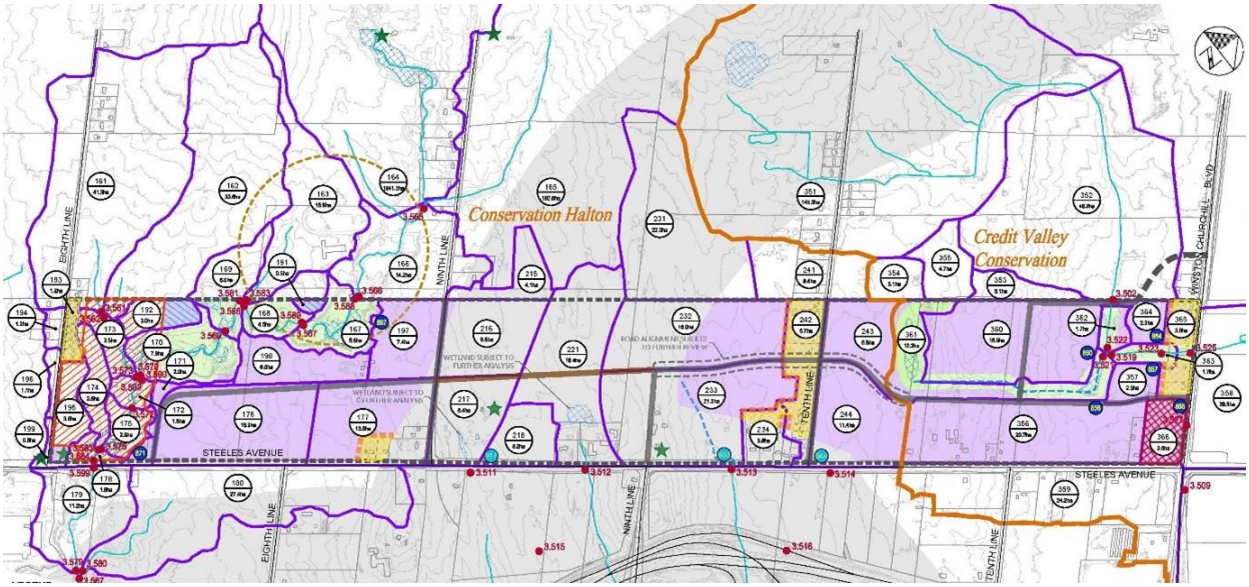
Town of Halton Hills

Premier Gateway Phase 2B Scoped Subwatershed Study

Phase 3: Implementation and Monitoring

November 15, 2023 Final



Premier Gateway Phase 2B Scoped Subwatershed Study

Phase 3: Implementation and Monitoring

Town of Halton Hills

Final

Project No.: WW20101004
Date: November 15, 2023

WSP E&I Canada Limited
3450 Harvester Road
Burlington, ON
Canada L7N 3W5

wsp.com

Revision History

FIRST ISSUE

April 21, 2023	Draft release of Phase 3 report	
Prepared by	Reviewed by	Approved by
Amin Azarkhish (WSP) Abhijeet Patel (WSP) Aaron Farrell (HDR)	Matt Senior (WSP)	Matt Senior (WSP)

REVISION 1

May 12, 2023	Revised per Town Comments	
Prepared by	Reviewed by	Approved by
Amin Azarkhish (WSP) Abhijeet Patel (WSP) Aaron Farrell (HDR)	Matt Senior (WSP)	Matt Senior (WSP)

DRAFT FINAL

October 10, 2023	Revised as per agency Comments	
Prepared by	Reviewed by	Approved by
Abhijeet Patel (WSP) Aaron Farrell (HDR)	Matt Senior (WSP)	Matt Senior (WSP)

FINAL

November 15, 2023	Revised as per agency Comments	
Prepared by	Reviewed by	Approved by
Abhijeet Patel (WSP) Aaron Farrell (HDR)	Matt Senior (WSP)	Matt Senior (WSP)

Signatures

Approved[1] by (must be reviewed for technical accuracy prior to approval)

November 15, 2023

Per: Matt Senior, M.A.Sc., P.Eng.
Associate, Senior Water Resources Engineer
WSP E&I Canada Limited

Date:

WSP E&I Canada Ltd. (WSP) prepared this report solely for the use of the intended recipient, Town of Halton Hills, in accordance with the professional services agreement. The intended recipient is solely responsible for the disclosure of any information contained in this report. The content and opinions contained in the present report are based on the observations and/or information available to WSP at the time of preparation. If a third party makes use of, relies on, or makes decisions in accordance with this report, said third party is solely responsible for such use, reliance or decisions. WSP does not accept responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken by said third party based on this report. This limitations statement is considered an integral part of this report.

The original of this digital file will be conserved by WSP for a period of not less than 10 years. As the digital file transmitted to the intended recipient is no longer under the control of WSP, its integrity cannot be assured. As such, WSP does not guarantee any modifications made to this digital file subsequent to its transmission to the intended recipient.

[1] Approval of this document is an administrative function indicating readiness for release and does not impart legal liability on to the Approver for any technical content contained herein. Technical accuracy and fit-for-purpose of this content is obtained through the review process. The Approver shall ensure the applicable review process has occurred prior to signing the document.

Contributors

Client

Project Manager (Town of Halton Hills)	Melissa Ricci
Project Manager (Macaulay Shiomi Howson)	Lorelei Jones

WSP

Project Manager	Matt Senior
Water Resources Engineer	Amin Azarkhish
Hydrology/Hydraulics & Water Quality	Abhijeet Patel
Air and Noise	Linda Lattner
Proof (non-technical) / Format	Melinda Nowak

Subconsultants

HDR (legacy WSP) Project Manager/Water Resources Lead	Aaron Farrell
Natural Resources Solutions Inc., Terrestrial and Aquatic Ecology	Katharina Richter
Natural Resources Solutions Inc, Terrestrial and Aquatic Ecology	Nathan Miller
Blackport and Associates, Groundwater	Bill Blackport
Matrix Solutions Inc., Groundwater	Jeff Melchin
Matrix Solutions Inc., Fluvial Geomorphology	John McDonald
Matric Solutions Inc., Fluvial Geomorphology	Natasha Cyples

TABLE OF CONTENTS

Tables

Figures

Appendices

1 INTRODUCTION

The Premier Gateway Phase 2B Lands lie at the southern limit of the Town of Halton Hills and are generally bounded by Steeles Avenue to the south and agricultural lands to the north, between Winston Churchill Boulevard to the east and Eighth Line to the west. The study area straddles the boundary between the Sixteen Mile Creek Watershed in Conservation Halton jurisdiction, and the Mullet Creek Subwatershed of the Credit River Watershed in CVC jurisdiction. In 2020, the Town of Halton Hills initiated the Premier Gateway Phase 2B Employment Area Integrated Planning Project. This Project represents an integrated planning project that involves both secondary planning and the completion of a Scoped Subwatershed Study.

The Scoped SWS has been established as a three-phase process, as follows:

Phase 1: Study Area Characterization

Phase 2: Impact Assessment and Management Strategy

Phase 3: Implementation and Monitoring

The Draft Phase 1 Report was completed in June 2021 and presented to the Technical Advisory Committee for review and comments. Comments received from the representatives of the Committee and associated responses and actions provided by the Town's Consulting Team are provided in Appendix 'A' of the Phase 2 report. The Draft Phase 1 Report has been updated on the basis of these comments during final reporting.

The Draft Phase 2 Report was completed in May 2022 and presented to the Technical Advisory Committee for review and comments. The Draft Phase 2 Report includes relevant information regarding the key findings from the Phase 1 Study Area Characterization, related to the overall characterization of the study area, which has informed the development of the management and implementation plan accordingly. Comments received from the representatives of the Technical Advisory Committee, and associated responses and actions provided by the Town's Consulting Team, regarding the Phase 2 report, are provided in **Appendix A** of this report, along with correspondence summarizing supplemental analyses and the information requested by Conservation Halton and Halton Region subsequent to the submission and review of the Draft Phase 2 Report. The Draft Phase 2 Report has been updated on the basis of these comments during final reporting and has incorporated the supplemental information accordingly.

This report summarizes the results and recommendations associated with Phase 3: Implementation and Monitoring of the Scoped Subwatershed Study Process. Additional information is also provided regarding the supplemental investigations and refinements to the characterization and management plan, completed subsequent to the submission of the Phase 1 and Phase 2 reports. Furthermore, it is noteworthy that the land use plan presented in this Phase 3 report incorporates revisions to the extent of the GTA West Corridor, as provided by the Province subsequent to the completion of the Phase 2 reporting.

2 MANAGEMENT PLAN

2.1 Introduction

As part of the Phase 2 Impact Assessment and Management Strategy, a set of recommendations has been developed to manage the area's watercourses and terrestrial features, as well as for managing storm runoff from future urban development. The Management Plan, presented herein, has been divided by watershed area, into the Sixteen Mile Creek Watershed and the Credit River Watershed. The recommendations related to the Sixteen Mile Creek Watershed include recommendations for the portions of the study area within the East Sixteen Mile Subwatershed, the most prominent natural corridor within the study area, as well as the East Lisgar Branch that drains into Middle Sixteen Mile Creek approximately 13 km downstream, south of Drumquin. The recommendations related to the Credit River Watershed are specifically for the portion of the study area within the Mullet Creek Subwatershed which flows into the Credit River approximately 13 km downstream, south of Burnhamthorpe Road West in Mississauga. The Sixteen Mile Creek watershed is regulated by Conservation Halton (CH); the Mullet Creek Subwatershed is regulated by Credit Valley Conservation (CVC).

2.2 Stormwater Management for Sixteen Mile Creek

Stormwater management for the portion of the Premier Gateway Phase 2B area within the Sixteen Mile Creek Watershed is required to address the following criteria:

- Provide extended detention storage for erosion control along receiving watercourses.
- Control post-development flows to pre-development levels at key locations within, and downstream of, the Premier Gateway Phase 2B Lands, for all events up to, and including, the Regional Storm (Hurricane Hazel) event.
- Provide stormwater quality control to an “Enhanced” standard of treatment, per current Provincial guidelines (ref. MOE, 2003), and address thermal enrichment of urban storm runoff.
- Incorporate Low Impact Development Best Management Practices (LID BMPs) to maintain pre-development groundwater recharge and reduce post-development runoff volumes.

The following technologies and practices are available to address the stormwater management criteria noted in the foregoing:

TSS removal as per MOE\MECP criteria:

- Wet end-of-pipe facilities (i.e., wetlands, wet ponds, hybrid facilities).
- Vegetated technologies (i.e., grassed swales, buffer strips, etc.).
- Oil / grit separators, when applied in series with other measures per current practice in Conservation Halton jurisdiction.
- Bioswales / biofilters.

For Thermal Control:

- Low Impact Development (LID) infiltration Best Management Practices (BMP)s
- Urban terrestrial canopy (also NHS)
- Facility shading (includes orientation and length / width ratio)
- Facility cooling trenches
- Facility bottom draws
- Stormwater management facility orientation
- Narrow stormwater management facility configuration (i.e., greater longitudinal length-to-width ratio)
- Concrete Sewer System
- Underground Storage Facilities
- Green & White roofs
- Floating Islands
- Other measures

For Salt Management:

- Bottom draws / submerged outlets
- Salt management plans

For Erosion Control:

- End-of-pipe facilities (i.e., wetlands, wet ponds, hybrid facilities, dry ponds).
- LID infiltration-based BMPs (i.e. bioswales / biofilters with underdrains, infiltration trenches, rain gardens, perforated pipes, etc.).

For Flood / Quantity Control:

- End-of-pipe facilities (i.e., wetlands, wet ponds, hybrid facilities, dry ponds).
- Underground Storage Facilities
- Surface storage (i.e., rooftop / parking lot storage)

In general, the selection of the appropriate stormwater management practice is dependent upon the size (i.e., drainage area) and land use conditions within the proposed development area draining to the specific stormwater management facility. The following general principles have been applied in developing the recommended stormwater management plan for the portion of the Premier Gateway Phase 2B Lands within the Sixteen Mile Creek Watershed:

1. Wet end-of-pipe facilities are preferred, due to their ability to address multiple stormwater management requirements (i.e., quantity, quality, thermal mitigation, and erosion control).
2. The stormwater management system for the GTA West Corridor is not to be integrated with the stormwater management for the balance of the development, in accordance with the requirements of MTO.
3. Where drainage areas are insufficient to support an end-of-pipe facility (i.e., generally drainage areas less than 5 ha), source controls (i.e., underground storage, surface storage, LID BMPs, oil / grit separators, vegetated technologies, etc.) are to be applied; LID BMPs and oil / grit separators are to be implemented as part of a treatment train approach for stormwater management.
4. LID BMPs are to be applied throughout the development area and sized for maintaining pre-development groundwater recharge (estimated capture volumes of 1 – 3 mm/impervious ha).
5. Stormwater management solutions are not to result in a negative impact to the Phase 2B Natural Heritage System.
6. Regional Storm controls are to be incorporated into the design of wet end-of-pipe facilities draining toward the East Lisgar Branch, however, are not required for areas draining toward the Sixteen Mile Creek East Branch.

Opportunities to utilize naturalized outlet designs, green infrastructure, and LIDs adjacent to the NHS are to be considered at detailed design.

It is noted that draft guidelines recently issued by MECP provide further direction for the implementation of LID BMPs, and the design of these systems accordingly. At the time that the guidelines are implemented into industry practice, they should be considered during the selection of SWM technologies.

The recommended stormwater management plan is presented in **Drawing WR-1**, which has been updated from that presented in the Phase 2 report (ref. Drawing WR-7) to reflect the updated GTA West Transportation Corridor from the Province. As indicated by the drawing, some of the facilities may be located within the limits of the GTA West Study Area, subject to confirmation of the limits of the MTO right-of-way and coordination between the landowner and MTO through subsequent stages of planning and design. Further, as indicated within the land use information, the western limit of the study area has been designated as a Special Policy Area. The Secondary Planning and supporting studies for the subject lands, referred to as the Gilbach property, have followed a separate but parallel process to the balance of the Premier Gateway Phase 2B lands and this Scoped Subwatershed Study, hence the recommendations for the Gilbach property are provided under separate cover. The following sections provide further details regarding the stormwater management plan for the Premier Gateway Phase 2B lands. The unitary sizing criteria and corresponding stormwater management facility sizing are to be verified and refined as part of future studies.

2.2.1 Erosion Control

Unitary storage and discharge criteria have been established as part of the Phase 2 Impact Assessment to mitigate erosion impacts at key locations within, and downstream of, the Premier Gateway Phase 2B Lands. These criteria have been developed, premised upon providing extended detention storage within the end-of-pipe facilities to maintain the duration of critical flow exceedance to pre-development levels. The unitary storage and discharge requirements within the end-of-pipe facilities for erosion control are presented in **Table 2.2.1.**

Table 2.2.1: Stormwater Management Facility Sizing Criteria for Erosion Control for Premier Gateway Phase 2B Lands – Sixteen Mile Creek Watershed

Operating Condition	Unitary Storage (m^3/impervious ha)	Unitary Discharge (m^3/s/ha)
Sixteen Mile Creek East Branch		
Extended Detention	400	0.00103
Lisgar District (Node 3.511)		
Extended Detention	275	0.0011
Lisgar District (Node 3.513)		
Extended Detention	275	0.0012
Lisgar District (Node 3.514)		
Extended Detention	275	0.0015

2.2.2 Flood Control and Regional Storm Control

Unitary storage and discharge criteria have similarly been established as part of the Phase 2 Impact Assessment to mitigate increased peak flows at key locations within, and downstream of, the Premier Gateway Phase 2B Lands, resulting from the future development, for all events up to, and including, the Regional Storm (Hurricane Hazel) event. The unitary storage and discharge requirements within the end-of-pipe facilities for flood control is presented in **Table 2.2.2.** The unitary storage and discharge requirements presented in **Table 2.2.2** are considered the best available information and are to be verified and refined as appropriate as new information becomes available either through refinements at the site-specific (SIS) level using topographic surveys and technical studies, or as new watershed-level data and technical analyses become available.

