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City of Mississauga
Transportation and Works Department
Tel: 905-615-3200

Schedule B Municipal Class Environmental Assessment – Project File
Cooksville Creek Erosion Control Project



Submitted by:

Aquafor Beech Limited

in association with

New Era Archaeology Inc.

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Contact:
Rob Amos, MASc, P. Eng
Aquafor Beech Limited
Amos.R@aquaforbeech.com
2600 Skymark Avenue
Building 6, Unit 202
Mississauga, ON L4W 5B2
T. 416.705.2367
Aquafor Beech Reference: 67489

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EXECUTIVE SUMMARY

Overview

The City of Mississauga (City) has commissioned Aquafor Beech Limited (Aquafor) to undertake a Municipal Class Environmental Assessment (MCEA) for the Cooksville Creek natural corridor between Lakeshore Road East and Lake Ontario. Residential properties on Hampton Crescent and Beechwood Avenue border the study area, as is illustrated in the below figure.



Cooksville Creek South of Lakeshore Road Study Area

The watercourse within the study area was realigned and channelized by Credit Valley Conservation (CVC) in the 1970s, and the channel bed and banks were lined with gabion baskets to provide erosion protection. As part of the realignment, an informal berm was constructed on the East Bank, with the intention of reducing nuisance flooding on the Hampton Cresent and Beechwood Avenue properties. The Helen Molasy Trail was also established as part of the channel realignment, constructed on top of the aforementioned berm. Drainage pipes were also installed below the berm, to provide drainage connections between the adjacent residential properties and the watercourse.

Study Objectives

The objective of the Municipal Class Environmental Assessment study was to develop and evaluate corridor restoration alternatives within the study area, to mitigate existing erosion and drainage problems within the creek corridor. This includes restoration of the watercourse bed and banks, the Helen Molasy Trail and informal berm along the eastern bank of the creek, and the rehabilitation of the associated drainage structures. Additional objectives of the MCEA study included:

- Maintaining or improving the hydraulic capacity of the creek,
- Providing naturalized erosion protection solutions,
- Protecting existing City owned infrastructure,

- Enhancing the aquatic and terrestrial environment wherever possible,
- Minimizing impacts to the natural environment during construction,
- Adherence to CVC's regulatory requirements,
- Minimizing future operational and maintenance activities, and
- Improving trail safety conditions.

Development and Evaluation of Alternatives

Restoration alternatives for the watercourse, trail and informal berm were developed based on a series of existing conditions inventories and technical studies. These alternatives were evaluated based on a variety of criteria including social, economic, environmental, and technical considerations, to determine the preliminary preferred alternatives. This evaluation process was further refined through first nations engagement, public consultation and discussions with regulatory agencies including Credit Valley Conservation. The preferred alternatives recommended to be carried forward to detailed design includes extended channel restoration works for the watercourse component, and the hybrid drainage alternative for the trail restoration component.

First Nations Consultation

The Ministry of Environment, Conservation and Parks (MECP) identified three First Nations communities with potential interest in the Class EA for Cooksville Creek South of Lakeshore Road, including:

- Huron-Wendat Nation,
- Mississaugas of the Credit First Nation, and
- Six Nations of the Grand River.

The following information was provided via email to each of the identified First Nations:

- Notice of Commencement (March 14th, 2024)
- Stage 1 Archaeological Assessment Results (October 15th, 2024)
- Offer for Representation in Stage 2 Archaeological Assessment (October 15th, 2024)
- Notice of Public Information Center and Invitation to Participate (October 22nd, 2024)

Public Consultation

Notice of Study Commencement letters were delivered on February 20th, 2024, to provide background information regarding the study, share a link to the project's website, and provide contact information for the project team. On October 21st, 2024, a Notice of Public Information Center (PIC) was emailed to stakeholders and delivered in-person to local residents. The PIC took place on October 29th, 2024, at a local community centre nearby the study area (Small Arms Inspection Building). Members from the consulting project team, the City of Mississauga project team, and the Ward 1 councillor were in attendance. All attendees expressed support for the preliminary preferred alternatives of the extended channel restoration works, coupled with the hybrid drainage solution.

Conclusions and Recommendations

In summary, this report signifies the completion of the Cooksville Creek South of Lakeshore Road Municipal Class Environmental Study. Moving forward, the City of Mississauga will carry forward the preferred restoration alternatives for the trail, berm, and watercourse into detailed design, and afterwards to construction. Prior to construction, all required regulatory approvals will be procured and targeted community notifications will be undertaken.

Table of Contents

EXECUTIVE SUMMARY ii

1 INTRODUCTION 1

1.1 Study Overview 1
1.2 Problem Definition 1
1.3 Study Objectives 2
1.4 Class Environmental Assessment Process 2

2 EXISTING CONDITIONS 6

2.1 Study Area 6
2.2 Historic Realignment 6
2.3 Storm Sewer Outfall Inventory 9
2.3.1 Storm Sewer Outfalls from Nearby Roadways 9
2.3.1.1 375mm Outfall at Richey Crescent 9
2.3.1.2 375mm Outfall from Beechwood Avenue 9
2.3.1.3 750mm Outfall from Beechwood Avenue 10
2.3.1.4 900mm Outfall from Lakeshore Road 10
2.3.2 Catchbasin-Outfall Pairs on East Bank (x8) 10
2.3.2.1 Catchbasin-Outfall #1 11
2.3.2.2 Catchbasin-Outfall #2 12
2.3.2.3 Catchbasin-Outfall #3 13
2.3.2.4 Catchbasin-Outfall #4 14
2.3.2.5 Catchbasin-Outfall #5 15
2.3.2.6 Catchbasin-Outfall #6 16
2.3.2.7 Catchbasin-Outfall #7 17
2.3.2.8 Catchbasin-Outfall #8 18
2.3.3 Catchbasin-Outfall Pairs on West Bank (x4) 19
2.3.3.1 Catchbasin-Outfall #10 19
2.3.3.2 Catchbasin-Outfall #11 20
2.3.3.3 Catchbasin-Outfall #12 21
2.3.3.4 Catchbasin-Outfall #13 22
2.4 Sanitary Sewer Crossings 23
2.5 Pedestrian Bridge 23
2.6 Helen Molasy Trail & Berm 24

3 TECHNICAL ASSESSMENTS 25

3.1 Fluvial Geomorphic Assessment 25
3.1.1 Basic Geomorphic Parameters 25

3.1.1.1 Reach Description 25
3.1.1.2 Grain Size Distribution Analysis 26
3.1.2 RGAs and RSAT 28
3.1.2.1 RGA and RSAT Results for the Reach 29
3.1.3 Geomorphic Characterization of the Study Area 31
3.1.3.1 Erosion Site 1 31
3.1.3.2 Erosion Site 2 31
3.1.3.3 Erosion Site 3 32
3.1.4 Erosion Hazard Assessment 32
3.2 Terrestrial Natural Heritage Assessment 32
3.2.1 Vegetation Communities and Flora 32
3.2.1.1 Vegetation Communities 33
3.2.1.2 Botanical Inventory 36
3.2.2 Tree Inventory and Bat Habitat Assessment 37
3.2.3 Other Terrestrial Wildlife 39
3.2.4 Species at Risk Screening 39
3.2.5 Significant Natural Heritage Feature Considerations 40
3.3 Aquatic Assessment 40
3.3.1 Aquatic Habitat 41
3.3.2 Fish Community Assessment 43
3.3.3 DFO Self-Assessment 45
3.3.4 In-Water Timing Window 46
3.4 Archaeological Assessment 48
3.5 Cultural Heritage Assessment 50
3.6 Hydraulic Assessment 51
4 DEVELOPMENT AND EVALUATION OF ALTERNATIVE SOLUTIONS 53
4.1 Study Area Constraints 53
4.2 Description of Alternatives 53
4.2.1 Creek Restoration Alternatives 53
4.2.1.1 Alternative 1: Do Nothing 53
4.2.1.2 Alternative 2: Local Channel Restoration Works 53
4.2.1.3 Alternative 3: Extended Channel Restoration Works 53
4.2.2 Drainage Improvement Restoration Alternatives 53
4.2.2.1 Alternative 1: Do Nothing 53
4.2.2.2 Alternative 2: Like-for-Like Drainage Replacement 54
4.2.2.3 Alternative 3: Partial Drainage Consolidation 54
4.2.2.4 Alternative 4: Hybrid Drainage Solution 54
4.3 Evaluation Criteria 54
4.4 Evaluation of Alternatives 55

4.5 Selection of the Preferred Alternatives 58
4.6 Description of the Preferred Alternatives 58
4.7 Inspection and Maintenance Requirements of the Preferred Alternatives 58
4.8 Property Permission Requirements of the Preferred Alternatives 58
4.9 Cost Estimate for the Preferred Alternative 59
5 PUBIC AND FIRST NATIONS CONSULTATION 62
5.1 First Nations Consultation 62
5.2 Public Consultation 62
5.2.1 Impact of Public Consultation on Selection of Preferred Alternative 63
5.3 Consultation with Regulatory Authorities 63
6 POTENTIAL ENVIRONMENTAL EFFECTS AND MITIGATION 64
6.1 Surface and Groundwater 64
6.2 Air Quality, Dust and Noise 64
6.3 Contaminated Soils & Excess Materials Management 64
6.4 Climate Change 64
6.4.1 Project's Impact on Climate Change 65
6.4.2 Impacts of Climate Change on the Project 65
7 DETAILED DESIGN RECOMMENDATIONS 66
7.1 Detailed Design and Investigations 66
7.1.1 Hydraulic Assessment 66
7.1.2 Geotechnical Investigation 67
7.1.3 Erosion Hazard Assessment 67
7.1.4 Tree Protection and Arborist Assessment 67
7.1.5 Utilities Confirmation 67
7.1.6 General Mitigation Measures 68
7.1.6.1 Erosion and Sediment Control 68
7.1.6.2 Fuel Spills 68
7.1.6.3 Environment Disturbance 68
7.1.7 Adherence to CVC Guidelines 68
7.1.8 Construction Services 69
7.2 Monitoring Program 70
7.3 As-Constructed Drawings and Analysis 70
8 CONCLUSION 71
9 SIGNATURES 72
10 REFERENCES 73

List of Figures

Figure 1-1: Cooksville Creek South of Lakeshore Road Study Area 1
Figure 1-2: Municipal Class Environmental Assessment Planning and Design Process 4
Figure 2-1: Historical Realignment of Cooksville Creek South of Lakeshore Road 6
Figure 2-2: Study Area Conditions in 1975 (Before Realignment) 7
Figure 2-3: Study Area Conditions in 1977 (During Realignment) 7
Figure 2-4: Study Area Conditions in 1980 (After Realignment) 7
Figure 2-5: Existing Conditions within the Cooksville Creek South of Lakeshore Road Study Area 8
Figure 2-6: 375mm Outfall Equipped with Flap Gate 9
Figure 2-7: Integration Outfall into Bank Protection 9
Figure 2-8: Upstream Catchbasin Location on Beechwood Avenue 9
Figure 2-9: Submerged Outlet with Stagnant Water and Organic Debris 9
Figure 2-10: 750mm Outfall Headwall Structure 10
Figure 2-11: Alignment of Outfall 10
Figure 2-12: 900mm Outfall's Integration into Armourstone Retaining Wall 10
Figure 2-13: Proximity of Outfall to Lakeshore Road Bridge 10
Figure 2-14: Catchbasin #1 Partially Covered in Organic Debris 11
Figure 2-15: Catchbasin #1 Relative to Trail 11
Figure 2-16: Build up of Organic Material and Mature Vegetation around Outfall #1 11
Figure 2-17: Buried Outfall #1 11
Figure 2-18: View of Catchbasin #2 12
Figure 2-19: Surrounding Area of Outfall #2 12
Figure 2-20: Catchbasin #2 Relative to Trail 12
Figure 2-21: Submerged Outfall #2 12
Figure 2-22: Catchbasin #3 Close Up 13
Figure 2-23: Catchbasin #3 Relative to Trail 13
Figure 2-24: Proximity of Outfall #3 to Creek 13
Figure 2-25: Buried Outfall #3 Headwall 13
Figure 2-26: View of Catchbasin #4 14
Figure 2-27: Catchbasin #4 Relative to Trail 14
Figure 2-28: Buried Outfall #4 14
Figure 2-29: Proximity of Outfall #4 to Surrounding Creek 14
Figure 2-30: View of Catchbasin #5 15
Figure 2-31: Location of Catchbasin #5 from Trail 15
Figure 2-32: Outflanked Outfall #5 Headwall Structure 15
Figure 2-33: Interior Pipe Conditions at Outfall #5 15
Figure 2-34: Catchbasin #6 Located on Private Property 16
Figure 2-35: Catchbasin #6 Relative to Trail 16
Figure 2-36: Outflanking & Partial Submergence of Oufall #6 16

Figure 2-37: Outflanked Headwall Structure for Outfall #6 16
Figure 2-38: View of Catchbasin #7 17
Figure 2-39: Catchbasin #7 Relative to Trail 17
Figure 2-40: Suspected Location Catchbasin #7 17
Figure 2-41: Suspected Location of Outfall #7 in Relation to Trail 17
Figure 2-42: View of Catchbasin #8 18
Figure 2-43: Outfall #8 Location from Trail 18
Figure 2-44: Outfall #8 Obstructions 18
Figure 2-45: Backwatered Channel Conditions Outfall #8 18
Figure 2-46: Location of Catchbasin #10 Relative to Fenceline 19
Figure 2-47: General Condition of Catchbasin #10 19
Figure 2-48: Partially Buried Outfall #10 19
Figure 2-49: Channel Conditions Surrounding Outfall #10 19
Figure 2-50: Catchbasin #11 Location 20
Figure 2-51: Catchbasin #11 Surrounding Area 20
Figure 2-52: Outfall #11 Headwall Conditions 20
Figure 2-53: Channel Conditions at Outfall #11 20
Figure 2-54: View of Catchbasin #12 21
Figure 2-55: Catchbasin #12 Surrounding Area 21
Figure 2-56: Outfall #12 Condition 21
Figure 2-57: View of Outfall #12 Channel Conditions 21
Figure 2-58: View of Catchbasin #13 22
Figure 2-59: Catchbasin #13 Surrounding Area 22
Figure 2-60: Outfall #13 Headwall 22
Figure 2-61: Channel Conditions at Outfall #13 22
Figure 2-62: View of Channel Conditions at Sanitary Sewer Crossings from Pedestrian Bridge 23
Figure 2-63: Engineering Drawings Showing Sewer Crossing in Relation to Pedestrian Bridge 23
Figure 2-64: Pedestrian Bridge Across Cooksville Creek 23
Figure 2-65: View of Complete Pedestrian Bridge Span 23
Figure 2-66: Deterioration of Trail Surface and Safety Railing 24
Figure 2-67: Gabion Basket Slumping Along Creek 24
Figure 2-68: Gabion Basket Trail Retaining Feature 24
Figure 2-69: Lack of Pedestrian Safety Railings on East Side of Trail 24
Figure 3-1: Representative photograph of the upstream portion of the Reach, facing upstream 26
Figure 3-2: Representative photograph of the downstream portion of the Reach, facing downstream 26
Figure 3-3: Grainsize Distribution of Upstream Location 26
Figure 3-4: Grainsize Distribution of Downstream Location 27
Figure 3-5: 35 Metre Long Scour and Slumping of Gabion Baskets 31
Figure 3-6: Bank Scour Forming Underneath Helen Molasy Trail 31

Figure 3-7: Outflanked Concrete Storm Sewer Outfall 31
Figure 3-8: Deteriorated Gabion Baskets Surrounding Outfall 31
Figure 3-9: Concrete Storm Sewer Submerged due to High Water Levels 32
Figure 3-10: Outflanked Storm Sewer Outfall 32
Figure 3-11: Fresh-Moist Willow Lowland Deciduous Forest (FOD7-3) and Open Aquatic (OAO) .. 33
Figure 3-12: Mineral Open Beach/Bar (BBO1) Inclusion 33
Figure 3-13: Ecological Land Classification for Cooksville Creek Study Area 35
Figure 3-14: Fish communities of the Credit River Watershed (MNRF and CVC, 2002) 44
Figure 3-15: Typical Aquatic Habitat at Downstream Extent 46
Figure 3-16: Fallen Riparian Tree Providing Habitat 46
Figure 3-17: Instream Substrate Looking Upstream 47
Figure 3-18: Typical Riparian Vegetation on Left Bank 47
Figure 3-19: Gabion Basket Bank Protection 47
Figure 3-20: Failing Gabion Basket with Tree Growing Out 47
Figure 3-21: Upstream Habitat with Gabion Baskets on Left Bank 47
Figure 3-22: Spawning White Sucker Fish 47
Figure 3-23: Stage 1 Archaeological Background Result 49
Figure 3-24: City of Mississauga's Mapping of Heritage Properties – No Properties Highlighted Within the Study Area 50
Figure 3-25: Existing HEC-RAS Schematic Showing Regional Floodline Extents and Model Cross-Section Locations 51
Figure 4-1: Preferred Alternative - Upstream Portion of Study Area 60
Figure 4-2: Preferred Alternative - Downstream Portion of Study Area 61

List of Tables

Table 3-1: Percentile Values of the Upstream Grainsize Distribution 27
Table 3-2: Percentile Values of the Downstream Grainsize Distribution 27
Table 3-3: Rapid Geomorphic Assessment Descriptions based on Index Value 28
Table 3-4: RSAT Scoring Matrix 29
Table 3-5: Stream Condition Based on Total RSAT Score 29
Table 3-6: RGA Field Score for Study Reach 30
Table 3-7: RSAT Score for Study Reach 30
Table 3-8: Botanical Inventory Results Summary 36
Table 3-9: Bat Acoustic Monitoring Results Summary – Low Frequency Bats 38
Table 3-10: Bat Acoustic Monitoring Results Summary – High Frequency Bats 38
Table 3-11: OSAP Findings for Study Area 41
Table 3-12: Species collected in the study area, Cooksville Creek (Ministry of Natural Resources, 2023) (Eakins, 2023) 45
Table 3-13: Range of Study Area Flows 51
Table 3-14: Erosion Thresholds for Stream Bed and Bank Materials (Fischenich, 2001) 52
Table 4-1: Alternative Evaluation Criteria – Physical / Natural Environment 54
Table 4-2: Alternative Evaluation Criteria – Economic Criteria 55
Table 4-3: Alternative Evaluation Criteria – Social/ Cultural Environment 55
Table 4-4: Alternative Evaluation Criteria – Technical/ Engineering Considerations 55
Table 4-5: Criteria Weighting Factors 55
Table 4-6: Ranking Scheme for Criteria Evaluation of Each Alternative 55
Table 4-7: Evaluation Matrix for Channel Restoration Alternatives 56
Table 4-8: Evaluation Matrix for Drainage Improvement Alternatives 57
Table 4-9: Cost Estimate for the Preferred Alternative 59

List of Appendices

Appendix A: Vascular Plant List
Appendix B: Tree Inventory Details
Appendix C: Species at Risk Screening
Appendix D: Wildlife Species List
Appendix E: Stage 1 Archaeological Assessment Report
Appendix F: Hydraulic Modelling Results
Appendix G: Creek and Trail Restoration Alternatives
Appendix H: First Nations Consultation Summary
Appendix I: Public Consultation Summary
Appendix J: Consultation with Regulatory Authorities

1 INTRODUCTION

1.1 Study Overview

The study area for this Municipal Class Environmental Assessment (MCEA) includes the Cooksville Creek natural corridor between Lakeshore Road East and Lake Ontario. The watercourse within the study area was realigned and channelized by Credit Valley Conservation (CVC) in the 1970s, and the channel bed and banks were lined with gabion baskets to provide erosion protection. As part of the realignment, an informal berm was constructed on the East bank of the creek, with the intention of reducing nuisance flooding impacts to the nearby properties on Hampton Cresent and Beechwood Avenue. The Helen Molasy Trail was established as part of the channel realignment, constructed on top of the berm. Drainage pipes were installed below the berm, to provide drainage connections between the adjacent residential properties and the watercourse. **Figure 1-1** below provides a general overview of the study area extents.



Figure 1-1: Cooksville Creek South of Lakeshore Road Study Area

1.2 Problem Definition

Deterioration of historic channelization works is prominent within the study area. Widespread gabion basket failure, in both the channel bed and banks is found throughout the study area, posing erosion risks to neighboring properties and infrastructure. The failure of this bank erosion protection has contributed to deteriorated trail conditions, including an uneven trail surface and leaning safety railings.

Furthermore, the informal berm and associated drainage features have deteriorated. Many of the drainage outlets connecting the adjacent backyards along Hampton Cresent and Beechwood Avenue have become outflanked, submerged, or buried in organic debris, and many of the drainage inlets have become obstructed by sediment. As such, this berm drainage is not functioning as originally intended, with ponding water present within the adjacent residential backyards. As a result, frequent maintenance is required to manually removal of ponded water from the residential backyards, and preform patchwork repairs to the trail surface.

Based on the deteriorated existing conditions within the study area, it is clear a long-term solution is required to rehabilitate the creek, trail and informal berm within the Cooksville Creek corridor from Lakeshore Road to Lake Ontario.

1.3 Study Objectives

The objective of this Municipal Class Environmental Assessment study is to develop and evaluate restoration alternatives intended to mitigate existing erosion and drainage problems within the creek corridor. This includes restoration of the watercourse bed and banks, the Helen Molasy Trail and berm along the eastern bank of the creek, and the rehabilitation of the associated drainage structures. Additional objectives of the Cooksville Creek South of Lakeshore Road Study include:

- Maintaining or improving the hydraulic capacity of the creek,
- Providing naturalized erosion protection solutions,
- Protecting existing City owned infrastructure,
- Enhancing the aquatic and terrestrial environment wherever possible,
- Minimizing impacts to the natural environment during construction,
- Minimizing future operational and maintenance activities, and
- Improving trail safety conditions to users.

1.4 Class Environmental Assessment Process

The Environmental Assessment Act was legislated by the Province of Ontario in 1975 to ensure that an Environmental Assessment (EA) is conducted prior to the onset of development and development-related (servicing) projects. The "environment" as defined by the EA Act is understood broadly to include the biophysical, socio-cultural, built and economic environments and the interrelationships between them. The EA Act applies primarily to public sector undertakings and extends to private sector projects where designated under the regulation. Depending on the individual project to be completed, there are different processes that municipalities must follow to meet Ontario's Environmental Assessment requirements.

The EA Act draws a distinction between "Individual" and "Class" environmental assessments. Individual EAs are prepared for large, complex projects in which significant environmental impacts are foreseeable. A "Terms of Reference" are devised which outline the EA process, and the final EA document is submitted to the Ministry of the Environment, Conservation and Parks (MECP) for approval. Alternatively, a Class EA is a streamlined approval process for a group of routine undertakings with predictable environmental impacts. Once a Class EA planning document is approved by the MECP, all projects of this type are pre-approved provided that they adhere to its design. In this fashion, the Class EA process expedites approval for smaller, recurring projects.

The MCEA, which is followed here, outlines how municipal infrastructure projects are planned in accordance with the EA Act. The MCEA is consistent with the EA Act's five key principles for successful planning, which include:

- Consultation with affected parties early on and throughout the process, such that the planning process is a cooperative venture;
- Consideration of a reasonable range of alternatives, both the functionally different "alternatives to" and the "alternative methods" of implementing the solution;
- Identification and consideration of the effects of each alternative on all aspects of the environment;
- Systematic evaluation of alternatives in terms of their advantages and disadvantages, to determine their net environmental effects; and,
- Provision of clear and complete documentation of the planning process followed, to allow "traceability" of decision-making with respect to the project.

As the project being undertaken is defined as an erosion control project, the Schedule B process as defined in the Municipal EA (2023) document, as amended in February 2024, is applicable.

A summary of the Class EA process and phases is provided below, with the accompanying flow chart (**Figure 1-2**) illustrating the process followed in the planning and design of projects covered by this Class Environmental Assessment:

Phase 1: Identify the problem or deficiency.

Phase 2: Identify alternative solutions to the problem by taking into consideration the existing environment, and establish the preferred solution taking into account public and agency review and input. At this point, determine the appropriate Schedule for the undertaking and document decisions in a Project File for Schedule B projects, or proceed through the following phases for Schedule C projects.

Phase 3: Examine alternative methods of implementing the preferred solution, based upon the existing environment, public and government agency input, anticipated environmental effects and methods of minimizing negative effects and maximizing positive effects.

Phase 4: Document, in an Environmental Study Report, a summary of the rationale and the planning, design, and consultation process of the project as established throughout the above phases, and make such documentation available for scrutiny by review agencies and the public.

Phase 5: Complete contract drawings and documents, and proceed to construction and operation; monitor construction for adherence to environmental provisions and commitments. Where special conditions dictate, also monitor the operation of the completed facilities. Public and agency consultation is also an important and necessary component of the five phases.

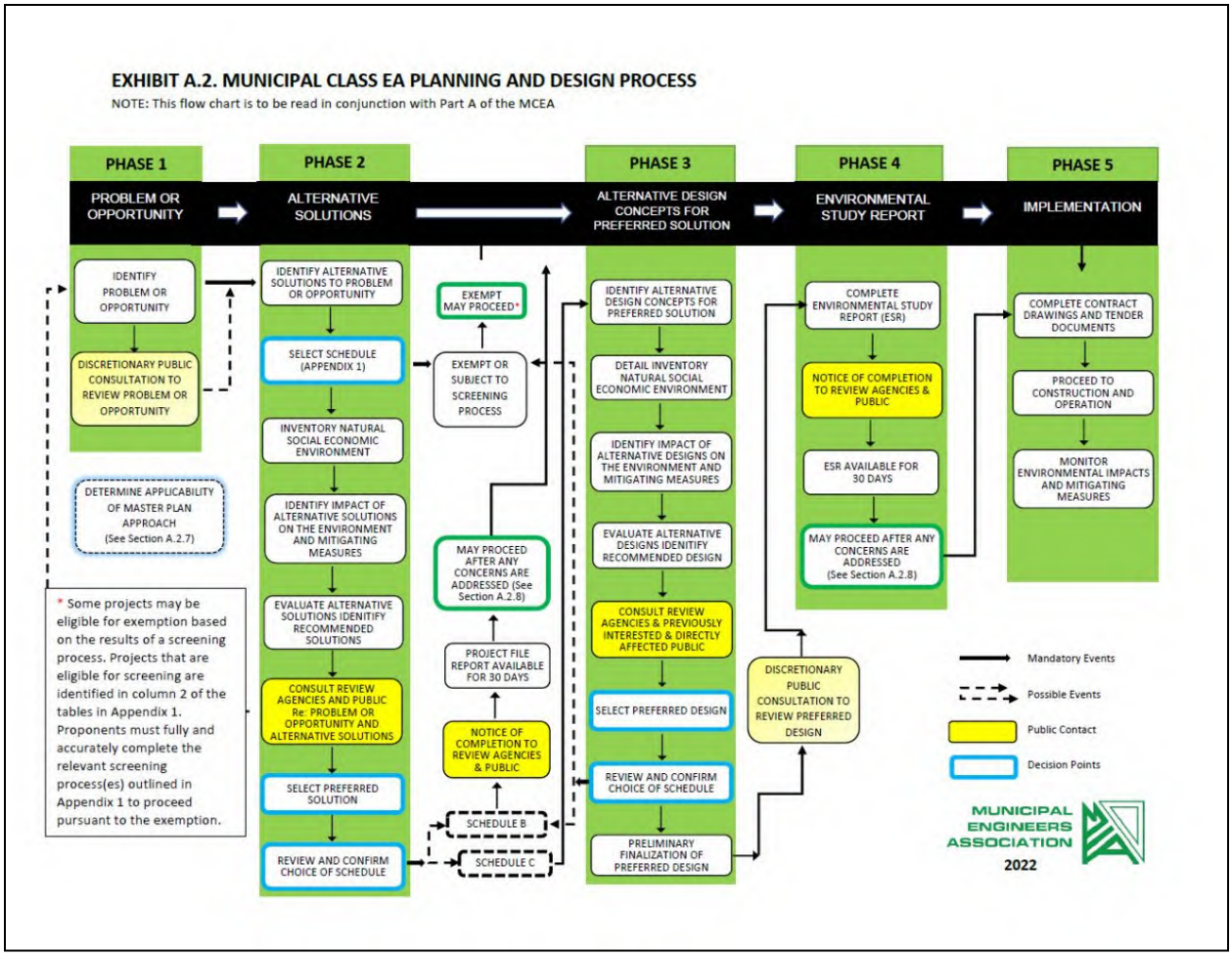


Figure 1-2: Municipal Class Environmental Assessment Planning and Design Process

The Municipal Engineers Association's Class EA document also classifies projects as Exempt, Eligible for Screening, Schedule B or Schedule C depending on their level of environmental impact and public concern.

- **Exempt** projects include specific municipal maintenance, operational activities, rehabilitation works, minor reconstruction or replacement of existing facilities, and new facilities that are limited in scale and have minimal adverse effects on the environment. These projects are exempt from the requirements of the *Environmental Assessment Act*.

- **Eligible for Screening to Exempt** projects may be eligible for exemption based on the results of a screening process. Proponents may choose to complete the applicable screening process to determine whether their project is eligible for exemption from the EAA or proceed with the applicable Schedule B or C process.

- **Schedule 'B'** projects have the potential for some adverse environment effects. Projects generally include improvements and minor expansions to existing facilities. These projects require completion of Phases 1 and 2 of the Class EA process, before proceeding to Phase 5 Implementation.

- **Schedule 'C'** projects have the potential for significant environmental effects. Projects generally include the construction of new facilities and major expansions to existing facilities. These projects require completion of Phases 1 through 4 of the Class EA process, before proceeding to Phase 5 Implementation.

The Cooksville Creek South of Lakeshore Road MCEA is classified as a Schedule B project and follows Phases 1 and 2 of the planning and design process with Phase 5 to follow at a subsequent stage.

2 EXISTING CONDITIONS

2.1 Study Area

As part of the historical 1970s creek realignment within the study area completed by CVC, an informal berm was constructed on the East Bank, with the intention of reducing flooding impacts to the nearby properties. The Helen Molasy Trail was also established as part of the channel realignment. This multi-use trail sits atop the constructed berm, and runs parallel to the creek for the entire length of the study area. The Waterfront Trail also crosses Cooksville Creek via a pedestrian bridge near the downstream extent of the study area.

Eight (x8) catchbasins were installed below the berm on the East Bank, to provide drainage from the adjacent backyards, into Cooksville Creek. The catchbasins convey flow to a storm sewer pipe, which outlets to a headwall structure, equipped with a flap gate to prevent water from flowing back up the pipe. Four (x4) similar catchbasin-outfall pairs were installed on the West Bank of the Creek, to facilitate drainage as part of the original channel realignment. This berm drainage infrastructure has become deteriorated, and is approaching the end of its design life. Some of the headwall structures have become outflanked, buried or submerged, with many of the catchbasins and pipes becoming clogged with organic debris. The existing conditions within the study area are further illustrated in **Figure 2-5**.

2.2 Historic Realignment

Credit Valley Conservation's channelization of Cooksville Creek involving bank and bed protection using stone filled wire gabion baskets to provide erosion protection is illustrated in **Figure 2-1**.

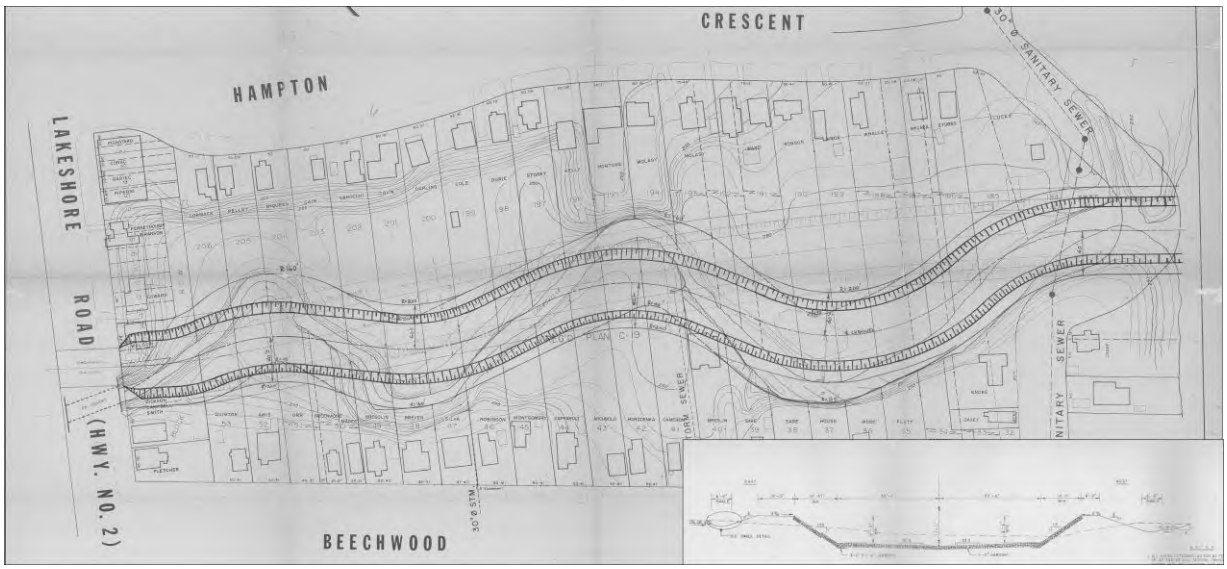


Figure 2-1: Historical Realignment of Cooksville Creek South of Lakeshore Road

Additionally, an ariel view of study area conditions before, during, and after the realignment are shown in **Figure 2-3**, **Figure 2-2**, and **Figure 2-4**.



Figure 2-2: Study Area Conditions in 1975 (Before Realignment)



Figure 2-3: Study Area Conditions in 1977 (During Realignment)



Figure 2-4: Study Area Conditions in 1980 (After Realignment)

A review of the historical channel realignment drawings and comparison of the historical ariel images clearly illustrate the realignment changed key watercourse characteristics including decreasing channel sinuosity and increasing channel width.

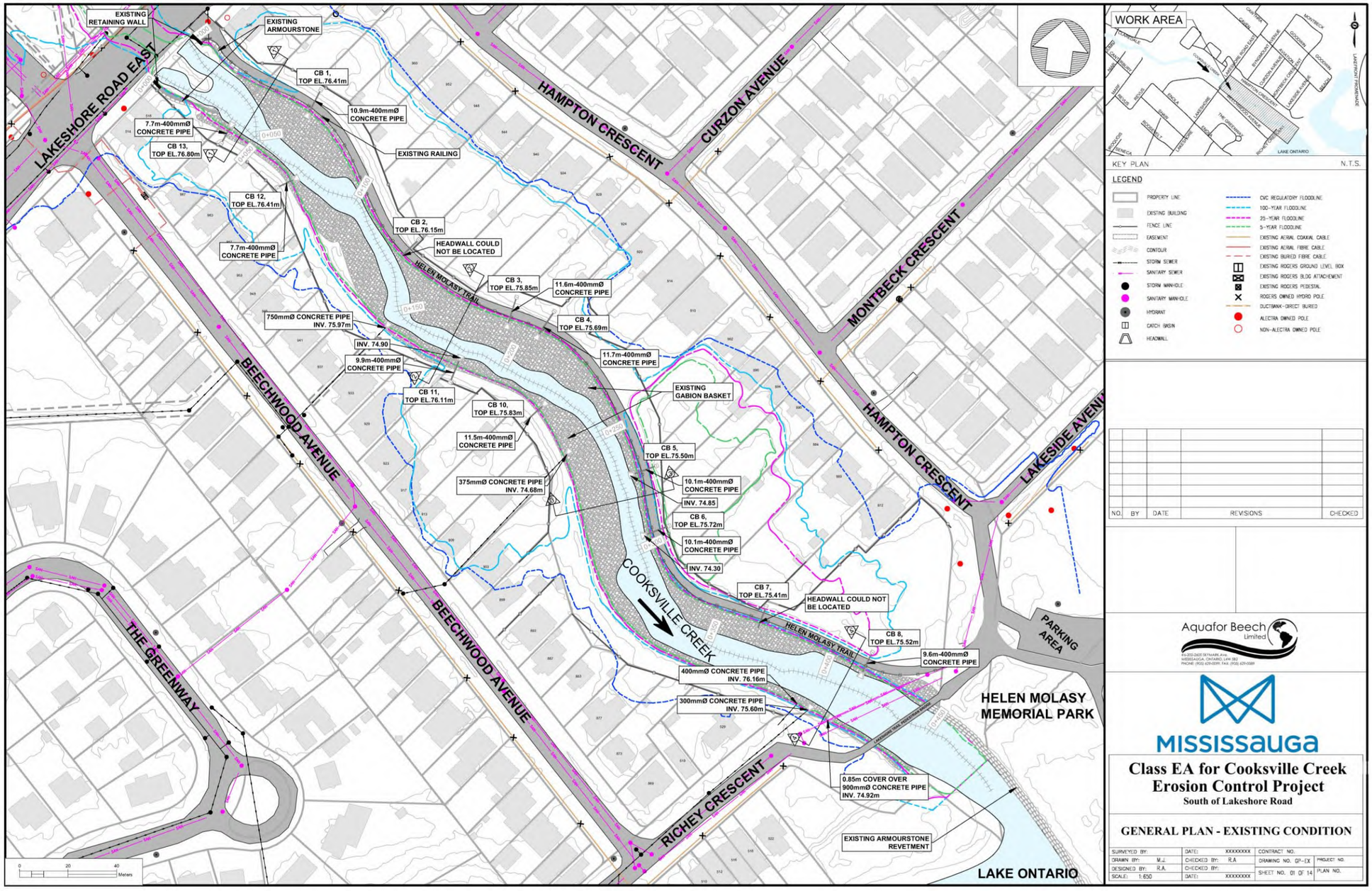


Figure 2-5: Existing Conditions within the Cooksville Creek South of Lakeshore Road Study Area

2.3 Storm Sewer Outfall Inventory

The study area receives stormwater input from various sources, including from storm sewers below roadways nearby the study area, such as Lakeshore Road East, Richey Crescent, and Beechwood Avenue. Additionally, there are a series of catchbasin-outfall pairs that provide drainage below the trail on the East side of the bank. Similar infrastructure exists on the West bank of the creek. The following subsections summarize the stormwater infrastructure present within the study area.

2.3.1 *Storm Sewer Outfalls from Nearby Roadways*

2.3.1.1 375mm Outfall at Richey Crescent

This 375 mm diameter storm sewer outfall is adjacent and upstream of the pedestrian bridge on the west bank. It features a large headwall with wingwalls on both sides as seen in **Figure 2-6** and **Figure 2-7**. There is a large flap gate intended to prevent backflow of the creek into the upstream sewer shed. The concrete headwall structure appears to be in good repair, with no notable degradation observed.



Figure 2-6: 375mm Outfall Equipped with Flap Gate



Figure 2-7: Integration Outfall into Bank Protection

2.3.1.2 375mm Outfall from Beechwood Avenue

The 375 mm diameter outfall collectively drains all of Beechwood Avenue through multiple connected culverts under residential driveways. A catchbasin collects the water drained from the roadside ditches on Beechwood Avenue (**Figure 2-8**), and conveys it between two residential properties on Beechwood Avenue to the storm outfall (**Figure 2-9**). At the outlet, the outfall pipe is fully submerged, and filled with organic debris.



Figure 2-8: Upstream Catchbasin Location on Beechwood Avenue



Figure 2-9: Submerged Outlet with Stagnant Water and Organic Debris

2.3.1.3 750mm Outfall from Beechwood Avenue

This 750 mm diameter outfall outlets from Beechwood Avenue into Cooksville Creek. The headwall structure is in good condition, as illustrated in **Figure 2-10**. The upstream storm sewer is aligned between two residential properties, as illustrated in **Figure 2-11**.



Figure 2-10: 750mm Outfall Headwall Structure



Figure 2-11: Alignment of Outfall

2.3.1.4 900mm Outfall from Lakeshore Road

This 900 mm diameter outfall is situated under Lakeshore Road East on the East bank of the creek, integrated into the armourstone retaining wall as per **Figure 2-12**. The outfall's location in proximity to the Creek Corridor and the Lakeshore Roade bridge is illustrated in **Figure 2-13**.



Figure 2-12: 900mm Outfall's Integration into Armourstone Retaining Wall



Figure 2-13: Proximity of Outfall to Lakeshore Road Bridge

2.3.2 *Catchbasin-Outfall Pairs on East Bank (x8)*

Eight catchbasin-outfall pairs are located along the East bank of the creek within the study area. Each of these outfalls are connected to one corresponding catchbasin on the other side of the Helen Molasy berm. These catchbasins were originally designed to function as drainage for the properties along Hampton Cresent. However, this infrastructure has become deteriorated, and is not functioning as originally intended.

2.3.2.1 Catchbasin-Outfall #1

Catchbasin-Outfall #1 is the most upstream pair of the eight catchbasin-outfall pairs along the East bank of the Creek, and is located closest to Lakeshore Road East. As illustrated in **Figure 2-14**, Catchbasin #1 is partially covered in organic material which may inhibit its intended function. Catchbasin #1 is significantly lower than the Helen Molasy Trail surface at this location, as illustrated in **Figure 2-15**. A 200 mm diameter concrete storm sewer connects Catchbasin #1 to Outfall #1 below the informal berm. Outfall #1 does not outlet directly into the creek, due to a buildup of organic material and mature vegetation, as illustrated in **Figure 2-16**. The concrete headwall structure for Outfall #1 is illustrated in **Figure 2-17**. This structure is almost completely buried under organic material, and there is no clear conveyance path between the outfall and the baseflow channel within Cooksville Creek.



Figure 2-14: Catchbasin #1 Partially Covered in Organic Debris



Figure 2-15: Catchbasin #1 Relative to Trail



Figure 2-16: Build up of Organic Material and Mature Vegetation around Outfall #1



Figure 2-17: Buried Outfall #1

2.3.2.2 Catchbasin-Outfall #2

Catchbasin-Outfall #2 is the second-most upstream pair of the eight catchbasin-outfall pairs along the East bank of the Creek. As illustrated in **Figure 2-18**, Catchbasin #2 is partially covered in organic material which may inhibit its intended function. Catchbasin #2 is in close proximity to private property fence lines, as illustrated in **Figure 2-19**. Catchbasin #2 is also significantly lower than the Helen Molasy Trail surface at this location, as illustrated in **Figure 2-20**. A 200 mm diameter concrete storm sewer connects Catchbasin #2 to Outfall #2 below the informal berm. Outfall #2 was not located in the field, and is suspected to be submerged, as shown in **Figure 2-21**.



Figure 2-18: View of Catchbasin #2



Figure 2-19: Surrounding Area of Outfall #2



Figure 2-20: Catchbasin #2 Relative to Trail



Figure 2-21: Submerged Outfall #2

2.3.2.3 Catchbasin-Outfall #3

Catchbasin-Outfall #3 is the third-most upstream pair of the eight catchbasin-outfall pairs along the East bank of the Creek. As illustrated in **Figure 2-22**, Catchbasin #3 is partially covered in organic material which may inhibit its intended function. Catchbasin #3 is significantly lower than the Helen Molasy Trail surface at this location, as illustrated in **Figure 2-23**. A 200 mm diameter concrete storm sewer connects Catchbasin #3 to Outfall #3 below the informal berm. Outfall #3 does not outlet directly into the creek, due to a buildup of organic material and mature vegetation, as illustrated in **Figure 2-24**. The concrete headwall structure for Outfall #3 is illustrated in **Figure 2-25**. This structure is almost completely buried under organic material, and there is no clear conveyance path between the outfall and the baseflow channel within Cooksville Creek.



Figure 2-22: Catchbasin #3 Close Up



Figure 2-23: Catchbasin #3 Relative to Trail



Figure 2-24: Proximity of Outfall #3 to Creek



Figure 2-25: Buried Outfall #3 Headwall

2.3.2.4 Catchbasin-Outfall #4

Catchbasin-Outfall #4 is the fourth-most upstream pair of the eight catchbasin-outfall pairs along the East bank of the Creek. As illustrated in **Figure 2-26**, Catchbasin #4 is in close proximity to private property. Catchbasin #4 is significantly lower than the Helen Molasy Trail surface at this location, as illustrated in **Figure 2-27**. A 200 mm diameter concrete storm sewer connects Catchbasin #4 to Outfall #4 below the informal berm. Outfall #4 does not outlet directly into the creek, due to a buildup of organic material, as illustrated in **Figure 2-28**. The concrete headwall structure for Outfall #4 is illustrated in **Figure 2-29**. This structure is buried under organic material, and there is no clear conveyance path between the outfall and the baseflow channel within Cooksville Creek. As such, the outfall is not functioning as intended.



