.1.13 Regulated Floodplains

The regulated floodplain associated with the Middle Branch of Sixteen Mile Creek in the northern portion of the Orlando Lands will not be impacted by proposed development or site alteration. Therefore, no impacts on the ecological functions of the area within with floodplain is expected.

The regulated floodplain associated with R3S1 will be altered as part of the proposed channel realignment plan. The proposed realigned channel corridor has considered floodplain storage and conveyance requirements will contain the floodplain within the corridor. A minimum 15 m setback from the limit of the floodplain within the corridor to the adjacent development will be provided. More information on the design of the corridor and associated floodplain is provided in **Section 7.3.1**.

The realigned channel corridor and floodplain are expected to result in improvements to the ecological form and function of the floodplain as a result of the proposed natural channel and vegetated corridor in this currently heavily modified agricultural environment. Therefore, no impact on the ecological function of the floodplain is expected after realignment is completed.

6.1.14 Greenbelt Planning Area

As discussed previously, the woodland found on Parcel 4 of the Orlando Lands is located within the Greenbelt and the area is designated as Protected Countryside (**Figure 2, Appendix B1**). No development will occur within the Greenbelt Planning Area; however, site alteration will occur adjacent to and within the Protected Countryside boundary within the existing agricultural field when realigning R3S1 (as discussed above in **Section 6.1.3**) and creating wetland mitigation habitat (as discussed in **Section 6.1.12**). Of the 0.61 ha of created wetland area proposed, 0.27 ha will be located within the Protected Countryside boundary within existing actively managed agricultural field, while the remaining 0.35 ha will be proposed outside of the Protected Countryside boundary. Rationale in support of wetland compensation within the Protected Countryside is provided above within **Section 6.1.12.**

Indirect effects are similar to those discussed for significant woodland (**Section 6.1.4**). The Sixteen Mile Creek RNHS will be protected with a minimum of a 30 m vegetated buffer. The vegetation buffer will enhance and increase the size of the Greenbelt features and/or functions, while creating increased connectivity and communications between the realigned channel corridor and the RNHS.

Monitoring the success of vegetated buffer zones and construction monitoring to ensure effectiveness of ESC measures is vital to ensure that they are functioning as required. No net negative impacts are anticipated within the Greenbelt Planning Area with the increased created wetland area proposed within 0.27 ha of the Protected Countryside boundary compared to existing conditions (agricultural fields).

6.1.15 Locally and Regionally Rare Species

Three species identified during ecological inventories are listed as Regionally or Locally important Species: Tule Bluet (*Enallagma carunculatum*) – Uncommon, Gray Comma – Rare, and Common Raven (*Corvus corax*) – Rare (Ryswyk 2017; Varga ed. 2005). No suitable breeding evidence was observed for Tule Bluet or Common Raven on the Orlando Lands, however suitable habitat for Gray Comma was identified.

Gray Comma are typically found along the edges of deciduous or mixed forests (Hall et al. 2014) that contain their host plants (Currants and Gooseberries - *Ribes* sp.). These host plants are present on the Orlando Lands within the woodland features associated with the Greenbelt Planning Area and significant woodlands.

No direct removal of Gray Comma habitat will occur to accommodate development. Potential impacts to the species are similar to that of SWH (**Section 6.1.6**) and significant woodlands (**Section 6.1.4**). The mitigation and avoidance measures identified in these sections will also provide for the protection and enhancement of Gray Comma habitat.

No negative impacts are predicted as a result of the proposed development.

6.2 Fluvial Geomorphology

6.2.1 Existing and Proposed Stream Lengths

Existing drainage density was determined for each drainage feature subcatchment in **Section 3.4.2** based on the watercourse layer obtained from Ministry of Natural Resources and Forestry (MNRF) and subcatchment mapping.

It should be noted that although drainage density is a requirement of the Terms of Reference, we advocate for a function-based approach to address low-order tributaries to ensure replication is achieved. Drainage density does not provide information regarding the function of low-order feature, which is typically replicated through stormwater management measures such as low impact development techniques, as appropriate. To assess future impacts as a result of the proposed development on site, we have also reviewed pre- to post-stream lengths as outlined in **Table 6-1** below.

Table 6-1 Pre- and Post-Development Stream Lengths by Drainage Feature Catchment

Watercourse or Headwater Drainage Feature	Existing Stream Length* (km)	Proposed Stream Length** (km)
Tributary of Middle Sixteen Mile Creek (R3S1) at downstream boundary of Subject Lands	4.088	3.032
R1S1 / R2S1 at James Snow Parkway	2.008	0.47 **
R5S0 at James Snow Parkway	1.369	1.280
Total	**7.465**	**4.782**

** Existing stream lengths account for all headwater drainage features reviewed on Orlando Lands, including those characterized as No Management Required (feature removal is permitted; no requirement to replicate feature form/length or function) and Mitigation (feature removal is permitted; no requirement to replicate feature form/length)*
*** Portion of tributary length (XX m) redirected to R3S1 via proposed bioswale*

Similar to drainage density, the existing and proposed stream lengths above do not adequately characterize the proposed mitigation for feature loss in the post-development condition. It should be noted that red stream length within the study area (Middle Branch of Sixteen Mile Creek) will be maintained in the post-development condition. As a result of the proposed natural channel design, blue stream length within the study area (Tributary R3S1) will increase in the post-development condition from 1,110 m to 1,364 m. The documented loss in stream length is entirely associated with the removal of low-order headwater drainage features classified as either No Management Required or Mitigation. In both cases, removal of the features is permitted, although Mitigation features must have their function replicated through enhanced lot level conveyance measures. This has been addressed as part of the stormwater management plan for the site. As such, we do not anticipate any negative impacts as a result in the loss of stream length on site.

6.2.2 Downstream Erosion Assessment

For Parcels 1 and 2, as described in **Section 5.4.3.2**, the proposed erosion criteria was based on the Highway 401 FSEMS due to the proposed realignment of HDF R5S0 through Parcels 1 and 2 and proposed erosion protection for the existing swale through the hydro corridor before the HDF terminates into the existing piped SWM system south of James Snow Parkway. Thus, a downstream erosion assessment was not required for R5S0. This approach acknowledges that permissions for proposed works in Parcel 2 (non-participant) and the hydro corridor will be granted. If not, an alternative strategy to mitigate erosion impacts is required for Parcel 1.

For Parcel 4, analyses for erosion control criteria were completed for the Tributary of Sixteen Mile Creek through the continuous hydrologic model at a flow node OF-103 at the downstream extent of the Subject Lands. Potential erosion within the receiving watercourses was analyzed based on modelled exceedance of the erosion threshold discharge (0.00068 $m^3/s/ha$, described in **Section 5.4.3.2**) for the existing hydrological conditions and proposed conditions with stormwater controls. Proposed erosion control volumes based on the hydrologic modeling was outlined in **Section 5.4.3.2.** The post- to pre-development erosion exceedance assessment was completed based on four indices:

1) Cumulative time of exceedance
2) Number of exceedance events
3) Cumulative effective discharge and volume
4) Cumulative effective work index (i.e. cumulative effective stream power)

These indices provide an evaluation of the number of events, period of transport, and magnitude. The most relevant indicator is the cumulative effective stream power (ω_{eff}), as it reflects both the duration and magnitude of erosion exceedance events. The cumulative time of exceedance (t_{ex}) is simply the summed duration of time where discharge exceeds the established erosion threshold, and the number of exceedances is the count of erosion exceedance events throughout the discharge record. The cumulative effective volume (CEV) represents the total volume of flow above the threshold level throughout the modelled period, whereas the cumulative effective discharge (CED) represents the average magnitude of flow exceeding the threshold during a given erosion event. A detailed explanation of each index and their computation methods is available within **Appendix C**.

The results of the post- to pre-development erosion exceedance assessment for R3SC0, based on continuous flow data spanning from 1962 to 2004, are presented in **Table 6-2.** With the application of the proposed erosion control storage (925 m^3 per impervious ha) and extended detention flow rate (0.00068 $m^3/s/ha$) to Parcel 4 stormwater management controls in the proposed conditions, the result was a 53% decrease in cumulative exceedance duration. Decreases ranging from 58% to 46% were predicted for the CED, CEV, and number of exceedances, and an increase of 16% was predicted for the cumulative exceedance duration.

Taken as a whole, the resulting indices from of the post- to pre-development erosion exceedance predict a general reduction in erosion potential within reach **R3S0C** following completion of development activities. The expected geomorphic regime within receiving reach **R3S0C** is characterized by longer duration but less severe and less frequent erosion events, which provides a welcomed level of channel resilience to future developments within the catchment and their associated hydrological effects.

Table 6-2 Results of the post- to pre-development erosion analysis for Reach R3S0C

Simulation		CED (m^3/s)	CEV (m^3)	ω_{eff} (N/m^2)	t_{ex} (hrs)	# of Exceedances
R3SC0 Qcrit: 0.118 m^3/s	**(PRE)**	0.18153	203730.50	1625.49	311.75	50.00
	(POST)	0.07687	99963.85	758.97	361.25	27.00
	Change (%)	**-57.63**	**-50.93**	**-53.31**	**15.88**	**-46.00**

The currently recommended criteria of 925 m^3 per impervious hectare is significantly larger than standard approaches for areas in the absence of erosion assessments (runoff from a 25 mm storm event) and is also significantly larger than the unitary storage volumes established for the Boyne and Derry Green development areas in the Town of Milton and Sixteen Mile Creek watershed (Amec, 2015) (typically in the order of 400 m^3 per impervious hectare). It is recognized that this large storage volume and relatively small release rate result in a very long drawdown period for the extended detention zone.

The erosion control criteria for Parcel 4 initially targeting matching the duration of erosive flow conditions, which require the very large storage volume. The additional analyses suggest that this approach would result

in a significant decrease in cumulative effective work and therefore a reduction in erosion potential. Additional discussions with staff and CH are warranted to further refine the erosion control criteria to achieve more reasonable extended detention storage volumes and drawdown times. The refinements could include matching cumulative effective work rather than matching the duration of erosive flow conditions, and could also include directing runoff from a portion of the roof areas to tributary R1S1/R1S2 and the culvert under James Snow Parkway.

For discharges to the stormwater system south of James Snow Parkway (primarily from Parcels 1 and 2), the proposed development is not expected to have an adverse impact on erosion since the downstream receiver is a closed storm sewer. However, the proposed erosion criteria for stormwater management facilities is to be consistent with criteria outlined in the Highway 401 Industrial/Business Park FSEMS (Philips, 2000) to not adversely impact the function of existing downstream stormwater management facilities.

6.3 Hydrology and Surface Water Quality

The impact assessment for future conditions with respect to hydrology evaluated the impacts of land use changes for Parcels 1, 2, and 4 within the Subject Lands, with and without stormwater controls. Industrial development is proposed for lands outside the natural heritage system and inside the urban boundary, with an imperviousness measured based on the concept plan for the North Porta lands. The analyses were based a proposed conditions continuous hydrologic simulation for peak flow rates at the downstream outlets of the Subject lands up to the 100-year return period and the Regulatory storm.

A summary proposed conditions peak flow rates and a comparison to existing conditions is provided in **Table 6-3** for the flow nodes at the downstream boundary of the Subject Lands. Additional modelled peak flow results are provided in **Appendix D2**. Proposed conditions peak flow rates used in the R3S1 hydraulic model are provided in **Table 6-4**, based on hydrologic model scenario with SWM ponds due to the Regional Storm control provided by SWMF4 as a public facility, as commented by CH.

In the proposed conditions scenario without stormwater controls, the peak flow rates are increased at drainage area outlets downstream of development areas. OF-102 and OF-104 do not have increases in peak flow rates due to reductions in drainage area in proposed conditions. The highest relative increases were during the more frequent storm events. The increase in proposed conditions peak flow rates at OF-102 and OF-104 were also attributable to the drainage area diversions into those outlets due to the development plan. The net increases in drainage area compared to existing conditions is 13.3 ha for OF-102 and 33.2 ha to OF-104.

In addition, as described in **Section 6.2.2**, the proposed conditions erosion assessment without stormwater controls indicated that the proposed development would cause adverse erosion in the downstream receiver.

The above impacts for flooding and erosion can be mitigated with the stormwater controls. In the proposed conditions hydrologic model with the recommended stormwater controls (i.e, end-of-pipe SWM facilities for each of the development parcels), the future conditions peak flow rates can be reduced to the existing condition peak flow rates up to the 100-year return period, and the Regional Storm.

Given that the proposed development consists of large-scale warehouses, it is generally more advantageous from land use efficiency perspective to consolidate end-of-pipe SWM facilities than to have multiple facilities at each development parcel to closely match existing drainage areas. The development plan for Parcel 4 does not allow for another end-of-pipe facility discharging to R1S1. The continuous hydrologic modelling results indicate that that very large extended detention storage volumes and very long drawdown times will be needed to mitigate the impact of the development, with the drainage diversion, on downstream erosion. This results in end-of-pipe SWM facilities that are larger than the upper range of SWM facilities from a unitary storage basis (as discussed in **Section 5.4.3**). However, the proposed conditions hydrologic modelling and erosive force analyses confirm that the strategy will be effective in mitigating downstream erosion and flood risk.

Conversely, the drainage area diversion away from OF-102 (R1S1) and OF-104 generally reduces the peak flow rates to those receiving drainage features / SWM systems. (The exception is the minor increase in the 2-year and 5-year peak flow rate to OF-102, from the proposed public road in the hydro corridor, which will be

addressed in later design stages.) As described in **Section 6.1.7**, the fish habitat potential is unknown downstream of R1S1, however, the industrial land use and drainage to an existing SWM facility impacts the fisheries habitat value. To avoid potential impacts on downstream habitat, clean roof water from Parcel 4 can be directed to the existing R1S1 through the hydro corridor if needed.

Mass balance modelling referenced in the Sixteen Mile Creek Areas 2 and 7 SUS (AMEC, 2015) noted that the application of Enhanced Level criteria for stormwater quality controls to development would provide a 20% reduction in in total suspended solids loadings compared to existing levels. Mass loadings of fecal coliforms, metals and Total Kjeldahl nitrogen (TKN) would increase by about 30% compared to existing levels, however, the application of stormwater quality controls will reduce contaminant loading compared to uncontrolled conditions.

Table 6-3 Peak Flow Rates Comparison

Location (Flow Node)	Drainage Area (ha)	Peak Flow Rates (m^3/s)						
		2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	Regional Storm
Existing Conditions Peak Flow Rate								
Tributary of Middle Sixteen Mile Creek (R3S1) at downstream boundary of Subject Lands (OF-101)	135.96	0.22	0.62	0.83	1.39	1.74	1.86	7.92
R1S1 / R2S1 at James Snow Parkway (OF-102)	65.21	0.23	0.44	0.63	0.86	1.01	1.12	4.14
R5S0 at James Snow Parkway (OF-103)	48.83	0.09	0.19	0.30	0.50	0.59	0.64	2.84
Southwest corner of Subject Lands (OF-104)	4.84	0.04	0.10	0.13	0.17	0.17	0.22	0.51
Proposed Conditions Without SWM Controls								
Tributary of Middle Sixteen Mile Creek (R3S1) at downstream boundary of Subject Lands (OF-101)	169.14	1.67	2.45	2.95	3.89	3.96	4.78	12.14
R1S1 / R2S1 at James Snow Parkway (OF-102)	15.62	0.29	0.49	0.54	0.64	0.67	0.80	1.64
R5S0 at James Snow Parkway (OF-103)	62.12	1.20	1.72	1.93	2.48	2.53	3.09	3.98
Southwest corner of Subject Lands (OF-104)	2.08	0.03	0.06	0.07	0.09	0.10	0.12	0.23
Proposed Conditions with SWM Controls								
Tributary of Middle Sixteen Mile Creek (R3S1) at downstream boundary of Subject Lands (OF-101)	169.14	0.10	0.19	0.24	0.38	0.50	0.75	7.26
R1S1 / R2S1 at James Snow Parkway (OF-102)	15.62	0.29	0.49	0.54	0.64	0.67	0.80	1.64
R5S0 at James Snow Parkway (OF-103)	62.12	0.09	0.14	0.18	0.19	0.25	0.27	2.84
Southwest corner of Subject Lands (OF-104)	2.08	0.03	0.06	0.07	0.09	0.10	0.12	0.23

Table 6-4 Proposed Conditions Flow Rates in R3S1 Hydraulic Model

Key Hydraulic Flow Node Location (PCSWMM Flow Node)	HEC-RAS River Station	Flow Rate (m^3/s)						
		2-year	5-year	10-year	25-year	50-year	100-year	Regional Storm
Upstream limit of Tributary to Sixteen Mile Creek (R3S1) at No. 5 Side Road (J1-4)	4400	0.11	0.22	0.34	0.37	0.40	0.48	1.47
Tributary to Sixteen Mile Creek (R3S1) at southern limit of Parcel 3 (J1-3)	4000	0.25	0.41	0.52	0.68	0.70	0.82	2.85
Tributary to Sixteen Mile Creek (R3S1) within Parcel 4, 200 m downstream of northern property limit (J1-1)	3500	0.14	0.24	0.29	0.39	0.52	0.86	7.32
150m downstream of Esquesing Line (OF-101)	2300	0.10	0.19	0.24	0.38	0.50	0.75	7.26

6.4 Hydrogeology

Similarly to the other technical studies, this Comprehensive Study presents and discusses the existing hydrogeological conditions that occur on, and/or adjacent to, the Orlando Lands, and in particular Parcels 1 and 4. Findings in this report should be considered to be preliminary with respect to Parcels 2, 3 and 5. Further field investigations and impact assessments should be completed on non-participating parcels following detailed evaluation of geological and hydrogeological conditions.

This Comprehensive Study focuses on assessing the potential changes to site water balance, the requirement for feature-based water balance, potential impacts to groundwater supported features, the hydrogeological feasibility of the proposed channel realignment, and dewatering related impacts. Mitigation recommendations related to meeting pre-development infiltration targets and maintaining function of existing natural features is also discussed such that these can be maintained or enhanced as part of the proposed development.

6.4.1 Post-Development Water Balance

6.4.1.1 Methodology

A post-development water budget for the Orlando Lands was completed using similar methods to the pre-development water balance provided in **Section 3.5.7**.

Similar to the pre-development water budget, the surplus was partitioned using the site-specific infiltration and runoff factors determined under pre-development conditions (MOEE, 1995). These factors have been modified from the pre-development condition to take into consideration the lot-level controls such as increased topsoil depth, reduced lot grading, and increased infiltration in the proposed buffer lands and along the new channel corridor. Overall infiltration and runoff estimates for the pervious surfaces were then calculated by multiplying the water surplus value by the factors.

6.4.1.2 Parcel Based Post-Development Water Balance

The post-development water balance was calculated for Parcel 1 and Parcel 4 based on the proposed land use plans. Under pre-development conditions approximately 141.8 mm/yr or about 16% of precipitation was estimated to infiltrate on both Parcels 1 and 4 combined (**Table 3-20**). The post development infiltration rates are estimated to range from 3,263 to 47,275 m^3/yr, which represents a decrease of between 69% and 92% from the pre-development condition. **Table 6-5** presents the unmitigated post-development water balance for Parcels 1 and 4.

Table 6-5 Post Development Water Balance (Development Parcels)

Parcel	Proposed Land Use	Total Area (ha)	Percent Impervious (%)	Impervious area (ha)	Surplus on Impermeable Surfaces (m/year)	Runoff from Impervious Area (m^3/year)	Estimated Pervious Area (ha)	Surplus on Pervious Areas (m/year)	Runoff Coefficient	Runoff from Pervious Area (m^3/year)	Infiltration Coefficient	Infiltration from Pervious Area (m^3/year)	Total Runoff Volume (m^3/year)	Total Infiltration Volume (m^3/year)
1	Buildings and Roadways	26.97	1.0	26.97	0.79	213,063	0.0	0.392	1.00	0	0	0	213,063	0
	Channel Corridor / Landscape Area / Wetland and Forest Area	1.85	0.0	0.0	0.79	0	1.85	0.392	0.55	9,055	0.45	3,263	3,989	3,263
	SWM Pond	1.52	1.0	1.52	0.79	12,008	0.0	0.392	1.00	0	0	0	12,008	0
	Total	**30.34**										**Post-Development Parcel 1 Total**	**229,060**	**3,263**
												Pre-Development Parcel 1 Total	**77,222**	**41,581**
												Difference	**151,838**	**-38,318**
												% Change	**296.63%**	**-92.15%**
4	Buildings and Roadways	74.86	1.0	74.86	0.79	591,394	0.0	0.392	1.00	0	0	0	591,394	0
	Channel Corridor / Landscape Area / Wetland and Forest Area	26.8	0.0	0.0	0.79	0	26.8	0.392	0.55	7,115	0.45	47,275	57,781	47,275
	SWM Pond	4.47	1.0	4.47	0.79	35,313	0.0	0.392	1.00	0	0	0	35,313	0
	Total	**106.13**										**Post-Development Parcel 4 Total**	**684,488**	**47,275**
												Pre-Development Parcel 4 Total	**263,710**	**152,001**
												Difference	**420,778**	**-104,726**
												% Change	**259.56%**	**-68.90%**
PARCELS TOTAL		**136.5**	**-**	**107.82**	-	**913,547**	**28.65**	**-**	**-**	**61,769**	**-**	**50,539**	**913,547**	**50,539**

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6.4.2 Feature Based Water Balance

Three wetlands have been identified to be retained post-development. Each wetland was identified as a deciduous swamp community (**Figure 1, Appendix E**). In order to determine whether a feature based water budget would be required for each wetland, the groundwater/surface water monitoring data as well as the catchment areas for each wetland have been assessed.

6.4.2.1 Mineral Deciduous Swamp (MP3)

MP3 is located in a deciduous swamp found at the northern border of the site boundary adjacent to an existing rural residential community (**Figure 1, Appendix E**). Monitoring data from this MP indicate the swamp is surface water supported from flow that occurs from the north of the site. This wetland is located north of the proposed development and upgradient of the proposed land-use change and channel realignments. Our assessment concludes that the surface water catchment for this wetland will not be affected and is not groundwater supported. As a result, no impact to the wetland or the wetland hydroperiod is expected from the development

6.4.2.2 Mineral Deciduous Swamp (MP5)

MP5 is also located in a deciduous swamp found on the north-east side of Boston Church Road (**Figure 1, Appendix E**). Monitoring data from this MP indicate the swamp is surface water supported from flow that occurs from the north to northeast of the site. This wetland is located north of the proposed development and upgradient of the proposed land-use change and channel realignments. Our assessment concludes that the surface water catchment for this wetland will not be affected and is not groundwater supported. As a result, no impact to the wetland or the wetland hydroperiod is expected from the development

6.4.2.3 Mixed Swamp (MP2)

MP2 is located in a mixed swamp at the north east border of the site boundary within the valleylands of the Sixteen Mile Creek. Monitoring data from this MP indicates that this wetland is both surface water and groundwater supported (**Figure 1, Appendix E**). The surface water catchment area for this wetland is located outside and upgradient from the proposed footprint of the development. Because of this, the surface water catchment will not be affected. However, because groundwater flows north-east through the proposed development, this wetland is directly supported by groundwater flow through the Orlando Lands. The area that was identified to support the function of this wetland was Parcel 4. Fortunately, the area in the vicinity of MW1, MW3 and MW8 located in Parcel 4 is an optimal place for infiltration-based LID that can maintain groundwater recharge/ discharge to this wetland community. Based on borehole logs completed by Terrapex (**Appendix A1**) and the proposed elevation of the realigned channel, the channel is not anticipated to encounter the sand and silt unit, and will therefore not be contributing or intercepting groundwater that is intended to support the mixed swamp. It is recommended that clean rooftop drainage from the proposed buildings be utilized to ensure groundwater quality is protected. LID recommendations are provided in **Section 7.4.4** to assist in maintaining infiltration post development.

6.4.3 Pre-to-Post Development Infiltration

The expected alterations to runoff and infiltration volumes within the North Porta lands were calculated under pre- and post- development scenarios in **Sections 3.5.7** and **6.4.1**. Without mitigation, it is expected that infiltration volumes within the Orlando Lands will be reduced from 193,582 m^3/year to 50,539 m^3/year which represents a decrease in infiltration by 74% from pre-development.

Source Water Protection policies for the site area does not require the balancing of the pre-to-post infiltration values. However, Parcel 4 contains two partially groundwater supported features (the swamp located at MP2, and R3S1), where maintaining or enhancing infiltration values post development will provide continued support for these features. The hydrogeology study results show that the area surrounding these features are optimal

for infiltration based LID due to the deep water table and permeable soils (i.e., sandy). The use of infiltration based LID would support maintaining or enhancing of infiltration values in Parcel 4.

For the Orlando Lands, it is expected that redirecting rooftop runoff from the proposed buildings to an infiltration based LID would be sufficient to meet an overall site infiltration volume of 193,582 m^3/year. Specific LID measures are provided in **Section 7.4.4**.

6.4.4 Impacts to Groundwater Supported Features

Wetland and surface water hydroperiod monitoring showed that the wetland communities retained post-development located at MP3, and MP5 are surface water supported. These wetlands are located up-gradient, and outside the Orlando Lands post-development. The surface water catchment areas of these wetlands are not expected to be affected by the development.

Surface water monitoring data collected from MP5 (**Table 3-16**) confirm that the existing water balance at SWD3-3 is dependant upon surface water input, and discharge into R3S1. To maintain the water balance at SWD3-3, it has been recommended that R1S1 be realigned within a portion of the 30 m wetland buffer as a green swale (refer to **Section 6.1.3** for additional context). This green swale will act as the discharge point for SWD3-3 to maintain water balance, and no hydrogeological impacts are anticipated from the realignment of this tributary. The green swale will likely act as an enhancement to the overall water balance by providing additional area for infiltration to meet water balance infiltration targets

Wetland and surface water hydroperiod monitoring showed that the wetland containing MP2 is both surface water and groundwater discharge supported. Based on the results of groundwater monitoring (**Table 5**), it was also recognized that the groundwater catchment to this feature is not restricted to the surface water catchment, as groundwater flow direction is controlled by the groundwater flux towards discharge areas in Sixteen Mile Creek and not topography. The surface water catchment is outside of the proposed development and not is expected to be affected (TMIG, 2020). Groundwater discharge to this wetland is expected to be derived from groundwater flow within the Subject Lands (**Figure 6, Appendix E**). It is expected that groundwater discharge to this feature will be maintained through implementing the selected LID strategies on Parcel 4 to balance overall infiltration volumes and maintain groundwater discharge to this feature. As LID strategies will maintain the overall infiltration volume on site, it is expected that groundwater discharge into Sixteen Mile Creek – Middle East Branch from the site area will be maintained post-development.