Table 2.2.2: Stormwater Management Facility Sizing Criteria for Flood Control – Sixteen Mile Creek Watershed

Operation Condition[1.]	Unitary Storage (m^3/impervious ha)[2.]	Unitary Discharge (m^3/s/ha)
Sixteen Mile Creek East Branch		
25 Year	700	0.0043
100 Year	1000	0.0118
Lisgar District (Node 3.511)		
25 Year	750	0.0033
100 Year	1150	0.0144
Regional	1995	0.0380
Lisgar District (Node 3.513)		
25 Year	750	0.0042
100 Year	1,150	0.0127
Regional	1,975	0.0471
Lisgar District (Node 3.514)		
25 Year	700	0.0075
100 Year	1000	0.0129
Regional 1	1300	0.0294
Regional 2	1815	0.0540

NOTE: [1]Ordinates provided below correspond to key operating conditions for designing outlet structure. Ordinates for 2 year, 5 year, 10 year, and 50 year control may be interpolated from control ordinates provided above.

[2]Cumulative unitary volumes are inclusive of extended detention storage requirements for erosion control (ref. Table 2.2.1).

2.2.3 Stormwater Quality Control

Stormwater quality control for the future development within the Premier Gateway Phase 2B Lands is required to control runoff to an “Enhanced” standard of treatment, per current Provincial standards (ref. MOE, 2003). Wet ponds have been advanced, as the recommended type of end-of-pipe facility for providing stormwater management within the Premier Gateway Phase 2B Lands, due to the opportunities to incorporate multiple stormwater management functions within the facility (i.e., stormwater quality, erosion, and quantity / flood control). The estimated permanent pool and extended detention storage volumes for the end-of-pipe facilities within the Premier Gateway Phase 2B Lands are presented in **Table 2.2.3**, based upon current Provincial Criteria (ref. MOE 2003) for stormwater quality control, and the sizing criteria for flooding and erosion control presented in **Table 2.2.1** and **Table 2.2.2.** The corresponding storage-discharge relationships for the stormwater management facilities are provided in Appendix B.

As noted previously, source controls are recommended for sites which are insufficient to support a wet end-of-pipe facility (i.e., generally for sites less than 5 ha in size). The candidate sites for implementing source controls are presented in **Drawing WR-1**.

2.2.4 Runoff Volume Reduction

As noted previously, the draft Provincial Criteria for stormwater management requires stormwater management practices to include measures to manage the 90th percentile event (i.e., 29 mm for Halton Hills) for future land use conditions. Additional guidance regarding the methods for managing runoff from the 90th percentile event (i.e., rainwater harvesting, infiltration, filtration / conveyance, etc.) is anticipated to be provided by the Province and is to be considered in the stormwater management plan for the Premier Gateway Phase 2B Lands accordingly.

2.2.5 Stormwater Management for GTA West Corridor

Per current practice of the Ministry of Transportation Ontario, all stormwater management for the GTA West Corridor and supporting facilities is to be provided separately from the Municipal stormwater management for the remainder of the Premier Gateway Phase 2B Lands. Although the stormwater management for the GTA West Corridor is to be developed through a separate process being undertaken for MTO, it is nevertheless recognized that the unitary sizing criteria provided as part of the Scoped Subwatershed Study will offer guidance for establishing the stormwater management plan for the GTA West Corridor.

Table 2.2.3: Stormwater Management Facilities Characteristics – Sixteen Mile Creek Watershed

Facility Number[3]	Sub-catchments	Outlet	Estimated Impervious Coverage (%)	Drainage Area (ha)	Required Volume (m^3)					Estimated Facility Area Requirements (ha)[2.]	Simulated Drawdown Time (days)
					Permanent Pool	Extended Detention		Flood Control	Total		
						Water Quality	Erosion[1.]				
871	171, 176, 177, 198	16 MC (3.593 – SWM) (3.599 – WC)	88%	39.24	12,230	10,224	13,800	37,950	51,750	2.72	7.87
897	197	16 MC (3.597 – SWM) (3.588 – WC)	90%	7.43	2,379	1,971	2,676	7,359	10,035	0.65	8.05
917	216, 217	Lisgar (3.617 – SWM) (3.511 – WC)	90%	18.20	4,098	4,826	4,505	9,506	14,333	1.08	5.21
933	232, 233	Lisgar (3.633 – SWM) (3.513 – WC)	90%	37.18	8,341	9,828	9,163	19,327	29,155	2.07	4.75
944	243, 244	Lisgar (3.644 – SWM) (3.514 – WC)	90%	18.22	4,101	4,830	4,507	7,053	11,883	0.91	3.82

NOTE: [1] Erosion control volumes are calculated based on sizing criteria presented in Table 2.2.1; the greater of the extended detention storage for water quality or erosion control has been used to calculate total facility volume requirements.

[2] Facility footprints for end-of-pipe facilities providing 100-year control only (i.e., no Regional Storm control) have been estimated assuming 2.5 m total detention storage above the permanent pool water level. Facility footprints for end-of-pipe facilities providing Regional Storm control, above the 100-year control, have been calculated assuming 3.5 m total detention storage above the permanent pool water level.

[3] Reference Drawing WR-1 for the location of proposed facilities

[4] Final details such as location and design criteria for stormwater management facilities, including Low Impact Development are to be determined through the Subwatershed Impact Study and Functional Servicing Study taking into account any proposed watercourse and/or headwater drainage feature alterations.

[5] Although the Scoped Subwatershed Study has advanced wet end-of-pipe facilities for stormwater management, it is anticipated that the ultimate SWM strategy would include privately owned facilities for some locations, as well as source-controls (i.e., rooftop and/or parking lot storage) for smaller sites which are insufficient to support a wet end-of-pipe facility.

2.3 Watercourse Management for Sixteen Mile Creek

As part of the Phase 1 Characterization, watercourses and headwater drainage features (HDFs) within the study area were evaluated. These evaluations have applied a methodology and framework developed through other Subwatershed Studies and Scoped Subwatershed Studies in CH and CVC jurisdiction and have led to the determination of appropriate constraint rankings, and classifications, respectively. The constraint rankings and classifications provide the basis from which impacts resulting from proposed land changes were evaluated in Phase 2, and corresponding management recommendations established to mitigate these impacts. In addition to geomorphology, this classification and management structure has integrated the findings and recommendations from the other study disciplines for: Surface Water, Fisheries, and Terrestrial Ecology. Management recommendations for watercourses and HDFs have been developed based on the Phase 2 Impact Assessment results. **Appendix C** includes an overview of feature definitions, management approaches and general recommendations, while the following sections describe reach specific management for watercourses and HDFs associated with East Sixteen Mile Creek.

Note: Watercourses and HDFs associated with the Gilbach SWS along the western limit of the Study Area have been evaluated, with management recommendations established as a part of that study, submitted under a separate cover. This includes feature mapping, constraints / classifications, hazards and buffers. Discussions, tables, and mapping presented herein within the Watercourse Management sections are exclusive of the finding and recommendations for the Gilbach Property.

2.3.1 Fluvial

Watercourses

Stream management has been approached on the basis of protecting or enhancing stream channels and their corridors, in order to maintain or improve the present condition of the area watercourses and their functions.

Table 2.3.1 summarizes the management considerations to maintain natural channel processes and functions, including: consideration of erosion hazards when siting and designing stream crossings, stream corridor protection to minimize or eliminate risk to public and private property from channel erosion and evolution, and the identification of erosion control targets (erosion thresholds) designed to reduce critical flow exceedances at key locations along receiving watercourses, by maintaining pre-development runoff volume to mitigate impacts to flow regime and sediment regime

(i.e. runoff volume management). Considerations and goals presented in **Table 2.3.1** are general and vary between subwatersheds depending on the existing condition and the proposed land use plan.

Table 2.3.1: Management Considerations and Goals – Steam Morphology

Management Consideration	Management Goals
Hazard corridors (confined and unconfined)	Stream corridors have minimal interference; however, it is understood that changes may be approved for infrastructure construction / maintenance, stream rehabilitation and enhancement where necessary.
	Natural cover maintained in stream corridors for High-Constraint (Red) streams and may be replicated / restored for realignments for Medium-Constraint (Blue) Streams
	Minimize or eliminate risk to public and private property from channel erosion and evolution
Stream length and realignment	Maintain natural channel structure* and rates of morphologic change[#]
	Complete HDF assessment to address drainage density function
Road crossings	Maintain natural channel structure* and rates of morphologic change[#]
	Minimize or eliminate risk to public and private property from channel erosion and evolution
	Minimize the number of road crossings
	Ensure fish passage
	Minimize the length of road crossings
Stormwater management ponds	Maintain natural channel structure* and rates of morphologic change[#]
	Maintain critical flow exceedance at critical locations[%]
Erosion thresholds	Work toward maintaining the pre-development water budget
	Minimize or eliminate risk to public and private property from channel erosion and evolution
	Maintain natural channel structure* and rates of morphologic change[#]
	Maintain critical flow exceedance at critical locations[%]
Sediment regime	Maintain or replicate sediment contributions, if required[$]. The quality of sediment produced from the feature should be evaluated. E.g., fine silts and sands from agricultural fields are likely of poor quality and produce little in the way of downstream form and habitat function. Maintain or enhance downstream form and function in the context of sediment regime and channel evolution.

*Maintaining natural structure refers to the ability for the plan to allow for the channel to evolve or be maintained naturally rather than requiring channelization or realignment, hardening, etc.
Maintain existing rates of change where possible, or allow for acceptable adjustment within a delineated hazard corridor.

% “Critical locations” refer to the governing locations for analyzing erosion impacts and controls; these are generally represented by the location with the lowest unitary critical flow rate (m^3/s per hectare drainage area).
$ Requires observations on natural sediment and sources (i.e., not from furrows or tilled land). Natural sediment sources can be replicated if the feature is relocated within an appropriate buffer (within an appropriate land use), or if a feature discharges to a designed sediment deposit that may become mobilized as designed.

Any proposed management of watercourses that includes alterations / modifications in the NHS must demonstrate that it is permitted as defined in the Regional Official Plan (ROP) and that it results in no negative impacts to the feature, its functions, and the overall system.

In addition to the considerations in **Table 2.3.1** ecological functions should be integrated into the watercourse management strategy, such as maintaining / enhancing a terrestrial or aquatic linkage, and/or enhancing aquatic and riparian habitat.

Stream management is to be approached on a reach or feature basis as these units display relative homogeneity with respect to form, function, and habitat. Key management practices, in terms of stream morphology, are recommended according to the geomorphic constraint rating, or HDF management recommendation. Management strategies may include several options or specific guidance. **Table 2.3.2** summarizes the geomorphological components of the management strategy for watercourses, while management recommendations for HDFs generally follow that of the TRCA / CVC protocols as summarized in the following subsection.

Table 2.3.2: Premier Gateway Phase 2B Scoped SWS Watercourse Classification

Watercourse Classification	Geomorphological Definition	Proposed Management Strategy
Red Classification (Solid Red Line on Map) – High Constraint	These corridors contain a defined active channel with well-developed channel morphology (i.e., riffle-pool), material sorting, floodplain development, and/or a well-defined valley. These corridors offer both form and function and have been identified as 'no touch' reaches that must be maintained undisturbed in their present condition, except for select locations where rehabilitation may be of benefit to the system. They have usually been deemed high-quality systems that could not be re-located and replicated in a post-development scenario.	Watercourse to be protected from erosion hazard in current form and location. Minor modification through rehabilitation / enhancement may be acceptable in select locations where it is a benefit to the system, or to allow for critical servicing as permitted by regulatory agencies. Options – Do nothing: Corridors must remain where they are in the landscape. Delineate meander belt or erosion hazard corridor depending on valley classification. Determine additional regulatory setbacks as required. – Channel adjustments may be permitted at select locations given sufficient rationale (e.g., addressing an immediate high-risk erosion hazard or a critical servicing issue). Natural channel design principles* to be implemented for any adjustments. – Degraded (channelized and straightened) portions may by realigned using natural channel design principles*, if realignment does not negatively impact rehabilitation.

* Natural channel design principles are to be applied based on the physical requirements of the system, or an appropriate reference. This should not suggest that pool-riffle streams are designed for every situation.

It should be noted that the constraint ranking for each reach may vary between disciplines, however, the final constraint ranking represents the most limiting classification (high, medium). During the Phase 1 characterization, any features which were documented to be of 'low' constraint were evaluated as an HDF where timelines permitted. The integrated multi-disciplinary constraint assessment of the watercourses is presented in **Table 2.3.3..** Only one watercourse reach was delineated within East Sixteen Mile Creek and was determined to be of a high constraint to development and should be managed accordingly.

Table 2.3.3: Integrated Watercourse Constraint Assessment – East Sixteen Mile Creek

watercourse Reach ID	Surface Water	Groundwater	Fluvial	Terrestrial	Fisheries	Net Constraint Ranking	Rationale/ Comments
ESMC(1)	High	High	High	High	High	**High**	Permanently flowing, sinuous, within the confined valley, fish present

Headwater Drainage Features

For HDFs, a modified classification and evaluation methodology to identify and characterize HDFs in Phase 1, then to determine management recommendations for which impacts could be evaluated through Phase 2. The approach first applies the guidelines set by TRCA / CVC (2014) to determine a feature classification ("**HDFA Management**"), which may then be carried forward to "**Final Management**" or altered based on site opportunities, or other constraints that the protocol may not capture (e.g., feature protection based on location within a significant valley or terrestrial feature). The following briefly summarizes management strategies for HDFs within the East Sixteen Mile Creek portion of the study area, while **Table 1 in Appendix C** provides an overview of feature definitions and management for watercourses and HDFs.

- **Mitigation feature** (green features) – maintain function to downstream features. These features are typically highly modified but provide some downstream function (e.g., supply of sediment and/or water, or seasonal fish habitat). Some complexities like the function of tile drains, where important, can be replicated through LID practices, swales, or other SWM, while fish habitat may be replicated within another nearby feature, or downstream in the floodplain (e.g., pond or wetland creation).
- **No management is required** (green-dashed features) – the feature can be removed from the surface without any implication to the system.
- **To be determined** (pink features) – final management to be determined based on future wetland analysis through additional study.

The integrated multi-disciplinary constraint assessment of the HDFs is presented in **Table 2.3.4**. Refer to the Phase 1 Characterization report for a photographic record of the HDFs.

Table 2.3.4: Headwater Drainage Feature Evaluation and Management Recommendations – East Sixteen Mile Creek Watershed

HDF ID	Hydrology	Riparian	Fish Habitat	Terrestrial	HDF Type	HDFA Classification	Final Management Recommendation	Rationale / Comments
ESMC(3)1-1	Limited	Limited	Contributing	Limited	Swale	No Management Required	No Management Required	swale with some definition, however standing water on first visit and dry by second
ESMC(3)1-1a	Limited	Limited	Contributing	Limited	Swale	No Management Required	No Management Required	swale with some definition, however standing water on first visit and dry by second
H4S1	-	-	-	-	-	-	No Management Required	Feature mapped and assessed by GEI (formerly Savanta) as part of the Gilbach SWS. Matrix Solutions Staff did not observe a feature in this location during the first visit. But have included it in the mapping as it falls within the Secondary Plan Area. The lack of observations by Matrix Solutions Staff is consistent with a 'no management required' recommendation, and therefore it has been maintained in the current, Scoped SWS.
TESMC(1)1-1	Limited	Limited	Contributing	Limited	No Defined Feature	No Management Required	No Management Required	poorly defined feature, no water observed.
TESMC(1)2-1	Limited	Limited	Contributing	Limited	No Defined Feature	No Management Required	No Management Required	poorly defined feature, no water observed.
TESMC(1)2-1a	Contributing	Important	Contributing	Valued	Wetland	Conservation	TBD	"conservation" based on important riparian vegetation and contributing hydrology. Important riparian due to feature type and vegetation being wetland. Final Management TBD pending further wetland studies at subsequent planning stages.
TESMC(1)3-1	Limited	Limited	Contributing	Limited	Swale	No Management Required	No Management Required	poorly defined feature, no water observed.
TESMC(1)3-1a	Contributing	Important	Contributing	Valued	Wetland	Conservation	TBD	"conservation" based on important riparian vegetation and contributing hydrology. Important riparian due to feature type and vegetation being wetland. Final Management TBD pending further wetland studies at subsequent planning stages.
TESMC(1)4-1	Limited	Limited	Contributing	Limited	Swale	No Management Required	No Management Required	"no management required" as it is a swale with standing water 1st visit and dry by 2nd visit.
TESMC(1)5-1	Contributing	Contributing	Contributing	Limited	Channelized	Conservation	TBD	Feature would be "mitigation" based on contributing hydrology score, however connection to wetland upstream results in "conservation" to maintain linkage. Final Management TBD pending further wetland studies at subsequent planning stages.
TESMC(2)1-1	Contributing	Limited	Contributing	Limited	Channelized	Mitigation	Mitigation	"mitigation" based on contributing hydrology score and valued riparian score. Maintain contribution downstream. Contributing hydrology score due to feature type being channelized and contained standing water 1st and 2nd visit. Valued riparian score due to cultural meadow vegetation.
TESMC(2)2-1	Limited	Limited	Contributing	Limited	Swale	No Management Required	No Management Required	"no management required" as it is a swale with standing water 1st visit and dry by the second visit
TESMC(2)2-1a	Contributing	Valued	Contributing	Limited	Channelized	Mitigation	Mitigation	"mitigation" based on contributing hydrology score. Maintain contribution downstream. Contributing hydrology score due to feature type being channelized and contained flowing water first visit, standing water second visit.
TESMC(3)1	Limited	Limited	Contributing	Limited	Swale	No Management Required	No Management Required	poorly defined swale, no water observed.
TESMC(3)2	Limited	Limited	Contributing	Limited	Swale	No Management Required	No Management Required	poorly defined swale, no water observed.
TESMC(4)	Limited	Limited	Contributing	Limited	Swale	No Management Required	No Management Required	swale with some definition, however standing water on 1st visit and dry by 2nd visit.
TESMC1a	Contributing	Important	Contributing	Valued	Wetland	Conservation	TBD	"conservation" based on important riparian vegetation and contributing hydrology. Important riparian due to feature type and vegetation being wetland. Final Management TBD pending further wetland studies at subsequent planning stages.
TESMC1b	Limited	Limited	Contributing	Limited	No Defined Feature	No Management Required	No Management Required	poorly defined feature, no water observed.