Figure 2-26: View of Catchbasin #4



Figure 2-27: Catchbasin #4 Relative to Trail



Figure 2-28: Buried Outfall #4



Figure 2-29: Proximity of Outfall #4 to Surrounding Creek

2.3.2.5 Catchbasin-Outfall #5

Catchbasin-Outfall #5 is the fourth-most downstream pair of the eight catchbasin-outfall pairs along the East bank of the Creek. As illustrated in **Figure 2-30**, Catchbasin #5 is partially obscured by organic debris. Catchbasin #5 is significantly lower than the Helen Molasy Trail surface at this location, as illustrated in **Figure 2-31**. A 200 mm diameter concrete storm sewer connects Catchbasin #5 to Outfall #5 below the informal berm. The concrete headwall structure is actively becoming outflanked by the creek, as shown in **Figure 2-32**. The flap-gate for the headwall structure is missing, allowing for water to flow back up into the connecting pipe. The condition of the pipe connecting Catchbasin #5 to Outfall #5 is illustrated in **Figure 2-33**.



Figure 2-30: View of Catchbasin #5



Figure 2-31: Location of Catchbasin #5 from Trail



Figure 2-32: Outflanked Outfall #5 Headwall Structure



Figure 2-33: Interior Pipe Conditions at Outfall #5

2.3.2.6 Catchbasin-Outfall #6

Catchbasin-Outfall #6 is the third-most downstream pair of the eight catchbasin-outfall pairs along the East bank of the Creek. As illustrated in **Figure 2-34**, Catchbasin #6 is located on private property, and is heavily obscured in organic debris. Catchbasin #6 is significantly lower than the Helen Molasy Trail surface at this location, as illustrated in **Figure 2-35**. A 200 mm diameter concrete storm sewer connects Catchbasin #6 to Outfall #6 below the informal berm. The concrete headwall structure is actively becoming outflanked by the creek, as shown in **Figure 2-36**. The flap-gate for the headwall structure appears to be sealed shut. The deteriorated erosion protection directly surrounding the Outfall #6 headwall is illustrated in **Figure 2-37**.



Figure 2-34: Catchbasin #6 Located on Private Property



Figure 2-35: Catchbasin #6 Relative to Trail



Figure 2-36: Outflanking & Partial Submergence of Outfall #6



Figure 2-37: Outflanked Headwall Structure for Outfall #6

2.3.2.7 Catchbasin-Outfall #7

Catchbasin-Outfall #7 is the second-most downstream pair of the eight catchbasin-outfall pairs along the East bank of the Creek. As illustrated in **Figure 2-38**, Catchbasin #7 is located directly beside the private property fence line. Catchbasin #7 is significantly lower than the Helen Molasy Trail surface at this location, as illustrated in **Figure 2-39**. A 200 mm diameter concrete storm sewer connects Catchbasin #7 to Outfall #7 below the informal berm. The concrete headwall structure was not able to be located in the field, and is suspected to be buried in sediment and organic debris, as shown in **Figure 2-40**. The suspected location of Outfall #7 in relation to the informal berm is illustrated in **Figure 2-41**.



Figure 2-38: View of Catchbasin #7



Figure 2-39: Catchbasin #7 Relative to Trail



Figure 2-40: Suspected Location Catchbasin #7



Figure 2-41: Suspected Location of Outfall #7 in Relation to Trail

2.3.2.8 Catchbasin-Outfall #8

Catchbasin-Outfall #8 is the most downstream pair of the eight catchbasin-outfall pairs along the East bank of the Creek. As illustrated in **Figure 2-42**, Catchbasin #8 is located within the maintained grassy area within Helen Molasy Park. Catchbasin #8 is lower than the Helen Molasy Trail surface at this location, as illustrated **Figure 2-43**. A 200 mm diameter concrete storm sewer connects Catchbasin #8 to Outfall #8 below the informal berm. During field investigations, Outfall #8 appeared to be covered in channel substate, with no visible outlet to the Creek (**Figure 2-45**). Due to the proximity of Outfall #8 to Lake Ontario, the lake backwatering effect influences the drainage at this location. Channel conditions at Outfall #8 illustrating this backwatering effect are shown in **Figure 2-45**.



Figure 2-42: View of Catchbasin #8



Figure 2-43: Outfall #8 Location from Trail



Figure 2-44: Outfall #8 Obstructions



Figure 2-45: Backwatered Channel Conditions Outfall #8

2.3.3 *Catchbasin-Outfall Pairs on West Bank (x4)*

Similar to the eight catchbasin-outfall pairs along the East Bank of the creek, the study area contains four catchbasin-outfall pairs on the west bank, as described in the following subsections. These catchbasin-outfall pairs are numbered 10 through 13, rather than 9 through 12 due to a minor discrepancy during field inventories. This has since been resolved, and the naming has been carried through the remainder of the report for consistency purposes.

2.3.3.1 Catchbasin-Outfall #10

Catchbasin-Outfall #10 is the most downstream pair of the four catchbasin-outfall pairs along the West bank of the Creek. As illustrated in **Figure 2-46**, Catchbasin #10 is in close proximity to a private property fence line. Catchbasin #10 is surrounded by organic debris, as illustrated in **Figure 2-47**. A 200 mm diameter concrete storm sewer connects Catchbasin #10 to Outfall #10. The headwall structure for Outfall #10 is partially obscured with organic debris and channel substrate, with no clear flow path to the creek, as illustrated in **Figure 2-48**. The channel conditions in direct proximity to Outfall #10 are shown in **Figure 2-49**.



Figure 2-46: Location of Catchbasin #10 Relative to Fenceline



Figure 2-47: General Condition of Catchbasin #10



Figure 2-48: Partially Buried Outfall #10



Figure 2-49: Channel Conditions Surrounding Outfall #10

2.3.3.2 Catchbasin-Outfall #11

Catchbasin-Outfall #11 is the second-most downstream pair of the four catchbasin-outfall pairs along the West bank of the Creek. As illustrated in **Figure 2-50**, Catchbasin #11 is in close proximity to the private property fence line. Catchbasin #11 is surrounded by organic debris, as illustrated in **Figure 2-51**. A 200 mm diameter concrete storm sewer connects Catchbasin #11 to Outfall #11. The headwall structure for Outfall #11 has become outflanked and undermined, as illustrated in **Figure 2-52**. The bank erosion in direct proximity to Outfall #11 is illustrated in **Figure 2-53**.



Figure 2-50: Catchbasin #11 Location



Figure 2-51: Catchbasin #11 Surrounding Area



Figure 2-52: Outfall #11 Headwall Conditions



Figure 2-53: Channel Conditions at Outfall #11

2.3.3.3 Catchbasin-Outfall #12

Catchbasin-Outfall #12 is the second-most upstream pair of the four catchbasin-outfall pairs along the West bank of the Creek. As illustrated in **Figure 2-54**, Catchbasin #12 is in close proximity to a private property fence line. Catchbasin #12 is surrounded by organic debris, as illustrated in **Figure 2-55**. A 200 mm diameter concrete storm sewer connects Catchbasin #12 to Outfall #12. The headwall structure for Outfall #12 has become deteriorated and coved in sediment, as illustrated in **Figure 2-56**. The bank erosion in direct proximity to Outfall #12 is shown in **Figure 2-57**.



Figure 2-54: View of Catchbasin #12



Figure 2-55: Catchbasin #12 Surrounding Area



Figure 2-56: Outfall #12 Condition



Figure 2-57: View of Outfall #12 Channel Conditions

2.3.3.4 Catchbasin-Outfall #13

Catchbasin-Outfall #13 is the most upstream pair of the four catchbasin-outfall pairs along the West bank of the Creek. As illustrated in **Figure 2-58**, Catchbasin #13 is in close proximity to the private property fence line. Catchbasin #13 is surrounded by organic debris, as illustrated in **Figure 2-59**. A 200 mm diameter concrete storm sewer connects Catchbasin #13 to Outfall #13. The headwall structure for Outfall #13 has become coved in sediment, as illustrated in **Figure 2-60**. The channel conditions in direct proximity to Outfall #13 are shown in **Figure 2-61**.



Figure 2-58: View of Catchbasin #13



Figure 2-59: Catchbasin #13 Surrounding Area



Figure 2-60: Outfall #13 Headwall



Figure 2-61: Channel Conditions at Outfall #13

2.4 Sanitary Sewer Crossings

Three Peel Region owned sanitary sewers are present within the study area. These sewers cross below Cooksville Creek directly upstream of the Waterfront Trail pedestrian bridge. Upon comparison of the as-built elevation of the sewer lines and the thalweg of the channel, it was determined that these sanitary sewers have over 0.75 metres of cover. A view of the channel conditions at the sanitary sewer crossings is provided in **Figure 2-62**. The engineering planform drawings showing the locations of the sanitary sewer crossings is provided in **Figure 2-63**.



Figure 2-62: View of Channel Conditions at Sanitary Sewer Crossings from Pedestrian Bridge

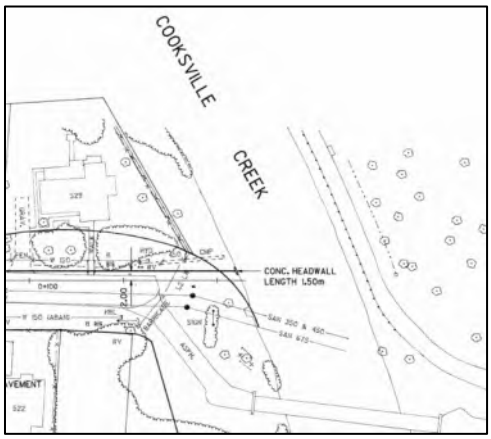


Figure 2-63: Engineering Drawings Showing Sewer Crossing in Relation to Pedestrian Bridge

2.5 Pedestrian Bridge

Located at the mouth of Cooksville Creek, the pedestrian bridge is a single span bridge that connects Helen Molasy Park at the base of Hampton Crescent to Richey Crescent to the west. It serves the purpose conveying the Waterfront trail across Cooksville Creek. **Figure 2-64** shows a forward view from the Richey Crescent side of the bank looking into the Helen Molasy Park. **Figure 2-65** illustrates the full span of the pedestrian bridge. High volumes of pedestrian and cyclist traffic were observed across this bridge during site investigations.



Figure 2-64: Pedestrian Bridge Across Cooksville Creek



Figure 2-65: View of Complete Pedestrian Bridge Span

2.6 Helen Molasy Trail & Berm

The Helen Molasy Trail constitutes a recreational trail that spans the entire study area, starting at Lakeshore Road East and connecting to the waterfront trail near Lake Ontario. The trail sits atop a berm, which was constructed as part of the historical realignment of the Creek. The trail has become deteriorated as a result of creek erosion, which is illustrated in **Figure 2-66**. Failure of erosion control measures intended to protect the trail were observed throughout the study area, as shown in **Figure 2-67**. The gabion basket retaining features on the east side of the trail have also shown signs of deterioration, as shown in **Figure 2-68**. Additionally, the east side of the trail lacks pedestrian safety railings to mitigate the fall risk on this side, as illustrated in **Figure 2-69**.



Figure 2-66: Deterioration of Trail Surface and Safety Railing



Figure 2-67: Gabion Basket Slumping Along Creek



Figure 2-68: Gabion Basket Trail Retaining Feature



Figure 2-69: Lack of Pedestrian Safety Railings on East Side of Trail

3 TECHNICAL ASSESSMENTS

3.1 Fluvial Geomorphic Assessment

Fluvial geomorphology is the study of the processes associated with streams and rivers, including stream hydraulics and sediment movement. Variables that influence the morphology of a stream include discharge, velocity, sediment load and grainsize, channel slope, and the width and depth of the channel. A change in one of these variables will eventually alter another variable causing the channel to adjust. Land-use changes within a subwatershed can alter the amount of surface runoff and the amount of sediment reaching a stream. This can result in erosion and flooding problems, as well as poor aquatic habitat. Channel restoration works can mitigate the impacts of land-use change, through natural channel design or other river engineering approaches. A fluvial geomorphic assessment of Cooksville Creek from Lakeshore Road East to Lake Ontario adjacent to the Helen Molasy Trail Park was conducted on June 25, 2024 by Aquafor Beech Fluvial Specialist staff.

3.1.1 *Basic Geomorphic Parameters*

Aquafor has undertaken a geomorphic assessment to attain a comprehensive understanding of the existing conditions and constraints, considering existing conveyance, localized sediment migration, and erosion risks. Locations along Cooksville Creek were assessed by collecting geomorphic parameters such as bankfull width, bankfull depth, bank material, and bed material. Photographs were taken capturing the conditions upstream, downstream, left bank, and right bank at each location. Based on observations, Cooksville Creek within the study area represents one reach.

Below is a comprehensive discussion of this Reach of Cooksville Creek, describing its geomorphic characteristics, based on its basic geomorphic parameters, rapid geomorphic assessments and the rapid stream assessment technique.

3.1.1.1 Reach Description

Cooksville Creek in the study area begins immediately downstream of the Lakeshore Road East culvert and outlets into Lake Ontario while running adjacent to the Helen Molasy Trail The average bankfull width of the Reach is 20 m, and the average bankfull depth is approximately 2 m. Bank material throughout the reach consists of sandy loam with Gabion baskets lining the reach. The average grain size of the bed material ranges from platy pebbles and cobbles, up to medium boulders. Representative photographs of the Reach are shown in **Figure 3-1** and **Figure 3-2** where pool-riffle sequences can be seen present within the reach.



Figure 3-1: Representative photograph of the upstream portion of the Reach, facing upstream



Figure 3-2: Representative photograph of the downstream portion of the Reach, facing downstream

3.1.1.2 Grain Size Distribution Analysis

The substrate size distribution at Cooksville Creek was sampled at 2 locations in the study reach, and is shown in **Figure 3-3** and **Figure 3-4**. The substrate size distribution at the upstream location revealed that the substrate consisted primarily of Gravel to Cobble sized sediment, with some coarse to very coarse sand (**Table 3-1**).

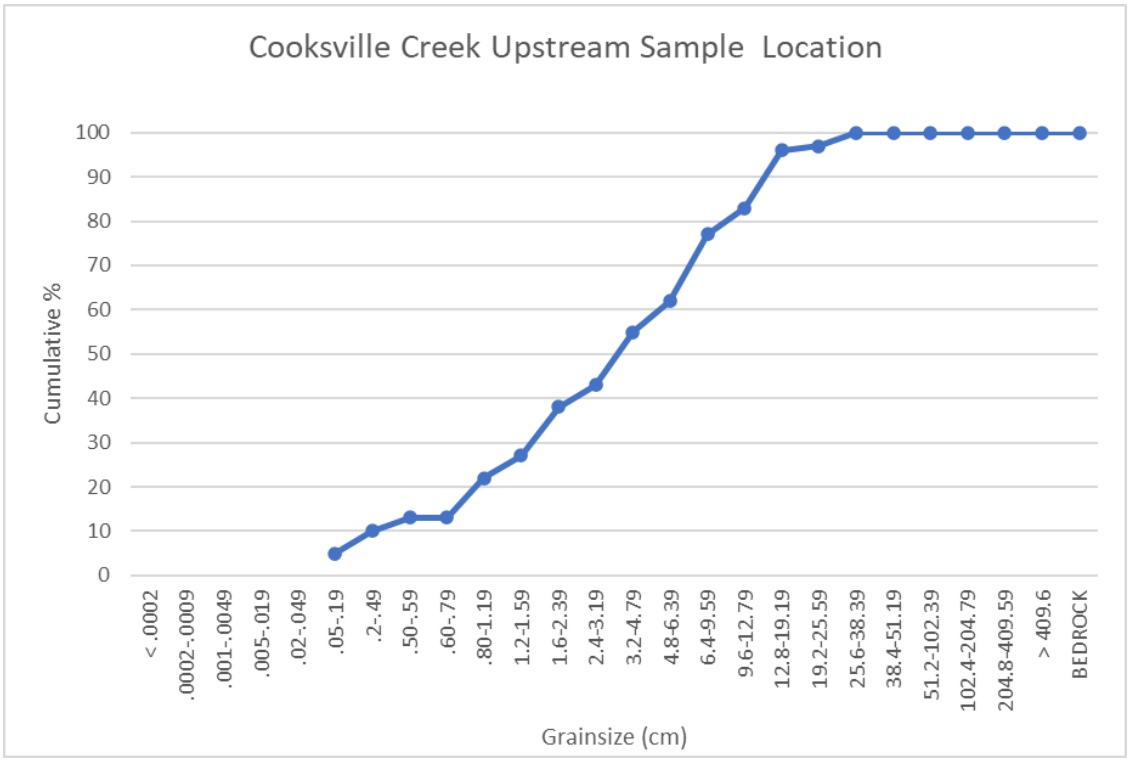


Figure 3-3: Grainsize Distribution of Upstream Location

Table 3-1: Percentile Values of the Upstream Grainsize Distribution

Site	Percentile	Grainsize (cm)	Comments
Upstream	D_{10}	0.3	Riffle immediately downstream of Lakeshore Rd.
	D_{50}	3.1	
	D_{90}	12.5	

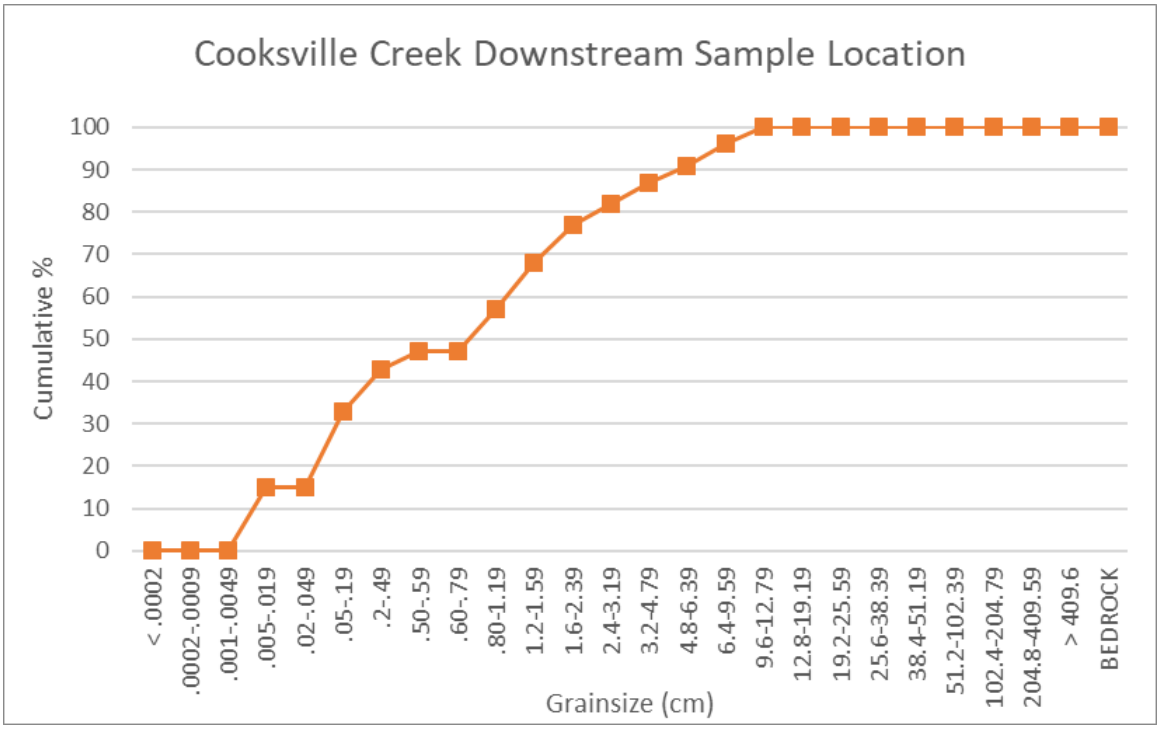


Figure 3-4: Grainsize Distribution of Downstream Location

The substrate size distribution at the downstream location revealed that the substrate consisted primarily of gravel to cobble sized sediment, with some coarse to very coarse sand. The grainsize percentile composition is significantly finer in the downstream location as compared to the upstream location, with an order of magnitude smaller D_{50} grainsize (**Table 3-2**). This finer grainsize is a result of the backwater influence of Lake Ontario, which slows the channel velocity at its confluence and tends to aggrade sediment in the lower part of the reach.

Table 3-2: Percentile Values of the Downstream Grainsize Distribution

Site	Percentile	Grainsize (cm)	Comments
Downstream	D_{10}	0.1	Backwater influence from Lake Ontario
	D_{50}	0.8	
	D_{90}	4.7	

3.1.2 *RGAs and RSAT*

The Rapid Geomorphic Assessment (RGA) (MOE, 2003) tool was used during the field walk to assess the fluvial conditions of Cooksville Creek adjacent to the Helen Molasy Memorial Park and Trail. The RGA protocol uses visual indicators to determine whether a given stream is stable, in transition, or in adjustment. Stability of the channel is determined by adjustments in slope; the bed elevation may be increasing due to sediment deposition (aggradation) or decreasing due to bed erosion (degradation). Consideration of increases in bank-to-bank width (widening) and indicators suggesting a change in the planform regime (planimetric form adjustment) are also part of the assessment. Based on the results of the RGAs, reaches were classified as "in regime", "in transition", or "in adjustment" depending on the stability index value as described in **Table 3-3**.

Table 3-3: Rapid Geomorphic Assessment Descriptions based on Index Value

Stability Index Value	Stability Class	Description
0 – 0.20	In Regime	Channel morphology is within the expected range of variance for stable channels of similar type. Channels are in good condition with minor adjustments that do not impact the function of the watercourse.
0.20 – 0.40	In Transition	Channel morphology is within the expected range of variance but with evidence of stress. Significant channel adjustments have occurred and additional adjustment may occur.
0.40 – 1.0	In Adjustment	Metrics are outside of the expected range of variance for channels of similar type. Significant channel adjustments have occurred and are expected to continue.

The Rapid Stream Assessment Technique (RSAT) developed by John Galli (Galli 1996) provides a qualitative assessment of the health and functions of a reach. This field assessment index provides a comparative assessment of stream conditions and identifies restoration opportunities on a reach scale within a given watershed. This system integrates visual estimates of channel conditions and numerical scoring of stream parameters using six categories:

1. Channel Stability;
2. Channel Scouring/Sediment Deposition;
3. Physical Instream Habitat;
4. Water Quality;
5. Riparian Habitat Conditions; and
6. Biological Indicators.

These parameters are assessed and recorded at riffles within the subject reach and evaluated within a 0 to 50-point scoring system. **Table 3-4** shows the scoring matrix for the six stream parameters.

Table 3-4: RSAT Scoring Matrix

	Excellent	Good	Fair	Poor	Points
1. Channel Stability	9 – 11	6 – 8	3 – 5	0 – 2	**0 – 11**
2. Channel Scouring/ Deposition	7 – 8	5 – 6	3 – 4	0 – 2	**0 – 8**
3. Physical Instream Habitat	7 – 8	5 – 6	3 – 4	0 – 2	**0 – 8**
4. Water Quality	7 – 8	5 – 6	3 – 4	0 – 2	**0 – 8**
5. Riparian Habitat Conditions	6 – 7	4 – 5	2 – 3	0 – 2	**0 – 7**
6. Biological Indicators	7 – 8	5 – 6	3 – 4	0 – 2	**0 – 8**

Once the stream parameters have been assessed and the scoring matrix completed, a verbal stream quality ranking is determined based on the RSAT score.

Table 3-5 classifies the stream condition based on the RSAT score.

Table 3-5: Stream Condition Based on Total RSAT Score

Score	Verbal Stream Quality Ranking
42 – 50	Excellent Condition
30 – 41	Good Condition
16 – 30	Fair Condition
< 16	Poor Condition

3.1.2.1 RGA and RSAT Results for the Reach

The rapid geomorphic assessment for the Reach was completed during the Geomorphic Assessment, and was able to inform its dominant process and stability indices. The results of the rapid geomorphic assessment are provided in **Table 3-6**. Aggradation was found to be the dominant process in this Reach, supported by the observations of silted up outfalls in the synoptic geomorphic assessment. This Reach has a stability index of 0.43, indicating that it is "In Adjustment" and, without intervention, further issues of instability can be expected.

The Rapid Stream Assessment Technique (RSAT) for Reach 1 as summarized in **Table 3-4**, indicates overall good condition. The channel stability in this reach is good, revealing some signs of bank sloughing or failure, but over all the channel seems to be functioning well ecologically. Some stream bend areas are unstable and young exposed tree roots are common. The toe of the bank is generally composed of erodible material. The channel scouring/deposition is good, indicated by a large number of deep pools with enhanced siltation. Physical instream habitat is excellent, as indicated by the large pools and lack of point bars. Water quality is good which was determined by the evidence of an only slight odor that is present. The riparian habitat conditions are good as the presence of canopy coverage is providing greater than 60% shading. The biological indicators are excellent determined from the presence of a moderately high number of diverse individuals Overall, the stream quality ranking for this Reach of Cooksville Creek is therefore in good condition.

Table 3-6: RGA Field Score for Study Reach

Form/ Process	Geomorphic Indicator no.	Description	Present No	Yes	FactorValue
Evidence of Aggradation (AI)	1	Lobate bar	✓		
	2	Coarse material in riffle embedded		✓	
	3	Siltation in pools		✓	
	4	Medial bars	✓		
	5	Accretion on point bars	✓		
	6	Poor longitudinal sorting of bed materials		✓	0.57
	7	Deposition in overbank zone		✓	
Evidence of Degradation (DI)	1	Exposed bridge footings	✓		
	2	Exposed sanitary/storm sewer/pipeline etc		✓	
	3	Elevated stormsewer outfall		✓	
	4	undermined gabion basket/concrete apron/etc		✓	
	5	Scour pools d/s of culverts/stormsewers		✓	
	6	Cut face on bar forms	✓		
	7	Head cutting due to knick point migration	✓		
	8	Terrace cut through older bar material	✓		
	9	Suspended armor layer visible in bank	✓		0.40
	10	Channel worn into undisturbed overburden/bedrock	✓		
Evidence of Widening (WI)	1	Fallen/leaning trees/fence posts/etc		✓	
	2	Occurrence of large organic debris		✓	
	3	Exposed tree roots		✓	
	4	Basal scour on inside meander bends	✓		
	5	Basal scour on both sides of channel through riffle	✓		
	6	Gabion baskets/concrete walls/armour stone etc. out flanked		✓	
	7	Length of basal scour > 50% through subject reach	✓		
	8	Exposed length of previously buried pipe/cable etc.	✓		
	9	Fracture lines along top of bank	✓		0.44
	10	~~Exposed building foundation~~			
Evidence of Planimetric Form Adjustment (PI)	1	Formation of chute(s)	✓		
	2	Evolution of single thread channel to multiple channel	✓		
	3	Evolution of pool-riffle form to low bed relief form		✓	
	4	Cutoff channel(s)	✓		
	5	Formation of island(s)		✓	
	6	Thalweg alignment out of phase with meander geometry	✓		0.29
	7	Bar forms poorly formed/reworked/removed	✓		
Stability Index (SI) = (AI+DI+WI+PI)/m				SI =	0.43

Table 3-7: RSAT Score for Study Reach

RSAT Evaluation Category	Points	Rating
1. Channel Stability	7	Good
2. Channel Scouring/ Deposition	4	Fair
3. Physical Instream Habitat	7	Excellent
4. Water Quality	5	Good
5. Riparian Habitat Conditions	5	Good
6. Biological Indicators	7	Excellent
Stream Quality Ranking	**35**	**Good**

3.1.3 *Geomorphic Characterization of the Study Area*

3.1.3.1 Erosion Site 1

Erosion site 1 (**Figure 3-5**) is characterized by an approximately 35 m long scour along the right bank (facing upstream). The site exhibits undermined gabion baskets with leaning and fallen trees. The toe of bank at the erosion site is within 2 m of a leaning fence line and trail. Additional bank scouring was also noted at the edge of the trail, beginning to form underneath the footpath as seen in **Figure 3-6**. The depth of the erosion is currently 50 cm. The bed material consists of angular cobblestone. The bankfull width is measured at 14 m and bankfull depth is measured to be 2 m.



Figure 3-5: 35 Metre Long Scour and Slumping of Gabion Baskets



Figure 3-6: Bank Scour Forming Underneath Helen Molasy Trail

3.1.3.2 Erosion Site 2

Erosion site 2 (**Figure 3-7**) is characterized by an approximately 20 m long segment of the south bank consisting of collapsing gabion baskets on either side of an outflanked and undermined headwall. The headwall of the outfall is eroding along the base with the cap broken, loosely hanging closed but not sealed causing the outfall to be at risk of breaking and falling into the channel (**Figure 3-8**). The gabion baskets along the bank are slumping in towards the channel, with fallen and leaning trees present all throughout the bank. The bank at this location consists of lined gabion basket and the bed substrate consisting of angular cobblestone. The bankfull width and depth at this location is 15 metre and 1 metre respectively.



Figure 3-7: Outflanked Concrete Storm Sewer Outfall



Figure 3-8: Deteriorated Gabion Baskets Surrounding Outfall

3.1.3.3 Erosion Site 3

Erosion site 3 (**Figure 3-9**) is characterized by an approximate 20 m long length of bank along the left bank (facing upstream), exhibiting an eroded and undercut toe of bank. The eroded bank is causing a stormwater outfall to become outflanked, with the back of the wingwall fully exposed and completely submerged underwater (**Figure 3-10**). The gabion baskets lining the bank are slumping, exposing the trail and fence to increased risk of deterioration. The toe of bank at the erosion site is within 2 meters of the trail and fence line. The bank at this location consists of lined gabion basket and the bed substrate consisting of angular cobblestone. The bankfull width and depth at this location is 25 m and 2 m respectively.



Figure 3-9: Concrete Storm Sewer Submerged due to High Water Levels



Figure 3-10: Outflanked Storm Sewer Outfall

3.1.4 *Erosion Hazard Assessment*

A detailed erosion hazard assessment will be completed as part of the subsequent detailed design process. Acknowledging that the proposed design is planned to improve the erosion hazard limits within the study area, it will be ensured that the proposed design does not negatively impact the erosion hazard at any point within the study area.

3.2 Terrestrial Natural Heritage Assessment

Aquafor utilized background information and completed field investigations to characterize the study area's existing terrestrial conditions and review vegetation and habitat that may be impacted by the proposed works. A tree inventory, including evaluation of potential bat roosting habitat, was also completed. The following subsections provide the results of those investigations combined with relevant information gained from a comprehensive review of background resources.

3.2.1 *Vegetation Communities and Flora*

The City of Mississauga's 2022 Natural Areas Update identifies the study area as part of Significant Natural Area Site LV4. The Natural Areas Fact Sheet for this site identifies the majority of the creek corridor as one plant community (FOD7-3, Fresh-Moist Willow Lowland Deciduous Forest), with open water (OAO) in the creek itself and cultural and manicured communities present further out towards the lakefront. It further notes that 214 floral species have been recorded from the site, with one provincially significant plant species (not identified) and three plant species considered uncommon within the City (Wild Blue Phlox - *Phlox divaricata*; American Mountain-ash - *Sorbus americana*; and Least Spike-rush -

Eleocharis acicularis). The site is noted to be in poor condition, with disturbances including "the channelization of Cooksville Creek, dumping, garbage, erosion, asphalt trails and unplanned dirt trails" as well as invasive plant species Garlic Mustard (*Alliaria petiolata*), Japanese Knotweed (*Reynoutria japonica*), Dog-strangling Vine (*Cynanchum rossicum*) and Purple Loosestrife (*Lythrum salicaria*).

3.2.1.1 Vegetation Communities

Terrestrial vegetation conditions were reviewed by Aquafor on June 5 and 6, 2024. At that time, it was determined that the bulk of the study area consisted of a Fresh-Moist Willow Lowland Deciduous Forest (FOD7-3) with the creek pulled out as open water (OAO), as illustrated in **Figure 3-11** and **Figure 3-12**.



Figure 3-11: Fresh-Moist Willow Lowland Deciduous Forest (FOD7-3) and Open Aquatic (OAO)



Figure 3-12: Mineral Open Beach/Bar (BBO1) Inclusion

The community south of Richey Cres was not significantly different than what was found upstream and, therefore, was lumped together. Additionally, the Mineral Open Beach/Bar (BBO1) community that was previously noted in the City's evaluation was significantly smaller than what was mapped in 2022, and was therefore only included as an inclusion. The following subsections provide a description of the polygons delineated by Aquafor in 2024.

Fresh-Moist Willow Lowland Deciduous Forest (FOD7-3) with a Mineral Open Beach/Bar (BBO1) Inclusion

This section of the riparian forest was dominated by large-diameter Crack Willow (*Salix x fragilis*) followed by Manitoba Maple (*Acer negundo*) with prevalent Silver Maple (*Acer saccharinum*), Siberian Elm (*Ulmus pumila*), Norway Maple (*Acer platanoides*), and Eastern White Cedar (*Thuja occidentalis*). The subcanopy was mostly Manitoba Maple and Siberian Elm with some American Elm (*Ulmus americana*). The shrub layer was generally patchy with Siberian Elm, Choke Cherry (*Prunus virginiana var. virginiana*), Red-osier Dogwood (*Cornus sericea*), European Buckthorn (*Rhamnus cathartica*), and White Ash (*Fraxinus americana*). The ground layer was highly variable with abundant Canada Goldenrod (*Solidago canadensis var. canadensis*), Thicket Creeper (*Parthenocissus vitacea*), and Kentucky Bluegrass (*Poa pratensis ssp. pratensis*). Three regionally rare species were identified within this polygon: Early Goldenrod (*Solidago juncea*), Red Pine (*Pinus resinosa*), and American Cow Parsnip (*Heracleum maximum*). A Mountain Ash seedling (*Sorbus sp.*) was found but was too small to identify to species. The City of Mississauga 2022 study, as previously noted, documented American Mountain-ash in the study area, which is regionally uncommon; the noted specimen could feasibly have been that species.

The noted Mineral Open Beach/Bar inclusion is located at the mouth of Cooksville Creek and extends along the shore line. It has formed on soils that are unconsolidated sandy loam and has sparse vegetation. The dominant species include Canada Goldenrod, White Sweet-clover (*Melilotus albus*), Rough Cockleburr (*Xanthium strumarium*), Smooth Brome (*Bromus inermus*), and Orchard Grass (*Dactylis glomerata*). Along the edge of the trees there were Pussy Willow (*Salix discolor*), Sandbar Willow (*Salix interior*), and Cottony Willow (*Salix eriocephala*).

Open Aquatic (OAO)

This section of the watercourse directly outlets into Lake Ontario. At the time of Aquafor's 2024 site visit, the water was slow moving with no floating or submerged vegetation present. Several large willows and Manitoba Maples extend over the creek giving minor tree cover. The creek is confined by retaining walls for the majority of the study area.

An illustration of the Ecological Land Classification within the study area is provided in **Figure 3-13**.



Figure 3-13: Ecological Land Classification for Cooksville Creek Study Area

3.2.1.2 Botanical Inventory

A total of 90 vascular plant species were identified within the study area, plus seven additional species identified to genus due to a lack of diagnostic features at the time of survey. Refer to **Appendix A** for a complete annotated list of vascular plants identified within the study area.

Table 3-8, provides an overview of the results of the botanical inventory. No federal or provincially significant species were recorded. Regional rarity was evaluated using Natural Areas Survey Database (City of Mississauga, 2002) and Distribution and Status of the Vascular Plants of the Greater Toronto Area (Varga *et al.* 2005). The following three species were found within the study area and are considered regionally rare:

- American Cow Parsnip (*Heracleum maximum*)
- Red Pine (*Pinus resinosa*)
- Sandbar Willow (*Salix interior*)

A total of 97 botanical species were identified within the study area. Of these, 46 were introduced, 44 native, and seven identified only to genus.

Table 3-8: Botanical Inventory Results Summary

Species Breakdown	Total Species: Native Species: Introduced Species: Species identified only to genus:	97 44 (45.4%) 46 (47.4%) 7 (7.2%)	The species are almost exactly split between native and introduced to Ontario. Of the introduced species Garlic Mustard, Goutweed (*Aegopodium podagraria*), Tree-of-heaven (*Ailanthus altissima*), Japanese Barberry (*Berberis thunbergii*), Russian Olive (*Elaeagnus angustifolia*), European Buckthorn, Tatarial Honeysuckle (*Lonicera tatarica*), and Purple Loosestrife (*Lythrum salicaria*) are considered non-native invasive species.
Significance	Federally rare species: Provincially rare species: Regionally Rare species:	0 0 3	Regional rarity was evaluated using Natural Areas Survey Database (City of Mississauga, 2002) and Distribution and Status of the Vascular Plants of the Greater Toronto Area (Varga et al. 2005).
Coefficient of Conservatism	Number of species with CC greater than 7:	1	• Red Pine (*Pinus resinosa*) - 8 CC values are range from 1 to 10 and are assigned based on a species' likelihood to be found in a relatively unaltered landscape (Oldham *et al.* 1995). Plants with high CC values are found only in a relatively narrow range of conditions provided by specific habitats and tend to be intolerant to anthropogenic disturbances. Species with low CC values are able to persist in a wide variety of habitats and are generally more tolerant to anthropogenic disturbances.

Floristic Quality Index	FQI:	21.86	FQI is a calculated value based on species richness and quality of species (i.e. CC value), see below for the equation. A high FQI indicates a higher quality of habitat. $$FQI = average\ CC\sqrt{species\ richness}$$ Calculation is based on the number of species with CC values assigned (44). Generally, FQI greater than 50 is considered high; 30 to 39 is medium, and less than 30 is considered low. This site has an FQI of 21.86 which is low likely due to intense urban influences surrounding the study area and the presence of non-native invasive species.

3.2.2 *Tree Inventory and Bat Habitat Assessment*

The tree inventory for this assignment was completed on March 7, 12, and 13, 2024. A total of 508 trees were inventoried of which 301 are native, 198 are introduced, and one was only identified to genus. A detailed tree inventory table can be found in **Appendix B**. The most abundant species was Manitoba Maple (109) followed by Silver Maple (90), Siberian Elm (83), Norway Maple (53) and Eastern White Cedar (40). The majority of trees were between fair and fair-good for structural and biological integrity. Due to the abundance of introduced species and moderate structural and biological integrity, almost half of the trees were considered to have low preservation priority (263). There were 84 trees classified as moderate preservation priority and 161 with high preservation priority.

The tree inventory was completed during the "leaf off" period so as to account for potential bat habitat (e.g., cavities, cracks, and similar features which would be visible without the canopy, as guided by the MECP's 2022 bat survey requirements and related documentation). The inventory encompassed the entire creek valley on public land but did not include the adjacent private properties. Tree inventory results have been incorporated into the design drawings for this assignment. Potential bat roosting habitat features were observed, including:

- 117 trees with characteristics of Tri-colored Bat (*Perimyotis subflavus*) habitat (i.e., oaks and large maples; other species if dead or dying leaf or branch clusters, debris accumulations, etc. are present). Most of the noted trees are mature maple species identified simply based on species and size.
- 16 trees with features that could appeal to Little Brown Myotis (*Myotis lucifugus*) or Northern Myotis (*M. septentrionalis*), such as cavities, cracks, and exfoliating bark.

Acoustic monitoring for bats was later completed between June 6 and June 17, 2024, using two Anabat Swift passive ultrasonic recorders which were installed on site and left to record overnight for the duration. The results were processed using Kaleidoscope Pro software with auto-ID functionality enabled, with manual QA/QC of files completed as required. A large number of "low-frequency" bats were recorded in the study area, primarily either Big Brown or Silver-haired Bat (*Eptesicus fuscus* or *Lasionycteris noctivagans*) but also some Eastern Red Bat (*Lasiurus borealis*) and/or Hoary Bat (*Lasiurus cinereus*). "High-frequency" bats were

also recorded in a lower abundance, including Little Brown Myotis, Northern Myotis, and Tri-colored Bat.

While species identification using acoustic recordings is not always reliable, given the similarities between the characteristics of the various species' vocalizations, the separation of species into high versus low frequency bands is clear, and is significant in that the high-frequency species are all currently listed as Endangered species under the provincial *Endangered Species Act*. So, the confirmed presence of high-frequency bats, regardless of species, confirms that Species at Risk (SAR) bats and their habitat will be a factor in this assignment. Potential for impact or injury to the noted trees providing potential habitat, and any associated regulatory requirements, will need to be determined during detailed design.

Of note, three out of the four low-frequency bats have also recently been recommended for designation as Endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), although they have not yet been added to either federal or provincial species lists for regulatory purposes. While there are not currently any regulatory requirements for these species, this could change in the near future. The bat acoustic monitoring results for low frequency bats are provided in **Table 3-9**.

Table 3-9: Bat Acoustic Monitoring Results Summary – Low Frequency Bats

Species Common Name	Species Scientific Name	# of Recordings Detector 1	# of Recordings Detector 2
Big Brown Bat or Silver-haired Bat	*Eptesicus fuscus or Lasionycteris noctivagans*	1473	2722
Eastern Red Bat	*Lasiurus borealis*	3	151
Hoary Bat	*Lasiurus cinereus*	75	498

In addition to the bat acoustic monitoring results for low frequency bats described above, unidentified Low-Frequency Species (under 40 kHz) were also recorded at both detectors. Across the monitoring period, Detector 1 registered 291 recordings and Detector 2 registered 598 recordings of unidentified Low-Frequency Species. Also of note, Big Brown and Silver-haired Bat are typically not possible to differentiate via acoustic recordings. Of the listed species, all but Big Brown Bat have been recommended for designation as Endangered by COSEWIC. The bat acoustic monitoring results for high frequency bats are provided in **Table 3-10**.

Table 3-10: Bat Acoustic Monitoring Results Summary – High Frequency Bats

Species Common Name	Species Scientific Name	# of Recordings Detector 1	# of Recordings Detector 2
Eastern Small-footed Myotis	*Myotis leibii*	1	0
Little Brown Myotis	*Myotis lucifugus*	13	21
Northern Myotis	*Myotis septentrionalis*	13	0
Tricolored Bat	*Perimyotis subflavus*	9	17

In addition to the bat acoustic monitoring results for high frequency bats described above, unidentified High-Frequency Species (under 40 kHz) were also recorded at both detectors. Detector 1 registered 20 recordings and Detector 2 registered 27 recordings of unidentified High-Frequency Species. All high-frequency bat species are listed as Endangered species under the Ontario *Endangered Species Act.*

3.2.3 *Other Terrestrial Wildlife*

Aquafor's scope of work for this assignment did not include targeted field surveys for other wildlife taxa, but all incidental observations of wildlife were recorded while staff were on site in March and June, 2024. The resulting list of species is provided in **Appendix C**.

Additional wildlife species that have been reported in the area were reviewed using primarily the community science websites eBird and iNaturalist; eBird in particular contains publicly-submitted records of 113 species since May of 2019 for the Helen Molasy Memorial Park birding hotspot. A full list of results from those background resources has not been reproduced in this document, but noteworthy observation records were incorporated into the analysis and into the SAR Screening.

Highlights of noteworthy observations include the following:

- Aquafor's observations included two provincially rare species: Red-necked Grebe (*Podiceps grisegena*; S3), a winter and migratory visitor on the Great Lakes; and Black-crowned Night Heron (*Nycticorax nycticorax*; S3B, S2N), which was observed both as adult and juvenile individuals, foraging in suitable habitat in the study area. Additional records of Black-crowned Night Heron are available for the area via eBird.
- SAR bird observations reported to eBird include Barn Swallow (*Hirundo rustica*), Chimney Swift (*Chaetura pelagica*), and Wood Thrush (*Hylocichla mustelina*).
- Other eBird records include a wide variety of migrant songbirds and waterfowl, potentially suggesting the presence of at least locally significant migrant stopover or overwintering habitats. The City's Natural Areas Fact Sheet for this location notes that the sandbar at the mouth of the creek, downstream, provides resting and foraging habitat for waterfowl and other birds.
- Aquafor's observations of reptiles in the study area included Eastern Garter Snake (*Thamnophis sirtalis sirtalis*), Snapping Turtle (*Chelydra serpentina*), Midland Painted Turtle (*Chrysemys picta marginata*), and Pond Slider (*Trachemys scripta*). Non-native Pond Slider was also reported in multiple locations via the iNaturalist website.
- American Toad (*Anaxyrus americanus*) is the only confirmed amphibian species for the area via background records. However, lack of observation records does not necessarily confirm that additional species are not present.