6.4.5 Channel Realignment

The intermittent channel running through the Orlando Lands (R3S1) is proposed to be realigned from its existing location to along the buffer limits for the woodlot and wetlands areas and protected countryside. This channel is characterized as intermittent as it receives seasonal groundwater discharge during the spring freshet and is supported through surface water runoff for the remainder of the year. This is supported through field observations of above ground surface water measurements and positive hydraulic gradients measured at the MPs installed within the feature annually in April and May. It is expected that the discharge to the feature originates from the sand and silt lens noted near the surface of MW4 (**Figures 3 and 4, Appendix E**). Following the spring freshet, it is expected that this channel is supported primarily through surface water runoff, and water present within the feature is perched on top of the low permeability Halton Till and fine grained glaciolacustrine soils.

Based on the results of the hydrogeological investigation, the proposed location for the channel realignment will be sufficient in supporting the natural hydrologic behaviour of the existing intermittent channel. The surficial geology of the proposed location is comprised of the same low permeability Halton Till and fine grained glaciolacustrine soils as the existing location and intersects the near surface silt and sand lens identified at MW4 and continues to MW8. In addition, as the channel realignment is situated along the same groundwater equipotential lines as the existing channel (**Figure 6, Appendix E**), the elevation of the groundwater table under the realigned channel is in the same range as the existing location (211.57 masl to 217.24 masl). It is therefore expected the stage of the realigned channel will follow the same behaviour, where it is primarily supported through surface water runoff through the year, with seasonal groundwater discharge during the early spring near MW4. Some added recharge may occur near MW1 due to the deep-water table and the

hydraulic effects of the valleyland, however this will only increase the groundwater recharge and subsequent groundwater discharge to the wetland at MP2 and Middle Sixteen Mile Creek. It is recommended that the surface elevation of the new channel bed is regraded to approximately the same elevation as the existing channel to ensure the natural hydrologic conditions of the channel are preserved

6.4.6 Dewatering

As the foundation of the buildings will be slab on grade, no dewatering is anticipated for the construction phase of the buildings. Based on the water level monitoring described in **Section 3.5.2** the seasonally high groundwater table plus one meter is expected to range from approximately 210 masl in the northeast portion of the site to approximately 220 masl in the west. Construction of the SWM facilities will be in the upper Halton till unit. Due to the thick layer of till present, the low hydraulic conductivity values (less than 10^{-7} m/s) and that no aquifer units were identified below SWM facilities, a clay liner is not expected to be required to protect groundwater quality.

Under the EASR system, water takings for construction dewatering that are less than 50,000 L/day and less than 400,000 L/day do not require a Permit to Take Water (PTTW) from the MECP or a registration on the Environmental Activity and Sector Registry (EASR). Water takings for this development are likely to be below 50,000 L/day, and therefore do not require a PTTW or a registration on the EASR. Additional dewatering analysis will be completed at detailed design.

7 SUBWATERSHED MANAGEMENT AND FUNCTIONAL SERVICING FOR ORLANDO LANDS

7.1 Overview

An overview of the subwatershed management strategies applied to the Orlando Lands is provided on **Figure 7-1**, which shows the proposed Natural Heritage System, watercourse management plan and stormwater management plan as an integrated strategy. The analysis and recommended subwatershed management strategies presented below were built upon the constraints and high-level strategies discussed in **Sections 4 and 5** of this Comprehensive Study.

The proposed Natural Heritage System reflects the results of natural heritage features analysis, watercourse realignment, headwater drainage features assessment, and the associated buffer requirements. The proposed stormwater management plan provides mitigation for the areas proposed for development, to mitigate potential impacts to downstream flood hazards, erosion, water quality, water balance, and downstream temperature regimes.

The opportunity to realign and enhance the Tributary of Sixteen Mile Creek within Parcel 4 is proposed. The realigned watercourse is integrated into the natural heritage system along the northern portion of Parcel 4. The impact assessment (**Section 6**) concluded that with the recommended strategies in place, there are no negative impacts expected on the Subject Lands as a result of the proposed development. Further, analysis for net gain is provided based on the specific mitigation and enhancement measures on the Orlando Lands (**Section 7.6**).

7.2 Natural Heritage System

7.2.1 Existing Natural Heritage Conditions

All existing conditions information collected within the Orlando Lands was documented in **Section 3.1** and **3.2.**

The following RNHS components were considered for impact avoidance, mitigation and/or potential offsets.

- Key Features
  - Habitat of Endangered and Threatened species;
  - Significant wetlands (SWD3-3, SWD4-5, SWD5-1);
  - Significant woodlands;
  - Candidate significant valleylands;
  - SWH:
    - Candidate Bat Maternity Colonies Habitat;
    - Candidate Turtle Overwintering Habitat;
    - Candidate Habitat for Species of Conservation Concern (Snapping Turtle);
    - Rare Vegetation Type; and
    - Habitat for Species of Conservation Concern (Eastern Wood-Pewee);
  - Fish habitat;
- Other RNHS components
  - Enhancements to Key Features;
  - Linkages;
  - Buffers;

- Watercourses within Conservation Authority Regulation Limit;
- Wetlands other than those considered significant (MAM2-11 and MAS2-1); and
- Regulated floodplains.

Figure 13 (**Appendix B1**) illustrates the components of the RNHS.

7.2.2 Proposed Natural Heritage Systems

Ecological restoration is proposed on lands associated with or immediately adjacent to the Greenbelt Protected Countryside area (**Figure 2, Appendix B1**) on the Orlando Lands. The restoration areas are depicted on **Figure 13** (**Appendix B1**) and include:

- 30 m vegetated buffer along the existing boundary of the RNHS that contains significant woodland and regionally significant wetland;
- Realigned watercourse (reach R3S1) plus a 15 m buffer applied to the south side of the realignment;
- Replicated tableland wetland; and
- Groundcover restoration in naturalized areas.

The restoration areas are envisioned to function as a healthy and diverse ecosystem where ecological functions will be augmented and replicated (as described further below). The vegetated buffers applied to the boundary of the key natural heritage and key hydrologic features provide mitigation for potential negative impacts to the RNHS. The proposed restoration areas will contain resilient, self-sustaining vegetation communities that will contribute to a more robust RNHS over the long term.

This Conceptual Restoration Plan outlines the restoration design principles and objectives for the Orlando Lands and provides an overview of the design components for each restoration area (i.e., planting area, planting density for woody stock, target vegetation communities, etc.). The sections below provide an: overview of the objectives of the restoration design; define target vegetation community types; outline habitat design elements; describe recommended planting standards; and outline the ecological monitoring plan and triggers for adaptive management.

Note that the restoration design specific to the realigned channel is discussed separately within **Section 7.3.1**.

At the detailed design stage, planting plans will be developed along with a corresponding Natural Heritage Design Brief that will provide specific details for each restoration area, including: plant species lists, proposed plant stock type and sizing, and planting timing considerations. This approach is consistent with CH's (2021) Guidelines for Landscaping and Rehabilitation Plans. Within this document, a detailed salvage plan will be prepared for flora and fauna species located within the proposed development area.

Wetland water balance information will also be available at the detailed design stage so that plant species lists are developed that suit the hydrological conditions (i.e., within the tableland wetland replication area and within the realigned stream corridor). Plantings will be selected to establish a suitable restoration trajectory towards the intended target vegetation community (described further below).

7.2.2.1 Overview

Based on the identification of various ecological constraints within the Subject Lands, development limits were prepared for Parcel 1 and Parcel 4 (**Figure 13, Appendix B1**). Key natural heritage features associated with the RNHS (e.g., significant woodlands, wetlands, fish habitat, SWH) were considered for impact avoidance, mitigation and/or potential offsets, and integrated with the findings from the hydrogeological, fluvial geomorphology, hydrologic and hydraulic investigations.

Although the implementation of the development plan will necessitate the removal of 0.61 ha of wetland habitat and the realignment of watercourse reach R3S1, no negative impacts to the RNHS are predicted with the implementation of the proposed ecological restoration and mitigation measures discussed herein, per **Section 6.1**.

A conceptual layout of the proposed restoration areas on the Orlando Lands is provided in **Figure 13** (**Appendix B1**). The size of each restoration area and the proposed target vegetation communities (latter described further in **Section 3.1**) are summarized below:

- Replicated Tableland Wetland: 0.61 ha mineral meadow marsh and/or shallow marsh;
- Realigned stream corridor: 0.43 ha mineral meadow marsh and/or shallow marsh;
- RNHS buffer 30 m in width (applied to staked boundary of retained significant woodland and regionally significant wetlands): 4.05 ha mineral successional woodland;
- Realigned stream corridor buffer 15 m in width applied to the south side of the stream corridor (fronting development): 1.89 ha cultural meadow; and
- Naturalized areas: 3.25 ha mineral cultural meadow.

Ecological restoration and mitigation strategies have been developed to ensure that the proposed development achieves no negative impact. Compensation for proposed removal of existing, non-regionally significant wetlands (totally 0.61 ha in size) is planned within tableland located north of the realigned channel corridor, immediately adjacent to the RNHS buffer, and partially within the Protected Countryside boundary (0.27 ha). The proposed tableland created wetland area will achieve a 1:1 replication ratio. The 30 m wide RNHS buffer will enhance the form and function of the Greenbelt Planning Area (Protected Countryside), while supporting linkage functions within the natural heritage system on the Orlando Lands. Plantings within naturalized areas, situated between the realigned channel and the RNHS buffer, will increase natural cover (these lands are presently under active agricultural use) and deter colonization by invasive and non-native plant species.

Established restoration areas will offer protection to retained, existing features retained within the RNHS, increase the biodiversity of native flora and fauna, and provide breeding, rearing and foraging habitat for a variety of local species over the long term. The potential to add amphibian breeding habitat will also be considered at the detailed design stage once water balance information is available for the proposed wetland areas (namely, within the realigned watercourse and replicated tableland wetland area).

7.2.2.2 Restoration Goals and Objectives

The restoration goal is to establish a healthy and diverse RNHS that compliments and enhances the ecological functions of existing habitat types on the Orlando Lands.

The restoration design reflects a combination of aquatic, wetland and terrestrial habitat elements. Overall, the restoration effort has been designed to enhance the ecological form and function of the RNHS by contributing biologically and structurally diverse aquatic, riparian, tableland wetland, and upland features to the existing mosaic of vegetation communities. The realigned channel, replicated tableland wetland and surrounding upland vegetation communities are expected to promote improved wildlife habitat functions, compared to existing conditions, to ensure that self-sustaining habitat persists on the landscape over the long term. Ecological restoration objectives for the Orlando Lands include:

- Increase overall natural cover and ecological linkage functions, and deter establishment of non-native / invasive plant species by establishing native tree, shrub and groundcover plantings;
- Provide tableland wetland replication on the Orlando Lands on an equal area basis (i.e., 1:1 replication ratio) as compensation for proposed removal of the existing MAM2-11 (0.06 ha) and MAS2-1 (0.55 ha) vegetation communities on the Orlando Lands;
- Include nectaring plants and Milkweed species within groundcover planting areas to attract / support local insect populations (e.g., Monarch);
- Stabilize soils through the application of an annual cover crop seed mix applied in conjunction with native perennial seed mixes;
- Create vegetatively diverse vegetation communities that will be self-organizing and resilient over the long-term;
- Develop diverse plant species lists that will improve structural diversity, floral diversity, and support a variety of native fauna species;

- Include diverse vegetation plantings within the realigned stream corridor to create shade and contribute allochthonous material input to the realigned watercourse (R3S1);
- Manage Category 1 invasive species within the retained RNHS, as appropriate; and
- Derive planting stock from locally propagated species (Seed Zone 34), where available.

Management of Category 2 species is not recommended within the Subject Lands. Six Category 3 species were noted within the Subject Lands (**Table 3**, **Appendix B2**), of which two features were noted within natural areas:

- Norway Maple (rare in the SWD4-5); and
- Moneywort (rare in the SWD4-5, rare in the SWM5-1).

All other Category 2 species (Bird's foot Trefoil, *Lotus corniculatus*; Kentucky Bluegrass, *Poa pratensis*; Tufted Vetch, *Vicia cracca*; and White Sweet Clover, *Melilotus alba*) will be removed as a result of the proposed development.

Given the infrequency of the Norway Maple within the SWD4-5 community and since this species is found within the swamp habitat, the habitat type should naturally prevent this species from becoming invasive within the community; Norway Maple has a wetness index of +5.

No BMPs for Moneywort are currently available for management and/or control of this species. This herbaceous species is a garden escapee that prefers organic wetland habitat types; suitable conditions for this plant are likely present within the SWM5-1 community. Since the Ontario Invasive Plant Council (OIPC) does not have any BMPs available for Moneywort, management for this species is not recommended as it could result in further invasive spread and degradation of the ecosystem. It is likely that this species has escaped from adjacent (offsite) residential communities.

7.2.2.3 Restoration Area Design

Five restoration areas have been identified within and adjacent to the Greenbelt Plan Protected Countryside area, as depicted on **Figure 13** (**Appendix B1**).

Proposed vegetation communities within each restoration area will reflect and enhance naturally occurring species groupings identified on the Orlando Lands. Plantings within these areas will help to mitigate edge effects on retained, high-quality vegetation communities (i.e., windthrow, sunscald, and invasive species colonization). All planting areas will be designed to enable the system to respond and adapt to changing abiotic (e.g., light, moisture, and nutrient) and biotic (e.g., pests and diseases) conditions over the long term.

Plant species will be chosen from across several functional groups (e.g., shrubs, forbs, and graminoids), reproductive strategies (e.g., seed-heavy annuals and biennials, clonal spreading perennials, and non-clonal perennials), guilds (e.g., nitrogen fixers), and moisture requirements (e.g., drought-tolerant, upland, facultative and obligate wetland) in consideration of the variety of habitat types present on the Orlando Lands. Within each group, several plant species should be selected in order to provide redundancy and adaptability within the community. This redundancy increases the likelihood that suitable species will colonize the microhabitats within the wetland, riparian and tableland areas, and that restoration areas can adapt to changing environmental conditions over the long term. Native plant species will be used throughout the restoration areas; plant species will be guided by those presented within CH's Native Species List (2018).

The following sections provide a summary of the target vegetation community types and general planting conditions required to establish a healthy and diverse ecosystem that replicates and enhances the ecological functions of existing retained, natural features. All species selected for planting will be provincially secure or apparently secure, globally common (G5; NHIC 2021) and not locally/regionally rare species.

Restoration design principles will follow CH's Guidelines for Landscaping and Rehabilitation Plans (2021).

7.2.2.3.1 Targeted Vegetation Communities

Plantings will be selected to establish a suitable restoration trajectory, within each restoration area, towards the intended target vegetation communities described below. The vegetation community ELC type codes are derived from Lee et al. (1998).

Target vegetation community within the replicated tableland wetland and realigned channel floodplain

- Mineral Graminoid/Forb Meadow Marsh (MAM2) and/or Mineral Shallow Marsh (MAS2): Meadow marsh consists of mineral substrates seasonally flooded that later become moist to dry, features dominated by grasses/sedges less tolerant to prolonged flooding, less than 25% cover of both emergent vegetation and trees/shrub. Shallow marsh contains mineral substrates (e.g., sand, gravel, shingle or cobble) inundated with standing or flowing water for much or all of the growing season, dominated by grasses/sedges/rushes with >25% hydrophytic emergent macrophyte cover. The target vegetation community (MAM2 or MAS2, or both) and suitable plant species will be selected once the hydroperiod within the replicated tableland wetland area is known at the detailed design phase.

Target vegetation community within the 30 m RNHS Buffer

- Fresh - Moist Sugar Maple Deciduous Forest (FOD6): The 30 m wide RNHS buffer fronts retained vegetation communities that include treed swamps and fresh-moist forest communities dominated by Maple species (*Acer* sp.) and/or Hickory species (*Carya* sp.). FOD6 communities typically contain Sugar Maple (*Acer saccharum*) as the dominant species with associate species varying, potentially including: Ash (*Fraxinus* sp.), White Elm (*Ulmus americana*), Beech (*Fagus grandifolia*), Yellow Birch (*Betula alleghaniensis*), Hemlock (*Tsuga canadensis*), White Cedar (*Thuja occidentalis*), Basswood (*Tilia americana*), Oak (*Quercus* sp.), Hickory, and Red Maple (*Acer rubrum*).

Target vegetation community within the 15 m Realigned Stream Corridor Buffer & Naturalized Areas

- Mineral Cultural Meadow (CUM1): CUM1 is a terrestrial community dominated by grasses or forbs with less than 25% tree and less than 25% shrub cover. CUM1 is identified an interim target since over time this vegetation community is expected to naturally succeed, through passive restoration (from seed bank, seed rain, and clonal spread), to shrub thicket and woodland.

General planting recommendations are provided in the following sections. At the detailed design stage, a planting plan based on the ultimate design, grading and hydrology of the restoration areas will be provided along with a corresponding Natural Heritage Design Brief.

7.2.2.3.2 Replicated Tableland Wetland

Two of the wetlands located on Parcel 1 of the Orlando Lands are proposed for removal to facilitate development:

- Cattail Mineral Shallow Marsh (MAS2-1): 0.55 ha; and
- Mixed Mineral Meadow Marsh (MAM2-11): 0.06 ha.

Under existing conditions, the MAS2-1 community is dominated by Narrow-leaved Cattail with an herbaceous layer composed of Reed Canary Grass and Tall White Aster (S*ymphyotrichum lanceolatum* ssp. *lanceolatum*). The MAM2-11 community is dominated by Bebb's Sedge (*Carex bebbii*), Redtop (*Agrostis gigantea*) and Tall White Aster. Associate species include Tall Goldenrod (*Solidago altissima*), Tufted Vetchand Reed Canary Grass. Both features are highly disturbed by adjacent residential and agricultural land uses, as evidenced by the presence of invasive and non-native species. Neither wetland was found to support amphibian breeding habitat due to low or absent surface water levels.

A replicated tableland wetland area is proposed, as shown on **Figure 13** (**Appendix B1**), to compensate for the proposed removal of the existing wetlands described above (MAM2-2 and MAM2-11 totalling 0.61 ha in size). The replicated tableland wetland will provide an equal area (i.e., 1:1 replication ratio).

A portion (0.27 ha) of the replicated tableland wetland will be located within the Protected Countryside boundary, where actively managed agricultural land use presently occurs. The remaining 0.35 ha of the replicated tableland wetland will be located outside of the Protected Countryside boundary. The location is

interior to the created RNHS and was selected based on the availability of water to support wetland vegetation, and to improve linkage functions within this area of the RNHS (including the potential for fauna movement between the replicated wetland and adjacent, retained features to complete life processes). Based on preliminary water availability information, the replicated tableland wetland area can support meadow marsh vegetation. The potential to create amphibian breeding habitat within the replicated wetland will be explored at the detailed design phase, when more detailed hydroperiod information is known for this area (i.e., duration and frequency of flooding that can be achieved along with water depths).

No amphibians were recorded during targeted surveys on-site. If suitable water is available to support the creation of amphibian breeding habitat, then the replicated wetland could be designed to support pool-breeding amphibians that rely on ephemeral or semi-permanent wetlands (i.e., Western Chorus Frog, *Pseudacris triseriata;* American Toad; Spring Peeper; Wood Frog, *Lithobates sylvaticus*), or deeper-water amphibians that rely on permanent wetlands (i.e., Northern Leopard Frog; Green Frog, *Lithobates clamitans*; Bullfrog, *Lithobates catesbeianus*). Western Chorus Frog is used (below) as an indicator species to guide the potential design of pool-breeding (ephemeral) wetland habitat. The habitat requirements described below would also be suitable for Spring Peeper, American Toad and potentially Wood Frog. Wetlands and foraging habitat used by Western Chorus Frog typically have the following characteristics (COSEWIC 2008b; Petranka et al. 2007; Lichko and Calhoun 2003):

- Small, shallow aquatic habitats with no fish (less than 40 cm deep and generally 11 cm to 22 cm deep with a shallower littoral zone for egg-laying) – namely temporary ponds and wetlands with 25% to 60% canopy cover. These habitats contain fewer predators than permanent waters. Vegetation associated with breeding habitat includes *Typha, Carex, Juncus*, grasses and herbaceous plants, partially submerged shrubs and trees, and submerged vegetation and plant debris (egg attachment sites, microhabitat and refugia).
- Exact hydroperiod of wetland varies, generally the pool contains the depths described above between Feb / March through July then it dries out in most years between late-July / Aug and September. These ephemeral wetlands can rewet in the autumn and winter.
- Summer foraging habitat can include a variety of habitats in close proximity to breeding ponds (e.g., other wetlands, fallow meadows, shrubby areas and woodlands).
- This species (along with American Toad, Spring Peeper, and Wood Frog) hibernates terrestrially. Hibernation habitat can be enhanced using large woody debris, rock piles, loose soil, and leaf litter.

Deeper-water amphibians, namely Bullfrog, Green Frog and Northern Leopard Frog, hibernate aquatically and require ponds with plunge pools the reach at least 1m in depth year-round. The plunge pools should not be greater than 1.5m in depth to avoid the creation of anoxic conditions.

Plant Species Selection

Marsh seed mix will be applied within the replicated tableland wetland. The seed mix will include a mixture of species suitable for emergent and littoral water depth conditions, allowing for species to germinate under variable moisture conditions. Milkweed species and nectaring plants will be included in the marsh seed mix and cultural meadow seed mix (latter to be applied within buffer areas and naturalized areas adjacent to the replicated tableland wetland). These plants serve to attract insects and provide foraging opportunities for aerial insectivore species, such as bats and birds.

The precise marsh seed mix will be once hydroperiod information is available for this area at the detailed design phase. The CH Meadow Marsh seed mix (2020) generally provides a good mixture of species tolerant of emergent and littoral conditions. The latter seed mix would be suitable within a MAM2 or MAS2 community (for the latter, germinating primarily in the littoral area with less than 30cm water depth). A cover crop will be applied if there will be an interim condition with no standing water present (dependent on conditions when the wetland is constructed and how much time will pass before ultimate water levels can be achieved). If utilized, the cover crop should be applied along with the perennial native seed mix to stabilize soils and to aid in the

establishment of native vegetation. The exact cover crop selection depends on the timing of planting. Several appropriate options will be provided in the planting plan at detailed design.

A selection of native shrubs will be planting at the periphery of the wetland (within or adjacent to the littoral zone). Shrub species will be selected at detailed design that match the wetland hydroperiod and could include:

- Dogwood species (*Cornus stolonifera, C. foemina, C. obliqua*)
- Willow species (*Salix discolor, S. bebbiana, S. lucida, S. petiolaris*)
- White Meadowsweet (*Spiraea alba*);
- Nannyberry (*Viburnum lentago*); and
- Speckled Alder (*Alnus incana*).

The supplier(s) of Speckled Alder should certify that the species has been correctly identified and supplied (in some cases the invasive species Black Alder, *Alnus glutinosa,* is provided in error). All planting stock delivered to the site is to be reviewed by a qualified botanist before installation to confirm species match the planting lists on the planting plans.

Inclusion of vegetation plugs should be considered within the replicated wetlands to aid in establishment.

7.2.2.3.3 30 m RNHS Buffer

A 30 m wide buffer will be applied to the existing, staked boundary of retained vegetation within the RNHS. The following existing ELC units occur within the RNHS (as shown on **Figure 13, Appendix B1**):

- Mixed Mineral Meadow Marsh (MAM2-11);
- Swamp Maple Mineral Deciduous Swamp (SWD3-3);
- Hickory Mineral Deciduous Swamp (SWD4-5);
- Red Maple – Conifer Organic Mixed Swamp (SWD5-1);
- Fresh – Moist Sugar Maple – Harwood Deciduous Forest (FOD6-5); and
- Dry – Fresh Sugar Maple – Hemlock Mixed Forest (FOM3-1).

Wetland communities identified on the Orlando Lands are considered regionally significant, however, the SWM5-1 community is provincially ranked S3S4. The SWM5-1 vegetation community is fed by both groundwater discharge and surface runoff. The SWD3-3 receives seasonal groundwater contributions. While the SWD4-5 and MAM2-11 are fed solely through surface water contributions and precipitation events. Under existing conditions, treed SWD generally contain small to moderate numbers of invasive plant species and represent natural vegetation communities. Treed communities (FOD, FOM, SWD) on the Orlando Lands comprise a contiguous area of significant woodland that supports interior forest habitat.

Buffer plantings will provide natural buffering functions (i.e., attenuation functions, protection from edge effects, noise, and light pollution) and allow natural successional processes to occur. The RNHS buffer (and other restoration areas between the RNHS boundary and the development limit) will serve to further protect features within RNHS, increase the biodiversity of native flora and fauna, and provide breeding, rearing and foraging habitat for woodland species over the long term.

Plant Species Selection

A Fresh - Moist Sugar Maple Deciduous Forest (FOM6) vegetation community is recommended as the target vegetation community for buffer planting restoration areas. The retained, adjacent vegetation communities within the RNHS will serve as reference ecosystems to guide planting list development that will be suitable for the soils and hydrology within the buffer area.

Native shrub and trees species within the RNHS buffer will be selected to provide a diverse assemblage of plant species and include fast-growing and pioneer species more tolerant of harsher/variable growing conditions.

As per CH's Guidelines for Landscaping and Rehabilitation Plans (2021) the planting of the 30 m RNHS buffer (which is adjacent to retained forest and swamp communities) will follow the guidance below:

- Tree stock to be comprised of 5% caliper, balled and burlap and/or wire basket material, 95% whips and/or saplings;
- Distribute plantings across three bands with Band 1 comprising the first 15m extending from the retained feature edge, Band 2 comprising the next 7.5m in width, and Band 3 comprising the final 7.5m in width (i.e. adjacent to the development limit).
  - Plant Band 1 with 5 trees / 100m^2, 5 shrubs per tree, apply native groundcover seed mix with cover crop between the tree/shrub beds;
  - Plant Band 2 with 3 trees / 100m^2, 5 shrubs per tree, apply native groundcover seed mix with cover crop between the tree/shrub beds; and
  - Plant Band 3 only with native groundcover mix with cover crop.