2.3.1.1 Stream Assessment and Reach-Specific Management Recommendations

East Sixteen Mile Creek has one watercourse reach – ESCMC(1) – that has been delineated through the study area and classified as a *high* constraint (red stream) as part of the watercourse classification and the current land use plan indicates that the erosion hazard corridor and agency setbacks and regulatory allowances will be protected within the NHS. Although the land use plan does not propose any watercourse removals or realignments of East Sixteen Mile Creek, the following management recommendations are provided to support the enhancement and protection of the watercourse.

Erosion Hazard Corridors

Watercourse features and associated erosion hazard limits (i.e., meander belts for unconfined systems, and stable top of slopes for confined systems) were incorporated into the development of the NHS in order to protect East Sixteen Mile Creek, reach ESMC(1) in place. Where necessary, natural channel design may be used for high-constraint (red) watercourses to address the localized issue or permit the construction of essential infrastructure. In cases where corridor enhancements are recommended, including realignment of medium constraint streams, it will be necessary to refine hazard limits for confined and unconfined systems as part of future studies (i.e., SISs) based upon refinements to the anticipated flow regime, design channel geometry and degree of stability (i.e., migration). Additional top of bank staking completed as part of suture studies may also further refine the stable top of slope assessment. Hazard delineations are not required for existing or realigned / enhanced HDFs, and the Provincial Policy Statement (2020) does not identify HDFs as erosional features or features which require a hazard setback. Erosion hazard corridors for watercourse reaches within the study area are presented in **Drawing FG-1**.

Localized Corridor Enhancements and Rehabilitation

Enhancements of watercourse corridors should include the removal of barriers to the movement of water and sediment in the downstream direction, and fish in the upstream direction (e.g., severe debris jams / dams, weirs), provided they do not serve a necessary function (e.g., grade control). In the case of grade control weirs, opportunities to replace the structure with natural channel design features (e.g., a series of riffles) should be explored.

For East Sixteen Mile Creek, ESMC(1) is situated within a well-defined valley, with management incorporating the long-term stable top of the slope into the NHS, it is not recommended that major realignment or watercourse enhancements should occur for ESMC(1). However, there is potential for localized enhancements such as removing in-

stream barriers that may require a natural channel design approach at such locations to provide stable transitions between upstream and downstream segments.

Where localized enhancements are proposed (at later planning stages), rehabilitation options to improve the geomorphic function of ESMC(1), locally, may include:

- **Re-establish / maintain a functioning floodplain:** Maintaining or creating (where applicable) a bankfull channel with better connectivity to a wider floodplain, or terrace, allows flows and fine sediment to overtop the banks during periods of high-water levels. This excess water would then travel across the floodplain, dissipating energy across a much larger surface area. Vegetation would also decrease velocity, promoting deposition, while also reducing erosion issues downstream. It is noted that the majority of the ESMC1 corridor is a well-functioning stream valley and only localized enhancement works near Steeles Avenue and the beaver dam upstream are recommended.
- **Provide a low-flow channel:** Creating a low-flow channel and removal of the large beaver dam upstream of Steeles Avenue will remove a potential fish barrier and provide storage and refugia for aquatic organisms during drought conditions as well as reducing the potential for sedimentation within the channel.
- **Re-establish riparian vegetation:** Re-establishing a healthy riparian vegetation community can help increase bank stability in addition to creating shading and improving fish and wildlife habitat. The provision of bank vegetation also provides a source of woody debris and organic matter for the stream.

Road Crossings and Alignments

Road crossings are not included within the current land use plan for ESMC(1). However, there may be potential in the future for upgrades at Steeles Avenue, or perhaps through the NHS at later planning stages. A collector road is proposed in the current land use plan that approaches the long terms table top of the slope of ESMC(1).

In general, road crossings should be oriented (perpendicular preference) and sized appropriately with consideration of geomorphic risk factors (e.g., bankfull width, channel stability, erosion rates, meander amplitude). For more detail, refer to “Road Crossings and Alignments” in Section 4.3.2 in the Phase 2 report. The following provides general guidance for crossing siting and sizing:

- Geomorphic considerations above (e.g., minimum span based on erosion risk)
- Size appropriately based on hydraulic criteria for freeboard, clearance, and 100-year storm conveyance

- Wildlife passage (aquatic and terrestrial)
- Minimum spacing of 100 m between crossings, with two channel wavelengths between each crossing (design or existing)
- Avoid or minimize grading within the erosion hazard

Maintenance of Channel Length, and Sediment Supply

Stream length and sinuosity should be maintained at a minimum unless rationale is provided where a balance cannot be maintained between pre- and post- development conditions. HDF assessments and management recommendations for each act to maintain the functional role of each feature to supply water and sediment in the downstream direction. However, it is also noted that sediment supply / transport under existing conditions is influenced by human activities, including agricultural land management and potential inputs from road surface drainage, and therefore does not represent “natural” conditions. ‘Conservation’ and ‘Mitigation’ management recommendations maintain connectivity, and the supply role of each feature. Some features may be replicated with LID practices or swales to maintain the primary function(s).

Channel design and subsequent channel management practices will be required to encourage the delivery of natural sediment supply. Streams in corridors should be designed such that natural erosion may occur in keeping with the nature of the channel, thereby replicating the natural potential to generate sediment for transport downstream. Naturalization of swales in urban areas should be encouraged where possible to facilitate natural sediment generation.

It should be noted that it is not necessarily desirable to replicate current sediment supply conditions in the headwaters since these are heavily impacted by agricultural practices, resulting in potential higher volumes of fine sediment conveyance of poor quality than would occur under more “natural” conditions during periods when the surface is bare and vegetation has yet to establish. Otherwise, these features are controlled by vegetation and in general, not considered erosive.

Erosion Thresholds and Stormwater Management

Critical discharges determined through the erosion threshold analysis should be applied as stormwater management targets to mitigate adverse erosion downstream following development. At the SIS stage, erosion thresholds should be confirmed or updated as appropriate, based on any revisions to the SWM plan (e.g., pond locations and changes to grading). This may include the selection and evaluation of additional sites.

Headwater Drainage Features

Eighteen HDFs have been identified within the Premier Gateway Phase 2B Study Area within the East Sixteen Mile Creek watershed. Based on observations made during the first visit (mid-March 2021), and second visit (May 2021), management recommendations for area HDFs were *No Management Required, Mitigation and To Be Determined (TBD)*. Three HDFs, TESMC(1)3-1a, TESMC(1)4-1, and TESMC(1)5 have resulted in TBD management recommendations due to the requirement for more detailed wetland studies through subsequent planning stages. **Table 2.3.5** includes comments relating the HDF recommendation to the land use plan. **Drawings FG3** and **FG-4** present final HDF management recommendations overlain on the land use plan.

Table 2.3.5: Headwater Drainage Feature Evaluation and Management Recommendations – East Sixteen Mile Creek Watershed

HDF ID	Final Management Recommendation	Comments Pertaining to Land Use Plan
ESMC(3)1-1	No Management Required	Limited function, may be removed. Surface features (e.g., swales) or LID BMPs can mitigate issues relating to loss of sediment supply and flow.
ESMC(3)1-1a	No Management Required	Limited function, may be removed. Surface features (e.g., swales) or LID BMPs can mitigate issues relating to loss of sediment supply and flow.
H4S1	No Management Required	Limited function, may be removed. Surface features (e.g., swales) or LID BMPs can mitigate issues relating to loss of sediment supply and flow.
TESMC(1)1-1	No Management Required	Limited function, may be removed. Surface features (e.g., swales) or LID BMPs can mitigate issues relating to loss of sediment supply and flow. Note this feature is within the proposed GTA West Transportation Corridor Protection Area.
TESMC(1)2-1	No Management Required	Limited function, may be removed. Surface features (e.g., swales) or LID BMPs can mitigate issues relating to loss of sediment supply and flow. Note this feature is within the proposed GTA West Transportation Corridor Protection Area.
TESMC(1)2-1a	TBD	Final Management TBD pending further wetland studies at subsequent planning stages. Note this feature is within the proposed GTA West Transportation Corridor Protection Area.
TESMC(1)3-1	No Management Required	Limited function, may be removed. Surface features (e.g., swales) or LID BMPs can mitigate issues relating to loss of sediment supply and flow. Note this feature is within the proposed GTA West Transportation Corridor Protection Area.

HDF ID	Final Management Recommendation	Comments Pertaining to Land Use Plan
TESMC(1)3-1a	TBD	Final Management TBD pending further wetland studies at subsequent planning stages. Note this feature is within the proposed GTA West Transportation Corridor Protection Area.
TESMC(1)4-1	No Management Required	Limited function, may be removed. Surface features (e.g., swales) or LID BMPs can mitigate issues relating to loss of sediment supply and flow. Note this feature is within the proposed GTA West Transportation Corridor Protection Area.
TESMC(1)5-1	TBD	Final Management TBD pending further wetland studies at subsequent planning stages. Note this feature is within the proposed GTA West Transportation Corridor Protection Area.
TESMC(2)1-1	Mitigation	Maintain, replicate, or enhance feature functions to receiving features. Note this feature is partially within the proposed GTA West Transportation Corridor Protection Area.
TESMC(2)2-1	No Management Required	Limited function, may be removed. Surface features (e.g., swales) or LID BMPs can mitigate issues relating to loss of sediment supply and flow. Note this feature is partially within the proposed GTA West Transportation Corridor Protection Area.
TESMC(2)2-1a	Mitigation	Maintain, replicate, or enhance feature functions to receiving features (not regulated). Existing feature is within the buffer for existing residential uses as shown on the land use plan. Note this feature is within the proposed GTA West Transportation Corridor Protection Area.
TESMC(3)1	No Management Required	Limited function, may be removed. Surface features (e.g., swales) or LID BMPs can mitigate issues relating to loss of sediment supply and flow. Note this feature is within the proposed GTA West Transportation Corridor Protection Area.
TESMC(3)2	No Management Required	Limited function, may be removed. Surface features (e.g., swales) or LID BMPs can mitigate issues relating to loss of sediment supply and flow. Note this feature is within the proposed GTA West Transportation Corridor Protection Area.
TESMC(4)	No Management Required	Limited function, may be removed. Surface features (e.g., swales) or LID BMPs can mitigate issues relating to loss of sediment supply and flow.
TESMC1a	TBD	Final Management TBD pending further wetland studies at subsequent planning stages. Note this

HDF ID	Final Management Recommendation	Comments Pertaining to Land Use Plan
		feature is within the proposed GTA West Transportation Corridor Protection Area.
TESMC1b	No Management Required	Limited function, may be removed. Surface features (e.g., swales) or LID BMPs can mitigate issues relating to loss of sediment supply and flow. Note this feature is within the proposed GTA West Transportation Corridor Protection Area.

2.3.2 Hydraulics

The watercourse management plan for the portion of the Premier Gateway Phase 2B Lands within the Sixteen Mile Creek Watershed has identified the Sixteen Mile Creek East Branch as the only regulated watercourse within the study area. The subject reaches of the Sixteen Mile Creek East Branch lie within well-defined valley systems, and the floodline mapping for the watercourse indicates that the flood hazard is contained within the well-defined valley without overtopping existing roadways (i.e., Steeles Avenue). Consequently, it is not anticipated that existing hydraulic structures along the Sixteen Mile Creek East Branch would require replacement post-development as part of future development. Should any new watercourse crossings be proposed, the crossings should follow the guidance presented herein for sizing to accommodate fluvial, aquatic, and terrestrial criteria, as well as governing hydraulic design criteria for freeboard, clearance, and conveyance for the Regional Storm event, and ensuring no increased flood risk to upstream private properties.

2.3.3 Aquatic Ecology

Detailed aquatic assessments have been conducted as part of the Phase 1 report to characterize the existing aquatic ecology within the study area. This included an assessment of aquatic habitats, including barriers to fish migration, sources of baseflow, seeps, and springs. Benthic invertebrate sampling, fish spawning surveys, and fish community surveys have been undertaken. East Sixteen Mile Creek has been identified as having a cool water thermal regime and providing Type 1 Fish Habitat. The benthic communities within East Sixteen Mile Creek are considered ‘fair to fairly poor’. East Sixteen Mile Creek provides a high constraint to development.

Fish have been observed in East Sixteen Mile Creek. Brook Stickleback (C*ulea inconstans*) was observed in both the pond and the pool associated with the HDF located east of 9th Line North (TESMC(1)5-1 and TESMC(1)) (**Drawing FG-3**). East Sixteen Mile Creek within the study area does not provide Trout spawning.

The proposed Natural Heritage System (NHS) includes the entire East Sixteen Mile Creek in a wide, natural corridor.

Any watercourse crossings required should be designed to accommodate and enhance existing fish passage through the use of bridges or open footing structures, natural channel design principles, incorporation of natural substrates, and wildlife passage opportunities, as appropriate. Proper sizing of hydraulic structures, as determined through the detailed design phase, will minimize erosion, the potential for culverts to become perched, and will serve to prevent the formation of barriers to fish movement.

Opportunities for habitat enhancement include the removal of existing farm crossings (e.g., fords and culverts), debris piles, and invasive species management (particularly of European Reed, *Phragmites australis ssp. Australis*).

2.4 Sixteen Mile Creek Wetland Management

There are three types of wetlands in the Sixteen Mile Creek Watershed as shown on Map 4A:

- Forb Mineral Meadow Marsh (MAM2-10)
- Mineral Shallow Marsh (MAS2)
- Cattail Mineral Shallow Marsh (MAS2-1)

The wetland areas are dominated by the Forb Mineral Meadow Marsh (MAM2-10) type, which is located all along East Sixteen Mile Creek. The Mineral Shallow Marsh (MAS2) and Cattail Mineral Shallow Marsh (MAS2-1) communities are located within the Special Policy Area.

The wetland boundaries outside the Special Policy Area have been delineated by the Premier Gateway Scoped SWS Team and reviewed in the field with staff from Conservation Halton. The wetland boundaries were then surveyed by the Premier Gateway Scoped SWS Team using a Trimble R10 GNSS receiver and antenna to achieve centimetre-level accuracy. The Conservation Authority's regulatory limits are to be confirmed through Subwatershed Impact Studies (SIS) when the wetland boundaries are to be staked and surveyed with an Ontario Land Surveyor (OLS) in the presence of Conservation Halton staff. Wetlands on the Gilbach property (Special Policy Area) were staked and surveyed with an OLS on October 10, 2019.

The Meadow Marsh wetlands located along East Sixteen Mile Creek are recommended for retention and protection. They fall within the larger creek valley and corridor and have been included within the proposed Natural Heritage System, along with 30 m

buffers. The wetlands located in the Special Policy Area (Gilbach property) are addressed within the *Scoped Subwatershed Study Northeast Corner Steeles Avenue and 8th Line Final Report* (Final Submission) (Jennifer Lawrence and Associates et al. 2022). Section 2.6.3 of the Phase 2 Report provides background on the Special Policy Area, including supporting documentation.