3.2.4 *Species at Risk Screening*

For the purpose of this assessment, Species at Risk (SAR) are defined as those designated Endangered (END), Threatened (THR), or Special Concern (SC) under either the provincial *Endangered Species Act* (ESA) or the federal *Species at Risk Act* (SARA). Species which have been assessed as any of those categories by the COSEWIC but are not yet listed by either Act have also been included here for discussion. Species listed as END or THR receive regulatory protection under the ESA and may require additional work or consultation with the MECP to confirm regulatory requirements. Species listed as SC do not receive regulatory protection, but significant habitats of these species may be recognized as Significant Wildlife Habitat and thus protected under municipal policy and/or the Provincial Policy Statement. Mitigation and

protection measures are still recommended to apply to Special Concern species and their habitats.

Aquafor compiled a species list of past or potential SAR occurrences from all available sources, including: the Ontario Natural Heritage Information Center (NHIC) database; the DFO's aquatic SAR mapping; provincial species atlases; and the iNaturalist and eBird websites. Several species were also included based on Aquafor's experience as a general screening measure, regardless of whether past records were available, as they may not have been formally surveyed or reported in the past. The resulting species list was then screened by comparing the habitat requirements of the listed species against the habitat that is present in the study area. The full results of this exercise are provided in **Appendix D**. Following below is an overview of those species which were deemed to be relevant to the current study area (i.e., could potentially be present and require protection or mitigation during construction).

- Eastern Wood-pewee (*Contopus virens*) - SC: Potentially nesting in woodland habitat in the study area. Mitigation and protection measures for this and other migratory birds will be required during construction to maintain compliance with the Migratory Birds Convention Act (e.g., limitations on timing of vegetation removals).
- Monarch (*Danaus plexippus*) - SC: Feeds and potentially breeds on milkweeds and other wildflowers in the vicinity of the study area. Recommend that post-construction restoration include native seed mixes and milkweed species (*Asclepias* sp.) to support the continued presence of Monarch.
- Eastern Red Bat, Hoary Bat, Little Brown Myotis, Northern Myotis, Silver-haired Bat, and Tri-colored Bat - END: Confirmed present in the study area; suitable trees are present to provide roosting habitat (see **Section 3.2.2**).
- Midland Painted Turtle and Snapping Turtle - SC: Observed in association with the creek and lake. Mitigation for the presence of turtles is recommended during construction (e.g., exclusion fencing and monitoring during the active season).

3.2.5 *Significant Natural Heritage Feature Considerations*

Existing mapping does not indicate that the study area includes any provincially significant wetlands or Areas of Natural and Scientific Interest (ANSIs).

The creek corridor in the study area is part of the City of Mississauga's Significant Natural Area Site LV4 under the 2022 Natural Areas Update. The City's Official Plan, Schedule 3 (Natural System) also maps this area as part of the Natural Heritage System, specifically under "Significant Natural Areas and Natural Green Spaces".

3.3 Aquatic Assessment

Fish community and aquatic habitat in Cooksville Creek was studied on April 10, 2024 by Aquafor Beech Limited aquatic biology staff. Surveys were conducted in accordance with the Ontario Stream Assessment Protocol (OSAP), Section 4, Module 1: Rapid Assessment Methodology for Channel Structure (Stanfield, 2017). The aquatic components of the study area are described in the following subsections. Photographs from Aquafor's site visit are included in the following sections.

Aquatic habitat characteristics, as described in the following section, are major determinants for biotic composition, which is an indicator of aquatic ecosystem health. Understanding aquatic habitat can therefore determine relationships with biotic composition, providing a better understanding of subwatershed health and integrity. While aquatic habitat changes

constantly, anthropogenic disturbance can impact habitat, stressing the relationship with aquatic habitat and biological/chemical indicators. The habitat characteristics investigated within the immediate study sites as well as the adjacent watercourses include:

- Bank characteristics;
- Stream width (wetted and bankfull);
- Instream cover (e.g., woody debris, undercut banks, boulders, vegetation);
- Riparian cover (vegetation composition, quality and width); and
- Physical barriers to fish movement (e.g., woody or debris jams, knickpoints, etc.)

3.3.1 *Aquatic Habitat*

One (1) OSAP site was established as part of the study for the Cooksville Creek Class EA Project. The study area focused on Cooksville Creek within Secret Park and alongside Helen Molasy Trail in the City of Mississauga. The downstream extent was located near the mouth of Cooksville Creek at Lake Ontario, and the upstream extent was noted by Lakeshore Road East. The site length extended ~450 m with the watercourse bordered by a narrow-naturalized buffer on either bank, bound by residential development.

The study area was located in Cooksville Creek, which is a permanently flowing watercourse within the Lake Ontario Shoreline East Tributaries Subwatershed, belonging to the Credit River Watershed. The study area is located in the Iroquois Plain physiographic region which is composed of gentle slope from the shoreline of Lake Ontario, to back about 3-5 km. This region is composed of a thin veneer of glacio-lacustrine sand and silty sand (CVC, TRCA, City of Brampton, Region of Peel, Halton-North Peel Naturalists' Club and the South Peel Naturalists' Club, 2011). The study area was surrounded by urban land use, resulting in reduced streamside vegetation and increased impervious cover which has caused an increase in runoff and sediment loading in Cooksville Creek (CVC, TRCA, City of Brampton, Region of Peel, Halton-North Peel Naturalists' Club and the South Peel Naturalists' Club, 2011). OSAP findings and habitat characteristics for the study area are detailed below.

Table 3-11: OSAP Findings for Study Area

Site ID	Cooksville Creek Class EA
General Flow Regime	Permanent
Subwatershed/ Watercourse	Lake Ontario Shoreline East Tributaries Subwatershed, Credit River Watershed
Site Location	Downstream extent was located at the mouth of Cooksville Creek draining into Lake Ontario, and bounded upstream by Lakeshore Road East. The study area was located in Secret Park, within the City of Mississauga, and ran parallel to the Helen Molasy Trail on the east bank.
Site Characteristics	Site length was ~450 meters. Average wetted width was ~15 meters, while the average depth at crossovers was ~150 mm. The maximum instream particle size observed was 100 mm, which was contributed by cobble substrate which potentially originated from failed gabion baskets (**Figure 3-17**). The watercourse has been historically straightened and confined by residential development, which has resulted in erosion (**Figure 3-20**). Anthropogenic impacts included dumping and garbage throughout the site. Impermeable surfaces consisted of asphalt trails which travelled parallel to Cooksville Creek with residential development beyond. Gabion baskets lined the watercourse throughout the study area and demonstrated signs of failure (**Figure 3-19**). Spawning White Suckers (*Catostomus commersoni*) were observed which confirms that

	the study area directly supports spawning and nursery activities for this species (**Figure 3-22**).
Habitat Description	Instream cover was moderately abundant and consisted of unembedded round and flat rocks, as well as some wood (**Figure 3-16**) and overhanging banks. Channel hardening and straightening was evident throughout the site with gabion baskets. Overall, the study area was distributed amongst medium depth pools as well as shallow glides and slow riffles. Fast riffles were noted at the upstream extent of the site (**Figure 3-21**). The most common habitat within the study area was medium-depth (101-600 mm) pools. Canopy cover was low due to the generous width of Cooksville Creek and the limited riparian vegetation (**Figure 3-15**).
Substrate Composition	The downstream extent of the site indicated finer instream substrate (**Figure 3-15**), whereas the middle and upstream extent was comprised of cobble which was likely contributed through failed gabion baskets. Multiple point bars were observed throughout the site, consisting of fine and gravel substrate (**Figure 3-18**). The water was relatively clear, suggesting healthy levels of sediment within the system.
Bank Stability	The banks of Cooksville Creek within the study area were mostly lined with stone-filled gabion baskets that were failing (**Figure 3-20**). Eroding banks were evident and ongoing throughout the site, with cut-face and exposed banks, resulting in leaning trees and exposed terrestrial roots (**Figure 3-16**). Deposition areas (point bars) were observed along some of the banks and consisted of gravel and finer sediments. Overall, banks demonstrated instability due to channel widening, ongoing erosion and failing gabion baskets. The asphalt Helen Molasy Trail was observed to be slumping towards the watercourse.
Instream and Riparian Vegetation	Macrophytes were not observed throughout the site, however some algae were noted on the cobble substrate near the upstream extent (**Figure 3-18**). A narrow-naturalized buffer surrounded both banks, consisting of scrubland vegetation and some established trees. The stability of terrestrial vegetation between the watercourse and pedestrian pathway was at-risk due to erosion. Impermeable surfaces and maintained lawns were within close proximity to the watercourse, followed by residential development. A larger naturalized riparian buffer was evident downstream of the pedestrian bridge, near the mouth of Cooksville Creek. Japanese Knotweed (*Fallopia japonic*), an aggressive invasive plant species that can grow through concrete, was observed along the upstream extent of the west bank.
Fish Barriers and Other Disturbances	The surrounding and upstream anthropogenic land use included residential, commercial development and roads (Lakeshore and QEW) which likely contribute contaminant and nutrient sources to the site. No fish passage barriers were noted throughout the site. Multiple outfall structure and drain pipes were observed, with some with algae on the infrastructure which suggests a source of excess nutrients (**Figure 2-20**). Groundwater upwellings were not observed throughout the site. During the site visit, a Red Fox (*Vulpes vulpes*), young Snapping Turtle (*Chelydra serpentina*) and Midland Painted turtle (*Chrysemys picta marginata*) was observed (**Figure 3-16**).

In general, the study area of Cooksville Creek in the City of Mississauga was surrounded by a narrow-naturalized buffer on each bank, followed by trails and residential land-use.

Cooksville Creek is a highly urbanized subwatershed, with multiple anthropogenic influences observed throughout the site.

3.3.2 *Fish Community Assessment*

The study area was located in Cooksville Creek within the Credit River Watershed. Credit Valley Conservation's Watershed Report Card (Credit Valley Conservation, 2023) detailed that the study area received a score of 'poor' in surface water quality, which was based on data from 2017 to 2021. Poor water quality can be harmful to fish and other aquatic life, which was reflected in the recorded fish community in Cooksville Creek. The fish community is classified as 'warmwater', which indicates that the study area is "comprised of species that are highly tolerant of a wide temperature and flow fluctuations and can withstand temperatures in excess of 26°C for prolonged periods of time. Communities are usually found where groundwater discharge is minimal" (MNRF and CVC, 2002). This is also supported by open data through the Ministry of Natural Resources and Forestry which states that the study area has a warm water thermal regime (Ministry of Natural Resources, 2023). The study site falls under the 'large, warmwater' fish community management zone where, "a number of species are only found in the lower Credit and may be associated with access from Lake Ontario including river chub, emerald, spottail, rosyface and spotfin shiners. Many additional lake species not normally associated with the river will utilize the lower reaches" (MNRF and CVC, 2002). The Fisheries Management Plan suggests that the study area was a historic migratory corridor for salmonids (MNRF and CVC, 2002). It is understood that spawning habitat upstream of Lakeshore has decreased in abundance and quality, with remaining salmonid species limited to the mouth of the Lake as demonstrated in incidental observations through citizen science. A list of previously found species that was updated on September 30, 2019 and made available through the Ministry of Natural Resources Aquatic Resource Area (ARA) data (Ministry of Natural Resources, 2023) is shown in **Figure 3-14**.

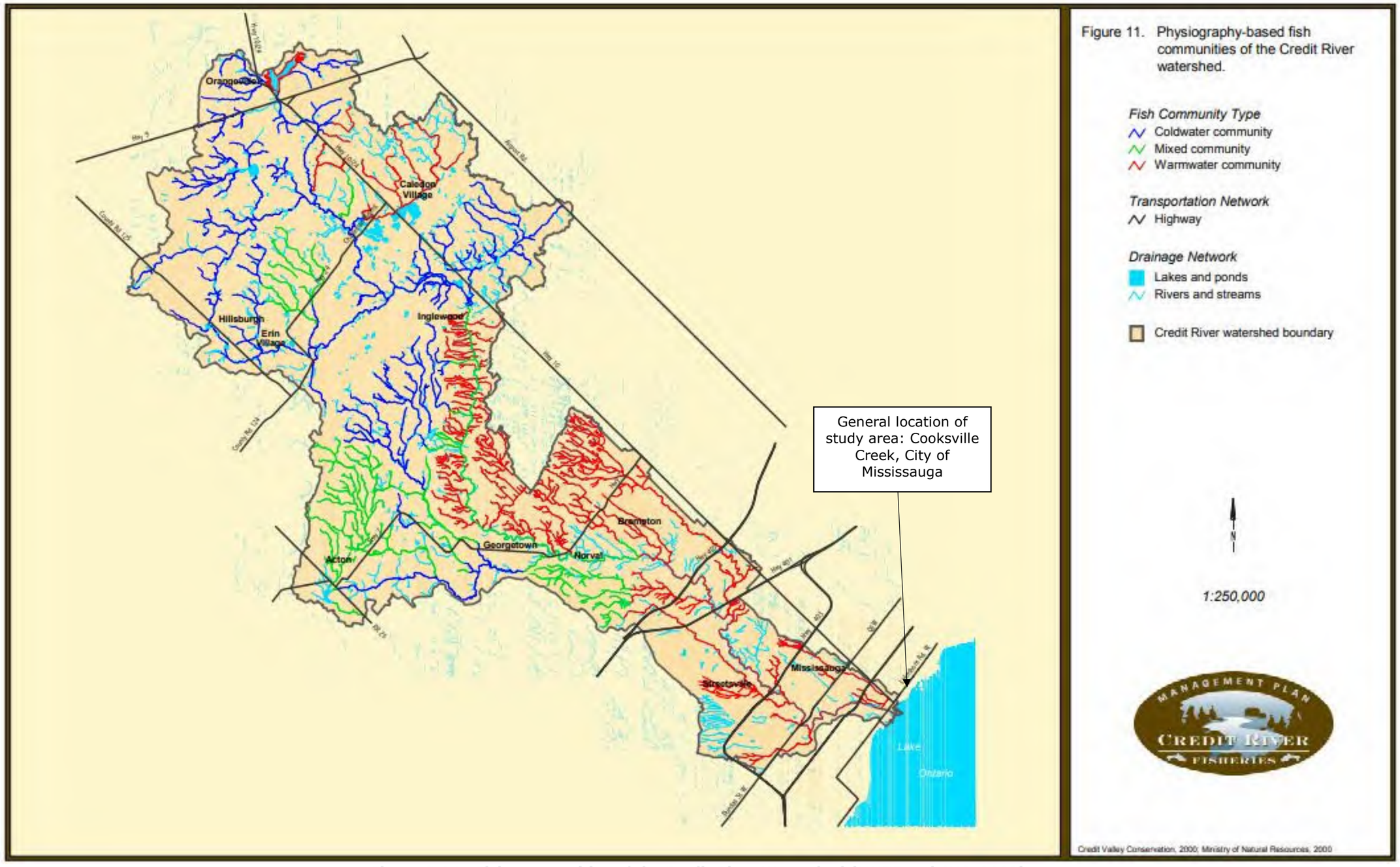


Figure 3-14: Fish communities of the Credit River Watershed (MNRF and CVC, 2002)

As detailed in **Table 3-12,** the majority of species found within the study area are common and intermediately tolerant to tolerant of disturbance.

Table 3-12: Species collected in the study area, Cooksville Creek (Ministry of Natural Resources, 2023) (Eakins, 2023)

Common Name	Scientific Name	Tolerance	Thermal Regime	General Abundance	Spawning Months
Blacknose dace	*Rhinichthys atratulus*	Intermediate	Coolwater	Common	May – June
Bluntnose minnow	*Pimephales notatus*	Intermediate	Warmwater	Common	June - August
Brook stickleback	*Culaea inconstans*	Intermediate	Coolwater	Common	May - July
Brown trout	*Salmo trutta*	Intolerant	Coldwater	Common	October – November
Carps and Minnows	*Cyprinidae* and *Leuciscidae*	--	--	--	--
Common Shiner	*Luxiulus cornutus*	Intermediate	Coolwater	Common	May – June
Creek chub	*Semotilus atromaculatus*	Intermediate	Coolwater	Common	May - June
Fathead minnow	*Pimephales promelas*	Tolerant	Warmwater	Common	May - August
Goldfish*	*Carassius auratus*	Tolerant	Warmwater	Common	May - July
Lake chub	*Couesius plumbeus*	Intermediate	Coldwater	Common	April – June
Longnose dace	*Rhinichthys cataractae*	Intermediate	Coolwater	Common	May - July
Rainbow trout	*Oncorhynchus mykiss*	Intolerant	Coldwater	Common	March – May
Round goby*	*Neogobius melanostomus*	Intermediate	Coolwater	Common	May – July
White sucker	*Catostomus commersonii*	Tolerant	Coolwater	Common	April - June

An "*" indicates an invasive species of Ontario.

Notably, Rainbow trout, Brown trout and Lake chub require higher quality aquatic habitat with a preference of coldwater. The presence of these three species is attributed to the close proximity and connectivity of Cooksville Creek to Lake Ontario. There are no records of species at-risk within the study area, as supported Fisheries and Oceans Canada Species at Risk mapping (Fisheries and Oceans Canada, 2023).

3.3.3 *DFO Self-Assessment*

The federal *Fisheries Act* requires that projects avoid causing the death of fish and the harmful alteration, disruption or destruction of fish habitat unless authorized by the Minister of Fisheries and Oceans Canada (DFO). This applies to work being conducted in or near waterbodies that support fish at any time during any given year or are connected to waterbodies that support fish at any time during any given year. As noted above, the study

area(s) does contain fish at any time during any given year. Therefore, the *Fisheries Act* applies to works conducted in or near water at the site.

Upon completion of the detailed design for the channel works at the study site, the works should be cross-referenced with the DFO "Projects Near Water" online service to determine if a request for regulatory review under the federal *Fisheries Act* is required (Department of Fisheries and Oceans, 2019). Based on field investigations conducted by Aquafor staff and background information, the study area **does** contain fish at any time during any given year. It is therefore the opinion of Aquafor Beech Limited that a request for regulatory review by Fisheries and Oceans Canada will be required. It is recommended that the proponent exercise the Measures to protect fish and fish habitat listed by Fisheries and Oceans Canada to avoid contravention with the federal *Fisheries Act* and exercise due diligence by further mitigating accidental death of fish and the harmful alteration, disruption or destruction of fish habitat (Fisheries and Oceans Canada, 2023). It is further recommended that these mitigation measures be included in the detailed designs, with any and all applicable Codes of Practice (Fisheries and Oceans Canada, 2022) exercised where feasible.

3.3.4 *In-Water Timing Window*

As discussed above and as outlined in the federal *Fisheries Act*, the proponent is to exercise mitigation measures to avoid contravention with the Act and exercise due diligence by further mitigating accidental death of fish and the harmful alteration, disruption or destruction of fish habitat. With the proposed works being undertaken within and/or adjacent to Cooksville Creek, and within the immediate proximity to Lake Ontario, construction should be undertaken such that the construction timing will be limited to outside of the critical life stages of the fish community listed above in **Table 3-12** (Fisheries and Oceans Canada, 2013). Therefore, the In-water Work Timing Window Guideline outlines that based on the reproduction requirements of the spring and fall spawning species within the watercourse and study area, in-water works must take place between **July 15th to September 30th** of any given year (Ministry of Natural Resources, 2013). These timing window guidelines are to be confirmed by the DFO during the Regulatory Review.



Figure 3-15: Typical Aquatic Habitat at Downstream Extent



Figure 3-16: Fallen Riparian Tree Providing Habitat



Figure 3-17: Instream Substrate Looking Upstream



Figure 3-18: Typical Riparian Vegetation on Left Bank



Figure 3-19: Gabion Basket Bank Protection



Figure 3-20: Failing Gabion Basket with Tree Growing Out



Figure 3-21: Upstream Habitat with Gabion Baskets on Left Bank



Figure 3-22: Spawning White Sucker Fish

3.4 Archaeological Assessment

New Era Archaeology completed a Stage 1 Archaeological Assessment of the study area on December 30th, 2023. All archaeological assessment works were completed in conformity with the Ontario Ministry of Tourism and Culture (MTC) *Standards and Guidelines for Consultant Archaeologists* (MTC 2011) and the *Ontario Heritage Act* (RSO 1990a).

The purpose of the assessment was to determine if the project area had potential to contain archaeological resources of importance and if any past land within the project area had removed areas of potential. The study involved the review of historical records and maps, current aerial photography, and project area inspections to confirm the project area conditions.

The entirety of the study area was subject to a desktop Archaeological Background Study. The site was surveyed on December 12, 2023 to gain a better understanding of the conditions of the area. The project area was determined to have a history long predating European settlement with high potential for yielding Indigenous resources and artifacts due to the close proximity to the water. Furthermore, potential for Euro-Canadian resources was also determined due to the proximity of the site to a historic road and structure along with a previously registered archaeological site. The previous creek realignments completed in 1977 has caused deep disturbances to the archaeological potential of the site close to the water with little to no potential remaining in those areas.

The Stage 1 Archaeological Assessment recommended that a Stage 2 Archaeological Assessment by test pit survey at intervals of 5 meters should be completed for areas of archaeological potential prior to any ground altering activities. **Figure 3-23** illustrates the areas of archeological potential. The completed Stage 1 Archaeological Assessment report is provided in **Appendix E**.



Figure 3-23: Stage 1 Archaeological Background Result

3.5 Cultural Heritage Assessment

The City of Mississauga maintains a comprehensive register of cultural heritage properties within its authority, including both designated and listed properties. Designated properties are those protected by the Ontario Heritage Act, while listed properties are non-designated properties of cultural heritage value or interest.

In support of the environmental assessment process, Aquafor conducted a screening of cultural heritage properties within the study area using the City's Heritage Property interactive mapping. The study area was searched for any properties with parcels adjacent to or extending into the riverine corridor.

Following Aquafor's review of the City of Mississauga's Heritage interactive mapping, it was determined that the study area currently has no properties listed in the heritage property register.

As such, the proposed trail and creek restoration solutions are not anticipated to have a negative impact on the City of Mississauga's Cultural Heritage resources.



Figure 3-24: City of Mississauga's Mapping of Heritage Properties – No Properties Highlighted Within the Study Area

3.6 Hydraulic Assessment

For the purposes of this environmental assessment, the Cooksville Creek HEC-RAS model obtained from CVC was used to define the existing hydraulic conditions within the study area. Filtered Lidar information within the study area was used to generate the existing terrain, and then used to plot existing floodlines. The schematics and cross-section arrangement of the existing HEC-RAS model within the study area boundary are depicted in **Figure 3-25**, along with the regional floodline shown in red.

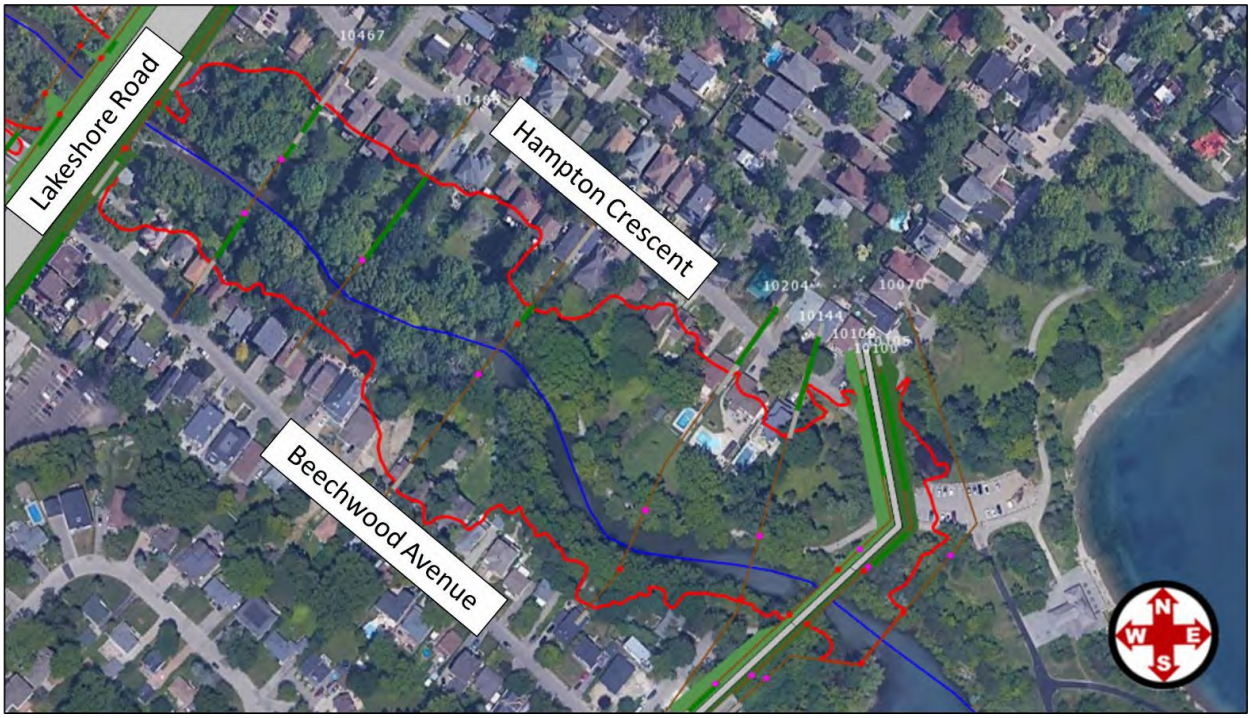


Figure 3-25: Existing HEC-RAS Schematic Showing Regional Floodline Extents and Model Cross-Section Locations

The range of flow flows experienced within the study area is provided in **Table 3-13**.

Table 3-13: Range of Study Area Flows

Return Period	Discharge (m^3/s)
2-Year	75.3
5-Year	109
10-Year	143.6
25-Year	171.5
50-Year	197.3
100-Year	225.4
Regional	316.1

The model was run under a subcritical flow regime, with a summary of the key hydraulic modeling results for each of the various flood flow events provided in **Appendix F**.

The results of the hydraulic assessment demonstrate that Cooksville Creek experiences moderately high velocities, shearing forces, and channel power under the range of flood flow conditions, which can contribute to continuous erosion and increased levels of channel activity under extreme wet-weather flow events. These conditions have been considered in the

process of defining the types of restoration options, the sizing and resistance thresholds for materials, and appropriate channel planform configurations. In order to provide further insight into the impact of the hydraulics parameters, Aquafor reviewed published data on the critical erosional thresholds for river bed and bank materials as presented in **Table 3-14**.

Table 3-14: Erosion Thresholds for Stream Bed and Bank Materials (Fischenich, 2001)

Material	Permissible Shear Stress Minimum (N/m^2)	Permissible Shear Stress Maximum (N/m^2)	Permissible Velocity Minimum (m/s)	Permissible Velocity Maximum (m/s)
Fine Gravels	3.6		0.76	
Stiff Clay	12.4		0.91	1.37
Alluvial Silt	12.4		1.14	
Graded Silt to Cobble	18.2		1.14	
Shales and Hardpan	32.1		1.83	
Non-Uniform Gravel / Cobble				
2-inch	32.1		0.91	1.83
6-inch	95.8		1.22	2.29
12-inch	191.5		1.68	3.66
Long native grasses	57.5	81.4	1.22	1.83
Short native and bunch grass	33.5	45.5	0.91	1.22
Reed plantings	4.8	28.7		
Hardwood tree plantings	19.2	119.7		
Wattles	9.6	47.9	0.91	
Reed fascine	28.7	59.8	1.52	
Coir roll	143.6	239.4	2.44	
Vegetated coir mat	191.5	383.0	2.90	
Live brush mattress (initial)	19.2	196.3	1.22	
Live brush mattress (grown)	186.7	392.6	3.66	
Brush layering (initial/grown)	19.2	299.2	3.66	
Live fascine	59.8	148.4	1.83	2.44
Live willow stakes	100.5	148.4	0.91	3.05
Gabions	478.8		4.27	5.79
Concrete / Armourstone	598.5		5.49	

These threshold values were then compared to the range of velocities modelled within the Cooksville Creek study area. A comparison between the values reported in **Table 3-14** and the parameters found within the study area indicate that shearing and velocity conditions will surpass the permissible thresholds for natural materials without reinforcement, and in turn, careful attention to stone sizing and placement of material will be required to mitigate failure of the reconstructed channel banks.

4 DEVELOPMENT AND EVALUATION OF ALTERNATIVE SOLUTIONS

A series of alternatives were developed to specifically address the observed concerns within the study area, using the information gathered from the technical assessments. Due to the unique conditions within the study area, the alternatives were separated into two separate categories: Creek Restoration Alternatives and Drainage Improvement Alternatives. A brief description of the alternatives within both of the categories is provided in the following subsections. A complete set of restoration alternative drawings is provided in **Appendix G**.

4.1 Study Area Constraints

In support of the development of the restoration alternatives, the following constrains were applied:

- Trail width within the study area must be maintained, to facilitate City Parks operations
- Berm elevations must be maintained, such that flooding impacts are not worsened to properties on either side of the creek
- Impacts to private property must be minimized, wherever possible.

Preliminary alternatives that did not meet these constraints were not included in the evaluation process. The alternatives that are described in the following subsections have met the constraints described above.

4.2 Description of Alternatives

4.2.1 *Creek Restoration Alternatives*

4.2.1.1 Alternative 1: Do Nothing

This alternative is required as part of the EA process, however, it would entail continued failure of existing bank protection measures, leading to continued erosion and deterioration of the stormwater infrastructure within the study area.

4.2.1.2 Alternative 2: Local Channel Restoration Works

This alternative would consist of the localized protection of stormwater infrastructure within the study area, and the restoration of a few key areas of severe back protection failure, through the use of vegetated buttress bank protection treatment with embedded armourstone retaining walls.

4.2.1.3 Alternative 3: Extended Channel Restoration Works

This alternative would consist of continuous bank restoration to provide comprehensive erosion protection within the entire study area, through the use of vegetated buttress bank protection treatment with embedded armourstone retaining walls.

4.2.2 *Drainage Improvement Restoration Alternatives*

4.2.2.1 Alternative 1: Do Nothing

This alternative is required as part of the EA process, however, it would entail continued deterioration of the Helen Molasy Trail, and the associated risks to public safety within the study area. Additionally, the drainage concerns resulting in ponding water in the adjacent properties will not be resolved. Continued maintenance activities will be required, including

patching the deteriorating asphalt surface, and pumping standing water out of the residential backyards.

4.2.2.2 Alternative 2: Like-for-Like Drainage Replacement

This alternative would consist of the like-for like replacement of the drainage infrastructure that connects the backyards within the adjacent residential neighbourhoods to Cooksville Creek. This will include the eight (x8) catchbasin-outfall pairs along the East Bank, and the four (x4) catchbasin-outfall pairs along the West Bank. Full depth restoration of the berm with engineered materials will be included as part of this alternative.

4.2.2.3 Alternative 3: Partial Drainage Consolidation

This alternative would consist of the consolidation of drainage infrastructure within the study area, to improve conveyance efficiency below the berm, and simplify the required maintenance activities. This would include reducing the catchbasin-outfall pairs on the East Side from eight (x8) to four (x4), through regrading of the drainage swales. The four (x4) catchbasin-outfall pairs along the West Bank would be replaced in a like-for-like manner. Full depth restoration of the berm with engineered materials will be included as part of this alternative.

4.2.2.4 Alternative 4: Hybrid Drainage Solution

This alternative would consist of a combination of like-for-like replacement and partial consolidation, recognizing the unique conditions and constraints throughout the study area. Drainage swales will be regraded and optimized, and pipes will be upsized where required. Full depth restoration of the berm with engineered materials will be included as part of this alternative.

4.3 Evaluation Criteria

As a part of the Municipal Class Environmental Assessment Process, each alternative must be evaluated based on a set of physical, natural, social, cultural, and economic environmental criteria, as well as technical and engineering considerations. These set of criteria were developed by Aquafor and reviewed by the City of Mississauga. The list of criteria and the associated description of the scoring rationale is presented in **Table 4-1** through **Table 4-4**.

Table 4-1: Alternative Evaluation Criteria – Physical / Natural Environment

Criteria	Description
Erosion	Rate of erosion, slope failures, and loss of tablelands
Water Quality	Impact on water quality
Aquatic Habitat	Impact on contributing aquatic habitat
Terrestrial Habitat	Impact on connectivity, diversity and quantity/quality of habitat
Terrestrial Vegetation	Impact on existing riparian vegetation and mature trees
Flooding	Impact on nuisance flooding on neighbouring properties

Table 4-2: Alternative Evaluation Criteria – Economic Criteria

Criteria	Description
Capital Costs	One time cost to City.
Operations & Maintenance Costs	Requirement for regular, irregular or no maintenance activities and ensure effectiveness of implemented measures

Table 4-3: Alternative Evaluation Criteria – Social/ Cultural Environment

Criteria	Description
Public Safety	Impact on public safety
Landowner Impacts	Impacts to adjacent private property
Benefit to Community	Enjoyment of surrounding parkland, improvement to shared spaces
Aesthetic Value	Impact on existing and proposed aesthetic value
Archaeological Impacts	Impact on lands that have archaeological potentials

Table 4-4: Alternative Evaluation Criteria – Technical/ Engineering Considerations

Criteria	Description
Impact on Existing Infrastructure	Protection of infrastructure (bridge, trail, and storm outfalls)
Constructability	Easiness to access, move equipment and construct
Lifespan of Works	Expected lifespan / years of works before intervention needs to be repeated

A weighting factor was assigned to each category, which ensured that each category was valued appropriately, regardless of the number of sub-criteria presented within the larger category. The maximum points for each category are shown in **Table 4-5**.

Table 4-5: Criteria Weighting Factors

Category	Maximum Points for Category
Physical and Natural Environment Criteria	25
Social/Cultural Environment	25
Technical/Engineering Considerations	25
Economic Environment	25
TOTAL	**100**

For all the criteria, a score was applied ranging from 0 to 5 (**Table 4-6**), where:

- 0 = Unfavourable, no improvement or negative impact
- 2 = Acceptable
- 4 = Favourable, most improvement or most positive impact
-

Table 4-6: Ranking Scheme for Criteria Evaluation of Each Alternative

Ranking Scale						
No / Negative Impact	0	1	2	3	4	**Ideal / Most Positive Impact**

4.4 Evaluation of Alternatives

The channel and drainage improvement restoration alternatives were evaluated using this set of criteria. The evaluation matrices are provided in **Table 4-7** and **Table 4-8**.

Table 4-7: Evaluation Matrix for Channel Restoration Alternatives

Cooksville Creek - Lakeshore Road to Lake Ontario Evaluation Matrix - Channel Restoration					
Category	**Evaluation Criteria**	**Indicator**	**Alternative 1 - Do Nothing**	**Alternative 2 - Local Channel Restoration Works**	**Alternative 3 - Extended Channel Restoration Works**
Physical and Natural Criteria	Erosion	Rate of erosion, slope failures, and loss of tablelands	**0**	**1**	**4**
	Water Quality	Impact on water quality	**1**	**2**	**3**
	Aquatic Habitat	Impact on contributing aquatic habitat	**1**	**2**	**3**
	Terrestrial Habitat	Impact on connectivity, diversity and quantity/quality of habitat	**3**	**2**	**1**
	Terrestrial Vegetation	Impact on existing riparian vegetation and mature trees	**3**	**2**	**1**
	Flooding	Impact on nuisance flooding on neighbouring properties	**1**	**1**	**1**
		Criteria Subtotal	***9.00***	***10.00***	***13.00***
		Weighted Score (maximum of 25 points)	***9.38***	***10.42***	***13.54***
Social and Cultural Criteria	Public Safety	Impact on public safety	**1**	**2**	**2**
	Landowner Impacts	Impacts to adjacent private property	**0**	**1**	**2**
	Benefit to Community	Enjoyment of surrounding parkland, improvement to shared spaces	**0**	**2**	**3**
	Aesthetic Value	Impact on existing and proposed aesthetic value	**2**	**3**	**3**
	Archaeological Impacts	Impact on lands that have archaeological potentials	**4**	**2**	**2**
		Criteria Subtotal	***7.00***	***10.00***	***12.00***
		Weighted Score (maximum of 25 points)	***11.25***	***12.50***	***15.00***
Technical and Engineering Criteria	Impact on Existing Infrastructure	Protection of infrastructure (bridge, trail, and storm outfalls)	**0**	**3**	**4**
	Constructability	Easiness to access, move equipment and construct	**4**	**3**	**2**
	Lifespan of Works	Expected lifespan / years of works before intervention needs to be repeated	**0**	**3**	**4**
		Criteria Subtotal	***4.00***	***9.00***	***10.00***
		Weighted Score (maximum of 25 points)	***8.33***	***18.75***	***20.83***
Economic Criteria	Capital Costs	One time cost to City	**4**	**3**	**2**
	Operations & Maintenance Costs	Requirement for regular, irregular or no maintenance activities and ensure effectiveness of implemented measures	**0**	**3**	**4**
		Criteria Subtotal	***4.00***	***6.00***	***6.00***
		Weighted Score (maximum of 25 points)	***12.50***	***18.75***	***18.75***
Total Score (maximum of 100 points)			**41.46**	**60.42**	**68.13**

Table 4-8: Evaluation Matrix for Drainage Improvement Alternatives

Cooksville Creek - Lakeshore Road to Lake Ontario Evaluation Matrix - Drainage						
Category	**Evaluation Criteria**	**Indicator**	**Alternative 1 - Do Nothing**	**Alternative 2 - Like-for-Like Drainage Replacement**	**Alternative 3 - Partial Drainage Consolidation**	**Alternative 4 - Hybrid Drainage Solution**
Physical and Natural Criteria	Erosion	Rate of erosion, slope failures, and loss of tablelands	**0**	**1**	**2**	**2**
	Water Quality	Impact on water quality	**1**	**2**	**2**	**2**
	Aquatic Habitat	Impact on contributing aquatic habitat	**1**	**2**	**3**	**3**
	Terrestrial Habitat	Impact on connectivity, diversity and quantity/quality of habitat	**4**	**3**	**1**	**2**
	Terrestrial Vegetation	Impact on existing riparian vegetation and mature trees	**4**	**3**	**1**	**2**
	Backyard Drainage	Impact on nuisance flooding on neighbouring properties	**1**	**3**	**4**	**4**
		Criteria Subtotal	***11.00***	***14.00***	***13.00***	***15.00***
		Weighted Score (maximum of 25 points)	***11.46***	***14.58***	***13.54***	***15.63***
Social and Cultural Criteria	Public Safety	Impact on public safety	**1**	**4**	**4**	**4**
	Landowner Impacts	Impacts to adjacent private property	**0**	**4**	**2**	**3**
	Benefit to Community	Enjoyment of surrounding parkland, improvement to shared spaces	**0**	**4**	**4**	**4**
	Aesthetic Value	Impact on existing and proposed aesthetic value	**2**	**3**	**3**	**3**
	Archaeological Impacts	Impact on lands that have archaeological potentials	**4**	**2**	**2**	**2**
		Criteria Subtotal	***7.00***	***17.00***	***15.00***	***16.00***
		Weighted Score (maximum of 25 points)	***13.75***	***21.25***	***18.75***	***20.00***
Technical and Engineering Criteria	Impact on Existing Infrastructure	Protection of infrastructure (bridge, trail, and storm outfalls)	**0**	**3**	**4**	**4**
	Constructability	Easiness to access, move equipment and construct	**4**	**2**	**2**	**2**
	Lifespan of Works	Expected lifespan / years of works before intervention needs to be repeated	**0**	**2**	**3**	**3**
		Criteria Subtotal	***4.00***	***7.00***	***9.00***	***9.00***
		Weighted Score (maximum of 25 points)	***8.33***	***14.58***	***18.75***	***18.75***
Economic Criteria	Capital Costs	One time cost to City	**4**	**3**	**2**	**2**
	Operations & Maintenance Costs	Requirement for regular, irregular or no maintenance activities and ensure effectiveness of implemented measures	**0**	**2**	**3**	**3**
		Criteria Subtotal	***4.00***	***5.00***	***5.00***	***5.00***
		Weighted Score (maximum of 25 points)	***12.50***	***15.63***	***15.63***	***15.63***
Total Score (maximum of 100 points)			**46.04**	**66.04**	**66.67**	**70.00**

4.5 Selection of the Preferred Alternatives

Based on the above alternative evaluation matrix, the highest scoring creek restoration alternative was the **Extended Channel Works Restoration Works**, with a score of **68.13**. The highest scoring drainage improvement alterative was the **Hybrid Drainage Solution**, with a score of **70.00**. As such, these alternatives will be selected as the preferred alternatives, and will be combined into one comprehensive restoration solution for the entire study area.

4.6 Description of the Preferred Alternatives

The preferred channel restoration alternative consists of continuous bank restoration to provide comprehensive erosion protection within the entire study area, through the use of vegetated buttress bank protection treatment with embedded armourstone retaining walls. The bank protection will be built such that there is no encroachment into the existing channel, maintaining the conveyance capacity of the channel.

This hybrid drainage solution consists of a combination of like-for-like replacement and partial consolidation, recognizing the unique conditions and constraints throughout the study area. Drainage swales will be regraded and optimized, and pipes will be upsized where required. Full depth restoration of the berm with engineered materials will be included. Within the downstream portion of the study area within Helen Molasy Park, additional setback of the trail may be explored during the detailed design phase, to increase the buffer distance between the trail network and the creek. An engineering drawing illustrating the preferred alternative is provided in **Figure 4-1** and **Figure 4-2**.

4.7 Inspection and Maintenance Requirements of the Preferred Alternatives

The preferred alternatives will require routine inspection and preventative maintenance, in order to keep the infrastructure functioning as intended. Anticipated inspection and maintenance activities include:

- Annual inspection of new infrastructure, including catchbasins, pipe segments, and headwall structures to ensure all infrastructure is functioning as intended.
- Annual inspection of trail surfaces and safety railings to ensure compliance with City Parks standards. Patchwork repairs to be completed, as required, to optimize infrastructure service life.
- Bi-annual removal of debris and flushing of pipe segments (or after a major storm event exceeding the 5-year return period)

4.8 Property Permission Requirements of the Preferred Alternatives

In order to implement the proposed works, it is anticipated that the following property permissions will be required:

- Access Permissions from CVC's Land Planning Group;
- Permission to Enter Agreement from 894, 884, and 934 Hampton Crescent to facilitate minor swale regrading; and
- Permission to Enter Agreement with 890 Hampton Cresent to relocate existing catchbasin infrastructure onto public property.
-

It is anticipated that landowner consultation and access agreement negotiation will be completed as part of the detailed design process. Any disturbance to private properties will be restored following completion of construction.

4.9 Cost Estimate for the Preferred Alternative

As presented in **Table 4-9,** a preliminary cost estimate was prepared for the implementation of the preferred alternative, including both expected construction as well as engineering design costs. The cost estimate provided below includes a 30% contingency and is exclusive of HST. The provided estimates are based on 2025 costs. It is expected that the construction cost estimate will be further refined throughout the detailed design phase of this project.