Between tree / shrub beds, a native seed mix will be applied (e.g., CH (2020) Upland Native Meadow Mix) that contains a diverse assemblage of complimentary plant species to support the growth of the target community during the early successional stage. The selected species should be sun and partial shade tolerant in order to persist within the understory until herbaceous woodland species from adjacent ecosites establish as the community develops along a natural successional pathway. During the initial growth phase of the buffers, the selected seed mix may also support pollinator breeding and foraging opportunities through the inclusion of nectaring species and Milkweed species to attract / support local insect populations (e.g., Monarch).

A cover crop will be applied along with the native perennial seed mix to stabilize soils and to aid in the establishment of native vegetation. The exact cover crop selection depends on the timing of planting. Several appropriate options will be provided in the planting plan at detailed design.

Potentially suitable tree and shrub species for the RNHS buffer are provided below (to be confirmed at detailed design) in **Table 7-1**.

Table 7-1 RNHS Buffer – Tree / Shrub Species

LATIN NAME	COMMON NAME
Trees	
Acer saccharum	Sugar Maple
Acer rubrum	Red Maple
Acer x freemanii	Swamp Maple
Carya ovata	Shagbark Hickory
Tsuga canadensis	Hemlock
Thuja occidentalis	Eastern White Cedar
Quercus rubra	Red Oak
Tilia americana	Basswood
Populus tremuloides	Trembling Aspen
Populus grandidentata	Large-Toothed Aspen
Betula papyrifera	White Birch
Shrubs	
Cornus foemina	Grey Dogwood
Rhus typhina	Staghorn Sumac
Rubus occidentalis	Black Raspberry
Rubus alleghaniensis	Blackberry
Rubus odoratus	Purple-flowering Raspberry
Rubus idaeus ssp. strigosus	Red Raspberry
Prunus virginiana	Chokecherry
Rosa blanda	Smooth Rose
Ribes cynosbati	Prickly Gooseberry
Viburnum lentago	Nannyberry

7.2.2.3.4 Bioswale/ Green Swale

A 5 m to 7.3 m wide bioswale will be installed within a portion of the 30 m of the vegetated buffer from the existing RNHS to convey flows from the north-western SWD3-3 vegetation community into the realigned channel (as previously discussed within **Section 6.1.3** and further in **Section 7.3.2.1**). Where feasible, the bioswale has been removed from the vegetated buffer; however, placement of it within a portion of the buffer was required as a result of flooding concerns associated with the realigned channel (**Figure D7-9**).

Plant Species Selection

The CH (2020) Early Succession/Riparian Mix is proposed for application within this bioswale. This native seed mix will be applied with a suitable annual cover crop.

7.2.2.3.5 Realigned Stream Corridor (Floodplain and Buffer)

Under existing conditions, watercourse reach R3S1 functions as a groundwater-fed drainage feature that supports seasonal direct fish habitat. R3S1 will be realigned through the application of natural channel design principles to relocate this watercourse reach adjacent to the Greenbelt Protected Countryside boundary. The proposed realignment will lengthen the linear distance of the channel corridor from 1,110 m to 1,364 m for a net increase of 220 m. This will result in a net gain in fish habitat through enhancements to fisheries habitat, increased riparian cover and bank stabilization.

As part of the proposed watercourse realignment, a 15 m buffer will be applied to the floodline. This will ensure that existing seasonal groundwater discharge into the feature is maintained and to provide enhanced wildlife habitat and movement opportunities along the corridor. The 15 m stream corridor buffer will also provide additional habitat and buffering functions to benefit the adjacent RNHS.

Plant Species Selection

Within the floodplain, proposed plantings will follow **Section 3.1** (Floodplains and Watercourses) of CH's Guidelines for Landscaping and Rehabilitation Plans (2021). A variety of early and late successional species that are flood tolerant will be selected. Tree and shrub plantings will be provided within the first metre of the realigned watercourse to maximize the benefit of shading, bank stability and instream habitat; this will help provide shade to 60-80% of the surface of the realigned watercourse. Trees will be planted at a density of 10 trees per 100 m2, with five shrubs planted per one tree. CH (2020) Meadow Marsh Mix will be broadcast seeded with an annual cover crop. The cover crop will be selected during detailed design, depending on construction timing.

Within the 15 m stream corridor buffer and channel slopes, proposed plantings will contribute allochthonous materials to R3S1, improve foraging opportunities for aerial insectivore species (e.g., birds and bats) and local insect populations, and promote thermal mitigation.

A CUM1 community type is recommended within the 15 m stream corridor buffer (located on tableland). The community will include nectaring species and Milkweed species to support local insect populations (e.g., Monarch), and attract a greater abundance and diversity of aerial insects preferred by foraging bird and bat species. The recommended native seed mix will be finalized at detailed design once hydrological conditions are known in detail for this area. CH (2020) Early Succession/Riparian Mix may be appropriate for this area. This mix includes species that are well-adapted to transitional habitats between terrestrial and riparian communities. The native seed mix will be applied along with an annual cover crop. The exact cover crop selection depends on timing of planting; several suitable options will be provided with the planting plan at detailed design.

7.2.2.3.6 Naturalized Areas

Naturalized areas located between the realigned channel and the 30 m RNHS buffer (**Figure 13, Appendix B1**) will be planted with native groundcover to limit colonization by non-native / invasive plant species.

Plant Species Selection

The CH (2020) Upland Native Meadow Mix is proposed for application within the naturalized areas. The native seed mix is to be applied along with a suitable annual cover crop (as described previously).

7.2.2.4 Invasive Management

Six Category 1 invasive species were documented on the Orlando Lands, as categorized by Urban Forest Associates (2002):

- Canada Thistle (*Cirsium arvense*)
  - Present in cultural meadow, hedgerows, disturbed, and residential areas.
- Garlic Mustard

- Present in disturbed, residential, hedgerows, forest, and swamp features.

- Dame's Rocket (*Hesperis matronalis*)
  - Present in disturbed, residential, hedgerows, forest, and swamp features.
- Tatarian Honeysuckle
  - Present in cultural meadow, hedgerows, forest, and swamp features.
- European Buckthorn
  - Present in cultural meadow, hedgerows, forest, and swamp features.
- Manitoba Maple (*Acer negundo*)
  - Present in cultural meadow, hedgerows, disturbed, and residential areas.

Category 1 species represent the most invasive plants, which are often difficult to control. These are aggressive invasive species that can dominate a site to the exclusion of all other species and can remain dominant on the site indefinitely.

Of these six species, four are known to occur within the retained RNHS (i.e., Garlic Mustard, Dame's Rocket, Tatarian Honeysuckle, and European Buckthorn). None of these species were abundant within the RNHS. Coverage of Garlic Mustard and Dame's Rocket generally consisted of sparse stems infrequent in forest and deciduous swamp habitat. Tatarian Honeysuckle, where present, was often mature but still infrequent in forest habitat, and even less common in deciduous swamp where it was restricted to drier portions of those features.

European Buckthorn was the most common Category 1 species within the RNHS, where it was often established along the edge of forest and deciduous swamp communities – most often where they abutted agricultural land. This shrub generally did not encroach much further than 10 m into these natural features, becoming infrequent in the woodland interiors.

Due to the sparsity of the Garlic Mustard, Dame's Rocket, and Tatarian Honeysuckle within the RNHS, no invasive species management is deemed necessary for these species. These species are infrequent and not restricted to any one location; management of these species could unintentionally introduce other exotic species or negatively impact native flora through foot traffic.

Through detailed discussions with CH, it has been agreed that management of European Buckthorn will occur to limit colonization of the species into newly created features (e.g., created wetlands and realigned watercourse corridor). Given that European Buckthorn is likely present offsite within the remainder of the RNHS, it is likely that European Buckthorn will continue to persist within the RNHS; however, efforts to manage the spread into created features will be undertaken (i.e., eradication of this species is unlikely and not the ultimate goal).

Various BMPs for European Buckthorn are presented within the OIPC's Buckthorn BMP (2012), including mechanical, chemical and biologic controls. As European Buckthorn is well established within the Subject Lands, chemical herbicide application has been determined to be the best approach for containment of the population. Herbicide application should occur by a qualified professional with a back-pack and targeted applicator to avoid broadcast application. However, it should be noted that herbicide application can only be applied when the features are dry (no surface water present). No spraying of herbicide should occur near areas with high groundwater interactions. In certain areas where herbicide application cannot be applied, targeted hand pulling and/or digging will occur. This should occur when the soil is moist to remove the rooting system; pulling can occur in the spring or fall months. Where mechanical removal is required, the root crown should be dug up as this has been found more effective than hand pulling. Stems should be placed in black garbage bags, sealed and disposed at a local landfill. Garbage bags should not be composted or left on site. These efforts will be applied to limit European Buckthorn colonization into created features.

Where invasive species management occurs, infilling of native species will be required to limit recolonization. This will be further explored within the NHS Design Brief.

7.2.2.5 Soil Amendments and Requirements

Ahead of planting, site preparation is key to ensure that soil moisture capacity and nutrient content (i.e., available N, P, K, etc.) are suitable for plant growth. Upland disturbed areas "should have at least 20 centimetres of topsoil containing 5 to 15% organic matter (by dry weight) depending on the type of vegetation to be established, a total uncompacted soil depth of at least 30 centimetres and a soil pH of 6.0 to 8.0" per the TRCA's Preserving and Restoring Healthy Soil: Best Practices for Urban Construction (2012). Topsoil requirements will also follow CH's Guidelines for Landscaping and Rehabilitation Plans (2021). Where soil has been compacted, a minimum of 45 cm of clean top soil will be evenly distributed throughout the site. Imported soil with native soil will be mixed to ensure soil microorganisms are adapted to the site.

Within tree pits (areas where trees will be planted), trees should have a topsoil layer of a minimum depth of 60 cm. The subsoil layer should be either tilled, scarified or excavated and replaced to a minimum depth of 30 cm. Incorporation of the upper layer into the sublayer should be included to avoid stratified layers where possible. This will produce a total of 90 cm of uncompacted soil, per the TRCA (2012).

The quality of the topsoil should be tested by a credited soil scientist to ensure that it will promote healthy vegetation growth.

Mulch will be applied only in planting nodes at a depth of up to 5 cm. Mulch must be plastic and compost free. Mulch should extend beyond the root ball and ensure that it is applied in a "doughnut" shape around the base of the tree, taking care to not place the mulch up to the base of the tree to prevent moisture from being trapped against the trunk.

7.2.2.6 Specialized Wildlife Habitat Structures

Terrestrial habitat design elements will create complementary habitat types within the restoration areas that will enhance the complexity and diversity of habitat conditions to encourage the movement of fauna across the Orlando Lands. Various wildlife enhancement structures will be proposed within the realigned watercourse corridor and wetland creation area, including:

- Brush piles
- Basking logs
- Raptor poles
- Terrestrial mounds
- Rock piles
- Pallet type wood piles
- Brush mattresses

Proposed locations of these enhancement structures within the realigned channel are shown on the design drawings provided as part of **Appendix C**. Locations for wildlife enhancement structures outside of the realigned channel will be defined during detailed design.

7.3 Watercourse and HDF Management

7.3.1 Tributary of Sixteen Mile Creek (R3S1)

The Tributary of Sixteen Mile Creek within Parcel 4 of the Orlando Lands (R3S1) would be realigned and enhanced according to the recommended management strategy for watercourse classified as medium constraint (**Section 5.3.1**). The following section describes the conceptual design of the realigned watercourse and restoration:

- The preliminary design of the proposed R3S1 realignment and enhancement includes the following channel parameters and specifications. The realigned R3S1 configuration is summarized in **Table 7-2** and **Figures D7-3 to D7-8, Figures D7-16 and D7-17 in Appendix D** show the preliminary design of the

channel, plan, profile and sections. The conceptual design of the bankfull channel planform and natural channel design is found in **Appendix C**.

- The proposed realignment was designed to match the existing inverts elevations upstream and downstream of the realignment to maintain smooth transitions between the proposed and existing channel. The invert elevations also dictate the overall slope of the realigned channel, the channel was designed to maintain the existing channel slope to the extent possible for hydraulic and hydrogeological purposes (i.e., to maintain existing surface water / groundwater interaction).
- In addition, a transition from the existing channel at the upstream end of realignment required a wider and deeper channel valley to convey flood flows from the existing wide floodplain to the narrower proposed valley. This was required to avoid restricting flood flows from entering the realigned channel and increasing upstream water surface elevations above existing conditions.
- The valley floor width considered the meander belt delineation, which was determined to be 13 m in width, as well as the proposed channel planform for stability. The proposed valley floor width generally varies from 21 m to 24 m with an overall slope of 0.39%, noting that the predicted meander belt width for the proposed R3S1 realignment was 13 m (**Section 7.4 of Appendix C**). The valley floor width has been reduced to 21 m at one location in order to provide a 6 m maintenance access between the channel and the 30 m buffer on the north side of the channel, but the localized reduction continues to exceed the minimum 13 m meander belt width. The additional valley base width was provided to achieve an overall net gain to the natural heritage system (refer to **Section 7.6**) and minimize flood depths.
- The valley embankment is irregular to facilitate grading to match existing grading along the north side of the realigned R3S1 without berms. Where needed, the valley embankment was designed with 3H:1V side slopes. The total width of the corridor for the realigned channel is variable, where the total width of grading ranges between 45 m and 70 m.
- The low flow (bank full) channel configurations were specified based on the 1:1.25-year return period event conveyance, based on post-development conditions, as well as channel planform for channel stability. Additional details for natural channel design are discussed in **Section 7.3.2**.
- A maximum 1.5 m depth was used for the design of the valley depth. The channel was designed to convey the Regional Storm with a minimum 0.3m of freeboard above the Regional Storm water level.
- As described in **Section 6.1.10**, a 15 m allowance and 6 m access allowance from the greater of the top of the channel embankment or proposed Regulatory floodline was applied to both sides of realigned channel.
- The realignment of R3S1 provides an opportunity to replace the existing morphologically-limited channel with a naturalized shallow and deep undulating typology, with cross sectional dimensions closer to that of a naturalized watercourse conveying similar flows. A naturalized watercourse will offer significant improvements to channel form and function, per unit length, over degraded channels impacted by past agricultural activities.
- To maintain and enhance detention and retention functions with regards to both flow and sediment, the design will provide good communication with the floodplain as well as diversity in channel and floodplain morphology. Floodplain enhancement features in the form of offline wetlands are proposed for the channel corridor. These features enhance aquatic and terrestrial habitat by increasing diversity and providing a more natural floodplain form. They also provide functional benefits by storing and discharging water over long attenuated periods.
- The proposed realignment and naturalization provide opportunities for improved riparian conditions and a well-developed bankfull channel with morphological variability. Improvement in morphology and function would provide additional benefits to sediment balance, floodplain storage, vegetation communities and terrestrial habitat features, edge impacts and restoration requirements, water balance, fish passage and water quality. In its existing form, Tributary R3S1 is a degraded feature heavily impacted by historical agricultural practices. The proposed channel design outlined here provides an overall improvement to existing conditions.

The conceptual design of the channel planform, bankfull channel configuration, channel corridor, and habitat restoration is found in the fluvial geomorphology report (**Appendix C**).

Table 7-2 R3S1 Channel Configuration

Channel	Inverts and Slope (m)	Valley Floor Width (m)	Bankfull Channel (m)	Valley Embankment Slope (H:V)	Valley Depth (m)	Corridor Width (grading extents) (m)	Channel Corridor Length / Bankfull Length (m)
Realigned R3S1	US: 217.00 DS: 212.72 Slope: 0.39%	21 to 24	2.00 to 2.50 m Width 0.30 to 0.45 m Depth	Max 3:1	Up to 1.50	45 to 70	1,110 / 1,364

7.3.1.1 Proposed Conditions Hydraulic Analysis and Flood Plain

The proposed channel realignment of R3S1 was modelled in HEC-RAS to analyze the proposed conditions water levels within the channel. **Figure D7-18** in **Appendix D** shows the proposed conditions HEC-RAS model cross-section plan.

Table 6-4 summarizes the flow rates that were applied to the proposed conditions HEC-RAS model. These flow rates were determined through the PCSWMM hydrologic modelling completed for this Comprehensive Study, which included development of Parcels 1, 2, 4 and 5 and the use of stormwater management measures. The proposed conditions hydrology is described in **Section 6.3**. The modelled 2-year peak flow rates were modelled to determine the outlet inverts for the SWM pond discharging to R3S1, while the Regulatory Storm flow rates were modelled to verify flood conveyance.

The updated existing conditions HEC-RAS model (described in **Section 3.4.6**) was used as the base model to modify for proposed conditions, specifically the realignment of R3S1 across the northern portion of Parcel 4. The channel configuration described in **Section 7.3.1** was entered into the proposed conditions HEC-RAS model. A Manning's n roughness coefficient of 0.045 was used for the low flow for a winding natural streams with pools, stones and vegetation; and 0.085 was used for the left and right of bank. The value of 0.085 assumes that the natural channel corridor will evolve into a fully vegetated system with medium brush and trees.

Table 7-3 summarizes the proposed conditions water levels for the 2-year storm, 100-year storm and Regional Storm at key locations of the Tributary of Sixteen Mile Creek, while the proposed conditions Regulatory floodline is shown on **Figure D7-18 in Appendix D1**. Detailed hydraulic modelling results are provided in **Appendix D3**.

Results from the proposed conditions hydraulic model indicated that the proposed channel realignment will provide flood conveyance of the Regional Storm with at least 0.3 m of freeboard along the south side (Parcel 4 development). The proposed floodplain is within the existing conditions floodplain along the north side of the channel. There is no increase in flood risk to external properties to the north of realigned R3S1. All reaches of the channel that are upstream and downstream of the proposed R3S1 realignment will not be adversely affected by the channel realignment with respect to flood elevations for all storm events up to the Regional Storm, including on the properties near the Esquesing Line crossing (**Appendix D3**).

Table 7-3 Proposed Conditions Water Surface Elevations

Key Hydraulic Location	HEC-RAS River Station	2-year (m)	100-year (m)	Regional Storm (m)	Regional Storm Freeboard (m)	Existing Conditions Regional Storm (m)
Upstream limit of Tributary to Sixteen Mile Creek (R3S1) at No. 5 Side Road	4400	221.26	221.34	221.45	n.a.	221.45
Approximately 100m upstream of realigned R3S1	3700	217.38	217.50	217.76	n.a.	217.92
Upstream limit of realigned R3S1	3600	217.27	217.41	217.73	0.57	217.90
300 m downstream of upstream limit of realigned R3S1	3300	216.15	216.35	216.78	0.80	216.83
Mid-reach of realigned R3S1	3100	215.34	215.54	215.96	0.84	216.27
150 m upstream of Esquesing Line	2700	213.70	213.91	214.34	0.89	214.89
Immediately upstream of Esquesing Line	2541.079	213.47	213.63	213.71	n.a.	213.71
Immediately downstream of Esquesing Line	2478.91	212.74	212.91	213.14	n.a.	213.16
200 m downstream of Esquesing Line	2300	212.05	212.08	212.20	n.a.	212.21

7.3.1.2 Proposed Riparian Storage

Riparian storage was assessed using the existing and proposed conditions geometry with all structures removed. As discussed in **Section 7.3.1.1**, the peak flow rates found in the HEC-RAS model from CH were higher compared to the hydrologically modelled proposed conditions model by TMIG. For the purposes of comparing existing and proposed conditions riparian storage, TMIG's proposed conditions peak flow rates were used for both scenarios.

Table 7-4 summarizes riparian storage for existing and proposed conditions for the 2-year to 100-year flow events and Regional Storm. The riparian storage in realigned channel (R3S1) exceeds existing conditions riparian storage for all return period events and the Regional Storm events.

Table 7-4 Riparian Storage in R3S1

Scenario	Riparian Storage in R3S1 from RS 3700 to RS 2513.932 (Esquesing Line) (1000 m^3)						
	2-year	5-year	10-year	25-year	50-year	100-year	Regional Storm
Existing Condition	0.90	1.86	2.30	3.48	4.12	4.37	16.26
Proposed Condition	0.94	2.87	3.68	5.66	6.59	6.96	19.37

7.3.2 Headwater Drainage Features

The management recommendations for each HDF within the Orlando Lands (**Figure 11** in **Appendix B1** and **Table 14** in **Appendix B2**), along with the site specific management approaches for each management classification, which are in alignment with the HDFA Guidelines are outlined below.

- Protection (R1S2)
  - Protect the existing feature and its riparian zone corridor with a vegetated buffer,;
  - Maintain hydroperiod through construction of a green swale to maintain existing outlet conditions currently provided by HDF R1S1; and
  - Incorporate site-wide shallow groundwater and base flow protection techniques such as infiltration treatment (e.g., LID infrastructure).
- Mitigation (R1S1, R2S1, R2S1C, R3S1A, R3S1D, R3S1G, R3S1H, R5S0, R5S0A, R5S1, R6S0)
  - Replicate wetland functions associated with HDF R6S0 through the creation of wetland habitat north of the realigned R3S1 channel;
  - Maintain conveyance functions of HDF R1S1 through construction of vegetated green swale to direct flows from HDF R2S1 into proposed realigned watercourse;
  - Maintain existing outlet drainage via SWM infrastructure and/or by directing clean roof-top drainage to existing offsite features for HDFs R1, R2 and R6 (i.e., maintaining existing outlet locations and flows).
  - Replication functions by lot level conveyance measures , such as LID stormwater options (locations and specific options to be determined at detailed design).
- No Management Required (R1S1A, R2S1A, R2S1B, R2S1D, R3S1B, R3S1C, R3S1E, R3S1F, R3S1I, R4S1, R5S2, R6S1)
  - Confirmed that there are no features and/or functions associated with HDFs and/or there are no connections downstream. These features are generally characterized by lack of flow, evidence of cultivation, furrowing, presence of a seasonal crop and lack of natural vegetation. No management recommendations required.

Application of the HDFA Guidelines (CVC/TRCA 2014) to existing conditions associated with R1S1 results in a management recommendation of Conservation since this feature is located downstream from a wetland (R1S2). However, the Conceptual Design indicates that flows from the wetland will be redirected into R3S1 to ensure that the flows are maintained to downstream fisheries. Therefore, the feature's final management recommendation has been downgraded to Mitigation.

Reaches R1S2, R1S1, R2S1, R2S1C, R3S1A, R3S1D, R3S1G, R5S0, R5S0A, R5S1 and R6S0 provide indirect fish habitat through the seasonal contribution of allochthonous material and flow conveyance to downstream habitats. Reaches R1S1A, R2S1A, R2S1B, R2S1D, R3S1B, R3S1C, R3S1E, R3S1F, R3S1H, R3S1I, R4S1, R5S2 and R6S1 do not provide fish habitat based on their limited hydrological function.

As previously discussed within **Section 1.6.8** of this Comprehensive Study, three reaches were identified immediately downstream of the Subject Lands within the FSEMS Study Area including N-3-A (downstream of reach R5S0), N-3-B/EU-2-A (downstream of reaches R1S1 and R2S1) and N-5-A (downstream of R3S1). FSEMS Table 3.9 identified N-3-A as a green (low constraint) reach, which compliments the mitigation management recommendation provided to reach R5S0. N-5-A was identified as a blue reach, which compliments the conservation management recommendation provided to R3S1. EU-2-A was identified as a blue (medium constraint) reach, which is a higher constraint than the mitigation management recommendation provided to R1S1 and R2S1 on the Subject Lands. It is important to note that the existing conditions of reaches R1S1, R2S1 and N-3-B/EU-2-A are different than those recorded within the FSEMS report, as watercourse alterations within the present industrial lands located south of James Snow Parkway have occurred since the time the FSEMS was prepared. As a result of this downstream alteration and conveyance of flows into an existing online SWM facility, the Mitigation management recommendation for R1S1 and R2S1 is warranted to ensure that the function of these reaches on the Subject Lands (allochthonous materials and flows) are still maintained post-development.

Additional information on the proposed HDF management of R1S2, R5S0, R5S1 and other mitigation measures are discussed on the following sections.

7.3.2.1 Bioswale for R1S2 Outlet

A hydrologic connection for outflows from the R1S2 (wetland) will be maintained through a proposed bioswale from R1S2 to the realigned R3S1. The proposed swale will be located along the edge of the RNHS bordering Parcel 4, partially within the 30m wetland and woodland buffer. The width of the swale varies from 5 m to 7.3 m, along the outer limit of the 30m buffer (i.e., away from the wetland and woodland).

Options for a bioswale design that would provide enhanced ecological and biophysical functions were considered, but, as per reviewing agency comments, the simplified bioswale design was selected in order to minimize the width of the feature and associated temporary disturbance during construction. The bioswale will continue to convey flows and allochthonous materials to downstream habitats from the regionally significant wetland.

As noted in **Section 6.1.3**, all reasonable efforts were made to construct the green swale entirely outside of the 30 m wetland buffer. Limited works are required within the buffer at the upstream limit of the swale to tie into the existing swale where it leaves the feature and flows into the active agricultural field. Similarly, works are needed within the buffer at the downstream of the swale in order to connect into the proposed realigned R3S1. In the vicinity of the connection to the realigned R3S1, the invert of the green swale will be below the elevation of the Regulatory flood plain associated with R3S1. As a 15 m setback is required from the Regulatory flood plain to the limit of development, relocating this portion of the green swale outside the 30 m buffer would have a significant impact on the limit of development in this area, which has already been pulled back to the extent feasible. With the exception of one small area where the flood plain impacts would have an unacceptable impact on the limit of development, the swale would be extend no further than 15 m into the 30 m buffer.