The Lisgar Wetlands, located east of the 9th Line, are identified as areas that require further study. These vegetation communities are "borderline" in that they exhibited both upland and wetland vegetation in almost equal proportions. More detailed vegetation work and soil assessments in these two units (to be completed at the SIS stage) will determine whether these areas need to be protected. Additional information on these two vegetation communities, with regard to potential provincial and regional significance, was provided to the Town of Halton Hills through a memo report dated January 20, 2023; included in **Appendix D**. The memo identified that the Lisgar communities are not provincially significant and would only be regionally significant if confirmed as wetlands. The Lisgar Wetlands have not been included in the proposed NHS as they are not connected to other natural heritage features or areas. These communities are shown on Map 6 with 15 m buffers, as these units are not provincially significant. These vegetation communities are to undergo a further assessment at the SIS stage. These areas, if they are wetlands, could potentially be removed and compensated for elsewhere, preferably adjacent to other areas of the NHS. The proposed GTA West Transportation Corridor route traverses the study area in this location and will require a separate Environmental Assessment process to be completed by the Province. Correspondence from the Ministry of Transportation Ontario (MTO) notes that there are no wetland communities located in this area, based on assessments completed by AECOM in 2022 (McGarry, Pers. Comm. 2023) (see Appendix D).

If the Lisgar Wetlands are confirmed as wetlands and are proposed to be removed within the context of the proposed development, relocation would be required. Replication of the wetlands is subject to the satisfaction of Conservation Halton, Region of Halton, and the Town of Halton Hills. The following principles for reconstruction of wetlands are to be included in future SIS for the area, to be used to determine an appropriate site for relocation:

- The reconstructed wetlands must be of equal or greater area than the original feature and support greater function than the original feature (e.g., additional native plant biodiversity, improved hydroperiod, more appropriate configuration).
- The reconstructed wetlands must be appropriately sited to provide the hydrology required to support the wetland. The site must be saturated with water long enough

to cause the formation of waterlogged (hydric) soils and the growth of water-loving (hydrophytic) or water-tolerant plants. The water source must convey clean water to the wetlands. For instance, this could include:

  - drainage from rooftops and backs of lots
  - a location where the site is seasonally inundated by overland flow from a creek or stream flooding
  - a location where the site is seasonally inundated by groundwater (however, the wetland should not be in the permanent groundwater table).

- When selecting a site, consideration should be given to link the reconstructed wetland to other features within the NHS. The recreated wetland would add additional area to the NHS. For example, if the reconstructed wetland were located within the buffer to a key feature, then additional buffer area must be added to the reconstructed wetland to equal or exceed the area occupied by the feature within the buffer.

If feasible, the site must be linked to other features within the NHS but must add additional area to the NHS. For example, if the reconstructed wetland were located within the buffer to a key feature, then additional buffer area must be added to the reconstructed wetland to equal or exceed the area occupied by the feature within the buffer.

2.5 Sixteen Mile Creek Natural Heritage System

The NHS has been developed and identified through Phases 1 and 2 of the Scoped SWS, in consultation with the Town, Region, Conservation Halton, and input from the public. The proposed NHS includes the following:

- Wetlands (surveyed boundaries) within the East Sixteen Mile Creek catchment area, as well as 30 m buffers
- Significant Woodland (FOD7-4) community with a 30 m buffer
- Other woodlands (CUW) with a 10 m buffer
- Confirmed SWH (FOD7-4, Eastern Wood-pewee) and candidate habitat for Turtle Wintering and Nesting Areas SWH
- Fish habitat (East Sixteen Mile Creek) with a 30 m buffer
- Stable top of the slope with a 15 m access allowance.

The proposed NHS is shown on Map 6A and Map 7A. The NHS protects the significant and sensitive natural heritage features within the study area and ensures connection to areas outside the study area. The proposed NHS is robust as it is comprised of wetlands, woodlands, watercourses, Significant Wildlife Habitat, and the floodplain. Through the SIS or detailed design stage, it is recommended that non-developable areas, created through the irregular NHS boundary, be included in the NHS and naturalized to provide an enhancement to the proposed system. The lands adjacent to the proposed NHS are ideal for any compensation measures that are to be provided, as well as open space uses such as stormwater management and LID Compensation for any future impacts associated with public infrastructure may be provided outside of the study area boundary if not feasible to be done within the Phase 2B lands.

The regulatory and NHS boundaries identified through the SWS are considered approximate, preliminary, and subject to change / increase through the future SIS process once the wetlands and top of slope for the East Branch of Sixteen Mile Creek are formally staked with the Conservation Authority and an Ontario Land Surveyor.

Additional areas may be added to the NHS through the SIS process, as in the further identification of Significant Wildlife Habitat or habitat for Species at Risk, and the integration of any compensation areas, such as compensation for the removal of isolated trees. It is recommended that compatible land uses be situated next to the NHS that will contribute to the protection of natural heritage features and the overall enhancement of the natural environment within the area. For instance, locating stormwater management facilities, Low Impact Development, parks, and trails next to the NHS can provide further opportunities for enhancement, while also providing the public and employees of the newly developed lands with access to natural areas for their enjoyment, recreation, and nature appreciation. Proposed locations of trails and SWM outlets / LIDS within buffers to Key Features must conform to applicable Regional and Secondary Plan natural heritage system policies and the objectives of the NHS. Opportunities to utilize naturalized outlet designs, green infrastructure, and LIDs adjacent to the NHS are to be considered at detailed design. The NHS provides an opportunity to design the proposed development in an environmentally sensitive way that mitigates climate change, protects and enhances the natural heritage features, and benefits the adjacent development.

A trail network should be considered at the outset of development, creating a network of trails along the NHS and within the Premier Gateway Employment Area, Phase 2B lands will provide people with walking / cycling trails right away, which will discourage the creation of ad hoc trails. Trails will foster nature appreciation and allow for passive recreation opportunities, which is part of a sustainable community.

Opportunities for habitat enhancement include the removal of existing farm crossings (e.g., fords and culverts).

The NHS must be managed and maintained following implementation, to ensure long-term sustainability. This includes stewardship and management opportunities such as the following:

- Managing informal access to the NHS (i.e., lands adjacent to the NHS should be fenced).
- Providing garbage receptacles along the trail system and providing regular maintenance of these.
- Management of invasive species.
- Removal of trash and debris within the NHS.
- Nature interpretive signs for education purposes, especially along trails.
- Nest box installation for birds, bats, and pollinators.
- Naturalization of lands that are currently farmed, including buffers.
- Monitoring of the NHS and adaptive management as required, such as removal of garbage, closure of ad-hoc trails, management of invasive species, planting of native species, etc.
- Management policies to deal with encroachment from properties adjacent to the NHS.
- Management policies for appropriate lighting to limit impacts to wildlife.

2.6 Stormwater Management for Mullet Creek

Stormwater management for the portion of the Premier Gateway Phase 2B area within the Credit River Watershed is required to address the following criteria:

- Provide extended detention storage for erosion control along receiving watercourses.
- Control post-development flows to pre-development levels at key locations within, and downstream of, the Premier Gateway Phase 2B Lands, for all events up to, and including, the Regional Storm (Hurricane Hazel) event.
- Provide stormwater quality control to an “Enhanced” standard of treatment, per current Provincial guidelines (ref. MOE, 2003), and address thermal enrichment of urban storm runoff.

— Incorporate Low Impact Development Best Management Practices (LID BMPs) to maintain pre-development groundwater recharge and reduce post-development runoff volumes.

The following technologies and practices are available to address the stormwater management criteria noted in the foregoing:

TSS removal as per MOE\MECP criteria:

— Wet end-of-pipe facilities (i.e., wetlands, wet ponds, hybrid facilities).

— Vegetated technologies (i.e., grassed swales, buffer strips, etc.).

— Oil / grit separators, when applied in series with other measures per current practice in Conservation Halton jurisdiction.

— Bioswales / biofilters.

For Thermal Control:

— Low Impact Development (LID) infiltration Best Management Practices (BMP)s

— Urban terrestrial canopy (also NHS)

— Facility shading (includes orientation and length / width ratio)

— Facility cooling trenches

— Facility bottom draws

— Stormwater management facility orientation

— Narrow stormwater management facility configuration (i.e., greater longitudinal length-to-width ratio)

— Concrete Sewer System

— Underground Storage Facilities

— Green & White roofs

— Floating Islands

— Other measures

For Salt Management:

— Bottom draws / submerged outlets

— Salt management plans

For Erosion Control:

- End-of-pipe facilities (i.e., wetlands, wet ponds, hybrid facilities, dry ponds).
- LID infiltration-based BMPs (i.e., bioswales / biofilters with underdrains, infiltration trenches, rain gardens, perforated pipes, etc.)

For Flood / Quantity Control:

- End-of-pipe facilities (i.e., wetlands, wet ponds, hybrid facilities, dry ponds).
- Underground Storage Facilities
- Surface storage (i.e., rooftop / parking lot storage)

In general, the selection of the appropriate stormwater management practice is dependent upon the size (i.e., drainage area) and land use conditions within the proposed development area draining to the specific stormwater management facility. The following general principles have been applied in developing the recommended stormwater management plan for the portion of the Premier Gateway Phase 2B Lands within the Mullet Creek Subwatershed of the Credit River Watershed:

1. Wet end-of-pipe facilities are preferred, due to their ability to address multiple stormwater management requirements (i.e., quantity, quality, thermal mitigation, and erosion control).
2. Where drainage areas are insufficient to support an end-of-pipe facility (i.e., generally drainage areas less than 5 ha), source controls (i.e., underground storage, surface storage, LID BMPs, oil / grit separators, vegetated technologies, etc.) are to be applied; LID BMPs and oil / grit separators are to be implemented as part of a treatment train approach for stormwater management.
3. LID BMPs are to be applied throughout the development area and sized for maintaining pre-development groundwater recharge (estimated capture volumes of 1 – 3 mm/impervious ha).
4. Stormwater management solutions are not to result in a negative impact to the Phase 2B Natural Heritage System.
5. Regional Storm controls are to be incorporated into the design of wet end-of-pipe facilities.

Opportunities to utilize naturalized outlet designs, green infrastructure, and LIDs adjacent to the NHS are to be considered at detailed design.

It is noted that draft guidelines recently issued by MECP provide further direction for the implementation of LID BMPs, and the design of these systems accordingly. At the time that the guidelines are implemented into industry practice, they should be considered during the selection of SWM technologies.

The recommended stormwater management plan is presented in **Drawing WR-1**, which has been updated from that presented in the Phase 2 report (ref. Drawing WR-7) to reflect the updated GTA West Transportation Corridor from the Province. The following sections provide further details regarding the stormwater management plan for the Premier Gateway Phase 2B lands. The unitary sizing criteria and corresponding stormwater management facility sizing are to be verified and refined as part of future studies.

2.6.1 Erosion Control

Unitary storage and discharge criteria have been established as part of the Phase 2 Impact Assessment to mitigate erosion impacts at key locations within, and downstream of, the Premier Gateway Phase 2B Lands. These criteria have been developed, premised upon providing extended detention storage within the end-of-pipe facilities to maintain the duration of critical flow exceedance to pre-development levels. The unitary storage and discharge requirements within the end-of-pipe facilities for erosion control are presented in **Table 2.6.1**.

Table 2.6.1: Stormwater Management Facility Sizing Criteria for Erosion Control for Premier Gateway Phase 2B Lands – Mullet Creek Subwatershed

Operating Condition	Unitary Storage (m^3/impervious ha)	Unitary Discharge (m^3/s/ha)
Extended Detention	250	0.0015

2.6.2 Flood Control and Regional Storm Control

Unitary storage and discharge criteria have similarly been established as part of the Phase 2 Impact Assessment to mitigate increased peak flows at key locations within, and downstream of, the Premier Gateway Phase 2B Lands, resulting from the future development, for all events up to, and including, the Regional Storm (Hurricane Hazel) event. The unitary storage and discharge requirements within the end-of-pipe facilities for flood control are presented in **Table 2.6.2**. The unitary storage and discharge requirements presented in **Table 2.6.2** are considered the best available information, and are to be verified and refined as appropriate as new information becomes available either through refinements at the site-specific (SIS) level using topographic surveys and

technical studies, or as new watershed-level data and technical analyses become available.

Table 2.6.2: Stormwater Management Facility Sizing Criteria for Flood Control – Mullet Creek Subwatershed

Operating Condition[1.]	Unitary Storage (m^3/impervious ha)[2.]	Unitary Discharge (m^3/s/ha)
25 Year	750	0.0031
100 Year	900	0.0108
Regional	1950	0.0319

NOTE: [1]Ordinates provided below correspond to key operating conditions for designing outlet structure. Ordinates for 2-year, 5-year, 10-year, and 50-year control may be interpolated from 25-year and 100-year control ordinates provided above.

[2]Cumulative unitary volumes are inclusive of extended detention storage requirements for erosion control (ref. Table 2.6.1).

2.6.3 Stormwater Quality Control

Stormwater quality control for the future development within the Premier Gateway Phase 2B Lands is required to control runoff to an “Enhanced” standard of treatment, per current Provincial standards (ref. MOE, 2003). Wet ponds have been advanced, as the recommended type of end-of-pipe facility for providing stormwater management within the Premier Gateway Phase 2B Lands, due to the opportunities to incorporate multiple stormwater management functions within the facility (i.e., stormwater quality, erosion, and quantity / flood control). The estimated permanent pool and extended detention storage volumes for the end-of-pipe facilities within the Premier Gateway Phase 2B Lands are presented in **Table 2.6.3**, based upon current Provincial Criteria (ref. MOE 2003) for stormwater quality control, and the sizing criteria for flooding and erosion control presented in **Table 2.6.1** and **Table** 2.6.2. The corresponding storage-discharge relationships for the stormwater management facilities are provided in Appendix B.

.

Table 2.6.3: Stormwater Management Facilities Characteristics – Mullet Creek Subwatershed

Facility Number[3,4]	Sub-catchments	Outlet	Estimated Impervious Coverage (%)	Drainage Area (ha)	Required Volume (m^3)					Estimated Facility Area Requirements (ha)[2.]	Simulated Drawdown Time (days)
					Permanent Pool	Extended Detention		Flood Control	Total		
						Water Quality	Erosion[1.]				
856	356	Mullet (3.506 SWM) (3.521 WC)	90%	20.65	4,651	5,477	4,648	26,126	31,603	1.75	3.51
857	357	Mullet (3.507 SWM) (3.523 WC)	90%	2.53	570	672	570	3,204	3,876	0.29	3.51
860	360	Mullet (3.520 SWM) (3.521 WC)	90%	18.86	4,246	5,000	4,243	23,849	28,849	1.61	3.51
864	364	Mullet (3.524 SWM) (3.523 WC)	90%	2.25	508	598	508	2,853	3,451	0.26	3.51
866	366	Mullet (3.517 SWM) (3.526 WC)	85%	3.59	768	912	763	4,273	5,185	0.37	3.31

NOTE:

1. Erosion control volumes are calculated based on sizing criteria presented in Table 2.2.1; the greater of the extended detention storage for water quality or erosion control has been used to calculate total facility volume requirements.
2. Facility footprints for end-of-pipe facilities providing 100-year control only (i.e., no Regional Storm control) have been estimated assuming 2.5 m total detention storage above the permanent pool water level. Facility footprints for end-of-pipe facilities providing Regional Storm control, above the 100-year control, have been calculated assuming 3.5 m total detention storage above the permanent pool water level.
3. Reference Drawing WR-1 for the location of proposed facilities.
4. Although the Scoped Subwatershed Study has advanced wet end-of-pipe facilities for stormwater management, it is anticipated that the ultimate SWM strategy would include privately owned facilities for some locations, as well as source-controls (i.e., rooftop and/or parking lot storage) for smaller sites which are insufficient to support a wet end-of-pipe facility. Opportunities to enhance the functionality of the Natural Heritage System through the incorporation of Regulatory Flood controls should be explored at the SIS stage. For example, in the Mullet Creek watershed, where a need for Regional Control has been demonstrated through the Scoped Subwatershed Study, there may be an opportunity to incorporate the Regional Storm Controls within the 60 m wide NHS linkage corridor, which should be explored at the SIS stage.
5. Final details such as location and design criteria for stormwater management facilities, including Low Impact Development are to be determined through the Subwatershed Impact Study and Functional Servicing Study taking into account any proposed watercourse and/or headwater drainage feature alterations.

2.6.4 Runoff Volume Reduction and Water Budget

As noted previously, the draft Provincial Criteria for stormwater management requires stormwater management practices to include measures to manage the 90th percentile event (i.e., 29 mm for Halton Hills) for future land use conditions. Additional guidance regarding the methods for managing runoff from the 90th percentile event (i.e., rainwater harvesting, infiltration, filtration / conveyance, etc.) is anticipated to be provided by the Province and is to be considered in the stormwater management plan for the Premier Gateway Phase 2B Lands accordingly.