Table 4-9: Cost Estimate for the Preferred Alternative

MCEA: Cooksville Creek South of Lakeshore Road					
City of Mississauga					
Item	**Description**	**Quantity**	**Unit**	**Unit Price**	**Extended Price (Excl. HST)**
Preferred Alternative: Extended Channel Restoration Works + Hybrid Drainage Solution					
1	Mobilization and Demobilization	1	LS	$150,000	$150,000
2	Field Office	1	LS	$20,000	$20,000
3	Staging & Access	1	LS	$50,000	$50,000
4	Flow Management System (Dewater, By-pass Pumps, Coffer Dams, etc.)	1	LS	$75,000	$75,000
5	Construction Layout and Utility Locates	1	LS	$25,000	$25,000
6	Excavate, Earthwork, Grading and Disposal of Excess Materials	1	LS	$100,000	$100,000
7	Supply and Installation of Armourstone Wall (including Leveling Materials, Filter Cloth, and Rear Drainage)	1	LS	$1,750,000	$1,750,000
8	Supply and Installation of Vegetated Buttress Toe Protection for Armourstone Wall	1	LS	$1,000,000	$1,000,000
9	Trail Restoration Works	1	LS	$350,000	$350,000
10	Drainage Improvements (including catchbasin & outfall replacements & swale grading)	1	LS	$250,000	$250,000
11	Additional Items (Traffic Control, Fencing, Tree removals, etc.)	1	LS	$75,000	$75,000
12	Engineering Design & Contract Administration	1	LS	$384,500	$384,500
13	Conceptual Stage Contingency ~30%	1	LS	$1,268,850	$1,268,850
Total (Excl of HST)					**$5,498,350**

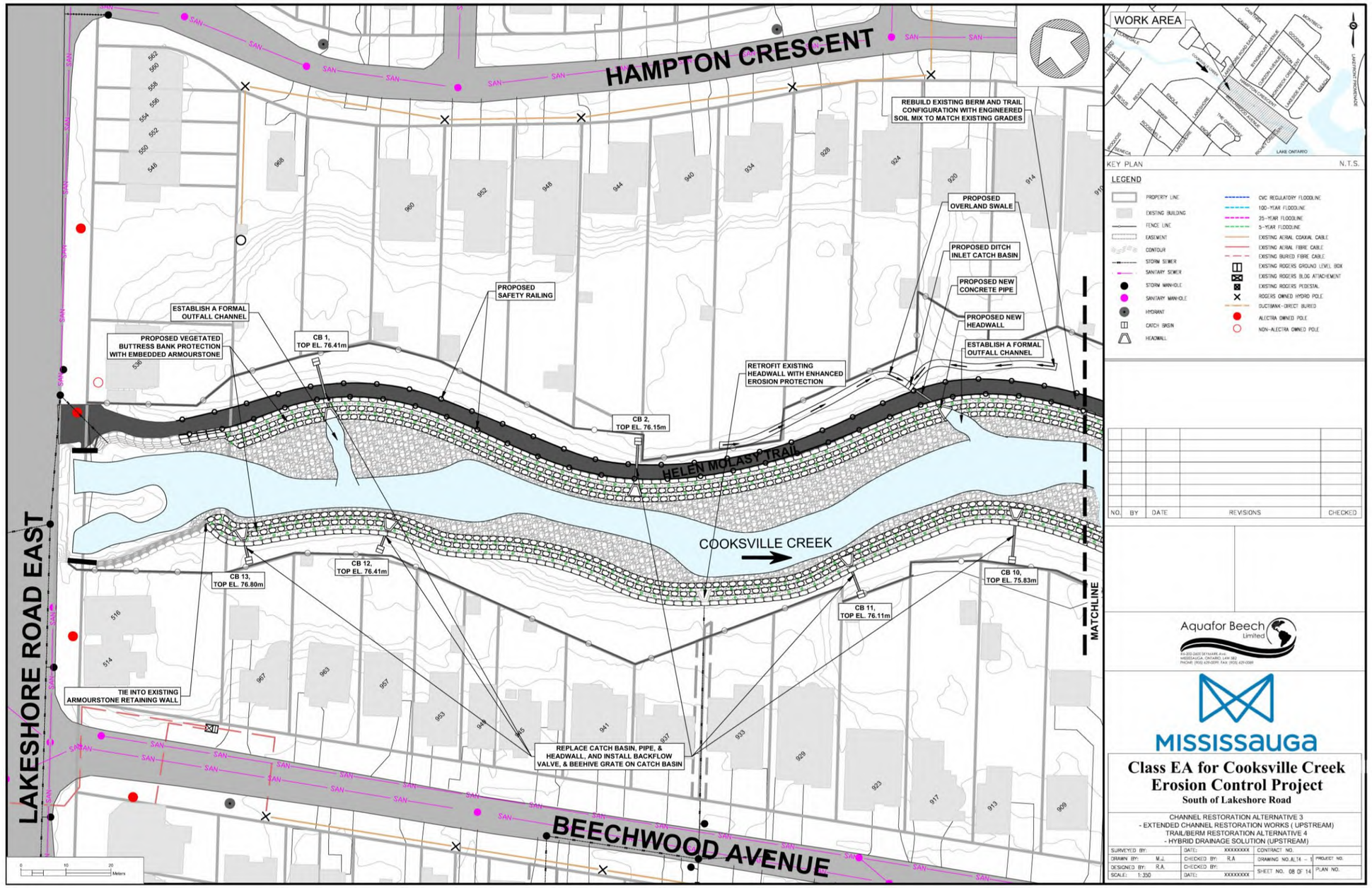


Figure 4-1: Preferred Alternative - Upstream Portion of Study Area

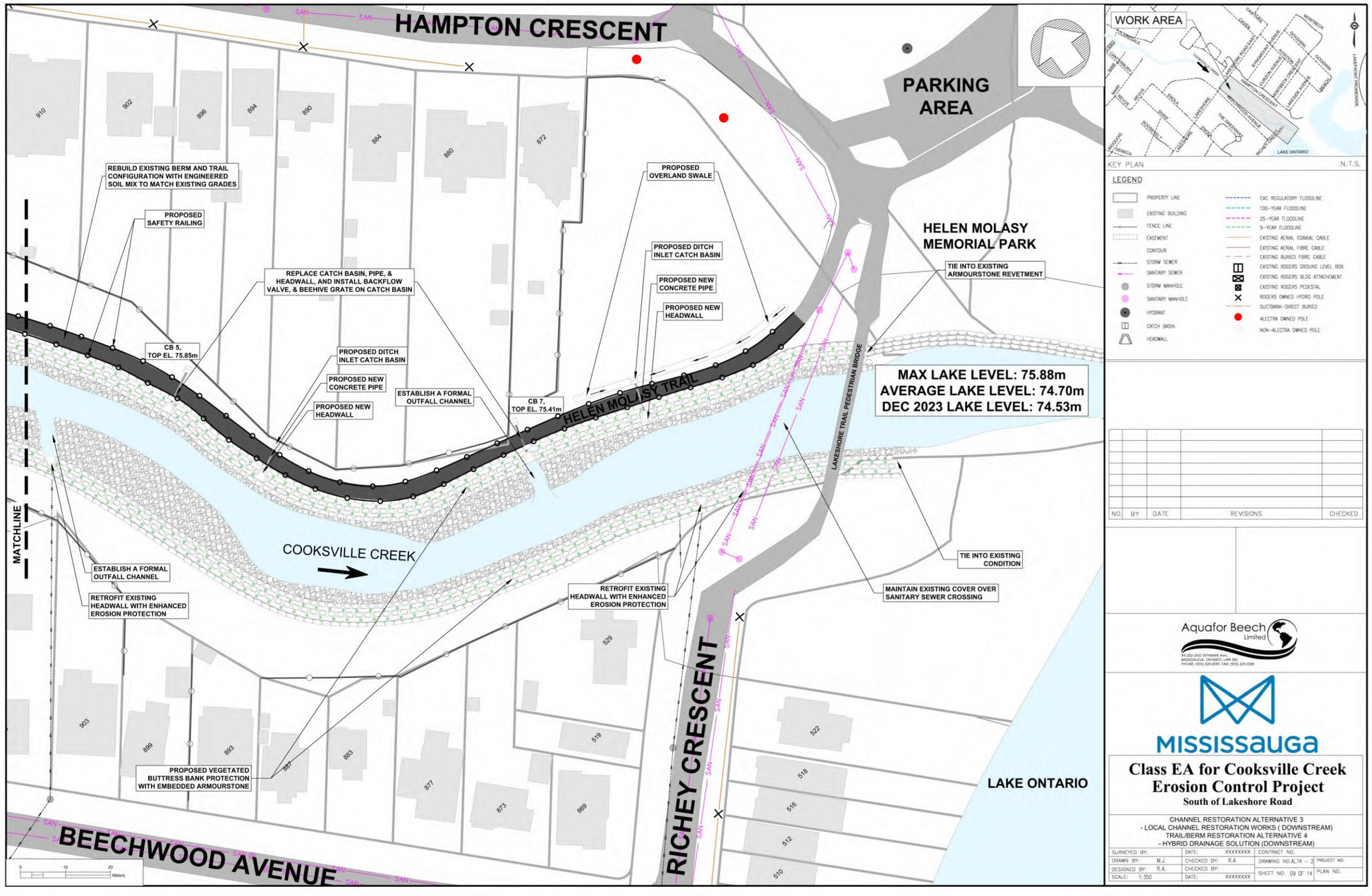


Figure 4-2: Preferred Alternative - Downstream Portion of Study Area

5 PUBIC AND FIRST NATIONS CONSULTATION

5.1 First Nations Consultation

The Ministry of Environment, Conservation and Parks (MECP) identified three First Nations communities with potential interest in the Class EA for Cooksville Creek South of Lakeshore Road, including:

- Huron-Wendat Nation
- Mississaugas of the Credit First Nation
- Six Nations of the Grand River

The following information was provided via email to identified First Nations:

- Notice of Commencement (March 14th, 2024)
- Stage 1 Archaeological Assessment Results (October 15th, 2024)
- Offer for Representation in Stage 2 Archaeological Assessment (October 15th, 2024)
- Notice of Public Information Center and Invitation to Participate (October 22nd, 2024)
- Notice of Completion (February 24th, 2025)

The Huron-Wendat Nation indicated they were interested in providing Field Liaison Representation as part of the Stage 2 Archaeological works, which will be conducted following the completion of the environmental assessment process. The City of Mississauga indicated that they will accommodate this request. No interest was expressed from the other First Nations communities for participation in the project. Copies of all consultation with First Nations, including engagement materials, email correspondence records and communication summary logs are provided in **Appendix H**.

5.2 Public Consultation

All project notifications were circulated to the project stakeholder list, which was refined as required throughout the environmental assessment process. Additionally, project notifications were hand-delivered to the local residents and businesses within the study area, as per the distribution plan. Notice of Study Commencement letters were delivered on February 20th, 2024, to provide background information regarding the study, share a link to the project's website, and provide contact information for the project team. Following the notice of commencement, two local residents indicated interest in being involved in upcoming public consultation, and we added to the stakeholder list to receive project updates.

On October 21st, 2024, a Notice of Public Information Center (PIC) was emailed to stakeholders and delivered in-person to local residents. The PIC took place on October 29th, 2024, at a local community centre nearby the study area (Small Arms Inspection Building). Members from the consulting project team, the City of Mississauga project team, and the Ward 1 councillor were in attendance. All attendees expressed support for the preliminary preferred alternatives of the extended channel restoration works, and the hybrid drainage solution. Although outside of this study's scope of work, attendees were also interested in the maintenance of vegetation along the trail system, and the implementation of stormwater management control within the upstream Cooksville creek watershed. On February 24th, 2025, a Notice of Completion was emailed to stakeholders and delivered in-person to local residents. Copies of all public consultation materials including project notices, PIC presentation materials, feedback forms, and attendance records, and communication summary logs are provided in **Appendix I**.

5.2.1 *Impact of Public Consultation on Selection of Preferred Alternative*

During the public information centre, all attendees expressed support for the preliminary preferred alternatives, which consisted of the extended channel restoration works, and the hybrid drainage solution. As such, these alternatives will be carried forward to the detailed design phase.

5.3 Consultation with Regulatory Authorities

EA Notifications were circulated to all relevant regulatory authorities as defined in the project stakeholder list, including:

- Credit Valley Conservation Authority (CVC)
- Ministry of the Environment, Conservation and Park (MECP)
- Ministry of Citizenship and Multiculturalism (MCM)
- Region of Peel

Notice of Study Commencement letters were emailed to contacts at these groups on February 20th, 2024, informing regulatory authorities of the study and providing contact information for the project team. Following the notice of commencement, the CVC, MECP, and MCM provided initial comments and feedback, including the MCM noting the requirement for a cultural heritage assessment. On July 8th, 2024, the CVC provided comments in response to the initial onsite meeting. A Notice of Public Information Center (PIC) was emailed to stakeholders on October 21st, 2024, which then took place on October 29th, 2024. Notice of Completion was emailed to all regulatory authorities on February 24th, 2025. All regulatory comments were incorporated into the environmental assessment process, and are reflected in the project file report. Copies of all consultation with regulatory authorities are provided in **Appendix J**.

6 POTENTIAL ENVIRONMENTAL EFFECTS AND MITIGATION

6.1 Surface and Groundwater

The entire study area containing Cooksville Creek South of Lakeshore Road East to Lake Ontario is within the Credit Valley Source Protection Area (CVSPA). Information on this source protection area was found using the MECP Source Protection Information Atlas tool.

According to O. Reg. 287/07, there are six (6) different designations of protected areas under the Clean Water Act. As the consultants undertaking this Municipal Class EA, Aquafor is responsible for considering these areas, and the impacts that its recommendations may have on these sensitive zones. There are four (4) different classifications of Source Protection areas that fall within the catchment of the study area.

This specific region of Cooksville Creek is within the Type 2 Intake Protection Zone (IPZ-2) for the Lorne Park Intake. This Intake Protection Zone represents an area near a drinking water intake where a contaminant spill could reach the potable water intake before the plant operator is able to respond. The IPZ-2 area is based on the estimation of the distance a contaminant might move in a two-hour time of travel to the intake.

Water quality is not expected to be adversely impacted by any alternative discussed within this environmental assessment. As part of future detailed design and tender packages Aquafor will create a detailed erosion and sediment control plan for the Contractor which will protect surface water from sediment runoff during construction. No groundwater impacts are anticipated.

6.2 Air Quality, Dust and Noise

Limited local impacts to air quality from the proposed alternatives are expected only during construction activities. Construction impacts are short duration and low intensity, with minimal impact. Considering the geographical location of this specific stretch of Cooksville Creek, there are no expected sensitive receptors within close proximity to the areas of impact. Therefore, active suppression is not necessary for construction activities. All sections of trail along the study area will be closed during construction, maintaining a buffer between park users and noise/dust hazards.

6.3 Contaminated Soils & Excess Materials Management

According to O. Reg. 406/19, consideration must be given to the management of excess construction soil, as well as identifying whether there is any risk of contaminants being in the soil existing in-situ. Review of historical aerial imagery available from the City of Mississauga does not show any additional previous industrial or commercial development on this stretch of the Cooksville Creek. However, soil chemical analysis for any areas of excavation will be completed at both the detailed design and construction stages to characterize the soil quality prior to excavation and inform excess soil management as required.

6.4 Climate Change

There are two parts to assessing climate change as part of the environmental assessment process. First, consideration of the project's effect on climate change via emissions or other environmental impacts. Second, an assessment of the effects of climate change on the project over its lifespan and how those impacts may pose a risk to the environment. The following subsections describe these two climate change considerations.

6.4.1 *Project's Impact on Climate Change*

All alternatives in this environmental assessment will impact the environment in the form of construction emissions. Construction emissions are limited where possible with strategies such as cut/fill balances, which reduce the need for hauling material on and off site.

In the future development of the staging and access plans as part of the detailed design process, existing cleared areas will be utilized where feasible to limit the impacts of clearing vegetation in natural areas. This reduces emissions from clearing equipment, and provides positive benefit from the maintained vegetation's carbon capture and storage abilities. Furthermore, vegetation restoration plans will be completed for each project location. These plans ensure that any affected vegetation is properly replaced, ensuring biodiversity and promotion of a native ecosystem. Due to the nature of the alternatives, no emissions or associated monitoring programs are anticipated post construction.

6.4.2 *Impacts of Climate Change on the Project*

Climate change is expected to increase the intensity and frequency of extreme rainfall events. Particularly in urban areas, this has limited opportunities for infiltration and rainfall is instead directed through storm sewers to local waterways. This results in a rapid and unnatural increase in water levels, flows and hydraulic forces. The potential for more intense and frequent flood events presents risk to the durability and life expectancy of erosion control measures.

To ensure the stability and longevity of the proposed designs, all existing and proposed conditions will be hydraulically modelled during detailed design to quantify the forces endured under different storm events. Designs will be sized and otherwise adjusted to withstand these forces, or will be constructed in such a way that the expected movement of placed bank materials does not impact their effectiveness.

7 DETAILED DESIGN RECOMMENDATIONS

7.1 Detailed Design and Investigations

Upon completion of the environmental assessment, the project will move forward into the detailed design component. The detailed design will include additional technical investigations and inventories, with the primary deliverable to be a design package used for construction. This package will be subject to regulatory review and permitting. A brief overview of the additional inventories and deliverables to be completed in support of the detailed design phase is summarized below.

For each project a detail design package will include the preparation of 60%, 90% and final design drawings for review by the City, CVC and relevant stakeholders. Each detailed design package will include the following components:

- **General plan - Existing Conditions and Removals:** Outlines project extents, property ownership and proposed site removals;
- **General plan - Proposed Conditions:** Delineates the proposed restoration designs including the proposed length of channel rehabilitation works and any proposed erosion control structures. Trail restoration and drainage improvement features will also be defined;
- **Plan and profile drawings:** Defines alterations to the planimetric alignment and longitudinal profile of Cooksville Creek;
- **Cross-Sections:** Outlines proposed changes to the cross-sectional configuration of Cooksville Creek;
- **Site Access and Staging Plan:** Delineates the recommended site access, staging and stockpile areas;
- **Erosion and sediment control plan**: Defines ESC requirements as per the Erosion and Sediment Guidelines for Urban Construction, as well as applicable CVC standards and guidelines. Should also include proposed flow management solutions to establish a dry working condition. Flow management solutions may include such measures as bypass pumping, implementation of a bypass flume or installation of longitudinal coffer dams.
- **Landscape restoration plans:** Includes tree removal, preservation and planting plans. The development of restoration plans should take into account impacts areas associated with different Ecological Land Classifications as well as CVC guidelines;
- **Construction details:** Outlines the construction requirements for key design components; and
- **Associated design brief:** Provides supplementary design information to support the permitting and construction process.

As part of the design process, additional inventories and plans will be required to further inform the design.

7.1.1 *Hydraulic Assessment*

A detailed hydraulic assessment of the proposed conditions for the preferred alternative will need to be undertaken to facilitate permitting with the CVC. The results of the assessment will be included in the project design brief. Computation of peak velocities, shear stresses and stream powers for bank full and peak floods (i.e., 2–100-year events and Regional Storm) shall be included and incorporated into evaluation of the proposed remedial measures. The assessment will be used to confirm that no negative flooding or erosion impacts will result

from the proposed works, a condition of CVC permits, and to size the material for the channel bank restoration works. To facilitate permitting, an existing and proposed conditions model will need to be prepared to allow for a comparison of the proposed designs impacts on water surface elevations as well as channel velocities, shear stresses and stream power values.

7.1.2 *Geotechnical Investigation*

A geotechnical investigation should be undertaken to determine the engineering properties of the existing soils for bank protection works, as well as the restoration of the Helan Molasy trail. The details of the geotechnical investigation are to be determined by a qualified geotechnical engineer in consultation with the stream restoration consultant.

Borehole logs containing appropriate and sufficient data should be prepared. Information from the boreholes is to be used for assessments of slope stability, soil properties for channel design, soil contamination, and any other geotechnical recommendations for engineered structures. Furthermore, soil chemical testing should be undertaken to provide recommendations for the disposal of excess material offsite in accordance with O.Reg. 406/19.

7.1.3 *Erosion Hazard Assessment*

A detailed erosion hazard assessment will be completed as part of the subsequent detailed design process. Acknowledging that the proposed design is planned to improve the erosion hazard limits within the study area, it will be ensured that the proposed design does not negatively impact the erosion hazard at any point within the study area.

7.1.4 *Tree Protection and Arborist Assessment*

Tree protection fences following the specifications in CVC's Landscaping and Tree Protection Guidelines should be erected along all construction access routes and work areas. If possible, it is also recommended that planting areas be fenced off for two years to protect newly planted vegetation and to allow time for growth and to anchor soils. Some mature trees will need to be removed to accommodate construction. To compensate, native trees and shrubs that fit the existing vegetation communities will be included within the restoration plan of the detailed design drawings. CVC's Ecosystem Offsetting Guideline, Buffer Enhancement Guideline, Plant Selection Guideline and Healthy Soils Guideline for the Natural Heritage System will be reviewed when developing the plan. To ensure that all these requirements are adhered to, it is recommended that an arborist be involved in the design process, and a standalone arborist report be prepared and submitted to the City of Mississauga and CVC.

7.1.5 *Utilities Confirmation*

Further SUE investigations will be required to confirm the impact of each proposed restoration design on the utilities and underground services within the proposed restoration areas. The utilities may include, but are not limited to, electricity, natural gas, cable television, telephone, water, sanitary sewer, and storm sewer.

SUE investigations should be completed in sufficient detail to identify all above ground and buried infrastructure within each project site. Prior to the start of construction, utility protection measures will need to be confirmed with each corresponding utility authority.

7.1.6 *General Mitigation Measures*

7.1.6.1 Erosion and Sediment Control

Erosion and sedimentation control techniques are necessary precautions to minimize sediment entry into surrounding creeks and/or storm sewer pipes. Installation of construction fencing and erosion & control silt fence are required well in advance of construction activities. Construction fencing and access routes shall be clearly delineated and appropriate setbacks maintained from private property for the duration of construction works. Sediment and erosion control measures should remain in place until vegetation has become established.

Sediment and erosion control measures should also act as wildlife exclusion fencing to prevent small mammals and herpetofauna from entering disturbance areas.

Public lands should be restored with woody vegetation as a part of bank stabilization efforts.

Potential sources for sedimentation related to construction activities include sediments disturbed and deposited by construction vehicles and blowing sand and dust. The following mitigating measures are proposed:

- Place sediment traps to receive storm runoff during construction;
- Provide tire washing facilities for construction vehicles that exit the site;
- Install silt fencing along the perimeters of the work sites where appropriate to prevent migration of sediment-laden storm runoff;
- Cover exposed excavated material to prevent erosion by rain and wind; and
- Water or other dust suppressants to be employed to control release of dust particles

An erosion and sediment control plan will be prepared and the selection of appropriate measures will be addressed during the detailed design stage. The erosion and sediment controls indicated are the minimum that are required. It is necessary to ensure that all erosion and sediment control measures are functional prior to and throughout the duration of construction.

7.1.6.2 Fuel Spills

Fuel spills may occur during the onsite refueling of construction equipment, and may potentially contaminate surface and groundwater as well as soils. Recommended mitigation measures include the following:

- Refueling in designated areas outside of the NHS;
- Spill containment for on-site storage tanks; and
- Develop and Implement as needed a spill clean-up contingency plan.

7.1.6.3 Environment Disturbance

During the detailed design phase, every reasonable effort shall be undertaken to limit disturbance to the natural environment, including the following:

- Reduction of the disturbance limits and tree removals to only the strictly required areas
- Strategical selection of access and staging/storage locations, using previously disturbed areas will low ecological value wherever possible

7.1.7 *Adherence to CVC Guidelines*

During the detailed design phase, adherence to CVC's technical guidelines is required, including, but not limited to the following guidelines:

- CVC's Technical Guidelines for Flood Hazard Mapping

- CVC's Ecosystem Offsetting Guidelines
- CVC's Plant Selection Guidelines
- CVC's Guidelines for Designing Enhancement Plans within Setbacks and Buffers
- CVC's Healthy Soil Guidelines

7.1.8 *Construction Services*

All tender documentation will be completed applicable to the City or CVC standards, with Special Provisions and Schedule of Quantities with refined engineering cost estimates provided. The package will include Project Descriptions, Special Provisions, Specifications, Form of Tender and a Schedule of Prices. The final detailed design drawings will be issued as a set of contract drawings with the completed tender package. The contract drawings will be stamped by a professional engineer, signed, and labeled "Issued for Tender" complete with all necessary material and performance specifications. The consulting engineer will typically assist the City during the tendering and procurement period as required, providing responses and clarification to bidders during the procurement process.

Inspection and administration services during construction under the guidance of a professional engineer (or geomorphologist) who has been integrated in the design and is well versed in similar construction projects is required. Tasks undertaken as part of the supervision role will include:

- Attend regular (bi-weekly) progress meetings, including pre-construction meeting, prepare and distribute meeting minutes within 5 days of the meeting;
- Respond to inquiries and request for information from external agencies, public stakeholders;
- Preparation of progress payment certificates and recording material quantities as they arrive to site;
- Overseeing the day-to-day construction and providing interpretation of the drawings;
- Ensuring that contractor's methodology complies with requirements of design;
- Monitor the traffic control measures to ensure they are consistent with traffic control plans;
- Inspect all layout and construction work to ensure compliance with the contract specifications and drawings;
- Provide advice to the contractor regarding the interpretation of the contract drawings and specifications and the preparation of supplemental details, instruction and clarifications as required;
- Notify the contractor of any deficiencies in the construction of the work, instructing the contractor to take appropriate corrective measures, confirm and report results of the corrective measures during construction. The deficiency list will be maintained and coordination of rectification throughout the 2-year maintenance period;
- Review, monitor and ensure compliance with contractor environmental conditions (i.e., Erosion and Sediment Control Plan).
- Preparation and issuance of substantial Performance certificate and recommendations; and
- Undertake a complete and thorough inspection of the contractor's work and prepare a report which lists all outstanding deficiencies at the end of the warranty period and coordinate and ensure that contractor corrects all warranty deficiencies expeditiously and to the satisfaction of the City.

7.2 Monitoring Program

A 2-year annual monitoring plan is recommended following completion of construction, which will include Warranty Period engineering review, as well as assessment of the efficacy of restoration plantings. The program should include time for inspection of both the channel works and vegetation plantings by the project geomorphologist/engineer, as well as the project ecologist. Both the monitoring and warranty will be defined to suit the detailed design, and satisfy City, CVC and other agency requirements.

7.3 As-Constructed Drawings and Analysis

This task will set baseline conditions following construction, which will enable future monitoring and comparative analysis. Specifically, an as-built survey of completed channel works (plan, profile, and cross sections) to verify implementation of design within reasonable tolerances should be undertaken. As-constructed drawings, together with a report summarizing pre- and post-construction conditions should be provided. The report should comment on significant deficiencies found with recommendations for correction or adaptive management as required.

8 CONCLUSION

In summary, a Municipal Class Environmental Assessment was conducted for the Cooksville Creek natural corridor between Lakeshore Road East and Lake Ontario. The objective of the Municipal Class Environmental Assessment study was to develop and evaluate restoration alternatives within the study area, to mitigate existing erosion and drainage problems within the creek corridor. This includes restoration of the watercourse bed and banks, the Helen Molasy Trail and berm along the eastern bank of the creek, and the rehabilitation of the associated drainage structures. Additional objectives of the Cooksville Creek South of Lakeshore Road Study included:

- Maintaining or improving the hydraulic capacity of the creek,
- Providing naturalized erosion protection solutions,
- Protecting existing City owned infrastructure,
- Enhancing the aquatic and terrestrial environment wherever possible,
- Minimizing impacts to the natural environment during construction,
- Minimizing future operational and maintenance activities, and
- Improving trail safety conditions to users.

Restoration alternatives for the watercourse, trail and informal berm were developed based on a series of existing conditions inventories and technical studies. These alternatives were evaluated based on a variety of criteria including social, economic, environmental, and technical considerations, to determine the preliminary preferred alternatives. This evaluation process was further refined through first nations engagement, public consultation and discussions with regulatory agencies including Credit Valley Conservation.

The preferred alternatives recommended to be carried forward to detailed design included the extended channel restoration works for the watercourse component, and the hybrid drainage alternative for the drainage improvement / trail restoration component.

The extended channel restoration works alternative consists of continuous bank restoration to provide comprehensive erosion protection within the entire study area, through the use of vegetated buttress bank protection treatment with embedded armourstone retaining walls. The hybrid drainage alternative would consist of a combination of like-for-like replacement and partial consolidation, recognizing the unique conditions and constraints throughout the study area. Drainage swales will be regraded and optimized, and pipes will be upsized where required. Full depth restoration of the berm with engineered materials will be included as part of this alternative.

As part of the environmental assessment process, the public and first nations groups were consulted. A public information centre was conducted, with all attendees generally supportive of the preliminary preferred alternatives. As such, these preferred alternatives will be carried forward to the detailed design phase, construction, and post-construction monitoring.

9 SIGNATURES

This report was completed with input from the following consulting staff:

Robert Amos – Project Manager
Jacob Ursulak – Water Resources Analyst
Chad Cota – Water Resources Analyst
David Kynaston – Fluvial Geomorphologist
Tanisha Sharma – Fluvial Specialist
Julie Scott – Terrestrial Ecologist
Kristen Beauchamp - Arborist
Graham Eby – Aquatic Biologist
Eilish Neilly – Junior Aquatic Biologist
Javad Khalilian – CAD Technician
Sarah MacKinnon - Archaeologist

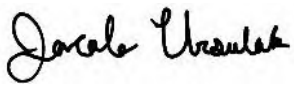
Should you have any questions please contact the undersigned at 416-705-2367.

Yours truly,

AQUAFOR BEECH LIMITED



Robert Amos, MASc., P.Eng
Aquafor Beech Limited



Jacob Ursulak, MASc., E.I.T
Aquafor Beech Limited



Chad Cota, BASc.
Aquafor Beech Limited

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Appendix A – Vascular Plant List

Scientific Name	Common Name	CC	CW	COSEWIC	SARA Status	ESA Status	G-Rank	S-Rank	Exotic Status	Regional Status *Regional Municipality of Peel*	Regional Status *City of Mississauga*	Native/Introduced
Acer negundo	Manitoba Maple	0	0				G5	S5				native
Acer platanoides	Norway Maple		5				GNR	SNA	SE5			introduced
Acer rubrum	Red Maple	4	0				G5	S5				native
Acer saccharinum	Silver Maple	5	-3				G5	S5				native
Acer saccharum	Sugar Maple	4	3				G5	S5				native
Aegopodium podagraria	Goutweed		0				GNR	SNA	SE5		1	introduced
Aesculus hippocastanum	Horse Chestnut		5				GNR	SNA	SE2			introduced
Ailanthus altissima	Tree-of-heaven		5				GNR	SNA	SE5		2	introduced
Alliaria petiolata	Garlic Mustard		0				GNR	SNA	SE5			introduced
Anemonastrum canadense	Canada Anemone	3	-3				G5	S5				native
Arctium minus	Common Burdock		3				GNR	SNA	SE5			introduced
Berberis thunbergii	Japanese Barberry		3				GNR	SNA	SE5			introduced
Bromus inermis	Smooth Brome		5				G5T5	SNA	SE5			introduced
Catalpa speciosa	Northern Catalpa		3				G4?	SNA	SE1		2	introduced
Circaea canadensis	Broad-leaved Enchanter's Nightshade	2	3				G5	S5				native
Cirsium arvense	Canada Thistle		3				G5	SNA	SE5			introduced
Cornus racemosa	Grey Dogwood	2	0				G5	S5				native
Cornus sericea	Red-osier Dogwood	2	-3				G5	S5				native
Dactylis glomerata	Orchard Grass		3				GNR	SNA	SE5			introduced
Daucus carota	Wild Carrot		5				GNR	SNA	SE5			introduced
Elaeagnus angustifolia	Russian Olive		3				GNR	SNA	SE3			introduced
Elymus virginicus	Virginia Wildrye	5	-3				G5	S5				native
Fraxinus americana	White Ash	4	3				G4	S4				native
Fraxinus excelsior	European Ash		3				GNR	SNA	SE2		1	introduced
Fraxinus pennsylvanica	Red Ash	3	-3				G4	S4				native
Galium asprellum	Rough Bedstraw	6	-5				G5	S5		U		native
Geranium robertianum	Herb-Robert	2	3				G5	S5				native
Geum aleppicum	Yellow Avens	2	0				G5	S5				native
Glechoma hederacea	Ground-ivy		3				GNR	SNA	SE5			introduced
Hamamelis virginiana	American Witch-hazel	6	3				G5	S4S5				native
Heracleum maximum	American Cow Parsnip	3	-3				G5	S5		R4		native
Hesperis matronalis	Dame's Rocket		3				G4G5	SNA	SE5			introduced
Hibiscus syriacus	Rose-of-sharon											
Impatiens glandulifera	Purple Jewelweed		-3				GNR	SNA	SE4			introduced
Juglans nigra	Black Walnut	5	3				G5	S4?				native
Leonurus cardiaca	Common Motherwort		5				GNR	SNA	SE5			introduced
Lonicera tatarica	Tatarian Honeysuckle		3				GNR	SNA	SE5			introduced
Lythrum salicaria	Purple Loosestrife		-5				G5	SNA	SE5			introduced
Matteuccia struthiopteris	Ostrich Fern	5	0				G5	S5				native
Melilotus albus	White Sweet-clover		3				G5	SNA	SE5			introduced
Morus alba	White Mulberry		0				GNR	SNA	SE5			introduced

Scientific Name	Common Name	CC	CW	COSEWIC	SARA Status	ESA Status	G-Rank	S-Rank	Exotic Status	Regional Status *Regional Municipality of Peel*	Regional Status *City of Mississauga*	Native/Introduced
Myosotis sylvatica	Woodland Forget-me-not		5				G5	SNA	SE4		2	introduced
Parthenocissus vitacea	Thicket Creeper	4	3				G5	S5				native
Persicaria maculosa	Spotted Lady's-thumb		-3				G3G5	SNA	SE5			introduced
Phalaris arundinacea	Reed Canarygrass	0	-3				G5	S5				native
Picea abies	Norway Spruce		5				G5	SNA	SE3			introduced
Pilosella caespitosa	Meadow Hawkweed		5				GNR	SNA	SE5			introduced
Pinus resinosa	Red Pine	8	3				G5	S5		R1		native
Pinus strobus	Eastern White Pine	4	3				G5	S5				native
Plantago major	Common Plantain		3				G5	SNA	SE5			introduced
Poa pratensis ssp. pratensis	Kentucky Bluegrass		3				G5T5	SNA	SE5			introduced
Populus deltoides	Eastern Cottonwood	4	0				G5	S5				native
Prunus virginiana	Chokecherry	2	3				G5	S5				native
Quercus macrocarpa	Bur Oak	5	3				G5	S5				native
Quercus rubra	Northern Red Oak	6	3				G5	S5				native
Ranunculus acris	Common Buttercup		0				G5	SNA	SE5			introduced
Ranunculus repens	Creeping Buttercup		0				GNR	SNA	SE5		2	introduced
Reynoutria japonica	Japanese Knotweed		3				GNR	SNA	SE5			introduced
Rhamnus cathartica	European Buckthorn		0				GNR	SNA	SE5			introduced
Rhus typhina	Staghorn Sumac	1	3				G5	S5				native
Ribes americanum	American Black Currant	4	-3				G5	S5				native
Rosa multiflora	Multiflora Rose		3				GNR	SNA	SE5			introduced
Rubus idaeus	Red Raspberry	2	3				G5	S5				native
Rubus occidentalis	Black Raspberry	2	5				G5	S5				native
Salix discolor	Pussy Willow	3	-3				G5	S5				native
Salix eriocephala	Cottony Willow	4	-3				G5	S5				native
Salix interior	Sandbar Willow	1	-3				G5	S5		R5	2	native
Salix matsudana	Corkscrew Willow						GNR	SNA	SE1			introduced
Salix x fragilis	(Salix alba X Salix euxina)						GNA	SNA				introduced
Sambucus racemosa	Red Elderberry	5	3				G5	S5				native
Securigera varia	Purple Crown-vetch		5				GNR	SNA	SE5			introduced
Solanum dulcamara	Bittersweet Nightshade		0				GNR	SNA	SE5			introduced
Solidago canadensis var. canadensis	Canada Goldenrod	1	3				G5T5	S5				native
Solidago juncea	Early Goldenrod	3	5				G5	S5		U		native
Symphyotrichum cordifolium	Heart-leaved Aster	5	5				G5	S5				native
Symphyotrichum lanceolatum	Panicled Aster	3	-3				G5	S5				native
Symphyotrichum novae-angliae	New England Aster	2	-3				G5	S5				native
Syringa reticulata	Japanese Tree Lilac						GNR	SNA	SE1			introduced
Syringa vulgaris	Common Lilac		5				GNR	SNA	SE5			introduced
Taraxacum officinale	Common Dandelion		3				G5	SNA	SE5			introduced
Thuja occidentalis	Eastern White Cedar	4	-3				G5	S5				native
Tilia americana	Basswood	4	3				G5	S5				native
Tilia cordata	Little-leaved Linden		5				GNR	SNA	SE1			introduced

Scientific Name	Common Name	CC	CW	COSEWIC	SARA Status	ESA Status	G-Rank	S-Rank	Exotic Status	Regional Status *Regional Municipality of Peel*	Regional Status *City of Mississauga*	Native/Introduced
Torilis japonica	Erect Hedge-parsley		3				GNR	SNA	SE4		1	introduced
Ulmus americana	White Elm	3	-3				G4	S5				native
Ulmus pumila	Siberian Elm		3				GNR	SNA	SE3			introduced
Urtica dioica ssp. dioica	European Stinging Nettle		0				G5T5?	SNA	SE2			introduced
Vinca minor	Lesser Periwinkle		5				GNR	SNA	SE5			introduced
Vincetoxicum rossicum	European Swallowwort		5				GNR	SNA	SE5		2	introduced
Vitis riparia	Riverbank Grape	0	0				G5	S5				native
Xanthium strumarium	Rough Cockleburr	2	0				G5	S5				native
Geum sp.	Avens											
Hemerocallis sp.	Daylilies											
Hosta sp.	Plantain lilies											
Rosa sp.	Roses											
Sorbus sp.	Mountain-ashes											
Viburnum sp.	Arrowwoods											

LEGEND

Scientific Name and Common Name (NHIC, 2020)

Based on NHIC's species list for Ontario downloaded on May 29, 2019.

COSEWIC (NHIC, 2020)

Federal Rarity List (does not provide protection under any Act)

EXT Extinct - A species that no longer exists.

EXP Extirpated - A species no longer existing in the wild in Canada, but occurring elsewhere.

END Endangered - A species facing imminent extirpation or extinction.

THR Threatened - A species likely to become endangered if limiting factors are not reversed.

SC Special Concern (formerly vulnerable) - A species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.

NAR Not At Risk - A species that has been evaluated and found to be not at risk of extinction given the current circumstances.

DD Data Deficient (formerly Indeterminate) - Available information is insufficient to resolve a species' eligibility for assessment or to permit an assessment of the species' risk of extinction.

Species on Schedule 1 of Species At Risk Act (SARA) (NHIC, 2020)

Federal Rarity List

EXP Extirpated - a species that no longer exists in the wild in Canada, but exists elsewhere in the wild.

END Endangered - a species that is facing imminent extirpation or extinction.

THR Threatened - a species that is likely to become an endangered species if nothing is done to reverse the factors leading to its extirpation or extinction.

SC Species of Special Concern - a species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.

S-Ranks (NHIC, 2020)

Provincial Rarity List (does not provide protection under any Act)

S1 Critically Imperiled—Critically imperiled in the nation or state/province because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state/province.

S2 Imperiled—Imperiled in the nation or state/province because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or state/province.

S3 Vulnerable—Vulnerable in the nation or state/province due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.

S4 Apparently Secure—Uncommon but not rare; some cause for long-term concern due to declines or other factors.

S5 Secure—Common, widespread, and abundant in the nation or state/province.

S#S# Range Rank —A numeric range rank (e.g., S2S3) is used to indicate any range of uncertainty about the status of the species or community. Ranges cannot skip more than one rank (e.g., SU is used rather than S1S4).

SX Apparently extirpated from Ontario, with little likelihood of rediscovery. Typically not seen in the province for many decades, despite searches at known historic sites.

SE Exotic; not believed to be a native component of Ontario's flora.

Species At Risk Ontario (SARO) (NHIC, 2020)

Provincial Rarity List (Species protected under ESA 2007 and listed in O reg. 230/08)

EXP Extirpated - A species no longer existing in the wild in Canada, but occurring elsewhere.

END Endangered - A species facing imminent extirpation or extinction.

THR Threatened - A species likely to become endangered if limiting factors are not reversed.

SC Special Concern - A species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.

Exotic Status (NHIC, 2020)

If an element is known to occur as an exotic in Ontario, the status value assigned to the element is SE. A ? qualifier added to that value indicates uncertainty about whether it is exotic or native. Numeric ranks of 1 through 5 added to the exotic status indicate the element's abundance in Ontario, with 1 indicating the least abundance and 5 the most.

Coefficient of Conservatism and Coefficient of Wetness (NHIC, 2020)

CC = Coefficient of Conservatism. Rank of 0 to 10 based on plants degree of fidelity to a range of synecological parameters: (0-3) Taxa found in a variety of plant communities; (4-6) Taxa typically associated with a specific plant community but tolerate moderate disturbance; (7-8) Taxa associated with a plant community in an advanced successional stage that has undergone minor disturbance; (9-10) Taxa with a high fidelity to a narrow range of synecological parameters.

CW = Coefficient of Wetness. -Value between 5 and –5. A value of –5 is assigned to Obligate Wetland (OBL) and 5 to Obligate Upland (UPL), with intermediate values assigned to the remaining categories (Oldham et al., 1995).

Regional Rarity

Regional Municipality of Peel (Varga et al. 2005)

+ introduced; X+ native species that is introduced in that municipality; (+) possibly introduced species or a native species that is introduced in some municipalities; X common native species or an introduced species that is present; R rare native species; E extirpated native species that has not been refound at its known locations or its habitat is gone; SR species record based on a sight record; LR species record based on a literature record; U uncommon native species; R# number of stations for a rare native species; H historical species not seen since 1950, however its habitat is still present; Pr provincially rare species (S1 to S3 species, with 100 or less occurrence in the province (Oldham,1999)); Ps provincial species of special concern; Pe provincially endangered species; Pt provincially threatened species.

City of Mississauga (2002)

0 = extirpated within the City; 1= 1 to 3 locations within the City, these species are considered to be regionally significant; 2= 4 to 10 locations within the City, these species are considered to be regionally significant; 3 = 11 to 39 locations within the City; 4 = >40 locations within the City

Native Status

VASCAN database (Brouillet et al. 2010)

Native = Native to Ontario
Introduced = Introduced to Ontario

Regional Status

Regional Municipality of Halton – *Varga et al. 2005 Legend:*

+ introduced;
X+ native species that is introduced in that municipality;
(+) possibly introduced species or a native species that is introduced in some municipalities;
X common native species or an introduced species that is present;
R rare native species;
E extirpated native species that has not been refound at its known locations or its habitat is gone;
SR species record based on a sight record;
LR species record based on a literature record;
U uncommon native species;
R# number of stations for a rare native species;
H historical species not seen since 1950, however its habitat is still present;
Pr provincially rare species (S1 to S3 species, with 100 or less occurrence in the province (Oldham,1999));
Ps provincial species of special concern; Pe provincially endangered species; Pt provincially threatened species.