Conceptual design drawings are provided on **Figures D7-9 and D7-10 in Appendix D.**

Table 7-5 Bioswale Configuration

Swale	Inverts and Slope (m)	Base Width (m)	Bankfull Channel (m)	Side Slope (H:V)	Average Depth (m)	Total Width (incl. grading) (m)	Swale Length (m)
Bioswale for R1S2 Outlet	US: 218.49 DS: 216.98 Slope: 0.33%	2	5 m Width 0.5 m – 1 m Depth	3:1	0.5	Varies, 5m to 7.3m	472

7.3.2.2 Conveyance Swale R5S0 and R5S1

A conveyance swale is proposed along the western boundary of Parcel 1 and southern boundary of Parcel 2. This swale provides drainage conveyance from external drainage areas across Parcel 1, in place of the existing R5S0 and R5S1 that were assigned with the management recommendation of Mitigation. In accordance with the HDFA Guidelines (TRCA/CVC 2014), the removal of these features is permitted provided their functions are replicated (e.g., flow conveyance and contribution of allochthonous material to downstream habitats). The design objectives and constraints at the site that guide the proposed conveyance swale, on a conceptual design level, include:

- Connect the existing external drainage area north of Parcel 1 to existing drainage feature (R5S0) located in the hydro corridor.
- Conveyance of the Regional Storm peak flow rate with a freeboard of at least 0.3 m.
- Erosion risk is to be mitigated for long-term channel stability (including the existing feature through the hydro corridor).
- Provide appropriate plantings using native species that enhance habitat diversity, increase soil stability, and increase floodplain roughness.
- Existing flows to the features must be replicated to maintain feature functions.

The configuration of the swales through are summarized in **Table 7-6**. Conceptual design drawings are provided on **Figures D7-11 through D7-15**. Within the hydro corridor, the conveyance swale configuration through Parcel 1 and Parcel 2 cannot be extended through the hydro corridor due to the surrounding flat grades. Instead, the proposed works through the hydro corridor include a swale lining with appropriate plantings to mitigate erosion risk (see **Appendix C**), while peak flow rates will be conveyed in the same manner as the current condition (with peak flow rates from Parcels 1 and 2 controlled to existing conditions).

Table 7-6 Conveyance Swale Configuration

Swale	Inverts and Slope (m)	Base Width (m)	Bankfull Channel (m)	Side Slope (H:V)	Total Depth (m)	Corridor Width (m)	Swale Length (m)
Swale R5S1	US: 221.77 DS: 218.21 Slope: 0.3%	9	1.3 m Width 0.20 m Depth	3:1	0.7	30	1,160

7.4 Stormwater Management

7.4.1 Stormwater Management Criteria

Stormwater management criteria for the Subject Lands was outlined in **Section 5.4.1**. Additional analysis for the stormwater management facilities on the Orlando Lands and the proposed public road were completed to assess the required design specifications to satisfy the proposed criteria and is described in the following sections. In general, the stormwater management criteria for the Orlando Lands is summarized below:

- Water Quantity Control – SWM facilities are required to control peak flow rates from post-development conditions to existing conditions to mitigate potential impacts on downstream flood hazards. Peak flow control will be applied for the 2-year up to the 100-year storm events, and the Regional Storm.
- Erosion Control - Post-development stormwater flow rates are to be managed to mitigate potential impacts on erosion on the downstream receiving watercourses. Erosion control criteria for discharge to the Tributary of Sixteen Mile Creek (from Parcel 4) are based on the local erosion threshold flow rate within the reach between Esquesing Line and Fifth Line and associated required storage volumes. For Parcel 1

that discharges south towards existing stormwater management systems south of James Snow Parkway, SWM facilities are to provide erosion control criteria consistent with the Highway 401 Industrial/Business Park FSEMS (Philips, 2000).

- Water Quality Control – Enhanced Level criteria as established by the MOE SWM Planning and Design Manual (MOE, 2003)
- Water Balance – The proposed development is to maintain pre-development recharge by providing infiltration to mitigate the reduction in infiltration in the post-development condition.

Additional considerations for the design of the stormwater management facilities include the following:

- Bottom-draw outlet may be used for frequent flow events to minimize the water temperature input to the receiving watercourse; and
- Provision of riparian vegetation at the pond outlet to the receiving watercourse.

7.4.2 On Site Controls for Water Quantity

The proposed SWM plan considered the use of on-site controls (i.e. roof-top, parking lot and below ground storage) for the industrial sites, given that site plans for these types of development are conducive to these types of controls with large roof and parking lot areas. The on-site controls can potentially assist with mitigating post-development runoff increases from the industrial sites and reduce the size (and associated long term maintenance by the Town) of the end of pipe SWM facilities, as well as the conveyance infrastructure (storm sewers and overland flow) within the private site and public right-of-ways. As described in **Section 5.4.2**, on-site controls were not included in the proposed conditions hydrologic model to size end-of-pipe facilities.

Roof-Top Storage

Roof storage for water quantity control is a key opportunity to supplement end-of-pipe controls. The roof area of warehouse buildings can be used to capture rainfall and release it at a controlled discharge rate to encourage evapotranspiration and reduce peak flow rates to end-of-pipe facilities. **Table 7-7** summarizes the assumptions for roof-top storage control. In general, the roof storage assumptions resulted in the control of roof discharge to 42 L/s/ha for 100% roof area, up to the 100-year storm event. For the Regional Storm event, runoff volume greater than the 100-year storm event volume will be discharged through an overflow weir and will be conveyed to the end-of-pipe facilities.

Table 7-7 Roof Top Storage Control

Design Parameter	Value / Assumption
Roof Drainage Area	100% roof area
Available Storage Area	50% roof area
Maximum Storage Depth	0.15 m
Discharge Rate	0.042 m^3/s/ha for 100% roof area

The roof-top storage and controlled discharge also provides an opportunity to discharge clean water to watercourses to support ecological function; or to LID features and buffer areas to promote infiltration for water balance purposes. The discharge of clean roof water directed away from end-of-pipe facilities will also reduce peak flow rates and runoff volumes at the end-of-pipe facilities.

Parking Lot and Underground Storage

Lot level controls (parking lot and underground storage) can be used to capture rainfall and release it at a controlled discharge rate to reduce peak flow rates to end-of-pipe facilities. The proposed release rate of 120 L/s/ha for runoff control from industrial sites was determined based on the achievability of on-site storage. Previous studies conducted in Ontario indicate a typical maximum allowable release rate from rooftops is at

42 L/s/ha. Parking lot storage, pipe storage and/or underground storage systems will be utilized to detain the remainder of runoff. Therefore, the ultimate compound release rate that can be achieved for the industrial sites is 120 L/s/ha.

7.4.3 End-of-Pipe Facilities

Wet ponds are proposed as end-of-pipe facilities within the North Porta Development Area. The two proposed SWM ponds for Parcels 1 and 4 on Orlando Lands have been conceptually designed to provide the required water quantity storage, water quality (permanent pool) and erosion control storage volumes. **Figure 7-1** provides an overall plan view of the SWM ponds. **Table 7-8** summarizes the required storage volumes for quality and quantity control, and the discharge rates for each proposed facility while **Figures D7-1 and D7-2 in Appendix D** provide the preliminary details for the SWM ponds with associated facility data. Calculations are included in **Appendix D**.

Table 7-8 SWM Pond Conceptual Design Quantity and Quality Control

Design Parameter	SWMF ID	
	SWMF 1	SWMF 4
Drainage Area (ha)	30.3	78.2
Quality Control – Permanent Pool		
Required Storage (m^3)	6,069	15,886
Provided Storage (m^3)	20,607	45,373
Erosion Control – Extended Detention		
Required Storage (m^3)	5,491	58,529
Provided Storage (m^3)	5,890	58,600
Discharge Rate (m^3/s)	0.048	0.031
Quantity Control – 25-Year		
Required Storage (m^3)	21,627	63,375
Provided Storage (m^3)	22,580	65,345
Discharge Rate (m^3/s)	0.078	0.047
Quantity Control – 100-Year		
Required Storage (m^3)	26,771	88,933
Provided Storage (m^3)	27,488	90,449
Discharge Rate (m^3/s)	0.101	0.053
Quantity Control – Regional Storm		
Required Storage (m^3)	56,863	138,909
Provided Storage (m^3)	56,881	146,400
Discharge Rate (m^3/s)	1.21	2.62

Conceptual designs for the SWM ponds have been completed to establish the required SWM block sizes for Parcels 1 and 4 to ensure sufficient lands are provided within the draft plans. The conceptual designs were generally limited to determining the general layout of the SWM ponds (inlet, outlet, forebay, wet cell and maintenance road), water level elevations for select storm events and provided storage volumes. Roof runoff was assumed to fully discharge to the SWM ponds in this study, however, some roof runoff is expected to

discharge directly to watercourses and LID features, away from the SWM ponds. In detailed design there are opportunities to further refine the required and provided SWM pond storage volumes.

Detailed design will follow the requirements set out in the Town of Milton standards. Typical criteria for the detailed design of these SWM ponds and the assumptions (if any) made for the conceptual design are as follows:

- Storm sewers designed to capture the 5-year storm event.
- Storm events greater than the 5-year event up to the Regional Storm event will be conveyed overland to the pond via the roads, driveways or easements.
- Side slopes of 5:1 from the pond bottom to the extended detention elevation or 3 m (horizontally) outside of the permanent pool elevation, whichever is greater, above which the slopes of a maximum of 3:1.
- Permanent pool volume as per MOE Manual (Enhanced Protection) with a minimum depth of 1.0 m and a maximum depth of 3.0 m.
- A 3 m deep pool provided at the outlet, sized to accommodate the 10 mm storm event, to provide thermal mitigation.
- Permanent pool elevation set above the 2-year level of receiving watercourse.
- Extended detention storage according to targets established in this Comprehensive Study.
- Flood control storage for all storm events up to the Regional Storm event.
- Emergency outlet sized for the Regional Storm flow, such that all property adjacent to the SWM facility will not be submerged during the Regional Storm event.
- A 4 m wide maintenance access route, from a municipal road or easement, with a maximum slope of 10:1 and a maximum crossfall of 2%. Used to facilitate the access to the forebay and outlet structure for maintenance.
- Efforts to design the pond for maximized shading through the use of berming and inlet/outlet orientation, shading, and to be further maximized through landscaping in the detailed design stage.
- Options to configure the facility outlet to minimize negative impact on the Regional NHS will be reviewed in later design stages, and may include cooling trenches, vegetated spreader swales, or other alternatives.

Finally, recall from **Section 6.2.2** that the erosion control targets for Parcel 4 contribute to the very large extended detention storage volume and very long drawdown time associated with SWMF-4. There are a number of opportunities that could be explored to reduce the extended detention storage volume in SWMF-4, which would lead to a reduction in the total storage volume required and size of the SWM pond block. These opportunities will be reviewed with staff from the Town and CH to refine the management strategy for erosion control and refine the size of the SWM pond blocks.

7.4.4 Post-Development Water Balance and Mitigation

As described in **Section 3.5.7 and 6.4.1,** water balance calculations were completed for pre-development and post-development conditions. Under pre-development conditions approximately 141.8 mm/yr or about 16% of precipitation was estimated to infiltrate on both Parcels 1 and 4 combined (**Table 3-20**). The post development infiltration rates are estimated to range from 50,539 m^3/yr, which represents a deficit of up to a decrease of 69% from the pre-development condition (193,582 m^3/yr).

While balancing the pre-to-post development water budget is not a requirement of the Orlando Lands based on Source Water Protection, the SWM plan proposes to capture 15 mm of runoff volume from each storm event from portions of the large building rooftops and direct the runoff to LID features to mitigate the pre-to-post development change in infiltration. The northwest portion of Parcel 4 was identified to support wetland functions near the Middle Sixteen Mile Creek valley. It is therefore recommended that the pre-to-post development infiltration be maintained or enhanced in this area. The areas that are most favourable for infiltration in Parcel 1 will be determined in later design stages.

Specifically for Parcel 4, 15mm from 14.6 ha of the 23.9 ha rooftop areas in the proposed development is equivalent to the 104,726 m^3/yr infiltration deficit based on the approximate 82% of total annual rainfall occurring during events of 15 mm volume or less (City of Toronto Wet Weather Flow Management Guidelines, 2006). The same approach was applied to Parcel 1.

Table 7-9 summarizes the surface area required to provide the LID storage volume necessary to hold 15 mm of runoff volume from building rooftops in each development parcel. The surface area requirements assume LID facilities with a depth of 1.0 m and a media void ratio of 0.4, and that the LID facilities can be located under parking areas or within landscaped areas of the proposed development. A schematic plan of the LID location on Parcel 4 is provided on **Figure D7-19**.

As discussed in **Section 3.5.4**, infiltration test results indicated infiltration rates ranging from 12.9 mm/hour to 22.5 mm/hour. However, in the silt and sand units identified on the northeast portion of the Orlando Lands, infiltration values ranging from 33 to 132 mm/hour were calculated in the area of MW1, MW3 and MW8. Additional drilling investigations and borehole infiltration testing at the proposed LID locations will be completed to confirm the suitability of the presence of the sand and silt layers and their ability to infiltrate water.

The site has the following characteristics that are supportive of infiltration-based LID measures:

- The spring high groundwater level as measured in March 2020 range in elevation from approximately 211.05 to 218.79 masl or between 1.31 and 5.95 mbgs at MW1 and MW6;
- Groundwater levels are shallowest in the western portion of the site and deepest in the eastern portion near the Middle Sixteen Mile Creek valley;
- The percolation rate of the surficial till is estimated to be 12.9 and 22.5 mm/hour, and 74 to 122 mm/hour within the sand and silt near MW1 and MW8 at approximately 2.5 mbgs where the invert of an LID would be installed; and
- Groundwater recharge near MW1, MW3 and MW8 supports observed groundwater discharge in the wetland unit within the Middle Sixteen Mile Creek valley. Positively, this area is also optimal for infiltration-based LIDs due to the deep water table and the presence of unsaturated interstadial sand and silt deposits. The other wetlands on site were found to be surface water supported from upgradient lands and do not require mitigation through LID measures.
- Additional drilling investigations and borehole infiltration testing at the proposed LID locations will be conducted to confirm the suitability of the soils to infiltrate water.

Based on the results of the hydrogeological investigation, the area in the vicinity of MW1, MW3 and MW8 near the proposed channel realignment is an optimal place for infiltration-based LIDs that can maintain groundwater recharge/ discharge to the valleyland wetland communities in this area. This will also help to maintain the seasonal groundwater discharge observed in R3S1 that is planned to be realigned along the north boundary of Parcel 4. Based on the proposed elevation of the realigned channel and borehole logs provided by Terrapex (**Appendix A4**), R3S1 will not intercept permeable units of sand or silt near the proposed LIDs and will therefore not be receiving groundwater discharge from water infiltrated in the LIDs intended to support the SWM5-1 wetland community. It is recommended that clean rooftop drainage from the proposed buildings be utilized to protect groundwater quality. No other groundwater supported features were identified on site that require specific LID measures to support. Specifications and locations for LID facilities will be determined in details design for each development parcel.

Table 7-9 Water Balance Mitigation

Parcel	Infiltration Deficit (m^3/year)	Rooftop Area Directed to LID (ha)	15 mm Runoff Volume (m^3)	Total Required Surface Area of LID Facilities (m^2) (Note 1)
Parcel 1	38,318	5.3	799	2,000
Parcel 4	104,726	14.6	2,184	5,500
Total	143,044	19.9	2,983	7,500

Note: (1) The surface area required to provide the runoff volume storage assumes infiltration type LID facilities with a depth of 1.0 m and a media void ratio of 0.4.

7.4.5 Stormwater Servicing

The Subject Lands are at the northern end of the Town of Milton and is currently undeveloped land. As such, there are no existing municipal storm servicing for the future developments. Stormwater runoff currently is directed to the low points within the Subject Lands. The proposed stormwater management plan for Parcels 1 and 4 will include internal (private) stormwater servicing and overland flow routes to direct runoff to the proposed end-of-pipe facilities. Details of the private stormwater servicing systems will be determined in site plan design stages.

For the public road right-of-way drainage within the Subject Lands (namely Boston Church Road and the proposed public road south of Parcel 4), stormwater servicing is proposed as follows:

- Boston Church Road – The stormwater management plan for the Orlando Lands considered the future upgrade and urbanization of Boston Church Road from No. 5 Sideroad to James Snow Parkway to service Parcels 1 and 4. Based on the preliminary review of existing grades along Boston Church Road, the post-development drainage from the road will discharge to at least two outlets for the respective northern and southern portions of the road. A drainage divide is located approximately near the mid-point of Boston Church Road between No. 5 Sideroad and James Snow Parkway.

  In the above drainage plan, stormwater runoff from the northern portion of Boston Church Road will be collected and discharge to SWMF 1 located on Parcel 1. Runoff from the southern half of Boston Church Road cannot be collected and directed to a stormwater management facility due to grading limitations, namely the shallow grades from the current and future road profile to the existing culverts and outlet swale west of Boston Church Road (about 200 m north of James Snow Parkway). It would not be feasible to implement a storm sewer system (with adequate cover) and provide an overland flow route to potential stormwater management facilities on either side of Boston Church.

  The feasible alternative to a storm sewer system and treatment in a stormwater management pond is the collection and treatment of runoff in enhanced grass swales within the right-of-way. Details for the right-of-way stormwater servicing plan will be further explored in later design stages.
- Public Road south of Parcel 4 – The public road along the south boundary of Parcel 4 provides conveyance of stormwater flows from Parcel 4 to SWMF 4. A storm sewer and overland flow route to SWMF 4 will be provided within the eastern portions of the public road right-of-way. The western portions of the public road right-of-way will discharge to the existing headwater drainage feature (R2S1) within the hydro lands.

  Post-development hydrological modelling for peak flow rates at the outlet of R2S1 (Node OF-102) determined that the proposed conditions peak flow rate is less than pre-development flow rates due to the significant reduction in drainage area.

7.4.6 Operation and Maintenance Considerations

7.4.6.1 Stormwater Management Ponds

SWM pond operation and maintenance will be according to recommendations in the MOE SWM Planning and Design Manual (MOE, 2003) and conform to Town of Milton standards and requirements. The post-construction operation and maintenance program should recommend items such as:

- Periodic general inspection of the SWM facility;
- Removal of debris that may accumulate and hinder the functioning of the SWM facility;
- Implementation of remedial measures including erosion stabilization, repair of damaged vegetation, and sediment removal, as required;
- Inspection of the SWM facility and the outlet after significant rainfall events (generally in excess of a 25 mm storm event);
- Inspection of sediment accumulation in the forebay; and

- Routine maintenance activities such as trash and debris removal, weed control and replanting of vegetation where required due to mortality.

A detailed operations and maintenance manual for each stormwater management facility will be prepared at the detailed design stage.

7.4.6.2 Site-level Stormwater Management Controls

The proposed measures for the development include the direction of roof runoff to watercourses, swales and runoff retention facilities. With respect to roof runoff, downspout and roof drain maintenance is required and is the responsibility of the property owner/manager. On-site storage measures will not be determined until the site plan stage, however, maintenance of the on-site stormwater management systems will be the responsibility of the property owner/manager. Agreements, by-laws or other policy tools can be used to ensure that these systems are adequately maintained.

7.4.6.3 Conveyance Measures

The current stormwater management plan for the site does not account for any conveyance measures to reduce the quantity of runoff and/or pollutant loadings to the stormwater management ponds. However, LID conveyance practices such as enhanced vegetated swales, bio-retention swales and / or enhanced street tree pits will be explored during subsequent design phases. Designs, locations and maintenance of such measures will be determined at that time in consultation with Town staff.

The maintenance of standard conveyance infrastructure (ditches, storm sewers, open watercourse systems and hydraulic structures (culverts and bridges)) shall be completed in accordance with the Town of Milton standards and requirements. The post-construction operation and maintenance program should recommend items such as: periodic inspection; routine maintenance activities such as trash and debris removal, weed control and replanting of vegetation where required due to mortality and flushing or cleaning of ditches and storm sewers.

7.5 Water and Wastewater Servicing

TYLin completed an Area Servicing Plan (ASP) (updated April 2022) for the Milton North Porta area to provide functional servicing information for water and wastewater services. The ASP is included in **Appendix E**. The purpose of the ASP was to:

- Identify existing and planned trunk water and wastewater infrastructure adjacent to the North Porta area
- Summarize proposed water and wastewater demands for the North Porta lands
- Identify proposed water and wastewater infrastructure to support the study area;
- Identify potential development phasing limits based on planned and proposed infrastructure timing
- Identify development timing, servicing constraints, interim servicing solutions, and potential easements associated with each development parcel in support of Draft Plan applications.

The following sections provide an overview of the existing and proposed water and wastewater infrastructure for the North Porta area. Additional information described above is provided in the ASP (**Appendix E**).

7.5.1 Existing Infrastructure

7.5.1.1 Water Servicing

The North Porta area is located at the northern limit of the Town of Milton, in Halton Region Pressure District M5-L. The following water infrastructure is adjacent to the proposed development:

- A 900 mm diameter CPP trunk feedermain is located along Boston Church Road from No. 5 Side Road to James Snow Parkway. This feedermain reduces to a 750 mm diameter main on James Snow Parkway and continues southeast to Steeles Avenue.

- A 500 mm diameter CPP trunk watermain is located along James Snow Parkway and is connected to the 300 mm CPP watermain on Boston Church Road, and
- A 300 mm diameter watermain is located on Esquesing Line south of James Snow Parkway and is connected to the 500 mm CPP watermain on James Snow Parkway, and
- A 300 mm diameter watermain is located on Boston Church Road south of James Snow Parkway and is connected to the 500 mm CPP watermain on James Snow Parkway.

These watermains have not been designed for service connections to the industrial buildings and additional water infrastructure will be required to be constructed to accommodate the proposed development. Refer to Figure 3 in the ASP (**Appendix E**) for the Existing and Proposed Water Infrastructure Plan.

7.5.1.2 Wastewater Servicing

The North Porta area is at the northern limit of the Town of Milton and is not currently serviced with the Region's infrastructure. The closest sanitary sewer to the subject site include a 300mm diameter local sanitary sewer on Boston Church Road approximately 100m south of James Snow Parkway and a 900mm diameter trunk sanitary sewer at the intersection of Steeles Avenue and James Snow Parkway approximately 1,400m southeast from the Subject Lands.

The subject lands are proposed to be serviced through future Halton Region DC projects as noted in *The Regional Municipality of Halton 2022 Development Charges Update Water/Wastewater Technical Report,* (GM BluePlan Engineering, 2021). Refer to Figures 4-1 and 4-2 of the ASP (**Appendix E**) for the Existing and Proposed Sanitary Servicing Plan.

7.5.2 Proposed Servicing

7.5.2.1 Water

The subject lands are anticipated to be serviced by future Halton Region watermain projects that have been proposed in *The Regional Municipality of Halton 2022 Development Charges Update Water/Wastewater Technical Report* (GM BluePlan Engineering, 2021). The DC watermain projects to accommodate the future development in this area are listed in **Table 7-10**. A figure from the Region's DC Technical Report showing the projects is provided in the ASP (**Appendix E)**.

Table 7-10 Region of Halton Development Charge Projects

Region IPFS ID	Project Description	Length (m)	Construction Year
6649	400mm WM on Esquesing Line from James Snow Pkwy to approx. 800m north (Zone 267)	784	2026
6650	400mm WM on new roadway from Esquesing Line to approx. 360m west of Boston Church Rd (Zone 267)	2,029	2026
6652	400mm WM on new roadway from 400m west of Third Line to No. 5 Side Road (Zone 267)	695	2026
6653	400mm WM on No. 5 Side Road from approx. 400m west of 3rd Line to 3rd Line (Zone 267)	390	2026

The alignments of the Region's proposed DC projects are not consistent with the proposed road network and service areas which will require future modification. For example:

- Project ID 6650 along the new roadway will need to be realigned to follow the plan's east-west road from James Snow Parkway.

- Project IDs 6652 and 6653 west of Boston Church Road should be realigned since there are no public ROWs proposed in the plan that are west of Boston Church Road. Instead, the watermain should be located on Boston Church Road, from James Snow Parkway North to No. 5 Side Road.

The proposed watermain network (Figure 3 of the ASP, **Appendix E**) follows the road network and development plan and considers looping of the system. The proposed watermain layout includes:

- A 400mm diameter watermain along the east side of Boston Church Road extended from James Snow Parkway to approximately 100 m south of No. 5 Side Road,
- A 300mm diameter watermain along the proposed future public right-of-way connecting from James Snow Parkway North, and
- A 400mm diameter watermain along Esquesing line from James Snow Parkway North to approximately 430 m north of James Snow Parkway.

This proposed watermain system is approximately 1580m of new 400mm diameter watermain to be included as DC projects in place of the four DC projects outlined in the Region's DC Technical Report. The system also proposes 850m of new 300mm diameter watermain along the future public-right-of-way to service the North Porta property.

The proposed development type (industrial) is as per the Region's official plan and therefore no water pressure issues are anticipated upon the completion of the Region DC projects. As noted previously, to further mitigate future issues such as stagnant water within the watermains and water pressures at the high end of the system, the DC projects are proposed to have looping at the dead ends.

The proposed developments cannot be serviced without the provision for potable water to the sites. If the proposed developments were to proceed prior to the construction of the DC projects, the projects would need to be constructed by the developers prior to construction of the individual site plans. Each development parcel could then be developed separately, and each block serviced with its own private water servicing network.

7.5.2.2 Wastewater

As previously noted, the proposed development is tributary to future Halton Region trunk sewers that have been proposed in *The Regional Municipality of Halton 2022 Development Charges Update Water/Wastewater Technical Report* (GM BluePlan Engineering, 2021). The DC wastewater projects designed to accommodate the future development are listed in **Table 7-11**.

Table 7-11 Halton Region Development Charge Projects

Region IPFS ID	Project Description	Length (m)	Construction Year
6560	525mm WWM on James Snow Pkwy and new road alignment from Steeles Ave to Esquesing Line (MIL)	1,708	2026
6564	525mm WWM on new alignment from Esquesing Line to 3rd Line (MIL)	2,104	2026

The sanitary sewer design for the subject site follows the design criteria in the Regional Municipality of Halton's *2022 Background Study and 2022 DC Update Water/Wastewater Technical Report.*

The proposed developments are considered in the Halton Region's DC projects and therefore no capacity constraints are expected in the future trunk sanitary sewer system. If the proposed developments move forward prior to the construction of the Regional DC projects, alternative servicing strategies will be required. The developers will be required to construct the proposed trunk wastewater infrastructure for individual sites.

A proposed local sanitary sewer along Esquesing Line from James Snow Parkway North to approx. 400 m north of James Snow may be required for future developments of the non-participating properties along the eastern boundary of the study area. This will be subject to approval by the Region of Halton.