In addition to the foregoing, and as noted in the Phase 2 report, the stormwater management plan for the Premier Gateway Phase 2B Lands will be required to maintain the pre-development water budget to the wetland feature in the Mullet Creek Subwatershed. Per the guidance provided in the Phase 2 report, the feature has been characterized as surface water dependent (i.e., no reliance on groundwater contributing), hence it is anticipated that the water budget to the feature would be maintained by the grading and direction of surface runoff toward the feature. The scope analyses completed for the Phase 2 report have demonstrated that the water budget to the feature may be maintained by the NHS, which would convey runoff from 4.65 ha of external land toward the wetland feature, as a result of the linkage along the north limit of the property. As such, this diversion would effectively maintain the total contributing drainage area to the wetland at pre-development conditions.

2.7 Watercourse Management for Mullet Creek

As part of the Phase 1 Characterization, watercourses and headwater drainage features (HDFs) within the study area have been evaluated. These evaluations have applied a methodology and framework applied for other Subwatershed Studies and Scoped Subwatershed Studies in CH and CVC jurisdiction and have led to the determination of appropriate constraint rankings, and classifications, respectively. The constraint rankings and classifications have provided the basis from which impacts resulting from proposed land changes have been evaluated in Phase 2, and corresponding management recommendations established to mitigate these impacts. In addition to geomorphology, this classification and management structure has integrated the findings and recommendations from the other study disciplines for Surface Water, Fisheries, and Terrestrial Ecology. Management recommendations for watercourses and HDFs have been developed based on the Phase 2 Impact Assessment results. **Appendix C** includes an overview of feature definitions, management approaches and general recommendations, while the following sections describe specific management for watercourses and HDFs associated with Mullet Creek.

2.7.1 Fluvial

Watercourses

Stream management has been approached on the basis of protecting or enhancing stream channels and their corridors, in order to maintain or improve the present condition of the area watercourses and their functions.

Table 2.7.1 summarizes the management considerations to maintain natural channel processes and functions have included: consideration of erosion hazards when siting and designing stream crossings, stream corridor protection to minimize or eliminate risk to public and private property from channel erosion and evolution, and the identification of erosion control targets (erosion thresholds) designed to reduce critical flow exceedances at key locations along receiving watercourses, by maintaining pre-development runoff volume to mitigate impacts to flow regime and sediment regime (i.e. runoff volume management). Considerations and goals presented in **Table 2.7.1** are general and vary between subwatersheds depending on the existing condition and the proposed land use plan.

Any proposed management of watercourses that includes alterations / modifications in the NHS must demonstrate that it is permitted as defined in the Regional Official Plan (ROP) and that it results in no negative impacts to the feature, its functions, and the overall system.

Table 2.7.1: Management Considerations and Goals – Steam Morphology

Management Consideration	Management Goals
Hazard corridors (confined and unconfined)	Stream corridors have minimal interference; however, it is understood that changes may be approved for infrastructure construction / maintenance, stream rehabilitation and enhancement where necessary.
	Natural cover maintained in stream corridors for High-Constraint (Red) streams and may be replicated / restored for realignments for Medium-Constraint (Blue) Streams
	Minimize or eliminate risk to public and private property from channel erosion and evolution
Stream length and realignment	Maintain natural channel structure* and rates of morphologic change#
	Complete HDF assessment to address drainage density function
Road crossings	Maintain natural channel structure* and rates of morphologic change#
	Minimize or eliminate risk to public and private property from channel erosion and evolution

Management Consideration	Management Goals
	Minimize the number of road crossings
	Ensure fish passage
	Minimize the length of road crossings
Stormwater management ponds	Maintain natural channel structure* and rates of morphologic change#
	Maintain critical flow exceedance at critical locations%
Erosion thresholds	Work toward maintaining the pre-development water budget
	Minimize or eliminate risk to public and private property from channel erosion and evolution
	Maintain natural channel structure* and rates of morphologic change#
	Maintain critical flow exceedance at critical locations%
Sediment regime	Maintain or replicate sediment contributions, if required$. The quality of sediment produced from the feature should be evaluated. E.g., fine silts and sands from agricultural fields are likely of poor quality and produce little in the way of downstream form and habitat function. Maintain or enhance downstream form and function in the context of sediment regime and channel evolution.

*Maintaining natural structure refers to the ability for the plan to allow for the channel to evolve or be maintained naturally rather than requiring channelization or realignment, hardening, etc.

Maintain existing rates of change where possible or allow for acceptable adjustment within a delineated hazard corridor.

% “Critical locations” refer to the governing locations for analyzing erosion impacts and controls; these are generally represented by the location with the lowest unitary critical flow rate (m^3/s per hectare drainage area).

$ Requires observations on natural sediment and sources (i.e., not from furrows or tilled land). Natural sediment sources can be replicated if the feature is relocated within an appropriate buffer (within an appropriate land use), or if a feature discharges to a designed sediment deposit that may become mobilized as designed.

In addition to the considerations in **Table 2.3.1**, ecological functions should be integrated into the watercourse management strategy, such as maintaining / enhancing a terrestrial or aquatic linkage, and/or enhancing a riparian habitat.

Stream management is to be approached on a reach or feature basis as these units display relative homogeneity with respect to form, function, and habitat. Key management practices, in terms of stream morphology, are recommended according to the geomorphic constraint rating, or HDF management recommendation. Management strategies may include several options, or specific guidance.

Table 2.3.2 summarizes the geomorphological components of the management strategy for watercourses, while management recommendations for HDFs generally follow that of the TRCA / CVC protocols as summarized in the following subsection.

Table 2.7.2: Premier Gateway Phase 2B Scoped SWS Watercourse Classification – Mullet Creek

Watercourse Classification	Geomorphological Definition	Proposed Management Strategy
Blue Classification (Solid Blue Line on Map) – Medium Constraint	These reaches have well-defined morphology (defined bed and banks, evidence of erosion / sedimentation, and sorted substrate). These reaches maintain geomorphic function and have the potential for rehabilitation. In many cases, these reaches are presently exhibiting evidence of geomorphic instability or environmental degradation due to historic modifications and land use practices.	Watercourse to be protected with applicable meander belt and setbacks. Realignment may be acceptable when deemed appropriate for restoration and enhancement. Options – Do nothing: Leave the corridors in their present condition and develop outside of their boundaries: Delineate appropriate meander belt or erosion hazard corridor depending on valley classification. Determine additional regulatory setbacks as required. – Enhance existing conditions: maintain the present location of the corridor but enhance the existing conditions (e.g., bank stabilization, re-establish a meandering planform, connect the channel to a functioning floodplain). Natural channel design principles* to be implemented for any adjustments. – Relocate and enhance existing conditions: many of the reaches within the study area have undergone extensive straightening and modification for agricultural drainage purposes. As such, they are not as sensitive to re-location and would benefit from enhancements such as the re-establishment of a meandering planform with a functioning floodplain and development of a riffle-pool morphology (i.e., natural channel design). In the event that these reaches are relocated, the corridor width (meander belt width / hazard corridor) associated with each reach must, at a minimum, be maintained. For reaches that have been straightened, appropriate surrogate reaches or empirical methods

Watercourse Classification	Geomorphological Definition	Proposed Management Strategy
		should be applied to determine the meander belt corridor. Natural channel design principles* to be implemented for any realignment or adjustments. – For features with realignment opportunities around roads, consideration should be made to select appropriate locations for realignment with respect to the road location, and to reduce the number of road crossings, where appropriate. This should reduce overall environmental impacts from roads Such changes require approval by regulatory agencies.

* Natural channel design principles are to be applied based on the physical requirements of the system, or an appropriate reference. This should not suggest that pool-riffle streams are designed for every situation.

It should be noted that the constraint ranking for each reach may vary between disciplines, however, the final constraint ranking represents the most limiting classification (high, medium). During the Phase 1 characterization, any features which were documented to be of '*low*' constraint were evaluated as an HDF where timelines permitted.

The integrated watercourse constraint evaluation has determined that the watercourse reaches within Mullet Creek (MC(4)1 and MC(4)2) were classified as *medium* constraint watercourses, and should be managed as described in **Table 2.7.3**, and in **Table 1 in Appendix C**.

Table 2.7.3: Integrated Watercourse Constraint Assessment – Mullet Creek Reaches

watercourse Reach ID	Surface Water	Groundwater	Fluvial	Terrestrial	Fisheries	Net Constraint Ranking	Rationale / Comments
MC(4)1	Medium	Low	Medium	Medium	Medium	**Medium**	Artificially constrained (has been historically straightened). Highly impacted by historical and current land uses, mostly dry.
MC(4)2	Medium	Low	Medium	Medium	Medium	**Medium**	Artificially constrained (has been historically straightened). Highly impacted by historical and current land uses, mostly dry.

Headwater Drainage Features

For HDFs, a modified classification and evaluation methodology to identify and characterize HDFs in Phase 1, then to determine management recommendations for which impacts could be evaluated through Phase 2. The approach first applies the guidelines set by TRCA / CVC (2014) to determine a feature classification ("**HDFA Management**"), which may then be carried forward to "**Final Management**" or altered based on site opportunities, or other constraints that the protocol may not capture (e.g., feature protection based on location within a significant valley or terrestrial feature). The following briefly summarizes management strategies for HDFs within the Mullet Creek portion of the study area, while **Table 1 in Appendix C** provides an overview of feature definitions and management for watercourses and HDFs.

- **Conservation feature** (yellow features) – Realignment is permitted provided important ecological functions are maintained, including linkage functions if the existing feature provides a linkage function. Conservation features providing important linkage functions may be incorporated into the NHS.
- **No management is required** (green-dashed features) – the feature can be removed from the surface without any implication to the system.

The integrated multi-disciplinary constraint assessment of the HDFs is presented in **Table 2.7.4**. Refer to the Phase 1 Characterization report for a photographic record of the HDFs.

2.7.1.1 Stream Assessment and Reach-Specific Management Recommendations

Mullet Creek watercourse reaches within the Study Area have been classified as a medium constraint (blue streams) (ref. Drawing FG-4) as part of the watercourse classification. The current land use plan indicates that the erosion hazard corridor and agency setbacks and regulatory allowances are protected within the NHS of Mullet Creek. The land use plan does not propose any watercourse removals or realignments of Mullet Creek, however, realignment is permissible for these *medium* constraint features, and enhancement is encouraged. There is also a watercourse crossing proposed over a Conservation HDF (MC (6)). The following management considerations are provided.

Erosion Hazard Corridors

Watercourse features and associated erosion hazard limits (i.e., meander belts for unconfined systems, and stable top of slopes for confined systems) were incorporated into the development of the NHS in order to protect Mullet Creek as it currently exists. As this is an impact, a constraint watercourse natural channel design may be used for channel realignments and enhancements at subsequent development stages. When corridor enhancements are recommended, including realignment of constraint streams, it will be necessary to refine hazard limits for these unconfined reaches MC(4)1 and MC4(2), as part of future studies (i.e., SISs) based upon refinements to the anticipated flow regime, design channel geometry and degree of stability (i.e., migration). Hazard delineations are not required for existing or realigned / enhanced HDFs, and the Provincial Policy Statement (2020) does not identify HDFs as erosional features, or features which require a hazard setback. Erosion hazard corridors for watercourse reaches within the Mullet Creek subwatershed in the context of current land use plans are presented in **Drawing FG-2**.

Table 2.7.4: Headwater Drainage Feature Evaluation and Management Recommendations – Mullet Creek Watershed

HDF ID	Hydrology	Riparian	Fish Habitat	Terrestrial	HDF Type	HDFA Classification	Final Management Recommendation	Rationale / Comments
MC(5)	Contributing	Important	Contributing	Contributing	Channelized	Conservation	Conservation	"conservation" due to wetland riparian vegetation.
MC(5)3-2	Limited	Limited	Contributing	Limited	Swale	No Management Required	No Management Required	defined swale; standing water first visit and dry by second visit
MC(6)	Contributing	Limited	Contributing	Limited	Swale	Mitigation	Conservation	"conservation" based on connection to wetland upstream.
MC(6)1-1	Limited	Limited	Contributing	Limited	Swale	No Management Required	No Management Required	defined swale; standing water first visit and dry by second visit

Corridor Enhancement and Rehabilitation

Enhancements of watercourse corridors should include the removal of barriers to the movement of water and sediment in the downstream direction, and fish in the upstream direction (e.g., severe debris jams / dams, weirs), provided they do not serve a necessary function (e.g., grade control). In the case of grade control weirs, opportunities to replace the structure with natural channel design features (e.g., a series of riffles) should be explored.

Rehabilitation options to improve the geomorphic function of watercourses, primarily those of medium constraint classification that have been previously channelized or modified by agricultural practices (as is the case with Mullet Creek in the study area), may include:

- **Re-establish a functioning floodplain:** Creating a bankfull channel with better connectivity to a wider floodplain, or terrace, allows flows and fine sediment to overtop the banks during periods of high-water levels. This excess water would then travel across the floodplain, dissipating energy across a much larger surface area. Vegetation would also decrease velocity, promoting deposition, while also reducing erosion issues downstream.
- **Provide a low-flow channel:** Creating a low-flow channel will provide storage and refugia for aquatic organisms during drought conditions as well as reducing the potential for sedimentation within the channel.
- **Re-establish a 'natural' meander planform:** Using reference reaches as an indication of channel planform prior to agricultural influences; it is obvious that historical ditching and straightening have removed the natural meander planform of medium constraint reaches within the study area. This channelization effectively increases stream gradient and, consequently, the energy available to erode the bed and banks. The restoration of a more 'natural' meandering planform can help to re-establish more natural geomorphological processes and increase geomorphological diversity. Mullet Creek within the study area has been previously straightened to accommodate farming practices and could benefit from sinuosity and other habitat features.
- **Re-establish riparian vegetation:** Re-establishing a healthy riparian vegetation community can help increase bank stability in addition to creating shading and improving fish and wildlife habitat. The provision of bank vegetation also provides a source of woody debris and organic matter for the stream, as well as providing a natural buffer to reduce fine sediment input from tilled agricultural fields. Currently,

Mullet Creek is surrounded by agricultural fields and could benefit from the enhancement of plantings in the riparian zone.

Overall, these reaches of Mullet Creek, in addition to the upstream headwater drainage features (HDFs) MC(5) and MC(6) present a restoration opportunity whereby the currently straightened channel planform could be restored to a more sinuous planform with enhanced riparian vegetation and bank treatments that would benefit aquatic species. A natural channel design approach is to be applied where modifications are proposed (local or reach scale). General riparian enhancements, farm crossing removals (e.g., fords and culverts), and in-channel habitat features (e.g., wood debris) are encouraged, which would enhance the form and function of area streams, and those receiving reaches downstream. It should be noted any proposed corridor enhancements and/or realignment will warrant greater rationale and approval from CVC.

Road Crossing and Alignments

Road alignments and road crossing designs should be developed with consideration of the management requirements for area watercourses and HDFs. Watercourse and HDF interactions, primarily at crossings, should be oriented perpendicular to the watercourse. Roads running parallel to watercourses and HDFs should avoid placement of fill and grading into the creek corridor. Only conservation HDFs associated with Mullet Creek have potential impacts from road alignments and crossings per the current plan.

In general, road crossings should be oriented and sized appropriately with consideration of geomorphic risk factors (e.g., bankfull width, channel stability, erosion rates, meander amplitude). For more detail, refer to “Road Crossings and Alignments” in Section 4.3.2 in the Phase 2 report. The following provides general guidance for crossing siting and sizing:

- Geomorphic considerations above (e.g., minimum span based on erosion risk)
- Size appropriately based on hydraulic criteria for freeboard, clearance, and 100-year storm conveyance
- Wildlife passage (aquatic and terrestrial)
- Minimum spacing of 100 m between crossings, with two channel wavelengths between each crossing (design or existing)
- Avoid or minimize grading within the erosion hazard

Maintenance of Channel Length, and Sediment Supply

Stream length and sinuosity should be maintained at a minimum unless rationale is provided where a balance cannot be maintained between pre- and post-development conditions. HDF assessments and management recommendations for each act to maintain the functional role of each feature to supply water and sediment in the downstream direction. However, it is also noted that sediment supply / transport under existing conditions is influenced by human activities, including agricultural land management and potential inputs from road surface drainage, and therefore does not represent “natural” conditions. ‘Conservation’ and ‘Mitigation’ management recommendations maintain connectivity, and the supply role of each feature. Some features may be replicated with LID practices or swales to maintain the primary function(s).