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Appendix B – Tree Inventory Details

Tag #	Scientific Name	Common Name	Diameter at Breast Height (DBH) (cm)	Aggregate DBH (cm)	Dripline Radius (m)	Biological Condition	Structure and Form	Natural Heritage Considerations	Preservation Priority	Defects and Decline Indicators/Notes	Tree Protection Zone (TPZ)
1001	*Salix x fragilis*	Crack Willow	35, 33.5, 33, 32, 32	74.1	3.5	F-G	F-G	Non-native invasive	High	Prolific epicormics, buried crotch, included bark	
1002	*Acer negundo*	Manitoba Maple	10	10.0	1.5	P-F	P-F	Native	Low	Severe adjacent lean over creek, rotten branch scar	0.60
1003	*Tilia americana*	Basswood	12	12.0	1.0	P-F	P-F	Native	Low	Severe damage to base, leaning on another tree, epicormics	0.72
1004	*Acer negundo*	Manitoba Maple	11, 8.5	13.9	1.0	P	P-F	Native	Low	Several old rotten branch scars, leaning toward creek, dieback	0.83
1005	*Acer negundo*	Manitoba Maple	15	15.0	1.5	F-G	F	Native	Low	Bendy stem, leaning away from lake	0.90
1006	*Ulmus pumila*	Siberian Elm	23, 23	32.5	2.0	F	F	Non-native invasive	Low	Buried crotch, minimal epicormics, vines, dieback	1.95
1007	*Salix x fragilis*	Crack Willow	57	57.0	3.0	F-G	F-G	Non-native invasive	High	Burls on trunk and branches	
1008	*Ulmus pumila*	Siberian Elm	19	19.0	1.0	F-G	F-G	Non-native invasive	Low	Slight lean	1.14
1009	*Juglans nigra*	Black Walnut	10	10.0	0.5	F-G	F-G	Native	Low	Damage to trunk that's healed	0.60
1010	*Tilia americana*	Basswood	10.5, 3	10.9	0.5	G	G	Native	Low	Vines	0.66
1011	*Juglans nigra*	Black Walnut	10	10.0	1.5	G	G	Native	Low		0.60
1012	*Ulmus pumila*	Siberian Elm	12, 11	16.3	0.5	F-G	F-G	Non-native invasive	Low	Old healed sun split, leaning toward lake, included bark	0.98
1013	*Acer rubrum*	Red Maple	20.5, 19, 16, 16, 16, 14, 8.5	42.6	2.5	F-G	F-G	Native	High	Beaver chew on one leader, buried crotch, poor form, ash growing in middle of it (dead)	
1014	*Salix x fragilis*	Crack Willow	25	25.0	2.5	F-G	F-G	Non-native invasive	Low	Leaning toward creek, minor dieback	1.50
1015	*Fraxinus sp.*	Ash species	10	10.0	0.5	F	F		Low	Vine infestation, signs of Emerald Ash Borer, cracked bark, lean toward lake	0.60
1016	*Ulmus pumila*	Siberian Elm	10.5	10.5	0.5	F-G	F-G	Non-native invasive	Low	Some dead branches	0.63
1017	*Ulmus pumila*	Siberian Elm	26	26.0	2.0	F	F	Non-native invasive	Low	Second dead broken leader	1.56
1018	*Salix x fragilis*	Crack Willow	38, 36	52.3	4.0	F-G	F-G	Non-native invasive	High	Dead branch leaning on tree, vines in canopy, low crotch with included bark	
1019	*Acer negundo*	Manitoba Maple	13	13.0	1.0	F	F	Native	Low	Dieback	0.78
1020	*Acer negundo*	Manitoba Maple	14.5	14.5	1.5	F-G	F	Native	Low	Lean toward creek	0.87
1021	*Salix x fragilis*	Crack Willow	12.5	12.5	1.0	G	F-G	Non-native invasive	Low	Lean toward creek	0.75
1022	*Ulmus pumila*	Siberian Elm	24	24.0	2.0	F-G	F-G	Non-native invasive	Low	Slightly lopsided, minor dead lower branches	1.44
1023	*Acer platanoides*	Norway Maple	35, 34.5	49.1	4.5	G	F	Non-native invasive	Moderate	Low crotch with included bark, minor dead branches, weak crotch	
1024	*Populus deltoides*	Eastern Cottonwood	56	56.0	2.5	G	G	Native	High	Exposed roots	
1025	*Populus deltoides*	Eastern Cottonwood	65	65.0	2.5	G	G	Native	High		

Tag #	Scientific Name	Common Name	Diameter at Breast Height (DBH) (cm)	Aggregate DBH (cm)	Dripline Radius (m)	Biological Condition	Structure and Form	Natural Heritage Considerations	Preservation Priority	Defects and Decline Indicators/Notes	Tree Protection Zone (TPZ)
1026	*Salix x fragilis*	Crack Willow	43.5	43.5	1.0	F-G	F	Non-native invasive	Moderate	Leaning toward creek	
1027	*Juglans nigra*	Black Walnut	30.5	30.5	2.0	F-G	F-G	Native	High	Growing in rocks	1.83
1028	*Acer saccharinum*	Silver Maple	21, 3	21.2	1.0	F	F	Native	Moderate	Growing in gabion baskets, beaver chew, one leader broken, leaning away from creek	1.27
1029	*Acer saccharinum*	Silver Maple	18.5	18.5	0.5	F	F	Native	Low	Old leader scar at base, growing in gabion baskets	1.11
1030	*Acer saccharinum*	Silver Maple	25, 16, 13, 5	32.8	2.5	F-G	F	Native, **SAR Bat**	High	Growing in gabion baskets, old leader scar, damage to lower trunk	1.97
1031	*Acer saccharinum*	Silver Maple	27, 25	36.8	3.0	F-G	F-G	Native, **SAR Bat**	High	Included bark, leaning away from creek	2.21
1032	*Juglans nigra*	Black Walnut	12	12.0	0.50	F	F	Native	Low	Growing in gabion baskets, leaning toward creek	0.72
1033	*Acer saccharinum*	Silver Maple	19.5, 16	25.2	2.0	F	F	Native	Moderate	Dieback, leaning toward creek, included bark	1.51
1034	*Acer saccharinum*	Silver Maple	12	12.0	1.5	F	F	Native	Low	Severe lean over creek, cracking bark	0.72
1035	*Acer saccharinum*	Silver Maple	14	14.0	0.5	P-F	F	Native	Low	Growing in gabion baskets, vines, dieback	0.84
1036	*Acer saccharinum*	Silver Maple	17	17.0	1.5	F	F	Native	Low	Growing in gabion baskets, included bark, vines, leaning over creek	1.02
1037	*Acer saccharinum*	Silver Maple	21, 12,	24.2	1.5	F-G	F-G	Native	Moderate	Growing in gabion baskets, included bark	1.45
1038	*Pinus resinosa*	Red Pine	39, 10	40.3	2.5	G	F-G	Native	High	Included bark	
1039	*Acer saccharinum*	Silver Maple	39	39.0	3.0	G	F-G	Native, **SAR Bat**	High	Exposed roots with pedestrian damage, slight lean toward creek	
1040	*Picea abies*	Norway Spruce	30.5	30.5	2.0	P	F	Non-native invasive	Low	Severe dieback	1.83
1041	*Acer saccharinum*	Silver Maple	39	39.0	3.0	G	G	Native, **SAR Bat**	High		
1042	*Acer saccharinum*	Silver Maple	66.5	66.5	3.5	F-G	F	Native, **SAR Bat**	High	Severe lean toward creek, exposed roots	
1043	*Acer saccharinum*	Silver Maple	71, 25	75.3	3.5	F-G	F	Native, **SAR Bat**	High	Burls growing on it, BAT - cavities in branches, canker	
1044	*Acer negundo*	Manitoba Maple	17.5	17.5	0.5	F	F	Native	Low	Leaning toward lake, open sun split, epicormics	1.05
1045	*Acer saccharinum*	Silver Maple	32.5	32.5	3.0	G	F	Native, **SAR Bat**	High	Leaning toward lake	1.95
1046	*Acer saccharinum*	Silver Maple	19.5	19.5	1.5	P	P	Native	Low	Leaning toward lake, minor epicormics, dieback	1.17
1047	*Acer saccharum*	Sugar Maple	83.5	83.5	5.0	F-G	F-G	Native, **SAR Bat**	High	Exposed roots, old pruning, included bark	
1048	*Acer saccharum*	Sugar Maple	52	52.0	5.0	G	G	Native, **SAR Bat**	High	BAT - knothole cavity and squirrel nest	
1049	*Salix x fragilis*	Crack Willow	41.5, 39, 36, 35, 29.5, 17, 15.5	84.6	5.0	F-G	F-G	Non-native invasive	High	Epicormics, poor form, spreading crotch, old cut leaders	
1050	*Picea abies*	Norway Spruce	47	47.0	2.5	G	G	Non-native	High	Lower branch pruning, engulfed with some wire (girdling wire)	
1051	*Picea abies*	Norway Spruce	53.5	53.5	3.0	G	G	Non-native	High	Lower branch pruning	
1052	*Ulmus pumila*	Siberian Elm	30, 28	41.0	3.0	F-G	F-G	Non-native invasive	Moderate	Included bark, minor dead branches	

Tag #	Scientific Name	Common Name	Diameter at Breast Height (DBH) (cm)	Aggregate DBH (cm)	Dripline Radius (m)	Biological Condition	Structure and Form	Natural Heritage Considerations	Preservation Priority	Defects and Decline Indicators/Notes	Tree Protection Zone (TPZ)
1053	*Acer negundo*	Manitoba Maple	22, 21, 13, 13, 10	36.9	3.0	F-G	F-G	Native	High	One branch growing horizontal	2.22
1054	*Acer saccharinum*	Silver Maple	33.5, 33, 29, 28.5	62.2	4.0	G	G	Native, **SAR Bat**	High		
1055	*Acer saccharinum*	Silver Maple	45, 32, 2	55.3	2.0	F-G	F-G	Native, **SAR Bat**	High	BAT - cavities, broken branches, slight lean	
1056	*Acer saccharinum*	Silver Maple	85	85.0	3.5	G	G	Native, **SAR Bat**	High	Minor broken branches, included bark, burls	
1057	*Acer saccharinum*	Silver Maple	91.5	91.5	9.0	G	G	Native, **SAR Bat**	High	BAT - cavities, multiple knotholes, lean over creek	
1058	*Pinus resinosa*	Red Pine	21	21.0	1.0	F	F	Native	Moderate	Lower branches dead, topped	1.26
1059	*Ulmus pumila*	Siberian Elm	47, 32	56.9	2.5	F-G	F-G	Non-native invasive	High	Growing partly in gabion baskets, dead branches	
1060	*Acer platanoides*	Norway Maple	13	13.0	0.5	F-G	F-G	Non-native invasive	Low	Minor trunk damage, eroding slope, bent stem, recent beaver chew	0.78
1061	*Acer negundo*	Manitoba Maple	23	23.0	2.0	F	P	Native	Low	Growing in gabion baskets, broken branch, severe lean over creek	1.38
1062	*Acer saccharum*	Sugar Maple	11	11.0	0.5	F	P	Native	Low	Exposed roots, being leaned on by 1061, bent leaning over creek, eroding slope, growing in gabion baskets	0.66
1063	*Acer saccharinum*	Silver Maple	72	72.0	4.0	G	G	Native, **SAR Bat**	High	Exfoliating bark - BAT, exposed roots, wounded crotch on one branch	
1064	*Acer saccharinum*	Silver Maple	78	78.0	4.0	F-G	G	Native, **SAR Bat**	High	Slight lean over creek, exposed roots	
1065	*Acer saccharinum*	Silver Maple	87	87.0	5.0	G	G	Native, **SAR Bat**	High		
1066	*Pinus resinosa*	Red Pine	31.5	31.5	1.5	F-G	F	Native	High	Slightly sparse canopy, some side branches dead, cut lower branches	1.89
1067	*Acer saccharinum*	Silver Maple	28.5, 23, 17, 6	40.8	2.5	F-G	F	Native, **SAR Bat**	High	Growing in gabion baskets, extensive damage to root flare, exposed roots, leaning over creek	
1068	*Acer negundo*	Manitoba Maple	21.5	21.5	1.0	F	F	Native	Moderate	Burls, epicormics, leaning over creek, growing in gabion baskets	1.29
1069	*Ulmus pumila*	Siberian Elm	44	44.0	4.0	F-G	F-G	Non-native invasive, **SAR Bat**	High	Growing in gabion baskets, large dead branches, BAT - cavities, squirrel nest	
1070	*Acer saccharinum*	Silver Maple	30, 30, 25, 22	53.9	3.5	F-G	F	Native, **SAR Bat**	High	Beaver chew, leaning slightly over creek, exposed roots, growing in gabion baskets	
1071	*Acer saccharinum*	Silver Maple	38, 34.5, 18, 16, 12	58.0	3.5	F-G	F-G	Native, **SAR Bat**	High	Growing in gabion baskets, exposed roots, old beaver chew	

Tag #	Scientific Name	Common Name	Diameter at Breast Height (DBH) (cm)	Aggregate DBH (cm)	Dripline Radius (m)	Biological Condition	Structure and Form	Natural Heritage Considerations	Preservation Priority	Defects and Decline Indicators/Notes	Tree Protection Zone (TPZ)
1072	*Acer negundo*	Manitoba Maple	25, 25, 17	39.2	3.0	F-G	P-F	Native, **SAR Bat**	Moderate	Growing in gabion baskets, swollen root flare, exposed roots, open wounds, dead branches	
1073	*Picea abies*	Norway Spruce	52.5	52.5	3.0	G	G	Non-native	High	Slightly lopsided, weird branch galls	
1074	*Picea abies*	Norway Spruce	54.5	54.5	4.0	G	G	Non-native	High	Minor girdling roots, dead raccoon underneath	
1075	*Picea abies*	Norway Spruce	58	58.0	4.0	G	F-G	Non-native	High	Weird growth form, coppiced mid stem	
1076	*Picea abies*	Norway Spruce	27	27.0	1.5	F	G	Non-native	Low	Dead lower branches, twig dieback, slightly sparse canopy	1.62
1077	*Acer saccharinum*	Silver Maple	74	74.0	5.0	G	G	Native, **SAR Bat**	High	Minor epicormics	
1078	*Ulmus pumila*	Siberian Elm	19	19.0	0.5	F-G	F-G	Non-native invasive	Low	Growing in gabion baskets, minor dead branches	1.14
1079	*Ulmus pumila*	Siberian Elm	28, 22, 16	39.0	1.5	F-G	F	Non-native invasive	Moderate	Growing in gabion baskets, broken branches	
1080	*Acer negundo*	Manitoba Maple	24	24.0	2.0	F-G	P-F	Native	Low	Growing in gabion baskets, horizontal lean over creek, swollen root flare	1.44
1081	*Ulmus pumila*	Siberian Elm	40, 22, 20	49.8	3.0	F-G	F-G	Non-native invasive	Moderate	Growing in gabion baskets, leaning toward creek	
1082	*Ulmus pumila*	Siberian Elm	18	18.0	0.5	F-G	F	Non-native invasive	Low	Growing in gabion baskets, damage to root flare	1.08
1083	*Ulmus pumila*	Siberian Elm	28	28.0	1.0	F-G	F	Non-native invasive	Low	Growing in gabion baskets, dead branches	1.68
1084	*Ulmus pumila*	Siberian Elm	18	18.0	0.5	F	F	Non-native invasive	Low	Growing in gabion baskets, twisted with 1083, dead branches	1.08
1085	*Acer saccharinum*	Silver Maple	17	17.0	1.0	F	P	Native	Low	Growing in gabion baskets, leaned on by dead debris, severe lean over creek, exposed roots	1.02
1086	*Acer negundo*	Manitoba Maple	13.5	13.5	1.5	F-G	F	Native	Low	Growing in gabion baskets, slight lean over creek, minor dead branches	0.81
1087	*Acer negundo*	Manitoba Maple	17	17.0	1.0	F-G	F-G	Native	Low	Growing in gabion baskets, minor dieback	1.02
1088	*Acer negundo*	Manitoba Maple	17	17.0	1.5	F-G	F	Native	Low	Growing in gabion baskets, leaning over creek	1.02
1089	*Ulmus pumila*	Siberian Elm	35, 30, 29, 22, 19, 19, 18, 18, 18	71.7	4.0	F-G	F	Non-native invasive	High	Growing in gabion baskets, leaning over creek, included bark, dead branches	
1090	*Acer negundo*	Manitoba Maple	21.5	21.5	2.5	F-G	F	Native	Moderate	Severe lean toward creek	1.29
1091	*Acer negundo*	Manitoba Maple	10.5	10.5	0.5	F-G	F	Native	Low	Growing adjacent to creek, bent root flare	0.63
1092	*Ulmus pumila*	Siberian Elm	13.5	13.5	1.0	F-G	F	Non-native invasive	Low	Growing in gabion baskets, poor form	0.81
1093	*Ulmus pumila*	Siberian Elm	33	33.0	1.5	F-G	F	Non-native invasive	Low	Growing in gabion baskets, large dead branches	1.98
1094	*Ulmus pumila*	Siberian Elm	34, 28, 22	49.2	2.0	F-G	F	Non-native invasive	Moderate	Growing in gabion baskets, weak crotch, leaning over creek, dead branches	
1095	*Ulmus pumila*	Siberian Elm	36.5	36.5	3.0	F-G	F-G	Non-native invasive	Moderate	Growing in gabion baskets, slight lean toward creek	2.19

Tag #	Scientific Name	Common Name	Diameter at Breast Height (DBH) (cm)	Aggregate DBH (cm)	Dripline Radius (m)	Biological Condition	Structure and Form	Natural Heritage Considerations	Preservation Priority	Defects and Decline Indicators/Notes	Tree Protection Zone (TPZ)
1096	*Ulmus pumila*	Siberian Elm	35.5	35.5	1.5	F-G	F-G	Non-native invasive	Moderate	Growing in gabion baskets, rubbing against another tree, old infected wound, epicormics	2.13
1097	*Acer platanoides*	Norway Maple	17	17.0	2.0	F	F	Non-native invasive	Low	Growing in gabion baskets, slight lean away from creek	1.02
1098	*Acer saccharinum*	Silver Maple	21, 4.5	21.5	0.5	F	F	Native	Moderate	Growing in gabion baskets, leaning away from creek	1.29
1099	*Populus deltoides*	Eastern Cottonwood	70	70.0	3.0	G	G	Native	High	Chicken wire around fence (protection from beaver), beaver chew	
1100	*Acer platanoides*	Norway Maple	16	16.0	1.0	F-G	F	Non-native invasive	Low	Beaver chew	0.96
1101	*Picea abies*	Norway Spruce	38.5	38.5	3.0	P	F-G	Non-native	High	Poison ivy going up tree, severe dieback, lopsided	2.31
1102	*Picea abies*	Norway Spruce	51	51.0	4.0	G	G	Non-native	High	Slight lopsided, minor dieback	
1103	*Pinus strobus*	Eastern White Pine	23.5	23.5	2.5	F	G	Native	Moderate	Lower branches pruned, dieback, lopsided	1.41
1104	*Pinus strobus*	Eastern White Pine	36.5	36.5	2.5	F-G	F-G	Native	High	Included bark, minor dead branches	2.19
1105	*Salix x fragilis*	Crack Willow	128	128.0	5.0	F	F	Non-native invasive, **SAR Bat**	Moderate	BAT - cavities in branches, large rotting branch scar, epicormics, lean toward parking lot	
1106	*Picea abies*	Norway Spruce	48.5	48.5	3.5	F-G	G	Non-native	High	Lower branch dieback	
1107	*Aesculus hippocastanum*	Horse Chestnut	26.5, 15.5, 15	34.2	3.0	G	F-G	Non-native	Low	Poor form, coppiced	2.05
1108	*Acer negundo*	Manitoba Maple	41	41.0	4.0	F	P	Native	Moderate	Horizontal lean toward path, dead branches, epicormics, minor trunk wound	
1109	*Aesculus hippocastanum*	Horse Chestnut	32.5	32.5	2.5	G	G	Non-native	Moderate		1.95
1110	*Pinus resinosa*	Red Pine	33	33.0	1.5	G	F-G	Native	High	Slight lean	1.98
1111	*Pinus resinosa*	Red Pine	33	33.0	1.5	G	F-G	Native	High	Slight lean	1.98
1112	*Pinus resinosa*	Red Pine	28	28.0	1.5	F-G	F-G	Native	High	Old healed wound on lower trunk	1.68
1113	*Pinus resinosa*	Red Pine	34	34.0	2.5	G	F-G	Native	High	Slight lean, lopsided	2.04
1114	*Pinus resinosa*	Red Pine	39.5	39.5	4.0	F-G	F-G	Native	High	Leaning slightly toward path, exposed sapwood, included bark, lopsided	
1115	*Acer saccharinum*	Silver Maple	18.5	18.5	3.0	F	F	Native	Low	Large wound, exposed sapwood, exposed roots with damage, dieback	1.11
1116	*Ailanthus altissima*	Tree of Heaven	17.5	17.5	3.0	G	F-G	Non-native invasive	Low	Rubbing against another tree	1.05
1117	*Acer negundo*	Manitoba Maple	37, 26, 25.5, 14	53.8	5.0	F	P-F	Native, **SAR Bat**	Moderate	Poor form, spreading, growing into rocks, leaning toward path/creek, minor branch dieback	
1118	*Acer negundo*	Manitoba Maple	13.5	13.5	0.5	P	P	Native	Low	Leaning toward creek, dieback	0.81
1119	*Acer saccharinum*	Silver Maple	19	19.0	0.5	F	F	Native	Low	Growing into rocks, dieback, epicormics	1.14
1120	*Juglans nigra*	Black Walnut	13.5	13.5	0.5	F	F-G	Native	Low	Growing into rocks, bendy	0.81
1121	*Elaeagnus angustifolia*	Russian Olive	21, 18, 15	31.5	0.5	P	F	Non-native invasive	Low	Leaning away from watercourse, bark damage	1.89

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1122	*Salix x fragilis*	Crack Willow	42.5, 40	58.4	2.0	F-G	F-G	Non-native invasive	High	Growing into rocks	
1123	*Acer saccharinum*	Silver Maple	18	18.0	1.0	F-G	F	Native	Low	Growing into rocks, slight lean toward water	1.08
1124	*Acer rubrum*	Red Maple	12.5	12.5	0.5	F	F	Native	Low	Small wounds up trunk, rubbing against tree, lean toward water, growing into rocks	0.75
1125	*Acer rubrum*	Red Maple	17.5, 9	19.7	3.0	F	F	Native	Low	Growing intro rocks	1.18
1126	*Acer saccharinum*	Silver Maple	33.5	33.5	3.0	F-G	F	Native, **SAR Bat**	High	Poor form, leaning over creek and twisty	2.01
1127	*Acer saccharinum*	Silver Maple	15	15.0	2.5	F-G	F	Native	Low	Poor form, bendy, rubbing against another tree	0.90
1128	*Pinus resinosa*	Red Pine	42	42.0	3.0	G	F	Native	High		
1129	*Elaeagnus angustifolia*	Russian Olive	31, 28	41.8	4.0	G	F-G	Non-native invasive	Moderate	Included bark, cankers, open knot holes with exposed heart wood	
1130	*Fraxinus pennsylvanica*	Green/Red Ash	13, 8.5	15.5	1.0	P-F	P	Native	Low	Growing into rocks, prolific epicormics, poor form	0.93
1131	*Salix x fragilis*	Crack Willow	26, 18.5	31.9	1.0	P-F	F	Non-native invasive	Low	Growing into rocks, severe dieback	1.91
1132	*Salix x fragilis*	Crack Willow	30, 30, 12	44.1	3.0	F-G	F-G	Non-native invasive	Moderate	Growing into rocks, severe dieback	
1133	*Acer negundo*	Manitoba Maple	13, 10	16.4	0.5	F	P-F	Native	Low	Poor form, bendy, leaning away from creek	0.98
1134	*Pinus resinosa*	Red Pine	32.5	32.5	2.5	G	G	Native	High	Slight lean	1.95
1135	*Pinus resinosa*	Red Pine	33.5	33.5	3.5	G	G	Native	High		2.01
1136	*Acer rubrum*	Red Maple	21.5, 20.5	29.7	2.0	F-G	F-G	Native	High	Included bark	1.78
1137	*Acer rubrum*	Red Maple	11	11.0	0.5	F-G	F-G	Native	Low	Leaning toward parking lot	0.66
1138	*Acer rubrum*	Red Maple	16.5	16.5	0.5	F-G	F-G	Native	Low	Leaning toward parking lot	0.99
1139	*Pinus resinosa*	Red Pine	49.5	49.5	4.0	G	F-G	Native	High	Leaning adjacent to creek, included bark	
1140	*Acer platanoides*	Norway Maple	15.5	15.5	2.0	G	G	Non-native invasive	Low	Slight lean	0.93
1141	*Pinus resinosa*	Red Pine	29	29.0	1.5	G	G	Native	High		1.74
1142	*Pinus resinosa*	Red Pine	28	28.0	1.5	F-G	F-G	Native	High	Slight lean, abnormal branch growth lower stem	1.68
1143	*Acer platanoides*	Norway Maple	11	11.0	0.5	G	G	Non-native invasive	Low	Slight lean	0.66
1144	*Pinus resinosa*	Red Pine	38	38.0	2.0	G	G	Native	High	Slight lean	2.28
1145	*Quercus rubra*	Northern Red Oak	22	22.0	1.5	G	G	Native, **SAR Bat**	High	Minor damage at base	1.32
1146	*Salix x fragilis*	Crack Willow	81	81.0	5.0	F	G	Non-native invasive, **SAR Bat**	High	BAT - cavities, epicormics	
1147	*Salix x fragilis*	Crack Willow	50	50.0	8.0	F	F	Non-native invasive, **SAR Bat**	Moderate	Lean toward trail, prolific epicormics, BAT - cavities, flaking bark	
1148	*Salix x fragilis*	Crack Willow	67	67.0	6.0	F	G	Non-native invasive, **SAR Bat**	High	BAT - cavities, prolific epicormics	
1149	*Salix x fragilis*	Crack Willow	72	72.0	5.0	F	F	Non-native invasive	Moderate	Prolific epicormics, major lean toward path	
1150	*Picea abies*	Norway Spruce	13.5	13.5	1.5	G	G	Non-native	Low		0.81
1151	*Picea abies*	Norway Spruce	13	13.0	0.5	G	G	Non-native	Low		0.78

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1152	*Picea abies*	Norway Spruce	13	13.0	0.5	G	G	Non-native	Low	Needle galls	0.78
1153	*Acer negundo*	Manitoba Maple	61.5	61.5	2.0	F	F	Native, **SAR Bat**	High	Severe lean toward path, big branch scar with exposed heart wood, fungus on wood, BAT - knothole	
1154	*Pinus resinosa*	Red Pine	38	38.0	4.0	G	F-G	Native	High	Slight lean, included bark	2.28
1155	*Acer saccharinum*	Silver Maple	88	88.0	6.0	G	G	Native, **SAR Bat**	High	Included bark	
1156	*Acer saccharinum*	Silver Maple	41.5	41.5	5.0	G	F	Native, **SAR Bat**	High	Lean toward creek/path	
1157	*Acer saccharinum*	Silver Maple	71	71.0	4.0	G	F-G	Native, **SAR Bat**	High	Lean toward creek/path	
1158	*Picea abies*	Norway Spruce	45	45.0	5.0	G	G	Non-native	High		
1159	*Picea abies*	Norway Spruce	46	46.0	4.0	G	G	Non-native	High		
1160	*Populus deltoides*	Eastern Cottonwood	143	143.0	5.0	G	G	Native, **SAR Bat**	High	BAT- Leaf clusters	
1161	*Pinus strobus*	Eastern White Pine	42.5, 24.5	49.1	3.0	G	F-G	Native	High	Rubbing branches, leaning toward path/creek, included bark	
1162	*Acer saccharinum*	Silver Maple	66.5	66.5	3.5	G	G	Native, **SAR Bat**	High		
1163	*Acer saccharinum*	Silver Maple	55, 55	77.8	4.0	G	G	Native, **SAR Bat**	High		
1164	*Elaeagnus angustifolia*	Russian Olive	27.5, 24	36.5	0.5	F-G	F-G	Non-native invasive	Moderate	Numerous old trunk wounds with exposed sapwood, leaning toward creek	2.19
1165	*Acer saccharinum*	Silver Maple	22.5, 15	27.0	0.5	F	F	Native	Moderate	Growing into riprap, leaning toward creek, old healed scar	1.62
1166	*Acer negundo*	Manitoba Maple	15.5, 13	20.2	1.0	F-G	F-G	Native	Moderate	Leaning over creek, epicormics	1.21
1167	*Acer negundo*	Manitoba Maple	14	14.0	1.0	F-G	F-G	Native	Low	Epicormics, growing in gabion basket	0.84
1168	*Acer negundo*	Manitoba Maple	32, 12.5	34.4	2.0	F-G	F	Native, **SAR Bat**	High	Severe lean over creek, twig dieback, root flare	2.06
1169	*Tilia americana*	Basswood	19, 6, 5, 3	20.8	1.0	F-G	F-G	Native	Moderate	Slight lean toward trail	1.25
1170	*Tilia americana*	Basswood	10	10.0	0.5	F-G	G	Native	Low	Growing in gabion baskets	0.60
1171	*Acer platanoides*	Norway Maple	14	14.0	0.5	F-G	G	Non-native invasive	Low	Growing in gabion baskets, slight lean toward creek, slight bend	0.84
1172	*Salix x fragilis*	Crack Willow	38, 37, 29, 25, 20	68.4	2.0	F	F	Non-native invasive	Moderate	Growing in gabion baskets, prolific epicormics, leaning over creek, poor form	
1173	*Fraxinus pennsylvanica*	Green/Red Ash	11	11.0	0.5	F	G	Native	Low	Growing in gabion baskets	0.66
1174	*Acer negundo*	Manitoba Maple	18.5, 16.5, 7	25.8	1.0	F-G	F-G	Native	High	Growing in gabion baskets, epicormics, old pruning, old branch scar rotting	1.55
1175	*Ulmus pumila*	Siberian Elm	21, 20, 20, 9	36.4	2.0	F-G	F	Non-native invasive	Moderate	Growing in gabion baskets, minor dead branches, included bark	2.18
1176	*Ulmus pumila*	Siberian Elm	26.5, 12	29.1	3.0	F-G	F	Non-native invasive	Low	Growing in gabion baskets, dead branches, slight lean over creek	1.75

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1177	*Ulmus pumila*	Siberian Elm	13.5	13.5	1.0	F-G	F-G	Non-native invasive	Low	Old healed sun split	0.81
1178	*Ulmus pumila*	Siberian Elm	17.5, 6,	18.5	0.5	F-G	F-G	Non-native invasive	Low	Growing in gabion baskets, lower dead branches	1.11
1179	*Acer saccharinum*	Silver Maple	28, 20, 8	35.3	1.0	F	F-G	Native, **SAR Bat**	High	Growing in gabion baskets, dead branches, slight lean over creek, included bark, exposed roots	2.12
1180	*Acer saccharinum*	Silver Maple	21, 10.5	23.5	3.0	P	P-F	Native	Low	Severe dieback, severe lean over creek, poor form	1.41
1181	*Ulmus pumila*	Siberian Elm	34	34.0	3.0	F-G	F-G	Non-native invasive	Low	Growing in gabion baskets, slight lean toward creek	2.04
1182	*Acer saccharinum*	Silver Maple	32.5, 26, 24, 10	49.1	2.0	F-G	F	Native, **SAR Bat**	High	Growing in gabion baskets, coppiced, branch and small leader dieback	
1183	*Picea abies*	Norway Spruce	34	34.0	2.0	P-F	F	Non-native	Low	Sparse canopy, dieback, growing in gabion baskets	2.04
1184	*Ulmus pumila*	Siberian Elm	20	20.0	1.0	F-G	F-G	Non-native invasive	Low	Leaning over creek, growing in gabion baskets	1.20
1185	*Acer negundo*	Manitoba Maple	23	23.0	0.5	P	F	Native	Low	Old pruning, growing in gabion baskets, dieback	1.38
1186	*Acer negundo*	Manitoba Maple	17.5	17.5	0.5	P-F	F	Native	Low	Slight lean toward creek, growing in gabion basket, dieback	1.05
1187	*Ulmus pumila*	Siberian Elm	17.5	17.5	0.5	F-G	F-G	Non-native invasive	Low	Growing in gabion baskets, swollen root flare	1.05
1188	*Ulmus pumila*	Siberian Elm	32, 29	43.2	2.0	F-G	F	Non-native invasive	Moderate	Growing in gabion baskets, old pruning, dead branches, leaning slightly over creek, included bark	
1189	*Ulmus pumila*	Siberian Elm	10	10.0	0.5	F-G	F-G	Non-native invasive	Low	Growing in gabion baskets	0.60
1190	*Acer saccharinum*	Silver Maple	25, 24, 14, 13, 12	41.4	3.0	F-G	F	Native, **SAR Bat**	High	Growing in gabion baskets, coppiced, poor form	
1191	*Ulmus pumila*	Siberian Elm	23.5	23.5	1.0	F-G	F-G	Non-native invasive	Low	Growing in gabion baskets, epicormics	1.41
1192	*Ulmus pumila*	Siberian Elm	37	37.0	1.5	F-G	F-G	Non-native invasive	Moderate	Growing in gabion baskets, included bark	2.22
1193	*Acer saccharinum*	Silver Maple	22.5, 17, 17, 15	36.2	0.5	F	P-F	Native	Moderate	Growing in gabion baskets, exposed roots, poor form, leader dieback, lean over creek	2.17
1194	*Acer saccharinum*	Silver Maple	16, 15, 13, 13, 12	31.0	3.0	F-G	F	Native	High	Growing in gabion baskets, exposed roots, poor form, branches rubbing, minor trunk damage	1.86
1195	*Acer saccharinum*	Silver Maple	21, 14	25.2	1.5	F	F	Native	Moderate	Growing in gabion baskets, exposed roots, beaver chew, minor dieback	1.51
1196	*Ulmus pumila*	Siberian Elm	34	34.0	2.0	F-G	F-G	Non-native invasive	Low	Growing in gabion baskets	2.04
1197	*Ulmus pumila*	Siberian Elm	13	13.0	0.5	F-G	F-G	Non-native invasive	Low	Growing in gabion baskets, minor epicormics	0.78

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1198	*Ulmus pumila*	Siberian Elm	33, 27.5, 23, 20	52.7	4.0	F-G	F-G	Non-native invasive	High	Growing in gabion baskets, included bark, dieback branches, coppiced	
1199	*Salix x fragilis*	Crack Willow	34, 25, 20	46.7	6.0	F	P	Non-native invasive	Low	Growing in gabion baskets, poor form, exposed roots, twisted root flare, prolific epicormics, bark damage	
1200	*Ailanthus altissima*	Tree of Heaven	10.5	10.5	0.5	F-G	F	Non-native invasive	Low	Growing in gabion baskets, old healed sun split, swollen root flare, twisted trunks	0.63
1201	*Acer negundo*	Manitoba Maple	11	11.0	0.5	F-G	F	Native	Low	Leaning adjacent to creek	0.66
1202	*Acer negundo*	Manitoba Maple	13	13.0	1.0	G	F	Native	Low	Bent root flare, slight lean	0.78
1203	*Fraxinus americana*	White Ash	12.5, 12.5	17.7	0.5	P	F	Native	Low	Signs of Emerald Ash Borer, cracked bark, epicormics, exit holes	1.06
1204	*Acer negundo*	Manitoba Maple	14	14.0	0.5	F	F	Native	Low	Minor broken branches, slightly bendy, epicormics	0.84
1205	*Picea abies*	Norway Spruce	34	34.0	2.0	G	G	Non-native	Moderate	Bird feeder on tree	2.04
1206	*Acer negundo*	Manitoba Maple	10	10.0	2.0	F-G	F	Native	Low	Lean toward creek	0.60
1207	*Acer saccharinum*	Silver Maple	82	82.0	5.0	G	G	Native, **SAR Bat**	High		
1208	*Acer platanoides*	Norway Maple	11.5	11.5	1.0	G	F-G	Non-native invasive	Low	Slight lean	0.69
1209	*Acer platanoides*	Norway Maple	13	13.0	1.0	G	G	Non-native invasive	Low		0.78
1210	*Pinus resinosa*	Red Pine	30	30.0	1.5	P-F	F	Native	Moderate	Sparse canopy, slight lean toward creek, sap sucker holes	1.80
1211	*Ulmus pumila*	Siberian Elm	58, 40.5	70.7	4.0	F-G	F-G	Non-native invasive	High	Weakened crotch, minor dead branches, old cut leader, growing into another tree	
1212	*Tilia americana*	Basswood	13	13.0	1.0	F-G	P	Native	Low	Growing into 1211, lean toward creek	0.78
1213	*Acer platanoides*	Norway Maple	14.5	14.5	0.5	F-G	F-G	Non-native invasive	Low	Growing in gabion baskets, beaver chew	0.87
1214	*Ulmus pumila*	Siberian Elm	60, 23.5	64.4	5.0	F	F	Non-native invasive	Moderate	Growing in gabion baskets, leaning toward creek, included bark, dead branches	
1215	*Ulmus pumila*	Siberian Elm	22.5, 11	25.0	2.0	F-G	F-G	Non-native invasive	Low	Growing in gabion baskets, vines, epicormics, included bark, some broken dead leaders	1.50
1216	*Acer saccharinum*	Silver Maple	23, 19.5, 15.5	33.9	2.0	F	F	Native	High	Damage to trunk, included bark, beaver chew, leaning over creek	2.03
1217	*Acer saccharinum*	Silver Maple	35.5, 31.5	47.5	3.0	F-G	F	Native, **SAR Bat**	High	Willow branch growing between, included bark, lean over creek, fence wire at base	
1218	*Salix x fragilis*	Crack Willow	80, 74, 32.5	113.7	4.0	F-G	P-F	Non-native invasive	Moderate	Prolific epicormics, extensive beaver chew, rotting heartwood, leaning over creek	
1219	*Acer negundo*	Manitoba Maple	32	32.0	2.0	F-G	F	Native, **SAR Bat**	High	Leaning adjacent to creek, vine infestation, lower dead branches	1.92
1220	*Acer platanoides*	Norway Maple	15	15.0	1.0	F	F	Non-native invasive	Low	Beaver chew, epicormics	0.90

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1221	*Fraxinus excelsior*	European Ash	15	15.0	1.0	G	G	Non-native	Low		0.90
1222	*Acer platanoides*	Norway Maple	15.5	15.5	1.5	G	G	Non-native invasive	Low		0.93
1223	*Acer platanoides*	Norway Maple	15	15.0	1.5	F-G	P	Non-native invasive	Low	Growing through fence	0.90
1224	*Acer platanoides*	Norway Maple	14.5	14.5	1.5	F-G	F-G	Non-native invasive	Low	Slight lean, vines	0.87
1225	*Acer platanoides*	Norway Maple	14, 14	19.8	1.0	F-G	F	Non-native invasive	Low	Included bark	1.19
1226	*Acer negundo*	Manitoba Maple	18.5	18.5	0.5	F	P-F	Native	Low	Growing in gabion baskets, exposed roots, vine infestation, leaning toward creek	1.11
1227	*Acer negundo*	Manitoba Maple	16, 14	21.3	1.0	F	F	Native	Moderate	Growing in gabion baskets, vine infestation, leaning toward creek	1.28
1228	*Acer negundo*	Manitoba Maple	13	13.0	0.5	F-G	F	Native	Low	Severe lean toward creek	0.78
1229	*Pinus resinosa*	Red Pine	30	30.0	1.5	F	F	Native	Moderate	Sapsucker holes, moderately sparse canopy	1.80
1230	*Acer negundo*	Manitoba Maple	28.5, 18.5, 10	35.4	2.5	F	F	Native, **SAR Bat**	High	Growing into gabion baskets, included bark, leaning over creek	2.13
1231	*Acer negundo*	Manitoba Maple	24, 19	30.6	2.0	F	F	Native	High	Growing into gabion baskets, leaning over creek, Planks nailed to tree, rope swing hanging from tree	1.84
1232	*Acer negundo*	Manitoba Maple	21	21.0	0.5	F-G	F	Native	Moderate	Dead branches	1.26
1233	*Acer platanoides*	Norway Maple	27	27.0	1.0	F-G	F-G	Non-native invasive, **SAR Bat**	Moderate	Slightly bent root flare	1.62
1234	*Acer platanoides*	Norway Maple	24	24.0	1.5	F-G	F-G	Non-native invasive	Low	Bendy upper stem, woody debris at base	1.44
1235	*Acer platanoides*	Norway Maple	21	21.0	1.5	G	F-G	Non-native invasive	Low	Slight lean toward creek, minor broken branches	1.26
1236	*Acer platanoides*	Norway Maple	16	16.0	0.5	F-G	F	Non-native invasive	Low	Slight lean toward creek, exposed roots	0.96
1237	*Acer platanoides*	Norway Maple	15	15.0	0.5	F-G	F	Non-native invasive	Low	Growing in gabion baskets, bent root flare, beaver chew	0.90
1238	*Acer platanoides*	Norway Maple	17, 15	22.7	1.5	F-G	F-G	Non-native invasive	Low	Growing in gabion baskets, leaning over creek	1.36
1239	*Acer platanoides*	Norway Maple	27.5, 15.5	31.6	1.5	F-G	F-G	Non-native invasive, **SAR Bat**	Moderate	A lot of debris at base	1.89
1240	*Acer platanoides*	Norway Maple	17, 12	20.8	1.0	F-G	F-G	Non-native invasive	Low	Growing into fence	1.25
1241	*Acer platanoides*	Norway Maple	12	12.0	0.5	F-G	F	Non-native invasive	Low	Growing into gabion baskets, leaning over creek	0.72
1242	*Acer platanoides*	Norway Maple	35.5	35.5	3.0	G	F	Non-native invasive, **SAR Bat**	Moderate	Lean toward creek	2.13
1243	*Acer platanoides*	Norway Maple	22	22.0	1.0	F-G	F	Non-native invasive	Low	Leaning over creek, dead branches	1.32
1244	*Acer platanoides*	Norway Maple	17	17.0	0.5	G	G	Non-native invasive	Low		1.02
1245	*Acer platanoides*	Norway Maple	28.5	28.5	1.5	G	F-G	Non-native invasive, **SAR Bat**	Moderate	Leaning toward creek	1.71
1246	*Acer platanoides*	Norway Maple	13.5	13.5	0.5	G	G	Non-native invasive	Low		0.81
1247	*Acer platanoides*	Norway Maple	25	25.0	1.0	G	G	Non-native invasive, **SAR Bat**	Moderate		1.50
1248	*Acer platanoides*	Norway Maple	15.5	15.5	2.0	F-G	F	Non-native invasive	Low	Starting to grow in fence, poor form	0.93
1249	*Acer saccharinum*	Silver Maple	82	82.0	4.5	G	G	Native, **SAR Bat**	High	Minor dead branches	

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1250	*Acer platanoides*	Norway Maple	10.5	10.5	0.5	F-G	F-G	Non-native invasive	Low	Growing in gabion baskets, slight lean toward creek	0.63
1251	*Acer platanoides*	Norway Maple	10	10.0	0.5	F	F	Non-native invasive	Low	Growing in gabion baskets, main dead branch	0.60
1252	*Acer platanoides*	Norway Maple	15	15.0	1.0	F-G	F-G	Non-native invasive	Low	Growing in gabion baskets, slightly bendy	0.90
1253	*Acer negundo*	Manitoba Maple	13	13.0	1.0	F	P	Native	Low	Growing in gabion baskets, leaning over creek	0.78
1254	*Thuja occidentalis*	Eastern White Cedar	12	12.0	0.5	F-G	G	Native	Low	Moderately sparse canopy	0.72
1255	*Thuja occidentalis*	Eastern White Cedar	13	13.0	0.5	F-G	G	Native	Low	Moderately sparse canopy	0.78
1256	*Thuja occidentalis*	Eastern White Cedar	14, 12	18.4	0.5	F-G	G	Native	Low	Moderately sparse canopy	1.11
1257	*Thuja occidentalis*	Eastern White Cedar	13.5	13.5	0.5	F-G	G	Native	Low	Moderately sparse canopy	0.81
1258	*Thuja occidentalis*	Eastern White Cedar	14, 12	18.4	0.5	F-G	G	Native	Low	Moderately sparse canopy	1.11
1259	*Thuja occidentalis*	Eastern White Cedar	18, 14	22.8	0.5	F-G	G	Native	Moderate	Moderately sparse canopy	1.37
1260	*Acer platanoides*	Norway Maple	28.5	28.5	2.0	G	G	Non-native invasive	Low	Exposed roots	1.71
1261	*Acer negundo*	Manitoba Maple	19	19.0	1.0	F-G	P-F	Native	Low	Bent root flare, growing in gabion baskets, leaning over creek	1.14
1262	*Ulmus pumila*	Siberian Elm	41	41.0	3.0	F-G	F	Non-native invasive	Moderate	Growing in gabion baskets, bent lower trunk, exposed roots	
1263	*Acer negundo*	Manitoba Maple	43	43.0	3.0	F	P	Native, **SAR Bat**	Moderate	Rotten wound, BAT - cavity, growing in gabion baskets, epicormics, extensive damage to root flare, exposed roots	
1264	*Acer platanoides*	Norway Maple	32	32.0	3.0	F-G	F	Non-native invasive, **SAR Bat**	Moderate	Growing in gabion basket, old healed sun split, intertwined stems	1.92
1265	*Quercus rubra*	Northern Red Oak	69.5	69.5	6.0	G	G	Native, **SAR Bat**	High	-	
1266	*Acer negundo*	Manitoba Maple	22	22.0	2.5	F	P	Native	Low	Growing in gabion basket, twisted, dieback, lean over creek, old open wound	1.32
1267	*Ulmus pumila*	Siberian Elm	35.5, 27.5, 19	48.8	4.0	F-G	F-G	Non-native invasive	Moderate	Fused with itself, included bark, minor dead branches	
1268	*Acer negundo*	Manitoba Maple	10.5	10.5	1.0	F-G	F-G	Native	Low	Lean over creek	0.63
1269	*Pinus resinosa*	Red Pine	52	52.0	2.5	G	G	Native	High	Lower branch pruning	
1270	*Quercus rubra*	Northern Red Oak	63.5	63.5	4.0	G	G	Native, **SAR Bat**	High	Minor damage at root flare	
1271	*Acer platanoides*	Norway Maple	39.5	39.5	4.5	G	G	Non-native invasive, **SAR Bat**	Moderate	Minor girdling roots	
1272	*Acer platanoides*	Norway Maple	42.5	42.5	4.0	G	G	Non-native invasive, **SAR Bat**	High	Minor girdling roots	
1273	*Acer saccharinum*	Silver Maple	41.5	41.5	3.5	G	G	Native, **SAR Bat**	High	Exposed roots	
1274	*Aesculus hippocastanum*	Horse Chestnut	33.5	33.5	1.5	G	G	Non-native	Moderate	Included bark, minor dead branches	2.01