Two options have been included as part of ASP, with both alignments starting at Boston Church Road and terminating at the James Snow Parkway and Steeles Avenue intersection. Option 1 proposes the trunk sewer continue along James Snow Parkway, whereas Option 2 proposes the trunk sewer to be constructed within the south limits of the Orlando lands. More information is discussed below.

Option 1

As mentioned above, this includes the installation of the 525mm trunk sewer from Boston Church Road which continues to James Snow Parkway connecting into the existing 900mm sanitary sewer at Steeles Avenue as shown on Figure 4-1 of the ASP (**Appendix E**). This option involves microtunneling for approximately 600m at the intersection of James Snow and Boston Church. The microtunnel is deemed the appropriate method given the significant depth of installation near the intersection and based on the need to avoid major traffic management/costs and traffic disturbance which would be the case if open cut were carried out in and around the intersection. On the other hand, the microtunnel will introduce significant construction costs of $11,155,244.

Option 2

For this option, the proposed 525mm sewers will be constructed within the Orlando property from approximately 180m north of James Snow Parkway until it reaches Esquesing Line where it will continue to James Snow Parkway and connect into the existing 900mm sanitary sewer. This layout is shown on Figure 4-2 of the ASP (**Appendix E**). This alternative eliminates the need for microtunneling and eliminates issues with traffic and utility conflicts. Cost Estimates show a lower construction cost of $5,328,686.

Due to the lowered costs and simpler installation, Option 2 is the preferred method. The design sheet for this network is presented in Appendix C and plan profiles are shown on Appendix D of the ASP (**Appendix E**).

7.6 Predicted Net Gain

The 2000 FSEMS does not qualify how to define net gain, therefore, the definition of net gain was researched to better understand how to quantify a net gain. Moreover, the FSEMS does not define specific restoration targets for consideration within this property, however, Section 3.8 of the FSEMS does suggest key stormwater servicing and environmental management opportunities including mitigation of thermal impacts to downstream cool-water species (including salmonid species), increasing infiltration capacity, flood control, enhancement of watercourses and use of buffers to protect woodlots, riparian areas and other natural features. Other priorities were focused around linkage protection and enhancement within the actively managed agricultural fields and increasing habitat diversity, which was reduced due to extensive agricultural uses including historical grazing.

The IUCN's Commission on Ecosystem Management and SER released a Preliminary Report on Achieving Net Gain for Biodiversity and Human Well-being: Integrating Ecological Restoration with other Nature-based Solutions (June 2021) where they presented a new working definition for "net gain" and a set of metrics for evaluating net gain across the restorative continuum. Their definition of net gain was "is a measurable positive change in ecosystem integrity, native biodiversity and human wellbeing that results from a combination of sustainable resource use, conservation and restoration. Net gain should be measurable at any scale, including the ecosystem and land/seascape scales, and sustained over time". They indicated that net gain (also called net benefit or net improvement) should be measured at "relevant timescales" for the project, recognizing that restorative actions may lead to short-term adverse effects before it is achieved. They further indicated that net gain should be "easily applicable and understandable". Metrics put forward by the IUCN and SER to evaluate net gain incorporated ecological and human wellbeing. The proposed metrics are illustrated below within **Table 7-12**.

Table 7-12 Net Gain Metrics

Net Gain Metrics	
Ecologically-focused	Ecosystem functions and services are restored and sustained
	Biodiversity is restored
	Disaster risk reduced (ties with Nature-based Solutions)
Combination of Ecological and Human Wellbeing	Activities take a multi-dimensional approach (e.g., human needs and habitat/ecological conditions are improved simultaneously)
	Net gain in native species and habitat that have cultural/social value (as tied to overarching frameworks such as UN Sustainable Development Goals, Convention on Biological Diversity's Global Biodiversity Framework (GBF), Nature's Contributions to People or other appropriate sideboards)
	Communities have incentives to improve ecosystems (e.g., greater access to sustainable resources)
Human Wellbeing-focused	Communities and livelihoods, especially in vulnerable communities, are more self-sustained; do not rely on large inputs from outside the community
	Benefits are shared equitably
	Local stakeholders are engaged

This definition and above ecologically-focused metrics guided the net gain section of this report. Although the IUCN and SER metrics discussed in **Table 7-12** are qualitative in nature, both quantitative and qualitative aspects of net gain are assessed in the following sections. Moreover, discussion around achieving FSEMS key stormwater servicing and environmental management opportunities is provided below.

7.6.1 Net Gain Metric #1: Ecosystem functions and services are restored and sustained

To achieve a net gain on this metric, quantitative and qualitative increases in ecosystem functions and services are recommended. From a quantitative perspective, achieving net gain could occur through an increase in the overall amount of naturalized vegetation on the Subject Lands (e.g., through ecological restoration of existing active agricultural fields or other disturbed areas). From a qualitative perspective, a net gain could occur through an increase in the complexity and/or diversity of habitats relative to current conditions. Such increases would be expected to increase the overall functionality of the RNHS in supporting diverse plant and wildlife communities.

No targeted restoration areas were identified within the Subject Lands as part of the FSEMS. As a result, Savanta completed a constraints and opportunities analysis which delineated all natural heritage features and potential enhancement/restoration opportunities to form the proposed RNHS. The proposed RNHS will consist of the following key components:

- 30 m vegetated buffer along the existing RNHS that contains significant woodland and regionally significant wetlands;
- Realigned watercourse (reach R3S1) plus a 15 m buffer from top of bank applied to the south side of the realigned channel adjacent to the proposed development;
- Replicated tableland wetland; and

- Groundcover restoration in naturalized areas (areas between realigned channel and 30 m vegetated buffers along the northern side of the channel corridor).

As previously discussed within **Section 7.2.2**, the following vegetation communities are targeted within the created portions of the RNHS to enhance existing vegetative communities:

- MAM2/MAS2 within the replicated tableland wetland and floodplain;
- FOD6 within the 30 m wide vegetated buffer; and
- CUM1 within the 15 m realigned stream corridor buffer and naturalized areas.

These elements of the proposed RNHS are expected to result in both a quantitative gain in functional naturalized vegetation communities on the Subject Lands as well as a qualitative increase in ecological and biophysical function, relative to the existing, predominantly agricultural conditions.

From a quantitative perspective, the proposed RNHS is expected to increase the amount of naturalized vegetation cover in the area by 9.62 ha through the restoration of existing active agricultural fields. This gain is broken down by the following communities/habitat types:

a. 30 m buffer from Significant Woodlands and Significant Wetlands – 4.05 ha of mineral successional woodland;

b. Realigned stream corridor – 0.43 ha of floodplain wetland (mineral meadow marsh and/or shallow marsh) and 1.89 ha of cultural meadow; and

c. Planting in naturalized areas between the buffers and the realigned stream channel – 3.25 ha of cultural meadow.

This is a substantial net gain in naturalized vegetation area relative to current conditions. The net gain quantitative calculation does not include the 0.61 ha of tableland wetland that will be replicated at a 1:1 ratio in the RNHS, although from a functional perspective, net gain is expected to occur (as outlined further below).

From an aquatic habitat perspective, a net gain in watercourse length is also expected as a result of the proposed realignment of R3S1. The existing channel is 1,110 m long and this will be increased to 1,364 m in the realigned corridor, resulting in a net gain of 254 m of channel length. From a purely quantitative perspective, this will result in a substantial increase in seasonal aquatic habitat for fish and benthic invertebrates on the basis of the increased length alone. As discussed further below, a substantial net gain in the form and function of the realigned watercourse is also predicted.

As demonstrated in the preceding paragraphs, a substantial net gain in the overall area of naturalized vegetation and watercourse length is predicted as a result of the proposed restoration initiatives within the RNHS. However, a net gain in the overall function is also predicted as a result of the proposed enhancements due to increased habitat complexity, biodiversity and overall connectedness of the various proposed features relative to current conditions. Through targeting various habitat types, this will provide a mosaic of habitat within the RNHS that are not currently provided and/or are not functionally contributing to the existing RNHS. For example, a small MAM2 wetland is present within the RNHS near Esquesing Line, however it is likely that over time this wetland will naturally succeed into a swamp community as it is surrounded by a SWM vegetation community. The 0.61-ha MAS/MAM communities along Boston Church Road, which are proposed for removal, are currently isolated from the existing RNHS and provide limited habitat functionality on the landscape. By removing the existing wetland and replicating it on the north side of the realigned channel at a 1:1 replication ratio, the wetland will be connected into the larger RNHS and will provide increased habitat and vegetative diversity compared to the existing wetland.

Moreover, currently there is a limited east-west connection within the RNHS within the Subject Lands and surrounding landscape from residential and agricultural land-uses. The 30 m wide vegetated buffer (which will result in the naturalization of 4.05 ha of existing agricultural fields) will enhance east-west linkage functions within the Subject Lands to allow for increased abiotic and biotic movement. A FOD6 vegetative community is targeted as it will replicate the existing significant woodland community (which will act as a reference community for the buffer).

The infilling of 3.25 ha of existing agricultural area between the realigned channel and the 30 m vegetated buffer on the north side of the realigned channel will increase habitat diversity and increase native vegetative cover, as these naturalized areas are currently agricultural fields.

Finally, the existing R3S1 watercourse reach has a limited riparian buffer due to extensive active agricultural practices within the Subject Lands. Through the enhancement and creation of the realigned channel, increased habitat functionality and linkage will be created. As noted previously, the realigned channel is expected to provide 0.43 ha of wetland in the floodplain and 1.89 ha of meadow in the adjacent upland areas relative to the existing agricultural fields in the current riparian area. The realigned channel corridor will contain various wildlife habitat structures and host various upland and lowland vegetative communities. The realigned channel, which will also have an increased stream length (+254 m), will also be designed using natural channel design principles to enhance aquatic habitat diversity.

Wildlife enhancement structures will also be installed throughout the RNHS. While the specific abundance, location and type of habitat structures will be defined within the detailed design stage of this project, wildlife enhancement structures (e.g., brush piles) will attract and protect a variety of wildlife. These types of structures will provide wildlife with habitat for resting, feeding, escaping predators, sheltering from bad weather, raising young and breeding/roosting. Moreover, through the establishment of the 30 m vegetative buffers along the edge of the woodlot, 2.6 ha of interior forest habitat will be created and/or enhanced within the existing RNHS.

The variety of vegetative communities will provide age and structural diversity within the existing RNHS. This is expected to lead to a more productive and resilient RNHS as it continues to establish and mature over time.

The protection of natural heritage features and significant restoration efforts (wetland mitigation, channel realignment, naturalized plantings) will provide a significant qualitative and quantitative net gain for the Subject Lands. All existing ecosystem functions will be protected and enhanced, while created habitats will add ecosystem value and contribute to a self-sustaining and self-organizing RNHS.

7.6.2 Net Gain Metric #2: Biodiversity is restored

The existing RNHS is already biodiverse as it hosts a variety of locally, regionally and provincially significant species, as well as common and secure species (S4 and S5 species; NHIC 2021). To further enhance the existing biodiversity, the restoration and enhancement areas will focus on providing differing habitats than is currently present within the RNHS (e.g., meadow marsh habitat, cultural meadows) to attract differing species and/or support the same species at different life stages.

Specifically, insect habitat is generally limited to the existing RNHS since the remainder of the Subject Lands are agriculturally-dominated. Through the creation of wetland and meadow habitats associated with the compensation wetland, realigned channel and naturalized areas, differing insect habitat for species that use wetland and meadow habitats will be provided (e.g., Monarch). As noted in section 7.6.1, overall increases of 0.43 ha of wetland habitat (within the realigned watercourse corridor floodplain) and 5.14 ha of meadow (within the watercourse corridor buffer and planted naturalized areas) are proposed. This will encourage different insect species to use the RNHS than the insect species that are currently found within the system. Moreover, increasing the availability of insect habitat will encourage aerial insectivores to forage within these areas. The Subject Lands currently provide breeding/roosting habitat for various bat and bird species, however, foraging habitat for these species is relatively limited due to agricultural land uses within the landscape.

In addition, R3S1 is currently a seasonally wet defined channel that provides limited fish habitat diversity (e.g., limited morphology). Through the realignment of this feature, increased habitat availability (through a 254-m increase in channel length) and increased functionality will be provided through the installation of riffle-pool morphology, vegetated wetland pockets, spawning and refuge areas. This feature is still expected to be seasonally wet, as no additional hydrologic inputs (e.g., clean roof top drainage) are proposed at the upper end of the reach.

The plant community is also quite diverse and productive within the existing forest and swamp units of the RNHS, although the area is generally lacking botanical species that occupy other habitat types (e.g., cultural meadows, open wetlands). By providing varying vegetative communities, an increase in native plant diversity

will be achieved. All proposed plant material for use within the RNHS will be locally sourced to reduce transplant shock and help better acclimatize to the site. The flora proposed will complement the existing flora diversity. The variety of vegetative communities will provide age and structural diversity within the RNHS.

Overall, the proposed RNHS will enhance and increase existing flora and fauna diversity, as well as provide increased habitat opportunities for species within the overall 9.62 ha increase in naturalized vegetation areas that are currently occupied by active agricultural fields.

7.6.3 Net Gain Metrix #3: Disaster risk reduced (ties with Nature-based Solutions)

Projected climate change poses many threats to the composition, structure, and function of ecosystems in Ontario. Given the magnitude and range of potential impacts associate with key climate trends such as rising temperatures, changes in precipitation patterns, and the increased frequency and severity of extreme weather events, it is essential to create, protect and restore natural features that offer an abundance of ecosystem services that provide both climate change mitigation and adaptation services.

Enhancing, restoring, and creating new habitat features increases the adaptive capacity of natural systems, allowing the areas to better cope with climate change. The proposed natural heritage management strategies and systems have been designed to enhance the ecosystem services they provide and create a more robust RNHS. A holistic approach has been taken to ensure that the designs consider a variety of services, including provisioning (e.g., habitat biodiversity), regulating (e.g., flood regulation), supporting (wastewater treatment and nutrient cycling) and cultural services (e.g., recreation and aesthetics).

Changes in the intensity, duration, and frequency of precipitation events under a changing climate is exacerbating flooding. Natural features such as wetlands, greenspace, and vegetated buffer zones provide climate adaptation services in the form of flood regulation and act as a natural buffer to help reduce pollutants entering water bodies from runoff and overland flow. Natural features can help intercept, store, and slow the speed of surface runoff, reducing flood potential. Precipitation events, in particular short-term extreme rainfalls, can contribute to soil erosion and slope instability. Vegetated spaces can assist in stabilizing and regulating soil and sediment erosion. Within this Comprehensive Study, it has been recommended that robust vegetative buffers as it is recognized the abundance of ecosystem functions and services it provides in the face of climate change.

As discussed in Section 7.6.1, an overall increase of 9.62 ha of naturalized vegetation within current active row crop agricultural fields is expected as a result of the proposed restoration plan. This includes 0.43 ha of proposed wetlands within the floodplain of the realigned R3S1 channel, as well as the replicated 0.61 ha wetland on the adjacent tablelands.

Under existing conditions, the floodplain and riparian area of this watercourse is primarily active agricultural land with very limited naturalized vegetation that would assist in regulating flood hydrology in the watercourse (e.g., slowing floodplain flows, storing floodwater and slowly releasing it). The creation of wetland communities (within the created 0.61 ha wetland area and the realigned channel, which is expected to accommodate 0.43 ha of floodplain wetland) is expected to influence the flow and quality of the water.

Wetland communities are known to improve water quality through filtering, removing or retaining nutrients and suspended soils before they enter open water. Wetlands also have additional storage capabilities and are sometimes able to maintain stream flows during drier periods by releasing flows that were captured during larger storm-events. Because of their topographic position relative to upland communities, wetlands are known to act as a form of flood protection by impeding movement of flood waters and disseminate them into a slower, more controlled flow path. This will help reduce downstream erosion as the roots of the wetland plants will help stabilize the soil, absorb energy from the flow and break apart concentrated flow paths. While there are currently regionally significant wetlands within the RNHS, differing wetland vegetation communities are proposed within the created portions of the RNHS.

Increases in the area of naturalized vegetation communities adjacent to the watercourse and other natural features on the Subject Lands are also expected to have long-term benefits in disaster risk reduction, as they also provide increased hydrological function (I.e., through increases in retention an associated increases in

evaporation and infiltration, and vegetative uptake of stormwater) compared to the existing row crops on the Subject Lands.

Increasing temperatures and frequency of extreme heat events threaten human and ecosystem health. Forested areas, wetlands and greenspace have the ability to provide climate mitigation services by sequestering greenhouse gases from the atmosphere and can provide temperature regulating services by contributing to a reduction in the urban heat island effect. The RNHS has been designed with these different climate mitigation communities in mind.

Climate change can alter habitat conditions and the ranges of vegetation and animal species. Diversity at the species, community and ecosystem level are foundational to resilient landscapes in the face of climate change. Well connected natural heritage features and systems provide functional linkages that allow species to move and adapt as needed as the climate changes, allowing them to migrate or find climate refugia. Through creating a more diverse, robust and larger RNHS, this will provide different wildlife habitat opportunities for a variety of species on the landscape to forage, breed, overwinter and migrate.

The proposed realignment of R3S1 includes a wide valley base to safely accommodate long term migration of the bankfull channel and fully contain the erosion hazard, and the channel grading includes significant freeboard above the predicted maximum flood level to protect against the potential impacts of future climate change. The 15 m buffer separating the channel corridor from the development to the south provides even greater resiliency against future disaster risks associated with a changing climate.

This target has been achieved, as the proposed restoration and enhancement works associated with the RNHS was designed to support the ecosystem services they provide and foster greater resiliency under a changing climate.

7.6.4 FSEMS Target #1: Mitigation of Thermal Impacts to Downstream Cool-water Species

Restoration and enhancement areas have been designed to provide thermal mitigation using natural heritage design principles. Specifically, overhanging vegetation and scattered shrub/tree plantings are proposed within the realigned channel to shade the feature. No large ponding areas are proposed within the realigned channel and/or the compensation wetland area to avoid thermal loading to downstream habitats.

The stormwater management strategy includes a number of different measures to mitigate potential thermal impacts, including the orientation and configuration of SWM ponds to maximize shading, wet detention ponds with deep pools and bottom draw outlets to draw cool water from the base of the pond for discharge to the receiving watercourses, cooling trenches at SWM pond outlets, and infiltration of clean storm runoff in areas that will emerge as cool groundwater discharge in the surrounding watercourses.

This target is predicted to be achieved.

7.6.5 FSEMS Target #2: Increasing Infiltration Capacity and Flood Control

The stormwater management strategy includes infiltration of clean water from building rooftops to match or exceed pre-development infiltration volumes on an average annual basis, and the locations for recharge areas have been selected to ensure that the inputs to groundwater supported natural heritage systems within and beyond the study area are preserved. **Section 7.4.4** demonstrated that infiltrating clean runoff from the building rooftops could increase groundwater recharge rates by more than 25% over existing conditions.

The stormwater management facilities and overall stormwater management strategy will control post-development peak flow rates to or below pre-development levels and mitigate potential downstream erosion impacts. In addition, the creation of wetland vegetative communities within the realigned channel corridor associated with tributary R3S1 will aid in flood mitigation and storm-event management through natural attenuation of flows in the channel corridors.

This target is predicted to be achieved.

7.6.6 FSEMS Target #3: Enhancement of Watercourses

Currently, R3S1 is a seasonally wet defined channel within an actively managed agricultural field. The feature has limited riparian buffer as cropped vegetation was identified up to the edge of the feature in most areas. The watercourse also had limited fish habitat diversity (e.g., limited morphology). The proposed realignment of this feature will incorporate natural channel design principles which will increase natural channel morphology and sinuosity, while enhancing the feature through installation of native plant materials within lowland and upland vegetative communities. An overall increase in the length of the channel (+254 m) is proposed.

Low-order streams such as R3S1 provide detention and retention functions with regards to both flow and sediment. To maintain and enhance these functions, the proposed realignment will provide good communication with the floodplain as well as diversity in channel and floodplain morphology. This approach will also enhance aquatic and terrestrial habitat by increasing diversity and providing a more natural floodplain form.

The proposed realignment and naturalization provide opportunities for improved riparian conditions and a well-developed bankfull channel with morphological variability. Improvement in morphology and function would provide additional benefits to sediment balance, floodplain storage, vegetation communities and terrestrial habitat features, edge impacts and restoration requirements, water balance, fish passage and water quality. In its existing form, R3S1 is a degraded feature heavily impacted by historical agricultural practices that spans a length of approximately 1,100 m. The proposed channel design provides an overall improvement to existing conditions and provides an increase in channel length with a total length of 1,364 m, resulting in a net gain of 254 m of length.

This target is predicted to be achieved.

7.6.7 FSEMS Target #4: Installation of Buffers to Protect Woodlots, Riparian Areas and Other Natural Features

Buffers provide a physical separation of natural heritage features from the proposed development. The NHRM suggests that buffers “contribute substantially to the protection of wetlands, woodlands, valleylands and other natural heritage features” (MNR 2010).

As previously discussed, substantive vegetated buffers have been proposed to protect existing natural heritage features. Specifically, 30 m vegetative buffers will be applied to regionally significant wetlands and significant woodland features and a 15 m vegetative buffer from top of bank will be applied to the realigned channel. The 30 m woodland and wetland buffer will occupy approximately 4.05 ha of currently agricultural area, while the 15 m channel buffer will occupy approximately 1.89 ha of agricultural area. The establishment of these vegetated buffers can prevent erosion and sedimentation into existing natural heritage features, provide habitat for terrestrial species such as birds, small to medium sized mammals, enhance linkage and connectivity functions and protect existing features from the proposed development.

Table 13-1 within the NHRM (MNR 2010) suggests buffers provide the following ecological benefits to existing natural heritage features:

- “Reduction of encroachment;
- Reduction of light and noise;
- Space for tree-fall;
- Protection of root zones;
- Enhancement of woodland interior;
- Allowance for hunting habits of cats and dogs;
- Location of trails; and
- Attenuation of runoff”.

The proposed industrial land-use will not increase the introduction of pets into the RNHS, nor are any trails proposed. The vegetative buffers will extend the functional edge of the woodland, protect existing plants and enhance long-term tree health. Specifically, vegetative buffers will shelter existing trees from any disturbance caused within the developable area, protect the root zones of existing trees, maintain moisture conditions, and prevent soil erosion.

This target is predicted to be achieved following the installation and establishment of the vegetated buffers.

7.6.8 FSEMS Target #5: Linkage Protection and Enhancement within Actively Managed Agricultural Fields

The NHRM (MNR 2010) states that the "ecological functions that a linkage performs will depend on the nature of the linkage". The NHRM suggests that certain factors may affect the following functionality of linkage features, including the following factors:

- Length and width;
- Composition;
- Orientation; and
- Configuration.

Presently, there is a limited east-west connection within the Subject Lands due to residential and agricultural land-uses. Through the establishment of the 30 m wide vegetated buffer along the regionally significant wetlands and significant woodlands, this will enhance east-west linkage functions within the Subject Lands to allow for increased abiotic and biotic movement. The realigned channel will encourage the movement and connectivity of aquatic, semi-aquatic and terrestrial habitats through the establishment of the channel corridor. Moreover, these linkages ultimately connect (offsite, further east of the Subject Lands) into Sixteen Mile Creek. The linkages of features immediately downstream (offsite) of R3S1 are generally more pronounced on the landscape and vegetatively defined (e.g., robust riparian corridors, connecting larger patches of naturalized areas together). By enhancing R3S1 within the Subject Lands, this will help connect the regionally significant wetlands and significant woodland units to other natural heritage features within the larger landscape system, relative to the current agriculturally influenced watercourse corridor, which contains limited naturalized riparian vegetation. These linkages will be robust in size and length within the Subject Lands, and connect together different functional habitats within a larger mosaic of vegetative communities.

Through the establishment of vegetated buffers and realignment of the R3S1, increase linkage function and connectivity east-west and (generally) north-south will be achieved. These lands are currently actively managed agricultural fields and will be restored into more ecologically functioning communities that contribute ecosystem services to the RNHS.

This target is predicted to be achieved following the realignment of R3S1 and the establishment of the restoration and enhancement areas (including vegetative buffers).

7.6.9 FSEMS Target #6: Increase Habitat Diversity within Actively Managed Agricultural Fields

The NHRM (MNR 2010) suggests that "natural areas (or clusters of areas) that span a range of topographic, soil and moisture conditions tend to contain a wider variety of plant species and plant communities, and may also support a greater diversity of ecological processes, than similar areas that occupy a narrower range of topographic, soil and moisture conditions".

Created RNHS features, which will occupy approximately 9.62 ha of currently active agricultural land, will provide differing vegetative communities than those that are already present within the Subject Lands. Specifically, created vegetative communities will target cultural meadow and meadow marsh communities, which are currently limited within the Subject Lands and within the existing RNHS. An increase of 5.14 ha of cultural meadow is proposed within the realigned instream corridor and the naturalized areas between the adjacent woodlands/wetlands and the realigned corridor. An increase of 0.43 ha of wetland habitat will occur in the realigned stream corridor and 0.61 ha of wetland will be replicated within this area (to mitigate removals

proposed on the west side of Boston Church Line). Through the addition of these habitats into the RNHS, additional habitat variability will be incorporated into the system and will inherently attract different fauna species (e.g., insects, aerial insectivores). Moreover, these differing vegetative communities will also support differing plant species than those that are currently found within the RNHS. The meadow marsh communities that are presently found within the Subject Lands are relatively disturbed from surrounding land-uses (especially the communities located along Boston Church Road). The creation of new habitats with local and native plant materials will encourage species diversity.

A greater range of habitat conditions for flora and fauna is predicted as part of the installation and establishment of the restoration and enhancement areas. This target is predicted to be achieved in comparison to the existing monocultural agricultural fields.

7.6.10 Net Gain Summary

As demonstrated within **Section 3.1**, limited naturalized vegetation and wildlife habitat exists outside of the significant woodlands/regionally significant wetland units within the Subject Lands due to the agricultural land-uses. Wildlife habitat will be enhanced through the establishment of native mosaic of wetland, meadow and forested habitats within the created RNHS units. Overall, the predicted increase in naturalized vegetation within existing agricultural fields will be 9.62 ha, which will result in a substantial quantitative net gain. Further, a net gain in watercourse length is also proposed. Once the restoration and enhancement area is established, it is predicted that a variety of aquatic, semi-aquatic and terrestrial species will colonize these areas as the RNHS becomes more naturalized and robust. All net gain ecologically-focused metrics and FSEMS targets are predicted to be achieved.