Channel design and subsequent channel management practices will be required to encourage the delivery of natural sediment supply. Streams in corridors should be designed such that natural erosion may occur in keeping with the nature of the channel, thereby replicating the natural potential to generate sediment for transport downstream. Naturalization of swales in urban areas should be encouraged where possible to facilitate natural sediment generation.

It should be noted that it is not necessarily desirable to replicate current sediment supply conditions in the headwaters since these are heavily impacted by agricultural practices, resulting in potentially higher volumes of fine sediment conveyance of poor quality than would occur under more “natural” conditions during periods when the surface is bare and vegetation has yet to establish. Otherwise, these features are controlled by vegetation and in general, not considered erosive.

Erosion Thresholds and Stormwater Management

Critical discharges determined through the erosion threshold analysis should be applied as stormwater management targets to mitigate adverse erosion downstream following development. At the SIS stage, erosion thresholds should be confirmed or updated as appropriate, based on any revisions to the SWM plan (e.g., pond locations and changes to grading). This may include the selection and evaluation of additional sites.

Headwater Drainage Features

Four HDFs have been identified within the Premier Gateway Phase 2B Study Area within the Mullet Creek subwatershed. Based on observations made during the first visit (mid-March 2021), and second visit (May 2021), management recommendations for area HDFs were Conservation and Management Required. **Table 2.7.5** includes

comments relating the HDF recommendation to the land use plan. **Drawing FG-4** presents the final HDF management recommendations overlain on the land use plan.

Table 2.7.5: Headwater Drainage Feature Evaluation and Management Recommendations – Mullet Creek Watershed

HDF ID	Final Management Recommendation	Comments Pertaining to Land Use Plan
MC(5)	Conservation	"conservation" due to wetland riparian vegetation, and wetland located upstream. Feature to remain open, but can be realigned and enhanced and the application of natural channel design principles should be considered. Hydrological functions and linkage to upstream HDF and wetland to be maintained (not regulated). Avoid road grading into the feature and its buffers as maintained or designed.
MC(5)3-2	No Management Required	Limited function, may be removed. Surface features (e.g., swales) or LID BMPs can mitigate issues relating to loss of sediment supply and flow. (not regulated).
MC(6)	Conservation	"conservation" based on connection to wetland upstream. Feature to remain open, but can be realigned and enhanced and the application of natural channel design principles should be considered. Hydrological functions and linkage to upstream wetland to be maintained (not regulated). Avoid road grading into the feature and its buffers as maintained or designed. Design road crossing at the downstream end with a consideration of hydrological, hydraulic, and ecological functions. (not regulated)
MC(6)1-1	No Management Required	Limited function, may be removed. Surface features (e.g., swales) or LID BMPs can mitigate issues relating to the loss of sediment supply and flow. (not regulated).

2.7.2 Hydraulics

The watercourse management plan for the portion of the Premier Gateway Phase 2B Lands within the Credit River Watershed has identified the tributary of Mullet Creek as the only regulated watercourse within the study area. The subject reach of Mullet Creek has been identified as a Medium Constraint Watercourse, hence may be realigned post-development subject to satisfying fluvial design criteria for natural channel design, hydraulic design criteria for flood protection and riparian storage, and terrestrial criteria for wildlife passage. It is anticipated that new and replacement hydraulic structures spanning the subject reach of Mullet Creek would be implemented as part of the future development within the Premier Gateway Phase 2B Lands. In particular, a new

hydraulic structure is anticipated at Winston Churchill Boulevard, to improve upon peak flow conveyance and reduce fill requirements for flood protection of the adjacent properties. The sizing of the hydraulic structure is to be completed as part of future studies.

2.7.3 Aquatic Ecology

Detailed aquatic assessments have been conducted as part of Phase 1 to characterize the existing aquatic ecology within the study area. This has included an assessment of aquatic habitats, including barriers to fish migration, sources of baseflow, seeps, and springs, as well as fish community surveys. Fish were not observed in Mullet Creek. The Mullet Creek tributary has been classified as a warm water Type 3 Fish Habitat, providing a medium constraint to development.

Mullet Creek and the HDF located in this area (MC(5) and MC(6)) are located within the proposed NHS, providing a linkage between the woodland (FOD4) and wetland (SWT2-2) to areas further east and north along Mullet Creek.

Any watercourse crossings required should be designed to accommodate and enhance existing fish passage through the use of open footing structures, natural channel design principles, incorporation of natural substrates, and wildlife passage opportunities, as appropriate. Proper sizing of hydraulic structures, as determined through the detailed design phase, will minimize erosion, the potential for culverts to become perched, and will serve to prevent the formation of barriers to fish movement.

Opportunities for habitat enhancement include the removal of existing farm crossings (e.g., fords and culverts), naturalizing Mullet Creek and its HDF tributary to include sinuosity and in-channel habitat features (e.g., wood debris), and invasive species management (particularly of European Reed, *Phragmites australis ssp. australis* and Purple Loosestrife, *Lythrum salicaria*).

2.8 Mullet Creek Wetland Management

There are two types of wetlands in the Mullet Creek subwatershed as shown on Map 4B:

— Forb Mineral Meadow Marsh (MAM2-10)

— Willow Mineral Thicket Swamp (SWT2-2)

The wetland boundaries have been delineated by the Premier Gateway Scoped SWS Team and reviewed in the field with staff from CVC where property access has been permitted. The wetland boundaries have been surveyed by the Premier Gateway

Scoped SWS Team using a Trimble R10 GNSS receiver and antenna to achieve centimetre-level accuracy. The Conservation Authority's regulatory limits are to be confirmed at the SIS stage when the wetland boundaries are to be staked and surveyed with an Ontario Land Surveyor (OLS) in the presence of CVC staff.

Wetlands within the Mullet Creek subwatershed are recommended for retention and protection. They are included within the proposed NHS with 30 m buffers.

2.9 Mullet Creek Natural Heritage System

The NHS has been developed and identified through Phases 1 and 2 of the Scoped SWS, in consultation with the Town, Region, CVC, and input from the public. The proposed NHS includes the following:

- Wetlands (surveyed boundaries) within the Mullet Creek catchment area, as well as 30 m buffers
- Woodlands (FOD4) with a 10 m buffer
- Confirmed SWH (Terrestrial Crayfish)
- Fish habitat (Mullet Creek) with a 30 m buffer
- Meander belt with a 15 m access allowance for reaches MC(4)1 and MC(4)2 – medium constraint watercourses
- Linkage (60 m wide) between the Mullet Creek wetlands along the HDF identified with a management recommendation of Conservation (MC(5) and MC(6))
- Linkage (60 m wide) between the thicket swamp (SWT2-2) and woodland (FOD4)

The proposed NHS is shown on Map 6B and Map 7B. The NHS protects the significant and sensitive natural heritage features within the study area and ensures connection to areas outside the study area. The proposed NHS is robust as it is comprised of wetlands, woodlands, watercourses, Significant Wildlife Habitat, and the floodplain. Through the SIS or detailed design stage, it is recommended that non-developable areas, created through the irregular NHS boundary, be included in the NHS and naturalized to provide an enhancement to the proposed system. The lands adjacent to the proposed NHS are ideal for any compensation measures that are to be provided, as well as open space uses such as stormwater management and LID. Compensation for any future impacts associated with public infrastructure may be provided outside of the study area boundary if not feasible to be done within the Phase 2B lands.

The regulatory and NHS boundaries identified through the Scoped SWS are considered approximate, preliminary, and subject to change / increase through the future SIS process once the wetlands are formally staked with the Conservation Authority and an Ontario Land Surveyor.

Additional areas may be added to the NHS through the SIS process, as in the further identification of Significant Wildlife Habitat or habitat for Species at Risk, and the integration of any compensation areas, such as compensation for the removal of isolated trees. It is recommended that compatible land uses be situated next to the NHS that will contribute to the protection of natural heritage features and the overall enhancement of the natural environment within the area. For instance, locating stormwater management facilities, Low Impact Development, parks, and trails next to the NHS can provide further opportunities for enhancement, while also providing the public and employees of the newly developed lands with access to natural areas for their enjoyment, recreation, and nature appreciation. Proposed locations of trails and SWM outlet / LIDs within buffers to Key Features must conform to applicable Regional and Secondary Plan natural heritage system policies and the objectives of the NHS. The NHS provides an opportunity to design the proposed development in an environmentally sensitive way that mitigates climate change, protects and enhances the natural heritage features, and benefits the adjacent development.

A trail network should be considered at the outset of development. Creating a network of trails along the NHS and within the Premier Gateway Employment Area, Phase 2B lands will provide people with walking / cycling trails right away, which will discourage the creation of ad hoc trails. Trails will foster nature appreciation and allow for passive recreation opportunities, which is part of a sustainable community.

Opportunities for habitat enhancement include the removal of existing farm crossings (e.g. fords and culverts), and natural channel design enhancements of watercourse reaches MC(4)1 and MC(4)2, which are impacted, medium constraint watercourses. Corridor designs for these reaches should incorporate principles of natural channel design, and aquatic, riparian and terrestrial habitat elements, which, in combination with the stormwater management plan, would improve upon the current ecological function of these impacted features.

Similarly, the HDF tributary to Mullet Creek is to be realigned using a natural channel / corridor design approach. Natural channel design does not suggest pools and riffles, rather feature designs and enhancements account for feature function, stability, conveyance, materials, and other habitat requirements that are deemed appropriate for the feature. A section of HDF MC(6) is currently piped for approximately 65 m, which should be daylighted. Hazard corridors are to be delineated based on the design

corridor geometry, and/or empirical approaches to accommodate the erosion hazard, which will require modifications to the NHS along this linkage corridor in subsequent studies.

The linkage along the Mullet Creek HDF tributary is currently comprised entirely of disturbed lands. The detailed design of the realigned channel should include a design for the linkage, including width, trails, incorporation of SWM facilities, and enhancement opportunities.

The NHS must be managed and maintained following implementation, to ensure long-term sustainability. This includes stewardship and management opportunities such as the following:

- Managing informal access to the NHS (i.e., lands adjacent to the NHS should be fenced).
- Providing garbage receptacles along the trail system and providing regular maintenance of these.
- Management of invasive species.
- Removal of trash and debris within the NHS.
- Nature interpretive signs for education purposes, especially along trails.
- Nest box installation for birds, bats, and pollinators.
- Naturalization of lands that are currently farmed, including buffers and linkages.
- Monitoring of the NHS and adaptive management as required, such as removal of garbage, closure of ad-hoc trails, management of invasive species, planting of native species, etc.
- Management policies to deal with encroachment from properties adjacent to the NHS.
- Management policies for appropriate lighting to limit impacts to wildlife.

3 IMPLEMENTATION PLAN

3.1 Introduction

The following section provides an overview of the future study requirements to accompany subsequent stages of planning and design within the Premier Gateway Phase 2B Lands.

3.2 Future Study Requirements

Future studies to verify and refine the recommended environmental and stormwater management plan presented in this Scoped Subwatershed Study are anticipated to be completed as part of subsequent stages in the planning process. Specifically, these are anticipated to consist of a Subwatershed Impact Study, Functional Servicing Reports, Stormwater Management Design Briefs, and Natural Channel Design Briefs. The following sections provide further details on these specific study requirements.

3.2.1 Subwatershed Impact Studies

Subwatershed Impact Studies (SISs) are to be completed at the next stage of planning to verify and refine the recommended environmental and stormwater management plan presented in this Scoped Subwatershed Study. The SISs should be completed using a systems-based approach and hence should be completed for areas with a common receiving watercourse (i.e., drainage outlet). The preliminary SIS study area boundaries are presented on Drawing WR-2. The respective SIS study areas are to be established in consultation with the Town of Halton Hills and its study partners, however, are anticipated to generally correspond to the following areas:

- Areas draining toward the Sixteen Mile Creek East Branch
- Areas west of the GTA West Corridor draining toward the East Lisgar Branch
- Areas east of the GTA West Corridor draining toward the East Lisgar Branch
- Areas draining toward Mullet Creek.

The SISs are intended to build upon the Scoped Subwatershed Study recommendations and refine the analyses and recommendations as appropriate based upon additional study and investigation, particularly for non-participating lands during the Scoped Subwatershed Study process. In particular, it is recommended that the SISs for the areas draining toward the East Lisgar Branch incorporate more current

information for the GTA West Corridor (i.e., limits of the right-of-way, crossings, stormwater management facilities, etc.). The detailed site-specific work may identify additional features / functions which were not captured as part of the higher-level studies, which should be evaluated using the same criteria as established in the higher-level study (i.e., this Scoped Subwatershed Study).

The specific objectives of the SIS level of study are to:

- Identify the opportunities and constraints to development at a site-specific level, including consideration for adjacent and neighbouring sites.
- Confirm the fisheries and watercourse classifications.
- Site-specific field surveys where necessary to confirm the presence or absence of Significant Wildlife Habitat or Species at Risk.
- Determine preferred servicing plan.
- Determine road layout.
- Develop and define the integration of stormwater management facilities.
- Document that the proposed stormwater management outlets proposed to discharge to a receiving waterbody or LIDs within the buffers, and/or Key Features of the NHS cannot discharge toward other conveyance infrastructure (i.e., storm sewers); this is required in order to satisfy Region of Halton criteria for essential infrastructure.
- Define phasing and cost-sharing in areas of multiple ownership.
- Field staking of NHS features (woodlands and wetlands) in consultation with the Town and Conservation Halton / CVC. Wetland boundaries are to be surveyed by an OLS.
- Ensure compliance with Endangered Species Act. Where appropriate, undertake bat habitat assessments and acoustic surveys.
- Where appropriate, demonstrate that the hydrologic function of created wetlands is such that it supports intended ecological functions.
- Finalize appropriate linkage and woodlot buffer widths in accordance with Scoped Subwatershed Study recommendations.
- Confirm and/or update long term stable top of slope assessment in accordance with “Conservation Halton Guidelines for Slope Stability Assessments for Valleys” Version 1.0 September, 2022.
- Meander belt width delineation for channel design / realignments.

- Preliminary natural channel design rationale, calculations, dimensions, material sizing and selection, and treatments, for channel realignments and enhancements.
- Confirm the application of erosion thresholds from the parent document and determine downstream erosion monitoring requirements and locations.
- Develop further characterization of groundwater resources and associated protection measures and mitigation techniques.
- Identify special treatments and stormwater management practices which are to be implemented within hydrogeologic areas of higher recharge potential.
- Apply refined groundwater characterization to determine the implementation of LID management practices.
- Confirm that the installation of infrastructure (including servicing, channel realignment works, foundations etc.) will not intercept critical groundwater flow which may discharge to local receptors.
- Verify that the water balance would be maintained through the proposed development and stormwater management plan; including the water balances of wetlands and other habitats that are being protected within the NHS, particularly those outside the East Sixteen Mile Creek corridor.
- Develop a groundwater quality management plan which would include:
  - Spills management plan
  - Locations for underground storage tanks and associated groundwater quality monitoring sites
  - The appropriate abandonment of unused water wells and maintenance of existing water wells (Regulation 903, Ontario Water Resources Act)
  - Approaches to managing road de-icing and locations of snow dumps
  - Requirements to maintain contaminant threats inventory
  - Guidance to minimize the application of lawn chemicals
- Site-specific standards for design, implementation and management of corridors, buffers, and any restoration areas.
- At detail design, develop strategies to enable construction phasing while allowing the rescue of biota from small, isolated habitats prior to any wetland or watercourse rehabilitation / removal, and maintenance of the NHS resources through the construction period.
- Provide mitigation measures for the protection of groundwater resources.

- Identify and size proposed LID BMPs for use in the stormwater management plan.
- Preliminary analysis of stream corridor dimensions required to maintain pre-development riparian strategy.
- Incorporate design elements into developed areas that complement, support, and facilitate biodiversity including, but not limited to enhanced low-maintenance landscape cover, including treed zones, shrub thickets, meadows, and wet features (sustained with clean runoff).
- As part of the monitoring and adaptive management plan, identify the type and location of aquatic and terrestrial ecology monitoring that will be undertaken for holistic and local-level monitoring programs.
- Where appropriate, identify adaptive management plans where mitigation implementation and monitoring are proposed for protected and restored terrestrial features.

The limits of the areas included within specific SISs are defined during the Secondary Planning process and are generally associated with common contributing drainage areas to a particular outlet or receiver from the Secondary Plan area. For the Premier Gateway Phase 2B lands, it is anticipated that the SIS areas would coincide with the contributing drainage areas to the three future stormwater management facilities at the outlets to the receiving systems.