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1275	*Acer platanoides*	Norway Maple	12	12.0	2.0	G	F	Non-native invasive	Low	Slightly bendy	0.72
1276	*Acer negundo*	Manitoba Maple	33	33.0	2.5	F	P	Native, **SAR Bat**	Moderate	Severe damage to root flare, minor dead branches	1.98
1277	*Acer negundo*	Manitoba Maple	19.5	19.5	1.0	F-G	P-F	Native	Low	Lean adjacent to creek, exposed roots	1.17
1278	*Acer negundo*	Manitoba Maple	14	14.0	0.5	F-G	F	Native	Low	Slight lean, rubbing against another tree	0.84
1279	*Acer negundo*	Manitoba Maple	11.5	11.5	0.5	F-G	F	Native	Low	Bent stem, lean toward creek, epicormics	0.69
1280	*Salix x fragilis*	Crack Willow	99, 45, 29	112.5	4.0	F-G	F	Non-native invasive	High	Lean over creek	
1281	*Acer negundo*	Manitoba Maple	13	13.0	0.5	G	F	Native	Low	Slightly bendy	0.78
1282	*Salix x fragilis*	Crack Willow	88	88.0	6.0	F-G	F-G	Non-native invasive	High	Included bark, second leader dead	
1283	*Acer negundo*	Manitoba Maple	21.5	21.5	1.0	F-G	F-G	Native	Moderate	Slight lean toward creek	1.29
1284	*Acer saccharinum*	Silver Maple	17	17.0	1.0	F-G	F-G	Native	Low	Minor trunk damage, lean toward creek	1.02
1285	*Acer negundo*	Manitoba Maple	14	14.0	1.0	F-G	F-G	Native	Low		0.84
1286	*Acer negundo*	Manitoba Maple	14	14.0	3.5	F-G	F	Native	Low	Epicormics, poor form	0.84
1287	*Salix x fragilis*	Crack Willow	70	70.0	3.5	F	F	Non-native invasive, **SAR Bat**	Moderate	BAT - cavities, dead branches, leaning toward creek	
1288	*Salix x fragilis*	Crack Willow	76	76.0	3.0	F-G	F-G	Non-native invasive	High	Minor dead branches, leaning away from creek, branch scar	
1289	*Salix x fragilis*	Crack Willow	79, 66	102.9	5.0	F-G	F-G	Non-native invasive	High	Slight lean toward creek, large broken leader, epicormics	
1290	*Picea abies*	Norway Spruce	15	15.0	1.0	G	G	Non-native invasive	Low		0.90
1291	*Fraxinus americana*	White Ash	11	11.0	0.5	P	P	Native	Low	Emerald Ash Borer	0.66
1292	*Thuja occidentalis*	Eastern White Cedar	11	11.0	0.5	F	F-G	Native	Low	Moderately sparse, slight lean	0.66
1293	*Thuja occidentalis*	Eastern White Cedar	11, 6	12.5	0.5	F	F-G	Native	Low	Moderately sparse, slight lean	0.75
1294	*Thuja occidentalis*	Eastern White Cedar	13, 9	15.8	0.5	F	F-G	Native	Low	Moderately sparse, slight lean, some small dead branches	0.95
1295	*Thuja occidentalis*	Eastern White Cedar	11, 7, 6	14.4	0.5	F	F-G	Native	Low	Moderately sparse, slight lean	0.86
1296	*Thuja occidentalis*	Eastern White Cedar	12	12.0	0.5	F	F-G	Native	Low	Moderately sparse, slight lean	0.72
1297	*Acer negundo*	Manitoba Maple	12	12.0	1.5	F-G	F-G	Native	Low	Epicormics, slight lean	0.72
1298	*Acer negundo*	Manitoba Maple	25	25.0	2.5	F-G	F-G	Native, **SAR Bat**	High	Vine infestation, wood debris, slight lean, growing in gabion baskets	1.50
1299	*Acer negundo*	Manitoba Maple	15, 7	16.6	1.5	F-G	F	Native	Low	Leaning over creek, growing in gabion baskets	0.99
1300	*Acer negundo*	Manitoba Maple	12	12.0	1.5	F-G	F-G	Native	Low	Leaning over creek, growing in gabion baskets	0.72
1301	*Ailanthus altissima*	Tree of Heaven	12	12.0	1.0	F-G	F	Non-native invasive	Low	Growing in gabion baskets, lean toward creek	0.72
1302	*Ailanthus altissima*	Tree of Heaven	13.5, 13	18.7	1.5	F-G	F-G	Non-native invasive	Low	Growing in gabion baskets, swollen root flare, included bark	1.12

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1303	*Ulmus pumila*	Siberian Elm	55	55.0	5.0	F-G	F-G	Non-native invasive	High	Growing in gabion baskets, included bark, old cut large branch	
1304	*Syringa reticulata*	Japanese Tree Lilac	15	15.0	2.0	F	F-G	Non-native invasive	Low	Growing in gabion baskets, twisted stem, slight lean dieback, swollen root flare	0.90
1305	*Ailanthus altissima*	Tree of Heaven	12	12.0	1.5	F-G	F-G	Non-native invasive	Low	Growing in gabion baskets, twisted stem	0.72
1306	*Ulmus pumila*	Siberian Elm	42	42.0	6.0	F-G	F	Non-native invasive	Moderate	Growing in gabion baskets, leaning over creek, large dead branches	
1307	*Ulmus pumila*	Siberian Elm	52	52.0	7.0	F	P	Non-native invasive	Moderate	Growing in gabion baskets, bent root flare, severe lean over creek, bent at base	
1308	*Salix matsudana*	Corkscrew Willow	45	45.0	5.0	P	P	Non-native	Low	Extensive damage to root flare, major dieback	
1309	*Acer saccharinum*	Silver Maple	23.5, 22, 16, 13	38.2	2.5	F	P	Native	Moderate	Soil eroded, extensive exposed roots, old healed sun split, included bark, lean over creek	2.29
1310	*Acer saccharinum*	Silver Maple	25	25.0	3.0	G	F	Native, **SAR Bat**	High	Leaning toward creek, damage to lower trunk	1.50
1311	*Acer saccharinum*	Silver Maple	20.5	20.5	3.0	G	F	Native	Moderate	Leaning toward creek	1.23
1312	*Acer platanoides*	Norway Maple	25, 14.5	28.9	3.0	F-G	F	Non-native invasive, **SAR Bat**	Moderate	Slight lean toward creek, old cut leader, included bark	1.73
1313	*Acer saccharinum*	Silver Maple	20	20.0	1.5	G	G	Native	Low	Swollen root flare	1.20
1314	*Acer saccharinum*	Silver Maple	31.5, 18	36.3	4.0	G	F-G	Native, **SAR Bat**	High	Buried crotch, leaning adjacent to creek	2.18
1315	*Ulmus pumila*	Siberian Elm	40, 33.5, 31.5, 31	68.4	2.0	F-G	F	Non-native invasive	High	Growing in gabion baskets, coppiced, dead branches, leaning toward creek	
1316	*Acer negundo*	Manitoba Maple	12.5, 7	14.3	0.5	F	F	Native	Low	Lower crotch, dieback	0.86
1317	*Acer saccharinum*	Silver Maple	38	38.0	3.0	G	F-G	Native, **SAR Bat**	High	Slight lean toward creek	2.28
1318	*Ulmus pumila*	Siberian Elm	31	31.0	2.5	F-G	F-G	Non-native invasive	Low	Growing in gabion baskets, slight lean toward path, growing into fence	1.86
1319	*Ulmus pumila*	Siberian Elm	23.5	23.5	2.5	F-G	F-G	Non-native invasive	Low	Growing in gabion baskets	1.41
1320	*Ulmus pumila*	Siberian Elm	33	33.0	2.5	F-G	F-G	Non-native invasive	Low	Growing in gabion baskets	1.98
1321	*Ulmus pumila*	Siberian Elm	23	23.0	2.5	F-G	F-G	Non-native invasive	Low	Growing in gabion baskets	1.38
1322	*Ulmus pumila*	Siberian Elm	36.5	36.5	4.0	F-G	F-G	Non-native invasive	Moderate	Growing in gabion baskets, minor dead branches	2.19
1323	*Ulmus pumila*	Siberian Elm	16	16.0	0.5	P	F	Non-native invasive	Low	Growing in gabion baskets, severe dieback	0.96
1324	*Acer negundo*	Manitoba Maple	11.5	11.5	0.5	G	F	Native	Low	Bent root flare, bent stem, branch dieback	0.69
1325	*Acer saccharinum*	Silver Maple	29, 23, 20.5, 19.5, 14, 13	50.4	2.5	G	G	Native, **SAR Bat**	High	Included bark, minor bark damage	
1326	*Salix x fragilis*	Crack Willow	114	114.0	4.0	G	G	Non-native invasive	High	BAT - cavities, lower dead branches	
1327	*Ulmus pumila*	Siberian Elm	13.5	13.5	0.5	F	G	Non-native invasive	Low	Growing in gabion baskets, dieback	0.81

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1328	*Ulmus pumila*	Siberian Elm	12	12.0	0.5	F	G	Non-native invasive	Low	Growing in gabion baskets	0.72
1329	*Ulmus pumila*	Siberian Elm	35.5, 20	40.7	2.5	F	F	Non-native invasive	Low	Growing in gabion baskets, large branch dieback	
1330	*Salix x fragilis*	Crack Willow	20.5	20.5	2.5	F	F	Non-native invasive	Low	Severe lean adjacent to creek, beaver chew at base	1.23
1331	*Ulmus pumila*	Siberian Elm	24.5	24.5	1.5	F-G	F-G	Non-native invasive	Low	Growing in gabion baskets, old cut small leaders, epicormics	1.47
1332	*Acer negundo*	Manitoba Maple	27, 17.5, 16	35.9	2.5	P-F	P-F	Native, **SAR Bat**	Moderate	Growing in gabion baskets, rotting crotch, cut branches	2.16
1333	*Salix x fragilis*	Crack Willow	111	111.0	4.0	G	G	Non-native invasive	High	Broken branches, minor dead branches, minor peeled bark	
1334	*Ulmus pumila*	Siberian Elm	44.5, 34, 26	61.7	4.0	F-G	F	Non-native invasive	High	Growing in gabion baskets, dead branches, included bark, low crotch	
1335	*Ulmus pumila*	Siberian Elm	30.5	30.5	1.5	F-G	F	Non-native invasive	Low	Growing in gabion baskets, larger cut leader	1.83
1336	*Ulmus pumila*	Siberian Elm	37.5	37.5	4.0	F	F	Non-native invasive	Low	Growing in gabion baskets, leaning over creek, old leader scar at base, dead branches, hollow	2.25
1337	*Ulmus pumila*	Siberian Elm	28, 18	33.3	2.5	F-G	F-G	Non-native invasive	Low	Growing in gabion baskets, included bark, leaning over creek	2.00
1338	*Ailanthus altissima*	Tree of Heaven	17.5	17.5	3.0	F	F	Non-native invasive	Low	Growing in gabion baskets, swollen root flare, leaning over creek	1.05
1339	*Ailanthus altissima*	Tree of Heaven	17	17.0	0.5	P	P	Non-native invasive	Low	Growing in gabion baskets, topped, epicormics, leaning over creek	1.02
1340	*Ailanthus altissima*	Tree of Heaven	17	17.0	3.0	F	P	Non-native invasive	Low	Growing in gabion baskets, leaning over creek, rubbing against another tree, dead branch, root flare	1.02
1341	*Acer negundo*	Manitoba Maple	25.5	25.5	2.0	F	F	Native, **SAR Bat**	High	Growing in gabion baskets, prolific epicormics, swollen root flare	1.53
1342	*Ulmus pumila*	Siberian Elm	36, 20	41.2	5.0	F-G	F-G	Non-native invasive	Moderate	Growing in gabion baskets, included bark, dead branches, vines, slight lean over creek	
1343	*Acer negundo*	Manitoba Maple	20	20.0	2.5	F	P-F	Native	Low	Growing in gabion baskets, minor bark damage to lower trunk, vines in canopy, epicormics, lean over creek	1.20
1344	Tilia americana	Basswood	20	20.0	1.5	F	P-F	Native	Low	Growing in gabion baskets, epicormics, lean over creek	1.20
1345	*Acer negundo*	Manitoba Maple	24, 12	26.8	1.0	F	F	Native	Moderate	Growing in gabion baskets, swollen root flare, dead leader, leaning toward path, epicormics	1.61
1346	*Acer negundo*	Manitoba Maple	14	14.0	2.0	F	P-F	Native	Low	Growing in gabion baskets, bent swollen root flare, leaning over creek	0.84
1347	*Salix x fragilis*	Crack Willow	26	26.0	2.0	F	F	Non-native invasive	Low	Growing in creek, leaning over creek, beaver chew, epicormics, lower dead branches	1.56
1348	*Acer negundo*	Manitoba Maple	32, 17	36.2	3.0	F-G	F	Native, **SAR Bat**	High	Growing in gabion baskets, lean toward creek, vine infestation, included bark, epicormics	2.17
1349	*Acer negundo*	Manitoba Maple	20, 16, 15, 14	32.8	3.0	F	P	Native	Moderate	Growing in gabion baskets, twisted stem, dead leaders, lean over creek	1.97
1350	*Juglans nigra*	Black Walnut	18	18.0	1.0	G	G	Native	Low	Vines	1.08

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1351	*Acer negundo*	Manitoba Maple	27.5	27.5	4.5	F	P	Native, **SAR Bat**	Moderate	Growing in gabion baskets, dead branches, vine infestation, severe lean over creek	1.65
1352	*Acer negundo*	Manitoba Maple	19	19.0	0.5	F	P	Native	Low	Growing in gabion baskets, cut leader, bent root flare, bent stem, vine infestation	1.14
1353	*Acer negundo*	Manitoba Maple	23, 13, 6	27.1	2.5	F-G	F	Native	High	Growing in gabion baskets, vine infestation, swollen root flare, poor form	1.63
1354	*Salix x fragilis*	Crack Willow	56, 52, 39	85.8	5.0	F-G	F-G	Non-native invasive	High	Included bark, low crotch, exposed roots, minor dead branches	
1355	*Acer negundo*	Manitoba Maple	23	23.0	2.0	F-G	F-G	Native	Moderate	Vine infestation, growing partly in gabion basket, damage to root flare, slight lean toward creek	1.38
1356	*Acer negundo*	Manitoba Maple	18	18.0	1.0	P	P	Native, **SAR Bat**	Moderate	BAT - squirrel nest, growing in gabion baskets, lean toward creek, dieback, epicormics	1.08
1357	*Ulmus pumila*	Siberian Elm	16, 5	16.8	3.5	F	F	Non-native invasive	Low	Vine infestation, slight lean toward creek, bendy stem	1.01
1358	*Acer negundo*	Manitoba Maple	35	35.0	4.0	P	P	Native, **SAR Bat**	Moderate	Twisted stem, lean toward creek, exposed sapwood, included bark, BAT - cavities (Decay Class 2)	2.10
1359	*Salix x fragilis*	Crack Willow	43, 33.5, 29.5, 19, 11	65.8	5.0	F-G	F	Non-native invasive	High	Lean toward creek, buried crotch, dead branches	
1360	*Acer negundo*	Manitoba Maple	15	15.0	1.0	F-G	F-G	Native	Low	Growing in gabion baskets, slight lean	0.90
1361	*Acer negundo*	Manitoba Maple	12	12.0	1.0	F	F	Native	Low	Growing in gabion baskets, damaged root flare, lean adjacent to creek	0.72
1362	*Acer negundo*	Manitoba Maple	14	14.0	2.0	F	P	Native	Low	Growing in gabion baskets, swollen bent root flare, dieback	0.84
1363	*Acer platanoides*	Norway Maple	17	17.0	2.0	F	G	Non-native invasive	Low	Growing in gabion baskets, exposed roots	1.02
1364	*Ulmus pumila*	Siberian Elm	29	29.0	4.0	G	G	Non-native invasive	Low	Minor dead branches	1.74
1365	*Acer negundo*	Manitoba Maple	21	21.0	2.5	F	P	Native	Low	Severe lean over creek, dead leader, vine infestation, included bark	1.26
1366	*Acer negundo*	Manitoba Maple	10	10.0	1.5	P	P	Native	Low	Growing in gabion baskets, bent root flare, severe dieback, epicormics	0.60
1367	*Acer negundo*	Manitoba Maple	29, 28	40.3	3.5	F-G	F-G	Native, **SAR Bat**	High	Included bark, vines, twig dieback	
1368	*Acer negundo*	Manitoba Maple	44, 40	59.5	4.0	F-G	F-G	Native, **SAR Bat**	High	Damage to base, included bark, vines, minor twig dieback, twisted root flare	
1369	*Ulmus pumila*	Siberian Elm	13.5	13.5	1.0	F	F	Non-native invasive	Low	Growing in armor stone	0.81
1370	*Ulmus pumila*	Siberian Elm	10	10.0	0.5	F	F	Non-native invasive	Low	Growing in armor stone	0.60
1371	*Ulmus pumila*	Siberian Elm	10.5	10.5	0.5	G	G	Non-native invasive	Low	Slight lean toward trail	0.63

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1372	*Salix x fragilis*	Crack Willow	16, 15.5	22.3	1.0	F-G	F	Non-native invasive	Low	Epicormics, growing into rocks, leaning over creek, beaver chew on 3rd leader	1.34
1373	*Salix x fragilis*	Crack Willow	10	10.0	0.5	F-G	F	Non-native invasive	Low	Epicormics, growing into rocks, leaning over creek	0.60
1374	*Ulmus pumila*	Siberian Elm	26, 9	27.5	1.5	F-G	F-G	Non-native invasive	Low	Growing into armor stone, branch dieback	1.65
1375	*Ulmus pumila*	Siberian Elm	17, 10	19.7	0.5	F-G	F-G	Non-native invasive	Low	Growing into armor stone	1.18
1376	*Ulmus pumila*	Siberian Elm	11, 4	11.7	0.5	F	F	Non-native invasive	Low	Growing into armor stone, slight lean toward road, old pruning	0.70
1377	*Acer negundo*	Manitoba Maple	34, 17	38.0	5.0	F	F	Native, **SAR Bat**	High	Growing on private property, between fence and shed, epicormics, cut leader, lean adjacent to path	2.28
1378	*Acer negundo*	Manitoba Maple	34, 32.5	47.0	4.0	F	F	Native, **SAR Bat**	High	Growing on private property, between fence and shed, root flare, debris in crotch	
1379	*Acer negundo*	Manitoba Maple	25	25.0	1.5	F-G	F-G	Native, **SAR Bat**	High	Leaning adjacent to path, epicormics	1.50
1380	*Acer negundo*	Manitoba Maple	30.5	30.5	3.0	F	F	Native, **SAR Bat**	High	Bent root flare, twisted stem, epicormics	1.83
1381	*Acer negundo*	Manitoba Maple	36, 30	46.9	2.5	F-G	F	Native, **SAR Bat**	High	Growing into fence	
1382	*Acer negundo*	Manitoba Maple	24.5, 24, 18	38.7	3.0	F-G	F	Native, **SAR Bat**	High	Weak crotch, exposed roots, prolific epicormics	
1383	*Acer platanoides*	Norway Maple	15	15.0	1.5	F-G	F	Non-native invasive	Low	Twisted stem, growing into fence	0.90
1384	*Acer saccharinum*	Silver Maple	33.5, 24, 13	43.2	8.0	F-G	F-G	Native, **SAR Bat**	High	Exposed roots, low crotch	
1385	*Ulmus pumila*	Siberian Elm	70.5	70.5	5.0	F-G	P	Non-native invasive	Moderate	Weak/failing crotch, exposed girdling roots, lean over trail	
1386	*Acer saccharinum*	Silver Maple	66	66.0	5.0	F-G	F-G	Native, **SAR Bat**	High	One large branch broken off, burls on lower trunk, included bark	
1387	*Acer negundo*	Manitoba Maple	15.5	15.5	1.5	F-G	F	Native	Low	Growing into the fence, leaning adjacent to fence	0.93
1388	*Acer saccharinum*	Silver Maple	40.5, 40, 39.5, 35, 32	84.0	6.0	G	G	Native, **SAR Bat**	High	Minor exposed roots, minor dead branches, coppiced	
1389	*Acer saccharinum*	Silver Maple	47.5, 45.5, 30.5	72.5	6.0	G	G	Native, **SAR Bat**	High	Coppiced, exposed roots, included bark	

Tag #	Scientific Name	Common Name	Diameter at Breast Height (DBH) (cm)	Aggregate DBH (cm)	Dripline Radius (m)	Biological Condition	Structure and Form	Natural Heritage Considerations	Preservation Priority	Defects and Decline Indicators/Notes	Tree Protection Zone (TPZ)
1390	*Acer saccharinum*	Silver Maple	38.5, 38, 30	61.9	6.0	G	G	Native, **SAR Bat**	High	Coppiced	
1391	*Acer saccharinum*	Silver Maple	54, 52	75.0	8.0	G	G	Native, **SAR Bat**	High	Included bark	
1392	*Acer saccharinum*	Silver Maple	96	96.0	8.0	G	G	Native, **SAR Bat**	High	Exposed roots, *potential heritage tree	
1393	*Ulmus pumila*	Siberian Elm	20.5	20.5	2.0	F-G	F-G	Non-native invasive	Low	Broken branches, lean away from trail, dead branches	1.23
1394	*Thuja occidentalis*	Eastern White Cedar	19.5	19.5	0.5	F-G	F	Native	Low	Vertical split up trunk	1.17
1395	*Catalpa speciosa*	Northern Catalpa	14	14.0	0.5	G	F-G	Non-native	Low	Bendy trunk	0.84
1396	*Picea abies*	Norway Spruce	26.5	26.5	1.5	G	G	Non-native, **SAR Bat**	High	Large nest in the canopy - BAT, slightly lopsided	1.59
1397	*Acer platanoides*	Norway Maple	14.5	14.5	1.0	F	F	Non-native invasive	Low	Leaning adjacent to path, epicormics	0.87
1398	*Acer platanoides*	Norway Maple	25	25.0	1.5	F-G	F-G	Non-native invasive, **SAR Bat**	Moderate	Leaning adjacent to path	1.50
1399	*Acer saccharinum*	Silver Maple	49.5, 36	61.2	5.0	G	G	Native, **SAR Bat**	High	Two squirrel nests - BAT, included bark	
1400	*Acer saccharinum*	Silver Maple	86, 74	113.5	7.0	G	G	Native, **SAR Bat**	High	Old cut branch	
1401	*Acer platanoides*	Norway Maple	33	33.0	2.5	F-G	F-G	Non-native invasive, **SAR Bat**	Moderate	Slightly lopsided, growing in gabion baskets	1.98
1402	*Acer platanoides*	Norway Maple	26.5	26.5	2.0	F-G	F-G	Non-native invasive, **SAR Bat**	Moderate	Slight lean	1.59
1403	*Ulmus pumila*	Siberian Elm	27, 10	28.8	2.0	G	G	Non-native invasive	Low		1.73
1404	*Acer negundo*	Manitoba Maple	28	28.0	2.0	F-G	P-F	Native, **SAR Bat**	High	Leaning toward creek	1.68
1405	*Acer negundo*	Manitoba Maple	13	13.0	0.5	F-G	F	Native	Low	Bendy stem	0.78

Tag #	Scientific Name	Common Name	Diameter at Breast Height (DBH) (cm)	Aggregate DBH (cm)	Dripline Radius (m)	Biological Condition	Structure and Form	Natural Heritage Considerations	Preservation Priority	Defects and Decline Indicators/Notes	Tree Protection Zone (TPZ)
1406	*Ulmus pumila*	Siberian Elm	24	24.0	1.0	F	F-G	Non-native invasive	Low	Slight lean, minor dead branches	1.44
1407	*Acer negundo*	Manitoba Maple	21	21.0	2.0	F-G	P-F	Native	Low	Severe lean toward creek, epicormics, minor dieback	1.26
1408	*Ulmus pumila*	Siberian Elm	29	29.0	0.5	F-G	F-G	Non-native invasive	Low	Minor dead branches, second leader growing through fence then cut	1.74
1409	*Ulmus pumila*	Siberian Elm	12	12.0	0.5	F-G	F	Non-native invasive	Low	Main leader topped	0.72
1410	*Ulmus pumila*	Siberian Elm	19	19.0	0.5	F-G	F-G	Non-native invasive	Low	Rubbing up against 1411	1.14
1411	*Acer negundo*	Manitoba Maple	20	20.0	0.5	F	F	Native	Low	Bendy, epicormics, broken leader	1.20
1412	*Acer negundo*	Manitoba Maple	13	13.0	1.0	F	F	Native	Low	Leaning, dieback	0.78
1413	*Acer negundo*	Manitoba Maple	11.5	11.5	0.5	F-G	F-G	Native	Low	Slight lean, minor dead branches	0.69
1414	*Acer negundo*	Manitoba Maple	11	11.0	0.5	F-G	F-G	Native	Low	Sparse canopy	0.66
1415	*Ulmus pumila*	Siberian Elm	72, 70, 37	107.0	5.0	F-G	F-G	Non-native invasive	High	Minor dead branches, included bark	
1416	*Acer negundo*	Manitoba Maple	22.5, 15	27.0	2.5	F	P	Native	Moderate	Severe lean toward creek	1.62
1417	*Acer negundo*	Manitoba Maple	19, 15	24.2	1.0	F	F	Native	Moderate	Wrapped around 1418, growing into fence	1.45
1418	*Ulmus pumila*	Siberian Elm	28	28.0	2.0	F	F	Non-native invasive	Low	Minor dead branches, growing into fence	1.68
1419	*Acer negundo*	Manitoba Maple	21	21.0	1.0	F	F	Native	Moderate	Growing into fence, leaning away from creek	1.26
1420	*Ulmus pumila*	Siberian Elm	35.5, 29	45.8	2.0	F-G	F-G	Non-native invasive	Moderate	Old healed wound on stem, minor dead branches	
1421	*Acer platanoides*	Norway Maple	13.5	13.5	1.0	G	F-G	Non-native invasive	Low	Slightly bendy	0.81

Tag #	Scientific Name	Common Name	Diameter at Breast Height (DBH) (cm)	Aggregate DBH (cm)	Dripline Radius (m)	Biological Condition	Structure and Form	Natural Heritage Considerations	Preservation Priority	Defects and Decline Indicators/Notes	Tree Protection Zone (TPZ)
1422	*Ulmus pumila*	Siberian Elm	28	28.0	2.0	G	G	Non-native invasive	Low	-	1.68
1423	*Acer saccharinum*	Silver Maple	15.5	15.5	0.5	G	G	Native	Low	Included bark	0.93
1424	*Ulmus pumila*	Siberian Elm	15	15.0	0.5	G	G	Non-native invasive	Low	Growing into fence	0.90
1731	*Acer saccharinum*	Silver Maple	58, 41.5, 36.5	80.1	3.5	G	G	Native, **SAR Bat**	High	Included bark	
1732	*Thuja occidentalis*	Eastern White Cedar	13	13.0	0.5	P	F-G	Native	Low	Sparse canopy	0.78
1733	*Acer negundo*	Manitoba Maple	17.5	17.5	0.5	F-G	F	Native	Low	Growing into fence, slight lean away from trail, epicormics	1.05
1734	*Thuja occidentalis*	Eastern White Cedar	20.5	20.5	0.5	P	F	Native	Low	Included bark, sparse canopy	1.23
1735	*Thuja occidentalis*	Eastern White Cedar	11	11.0	0.5	P	F	Native	Low	Sparse canopy, bend in trunk	0.66
1736	*Thuja occidentalis*	Eastern White Cedar	11.5, 11	15.9	0.5	P	F	Native	Low	One leader dead, one leader sparse	0.95
1737	*Thuja occidentalis*	Eastern White Cedar	13	13.0	0.5	P-F	F	Native	Low	Sparse canopy, included bark	0.78
1738	*Acer negundo*	Manitoba Maple	24	24.0	2.5	F	F	Native	Moderate	Prolific epicormics, leaning away from trail, growing into fence	1.44
1739	*Acer negundo*	Manitoba Maple	18	18.0	2.5	F	F	Native	Low	Bendy stem, growing into fence, leaned on by dead tree, epicormics, leaning over path	1.08
1740	*Thuja occidentalis*	Eastern White Cedar	17	17.0	0.5	P	P-F	Native	Low	Two cut leaders	1.02
1741	*Thuja occidentalis*	Eastern White Cedar	22.5	22.5	1.5	F	F-G	Native	Moderate	Moderately sparse canopy	1.35
1742	*Acer saccharinum*	Silver Maple	66	66.0	3.0	G	G	Native, **SAR Bat**	High	Healed vertical split with water within, leaning adjacent to trail	
1743	*Acer saccharinum*	Silver Maple	60	60.0	6.0	G	G	Native, **SAR Bat**	High	BAT - cavities (decay class 1)	

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1744	*Acer saccharinum*	Silver Maple	47	47.0	3.5	F-G	G	Native, **SAR Bat**	High	Old healed wound in lower trunk, epicormics	
1745	*Acer saccharinum*	Silver Maple	48.5	48.5	3.5	F-G	G	Native, **SAR Bat**	High	Old healed wound at base, exposed sapwood, lean away from trail	
1746	*Acer saccharinum*	Silver Maple	28.5	28.5	2.0	F-G	F-G	Native, **SAR Bat**	High	Epicormics, old healed wound, slight lean toward trail	1.71
1747	*Acer saccharinum*	Silver Maple	60.5	60.5	4.5	G	F-G	Native, **SAR Bat**	High	Slight lean toward path	
1748	*Acer saccharinum*	Silver Maple	44	44.0	3.0	G	F	Native, **SAR Bat**	High	Leaning over path	
1749	*Acer saccharinum*	Silver Maple	74	74.0	4.0	G	F-G	Native, **SAR Bat**	High	Slight lean toward trail, BAT - knothole cavity split, animal may be living within	
1750	*Acer saccharinum*	Silver Maple	35	35.0	3.5	G	F-G	Native, **SAR Bat**	High	Bulging root flare, leaning adjacent to trail	2.10
1751	*Acer saccharinum*	Silver Maple	40	40.0	2.5	F-G	F-G	Native, **SAR Bat**	High	Epicormics, bendy upper trunk	
1752	*Acer saccharinum*	Silver Maple	54	54.0	5.5	F-G	F	Native, **SAR Bat**	High	Severe lean adjacent to path	
1753	*Acer saccharinum*	Silver Maple	26	26.0	2.5	F	F	Native, **SAR Bat**	High	Leaning away from path, epicormics	1.56
1754	*Acer saccharinum*	Silver Maple	52	52.0	3.0	G	F	Native, **SAR Bat**	High	Leaning away from path	
1755	*Acer saccharinum*	Silver Maple	54	54.0	4.0	F-G	F-G	Native, **SAR Bat**	High	Leaning away from path	
1756	*Acer saccharinum*	Silver Maple	75.5	75.5	6.0	G	F-G	Native, **SAR Bat**	High	Lean adjacent to path, included bark	
1757	*Picea glauca*	White Spruce	40	40.0	3.0	G	G	Native	High	Lower branches missing needles, slight lopsided	
1758	*Picea abies*	Norway Spruce	33	33.0	2.5	F	G	Non-native	Moderate	Weird growth pattern half way up stem, old cut small leader	1.98
1759	*Thuja occidentalis*	Eastern White Cedar	12	12.0	0.5	F	G	Native	Low	Moderately sparse canopy	0.72

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1760	*Picea glauca*	White Spruce	30.5	30.5	3.0	P	F	Native	High	Sparse canopy	1.83
1761	*Acer negundo*	Manitoba Maple	35	35.0	3.5	F-G	P	Native, **SAR Bat**	Moderate	Severe lean adjacent to path, minor dead branches	2.10
1762	*Acer negundo*	Manitoba Maple	39.5	39.5	3.5	F-G	P-F	Native, **SAR Bat**	High	Severe lean over path, exposed roots	
1763	*Pinus strobus*	Eastern White Pine	36, 20.5, 17.5	45.0	2.0	F-G	F	Native	High	Poor form, lower dead branches	
1764	*Picea glauca*	White Spruce	13.5	13.5	0.5	F-G	F-G	Native	Low	Lopsided, slightly sparse canopy, slight lean	0.81
1765	*Ulmus pumila*	Siberian Elm	20	20.0	1.5	G	G	Non-native invasive	Low	Old healed sun split, being leaned on by broken stem	1.20
1766	*Acer negundo*	Manitoba Maple	13	13.0	1.5	F	P	Native	Low	Lean away from path, bendy stem	0.78
1767	*Acer saccharinum*	Silver Maple	69.5	69.5	8.0	G	F-G	Native, **SAR Bat**	High	Leaning over path, included bark	
1768	*Acer saccharinum*	Silver Maple	88.5	88.5	5.0	G	G	Native, **SAR Bat**	High	Included bark	
1769	*Acer saccharinum*	Silver Maple	38	38.0	3.5	G	F-G	Native, **SAR Bat**	High	Leaning over trail, broken branches	2.28
1770	*Acer saccharinum*	Silver Maple	69	69.0	7.0	G	F-G	Native, **SAR Bat**	High	Included bark, girdling roots	
1771	*Acer saccharinum*	Silver Maple	65.5, 53.5, 20	86.9	6.0	G	G	Native, **SAR Bat**	High	Included bark, BAT - squirrel nest (Decay class 1)	
1772	*Acer negundo*	Manitoba Maple	15.5	15.5	1.0	F-G	F	Native	Low	Several main leaders cut, prolific epicormics, leaning toward path	0.93
1773	*Acer negundo*	Manitoba Maple	26.5, 22, 10, 8	36.7	2.5	F	F	Native, **SAR Bat**	High	Fused crotch, dieback, slight lean toward path	2.20
1774	*Acer negundo*	Manitoba Maple	20.5	20.5	2.0	F-G	F-G	Native, **SAR Bat**	High	Slight lean adjacent to path, BAT - squirrel nest	1.23
1775	*Acer negundo*	Manitoba Maple	37	37.0	3.5	F-G	F-G	Native, **SAR Bat**	High	Damage to root flare, leaning toward path, minor dieback	2.22

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1776	*Fraxinus americana*	White Ash	15	15.0	1.0	F	F	Native	Low	Emerald Ash Borer, cracking bark, exposed sapwood, epicormics	0.90
1777	*Acer platanoides*	Norway Maple	24	24.0	1.0	F-G	F	Non-native invasive	Low	Bent trunk, old pruning	1.44
1778	*Acer negundo*	Manitoba Maple	20	20.0	2.0	F-G	F	Native	Low	Old pruned branches, bent lower trunk, leaning away from path	1.20
1779	*Thuja occidentalis*	Eastern White Cedar	11.5	11.5	0.5	F	G	Native	Low	Slightly sparse canopy	0.69
1780	*Thuja occidentalis*	Eastern White Cedar	17, 7	18.4	0.5	F	G	Native	Low	Moderately sparse canopy	1.10
1781	*Thuja occidentalis*	Eastern White Cedar	13	13.0	0.5	G	G	Native	Low	Geocache in tree	0.78
1782	*Thuja occidentalis*	Eastern White Cedar	11.5, 10.5, 10, 4	18.9	0.5	G	G	Native	Low	Leaned on by another tree	1.14
1783	*Thuja occidentalis*	Eastern White Cedar	14, 10	17.2	0.5	F	G	Native	Low	Tree leaning on, sparse canopy	1.03
1784	*Thuja occidentalis*	Eastern White Cedar	10.5	10.5	0.5	G	G	Native	Low	Slight lean	0.63
1785	*Acer negundo*	Manitoba Maple	64	64.0	3.0	G	G	Native, **SAR Bat**	High	Slight lean over path	
1786	*Thuja occidentalis*	Eastern White Cedar	11	11.0	0.5	F	G	Native	Low	Slight lean, sparse canopy	0.66
1787	*Thuja occidentalis*	Eastern White Cedar	14, 13	19.1	0.5	F	G	Native	Low	Sparse canopy	1.15
1788	*Thuja occidentalis*	Eastern White Cedar	15, 8	17.0	0.5	F	G	Native	Low	Sparse canopy	1.02
1789	*Thuja occidentalis*	Eastern White Cedar	16	16.0	0.5	F	G	Native	Low	Sparse canopy	0.96
1790	*Thuja occidentalis*	Eastern White Cedar	14	14.0	0.5	G	G	Native	Low		0.84
1791	*Thuja occidentalis*	Eastern White Cedar	15.5	15.5	0.5	G	G	Native	Low		0.93

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1792	*Thuja occidentalis*	Eastern White Cedar	13.5	13.5	0.5	G	G	Native	Low		0.81
1793	*Thuja occidentalis*	Eastern White Cedar	15.5	15.5	0.5	G	G	Native	Low		0.93
1794	*Thuja occidentalis*	Eastern White Cedar	14, 9, 7	18.1	0.5	G	G	Native	Low		1.08
1795	*Thuja occidentalis*	Eastern White Cedar	14.5, 13	19.5	0.5	G	G	Native	Low		1.17
1796	*Thuja occidentalis*	Eastern White Cedar	16	16.0	0.5	G	G	Native	Low		0.96
1797	*Thuja occidentalis*	Eastern White Cedar	16, 12, 10, 5	22.9	0.5	G	G	Native	Moderate		1.37
1798	*Acer negundo*	Manitoba Maple	19, 10	21.5	3.0	F-G	P-F	Native	Low	Epicormics, growing into fence	1.29
1799	*Thuja occidentalis*	Eastern White Cedar	13	13.0	0.5	F-G	G	Native	Low	Sparse canopy	0.78
1800	*Thuja occidentalis*	Eastern White Cedar	16.5	16.5	0.5	F-G	G	Native	Low	Sparse canopy	0.99
NT01	*Ailanthus altissima*	Tree of Heaven	19	19.0	2.0	F	P	Non-native invasive	Low	Growing in gabion baskets, leaning over creek, rubbing against another tree, dead branch, root flare	1.14
NT02	*Acer negundo*	Manitoba Maple	21	21.0	4.0	P-F	P	Native	Low	Growing in gabion baskets, horizontal lean into creek, epicormics	1.26
NT03	*Acer platanoides*	Norway Maple	27, 25, 19	41.4	2.5	F-G	P	Non-native invasive, **SAR Bat**	Low	Growing into gabion baskets, leaning over creek	
NT04	*Acer platanoides*	Norway Maple	15	15.0	2.0	P	P	Non-native invasive	Low	Growing in gabion baskets, severe lean over creek, crushed by fallen tree	0.90
NT05	*Ulmus pumila*	Siberian Elm	18	18.0	1.0	F-G	F-G	Non-native invasive	Low	Growing in rocks, slightly leaning	1.08
NT06	*Fraxinus americana*	White Ash	13	13.0	0.5	F	F	Native	Low	Emerald Ash Borer, peeling bark	0.78
NT07	*Ulmus pumila*	Siberian Elm	10	10.0	0.5	G	G	Non-native invasive	Low		0.60

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NT08	*Acer platanoides*	Norway Maple	12	12.0	0.5	G	G	Non-native invasive	Low	Slight lean	0.72
NT09	*Ulmus pumila*	Siberian Elm	14	14.0	0.5	G	G	Non-native invasive	Low		0.84
NT100	*Acer platanoides*	Norway Maple	16	16.0	2.5	G	F	Non-native invasive	Low	Growing under 1210, bent trunk	0.96
NT101	*Acer platanoides*	Norway Maple	12	12.0	2.0	G	G	Non-native invasive	Low	-	0.72
NT103	*Ulmus americana*	White Elm	11	11.0	1.5	F	P	Native	Low	Rooted in gabion baskets, severe lean over creek	0.66
NT104	*Acer negundo*	Manitoba Maple	50	50.0	2.0	P	P	Native, **SAR Bat**, HAZARD TREE	Low	Large crack, fallen over trail toward creek, HAZARD, epicormics	
NT105	*Pinus strobus*	Eastern White Pine	13, 9, 9, 7	19.5	1.0	G	F	Native	Low	Low crotch, pruned branches, suppressed	1.17

Tag Number: The identification tag number of each tree, stapled to the tree at approximately breast height.

Scientific Name: The scientific name or botanical name of each identified tree (Genus specific epithet).

Common Name: The common name of each identified tree.

DBH: Diameter-at-breast-height, measured 1.37 meters above the ground, in centimeters.

Dripline: Estimated radius of the tree canopy measured in meters.

Biological Health: Related to presence and extent of disease/disease symptoms and the vigour of the tree.

G (good) - No diseases/disease symptoms present, and moderate to high vigour.

M (Moderate) - Presence of minor diseases/disease symptoms, and/or moderate vigour.

P (Poor) - Presence of major diseases/disease symptoms, (i.e., extensive crown dieback), and/or poor vigour.

Structural Condition: Related to defects in a tree's structure, (i.e., lean, co-dominant trunks).

G (Good) - No structural defects, well-developed crown.

M (Moderate) - Presence of minor structural defects.

P (Poor) - Presence of major structural defects.

Preservation Priority: Related to the quality of tree, native status, habitat availability, and other desirable features.

H (High): high-quality native species exhibiting good health, condition, large size (generally > 30cm diameter-at-breast height), and good growing conditions, or provide habitat for wildlife or Species at Risk.

M (Moderate): native or non-native (non-invasive) trees with moderate qualities.

L (Low): introduced species, trees with poor health, poor structure, small size, and/or status as currently or potentially able to damage or interfere with existing structures.

Appendix C – SAR Screening

Schedule B Municipal Class Environmental Assessment – Project File
Cooksville Creek Erosion Control Project

Appendix C - Species at Risk Screening

Definitions:

- Endangered Species Act, Species at Risk Act, and COSEWIC status: **EXT** – Extinct; **EXP** – Extirpated; **END** – Endangered; **THR** – Threatened; **SC** – Special Concern; **NAR** – Not at Risk; **DD** – Data Deficient

- G-Rank and S-Rank: **G1/S1** - Critically Imperiled; **G2/S2** - Imperiled; **G3/S3** - Vulnerable; **G4/S4** - Apparently Secure; **G5/S5** - Secure; **GNA/SNA** - rank not applicable, typically applied to non-native species; **B** or **N** - indicator for when the rank applies specifically to breeding or non-breeding ranges

- Data Sources: **NHIC** - Ontario Natural Heritage Information Center occurrence record database; **OBBA** - Ontario Breeding Bird Atlas; **ORAA** - Ontario Reptile and Amphibian Atlas; **OBA** - Ontario Butterfly Atlas; **eBird** - eBird.org website; **iNaturalist** - iNaturalist.org website, research-grade records only; **DFO** - Government of Canada aquatic species at risk map; **General Screening** - records not available, but presence will be screened anyway due to known limitations on data

N.B.: Regarding data accuracy, the NHIC occurrence records are generalized to a 1 x 1 km square grid, so a result from that source does not necessarily indicate the presence of a species within the specific study area but does indicate they have been found in the vicinity at some point in the past. Similarly, the species atlases (OBBA, ORAA, OBA) generalize results to a 10 x 10 km grid. Results from those sources may therefore be referring to occurrences at some distance from the study area, but the noted species have been evaluated regardless as a due diligence measure. Any noted records from eBird or iNaturalist were reported from the areas within or directly adjacent to the study area, and can therefore be assumed to be more accurate in terms of their proximity to the study area.

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Appendix C - Species at Risk Screening

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Appendix C - Species at Risk Screening

Species		**Status**					**Data Source**	**Habitat Requirements (MNRF, 2000 unless otherwise cited)**	**Assessment of Species Occurrence in Study Area**
Scientific Name	**Common Name**	**SARA**	**ESA**	**COSEWIC**	**G-Rank**	**S-Rank**			
Fish									
Anguilla rostrata	American Eel	Not Listed	END	THR	G4	S1S2	NHIC	In Ontario, occurs mainly along the St. Lawrence River and Lake Ontario and their tributaries. Uses a broad diversity of habitats throughout their life cycle. Young eels use substrate such as rock, sand and mud for protection and cover. While in migration, eels occupy saltwater while during their continental phase can be found in all salinity zones. Anthropogenic factors such as hydro-dams, habitat modification and fisheries are among the factors that impact eel migration/survivability. (COSEWIC 2006)	**Not Likely Present:** Not relevant to the current study area per the aquatic habitat and fisheries assessment completed for the study.
Coregonus reighardi	Shortnose Cisco	END	END	END	GH	SH	DFO	Inhabits deep waters, substantial sampling of historical and suitable habitats in Lake Ontario since 2005 has captured other cisco species. Decline in this species is most likely due to commercial overfishing, as well as being preyed on/competing with introduced fish species. Little is known about their general biology and habitat requirements. (COSEWIC 2017)	**Not Likely Present:** Not relevant to the current study area per the aquatic habitat and fisheries assessment completed for the study. DFO mapping is associated with Lake Ontario.
Birds									
Riparia riparia	Bank Swallow	THR	THR	THR	G5	S4B	OBBA	Sand, clay or gravel riverbanks or steep riverbank cliffs; lakeshore bluffs or easily crumbled sand or gravel; gravel pits, road cuts, grassland or cultivated fields that are close to water. Nesting sites are limiting factor for species presence.	**Not Present:** Suitable habitat is not present within study area.
Hirundo rustica	Barn Swallow	THR	SC	SC	G5	S4B	NHIC, eBird, OBBA	Prefers farmland, lake/river shorelines, wooded clearings, urban populated areas, rocky cliffs and wetlands. They nest inside or outside buildings, under bridges and in road culverts, or on rock faces and caves.	**Potentially Present - Foraging Habitat Only**: Reported in the vicinity of the study area via background resources. However, there is minimal open foraging habitat present in the immediate study area, and no suitable structures are present for nest attachment.