In conjunction with the protection of natural heritage features, the proposed RNHS restoration efforts/design will result in a predicted net gain in ecological features and functions. The proposed RNHS is anticipated to enhance linkage functions, enhance fish habitat, introduce various new habitats and vegetative communities into the RNHS (e.g., meadow marsh, cultural meadows) and provide a more robust, self-organizing and resilient system within the landscape.

8 IMPLEMENTATION STRATEGY

8.1 Development Phasing

The subwatershed management strategy for the study area and functional servicing for the Orlando lands have been developed with the anticipated phasing of development in mind. The proposed development in the study area was described in **Section 1.2**. Parcels 1 and 4 are owned by Orlando. Planning is underway for employment development on these lands, and draft plans of subdivision for both parcels are included in **Appendix A**. The owners of Parcels 2 and 5 are not participating in this Comprehensive Study, and there is currently no plans or timeline for employment development within those parcels. Portions of Parcel 3 are outside the Greenbelt but remain outside the Urban Boundary and not future development has been contemplated for this property.

Development in the study area is expected to proceed on a parcel by parcel basis, consistent with commercial and industrial development throughout the Greater Toronto Area. As such, the plans have been prepared to allow each parcel to proceed independently and implement the natural heritage and stormwater management systems within each developing parcel.

The implementation plan for the study area been developed with the following general objectives:

- Development phasing and servicing designs achieve the most efficient means of extending services to the study area.
- Adequate stormwater management is provided, and net environmental gain is achieved for each phase of development.
- Interim works are minimized to the extent feasible.
- Systems are to be designed and constructed for the ultimate condition. Flood and erosion hazard management should consider the worst case of existing, interim and ultimate development conditions in the study area.
- Future phases of development are to avoid or minimize Impacts to restored natural heritage system elements and stormwater management facilities in prior phases of development.

Opportunities to create the replicated wetland unit within the Parcel 4 lands prior to their removal from the Parcel 1 lands will be explored as part of this phasing process. The relevant elements and considerations of the implementation strategy are discussed in the following sections.

8.1.1 Water and Sanitary Servicing

The North Porta area servicing is within the Region's Water and Wastewater Master Plan and watermain and sanitary servicing projects are listed as development charge (DC) projects for the Region. The construction year for the DC projects noted in the Region's DC Technical Report (GM BluePlan Engineering, 2016) is 2026.

If any proposed development within the North Porta area were to proceed prior to the construction of the DC projects, servicing works within public right-of-ways would need to be constructed by the developers prior to construction of the individual site plans. After public servicing works are in place, each development parcel could be developed separately and each block would require its own private water and sanitary servicing.

8.1.2 Stormwater Management and Watercourse/HDF Management Plans

The development plan follows the property parcels within the North Porta area, which in general, allows for stormwater management and servicing at each property to be implemented independently of each other, provided that local municipal servicing is available, as discussed above.

The SWM plan also follows the property parcels within the North Porta area, such that each property parcel has a dedicated stormwater management system, which can be implemented independently of neighbouring

properties. For example, each SWM facility services its associated parcel and is not shared with other properties. The channel realignment and conveyance swales will also be implemented in parallel to the stormwater management plan and follow the same phasing. The phasing considerations for each property's stormwater management and watercourse management plans are as follows:

- **Parcel 1** – The SWM plan for this property includes SWMF1 at the southwest corner of the property and a 30 m wide swale (realigned R5S1) along the west boundary of the property, which can be constructed when the site is developed. If this property is developed before the adjacent property to the south, permissions for the proposed swale realignment (R5S1) through Parcel 2 is required (see below).
- **Parcel 2** – A SWM plan has not been advanced for this property, as the owner has not participated in the study and there are no concepts available for the potential development of the property. It is expected that any development concept would include a SWM facility near the southeast corner of the property.

  In addition, the SWM Plan for Parcel 1 requires a continuation of the realigned bioswale (R5S1) from Parcel 1 along the west and south boundary of the property to its outlet at the hydro corridor to mitigate potential erosion impacts on Parcel 2. The realigned bioswale is required to receive and convey SWMF1 discharge to the ultimate outlet at the hydro corridor. The downstream extent of HDF R5 should be assessed following the HDFA Guideline (CVC/TRCA 2014) to confirm that the management recommendation is similar to upstream reaches, and that the feature can be realigned. This approach acknowledges that permissions for proposed works in Parcel 2 and the hydro corridor will be granted. If not, an alternative strategy to mitigate erosion impacts is required for Parcel 1.
- **Parcel 3** – This non-participating property is located outside of the urban boundary area, but portions of the property are located outside of the Greenbelt Plan's "Protected Countryside" area. It has been included in this Comprehensive Study given its location within the Subject Lands, but the Comprehensive Study does not account for any future urban development on this property.
- **Parcel 4** – This property includes SWMF4 and the realignment of Tributary R3S1. SWMF4 and the channel realignment can proceed independent of any other works when the property is developed.
- **Parcel 5** – A SWM plan has not been advanced for this property, as the owner has not participated in the study and there are no concepts available for the potential development of the property. The portion of Parcel 5 within the urban boundary is very small, and it is expected that any development would include on-site controls and/or a small SWM facility in the south-east corner of the developable area.

8.2 Future Study and Detailed Design Requirements

The preferred approach and recommendations to provide servicing and manage surface water and groundwater within the North Porta area described in this report will be refined through detailed design. Under each plan, additional technical assessments and design specifications are required to confirm the measures outlined within this Comprehensive Study, as described in the following sections.

8.2.1 Watercourse and HDF Management

Similar to the SWM plan, the watercourse management plan can be designed and implemented for each property as it is developed. In detailed design, the conceptual design provided in this Comprehensive Study will be refined to include:

- Configuration for transition areas between the existing channel and proposed works at property boundaries and public ROWs. In particular, consideration will be given to improving the Tributary of Sixteen Mile Creek crossing at Esquesing Line to accommodate greater flows without overtopping the road. Modelled existing and proposed conditions indicate that the road is overtopped at the 2-year storm event.
- Additional hydraulic analysis will be completed to confirm conveyance and riparian storage requirements with the refinements in the design. In late 2021, CH initiated a Flood Hazard Mapping Study for Sixteen Mile Creek that will generate updated flood hazard mapping for the watershed. Flood hazard limits may

be subject to change in the future and will be reflected in future regulatory decisions and approvals for the Subject Lands.

- The downstream extent of HDF R5 is to be assessed following the HDFA Guideline (CVC/TRCA 2014) to confirm that the management recommendation is similar to upstream reaches, and that the feature can be realigned.
- Incorporate geotechnical recommendations for channel embankment and crossing features.
- Grading along the realigned channel and conveyance swales.
- Detailed design for natural channel design features such as the pool-riffle morphology and habitat structures, to improve channel function, floodplain interaction, and aquatic habitat quality.
- Landscape and planting specifications.

8.2.2 Stormwater Management

The detailed design of the SWM plan will be completed as each development proceeds. As discussed in **Section 8.1.2**, each major property within the North Porta area can proceed independently with respect to stormwater management due to the provision of SWM facilities for each major property.

The Comprehensive Study SWM plan provided a concept design that was intended to determine the feasibility of the plan. The plan also discusses a number of options for lot-level controls that have not been determined at this stage, in part because the development plan is at a conceptual level and is subject to change. At the detailed design stage, the stormwater management plan will be refined based on the subdivision and site plan to include:

- Major and minor system design based on the final site layout and detailed grading. Coordination is required with the detailed grading design of the channel and swale realignments and SWM facility outlet configuration.
- On-site storage volume, discharge rate and discharge locations based on the building configuration.
- Lot-level controls such as LID facilities, conveyance features, water quality control devices, parking lot storage, or underground storage. Additional test pitting and infiltration testing is recommended to inform the design of infiltration LIDs when their locations have been finalized.
- Technical analysis will be completed in consideration for the above components of the SWM plan to assess the final design parameters for the proposed SWM facilities, based on the Town, CH and other standards and guidelines. This includes additional hydrologic verification following the same modelling methodology described in this Comprehensive Study (i.e. PCSWMM continuous simulation) to confirm that the proposed SWM plan would satisfy the objectives and criteria that was established.
- Detailed design of the SWM facilities that will determine the outlet control structures, pond grading, pond liner (if required), and landscape/planting plan. The outlet configuration shall minimize impacts to the receiving watercourse. Geotechnical recommendations are to be incorporated in detailed design.
- An operation and maintenance manual.

8.2.3 Water and Sanitary Servicing

As discussed in **Section 7.1.1**, the public servicing required for the development of the North Porta area is scheduled for construction in 2026. These DC servicing projects would need to be constructed prior to construction of the individual site plans. Therefore, should the development within the North Porta lands proceed prior to the construction of the DC projects, consultation with the Region would be required for the developers to advance the servicing works within the public right-of-ways. The developer would work with the Region to complete the detailed design of the external services on behalf of the Halton region, and in parallel with the detailed design of the site plan.

The detailed design of the water and sanitary servicing infrastructure for each site plan will be completed as each development proceeds. Each development parcel would be serviced with its own private water and sanitary servicing network designed in accordance with Town and Region standards.

Detailed grading will need to be completed for each site plan in conjunction with the servicing designs to ensure sufficient cover over the services and that existing grades are met at the property boundaries.

8.3 Construction Staging

Construction staging plans will be developed in conjunction with site alternation plans and detailed design of the realigned R3S1, SWM facilities and site plans. As described in Section 8.1.2, each development parcel at North Porta requires the full construction of drainage works and SWM facilities specific to each parcel prior to development of the parcel. Interim works shall be minimized to the extent possible. Realigned channels and conveyance swales shall be constructed in dry conditions where possible. Opportunities for construction of the created wetland unit within the Parcel 4 lands to occur prior to the removal of the existing wetland units along Boston Church will be explored, as feasible.

For Parcel 4, the proposed channel R3S1 is located to north of the existing R3S1 and the development site. All initial site alteration works are to take place to the south of the existing R3S1 (and associated regulated area) to not disturb the existing drainage feature. The majority of the proposed R3S1 can be constructed in the dry without the need for lengthy temporary flow diversions. Once constructed, the proposed R3S1 channel can be tied into the existing R3S1 channel at the upstream and downstream locations. The remaining portion of the Parcel 4 can be graded for development once the proposed R3S1 channel is constructed and conveying drainage. Overall, the construction of the proposed R3S1 and SWM facility SWMF-4 is required for development at Parcel 4 (i.e., interim development scenarios are not recommended) due to size and orientation of the proposed warehouse buildings in Parcel 4.

8.4 Construction Mitigation

BMPs for the protection of aquatic habitat and source water protection will be reviewed at the detailed design stage and incorporated into an Erosion and Sediment Control (ESC) plan. Channel realignment should occur outside of the spring spawning window (March 15 to July 15). If water is present when channel realignment is proposed, a fish and wildlife salvage should be completed prior to any alteration. Following the salvage, the area must remain isolated from downstream reaches to reduce the opportunity for fish to migrate back into the work area. The use of erosion and sediment control devices and techniques should adhere to the principles limiting soil mobilization and trapping sediment as close to the source as possible. The TRCA Erosion and Sediment Control Guidelines for Urban Construction (TRCA, 2019) will be followed for the development and implementation of the comprehensive ESC plan.

The construction mitigation plans will be major components of the permitting and approvals for construction of the proposed works, which include permitting from CH and, where applicable, approvals or letters of advice from the Ministry of Natural Resources and Forestry (MNRF) and/or the Department of Oceans and Fisheries (DFO). Mitigation measures specific to natural environment features, related to terrestrial features (trees and vegetation), wetlands, wildlife habitat, fish habitat, as well as habitat of endangered and threatened species are covered in **Section 6.1.** Removal of trees within the Orlando Lands should occur outside of the Migratory Bird Window (April 1 to August 31) and bat maternity window (April 1 to September 30), where feasible.

A monitoring program specific to the construction period (and separate from the long-term monitoring program described in **Section 9**) will be developed to assess the performance of construction mitigation plans. The construction mitigation plans will provide guidance on corrective action.

8.5 Operation and Maintenance

An operation and maintenance plan is required to provide guidance for the effective and efficient operation, and maintenance, of all infrastructure and environmental systems that are recommended through this Comprehensive Study. The operation and maintenance plan is intended to minimize the degradation and risk of failing or premature replacement of infrastructure, to maintain the servicing and environmental objectives

of the Comprehensive Study. The operation and maintenance plans will apply to Municipality owned or privately owned infrastructure.

SWM facilities require periodic maintenance to retain effective water quantity and quality control, which was discussed in **Section 7.4.5**. Additional SWM practices such as LIDs may be included in the SWM plan in later design stages and must also be captured in the operation and maintenance plan. In addition, a key component of the operation and maintenance plan is the monitoring program that is in effect for the early operational period, to assess the performance of the SWM plan. The monitoring program is described in **Section 9**. Agreements, by-laws or other policy tools can be used to ensure that these systems are adequately maintained.

Similarly, the watercourse systems (realigned channels and conveyance swales) require periodic maintenance to remain effective in the long-term. However, the proposed constructed watercourses will include natural channel design that include features such as low-flow channels, appropriate meander belt widths, riparian vegetation and natural substrate. The watercourse systems are designed to be dynamically stable and thus expected to have minimal and localized long-term maintenance requirements. Similar to the SWM plan, the monitoring program for watercourses is a key component of the early period operation and maintenance plan, as described in **Section 9**. Agreements, By-laws or other policy tools can be used to ensure that the realigned watercourses and conveyance swale systems are adequately maintained. In addition, easements dedicated to the Town may be used to better ensure the proper maintenance of the conveyance swales, subject to agreement and approval from the Town. No maintenance is required for the vegetated bioswale, as this will be naturalized and incorporated into the buffers to the RNHS.

9 MONITORING AND ADAPTIVE MANAGEMENT

Environmental compliance monitoring prior to and following development of the Subject Lands is needed to verify the performance of the stormwater and environmental management systems and confirm that the goals, objectives and targets established in this Comprehensive Study have been achieved.

As noted in **Section 8**, it is expected that development in Subject Lands will proceed on a property-by-property basis, consistent with commercial and industrial development throughout the GTA. The proposed watercourse realignment and other NHS elements will be implanted within each property as it is developed, with interim transitions where required at property boundaries. It is therefore expected that monitoring programs will be implemented at the property level to focus on verifying the success of the management plans on each developing property.

The monitoring programs for both of the Orlando properties (Parcels 1 and 4) will be co-ordinated and integrated, and subsequent development in the study area will build upon previous monitoring programs while also making use of any collected data to refine the design of NHS elements and refine the associated monitoring programs. The below noted post-construction monitoring program will ensure that all disciplines (engineering, fluvial geomorphology, hydrology, hydrogeology, and natural heritage) collaborate, where appropriate.

9.1 Stormwater Management

9.1.1 Overview

The proposed stormwater management facilities within the Subject Lands shall be monitored to assess their effectiveness and operation with respect to quantity control, quality treatment, thermal impacts, and the quality of accumulated sediments. The details of these assessments are provided in the following sections. For SWMFs to be assumed by the Town, requirements for assumption must be followed in addition to the monitoring and reporting outlined below, including sediment cleanout, as-constructed plans, final stormwater design analysis, operation and maintenance manual, and works are to be certified by a professional engineer.

9.1.2 Flow Monitoring (Quantity Control)

Continuous flow and level monitoring shall be conducted at both the inlets and outlets of the stormwater management facilities during non-frozen conditions (April-November). Equipment includes a pressure transducer for water level measurement and a data logger, with flow data derived using the water level and stage-discharge relationship. Monitoring shall commence upon substantial completion of each facility and continue for a minimum of three (3) years or until at least 80% build-out of each facility's tributary area.

Additionally, the opportunity to install staff gauges within each pond shall be explored as a means to record water levels throughout the construction period as part of the erosion sediment control inspections. Staff gauge installation will be dependent upon the availability of suitable locations for both placement and observation, to be determined visually during pond construction.

Evaluation of the flow monitoring program will incorporate available rainfall data from Environment Canada and Conservation Halton to provide an assessment of facility performance with respect to general operation as well as adherence to discharge targets established in this Comprehensive Study.

9.1.3 Water Chemistry (Quality Treatment)

Water quality testing of pond inflows and outflows shall be conducted to verify the required reduction in concentration of total suspended solids, as well as additional parameters as outlined below, consistent with most other public SWM facilities in the Town of Milton.

Table 9-1 Water Chemistry Sampling Parameters

Water Chemistry Sampling Parameters	
Oil and grease	Total phosphorous
Anions (nitrate, nitrite, phosphate, chloride)	Ammonia
Total Kjeldahl Nitrogen (TKN)	Conductivity
Total solids	Total suspended solids
BOD_5	Dissolved oxygen
pH/alkalinity	Salinity
Total coliforms	Faecal coliforms
PAH	Metals (Al, Sb, As, Ba, Be, B, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, P, K, Se, Si, Ag, Na, Sr, Tl, Sn, Ti, W, U, V, Zn, Zr)

The water chemistry data will be collected by grab samples at the facility outlet and within the receiving watercourse upstream and downstream of the outlet to compare facility effluent with background water quality within the receiving watercourse. Monitoring shall commence upon substantial completion of each facility and continue until at least 80% build-out of each facility's tributary area and shall endeavour to collect data for a minimum of three (3) precipitation events per year. Each facility is to be monitored for at least three (3) years.

Where possible, grab samples should be collected from the receiving watercourses prior to development and/or upstream of SWM facility outlets and analyzed for the parameters listed above. Baseline surface water monitoring was established in 2021 (refer to **Section 3.4.4**) and has included preliminary sampling. Although, it should be noted that significant flows have not been documented in the system due to the intermittent nature of the channels. Grab sampling will continue through fall 2021 and be re-initiated in spring 2022. Any predevelopment samples collected and analyzed are intended to aid in understanding the changes in water quality as the study area transitions from agricultural to commercial and industrial land use. They are not to be used to modify or augment the water quality criteria established in this Comprehensive Study.

9.1.4 Temperature (Thermal Impacts)

Monitoring of water temperatures at facility inlets and outlets shall be integrated with the continuous flow monitoring program. Temperature sensors are also to be installed in the receiving watercourses upstream and downstream of the facility outlets. Temperature sensors shall collect continuous data to be recorded by the flow monitoring data logger. Baseline temperature data in the existing watercourses should be collected prior to construction, and monitoring shall resume upon substantial completion of each facility and continue for at least 10 years or until at least 80% build-out whichever is greater of each facility's tributary area.

9.1.5 Accumulated Sediment Quality

Sediments that accumulate at the bottom of each facility's main cell shall be sampled and tested for the parameters listed in **Table 9-2**. Sampling shall occur every three years following construction of each SWM facility, and shall consist of two (2) sediment samples at each stormwater management facility. Samples are to be collected in the fall (after September 30th).

Table 9-2 Accumulated Sediment Sampling Parameters

Accumulated Sediment Sampling Parameters			
Ag	Co	Mo	Ti
Al	Cr	Na	V
Ba	Cu	Ni	Zn
Be	Fe	P	PAH's
Ca	K	Pb	pp'DDE
Cd	Mg	Sr	PCB's
	Mn		General pesticides

9.2 Fluvial Geomorphology / Erosion

This component of the monitoring program is intended to assess near-term trends associated with channel adjustments after the substantial completion of the proposed natural channel realignment for R3S1. Following completion of the channel, monitoring will include the establishment of a cross section and longitudinal bed survey, observations of bed and bank characteristics and substrate material, and photographs. The initial survey will provide baseline data for comparison against future monitoring works. Erosion pins will also be installed at each fluvial geomorphology station. Subsequent surveys will be done bi-annually in the spring and fall with an annual report prepared at the end of the year.

The baseline survey should be conducted over a length of at least 40 m. The cross sections will need to be demarcated in the field using permanent monuments such as steel bars or posts. These markers should be established within a reasonable setback from the top of channel bank to allow for simple linear measurement of any recession at future monitoring intervals, and to establish the alignment of detailed cross-sectional hydraulic geometry measurements. The erosion pins will also be measured at the time of the cross-section surveys.

A digital photo inventory will be completed to show both large scale and detailed scale features. Subsequent monitoring intervals will take photos from the same vantage points to show the relative change in the system. Large scale photos will show changes relative to fixed features such as tress and the installed cross-section markers. Detailed photos will show bank erosion scars and channel bed features.

A channel profile survey will be done as centred on each of the monitoring cross-section locations. The survey will establish the vertical and longitudinal limits of adjacent bed form features. Subsequent surveys will be done to show aggradation or degradation adjustments on the channel bed. Monitoring shall commence upon completion of the realigned channel reach and continue for a period of three (3) years or until 80% buildout of the contributing area.

9.3 Groundwater

Palmer is currently engaged in quarterly groundwater and surface water level monitoring for the retained wetlands and the area within the vicinity of the channel realignment to add on to the already robust set of pre-development water level data (**Table 3-15 and Table 3-16**). It is recommended that continued monitoring occur quarterly during construction, and for three (3) years post-construction or until at least 80% buildout to monitor any changes to the overall groundwater table that may result from the proposed development (**Table** 9-3).

In the interest of protecting existing water users from the unlikely event of construction related impacts, Palmer has been engaged in a monitoring program with seven (7) residents within the vicinity of the study area since October 2019. The purpose of this monitoring program is to establish the baseline groundwater chemistry and groundwater levels of surrounding existing water users. It is recommended that private well monitoring of the seven residents continue quarterly during construction, and for 1-year post construction to monitor any changes that may be related to construction of the development.

Table 9-3 Groundwater and Wetland Water Level Monitoring Plan

Monitoring Locations	Monitoring Frequency
Monitoring wells in the vicinity of R3S1 channel realignment (MW1, MW2, MW4, and MW8)	▪ Quarterly manual monitoring during construction and minimum 3-year post-construction or until 80% build-out ▪ Dataloggers for continuous monitoring
Mini-piezometers in the vicinity of R3S1 channel realignment and within related wetland communities (MP2, MP3, MP4, MP5, MP11)	▪ Quarterly manual monitoring during construction and minimum 3-year post-construction or until 80% build-out ▪ Dataloggers for continuous monitoring
Infiltration LIDs at Parcel 4	▪ Quarterly manual monitoring for a minimum 3-year post-construction or until 80% build-out ▪ Dataloggers for continuous monitoring
Residential well monitoring	▪ During construction and 1-year post-construction

9.4 Ecological Post-Construction Monitoring

The post-construction ecological monitoring program described below is intended to assess the change in retained and constructed ecological features between pre- and post-construction periods. The terrestrial and aquatic data collected by Savanta within the Orlando Lands will serve as baseline for ecological monitoring.

The below post-construction monitoring program does not include the inspection activities typically associated with construction, including the reporting of deficiencies and landscaping survival assessments Inspections will be conducted in a standard manner to confirm that the design has been constructed as designed and approved. Construction monitoring (e.g., ESC monitoring) are discussed within **Section 8.3.**

The below post-construction monitoring program will be undertaken throughout the Orlando Lands; however, this is considered a “local” monitoring program per the Town’s Restoration Framework (2015; herein referred to as “the Town’s Restoration Framework”). Holistic monitoring is to be undertaken by the Town, per the Town’s Restoration Framework (Dougan & Associates 2015).

The RNHS within the Orlando Lands is found along the northern Subject Lands boundary within Parcel 4 (**Figure 13**, **Appendix B1**). As previously discussed within **Section 4.1** of this report, the RNHS includes several natural heritage features including significant woodlands, regionally significant wetlands, constructed wetland, realigned channel, buffers and naturalized areas between the channel realignment and RNHS buffers. As discussed within **Section 7.2**, the constructed wetland area and vegetated buffers within the Orlando Lands will protect, enhance and expand the RNHS by providing and enhancing existing terrestrial and aquatic systems. Ecological monitoring will commence when development is complete and extend at least five years.

RNHS monitoring within the Orlando Lands will include the following:

- RNHS compliance monitoring – comparison of the NHS system outlined within the preceding studies to the as-built condition;
- RNHS-Urban Interface Integrity;
- Ecosite Description;
- Canopy Health;
- Native Communities and Species Diversity;
- Invasive Plant Species;
- Wetland Hydrology;
- Fish Community Sampling;
- Wildlife Assessment; and
- Human Impacts.

The proposed RNHS described within this Comprehensive Study will be compared against (by overlaying of surveys and draft plans) the RNHS adopted in the site plans and finally with the as-built compliance surveys. Monitoring will occur in both retained, existing natural heritage features and within the constructed wetland area and realigned channel. Incidental wildlife observations (including location and evidence type) will also be recorded during all flora and fauna surveys.

The RNHS monitoring types are summarized below:

i. RNHS-Urban Interface and Boundary Integrity
   a. Photo monitoring plots
   b. Encroachment monitoring

ii. RNHS Survey Locations
   a. Vegetation surveys
   b. Breeding bird surveys
   c. Insect surveys
   d. Terrestrial crayfish survey
   e. Fish community sampling survey
   f. Aquatic habitat assessment
   g. Calling amphibian survey
   h. Wetland hydrology survey

9.4.1 Duration of RNHS Monitoring

Table 9-4 provides a summary of monitoring parameters within the Orlando Lands. The following notes explain the duration of the RNHS monitoring and triggers to commence the monitoring period:

- Monitoring duration for terrestrial monitoring parameters in the “local” monitoring program is summarized in **Table 9-4**, which is generally every other year commencing one growing season after landscaping vegetation is installed (years 1,3,5). There are some vegetation monitoring parameters (specifically related to monitoring of planted vegetation) where monitoring commences in year 3 (i.e., node cover, corridor cover and performance/free-to-grow monitoring).
- Monitoring duration for fisheries (fish community sampling, aquatic habitat assessment) and wetland hydrology, and other water-based parameters will occur in year 1, 3 and 5 post-construction.
- Within the buffer of the retained RNHS units, monitoring of the landscaping vegetation and RNHS-Urban boundary will commence one full growth season after planting (except as noted in **Table 9-4** where monitoring starts 3 years after planting for certain parameters).