Key outcomes from the SISs include:

1. Updated and refined stormwater management facility siting and sizing criteria
2. Updated and refined water budget assessment and LID capture targets and general guidance for siting LID BMPs
3. Verification that proposed development would not impact or constrain grading and drainage of adjacent and neighbouring properties
4. HDF and watercourse management recommendations (confirm and/or update)
5. Staked top-of-bank for confined watercourse systems
6. Establish the NHS to ensure proper delineation of natural hazard lands (flooding and erosion hazards) and regulatory allowances, and the application of appropriate buffers / setbacks to the natural features; additional studies will need to be completed as part of the SIS to establish / refine buffers / setbacks to NHS features
7. Confirm / reflect SWH and Significant Woodlands from the Scoped Subwatershed Study

8 Provide guidance regarding principles and objectives where salvage of natural features can occur

9 Linkage and enhancement area refinements to be confirmed and protected

10 Establish watercourse / valley crossing locations and corresponding sizes and geometry of each structure for morphological criteria, hydraulic design criteria of freeboard and clearance, regulatory peak flow conveyance, and wildlife passage.

11 Identify general guidance and requirements for holistic monitoring programs and principles for developing local monitoring programs.

In addition, and as previously noted, although the Scoped Subwatershed Study has advanced wet end-of-pipe facilities for stormwater management, it is anticipated that the ultimate SWM strategy would include privately owned facilities for some locations, as well as source-controls (i.e., rooftop and/or parking lot storage) for smaller sites which are insufficient to support a wet end-of-pipe facility. Any proposed privately owned stormwater management facilities should confirm the feasibility of providing a safe outlet to a receiving drainage system (i.e., discharge to defined ditch, watercourse, or storm sewer) to confirm the feasibility of implementing privately owned facilities. Further, implementing communal facilities which serve multiple landowners is encouraged.

Surface storage (i.e., rooftop/parking lot storage) installed in addition to a pond as part of a multi-component linear quantity control system may be considered for the Regulatory Storm Event (Regional or 100-year storm) on a case-by-case basis. CH noted that these controls will not be reflected in future Regulatory Storm flood hazard mapping until such time that the use of these types of controls for extreme storm events is supported through clear Provincial direction and/or a comprehensive watershed approach is established between CH and its watershed municipalities.

Opportunities to enhance the functionality of the Natural Heritage System through the incorporation of Regulatory Flood controls should be explored at the SIS stage. For example, in the Mullet Creek watershed, where a need for Regional Control has been demonstrated through the Scoped Subwatershed Study, there may be an opportunity to incorporate the Regional Storm Controls within the 60 m wide NHS linkage corridor, which should be explored at the SIS stage. The refinement of the stormwater management facility siting and sizing criteria is suggested to apply the following approach:

— Develop preliminary siting of stormwater management facilities at SIS stage, based upon more detailed information.

- Compare stormwater management plan for SIS with that advanced in the Scoped Subwatershed Study to determine key differences (i.e., location of stormwater management facility and corresponding outlet, size and impervious coverage of contributing drainage area, any uncontrolled discharge locations, etc.).
- Compare storage-discharge relationship for stormwater management facility with that required per the unitary sizing criteria advanced in the Scoped Subwatershed Study to determine any differences.
- Update HSPF and Visual OTTHYMO hydrologic models developed for Scoped Subwatershed Study to reflect refinements to drainage areas and storage-discharge relationships per the SIS.
- Assess differences in peak flow rates at stormwater management facility outlets and key downstream locations based upon development and stormwater management plan advanced in the SIS versus those determined for existing and proposed land use conditions per the Scoped Subwatershed Study.
- Where the results of the hydrologic assessment indicate that the development and stormwater management plan advanced in the SIS results in residual increases to peak flow rates compared to existing land use conditions and/or insufficient capacity within the stormwater management facility, conduct additional analyses to revise the sizing of the stormwater management facility to achieve the required post-to-pre control and/or erosion control.

Pre-consultation with the Town of Halton Hills and its study partners is recommended to develop Terms of Reference for SISs.

It is expected that additional data will be collected at the SIS stage to support local scale characterization of the hydrogeologic system with specifics documented in the individual SISs. The additional data would include all the various types of hydrogeological field data necessary to define the site-specific hydrogeologic setting and associated groundwater-surface water connections (i.e., borehole logs, monitoring wells, groundwater levels, discharge areas). The number and location would need to be determined by the proponent's consultant at the SIS stage. Where substantive differences in current conditions are identified in soil type (e.g., sand vs. till), subsurface geology, overburden thickness, groundwater depth, groundwater flow direction, and groundwater discharge locations, the local characterization should be refined and include a discussion of how these local refinements may influence or change the hydrogeological characterization presented in the Scoped Subwatershed Study.

To prevent potential contaminants from entering the groundwater flow system through abandoned private domestic wells or unused monitoring wells, it is necessary that they be properly decommissioned as per MECP Ontario Regulation 903.

The existence and potential removal of tile drainage may increase the local water table and could potentially reduce short-term groundwater discharge to local surface features. Dewatering and construction considerations along with any related site-specific water management practices should take this into account.

Management direction and consideration for site-specific feature-based water balance assessments are expected to be addressed. The extent of assessment will be determined based on any future refinements to the ecological connection or future requirements from Conservation Halton or Credit Valley Conservation. Areas recommended for further study are expected to need a groundwater field program to refine the groundwater function and provide appropriate groundwater management options.

More detailed vegetation work and soil assessments are required in the “Lisgar Wetlands”. The assessment is to determine whether these vegetation communities meet the wetland definition as per the Conservation Authorities Act, to confirm each wetland:

1. is seasonally or permanently covered by shallow water or has a water table close to or at its surface
2. directly contributes to the hydrological function of a watershed through connection with a surface watercourse
3. has hydric soils, the formation of which has been caused by the presence of abundant water
4. has vegetation dominated by hydrophytic plants or water-tolerant plants, the dominance of which has been favoured by the presence of abundant water

The regional significance of these two vegetation communities should be addressed as per Halton Region’s Official Plan, Policy 276.5(3), in reference to the Memo included in **Appendix D** (NRSI, January 20, 2023). Further study of these vegetation communities will feed into the assessment of HDFs in this area, specifically TESMC1a, TESMC(1)2-1a, TESMC(1)3-1a, and TESMC(1)5-1.

The assessment of these two vegetation communities must include the following:

— A preliminary assessment in early spring to investigate whether there is standing water that likely persists into summer.

— If there is sufficient standing water, amphibian calling surveys (and surveys for other groups such as marsh birds and turtles if the habitat appears to be appropriate) should be conducted according to standard protocols.

— At least two season vegetation surveys should take place between May 31 and September 1 to include a fulsome inventory of flora species.

Should these two areas be confirmed as wetlands, a feature-based water balance needs to be undertaken if the wetlands are to remain in place. If they are to be relocated, suitable areas and water balance need to be determined in consultation with Conservation Halton.

The SISs would be submitted to the Town of Halton Hills and its study partners for review and approval.

3.2.2 Functional Servicing Reports

Functional Servicing Reports are typically prepared as part of the detailed site design process, in order to identify the manner in which water, sanitary, and storm servicing is to be provided for the site. The information provided within these documents generally includes, but is not limited to:

— Location and preliminary sizing of sanitary sewers.

— Location and preliminary sizing of storm sewers.

— Location and preliminary sizing of water mains.

— Preliminary site grading plan.

— Location and preliminary sizing of stormwater management facilities.

— Location and preliminary sizing of hydraulic structures (i.e., bridges and culverts).

— Preliminary channel grading plans and supporting analyses.

— Assessment of riparian storage for existing channel and preliminary channel designs.

3.2.3 Stormwater Management Plans

Requirements for Stormwater Management Plans are outlined within the March 2003 Stormwater Management Best Management Practices Guidelines. Stormwater Management Plans are prepared in support of individual development applications. The stormwater management plans complement the planning process associated with Draft Plans of Subdivision or individual Site Plans. Stormwater management reporting associated with this planning stage would be the “Functional Design” plan.

Subsequently, in support of the final subdivision design, a “Detailed Design” plan is prepared.

Functional Design

This level of design typically involves demonstrating the feasibility of providing stormwater management for a particular development. In areas where no Subwatershed Plan has been completed, the Stormwater Management Plan will be required to address additional issues such as environmental baseline conditions and screening of various stormwater management strategies and techniques. For the Premier Gateway Phase 2B Lands, the intent of the Functional Design Stormwater Management Plan would focus on demonstrating compatibility and compliance with principles and requirements prescribed in the corresponding Functional Stormwater and Environmental Management Strategies, as well as the specifics emanating from the Subwatershed Impact Study. This includes identifying specific stormwater management infrastructure which is to be implemented for the proposed development (i.e., type of LID BMPs, end-of-pipe facilities, thermal mitigation techniques such as cooling trenches and bottom draws, etc.).

Detailed Design

The detailed design submission is required to demonstrate how the required information, outlined in the Functional Design report, has been integrated as well as addressing details related to minor system design details, landscaping, safety, and maintenance aspects of Stormwater Management Facility design, as well as outlining subsequent specific monitoring requirements.

3.2.4 Natural Channel Design Briefs

Natural Channel Design Briefs are prepared in support of any proposed realignment, alteration, or enhancement to a regulated open watercourse. These reports would provide the following information, specifically related to such detailed designs:

- Details related to the natural channel design principles applied to the detailed design of the watercourse.
- Fluvial geomorphological analysis of the proposed watercourse design.
- The rationale for the selection of plantings within the riparian zone and floodplain.
- Details regarding any enhancements proposed within the adjacent watercourse.
- Detailed hydrologic and hydraulic analyses of the proposed watercourse and hydraulic structures to demonstrate impacts to floodplains, freeboard under proposed conditions, and maintenance of riparian storage post-development.

- Detailed assessment of impacts of the proposed watercourse on aquatic habitat and fish species.
- Detailed assessment of impacts of the proposed watercourse on any associated wetland, terrestrial corridor, or wildlife species.
- Demonstration that the proposed works satisfy the requirements for mitigating impacts on fish habitat
- Detailed design drainage for proposed watercourse and corridor.

For the Premier Gateway Phase 2B Lands, a Natural Channel Design Brief would only be required for any proposed realignment or alteration to Mullet Creek. This Natural Channel Design Brief would also be required to specifically verify that the enhancements to the Mullet Creek would maintain riparian storage along the subject reach of the Mullet Creek, as well as to provide details regarding the terrestrial enhancements implemented to achieve the NHS through the linkage corridor.

4 MONITORING PLAN

4.1 Components

Monitoring and Adaptive Management Plans are generally developed as part of SISs, Environmental Impact Studies, and/or as conditions of approval for stormwater management plans and watercourse reconstructions / realignments. The information collected as part of these plans is intended to verify the performance of the environmental and stormwater management system, as well as to provide guidance for potential modifications to the management plan to satisfy the objectives of the Scoped Subwatershed Study.

Overall, the baseline monitoring program would extend for 2 - 3 years, then annual during-construction monitoring (pre-80% built out), followed by three years of monitoring spread over 5 years post-construction (80 to 100% built out). This recommendation is to be confirmed on a site-by-site basis through the development of an Environmental Monitoring and Adaptive Management Plan as approved by the Town of Halton Hills and its study partners and may include scoping various components of the program based upon site-specific conditions and findings from the initial years of monitoring. Additional details regarding the framework for various components of the monitoring and adaptive management plan are provided below.

4.1.1 Surface Water

Surface water monitoring should include the collection of local stream flow and rainfall data. The selection of the appropriate gauge site should be completed in consultation with the Town of Halton Hills and its study partners. Available flow data from Conservation, CVC and the Town of Halton Hills should be used to inform the monitoring programs, where available. Surface water monitoring requirements should also address any monitoring requirements associated with any proposed channel realignment and/or reconstruction as well as the stormwater management plan.

Each stormwater management facility should be monitored for inflow and outflow and temperature. Given that the inlet and outlet control structures are generally well documented with well-defined hydraulic rating curves, continuous water level recording devices would be considered appropriate. Should the results of the stormwater management facility monitoring program indicate deficiencies with respect to facility performance, including deficiencies related to stormwater quality treatment, requirements for remediation will be the responsibility of the facility owner. Where the

facility has not been assumed by the Town, it will be the responsibility of the landowner, and remediation will typically be required as a condition of the ECA.

Regular inspection of the inlets and outlets should be completed to ensure that they are free of debris and sediment and are functioning in accordance with theory. As a minimum, inspections should be completed every month and following major storms for the first two years of operation. Any problems should be rectified by the consultant or reported to the Town for rectification if special equipment is required. The gauges should be installed from April 1 to November 30 and be capable of providing data in a minimum of 5-minute increments. All data should be collected in digital format and processed into a tabular inlet / outlet hydrograph form.

Depending on the results of the first year of monitoring, consideration should be given to monitoring the performance of the facilities year-round (i.e., inclusive of the December 1 to March 31 period).

4.1.2 Groundwater

A groundwater monitoring program is recommended prior to and during development to further characterize local site hydrogeological conditions and evaluate potential changes in the groundwater flow system over time (e.g., groundwater levels, groundwater quality, groundwater discharge, hydraulic gradients, and baseflow.). This work and the monitoring work associated with the other disciplines is to be carried out and paid for by the developer at a future planning stage for further characterization and assessment. The majority of the data used to characterize the subsurface lithology, groundwater levels, and groundwater flow systems within the present study area were sourced from the Ministry of Environment, Conservation, and Parks (MECP) Water Well Information System (WWIS). The majority of the water wells that comprise this dataset were located and clustered along the existing road network. Therefore, it is recommended that a new spatially representative network of monitoring wells be installed to fill the gaps away from the road network, between Steeles Avenue and the northern Phase 2B area boundary and the interior land areas between the 9th Line and 10th Line, and between 10th Line and Winston Churchill Boulevard.

Drilling, installation of water table monitoring wells, multi-level monitoring wells, test pits, and infiltration tests will provide the information needed to confirm the site-specific subsurface characteristics, including the continuity and thickness of sandy layers, potential for strong upward gradients, and flowing well conditions, and larger scale groundwater flow directions (including delineation of the groundwater flow divide between Mullet Creek and East Sixteen Mile Creek subwatersheds). While no bedrock valleys or flowing wells are interpreted for the current Study Area based on current data,

a bedrock valley infilled with more permeable sediments is interpreted in the Premier Gateway Phase 1B Study Area located southwest of the current Study Area in the Hornby area. This suggests that hydrostratigraphic conditions are present within the regional setting for strong upward gradients and potential connections to local stream reaches near the current Study Area. Flowing wells were identified in the MECP WWIS database within 800 m of the Study Area (see Section 2.1.4.3.3 of Phase 1: Study Area Characterization report).

Currently, vulnerable area delineation completed under the Source Water Protection program includes the delineation of a Significant Groundwater Recharge Area (SGRA) and Highly Vulnerable Aquifer (HVA) in the Study Area (see Section 2.1.4.3.4 and 2.1.4.3.7 in Phase 1: Study Area Characterization report).). Mapping of these vulnerable areas can be found in the Assessment Report for the Halton Region Source Protection Area (Source Protection Area Link) and (Chapter 4 Link). Since this mapping is based on a regional analysis of data, any constraints with respect to the mapping should be re-evaluated based on more localized site-scale investigations to further evaluate the hydrogeologic sensitivity of these areas (e.g., localized details of soil types / surficial geology, depth to the water table, overburden thickness, depth to and thickness of aquifers and aquitards, groundwater velocity, and the potential for the occurrence of man-made transport pathways).

In addition to confirming current conditions, pre-construction and post-construction groundwater monitoring are recommended for at least 5 years beyond build-out, followed by the assessment to determine if static trends have been realized. This monitoring should include:

- Groundwater level monitoring – manual and continuous (using loggers) groundwater level measurements from water table monitoring wells and multi-level monitoring wells to evaluate potential changes in the water table, vertical gradients, and flow directions both seasonally (and correlated with precipitation data) and to capture shorter-term trends.
- Water quality monitoring – annual groundwater and surface water quality sampling of selected monitoring wells and spot baseflow locations, respectively, to evaluate potential changes in water quality and groundwater-surface water interaction. Parameters should include basic anions (including nitrogen species) and metals.
- Spot baseflow measurements – seasonal (i.e., spring, summer, and fall) monitoring of East Sixteen Mile Creek to evaluate potential changes in groundwater discharge dynamics over time.