Appendix C - Species at Risk Screening

Species		**Status**					**Data Source**	**Habitat Requirements (MNRF, 2000 unless otherwise cited)**	**Assessment of Species Occurrence in Study Area**
Scientific Name	**Common Name**	**SARA**	**ESA**	**COSEWIC**	**G-Rank**	**S-Rank**			
Haliaeetus leaucocephalus	Bald Eagle	Not Listed	SC	NAR	G4	S2N, S4B	eBird, iNaturalist, OBBA	Prefers deciduous and mixed deciduous forest; and habitat close to water bodies such as lakes and rivers.	**Potentially Present - Overwintering Habitat**: Woodlands within the study area are not conducive to breeding (i.e. there are no super-canopy pines to build nests in). However, winter hunting and roosting habitat may occur along the adjacent lakefront; multiple Bald Eagle observations have been reported along the lakefront in the vicinity via eBird.
Dolichonyx oryzivorus	Bobolink	THR	THR	THR	G5	S4B	OBBA	Forage crops fields, grassland habitats including wet prairie, graminoid peatlands and abandoned fields dominated by tall grasses, remnants of uncultivated virgin prairie (tall-grass prairie), no-till cropland, small-grain fields, restored surface mining sites and irrigated fields in arid regions (COSEWIC, 2022). Requires large tracts of grassland habitat (>50 ha).	**Not Present:** Suitable habitat is not present within study area.
Chaetura pelagica	Chimney Swift	THR	THR	THR	G4G5	S3B	eBird, OBBA	Historically found in deciduous and coniferous, usually wet forest types, all with a well-developed, dense shrub layer. Now, most are found in urban areas in large, uncapped chimneys.	**Not Present:** Suitable nesting habitat (i.e., buildings) is not present within study area. Could be found moving overhead if nesting/roosting locations are found on adjacent properties but this is not considered relevant to the current study.
Contopus virens	Eastern Wood-Pewee	SC	SC	SC	G5	S4B	eBird, OBBA	Associated with deciduous and mixed forests. Within mature and intermediate age stands it prefers areas with little understory vegetation as well as forest clearings and edges.	**Present:** Woodland habitat that is potentially suitable for nesting is found throughout the study area. Multiple records exist on eBird for this species in the study area.

Appendix C - Species at Risk Screening

Species		**Status**					**Data Source**	**Habitat Requirements (MNRF, 2000 unless otherwise cited)**	**Assessment of Species Occurrence in Study Area**
Scientific Name	**Common Name**	**SARA**	**ESA**	**COSEWIC**	**G-Rank**	**S-Rank**			
Centronyx henslowii	Henslow's Sparrow	END	END	END	G4	S1B	NHIC	Large, fallow, grassy area with ground mat of dead vegetation, dense herbaceous vegetation, ground litter and some song perches; neglected weedy fields; wet meadows; cultivated uplands; a moderate amount of moisture needed; requires a minimum tract of grassland of 40 ha, but usually in areas >100 ha. Tends to avoid fields that have been grazed or are crowded with trees and shrubs, instead preferring dense, tall grasslands where it can more easily conceal its small ground nest.	**Not Present**: Suitable habitat is not present within study area.
Falco peregrinus	Peregrine Falcon	Not Listed	SC	NAR	G4	S4	NHIC	Peregrine Falcon breeds in areas containing suitable nesting locations and sufficient prey resources. Such habitat includes both natural locations containing cliff faces (heights of 50 - 200 m preferred) and also anthropogenic landscapes including urban centres containing tall buildings, open pit mines and quarries, and road cuts, most often near water. Nests consist of a simple scrape in the substrate.	**Not Present:** Suitable nesting habitat (i.e., buildings, cliffs, ledges) is not present within study area. Could be found moving overhead or hunting nearby if nesting/roosting locations are found on adjacent properties but this is not considered relevant to the current study.
Insects									
Danaus plexippus	Monarch	SC	SC	END	G4	S2N, S4B	iNaturalist	Exist primarily where milkweed (obligate larval host plant) and other wildflowers exist. This includes abandoned farmland, roadsides and other open spaces.	**Present:** Confirmed in the study area via iNaturalist observation records. Immediate study area was not observed to contain abundant milkweed.
Mammals									

Appendix C - Species at Risk Screening

Species		**Status**					**Data Source**	**Habitat Requirements (MNRF, 2000 unless otherwise cited)**	**Assessment of Species Occurrence in Study Area**
Scientific Name	**Common Name**	**SARA**	**ESA**	**COSEWIC**	**G-Rank**	**S-Rank**			
Lasiurus borealis	Eastern Red Bat	Not Listed	Not Listed	END	G3G4	S4	General Screening	Use deciduous and coniferous forests of any age class. Maternity roosts occur in tall and large diameter trees. Switch roosting areas multiple times during breeding season, indicating any area size is suitable. Forage in a variety of habitats, including forests of any age class, open or semi-cluttered habitats, above or below canopies. (COSEWIC, 2023) *Although not listed yet under the ESA or SARA, COSEWIC designation suggests this species will likely be listed under such designations in the future.	**Present:** Species was detected during acoustic bat surveys. Suitable forest habitat for roosting is present within the study area. Forest area contains trees suitable for maternity roosts and foraging habitat throughout.
Myotis leibii	Eastern Small-footed Myotis	Not Listed	END	Not Listed	G4	S2S3	General Screening	Overwinters in humid caves and mines. Summer maternity habitat poorly understood but thought to occur mainly in rocky habitats and not trees (e.g., under loose rocks on exposed rock outcrops, crevices and cliffs, and occasionally in buildings, under bridges and highway overpasses) (Humphrey, 2017.). Changes roost locations frequently, sometimes daily. Hunts in forests (MNRF, 2000).	**Potentially Present**: Rock piles, outcrops, and other potential habitat features were not observed in the study area. One recording was identified as this species during acoustic surveys; however, given the lack of habitat and the known difficulties in identifying bats to species via acoustics, it is possible that this was a mid-identification.
Lasiurus cinereus	Hoary Bat	Not Listed	Not Listed	END	G3G4	S4	General Screening	Use deciduous and coniferous forests of any age class. Maternity roosts occur in tall and large diameter trees. Switch roosting areas multiple times during breeding season, indicating any area size is suitable. Forage in open areas such as wetlands, grasslands, open fields with patchily distributed trees. (COSEWIC, 2023) *Although not listed yet under the ESA or SARA, COSEWIC designation suggests this species will likely be listed under such designations in the future.	**Present:** Species was detected during acoustic bat surveys. Suitable forest habitat for roosting is present within the study area. Forest area contains trees suitable for maternity roosts and foraging habitat throughout.

Appendix C - Species at Risk Screening

Species		**Status**					**Data Source**	**Habitat Requirements (MNRF, 2000 unless otherwise cited)**	**Assessment of Species Occurrence in Study Area**
Scientific Name	**Common Name**	**SARA**	**ESA**	**COSEWIC**	**G-Rank**	**S-Rank**			
Myotis lucifugus	Little Brown Myotis	END	END	END	G3G4	S3	General Screening	Overwinters in humid caves and mines. Maternity roost habitat often exists in building attics, under bridges, in rock crevices, or in cavities of forest canopy trees. Roost trees will generally be tall, large-diameter snags in the early to middle stages of decay, located in open areas of mature forest (COSEWIC, 2013).	**Present:** Species was detected during acoustic bat surveys. Suitable forest habitat for roosting is present within the study area. Forest area contains trees suitable for maternity roosts and foraging habitat throughout.
Myotis septentrionalis	Northern Myotis	END	END	END	G2G3	S3	General Screening	Overwinters in humid caves and mines. Rarely uses human-made structures for maternity roosting, preferring forests with larger trees. Roost trees will generally be tall, large-diameter snags in the early to middle stages of decay, located in open areas of mature forest. Foraging occurs mainly along waterways, forest edges, and in gaps in the forest (COSEWIC, 2013).	**Present:** Species was detected during acoustic bat surveys. Suitable forest habitat for roosting is present within the study area. Forest area contains trees suitable for maternity roosts and foraging habitat throughout.
Lasionycteris noctivagans	Silver-haired Bat	Not Listed	Not Listed	END	G3G4	S4	General Screening	Relies on habitats where large, decaying trees are available as they roost primarily under bark and in cavities. Will roost in both coniferous and deciduous large diameter trees. Reproductive females will roost in groups. May occasionally use anthropogenic structures for roosting when natural roosting sites may be scarce. Forage in young and old forest, forest openings, edges and riparian zones during migration. (COSEWIC, 2023) *Although not listed yet under the ESA or SARA, COSEWIC designation suggests this species will likely be listed under such designations in the future.	**Present:** Species was detected during acoustic bat surveys. Suitable forest habitat for roosting is present within the study area. Forest area contains trees suitable for maternity roosts and foraging habitat throughout.

Appendix C - Species at Risk Screening

Species		**Status**					**Data Source**	**Habitat Requirements (MNRF, 2000 unless otherwise cited)**	**Assessment of Species Occurrence in Study Area**
Scientific Name	**Common Name**	**SARA**	**ESA**	**COSEWIC**	**G-Rank**	**S-Rank**			
Perimyotis subflavus	Tricoloured Bat	END	END	END	G3G4	S3?	General Screening	Overwinters in humid caves and mines; considered to have narrower range of conditions for hibernation than the other listed bat species. Maternal roosts can occur in trees or dead clusters of leaves or arboreal lichens on trees; large-diameter oaks and maples preferred. May also use barns or similar structures (COSEWIC, 2013; MNRF, 2017).	**Present:** Species was detected during acoustic bat surveys. Suitable forest habitat for roosting is present within the study area. Forest area contains a large number of trees suitable for maternity roosts and foraging habitat throughout.
Reptiles and Amphibians									
Emydoidea blandingii	Blanding's Turtle	THR	THR	END	G4	S3	ORAA	Generally occur in freshwater lakes, permanent or temporary pools, slow-flowing streams, marshes and swamps. They prefer shallow water that is rich in nutrients, organic soil and dense vegetation. Adults are generally found in open or partially vegetated sites, and juveniles prefer areas that contain thick aquatic vegetation including sphagnum, water lilies and algae. They dig their nest in a variety of loose substrates, including sand, organic soil, gravel and cobblestone. Overwintering occurs in permanent pools that average about one metre in depth, or in slow-flowing streams.	**Not Likely Present:** Lack of connectivity to wetlands, low in-water vegetation cover, and lack of observed potential nesting sites suggests this species is not in the study area.
Lampropeltis triangulum	Eastern Milksnake	SC	NAR	SC	G5	S4	ORAA	This habitat generalist may utilize a variety of different habitats including open or forested natural areas, but shows preference to sites that can provide hibernation opportunities (old foundations, mammal burrows, old logs, etc.) and are in close proximity to water. (COSEWIC, 2014)	**Potentially Present:** Not observed during field investigations but could feasibly occur in the study area based on habitat features present (e.g. generalist habitat along river corridor, moderate connectivity to other natural areas)

Appendix C - Species at Risk Screening

Species		**Status**					**Data Source**	**Habitat Requirements (MNRF, 2000 unless otherwise cited)**	**Assessment of Species Occurrence in Study Area**
Scientific Name	**Common Name**	**SARA**	**ESA**	**COSEWIC**	**G-Rank**	**S-Rank**			
Sternotherus odoratus	Eastern Musk Turtle	SC	SC	SC	G5	S3	ORAA	This cryptic species is generally found in aquatic habitats such as shallow slow-moving water of lakes, streams, marshes and ponds with abundant emergent vegetation. Winter hibernation takes place in underwater mud, in banks or in muskrat lodges, and individuals sometimes congregate at hibernation sites. Eggs are laid in debris or under stumps or fallen logs at waters edge; this species often share nest sites.	**Not Present:** Habitat in the study area does not match the preferred habitat requirements for this species.
Chrysemys picta marginata	Midland Painted Turtle	SC	Not Listed	SC	G5T5	S4	Aquafor, iNaturalist, ORAA	Generally inhabit slow-moving water areas such as ponds, marshes, lakes and creeks with soft mud and aquatic vegetation. Also require basking objects such as logs and rocks at the water's surface. Midland Painted turtles often take advantage of man-made structures for nest sites, including roads (especially gravel shoulders), dams and aggregate pits.	**Present:** Aquafor's aquatic biology staff observed one Midland Painted Turtle in the study area.
Graptemys geographica	Northern Map Turtle	SC	SC	SC	G5	S3	ORAA	Large bodies of water with soft bottoms and aquatic vegetation, basks on logs or rocks or on beaches and grassy edges. Uses soft soil or clean dry sand for nest sites, may nest some distance from water. Home ranges can range from can be anywhere between 2.2 - 7.8 km^2.	**Potentially Present:** Prefers large bodies of water, so possibly present within Lake Ontario and the lower reaches of the creek, but not in more upstream portions of the study area where the water becomes shallower.
Chelydra serpentina	Snapping Turtle	SC	SC	SC	G5	S4	ORAA	Generally inhabit shallow waters where they can hide under the soft mud and leaf litter. Nesting sites usually occur on gravely or sandy areas along streams. Snapping turtles often take advantage of man-made structures for nest sites, including roads (especially gravel shoulders), dams and aggregate pits.	**Present:** Aquafor's aquatic biology staff observed young Snapping Turtle in the study area.

Appendix C - Species at Risk Screening

Species		**Status**					**Data Source**	**Habitat Requirements (MNRF, 2000 unless otherwise cited)**	**Assessment of Species Occurrence in Study Area**
Scientific Name	**Common Name**	**SARA**	**ESA**	**COSEWIC**	**G-Rank**	**S-Rank**			
Pseudacris triseriata maculata pop. 1	Western Chorus Frog - Great Lakes - St. Lawrence - Canadian Shield population	THR	NAR	THR	G5TNRQ	S4	ORAA	Habitat for this species typically consists of marshes or wooded wetlands, particularly those with dense shrub layers and grasses. Prefers fishless ponds with at least 10 cm of standing water for breeding (Environment Canada, 2015). This species hibernates in terrestrial habitats under rocks, dead trees or leaves, in loose soil or in animal burrows.	**Not Present:** Suitable habitat not present within study area; no ponds and little to no grass or shrub layers.

Appendix D – Wildlife Species List

Appendix D - Wildlife Observation Species List

Common Name	Scientific Name	Comments
Insects		
Common Eastern Bumblebee	*Bombus impatiens*	
Birds		
American Crow	*Corvus brachyrhynchos*	
American Goldfinch	*Spinus tristis*	
American Robin	*Turdus migratorius*	
Baltimore Oriole	*Icterus galbula*	
Belted Kingfisher	*Megaceryle alcyon*	
Black-capped Chickadee	*Poecile atricapillus*	
Black-crowned Night Heron	*Nycticorax nycticorax*	Juvenile observed foraging on two occasions, adult foraging on one occasion. Provincially rare (S3 breeding; S2 non-breeding)
Blue-gray Gnatcatcher	*Polioptila caerulea*	
Blue Jay	*Cyanocitta cristata*	
Bufflehead	*Bucephala albeola*	
Canada Goose	*Branta canadensis*	
Cedar Waxwing	*Bombycilla cedrorum*	
Common Merganser	*Mergus merganser*	
Common Grackle	*Quiscalus quiscula*	
Double-crested Cormorant	*Phalacrocorax auritus*	
Downy Woodpecker	*Dryobates pubescens*	
European Starling	*Sturnus vulgaris*	
Gray Catbird	*Dumetella carolinensis*	
House Finch	*Haemorhous mexicanus*	
Killdeer	*Charadrius vociferus*	Calling from nearby, not within site
Mallard	*Anas platyrhynchos*	>40 individuals observed within creek. Adults with young seen in June, confirming breeding activity in or near study area.
Mourning Dove	*Zenaida macroura*	
Mute Swan	*Cygnus olor*	
Northern Cardinal	*Cardinalis cardinalis*	
Red-bellied Woodpecker	*Melanerpes carolinus*	
Red-breasted Nuthatch	*Sitta canadensis*	
Red-necked Grebe	*Podiceps grisegena*	Provincially rare (S3)

Appendix D - Wildlife Observation Species List

Common Name	**Scientific Name**	**Comments**
Red-winged Blackbird	*Agelaius phoeniceus*	
Ring-billed Gull	*Larus delawarensis*	
Turkey Vulture	*Cathartes aura*	Flyover
Warbling Vireo	*Vireo gilvus*	
White-breasted Nuthatch	*Sitta carolinensis*	
Reptiles		
Eastern Garter Snake	*Thamnophis sirtalis sirtalis*	
Red-eared Slider	*Trachemys scripta elegans*	
Mammals		
American Red Squirrel	*Tamiasciurus hudsonicus*	
Beaver	*Castor canadensis*	Chewed trees observed
Chipmunk	*Tamias striatus*	
Eastern Cottontail	*Sylvilagus floridanus*	
Eastern Gray Squirrel	*Sciurus carolinensis*	
Raccoon	*Procyon lotor*	One individual found dead under additional tracks found along creek
Red Fox	*Vulpes vulpes*	Observed crossing bridge
Striped Skunk	*Mephitis mephitis*	Identified by scent

Appendix E – Stage 1 Archaeological Assessment Report

Stage 1 Archaeological Background Study

Original Report

2023

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Cooksville Creek Erosion Control
Part of Lot 11, Concession 3 South of Dundas Street,
(Former Township of Toronto, County of Peel),
City of Mississauga, Regional Municipality of Peel

Prepared For
Aquafor Beech Limited
Mississagua, Ontario

Project Information
Archaeological License: P1024 (Sarah MacKinnon MSc.)
MTCS PIF#: P1024-0311-2023
Corporate File #: 221-2023
Development Project Designation #: N/A

December 30th, 2023

New Era ARCHAEOLOGY
neweraarchaeology.ca
contact@neweraarchaeology.ca

EXECUTIVE SUMMARY

The City of Mississauga is addressing erosion along part of Cooksville Creek and as part of the processes New Era Archaeology Inc. was retained by Aquafor Beech Ltd. to complete a Stage 1 Archaeological Background Study and was given permission to access the project area to conduct all required archaeological fieldwork activities. This report describes the Stage 1 Archaeological Background Study for the Cooksville Creek Erosion Control within, Part of Lot 11, Concession 3 South of Dundas Street, (Former Township of Toronto, County of Peel), City of Mississauga, Regional Municipality of Peel. The study was conducted under Professional Archaeological License P1024 issued by the Minister of Citizenship and Multiculturalism (Ontario) to Sarah MacKinnon. The Stage 1 Archaeological Background Study was undertaken under the Class Environmental Assessment (1990). This report confirms that all the work conducted as part of this assessment conforms to the *Standards and Guidelines for Consultant Archaeologists* (MCM 2011) and the *Ontario Heritage Act* (MCL 2005).

The objectives of the Stage 1 Background Study are to determine if the project area has the potential to contain archaeological resources and determine if any past use activities within the project area have removed areas of potential. The *Checklist for Determining Archaeological Potential* and the 2011 *Standards and Guidelines for Consultant Archaeologists* (MCM 2011) published by the Ontario Ministry of Citizenship and Multiculturalism (MCM 2011) outlines features and the buffers around these features within which there is potential for archaeological resources. There are two groups of features, one for Indigenous (pre-contact) potential and one for Euro-Canadian (post-contact) archaeological potential. The main feature, which indicates potential for Indigenous archaeological resources, is the proximity to a potable water source. Additional features include topography, soil type and proximity to previously identified archaeological sites. Historic potential is based on proximity to historic features such as structures, roads, railways, settlements and previously identified archaeological sites.

The Stage 1 Archaeological Background Study involved the review of historical records, historic maps, current aerials, and project area inspection to confirm the current conditions of the project area. Both historic and current resources are consulted to identify areas of archaeological potential and activities conducted within the project area, which have removed potential. This information is used to determine if the project area has archaeological potential, note areas of no potential, and recommend appropriate strategies for Stage 2 for areas of archaeological potential. Prior to the site visit, it was determined that the project area has potential for both Indigenous (pre-contact) and Euro-Canadian (post-contact) archaeological resources and that past activities resulting in deep disturbance have removed potential within the project area. The site visit was completed on December 12th, 2023, to confirm the current conditions of the project area.

As a result of the Stage 1 Archaeological Background Study, it was determined that the project area has potential for both pre-contact and post-contact archaeological resources. It has also been determined that a portion of the project area has undergone significant disturbances relating to previous construction activities. Archaeological potential remains for portions of the project area, consequently, Stage 2 Archaeological Assessment by test pit survey is recommended.

DRAFT

TABLE OF CONTENTS

EXECUTIVE SUMMARY **2**

1.0 PROJECT CONTEXT **6**

1.1 DEVELOPMENT CONTEXT 6

1.2 HISTORICAL CONTEXT 6

1.2.1 Ontario Prehistory *6*

1.2.2 General Indigenous Overview *9*

1.2.3 Peel County Historic Overview *11*

1.2.4 Township of Toronto *13*

1.2.5 Historic Mapping *14*

1.3 ARCHAEOLOGICAL CONTEXT 15

1.3.1 Previously Registered Sites *15*

1.3.3 Current Land Use and Field Conditions *15*

1.3.4 Physiographic Region *15*

1.3.5 Water Resources *17*

2.0 SITE VISIT **17**

3.0 ANALYSIS AND CONCLUSIONS **18**

3.1 STAGE 1 BACKGROUND RESULTS 18

4.0 RECOMMENDATIONS **18**

5.0 ADVICE ON COMPLIANCE WITH LEGISLATION **19**

6.0 BIBLIOGRAPHY **20**

7.0 MAPS **21**

8.0 PLATES **27**

DRAFT

LIST OF MAPS

Map 1: Location of Project Area 21
Map 2: Historic Map Illustrating the Environment Surrounding the Property Area in 1859 21
Map 3: Historic Map Illustrating the Environment Surrounding the Property Area in 1877 22
Map 4: Project Area on National Topographic Survey from 1909 22
Map 5: Project Area on National Topographic Survey from 1929 23
Map 6: Project Area on Historic Aerial from 1954 23
Map 7: Project Area on Historic Aerial from 1980 24
Map 8: Project Area on Historic Aerial from 1985 24
Map 9: Project Area 25
Map 10: Stage 1 Archaeological Background Study Results 25
Map 11: Stage 1 Archaeological Background Study Results 26

LIST OF TABLES

Table 1: General Indigenous History Throughout Ontario 6
Table 2: Site Visit Documentary Record Inventory 17

LIST OF PLATES

Plate 1: Wooded Park Land 27
Plate 2: Asphalt Pathways and Two Manholes Between Them 27
Plate 3: Wooded Area Along Lake Ontario 27
Plate 4: Cooksville Creek 27
Plate 5: Cooksville Creek Emptying into Lake Ontario 27
Plate 6: Wooded Area Along the Creek and Manhole 27
Plate 7: Wooded Area Along the Creek 28
Plate 8: Wooded Area Along the Creek 28
Plate 9: Wooded Area and Gibbons Along the Creek 28
Plate 10: Wooded Area Along the Creek 28
Plate 11: Asphalt Pathway Surrounded by Mature Trees; Manhole 28
Plate 12: Sewer Outlets Emptying into Creek 28
Plate 13: Elevated Pathway Surrounded by Trees and Lawn 29
Plate 14: Elevated Pathway Surrounded by Trees and Lawn 29
Plate 15: Asphalt Pathway Surrounded by Mature Trees 29
Plate 16: Asphalt Pathway Surrounded by Mature Trees 29
Plate 17: Infrastructure Where Cooksville Creek Passes Under Lakeshore Road East 29
Plate 18: Cooksville Creek 29

DRAFT

PROJECT PERSONAL

LICENSED ARCHAEOLOGIST:
Sarah MacKinnon MSc. (P1024)

FIELD DIRECTOR:
Sarah MacKinnon MSc. (P1024)

REPORT PREPARATION:
Kayleigh MacKinnon MSc. (P384)

REPORT MAPPING:
Kayleigh MacKinnon MSc. (P384)

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1.0 PROJECT CONTEXT

1.1 DEVELOPMENT CONTEXT

The City of Mississauga is addressing erosion along part of Cooksville Creek and as part of the processes New Era Archaeology Inc. was retained by Aquafor Beech Ltd. to complete a Stage 1 Archaeological Background Study and was given permission to access the project area to conduct all required archaeological fieldwork activities. This report describes the Stage 1 Archaeological Background Study for the Cooksville Creek Erosion Control within, Part of Lot 11, Concession 3 South of Dundas Street, (Former Township of Toronto, County of Peel), City of Mississauga, Regional Municipality of Peel. The study was conducted under Professional Archaeological License P1024 issued by the Minister of Citizenship and Multiculturalism (Ontario) to Sarah MacKinnon. The Stage 1 Archaeological Background Study was undertaken under the Class Environmental Assessment (1990). This report confirms that all the work conducted as part of this assessment conforms to the *Standards and Guidelines for Consultant Archaeologists* (MCM 2011) and the *Ontario Heritage Act* (MCL 2005).

1.2 HISTORICAL CONTEXT

1.2.1 Ontario Prehistory

Table 1: General Indigenous History Throughout Ontario

Period	Date Range	Cultural Group	Diagnostic Material	Period Details
Paleo-Indian – ca. 11,000-7,500 BC				
Early	ca. 11,000-8,500 BC	Clovis, Plano	Fluted projectile points	The continental glacier covering Ontario continued to recede north exposing more habitable land for flora and fauna attracting the nomadic hunters from the south-west. These hunter-gatherers set up sites along shorelines, with fish a main dietary staple and would periodically gather into larger groups typically during the summer months when food was more abundant. The Clovis culture remained in Southern Ontario where the Plano culture moved into Northern Ontario
Late	ca. 8,500-7,500 BC		Plano, Holxombe, Hi-Lo projectile points	
Archaic – ca. 7,800-1,000 BC				
Early	ca. 7,800-6,000 BC	Shield Archaic, Laurentian Archaic	Bifurcate, nettling projectile points	Small nomadic hunter-gatherer bands slowly transition to small territorial camps. There is a continuation of gathering into larger groups in the summer and dispersing into smaller groups over the winter. Dependence on hunting meant that great distances were often covered throughout the year. There is an increase in the use of localized material and the re-purposing of stone tools. Local and long-distance trade networks appear leading to an influx of exotic material and goods, including natural copper and conch shells, often used as grave offerings. Trading often occurred in the summer months when groups came together at the mouths of rivers to take advantage of the spawning fish. The open water also allowed for easier travel over longer distances.
Middle	ca. 6,000-2,000 BC		Brewerton, Stanly, Side-notched projectile points	
Late	ca. 2,500-1000 BC		Lamoka, Adder Orchard, Genesee, Lamoka, Innes, Crawford Knoll, Innes, Hind projectile points	

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				The bow and arrow was adopted towards the end of the period, which was already in use on the east coast. The Plano cultural group are the ancestors of the Shield Archaic and the Clovis are ancestors of the Laurentian Archaic.
Woodland – ca. 1,000 BC – AD 1600				
Early	ca. 1000-400 BC	Meadowood, Middlesex	Birdstones, Cache blades, Kramer, Meadowood projectile points	Hunter-gatherer groups continue to come together in the warmer months and disperse in the fall occupying the margins of Southern Ontario. Both large and small campsites have been identified. The same trade networks are maintained. One distinguishing characteristic of this period is the introduction of pottery. Burial ceremonialism is also practiced. Late Archaic ancestors. The Meadowood culture is changed or absorbed by Point Peninsula.
Middle	ca. 400 BC - AD 700	Point Peninsula, Saugeen	Vanport, Snyder, Saugeen projectile points	Hunter-gatherers, but evidence of increased sedentism and seasonal site reuse and emergence of horticulture. Diets expanded to include the collection of wild fruits and wild rice. More intricate burial ceremonialism adopted from Hopewell culture to the south, as a result of trade networks, including the use of burial mounds. More decorative pottery techniques also appear including stamped and scalloped techniques. Items from the Ohio Valley also start to appear for the first time including stone platform pipes, copper ear spools and copper panpipes. Point Peninsula sites in the Toronto, Quebec and New York areas. Saugeen sites found in the area between Lake Huron and Lake Erie west of Toronto.
Transitional	ca. AD 600 - 1000	Princess Point, Laurel	Princess Point pottery, Triangular projectile points	Princess Point sites remain smaller in size located along the north shore of Lake Erie and the west end of Lake Ontario. They are the first to adapt corn in Ontario, which spread northeast from Mexico. Princess Point pottery decorative techniques include cord-wrapped stick and punctuates. The Shield Archaic are ancestors of the Laurel culture who occupied Northern Ontario, Western Quebec and areas to the west and received their pottery knowledge from Point Peninsula and Saugeen cultures. The Laurel also created some of the largest burial mounds.
Late - Early	ca. AD 900 - 1300	Glen Meyer, Pickering	Glen Meyer Tanged-Triangular projectile point	The Pickering culture developed out of the Point Peninsula culture and occupied an area between Lake Ontario and Georgian Bay to Lake Nipissing. The Glen Meyer culture developed out of the Princess Point culture and occupied southwestern Ontario between Long Point and Lake Huron. Small single-family houses change to larger multi-family longhouses within small village sites with the appearance of palisades at some. There is an increase in corn agriculture. Pottery vessels are thinner walled with improved manufacturing. There is a switch in burial customs to the use of burial pits, a precursor to large ossuaries. Towards the end of the period pipes become more common.
Late - Middle	ca. AD 1300 - 1400	Uren, Middleport, Lalonde	Middleport projectile points	Increase in village size and reliance on agriculture including corn, beans and squash. Farming provided increased food resources with better nutrition allowing populations to grow. Decrease in decorated pottery vessels and an increase in decorative pipes including effigy pipes. Some sites still include a palisade.

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Late - Late	ca. AD 1400 - 1600	Ontario Iroquoian	Nanticoke, Daniels Triangular projectile points	Village size increased and locations were strategically picked to ensure enough arable land as their diets were heavily dependent on agriculture. Locations were also chosen for their proximity to woodlots for both heating and building, proximity to water and a location which could be easily defended. Good hunting grounds to support the growing village population became important and as a result hostilities over these hunting grounds increased with neighboring communities. Emergence of tribes and territories. Dogs were domesticated and large ossuaries become common. Towards the end of the period the first Europeans goods appear periodically in Ontario through trade networks with groups further east who were in contact with the first French explorers who had reached the St. Lawrence.
Contact-Historic – ca. AD 1600-1800				
European Contact	AD 1600-1650	Huron, Neutral, Petun, Odawa, Ojibwa	Minimal European items	Establishment of the fur trade. Increase in warfare resulted in tribal disbursement leaving much of the area between Lake Ontario and Lake Simcoe with no permanent large villages. Many villages move north of Lake Simcoe further away from the Iroquois. Continued warfare from the Iroquois to the south resulted in the dispersal of the remaining Huron-Wendat and abandonment of their remaining villages and resettlement in Quebec at the closing of this period. The French arrive in Ontario with an increase in Jesuit missionaries and European goods.
Late	AD 1650- ca. 1800	Algonquin, 6 Nations Iroquois,	Mixture of Indigenous and European items	The Iroquoian continued to use their conquered land of Southern Ontario as mainly hunting grounds with a few settlements located along the shoreline of Lake Ontario. The Iroquoian were then challenged and pushed out of the region by the Anishinaabeg (Ojibway, Chippewa, Odawa). Trade continued with both English and French. Numerous migrations and resettlements. The end of this period there saw an influx of European and American settlers transitioning to the historic period.

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1.2.2 General Indigenous Overview

1.2.2.1 Southern Ontario

As the glaciers that covered southern Ontario began to retreat approximately 12,500 years ago, the area began to become habitable for the Paleo-Indian hunting bands arriving between 11, 000 and 10,500 years ago finding large meltwater lakes formed in the wake of the retreat. The lakes were accompanied by relatively barren tundra interspersed with areas of open boreal forest. The Paleo-Indian hunters focused on the large Pleistocene mammals including mastodon, moose, elk, and especially herds of caribou that roamed the area. Following the herds of animals, the Paleo-Indian groups travelled long distances and seldom stayed in one campsite for a significant length of time leaving behind little material culture. Stone tools and by-products of their flaked stone industry are virtually all that remains. They manufactured large distinctive spear points that have a prominent channel or groove on each face. Campsites from this period are frequently found adjacent to remnant shorelines of large post-glacial lakes indicating that camping sites were set up along the shores of lakes to intercept migrating herds. The water levels of the Lake Ontario basin fell in the early post-glacial period and subsequently rose again to modern levels resulting in these campsites now being situated more than a kilometer into the lake (Archaeological Services Inc. 2014).

The Archaic Period (7,000 B.C – 1,000 B.C) saw a mixed needle and broadleaf forest cover established in Ontario and nomadic hunter-gatherers hunted deer, moose, as well as other animals, fished and gathered plant resources while moving relatively large distances over the landscape during the year. From the archaeological record, the technological and cultural change can be identified including a wide variety of tools produced which resulted in shifts in hunting strategies to adjust to a constantly evolving environment. During the Late Archaic period hunter-gatherer bands most likely settled into familiar hunting territories. Two types of sites evolved as a result of their hunting patterns, the small inland camps that were occupied by small groups of related families during the fall and winter where they could harvest nuts and hunt deer, and the larger spring and summer settlements that were located near river mouths where groups came together to trade, exploit spawning fish resources and to bury their dead. Many of the ground stone tools have both social and symbolic functions, they had a day-to-day use, but their inclusion in burials ascribes to them a sacred intent (Archaeological Services Inc. 2014).

The Woodland Period (1,000 B.C – 1600 A.D.) is distinguished from the previous Archaic period with respect to settlement patterns and subsistence pursuits and is most specifically marked by the instruction of ceramics into Ontario. Though the appearance of these ceramics provides a temporal marker for archaeologists their use does not seem to have profoundly changed the hunter-gatherer lifestyle of the previous period. The Iroquoian society flourished in the southern Great Lakes region in the Late Woodland Period. Increasingly sophisticated burial ceremonies and an increase in the trade of exotic items developed which may have come out of the need for greater social solidarity as the population increased causing competition for resources. Trade with communities living south of the Great Lakes introduced maize and squash creating a transition to food production that then reduced reliance on naturally occurring resources and led to less movement as people tended to their crops. As sites were more intensively occupied the need for a greater degree of internal spatial organization came about which can be seen in the archaeological record (Archaeological Services Inc. 2014). The ancestors of the Neutral, Huron, and Petun resided along the central north shore of Lake Ontario and the ancestral Iroquoians became the Five Nation Iroquois (Seneca, Cayuga, Onondaga, Oneida, and Mohawk) occupied the area south of Lake Ontario in what is now central New York State. Though there were most likely interactions between these Iroquoian-speaking groups it was not until the mid to late 17th century that the Five Nation Iroquois inhabited the Toronto area. The focus on agricultural practices led to a more sedentary lifestyle with larger communities coming together and forming alliances with separate villages. Some villages were fortified with palisade walls with land cleared around them for crops. By the time European explorers and missionaries arrived in Ontario at the beginning of the 17th century the villages were

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under the direction of various chiefs elected from the principal clans and subsequently allied within powerful tribal confederacies (Archaeological Services Inc. 2014).

By 1600 most of the Lake Ontario north shore communities had moved northward joining communities in Simcoe County to form the Petun and Huron. Though the movement of these communities took place over many generations the conflict with the Five Nations Iroquois of New York State was the final impetus. The collapse and dispersal of the three Ontario Iroquoian confederacies (the Huron, the Petun, and the Neutral) during the first half of the 17th century was caused by intertribal warfare with the Five Nations Iroquois and exacerbated by the intrusion of Europeans (Archaeological Services Inc. 2014).

1.2.2.2 Peel County

While Indigenous groups have long inhabited Southern Ontario, during the 1600s it was those in the Iroquois Confederacy (also known as Five Nations) who controlled large areas, including what is now known as Peel. By the 1700s the Iroquois had become weakened by disease and warfare with the French and were pushed out of the area by the Anishinaabeg as they migrated southward to settle along the north shore of Lake Ontario. This group would later become known as the Mississaugas by European settlers (Peeling the Past, 2017).

After the Seven Years War between Britain and France ended in 1763 the overall control of the lands that now comprise Ontario and Quebec were ceded by France to the British who continued to maintain forts at Kingston and Niagara. The influx of settlers after the American Revolution and the subsequent migration of Loyalist settlers convinced the British Crown to formally acquire new lands for settlement through a series of land purchases from Indigenous groups including the Mississaugas. Between 1783 and 1818 tracts of land within Ontario were purchased and surveyed for settlement (Peeling the Past, 2017).

> *On August 2nd, 1805 the British and Mississaugas signed a treaty covering the southern portion of the "Mississauga Tract" on the Lake Ontario waterfront, reaching from the Etobicoke Creek on the east to Burlington Bay on the west, and running north to what in Peel is known as the Second Concession North of Dundas Street (also known as Eglinton Avenue). Within a year the land was surveyed and divided into "Townships" for settlement purposes. The township in the Peel area was known as Toronto Township (now the City of Mississauga). It is interesting to note that the naming of this Township predated the incorporation of the City of Toronto in 1834 (founded as the Town of York in 1793).*
>
> *When Toronto Township was purchased the Mississaugas withheld a strip of land 1 mile wide on either side of the Credit River. The rest of the land was surveyed, and settlement began in earnest. Small hamlets sprung up at crossroads throughout the Township, including Summerville and Dixie. These hamlets were usually composed of a blacksmith shop, general store, church, and perhaps an inn or hotel. By 1818 the need for more land was apparent, and negotiations were started to purchase the remaining Mississauga land north of Eglinton Avenue. That same year 648,000 additional acres were purchased* [Treaty 19]*, and by 1819 the land was surveyed and divided into Townships. The Peel area now included an enlarged Toronto Township, as well as four additional townships: Chinguacousy, Toronto Gore, Albion, and Caledon. In February 1820 the Mississaugas surrendered the last of their lands along the Credit River, only keeping a small piece for a village that they subsequently abandoned in 1847 (now the Mississaugua Golf and Country Club).*
>
> (Peeling the Past, 2017).

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The project area is located within the traditional territory of the Mississaugas of the Credit River First Nation and included within the Ajetance Purchase (Treaty No. 19), the last large tract of land they ceded. The Ajetance Purchase includes lands within the Halton and Peel Regions and Dufferin and Wellington Counties. On October 23rd, 1818, members of the Mississaugas of the River Credit and Twelve and Sixteen Mile Creeks as well as, Chief of the Eagle Tribe, Weggishigomin of the Eagle Tribe, Kawwahkitahqubi of the Otter Tribe, Cabibonike of the Otter Tribe, and Pagitaniquatoibe of the Otter Tribe met with Deputy Superintendent William Claus on behalf of His Majesty to discuss the purchase of land (Filice 2018, Mississaugas of the Credit First Nation 2017b, Surtees 1984, Crown-Indigenous Relations and Northern Affairs 2016). The treaty was signed on October 28th, 1818, and included:

> *"A tract of land in the Home District, called the Mississauga tract," bounded southerly by the purchase made in 1806; on the east by the Townships of Etobicoke, Vaughan and King; on the south-west by the Indian purchase, extending from the outlet at Burlington Bay, north forty-five degrees west fifty-miles, and from thence north seventy-four degrees east or thereabout to the north-west angle of the Township of King, containing by computation six hundred and forty-eight thousand acres; and the said Adjutant, Weggishigomin, Cabibonikem, Pagitaniquatoibe and Kawahkitahquebi, as well for themselves as for he Mississauga Nation inhabiting and claiming the said tract of land as above described, do freely, fully and voluntarily surrender and convey the same to His Majesty without reservation or limitation in perpetuity. And the said William Claus, on behalf of His Majesty does hereby, promise and agree to pay to the said Nation of Indians inhabiting as above mentioned, yearly and every year for ever the said sum of five hundred and twenty two pounds then shillings currency in goods at the Montreal price, which sum the said Principal Chiefs and people, parties hereunto, acknowledge as a full consideration for the lands hereby sold and conveyed to His Majesty.*
>
> (Crown-Indigenous Relations and Northern Affairs 2016)

The Mississaugas had negotiated the sale of all their territory with the exception of 200 acres near the mouth of the Credit River by 1820 (Filice 2018, Mississaugas of the Credit First Nation 2017b, Surtees 1984).

1.2.3 Peel County Historic Overview

In 1788 four Districts were created including the Nassau District (later the Home District) which included what would later become the County of Peel. Then in 1791, the province of Quebec was divided into Upper Canada and Lower Canada, and the Home District became part of Upper Canada with most of what is now southern Ontario (Walker & Miles, 1877, Mercer et al 1885).

Lieutenant-Colonel John Graves Simcoe was appointed the first Lieutenant-Governor of Upper Canada. He moved the capital from Newark (Niagara) to Toronto, which he renamed York in honour of the King's son Frederick the Duke of York, in order to provide it more protection. In 1792 he divided Upper Canada into 19 Counties and created a road system. To establish and open the road system Governor Simcoe brought troops over from England. He also employed them in other building operations and posted them along these roadways. The establishment of a road system prepared the Counties for an influx of settlers and aided settlers on their journey to their new home (Mercer et al 1885). The Home District, albeit with the inclusion of fewer townships, continued until the institution of districts was abolished in 1852 and as a result the united County of York, Peel and Ontario was formed. The County of Ontario was the first to separate. It was not until 1866 that Peel was separated from York. After some time, the Village of Brampton was finally selected as County Town and the County buildings were erected at a cost of over $40,000. The first council met at the Brampton Court House in January 1867 (Walker & Miles, 1877).

The County of Peel was named after Sir Robert Peel (1788-1850), a British politician who served as both Home Secretary and Prime Mister of Great Britain (Walker & Miles, 1877). Located on the north shore of Lake Ontario,

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bounded on the east by the County of York, on the north by the Counties of Simcoe and Wellington, and on the west by the Counties of Wellington and Halton, it is comprised of the Townships of Toronto, Toronto Gore, Chinguacousy, Caledon and Albion, the incorporated Town of Brampton, and the incorporated villages of Streetsville and Bolton. As a small County, it contains 293,300 acres of land measuring 37 miles in length with an average width of 15 miles. A chain of ridges runs through it dividing it into two distinct sections, entering at Caledon at a south-west angle and passing out of the County approximately midway through the eastern boundary of Albion. The two sections are distinct in character of soil and climate as well as general appearance above and below this chain. The land in the lower region is gently undulating with a gradual but continual ascent from the Lake to the base of the ridges where it then rises nearly perpendicular. In other areas, it is broken for some miles, with hills over hills making it difficult to ascertain when you have actually ascended the range with the mountain about 900 feet above the level of Lake Ontario (Walker & Miles, 1877).

Generally, the roads through Peel were considered of good quality and were opened and more or less travelled between every two concessions as well as side roads every five lots. One of the main roads, Dundas Street, passes through the front part of Toronto Township. This road was partly graveled and macadamized by grants from the Legislature in 1836. Settlement was concentrated along Dundas Street and being heavily travelled meant good business for shops and other businesses established along it. Another well-travelled road, first planked by a private company and later graveled, was Lakeshore. Hurontario Street, which runs from Port Credit north-west through the center of Toronto, Chinguacousy and Caledon, and then through to Collingwood was also well-travelled. Another key road was cut through the sixth line that extends from Dundas St. north, west to Mono Mills in Mono, on the west, and the Gore and Albion on the East. The Grand Trunk Railroad and the Toronto Grey and Bruce Railroads run through the County with the Credit Valley Railway being added shortly after (Walker & Miles, 1877). The County, like many others, benefitted economically from the railway.

The County is well watered with running streams of various sizes throughout. The Credit River, considered to be the principal River, provides an excellent stream of water which runs through the western part of the County. The numerous branches of the river provide a source of wealth for many communities, including Caledon where waterpower is supplied. The Humber River also plays an important role in the County and specifically to Albion where it provides waterpower through its tributaries. Each township had several mills which utilized the numerous waterways (Walker & Miles, 1877).