RNHS monitoring locations are illustrated on Figure 15 (Appendix B1). The breeding bird and amphibian call count station locations within retained RNHS features will be at the same locations as the pre-construction sampling stations to allow for pre to post comparison.

Following completion of construction of the enhancement and restoration areas within the RNHS, a sampling event should be conducted in years 1,3 and 5. However, if assumption has not occurred by Year 5 then monitoring would be required every other year following Year 5 until assumption occurs. Specifically, natural heritage monitoring will be initiated following one year growing/establishment period.

Table 9-4 Natural Heritage System Monitoring Summary

Component	Location	Timing	Frequency Monitoring
a. Photo Monitoring	RNHS – Urban boundary along edge of the retained RNHS and realigned channel	Summer (one round)	Years 1,3 and 5 (or until assumption)
b. Vegetation – ELC, Canopy Health	Plot-based ELC in retained woodlands and wetland features, and created wetland	Spring, Summer and Fall (generally June 1 to October 14) (three seasons); spring ephemeral survey in May within retained woodlands/wetlands	Years 1,3 and 5 (or until assumption)
c. Breeding Bird Surveys	Targeted point count stations	Late May to early July (two rounds)	Years 1,3 and 5 (or until assumption)
d. Insect Surveys	Throughout retained and created RNHS features	Spring – Summer (May, June, August; three rounds)	Years 1,3 and 5 (or until assumption)
e. Calling Amphibians	Targeted sampling locations	March/April to June (three rounds)	Years 1,3 and 5 (or until assumption)
f. Fish Community Sampling	Targeted sampling locations within realigned watercourse	Spring (April/May), Summer (June/July)	Years 1,3 and 5 (or until assumption)
g. Aquatic Habitat Assessment	Targeted sampling locations within realigned watercourse	Spring (April/May)	Years 1,3 and 5 (or until assumption)
h. Wetland Hydrology	Targeted sampling locations within retained and created wetland communities	To be agreed upon with CH (i.e. spring freshet, mid-spring and late summer)	Years 1,3 and 5 (or until assumption)
i. Invasive Plant Species	Walk transects throughout RNHS, with special concentration along urban boundary and near known concentration points of invasive species (identified during Savanta pre-construction monitoring efforts)	Twice during growing season in realigned channel and created wetland; summer in retained woodlands and wetlands	Years 1,3 and 5 (or until assumption)
j. Planted Vegetation - Growth Rate	Plot method created communities (wetlands, buffers)	Summer (one round)	Years 1,3 and 5 (or until assumption)
k. Planted Vegetation – Survivorship	Plot method created communities (wetlands, buffers)	Summer (one round)	Years 1,3 and 5 (or until assumption)

Component	Location	Timing	Frequency Monitoring
l. Planted Vegetation – Performance	Plot method created communities (wetlands, buffers)	Summer (one round)	Years 1,3 and 5 (or until assumption)
m. Planted Vegetation – RNHS Cover	Plot method created communities (wetlands, forest)	Summer (one round)	Years 1,3 and 5 (or until assumption)
n. Planted Vegetation - Node Coverage	Plot method created communities (wetlands, forest)	Summer (one round)	Years 1,3 and 5 (or until assumption)

9.4.2 RNHS Urban Interface and Boundary Integrity

Disturbance and boundary integrity monitoring should occur annually in the summer season after onset of construction in years 1,3 and 5 (or until assumption).

Encroachment monitoring will consist of walking all RNHS and urban interface boundaries. The locations of all encroachments into the RNHS will be recorded, photographed and location mapped in UTM coordinates and reported to the Town. The intended use of the Orlando Lands is commercial/business park and as such is not anticipated to be impacted by adjacent land uses as compared to areas that are developed for residential purposes. In addition, no public trails are proposed adjacent to RNHS areas, which will further limit encroachment opportunities within the Orlando Lands. Monitoring will look for, but not be limited to, the following activities within the RNHS (as applicable):

- Gates added to fencing dividing development lots from the RNHS;
- Cutting/manicuring of features;
- Deposits of landscaping waste and other debris; and
- Informal trails.

The RNHS/urban boundary will be monitored through a combination of field reconnaissance (walking the interface) and photo-monitoring plots. Photos should be taken within the growing seasons at the same time each year.

9.4.3 RNHS Monitoring Locations

RNHS monitoring locations are shown on **Figure 15** (**Appendix B1**). RNHS monitoring locations have been placed within retained and created RNHS features. Within retained features, sampling locations have been placed within the same location as pre-construction (baseline) stations to allow for comparison of collected data. Stations within the created habitats will be field-fit to ensure even distribution throughout created features. Specifically, sampling efforts within created habitats will focus within the constructed wetland and realigned channel.

Vegetation

Following the initiation of construction, a sampling event will be conducted in years 1, 3, 5 (or until assumption).

Three-season botanical inventories will be completed at the RNHS sampling locations within the retained and constructed vegetation communities. The plot method will be applied within the retained woodlands to compare and contrast ecological data and values. Within each node, three plots (one each for shrub, tree, groundcover) will be established within the vegetation community. Based on quantitative data collected, Floristic Quality Index (FQI) will be calculated. These surveys will also detect local species of significance and non-native/invasive species. During vegetation surveys, any situations of major dieback, evidence of damage due to pest or disease, and major hazards will be noted. Major infestations will be sampled and submitted for approved control methods. Should major infestations be identified; a joint management strategy with reviewing agencies will be reviewed.

In addition to the vegetation surveys described above, a qualified botanist will also perform transects through the restored and retained natural features twice during the growth season to monitor specifically for Category 1 and Category 2 invasive species (Urban Forest Associates Inc., 2002). Category 1 invasive species are the priority for management if they begin to colonize within newly created RNHS features. Management planning should commence promptly once specimens/colonies are discovered in new RNHS features (i.e., management may occur before 5% cover is reached). Within retained RNHS features the priority is to limit exposure and spread of existing populations of highly invasive species. As previously discussed, invasive management of European Buckthorn will occur within retained RNHS features (as discussed within **Section 7.2.2.4**).

Following RNHS planting, there is an initial period (3 to 5 years) for native vegetation cover to establish. This self-organizing period includes the expected presence of some level of non-native plant species, which may include some Category 2 (Urban Forest Associates Inc., 2002) species that may not necessarily trigger the need for active management depending upon observations during monitoring. Some of these Category 2 species will be shaded out over time, as is noted in the Town's Restoration Framework.

In keeping with guidance provided in the Town's Restoration Framework, a risk assessment will be performed to determine the current extent of the species, the risk of further spread, and undertake removals/eradication of significant spread is likely. High priority areas for management of Category 2 species, to limit spread, include areas within the vicinity of high-quality natural areas.

Some other non-native species are expected to occur in limited amounts and do not pose a threat to the RNHS. Many of these non-native species may occur initially at higher cover values within the created areas (5 to 10%) and then decrease naturally to trace amounts, without active management as the natural system establishes (e.g., Red Clover – *Trifolium pratense)*.

The Town's Restoration Framework provides for an RNHS that will be designed to be a resilient and self-organizing natural system comprised of numerous vegetation communities and specialized habitat features. Through detailed design, vegetative composition will be selected to be resilient and to enable it to respond and adapt to changing conditions (moisture regimes, nutrient contributions, light levels). As well, species across the spectrum of functional groups with different reproductive strategies will be selected (i.e., seed heavy annuals, colonial spread, root vs. shoot growth, large biomass producers). Within each guild and each functional group, redundancy (multiple species) will be provided. With this variety of species across functional groups and guilds there will be suitable species for each microhabitat, and, if conditions change (moisture, nutrients, light levels) there is another species present in the system that can occupy this space.

Breeding Birds

Breeding bird surveys will be completed in accordance with the OBBA protocol (two rounds per monitoring year between late May and early July at least ten days apart). The RNHS sampling locations are evenly distributed throughout the RNHS across a variety of habitats, with sampling stations similar to pre-construction sampling locations within the retained features. Monitoring locations may be refined, with input from CH, upon completion of the wetland creation and channel realignment.

Insects

Monitoring of butterflies and odonates will be completed on warm (>18°C), sunny, near windless days from 09:00 to 15:00 hours (Hall et al., 2014). Three temporal periods will be sampled: early May to mid-June; late-June to mid-July; early August to late August. This ensures that a maximum number of species' flight periods are sampled during the warmer months of the year (Catling and Brownell, 2000). Monitoring is required to monitor changes to butterfly and odonate species documented within the Orlando Lands. Following the initiation of construction, a sampling event should be conducted in years 1, 3 and 5 (or until assumption).

Fish Community Sampling

Fish community sampling will be completed in the realigned watercourse in the spring (when water is expected to be present). An additional fish community sampling event will be completed in summer (July) if water remains present in the channel.

Fish community sampling will be completed at two permanent monitoring stations, located within the RNHS monitoring nodes. The two stations will be located at the upstream and downstream extent of the realigned channel. Stations will be selected following Section 1 Module 1 of OSAP (Version 10; Stanfield 2017) and will be 40 m in length. Sampling will follow OSAP's single pass survey method (OSAP Module S3:M1). Fish will be identified to species level, enumerated and weighed before being returned to the channel, downstream from the sampling location. Additional information collected during sampling events will include water temperature, conductivity and pH measurements. All data recorded will be reported to the MNRF in accordance with the License to Collect Fish for Scientific Purposes requirements. Following the initiation of construction, sampling will be conducted annually in years 1, 3 and 5 (or until assumption).

Aquatic Habitat Assessment

Aquatic habitat assessments will be completed in conjunction with fish community sampling in the spring to assess the fish habitat characteristics within the realigned channel. Sampling will be completed at the two fish community sampling stations to compare fish sampling results with habitat availability. The aquatic habitat assessment will be completed in accordance with OSAP Module S4:M1 (Point-Transect Sampling for Channel Structure, Substrate and Bank Conditions). Stream characteristics such as stream morphology (riffles, runs, pools), channel bed and bank substrate, in-stream cover (e.g., woody debris, undercut banks), bank stability and in-stream and riparian vegetation communities will be assessed to determine the overall fish habitat available within the realigned channel, as well as understanding the suitability of habitat for providing a range of life cycle functions for the fish community. Aquatic habitat assessments will be conducted once annually in years 1, 3 and 5 (or until assumption).

Amphibian Call Count

Calling amphibian surveys will be completed in accordance with BSC's Marsh Monitoring Protocol (2003) (three rounds during late March to end of June at least 15 days apart). Proposed monitoring locations correspond with the RNHS monitoring nodes; however, efforts will be focused to wetland communities that provide suitable amphibian breeding habitat.

As discussed in Section 7.2.2.3.2, hydrological limitations may prevent the replicated wetland from being designed to support amphibian breeding, although opportunities will be explored at detailed design. Regardless of whether or not the replicated wetland is ultimately designed to provide amphibian breeding habitat, monitoring stations will be placed within the created wetland. If it is not designed to support amphibian breeding, the intent of monitoring will be to understand whether these wetlands are naturally providing breeding opportunities. If it is designed to support amphibian breeding, the intent of monitoring will be to confirm if amphibians are breeding in the feature.

Wetland Hydrology

Surveys will occur in years 1, 3, 5 (or until assumption).

Wetland hydrology will be monitored within the retained and created wetland communities. Stations will be selected through dialogue with CH at the detailed design stage. Monitoring of wetland hydrology will occur at an interval agreed upon with CH (i.e., spring freshet, mid-spring and late summer) and will include:

- Continuous water level measurement (using pressure transducer level loggers or an approved equivalent). It is recommended a staff-gauge is installed in conjunction with the level loggers for stage verification and calibration.
- Visual inspection for silt accumulation; and
- Visual inspection for active erosion.

Changes in vegetation canopy composition will also be visually assessed within each wetland where hydrology monitoring is completed.

- Post-construction hydrologic monitoring will be completed concurrently with the wetland hydrology monitoring in Year 1 (as discussed previously within **Section 9.4**). Wetland hydrology and hydrologic monitoring within the wetland areas are important to ensure that hydroperiods are maintained (for retained

features) and/or match intended hydroperiods (for created features).If hydroperiods are not maintained and/or matched, then adaptive management may be required (as discussed further within **Section 9.4.5**).

9.4.4 Planted Vegetation Performance Monitoring

In terms of monitoring the performance of planted vegetation, five performance measures have been identified in the Town's Restoration Framework:

1. Growth Rate (monitor in years 1, 3, 5, or until assumption);
2. Survivorship (monitor in years 1, 3, 5, or until assumption);
3. 'Free-to-grow' Performance (FTG) (monitor in years 1, 3,5, or until assumption);
4. Corridor Cover (monitor in years 3, 5, or until assumption); and
5. Node Coverage (monitor in years 3, 5, or until assumption).

The first three parameters will be addressed through the establishment of permanent plots placed in a random, stratified fashion within the various topographic sections of the realigned channel and buffers applied to retained woodlands/wetlands within vegetation restoration categories, e.g., shrub nodes, tree nodes. The precise location and number of plots will depend on the final number of constructed nodes. The monitoring sample will be statistically representative, in the range of 5-10% of the nodes per category and topographic location. The size and shape of the plots will depend on local planting nodes; however, the plots will be generally capped at 25 m^2 (the maximum area may change depending on the eventual average size of the planting nodes).

Within the plots, the following parameters will be recorded:

- Woody species cover-abundance within each stratum (shrubs, trees);
- Total cover of woody species;
- Total cover and species composition of herbaceous species;
- Cover of native and non-native herbaceous species;
- Number of woody stems (live and dead); and
- Height of woody stems.

Amongst other statistics, this approach will enable collection of necessary data to assess:

- Growth rate based on the height and cover-abundance of the species, broken down by size category;
- Survivorship based on live:dead counts and ratios across monitoring years, per species and per plant size; herbaceous and woody species quantitative data will be compared to the prescribed plant species list / stock size / densities / quantities to assess re-vegetation success (this information will be used to provide recommendations to benefit future RNHS design in the broader Milton area; mitigation measures will be proposed for any significant deficiencies (i.e., failed cover crop); and
- Free-to-grow based on height measurements of shrubs and trees.

Node coverage statistics will be generated from the permanent plot data.

9.4.5 Adaptive Management Plan

The Town's Restoration Framework summarizes targets, potential observations and recommended adaptive management actions related to the performance measures. Specific monitoring targets and appropriate adaptive management responses are identified in this Comprehensive Study and are summarized as follows.

Adaptive management has been defined as systematic approach to improve resource management by learning from management outcomes. Adaptive management is described as "a decision process that promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both

advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. Adaptive management also recognizes the importance of natural variability in contributing to ecological resilience and productivity. It is not a 'trial and error' process, but rather emphasizes learning while doing. Adaptive management does not represent an end in itself, but rather a means to more effective decisions and enhanced benefits. It's true measure is in how well it helps meet environmental, social and economic goals, increases scientific knowledge, and reduces tensions amongst stakeholders" (The U.S. Department of the Interior 2009).

Given that all potential deficiencies in the form and function of the proposed features can not be predicted, recommendations for adaptive management and any subsequent follow-up actions will be addressed through annual monitoring and reporting, as discussed below.

Vegetation Monitoring and Potential Adaptive Management Parameters

Growth Rate

The monitoring approach described in **Section 9.4.4** will enable collection of necessary data to assess growth rate based on height of woody species, size category and cover-abundance.

Target, potential outcome, and adaptive management actions in the Town's Restoration Framework Table 7 will be applied in-line with this monitoring approach.

Survivorship

The monitoring approach described in **Section 9.4.4** will enable collection of necessary data to assess survivorship based on live:dead counts and ratios over assigned monitoring years, per species and per plant size. Herbaceous and woody species quantitative data will be compared to the prescribed plant species list / stock size / densities / quantities to assess re-vegetation success (this information will be used to provide recommendations to benefit future RNHS design in the broader Milton area). Mitigation measures will be proposed for any significant deficiencies (i.e., failed cover crop).

Target, potential outcome and adaptive management actions in the Town's Restoration Framework Table will be applied in-line with this monitoring approach.

Free to Grow Performance

The monitoring approach described in **Section 9.4.4** will enable collection of necessary data to assess free-to-grow performance based on height measurements of shrubs and trees.

Target, potential outcome and adaptive management actions in the Town's Restoration Framework Table will be applied in-line with this monitoring approach.

Node Coverage

The monitoring approach described in **Section 9.4.4** will enable collection of necessary data to assess node coverage based on statistics generated from the permanent plot data.

Invasive Species

As discussed within **Section 9.4.4**, invasive management within the retained RNHS is not recommended due to the sensitivity of the features. Should monitoring identify new colonies of Category 1 invasive species within the created features (replicated wetland, buffer and realigned watercourse corridor), species-specific adaptive management plans will be prepared for those species that would be expected to be reasonably removed or the spread contained. Species-specific adaptive management plans (if required) will consider, among other things, the adaptive management guidance from Table 7 of the Town's Restoration Framework (Dougan & Associates 2015). Adaptive management will be discussed with reviewing agencies.

Wetland Hydroperiod Adjustment

Potential infrastructure alterations to achieve the target hydroperiod (e.g., installation of naturalized bioswales to convey water from the realigned channel into the created wetland units) may be considered if the targeted

hydroperiod of the created wetland is not met. Discussions with agencies would be required to determine whether this is warranted given monitoring results.

Disturbance and Encroachment

Where disturbance/encroachment into the RNHS is observed during post-construction monitoring efforts, photographs and documentation will be reported to the Town and appropriate reviewing agencies. Additional correspondence with the appropriate agencies will occur to determine follow-up actions.

9.5 Reporting

9.5.1 Annual Reporting Requirements

Following the implementation of restoration measures, annual monitoring reports are to be prepared summarizing the findings from the previous year. In general, these reports are not expected to contain detailed assessment or interpretation of data; however, they will summarize cumulative results from all disciplines. Discussion will be limited to general observations and summary of restoration activities and extent during the monitoring year; however, collaboration between the disciplines will occur. Specifically, both hydrology and ecology reports will discuss whether the targeted hydroperiods within the created and retained wetlands are achieved and whether adaptive management is required. Given that only one year of hydrogeology monitoring is recommended, detailed interpretation will be provided within the Year 1 report summarizing the hydroperiod data and comparing it to the targeted wetland hydroperiod requirements. Moreover, if in-stream channel erosion is observed during targeted aquatic ecology surveys this will be relayed onto the fluvial geomorphology team to inform their field investigations and reporting. In addition, these reports will include any required recommendations for modifications to the monitoring program, repair/rehabilitation work required, and system design modifications. The reports will be provided to CH on or before March 1 of each year, covering the monitoring from the previous calendar year.

9.5.2 Milestone Reporting

Milestone reports are proposed at year 2 and year 4 for the local monitoring programs for the individual development sites within the Subject Lands. These reports will include more detailed commentary on RNHS integrity, any perceived trends in the data collected, and general infrastructure (e.g., diversion swale from SWD3-3 community into realigned channel) performance. In addition, these reports will include any required recommendations for: modifications to the monitoring program, repair/rehabilitation work required, and system design modifications.

9.6 Monitoring Summary

Table 9-5 and **Figure 9-1** summarize the monitoring work plan for the North Porta lands.

Table 9-5 Monitoring Work Plan Summary

Category	What	Where	How	Frequency / Duration
Stormwater Management Facilities	Flow and Level	SWMF Inlets and Outlets	Continuous monitoring with pressure transducer, data logger – flow determined with level and stage-discharge relationship	Annually until 80% build-out of catchment area

Category	What	Where	How	Frequency / Duration
	Water Chemistry	SWMF Inlets and Outlets	Either automatic sampling, siphon monitor, or grab sampling Samples sent to lab for testing, parameters listed in **Table 9-1**	Annually until 80% build-out of catchment area Minimum 3 precipitation events per year
	Temperature	SWMF Inlets and Outlets, Watercourses upstream and downstream of Outlets	Continuous temperature sensor readings recorded by data logger	Annually until 80% build-out of catchment area
	Sediment Chemistry	Main Cells of SWMF	2 sediment (core) samples obtained from bottom of pond's main cell, tested for parameters listed in **Table** 9-2	Every 3 years until 80% build-out of catchment area Samples obtained and tested annually, in the fall after September 30
Fluvial Geomorphology / Erosion	Channel Movement	Pool-riffle sequences along realigned channel works	Baseline survey and reference point demarcation (permanent markers) Photo inventory and visual inspection Profile and pool/riffle cross-section surveys, bed substrate characterization	Commences upon completion of channel works for a period of 3 years Bi-annual inspection with annual surveys
Groundwater	Depth to Water Table	Retained features and nearby water users	Monitoring Wells and Piezometers	Water level recorded quarterly throughout construction period, and quarterly for 3-year post construction.
Natural Heritage System	Refer to **Table 9-4**			

10 CLOSING

In summary, this Comprehensive Study prepared for the proposed Milton North Porta employment lands in Milton, Ontario has provided the following:

- Documented all relevant background information.
- Established goals and objectives for the study area at the subwatershed level.
- Inventoried the existing natural heritage, aquatic habitat, watercourses, surface water and groundwater systems in and around the study area.
- Identified opportunities and constraints, which informed the development of a comprehensive subwatershed management strategy.
- Completed an impact assessment to verify that the subwatershed management strategy will adequately mitigate impacts and achieve the goals and objectives established for the study area.
- Developed the management plan to a functional level of detail for Parcels 1 and 4, which are owned by Orlando Corporation. This included preliminary designs for the realignment of Tributary R3S1, stormwater management facilities, infiltration areas and wetland restoration areas, and plans to bring water and sanitary services to the study area.
- Prepared a plan for implementation of the management strategy, including monitoring and adaptive management.

Sincerely,

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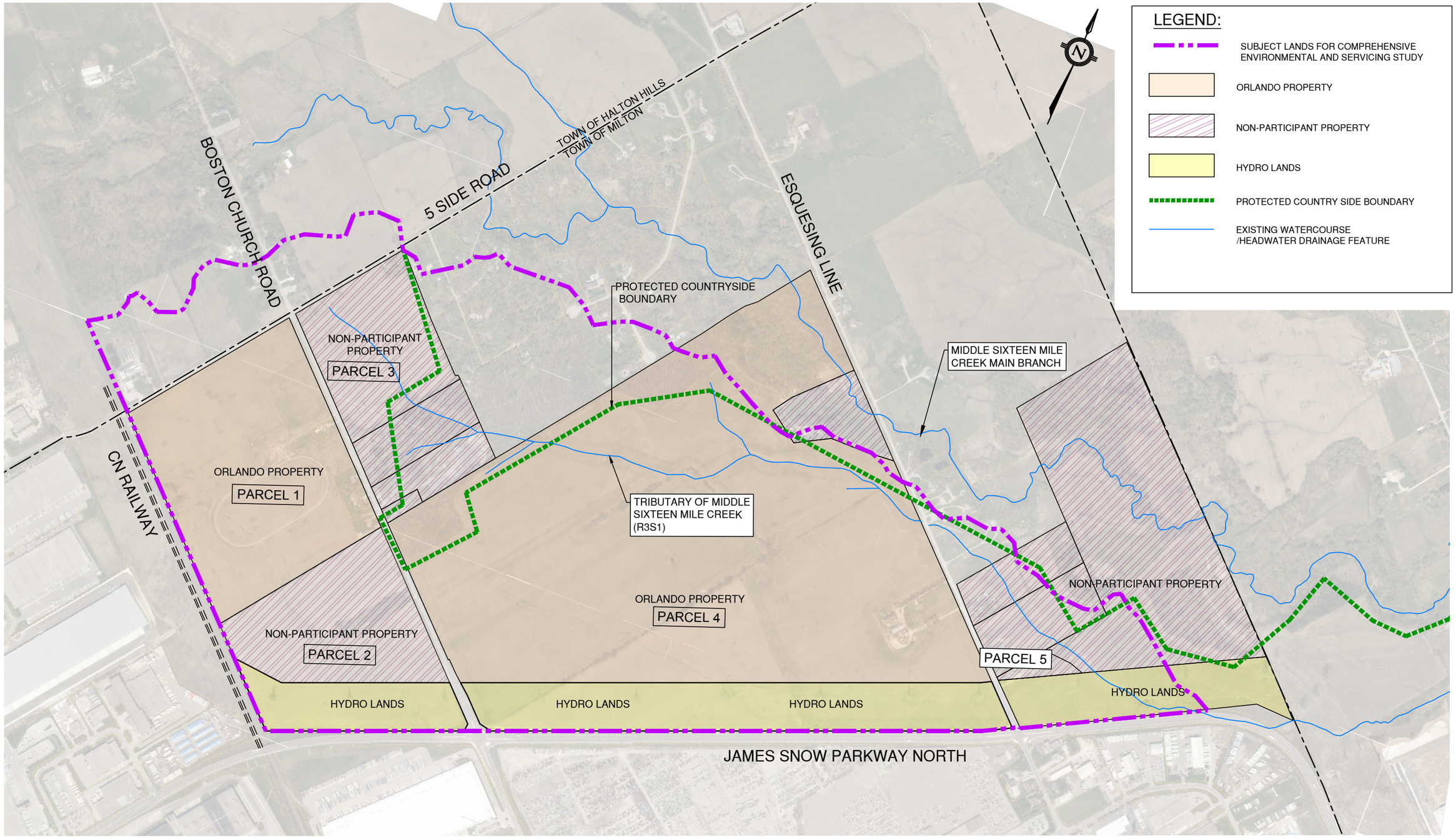
FIGURES



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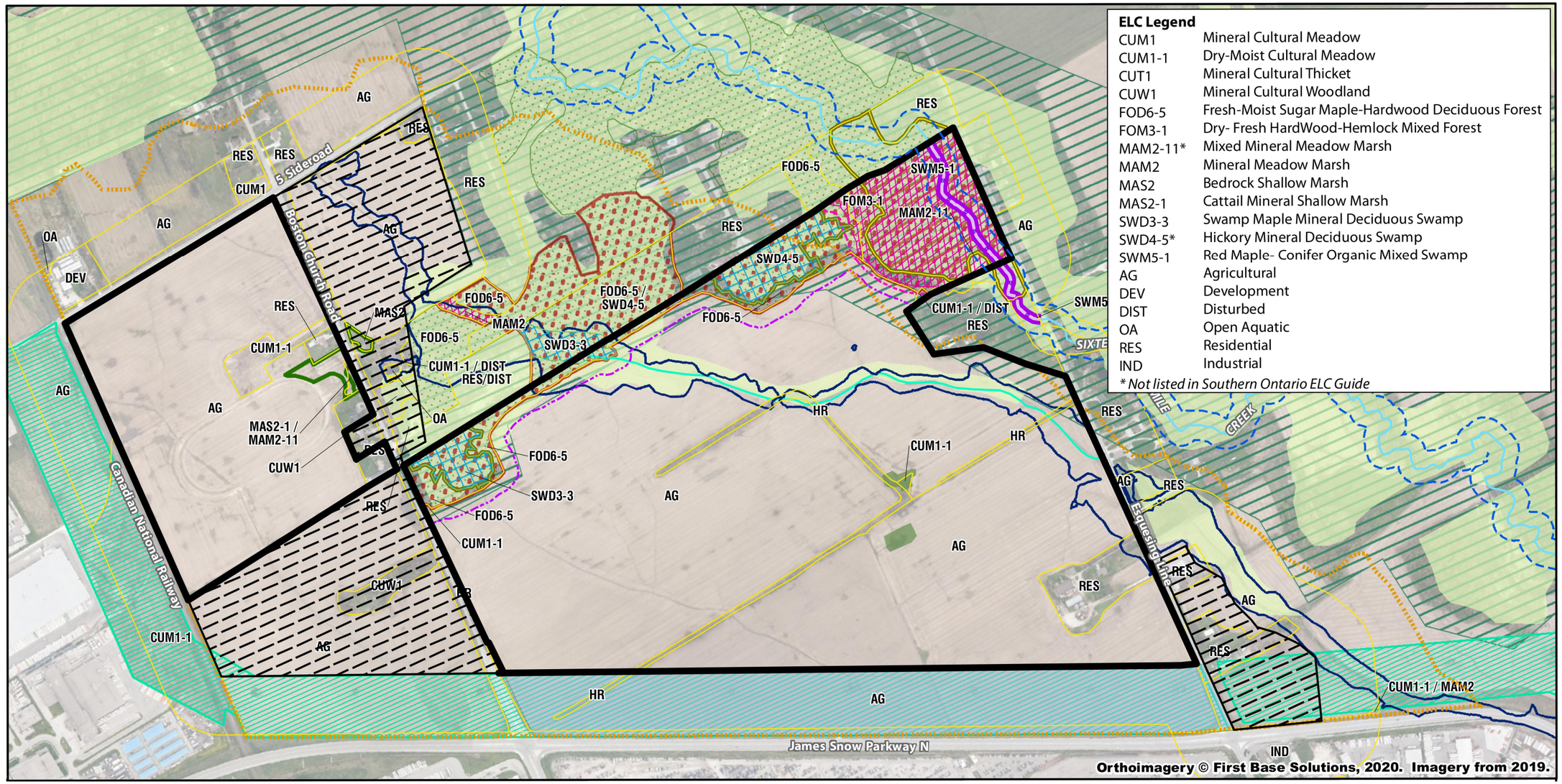
ORLANDO - NORTH PORTA
COMPREHENSIVE ENVIRONMENTAL AND SERVICING STUDY
STUDY AREA & OWNERSHIP

SCALE: 1:10000			PROJECT No. 17197
DATE: APRIL 2022			
DESIGNED BY: E.T	DRAWN BY: E.T.		FIGURE No. 1-1
CHECKED BY: T.D.	CHECKED BY: T.D.		