— Shallow groundwater - surface water level monitoring – installation of a number of shallow / deep drive point piezometer pairs along East Sixteen Mile Creek and in the area of the apparent discharge zone observed during the winter of February 2021 (see Figure GW-11 of Phase 1: Study Area Characterization report) to assess vertical gradient trends over time using manual and continuous (logger) water level monitoring methods.

4.1.3 Watercourses

Monitoring sites were installed during the Phase 1 Characterization in receiving watercourses immediately downstream of the Scoped SWS Study Area in East Sixteen Mile Creek reach ESMC(2) and Mullet Creek reach MC(4) (**Figure 4.1**) as per the Terms of Reference (TOR). One benchmarked cross-section was installed at each site in addition to erosion pins within the vicinity of the cross-section. The collection of field data from these sites over an extended period of time can provide great insight on channel processes and functions. This monitoring can also yield information regarding the response of a watercourse to changes in upstream land use.

Despite measures to maintain the hydrological regime and reduce impacts of impervious surfaces, there is the potential that a local land use change will result in some alteration in the hydrologic regime (i.e., increased flow volumes) and sediment regime (i.e., initially more sediment being supplied to the channel followed by an overall decrease in loadings). These alterations can result in changes in the channel planform, bank erosion, cross-sectional area and substrate composition, which, in turn, may locally affect aquatic habitat and water quality.

Additional monitoring locations should therefore be established, and baseline surveys completed for reaches downstream of impacted watercourses. Specifically, the following steps should be taken to monitor development impacts:

— **General channel morphology:** Photographs from a known vantage point and photo logs should be used to document general geomorphic site conditions on an annual basis. An additional site visit will be conducted at each site following a peak storm in excess of the 5-year storm event for the system. These photographs will be used as supplemental information to inform decisions regarding the need for mitigation.

— **Control Cross-sections:** To be monitored twice annually. Once following the spring freshet, and again in the fall. An additional site visit should be conducted at each site following a peak storm in excess of the 5-year storm event for the system.

— **Substrate Composition:** A modified Wolman pebble count should be conducted at each control cross-section on an annual basis. An additional site visit will be

conducted at each site following a peak storm in excess of the 5-year storm event relevant to the hydrologic regime. Due to the dynamic nature of substrate composition, no action will be taken until Year 5 unless the adjustment is identified as a potential risk to the function of the channel by a qualified geomorphologist.

— **Lateral Migration:** A series of erosion pins installed in areas of active bank migration as well as areas of anticipated migration should be measured during each monitoring visit to determine rates of bank adjustment. An additional site visit will be conducted at each site following a peak storm in excess of the 5-year storm event for the system.

Key geomorphic parameters to monitor and record should include but not be limited to Bankfull cross-sectional area (m^2), mean bankfull channel depth, bank migration rates (cm/yr), and substrate distribution (D_{50} and D_{90}). Alternative methods for measuring changes may be proposed through the development of an EMP, and approved by the Town and Conservation Authorities, accordingly.

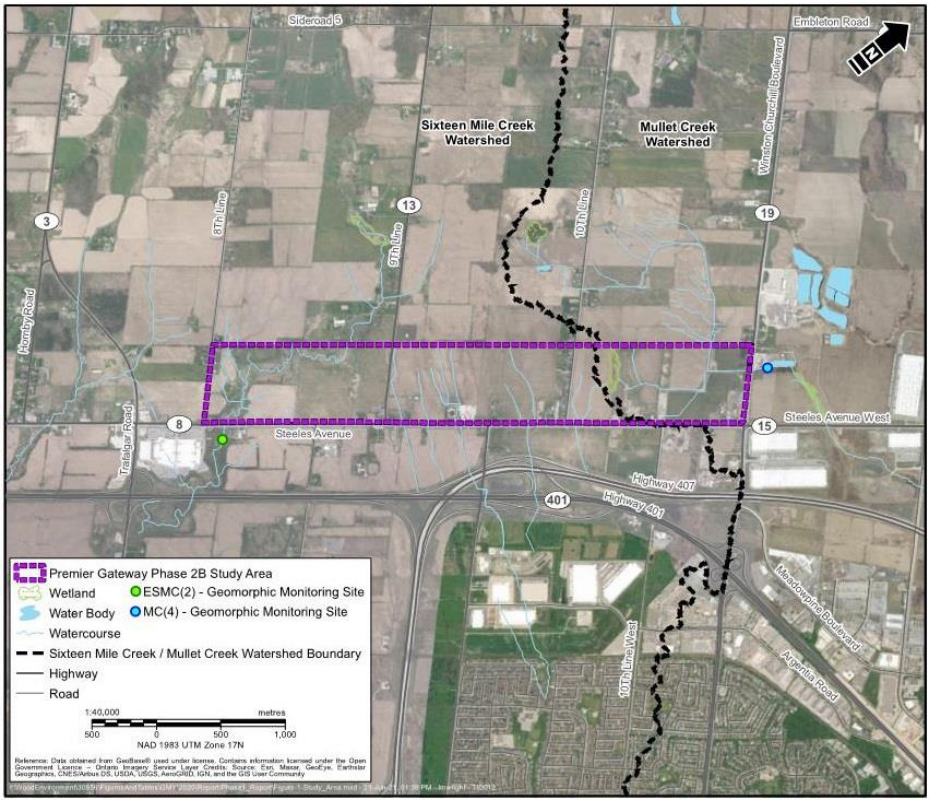


Figure 4.1: Baseline Stream Morphology Monitoring Locations

Baseline Monitoring and Establishing Thresholds of Adjustment

It is recommended that baseline geomorphic monitoring occur twice annually (e.g., spring and fall), over a period of 2 to 3 years to observe trends in the parameters described above for the existing condition. Through an interpretation of baseline monitoring results by a qualified professional, thresholds (or targets) of adjustment to guide the interpretation of during- and post-construction monitoring results should be developed.

Given that channels are naturally active, acceptable rates of change may be difficult to define. Therefore, targets may be recommended as proportional changes between years (e.g., greater than 20% channel width). Monitoring plans and target thresholds may need to be developed on a site-by-site basis depending on the variability of adjustment between site locations (i.e., some channels may be more active than others). Monitoring plans and targets should be confirmed in consultation with CH, CVC, the Town, and other agencies (e.g., MECP) where appropriate. Baseline monitoring results, target thresholds, and monitoring schedules / plans and responsibilities should be summarized in the monitoring report, and approved by the Town and Agencies.

During- and Post-Construction Monitoring

Annual during-construction monitoring (e.g., pre-80% built out), followed by three years of monitoring spread over 5 years post-construction (e.g., 80 to 100% built out) are recommended but may be modified as appropriate within the monitoring program. This monitoring should occur twice annually (e.g., spring and fall), and at least once following a significant precipitation event (i.e., 10 mm within 24 hours).

Threshold exceedances, if documented, will require an interpretation of site conditions and trends by a qualified Professional Geomorphologist to explore if any adaptive management or remediation recommendations are appropriate.

4.1.4 Surface Water Quality

Surface Water Chemistry

Surface water quality monitoring is to be undertaken in accordance with the MECP Monitoring Guideline under the CLI-ECA process. Chemical sampling using grab sampling should be completed to characterize and verify the stormwater quality management system. Instream monitoring to establish pre-development (i.e., baseline) conditions should be completed two years prior to development; the location of in-stream water quality monitoring should be determined in consultation with the Town of Halton Hills and its study partners.

Water chemistry monitoring of post-developed conditions should be completed for a minimum of three years post development and should include monitoring of the inlet and outlet of each stormwater management facility after construction as well as online the receiving watercourse at the same location identified for pre-development monitoring.

Grab sampling is recommended for collecting water quality samples from each facility for the monitoring program. Each site should have three events sampled per year, typically representative of an average spring, summer and fall event (rainfall event volumes of over 15 mm depth are preferable).

The following parameters are recommended for monitoring surface water chemistry and water quality:

The parameters to sample include:

- Oil and Grease
- Total Phosphorus
- Anions (Nitrate, Nitrite, Phosphate, Chloride)
- Ammonia
- Total Kjeldahl Nitrogen (TKN)
- Conductivity
- Total Solids (TS)
- Total Suspended Solids (TSS)
- BOD5
- 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).

Surface Water Temperature

Continuous temperature gauges should be installed from June 1 to September 30 at the outlet from all facilities and both upstream and downstream of the facility outlets, to monitor the effectiveness of measures to cool the effluent and the impact on stream temperature. Locations for online monitoring of water temperature should be determined in consultation with the Town of Halton Hills and its study partners.

4.1.5 Aquatic Ecology

The monitoring conducted for the SWS is baseline data, but additional surveys should be undertaken within each SIS study area for more detailed data. This monitoring data provides baseline conditions, prior to development. Monitoring of fish and aquatic habitats should be undertaken where appropriate. Monitoring may be triggered by requirements arising from aquatic habitat reconstruction or compensation, and/or site-specific development impacts on aquatic features. Monitoring may also be required to determine the effectiveness of stormwater management facility design for both water quality and temperature mitigation. Areas of degradation that could benefit from restoration should be identified during all monitoring efforts.

As Mullet Creek is proposed to be realigned through natural channel design, monitoring of this watercourse and HDF system is essential to ensure that created and altered systems perform as designed and intended. Specific effectiveness monitoring should be developed in consultation with the appropriate agencies.

The following conditions are anticipated for aquatic habitat monitoring to address the re-aligned channel associated with Mullet Creek:

- Pre-construction monitoring / baseline monitoring (re-aligned channels)
  - Fish community
    - No fish were found in Mullet Creek or its HDF tributary during surveys by the SWS Team. Fish community assessments are required pre-construction to confirm this, or in order to establish the existing community and to guide watercourse and aquatic habitat designs. The existing fish community and species will dictate how the channel will be designed to ensure the fish community returns to the watercourse post-construction. The pre-construction fish survey should be completed during high flows (preferably spring).
    - Watercourse realignments and designs will need to incorporate aquatic habitat enhancement design features and need to be designed for the target fish community, if applicable.

        - Fish communities within the study area should be surveyed according to the screening level assessment protocol as described in OSAP, Section 3, Module 1 (Stanfield 2017), consistent with the methods used in the SWS. The methodology should be confirmed with the CVC prior to work and should be consistent with the methods that are to be used post-construction of the realigned channel.
    - Aquatic Habitat
        - Detailed habitat mapping of Mullet Creek is to be conducted as part of Fisheries Act approvals.
        - To ensure consistency between pre- and post-construction assessments, a standardized protocol, such as OSAP is recommended.
- Post-construction monitoring (re-aligned channels)

The detailed design plan for the realignment of Mullet Creek is to outline the specific monitoring plan required for the channel; however, the following provides general guidance for post-construction monitoring activities for the constructed and existing habitat features:

- Aquatic Habitat
- Ensure that the realigned channel is constructed according to the design plan.
- Detailed aquatic habitat assessments and habitat mapping of pools, riffles, and installed habitat features to assess function.
    - Aquatic habitat monitoring should occur over a 10-year period to assess the stability of the designed system and ensure the system is functioning as intended and designed. The frequency of monitoring will be established as part of the detailed design approvals, and in consultation with CVC.
- Fish community assessments
    - Monitoring stations should be established in a diversity of locations that reflect the variety of habitat features and designed functions of the system.
    - The objective is to ensure the fish community that the watercourse was designed for, if applicable, is established within the realigned system.
    - To ensure monitoring data can be compared across years, the same methodology should be applied to conduct the fish community assessments post-construction, as was used pre-construction.

- Post-construction monitoring should occur over a 10-year period to assess the re-establishment, health, abundance and diversity of the fish community in the realigned channel. The frequency of monitoring within the 10-year period should be established as part of the detailed design approvals, and in consultation with CVC.

Development-related monitoring will be site-specific and determined at the SIS stage and in consultation with the Town, Region, Conservation Halton, and CVC. An adaptive management approach to the monitoring plan should be applied and detailed through the SIS stage. It is recommended that the detailed monitoring plans outline the specifics of the adaptive management approach, in particular when feedback and changes to the design will occur. Key milestones (e.g., end of year 1, 3, 5, and 10) should be established that allows for agencies to evaluate the effectiveness and stability of the overall system. This process will identify deficiencies in the function of the watercourses and recommendations or requirements to remedy the deficiencies and design issues.

Prior to construction, on-site inspections of erosion and sediment control (ESC) measures should be undertaken. During construction, it must be ensured that ESC measures are functioning well and as intended and that any deficiencies are addressed promptly. Mitigation measures recommended for the development process should be adhered to, such as fueling of machinery at designated locations away from watercourses; storage of machinery and material, fill, etc. in designated areas; and equipment movement through natural areas and buffers must be controlled.

4.1.6 Terrestrial Ecology

Development-related monitoring (i.e., impact prediction validation) will be site-specific and determined as part of the SIS stage. This will be led by the Town of Halton Hills, with input and advice from Conservation Halton and CVC.

The following are considerations for terrestrial and wetland monitoring. Monitoring will address and validate predicted effects and the establishment of the NHS and may include:

- Pre-construction monitoring: establishment of monitoring stations / locations, baseline inventories, etc.
- Construction monitoring: environmental protection and mitigation measures effectiveness monitoring, which may include buffer / setback integrity monitoring.
- Post-construction monitoring: assessment of early NHS restoration success, including addressing restoration planting establishment and installation warranties.

Monitoring will be practical and focused on areas where impact prediction validation and/or NHS restoration success information is deemed to be beneficial. The specific items included in the monitoring plan (e.g., anuran call surveys, breeding birds, etc.) will be determined based on the overall objectives of the development application, as detailed at the SIS stage, in consultation with the Town, Region, Conservation Halton, and CVC. To provide support for the feature-based water balance assessments, wetlands should be instrumented to monitor hydrological function for at least one year pre-development. Wetland hydrological monitoring should be undertaken for both existing and any proposed replicated wetlands within the study area to ensure there will be no impact to the hydrological functions.

An adaptive management approach to the monitoring plan should be applied and detailed through the SIS stage. It is recommended that the detailed monitoring plans outline the specifics of the adaptive management approach, in particular when feedback and changes to the design will occur. Key milestones (e.g., end of year 1, 3, 5, and 10) should be established that allows for agencies to evaluate the effectiveness and stability of the overall system. This process will identify deficiencies in the function of the watercourses and recommendations or requirements to remedy the deficiencies and design issues. Adaptive management techniques may include additional plantings, wildlife habitat creation, changes to lighting design, fencing, wildlife crossings, signage, and/or modifications to stormwater management, among others.

Prior to construction, on-site inspections of erosion and sediment control (ESC) measures should be undertaken. During construction, it must be ensured that ESC measures are functioning well and as intended and that any deficiencies are addressed promptly. Mitigation measures recommended for the development process should be adhered to, such as fueling of machinery at designated locations away from woodlands, wetlands, and watercourses; storage of machinery and material, fill, etc. in designated areas; and equipment movement through natural areas and buffers must be controlled.

Post-construction, buffer, restoration, and compensation plantings should be monitored after installation. The target survival rate and monitoring frequency should be established during the creation of detailed planting plans. Buffer monitoring should assess whether buffers are providing protection to the natural heritage features as designed (e.g., monitoring stations are to include buffers) and should include monitoring of encroachment, trampling, ad hoc trails, dumping, litter, invasive species, as well as light and noise impacts. Non-native invasive species should be monitored in buffers and enhancement areas and managed.

Duration

The duration of the monitoring program will be determined based on the timeframe for implementation. Although no specific timeframe can be provided for completing the monitoring program, monitoring should be conducted at least two years prior to construction (if not already accomplished through baseline data collection work) and should continue until at least 80% build-out of the area.

For stormwater management facilities, the greater of a three-year monitoring program or post-construction monitoring to 80% build-out of the contributing drainage area to the stormwater management facility is recommended to verify facility performance prior to the assumption by the Town. The monitoring should include any other requirements or conditions on the part of the Town and approval agencies (i.e., MECP), as pertaining to the approval and/or assumption of the facility.

For the purpose of monitoring the watercourses and the NHS, as well as verifying stormwater management facility performance on a systems-basis for the study area, a longer-term holistic monitoring program is recommended. This monitoring program should be led by the Town of Halton Hills and is recommended to include at least two years of baseline data and continue until the greater of 10 years or 80% build-out of the Secondary Plan Area.

4.2 Reporting

Annual reports are to be prepared for all monitoring programs. Annual monitoring reports to verify facility performance prior to the assumption by the Town should be submitted to the Town and any other permitting agencies (i.e., MECP) per the conditions of approval. Annual monitoring reports for the holistic monitoring programs should be submitted to the Town of Halton Hills and its study partners.