Orlando Lands
Non-participating Lands
Subject Lands For Comprehensive Environmental Servicing Study
Ecological Land Classification
Floodlines (TMIG 2021)
NHS Staked Limit (Greater of Significant Woodland and/or Regionally Significant Wetland)
Staked Top of Bank (Candidate Significant Valleyland)
Candidate Significant Valleylands
Significant Woodlands

Regionally Significant Wetlands
Permanent, Direct Fish Habitat

Significant Wildlife Habitat

Habitat for Species of Conservation Concern Eastern Wood-Pewee
Candidate Bat Maternity Colonies Habitat
Rare Vegetation Type
Candidate Turtle Overwintering Habitat
Habitat for Species of Conservation Concern (Snapping Turtle)
Candidate Terrestrial Crayfish Habitat

Other Components of the RNHS

Linkage (as defined by Regional NHS)
Environmental Linkage Area (Town of Milton OP)
Other Wetlands
Key Features (Halton OP Map 1G, Approximate)
Enhancement Areas, Linkages and Buffers Key Features (Halton OP Map 1G, Approximate)
Greenbelt Protected Countryside

Natural Feature Buffers/Vegetation Protection Zones

NHS Staked Limit (Greater of Significant Woodland and/or Regionally Significant Wetland) +30 m
Staked Top of Bank (Candidate Significant Valleyland) +15 m
Direct Fish Habitat +30m

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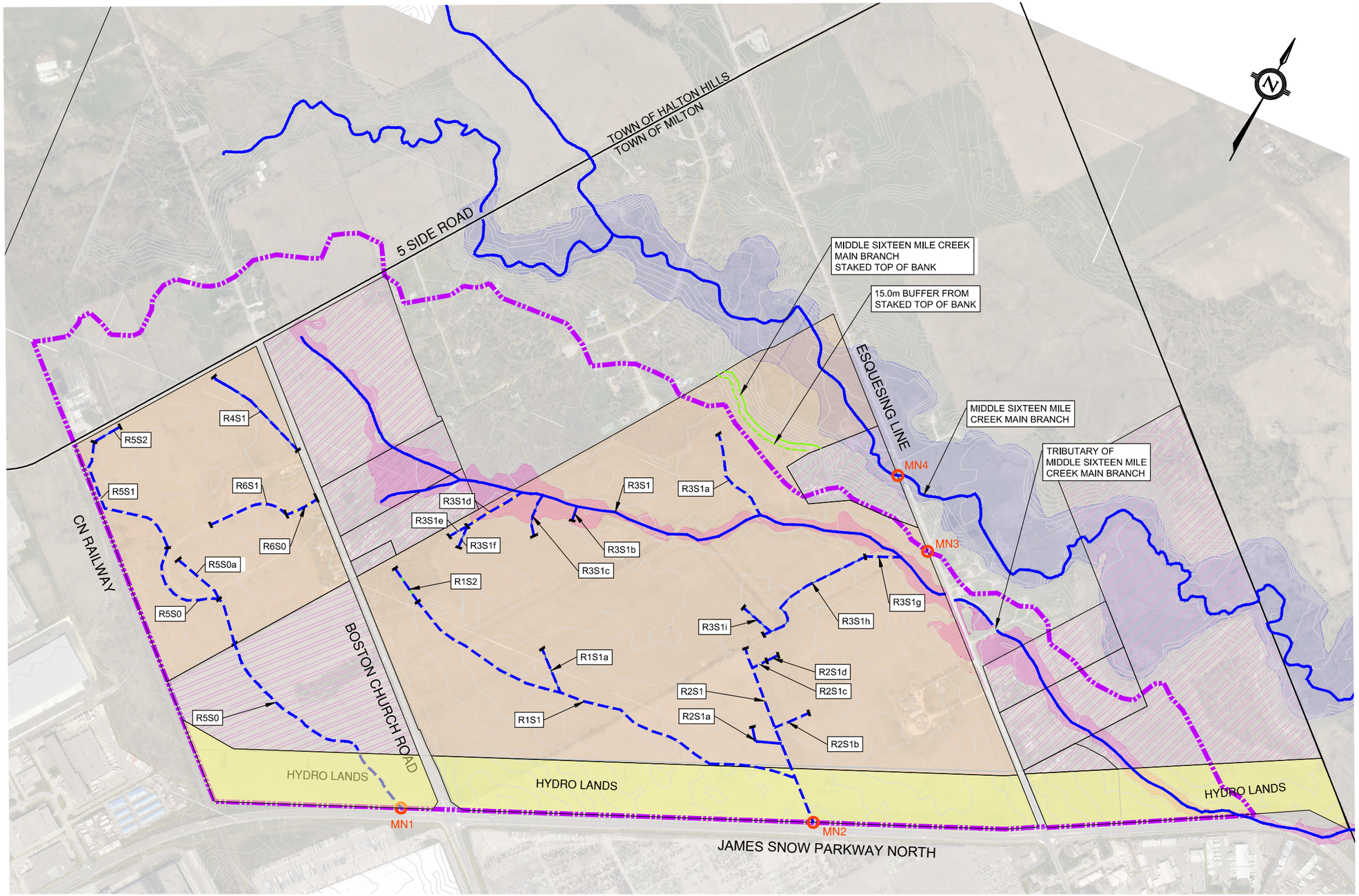
ORLANDO - NORTH PORTA
COMPREHENSIVE ENVIRONMENTAL AND SERVICING STUDY
REGIONAL NATURAL HERITAGE FEATURE COMPONENTS

SCALE: N.T.S		PROJECT No.	17197
DATE: APRIL 2022			
DESIGNED BY: E.T	DRAWN BY: E.T.	FIGURE No.	4-1
CHECKED BY: T.D.	CHECKED BY: T.D.		



LEGEND:

- SUBJECT LANDS FOR COMPREHENSIVE ENVIRONMENTAL AND SERVICING STUDY
- ORLANDO PROPERTY
- NON-PARTICIPANT PROPERTY
- HYDRO LANDS
- EXISTING WATERCOURSE
- EXISTING HEADWATER DRAINAGE FEATURES
- STAKED TOP OF BANK
- 15.0m BUFFER FROM STAKED TOP OF BANK
- GENERIC FLOODPLAIN MAPPING (CONSERVATION HALTON)
- EXISTING REGULATORY FLOODPLAIN MAPPING (TYLIN)
- MN1 — SURFACE WATER MONITORING STATION

OFFSITE HEADWATER DRAINAGE FEATURE, TO BE EVALUATED DURING SITE SPECIFIC APPLICATIONS

FLOODLINE HAZZARD MAPPING IS PROVIDED BY CONSERVATION HALTON ON NOVEMBER 2017

FLOODLINE HAZZARD MAPPING ALONG REACH 1 OF 16MILE MIDDLE CREEK (REACH R3S1) IS GENERATED BY TYLIN USING THE UPDATED EXISTING HYDROLOGIC MODEL FLOWS AND GIS TOPOGRAPHIC INFORMATION PROVIDED BY CONSERVATION HALTON ON NOVEMBER 2017

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ORLANDO - NORTH PORTA
COMPREHENSIVE ENVIRONMENTAL AND SERVICING STUDY
EXISTING WATERCOURSES AND HEADWATER FEAURES

SCALE: 1:10000		PROJECT No.	17197
DATE: APRIL 2022			
DESIGNED BY: E.T	DRAWN BY: E.T.	FIGURE No.	4-2
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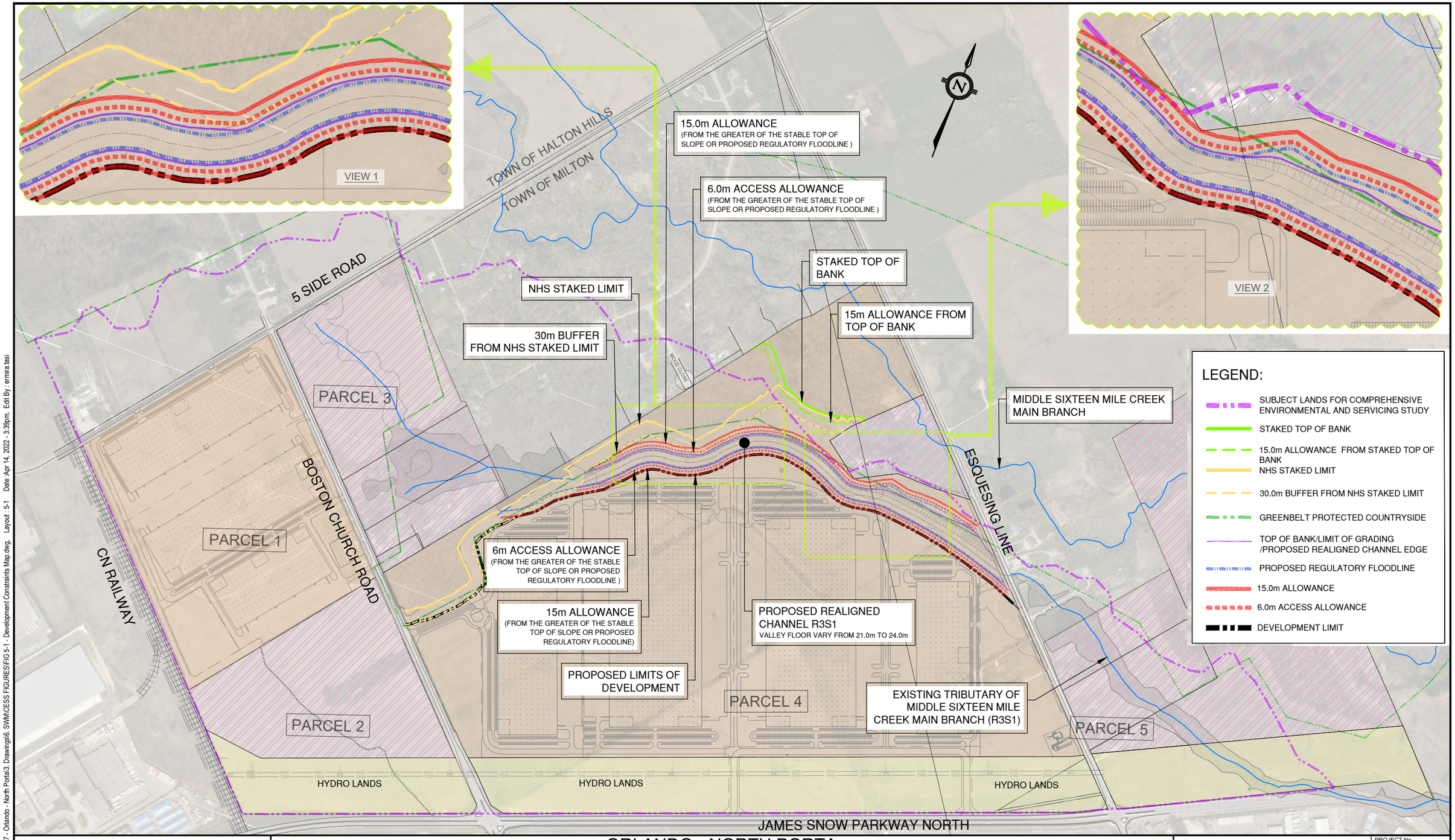

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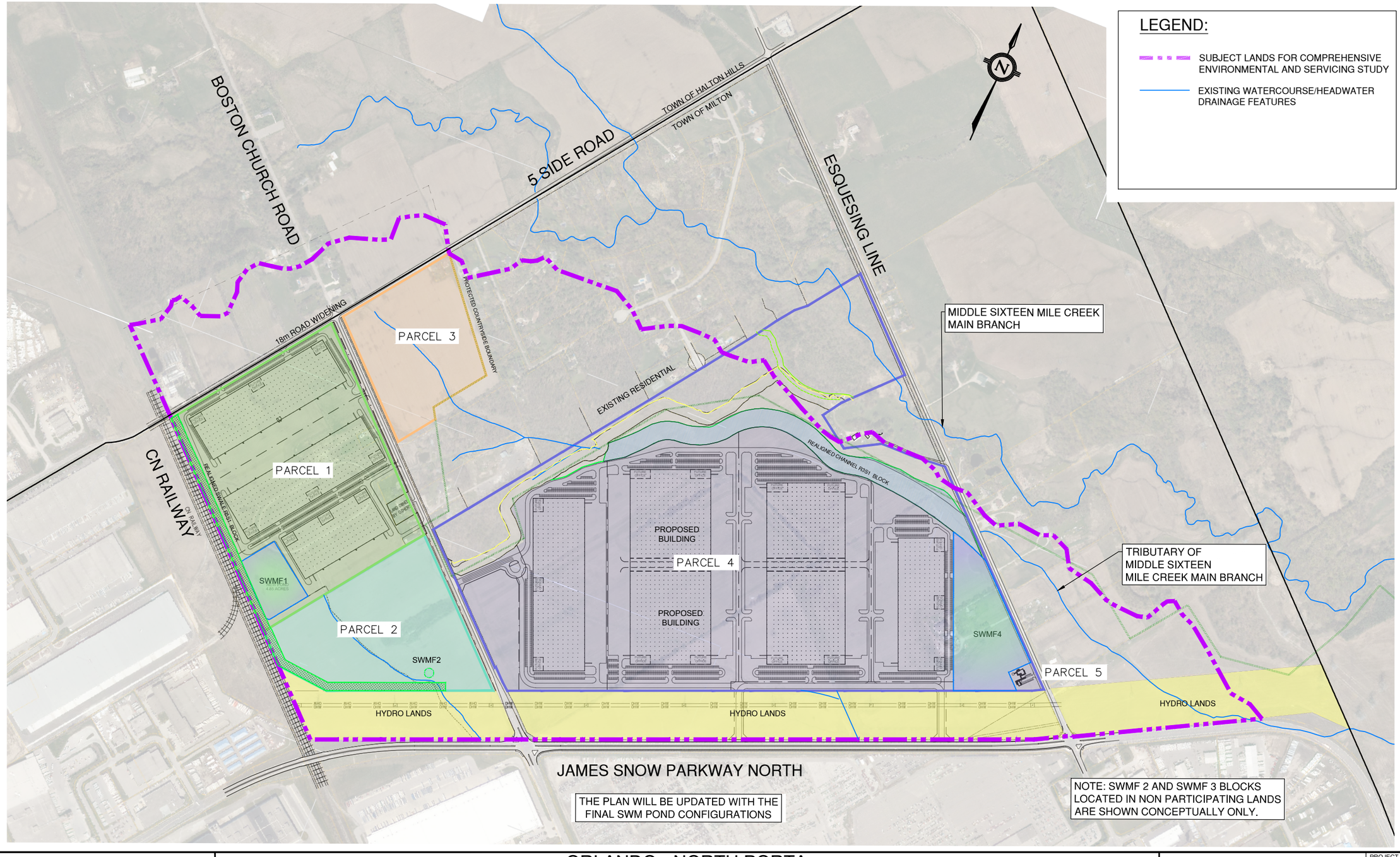
ORLANDO - NORTH PORTA
COMPREHENSIVE ENVIRONMENTAL AND SERVICING STUDY
DEVELOPMENT CONSTRAINTS MAPPING

SCALE: N.T.S		PROJECT No.	17197
DATE: APRIL 2022			
DESIGNED BY: E.T	DRAWN BY: E.T.	FIGURE No.	5-1
CHECKED BY: T.D.	CHECKED BY: T.D.		



File : G:\Projects\2017\17197 - Orlando - North Porta\3. Drawings\6. SWM\CESS FIGURES\FIG 5-2 - Proposed Development Plan.dwg, Layout : 5-2 Date : Apr 14, 2022 - 4:23pm, Edit By : emira tasi

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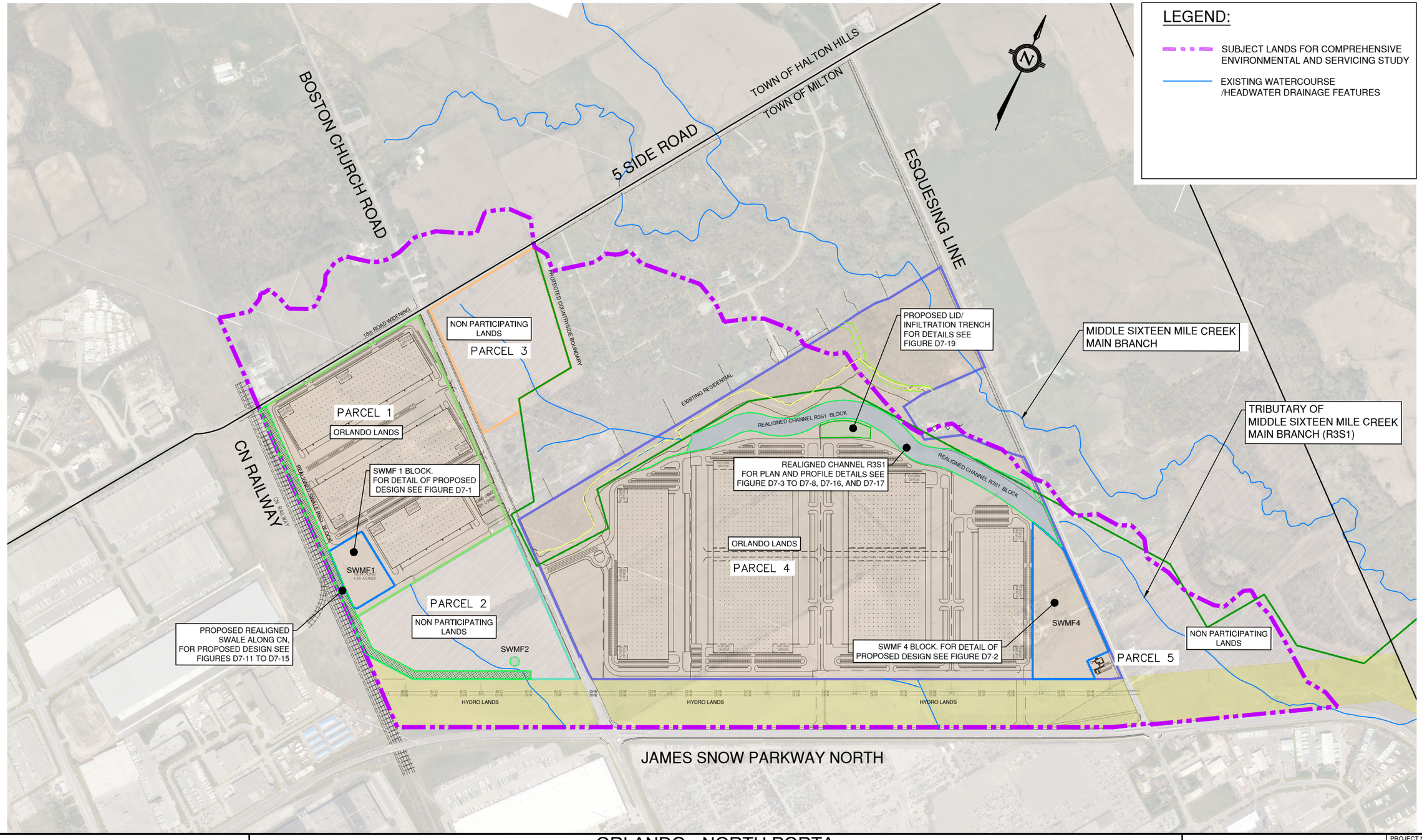
ORLANDO - NORTH PORTA
COMPREHENSIVE ENVIRONMENTAL AND SERVICING STUDY
PROPOSED DEVELOPMENT PLAN

SCALE: 1:10000			PROJECT No. 17197
DATE: APRIL 2022			
DESIGNED BY: E.T	DRAWN BY: E.T.		FIGURE No. 5-2
CHECKED BY: T.D.	CHECKED BY: T.D.		



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ORLANDO - NORTH PORTA
COMPREHENSIVE ENVIRONMENTAL AND SERVICING STUDY
OVERVIEW OF WATERCOURSE MANAGEMENT AND STORMWATER MANAGEMENT

SCALE: 1:10000		PROJECT No.	17197
DATE: APRIL 2022			
DESIGNED BY: E.T	DRAWN BY: E.T.	FIGURE No.	7-1
CHECKED BY: T.D.	CHECKED BY: T.D.		

OVERALL LEGEND:

- SUBJECT LANDS FOR COMPREHENSIVE ENVIRONMENTAL AND SERVICING STUDY
- EXISTING WATERCOURSE/HEADWATER DRAINAGE FEATURES
- ORLANDO PROPERTY
- NON-PARTICIPANT PROPERTY
- HYDRO LANDS
- PROTECTED COUNTRY SIDE BOUNDARY

MONITORING LOCATION LEGEND:

- FLUVIAL GEOMORPHOLOGY MONITORING LOCATION
- SWM POND MONITORING LOCATION
  - FLOW/ LEVEL AT INLETS AND OUTLETS
  - WATER CHEMISTRY AT INLETS AND OUTLETS
  - TEMPERATURE AT INLETS AND OUTLETS
  - SEDIMENT CHEMISTRY OF MAIN CELLS
- NHS/ECOLOGY MONITORING STATIONS
  - BREEDING BIRD POINT STATIONS
  - AQUATIC SURVEY LOCATIONS
  - AMPHIBIAN CALL COUNT STATIONS
  - VEGETATION STATIONS
  - WETLAND HYDROLOGY STATIONS
- GROUNDWATER AND WETLAND WATER LEVEL MONITORING LOCATIONS
  - MINI-PIEZOMETER
  - MONITORING WELL
  - INFILTRATION LID

TOWN OF HALTON HILLS
TOWN OF MILTON
5 SIDE ROAD
MIDDLE SIXTEEN MILE CREEK MAIN BRANCH
ESQUESING LINE
18m ROAD WIDENING
NON PARTICIPATING LANDS
PROTECTED COUNTRYSIDE BOUNDARY
EXISTING RESIDENTIAL
REALIGNED CHANNEL RS1 BLOCK
REALIGNED CHANNEL RS5+ BLOCK
CN RAILWAY
ORLANDO LANDS
BOSTON CHURCH ROAD
REALIGNED SWALE RS5↑ BLOCK
SWMF1
SWMF2
SWMF4
HYDRO LANDS
TRIBUTARY OF MIDDLE SIXTEEN MILE CREEK MAIN BRANCH
JAMES SNOW PARKWAY NORTH
1
2
3
4

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ORLANDO - NORTH PORTA
COMPREHENSIVE ENVIRONMENTAL AND SERVICING STUDY
MONITORING AND ADAPTIVE MANAGEMENT PLAN

SCALE: 1:10000		PROJECT No.	17197
DATE: APRIL 2022			
DESIGNED BY: E.T	DRAWN BY: E.T.	FIGURE No.	9-1
CHECKED BY: T.D.	CHECKED BY: T.D.		

File : G:\Projects\2017\17197 - Orlando - North Porta\3. Drawings\6. SWM\CESS FIGURES\FIG 9-1 - Monitoring and Adaptive Management Plan.dwg, Layout : 9-1 Date: Apr 14, 2022 - 4:14pm, Edit By : ermira.tasi