1819 and the following years saw the greater part of the County settled, though the old survey of Toronto Township was thinly settled in 1808 or 1810. Many first settlers came from New Brunswick, the United States, and other parts of Upper Canada. Some of the first settlers in the ‘New Survey’ of Toronto Township included a colony of Irish families from New York City who came to their grants of land in 1819 under the Superintendence of Messrs. Beaty and Graham. U.E. Loyalists and their descendants were the main settlers of Chinguacousy as well as a number of other inhabitants of Upper Canada. The other townships were mostly made of emigrants from the old country (Walker & Miles, 1877).

At the time the first regular organization of all the townships that became the County of Peel was made in 1821 the population was only 803, however, settlement within the County continued to grow steadily and by 1871 the population had risen to 26,011 inhabitants (Walker & Miles, 1877). By 1877 life in the County was becoming easier with fewer hardships as farms were well established and more and more shops, mills and other businesses had been opened.

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1.2.4 Township of Toronto

Toronto Township located in the southeast of Peel County was first surveyed in 1806 by Mr. Wilmost. The first survey only covered about one mile deep from each side of the Credit River. Colonel Thomas Ingersoll is thought to have been the first settler in the Township as well as the County, arriving before 1806. He kept a government storehouse and operated a ferry service at what would become Port Credit. By 1808 seven families were living in the Township including John Silverthorn, Joseph Silverthorn, Philip Cody, Daniel Harris, Allen Robinett, William Barber and Absolom Wilcox. They had settled along Dundas Street within the original survey (Walker & Miles 1877). Settlement continued to steadily increase until the War of 1812. In 1819 the remaining portion of the Township was surveyed, a large part of which was granted to a number of Irish families who had originally settled in the US before the war. Being persecuted after the war for not taking up arms with the Americans against the British led them to appeal to the British Council, in New York, for land in Canada. Twenty-six families were given land grants and in Map 1819 they began their journey to Toronto Township. Their journey was long and arduous and not made easier by the wagons they brought filled with supplies. There were not many roads open by the time they arrived in Canada and further inland they were not well maintained. Early settlers often used sleighs pulled by oxen. The sleighs were easier to maneuver around stumps, over logs and through marshy areas. Not all the covered wagons made it to their final destination, some being left in York (later Toronto). Settlement of the Toronto Township continued after the arrival of the Irish families so much so that it was incorporated by 1876 and was the first in the County to be incorporated. Several settlements started to grow up throughout the Township as settlement increased (Walker & Miles 1877).

Streetsville is the oldest settled village in the County and was ideally located along the Credit River. The Village was incorporated in 1858. The first three settlers to the area that would become Streetsville are thought to be James Glendenning, Frank Lighthearn and John Barnhart respectively. Streetsville is thought to have had the most extensive woollen factory in the province. It also boasted the largest grist mill in operation by 1876, at least in the Township. Another grist mill in the village was also large, running two stones and manufacturing flour for both local residences as well as for foreign markets. By 1876 Streetsville also had a cabinet warehouse and shop, broom factory, tub and pail factory, chair and paint shop, blacksmith, lumber businesses, a few stores, a large brick schoolhouse and four churches. The population by 1876 had risen to 678. The village after flourishing for many years began to struggle. The completion of the Credit Valley Railway was anticipated to help revive the Village Walker & Miles (1877).

Meadowvale was another village also located along the Credit River. The Village sprung up around the sawmill built in 1831 by John Crawford. By the time John Simpson built his sawmill in 1836, there were already a number of settlers there. These settlers had to travel to Toronto for supplies until 1847 when the first store in the Village was opened by Hames Ward. Having a store closer made everyday life easier for these early settlers. Life was made easier again when in 1856 Francis Silverthorn built a grist mill. The grist mill was purchased in 1860 by Gooderham and Worts who significantly increased the business. Running five stones meant that they could grind 250 barrels of flour a day and employ more hands. Gooderham and Worts being the businessmen they were also had a barrel business (among other businesses) where they manufactured their own barrels for their flour and also sold them to their grist mill customers. By 1876 Meadowvale also had a sawmill, lumber, lath and shingle factory, general store and a few other stores Walker & Miles (1877).

Port Credit was established by the Government in 1804 when they sent Thomas Ingersoll to run a storehouse and ferry. New emigrants to this part of the Country were accommodated in an inn also built by the Government. Port Credit is the only port in the County and has became one of the best shipping ports on the Lake. The opening of the Great Western Railway Station at Port Credit greatly benefitted both the Village and the shipping businesses. By 1877 Port Credit had also become a large shipper of strawberries. Over 100 acres of strawberries were cultivated, which increased each year. At one time two steamboats full of strawberries were shipped to Toronto daily. The

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harbour opened up the market for many Villagers to ship their goods further afield. Port Credit also became a sporting retreat for men from Toronto. Travellers would come by train to fish and hunt, staying in one of three hotels. Much of the surrounding area was still wild and offered great hunting Walker & Miles (1877).

Cooksville boasting a population of 300 by 1876 was located just south of the center of the Township and had a sawmill, a church, a two-story brick schoolhouse with three teachers, a baker, a waterhouse, a blacksmith and two hotels. Cooksville was named after Jacob Cook Esq. who originally owned the land which would become the location of the Village. Cooksville was ideally located along the main road between Hamilton and Toronto, flourishing as a result. Unfortunately, like so many other early settlements it was devastated by fire. The devastation of the fire in 1852 was so great that only a few houses were left standing, and the Village never fully recovered. The opening of the Grand Trunk and the Great Western Railways also took business away from the Village, having stations established elsewhere. Like Streetsville, it was hoped that the opening of the Credit Valley Railway would help. Cooksville did benefit from the establishment of the Canada Vine Growers Association in the village Walker & Miles (1877).

1.2.5 Historic Mapping

Historic maps although providing some information on historic features the inclusion of such information was often based on a subscription and the purpose of the map. Therefore, it is unknown how many features have been excluded from these early maps. Additionally, there can also be a discrepancy between the actual location of a feature and where it is depicted on the map. A site visit together with later maps can help narrow down the potential location of historic features illustrated on the early maps.

Map 2 illustrates the location of the project area and environs as of 1859. This map illustrates the project area on the shore of Lake Ontario and Cooksville Creek running through it, emptying into the Lake. The Credit River and other watercourses are also shown within the surrounding area. An unnamed toll road is illustrated adjacent to the northwestern boundary of the project area and corresponds to the current Lakeshore Road East. The Hamilton and Toronto Railway is illustrated running parallel with Lakeshore Road East further northwest of the project area. Lot 11 is shown to be owned by Wesley Watson and two structures are illustrated within the lot along Lakeshore Road East. Structures are also illustrated on the lots on the north side of Lake Shore Road East, across from the project area. The settlement of Port Credit is illustrated just west and Cooksville to the northwest. All of the lots surrounding the project area are shown to be owned, however, a structure is not illustrated on each lot. The schoolhouse to the southwest of the project area suggests the demographics of the area and the requirement for such an institution. An “Old Indian Village” is noted to the northwest of Port Credit adjacent to the Credit River. The larger area well known as being the traditional territory of the Mississaguas.

Map 3 from 1877 shows the project area within a similar environment to the 1859 map. Cooksville Creek still runs through the project area which is located on the shore of Lake Ontario. Lakeshore Road East and the Hamilton and Toronto Railway, now the Great Western Railway are located to the northwest. The Credit Valley Railway was opened north of Cooksville by 1877. Port Credit and Cooksville don’t appear to have grown much since 1859. Lot 11 is now shown to be owned by Stephen Crawford, a non-resident. Many of the lots along the water and a few others show that they were owned by non-residents. Both structures within the lot are still shown on this map. The structures to the north of the project area are illustrated with large orchards, suggesting these farms were well established by this time. The manufacturing industry growing since 1859 is shown owning several parcels of land to the west of the project area.

National topographic surveys were gathered to provide more detail about the project area and its surroundings. The survey from 1909 (Map 4) shows the project area within a rural environment with Cooksville Creek flowing through

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the it into Lake Ontario surrounded by woodlot and by wooden and brick structures. By 1929 (Map 5) urbanization had expanded around the project area.

The urbanization illustrated on the 1929 survey can be seen on the aerial from 1954 (Map 6). A structure is shown within the northern portion of the project area along Lakeshore Road East adjacent to the Creek. By 1980 (Map 7) Cooksville Creek had undergone significant changes straightening and widening it and further widening and the installation of path along the Creek by 1985 (Map 8). The structure in the northern portion of the project area was removed perhaps to allow the widening of the Creek. Prior to 1980, a portion of the Lake was filled in to extend the shoreline into the Lake southeast of the project area to create parkland. Part of the Lake in the southwest corner of the project area was also filled in by 1980 and then further into the Lake by 1989.

The project area's proximity to the historic structure and road suggests potential for Euro-Canadian archaeological resources.

1.3 ARCHAEOLOGICAL CONTEXT

1.3.1 Previously Registered Sites

According to the Minister of Citizenship and Multiculturalism Archaeological Site Database (ASD) the Adamson Estate Euro-Canadian homestead site is located within 1km of the project area.

No reports were identified that document archaeological fieldwork conducted within or adjacent to the limits of the project area.

1.3.3 Current Land Use and Field Conditions

The project area is approximately 2.88 hectares in size and consists of mainly Cooksville Creek which flows through the project area into Lake Simcoe surrounded by mature trees. The Creek has steep banks along some of it which in places have been reinforced with gibbons, large stones and concrete at the northern end where it passes under Lakeshore Road East. An asphalt path follows the east side of the Creek. Storm sewer lines are located along both sides of the Creek which empty into it. A bridge crossing the Creek is located in the southern portion of the project area. The parklands in the southern portion of the project area are mainly manmade land. Areas of lawn are located along the eastern side of the Creek where the study area crosses the rear portion of residential lots.

The project area is bounded on the northwest by Lakeshore Road East, on the northeast and southwest by residential and on the southeast by parkland and Lake Ontario. Map 10 illustrates the current land use.

1.3.4 Physiographic Region

The project area is located within the Iroquois Plain physiographic region. The lowland area bordering Lake Ontario was inundated by water when the last glacier was receding, though still within the St. Lawrence Valley, and was called Lake Iroquois. This glacial lake emptied eastward at Rome, New York State. The old shorelines with its cliffs, bars, beaches, and boulder pavements are still identifiable features with the undulating till plains above are

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contrasted by the wave smoothed lake bottom. The area of the Iroquois plain extends some 190 miles around the western part of Lake Ontario, from the Niagara River to the Trent River, with varying width from about eight miles to only a few hundred yards. A large area is located in the Trent River valley. Due to the varying conditions within the old lake plain the region has been divided into a number of sub-sections including Niagara Fruit Belt, Ontario Lakehead, Hamilton to Toronto, Toronto, Scarborough, Scarborough to Newcastle, Newcastle to Trenton, and Trent Embayment (Chapman and Putnam 1984).

Ontario Lakehead

This portion lies at the head of Lake Ontario and is a special part of the Iroquois plain. The characteristics of lake heads make them ideal for the establishments of cities and the area of glacial Lake Iroquois had some advantages. With a narrow plain between the lake and the "mountain" there is direct connection with Niagara through the old shoreline, and a corridor to the north shore was provided by the old bayhead bar. An easy grade up the escarpment to Ancaster is found through the old higher terraces inside the bar bypassing Dundas in two directions (Chapman and Putnam 1984).

Hamilton to Toronto

Occupying the northeast shore of Lake Ontario from Burlington to Toronto and beginning with a great gravel bar running through Aldershot. For about 18 miles the shoreline continues as a distinct bluff in the red shale of the Queenston Formation. The grey shale of the Georgian Bay Formation is the old shore near Clarkson and Cooksville, whereas in other places such as Toronto itself (along Davenport Road west of Yonge Street) the Iroquois shoreline is cut in Pleistocene deposits. Barrier beaches were created by the old lake at Bronte Creek, Oakville Creek, Etobicoke Creek, Credit River, Humber River, Don River, with significant sources of sand and gravel at each of the three rivers (Chapman and Putnam 1984). The shoreline of Lake Ontario provides the other boundary of the plain while the water gradually cuts into the red shale of Burlington to Oakville, grey shale at Clarkson, and the delta sands at Lorne Park. Along the shoreline the mouths of streams have been drowned and at the mouth of Twenty Mile Creek with such significance that the lagoon of Jordan Harbour has been formed by a bar. A surviving portion of the bed of Lake Iroquois is found between the two shorelines (ancient and modern), with a sloping plain at an average width of approximately two miles with varying compositions including stratified sands of varying depth, shallow cover of till over the bedrock, and in some the wave-eroded surface of red shale is the basis for soil formation. The soil of Aldershot, Bronte, Burlington, Oakville, Lorne Park, Clarkson, and Humber Bay is sandy and is preferable to the clay of the adjoining areas (Chapman and Putnam 1984).

Toronto

The waves and currents of Lake Ontario created the harbour protecting sandbar of Toronto Island by moving the sand from the Scarborough Bluffs. The area of first settlement in Toronto was once the realm of glacial Lake Iroquois which cut in previously deposited clay and till and then covered in sand deposits measuring approximately 3 miles wide with a general northward slop from the level of Lake Ontario approximately 50-60 feet per mile. Evidence of the old beach and a steep bluff or shorecliff is found along the northern border with a height of about 75 feet at Casa Loma. The deep valleys of the Don and Humber Rivers are found to the east and west of the shorecliff having been cut into early Iroquois base levels. Immense sand and gravel barriers were built across these valleys by Lake Iroquois so much so that in Iroquois times Toronto had two harbours instead of one. While the sand and gravel was deposited by Lake Iroquois, the clay was part of the pre-Iroquoian age (Chapman and Putnam 1984).

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1.3.5 Water Resources

The project area is located on the shoreline of Lake Ontario and Cooksville Creek flows through the project area emptying into Lake Ontario. Water is not only a necessity of life but it was also frequently utilized as a mode of travel for everyday life as well as for trade and communication. Watercourses were also used as landmarks by Indigenous groups as well as early settlers and explorers.

The project area is not only within proximity to water today but was also within proximity to a past water source. The project area was once covered by the waters of the Ontario Basin. Remnant shorelines are located over four kilometers inland today. As the Ontario Basin drained to present levels the project area would have become exposed.

The proximity of water to the project area suggests the potential for Indigenous occupation and land use in the area in the past.

2.0 SITE VISIT

A site visit was completed on December 12th, 2023, to obtain a better understanding of the current conditions, the topography, and the surrounding environment of the project area. The entire project area was inspected during ideal conditions. The identified features and current conditions of the property were photographed and are illustrated on Map 10.

Table 3: Site Visit Documentary Record Inventory

Type of Documentation	Description
Field Notes	1 digital file of field notes describing the daily site activities, weather, personal
Maps	1 map showing the project activities
Photographs	46 digital photographs showing the current conditions encountered during the site visit

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3.0 ANALYSIS AND CONCLUSIONS

3.1 STAGE 1 BACKGROUND RESULTS

The project area and its surroundings have a long history starting long before European settlement. The project area has been determined to have archaeological potential for Indigenous resources based on its proximity to water. Additionally, the project area has been determined to have archaeological potential for Euro-Canadian resources based on its proximity to historic a structure, historic road, and previously registered archaeological site.

The project area has undergone modern deep disturbances and as a result, archaeological potential has been removed from these areas. Additionally, there is no or low archaeological potential within the low-lying and wet areas of the Creek.

4.0 RECOMMENDATIONS

Based on the results the following recommendations are made:

1. Archaeological potential remains within the project area. Stage 2 Archaeological Assessment by test pit survey at an interval of 5 meters is recommended for these areas if impacted by the proposed restorations and prior to any ground-altering activities in these areas (see Map 10).

2. Stage 2 Archaeological Assessment is not recommended for areas of no archaeological potential including areas of modern deep disturbance and low-lying and wet areas (see Map 10).

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5.0 ADVICE ON COMPLIANCE WITH LEGISLATION

a. This report is submitted to the Minister of Tourism and Culture as a condition of licensing in accordance with Part VI of the *Ontario Heritage Act,* R.S.O. 1990, c 0.18. The report is reviewed to ensure that it complies with the standards and guidelines that are issued by the Minister, and that the archaeological fieldwork and report recommendations ensure the conservation, protection and preservation of the cultural heritage of Ontario. When all matters relating to archaeological sites within the project area of a development proposal have been addressed to the satisfaction of the Minister of Citizenship and Multiculturalism, a letter will be issued by the ministry stating that there are no further concerns with regard to alterations to archaeological sites by the proposed development.

b. It is an offence under Sections 48 and 69 of the *Ontario Heritage Act* for any party other than a licensed archaeologist to make any alteration to a known archaeological site or to remove any artifact or other physical evidence of past human use or activity from the site, until such time as a licensed archaeologist has completed archaeological fieldwork on the site, submitted a report to the Minister stating that the site has no further cultural heritage value or interest, and the report has been filed in the Ontario Public Register of Archaeological Reports referred to in Section 65.1 of the *Ontario Heritage Act.*

c. Should previously undocumented archaeological resources be discovered, they may be a new archaeological site and therefore subject to Section 48(1) of the *Ontario Heritage Act.* The proponent or person discovering the archaeological resources must cease alteration of the site immediately and engage a licensed consultant archaeologist to carry out archaeological fieldwork, in compliance with Section 48(1) of the *Ontario Heritage Act.*

d. The *Cemeteries Act,* R.S.O. 1990 c. C.4 and the *Funeral, Burial and Cremation Services Act,* 2002, S.O. 2002, c.33 (when proclaimed in force) require that any person discovering human remains must notify the police or coroner and the Registrar of Cemeteries at the Ministry of Consumer Services.

e. Archaeological sites recommended for further archaeological fieldwork or protection remain subject to Section 48 (1) of the *Ontario Heritage Act* and may not be altered, or have artifacts removed from them, except by a person holding an archaeological license.

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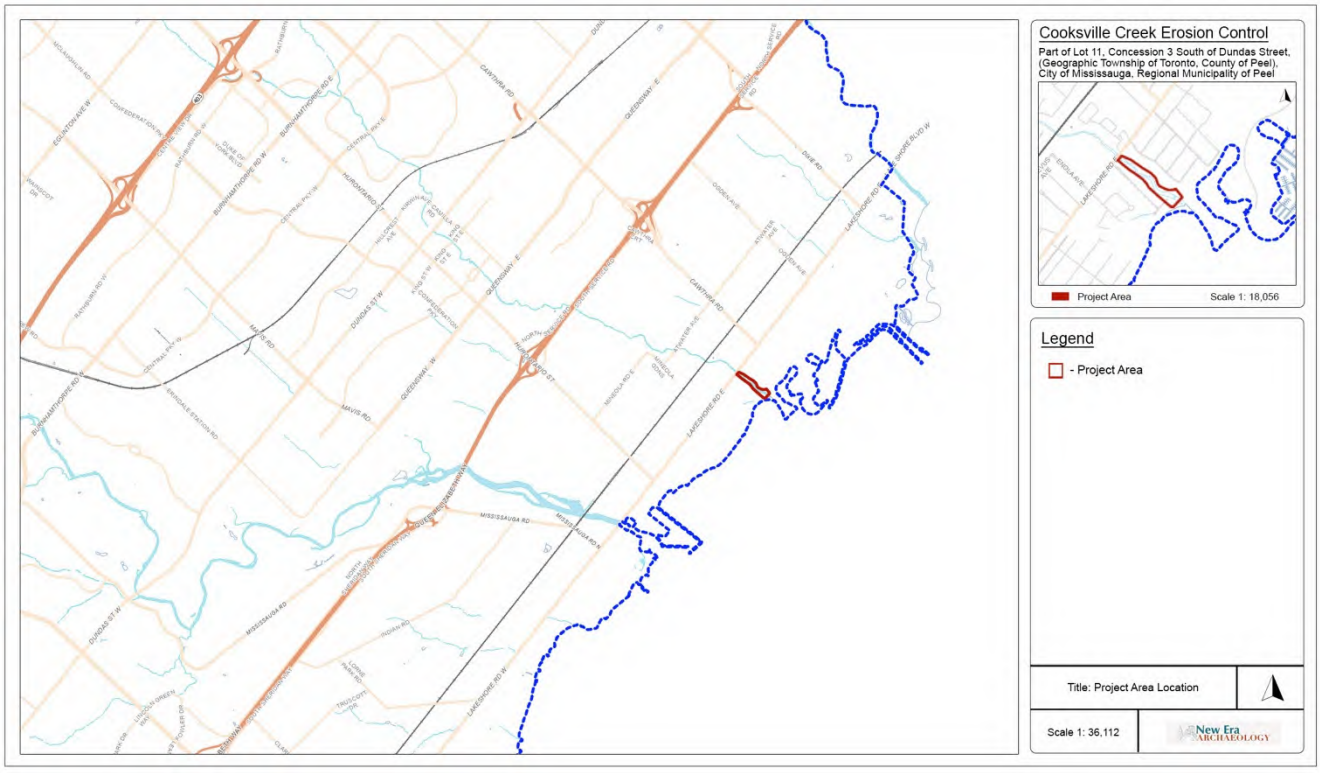
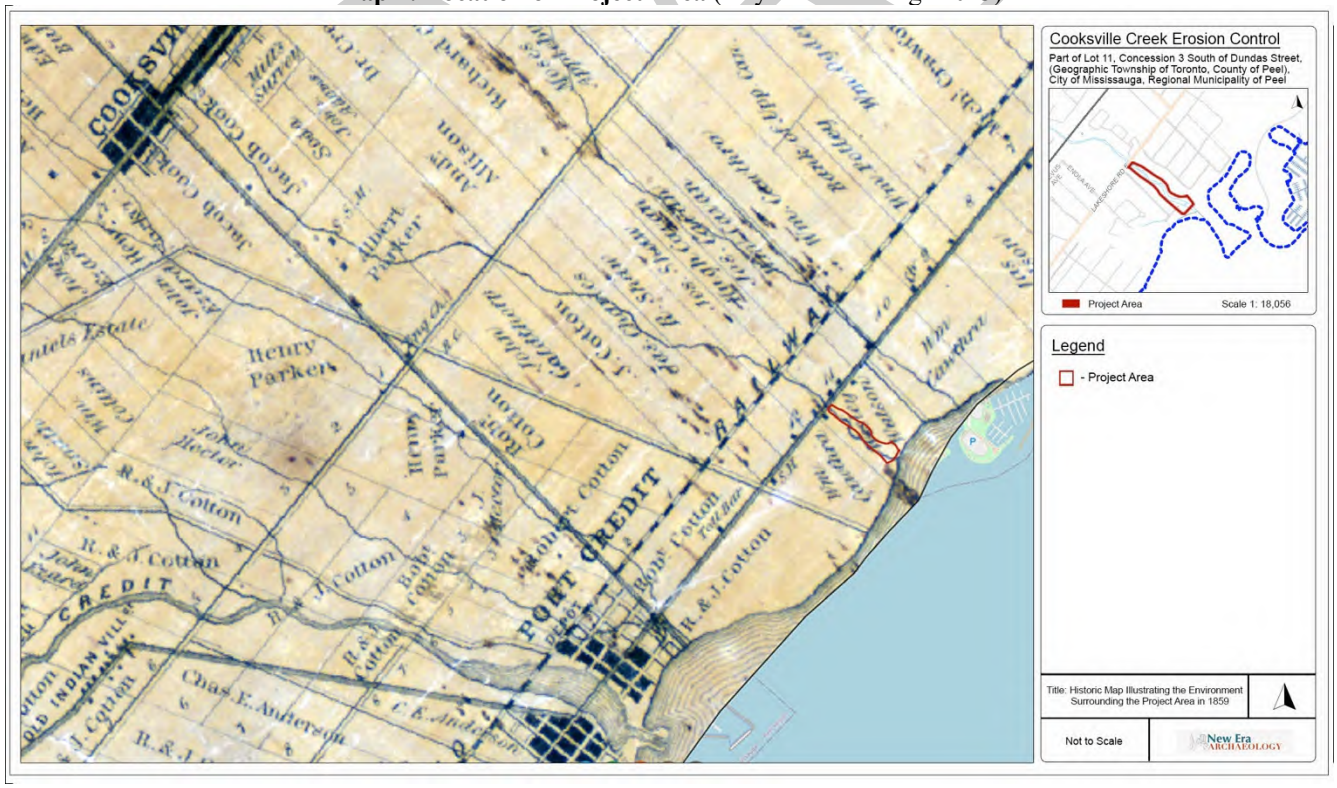
7.0 MAPS



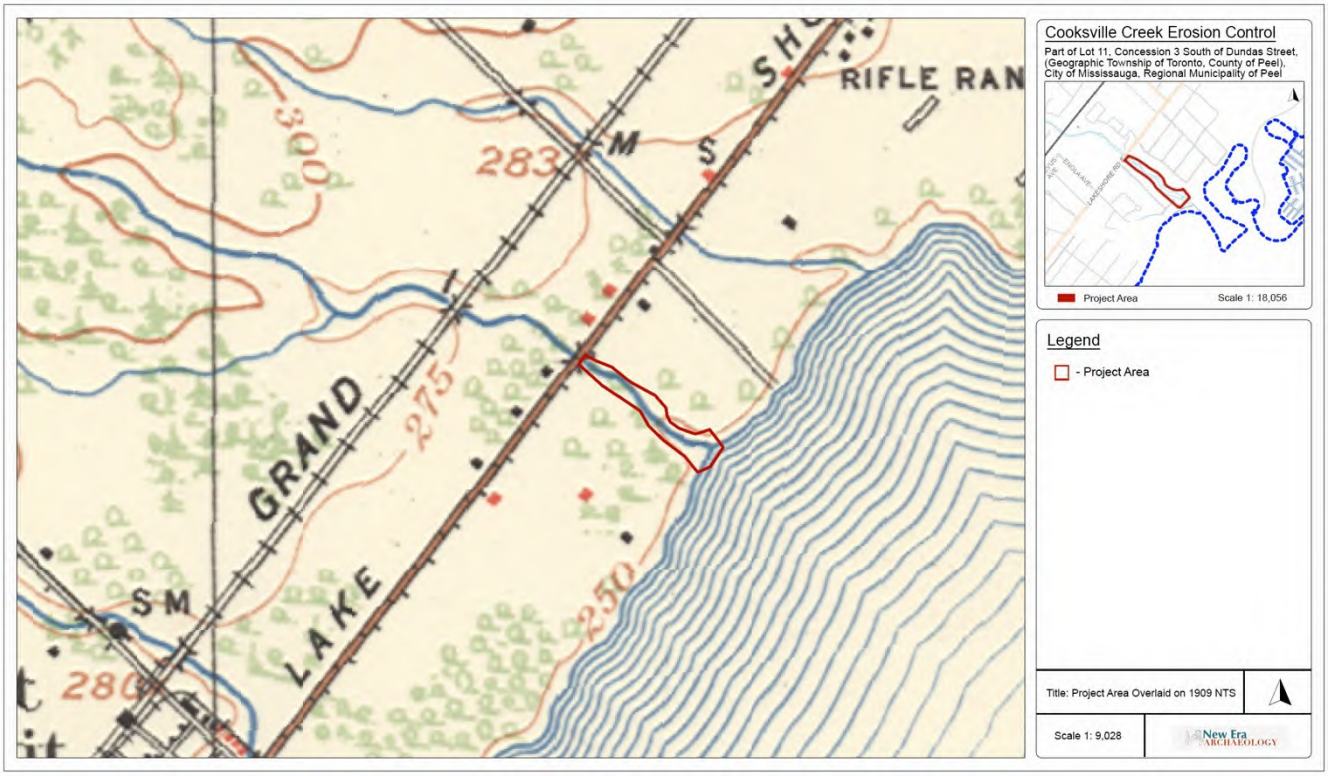
Map 1: Location of Project Area (City of Mississauga 2023)



Map 2: Historic Map Illustrating the Environment Surrounding the Property Area in 1859 (Tremaine 1859)



Map 3: Historic Map Illustrating the Environment Surrounding the Property Area in 1877
(Walker & Miles. 1877)



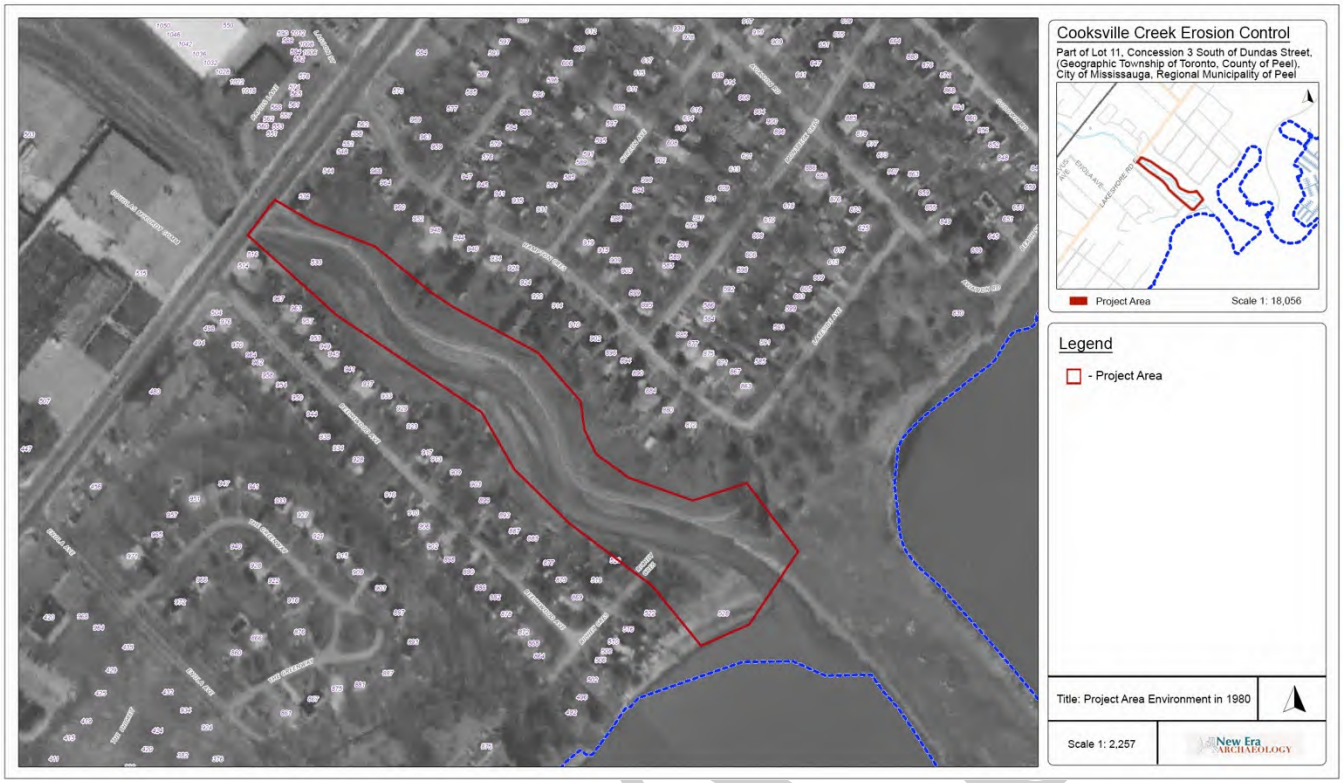
Map 4: Project Area on National Topographic Survey from 1909 (National Resources Canada)



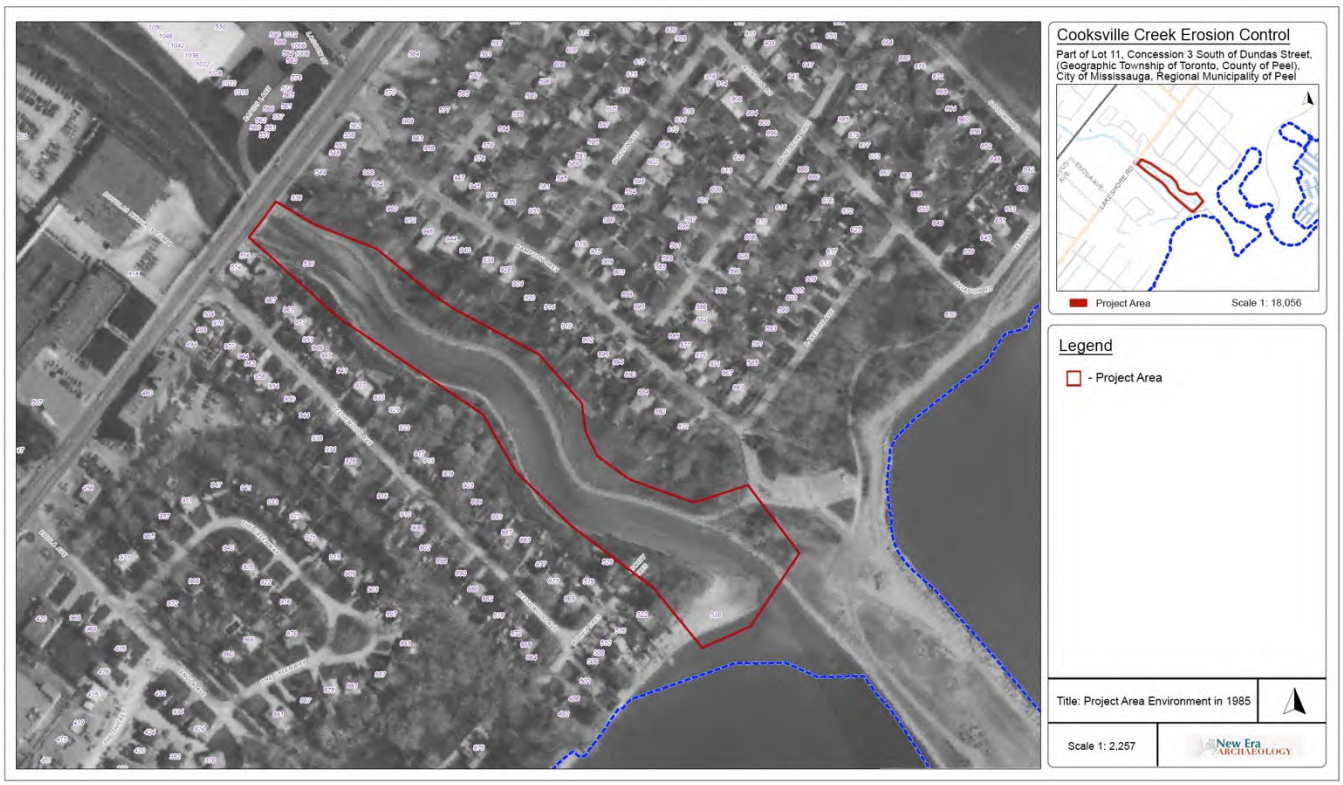
Map 5: Project Area on National Topographic Survey from 1929 (National Resources Canada)



Map 6: Project Area on Historic Aerial from 1954 (City of Mississauga 2023)



Map 7: Project Area on Historic Aerial from 1980 (City of Mississauga 2023)



Map 8: Project Area on Historic Aerial from 1985 (City of Mississauga 2023)



Map 9: Project Area (Provided by Aquafor Beech Ltd.)



Map 10: Stage 1 Archaeological Background Study Results (Base Map: City of Mississauga 2023)



Map 11: Stage 1 Archaeological Background Study Results (Base Map: City of Mississauga 2023)

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8.0 PLATES



Plate 1: Wooded Park Land



Plate 2: Asphalt Pathways and Two Manholes Between Them



Plate 3: Wooded Area Along Lake Ontario

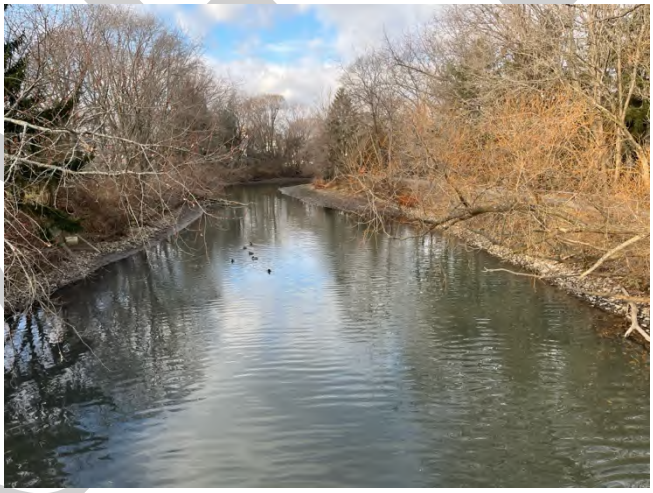

Plate 4: Cooksville Creek



Plate 5: Cooksville Creek Emptying into Lake Ontario



Plate 6: Wooded Area Along the Creek and Manhole



Plate 7: Wooded Area Along the Creek



Plate 8: Wooded Area Along the Creek



Plate 9: Wooded Area and Gibbons Along the Creek



Plate 10: Wooded Area Along the Creek



Plate 11: Asphalt Pathway Surrounded by Mature Trees; Manhole



Plate 12: Sewer Outlets Emptying into Creek



Plate 13: Elevated Pathway Surrounded by Trees and Lawn



Plate 14: Elevated Pathway Surrounded by Trees and Lawn



Plate 15: Asphalt Pathway Surrounded by Mature Trees



Plate 16: Asphalt Pathway Surrounded by Mature Trees



Plate 17: Infrastructure Where Cooksville Creek Passes Under Lakeshore Road East



Plate 18: Cooksville Creek

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Appendix F – Hydraulic Modelling Results

HEC-RAS Reach	River Station	Profile	Q Total	Hydr Depth	Vel Chnl	Shear Chan	Power Chan
			(m3/s)	(m)	(m/s)	(N/m2)	(N/m s)
2211	10567	2yr_Ex	75.3	0.76	4.02	110.38	444.26
2211	10567	5yr_Ex	109	0.97	4.43	123.32	545.85
2211	10567	10yr_Ex	143.6	1.16	4.75	133.99	636.28
2211	10567	25yr_Ex	171.5	2.4	2.14	21.58	46.24
2211	10567	50yr_Ex	197.3	2.54	2.15	20.72	44.49
2211	10567	100yr_Ex	225.4	2.24	2.15	19.95	42.94
2211	10567	Reg_Ex	316.1	1.21	2.87	35.13	100.87
2211	10549 2-Lakeshore Rd		Bridge				
2211	10532	2yr_Ex	75.3	0.92	3.46	76.39	264.39
2211	10532	5yr_Ex	109	1.17	3.88	89.16	346.25
2211	10532	10yr_Ex	143.6	1.39	4.25	101.36	431.23
2211	10532	25yr_Ex	171.5	1.61	4.32	99.65	430.38
2211	10532	50yr_Ex	197.3	1.76	4.53	106.9	484.47
2211	10532	100yr_Ex	225.4	2.02	4.45	98.83	439.94
2211	10532	Reg_Ex	316.1	2.49	4.94	114.2	564.11
2211	10467	2yr_Ex	75.3	1.06	2.88	50.05	143.96
2211	10467	5yr_Ex	109	1.11	3.95	92.9	366.66
2211	10467	10yr_Ex	143.6	1.28	4.38	108.95	476.72
2211	10467	25yr_Ex	171.5	1.4	4.71	122.72	577.89
2211	10467	50yr_Ex	197.3	1.5	4.95	132.43	655.5
2211	10467	100yr_Ex	225.4	1.08	3.21	50.06	160.44
2211	10467	Reg_Ex	316.1	1.63	3.29	48.45	159.35
2211	10406	2yr_Ex	75.3	1.14	2.8	46.27	129.53
2211	10406	5yr_Ex	109	1.41	3.08	52.18	160.6
2211	10406	10yr_Ex	143.6	1.64	3.3	57.29	189.3
2211	10406	25yr_Ex	171.5	1.8	3.44	60.33	207.76
2211	10406	50yr_Ex	197.3	1.86	3.76	71.09	267.27
2211	10406	100yr_Ex	225.4	1.96	3.91	75.65	295.96
2211	10406	Reg_Ex	316.1	1.03	4.09	77.64	317.5
2211	10323	2yr_Ex	75.3	1.43	2.11	24.35	51.27
2211	10323	5yr_Ex	109	1.72	2.43	30.48	73.96
2211	10323	10yr_Ex	143.6	1.97	2.7	36.02	97.08
2211	10323	25yr_Ex	171.5	2.13	2.87	39.89	114.6
2211	10323	50yr_Ex	197.3	1.45	2.45	28.22	69.06

HEC-RAS Reach	River Station	Profile	Q Total	Hydr Depth	Vel Chnl	Shear Chan	Power Chan
			(m3/s)	(m)	(m/s)	(N/m2)	(N/m s)
2211	10323	100yr_Ex	225.4	1.47	2.44	27.35	66.75
2211	10323	Reg_Ex	316.1	1.56	3.24	47.69	154.73
2211	10204	2yr_Ex	75.3	1.05	3.06	57.06	174.83
2211	10204	5yr_Ex	109	1.27	3.44	67.59	232.79
2211	10204	10yr_Ex	143.6	1.49	3.76	76.4	286.89
2211	10204	25yr_Ex	171.5	1.65	3.98	82.97	329.9
2211	10204	50yr_Ex	197.3	1.8	4.11	86.31	354.9
2211	10204	100yr_Ex	225.4	1.93	4.24	89.84	381.34
2211	10204	Reg_Ex	316.1	1.61	2.69	32.28	86.87
2211	10144	2yr_Ex	75.3	1.12	2.83	47.4	133.95
2211	10144	5yr_Ex	109	1.38	3.19	56.62	180.85
2211	10144	10yr_Ex	143.6	1.6	3.51	65.26	229.2
2211	10144	25yr_Ex	171.5	1.76	3.75	72.42	271.92
2211	10144	50yr_Ex	197.3	1.93	3.85	73.89	284.49
2211	10144	100yr_Ex	225.4	2.09	3.98	76.91	305.83
2211	10144	Reg_Ex	316.1	1.42	3.91	71.77	280.89
2211	10109	2yr_Ex	75.3	1.11	2.76	45.38	125.42
2211	10109	5yr_Ex	109	1.36	3.08	52.83	162.7
2211	10109	10yr_Ex	143.6	1.56	3.35	59.59	199.45
2211	10109	25yr_Ex	171.5	1.7	3.55	65.24	231.63
2211	10109	50yr_Ex	197.3	1.87	3.57	64.05	228.79
2211	10109	100yr_Ex	225.4	2.02	3.64	64.89	236.29
2211	10109	Reg_Ex	316.1	1.28	3.3	49.17	162.47
2211	10105 1-Waterfront Tr		Bridge				
2211	10100	2yr_Ex	75.3	1.3	2.36	31.54	74.43
2211	10100	5yr_Ex	109	1.49	2.8	42.62	119.44
2211	10100	10yr_Ex	143.6	1.61	3.13	51.91	162.69
2211	10100	25yr_Ex	171.5	1.66	3.5	64.18	224.83
2211	10100	50yr_Ex	197.3	1.68	3.92	79.87	312.87
2211	10100	100yr_Ex	225.4	1.75	4.13	87.65	362.01
2211	10100	Reg_Ex	316.1	1.36	3.04	42.12	127.84
2211	10070	2yr_Ex	75.3	0.94	3.03	57.73	175.02
2211	10070	5yr_Ex	109	1.16	3.38	66.78	225.53
2211	10070	10yr_Ex	143.6	1.36	3.65	74.22	270.94

HEC-RAS Reach	River Station	Profile	Q Total	Hydr Depth	Vel Chnl	Shear Chan	Power Chan
			(m3/s)	(m)	(m/s)	(N/m2)	(N/m s)
2211	10070	25yr_Ex	171.5	1.11	3.75	76.56	287.05
2211	10070	50yr_Ex	197.3	1.12	3.85	77.81	299.48
2211	10070	100yr_Ex	225.4	1.24	3.99	81.14	323.81
2211	10070	Reg_Ex	316.1	1.54	4.41	92.21	406.89

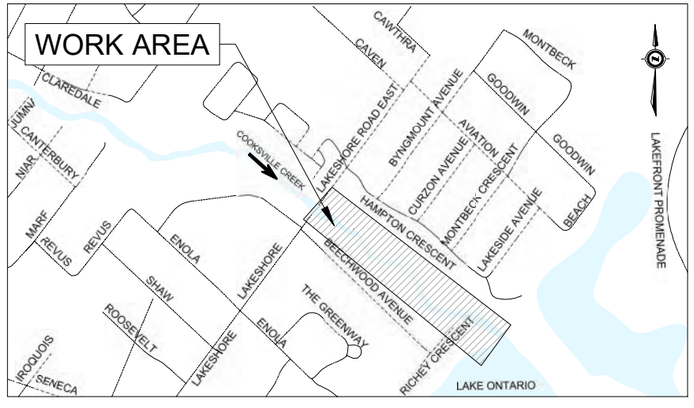
Appendix G – Creek and Trail Restoration Alternatives

Class EA for Cooksville Creek Erosion Control Project

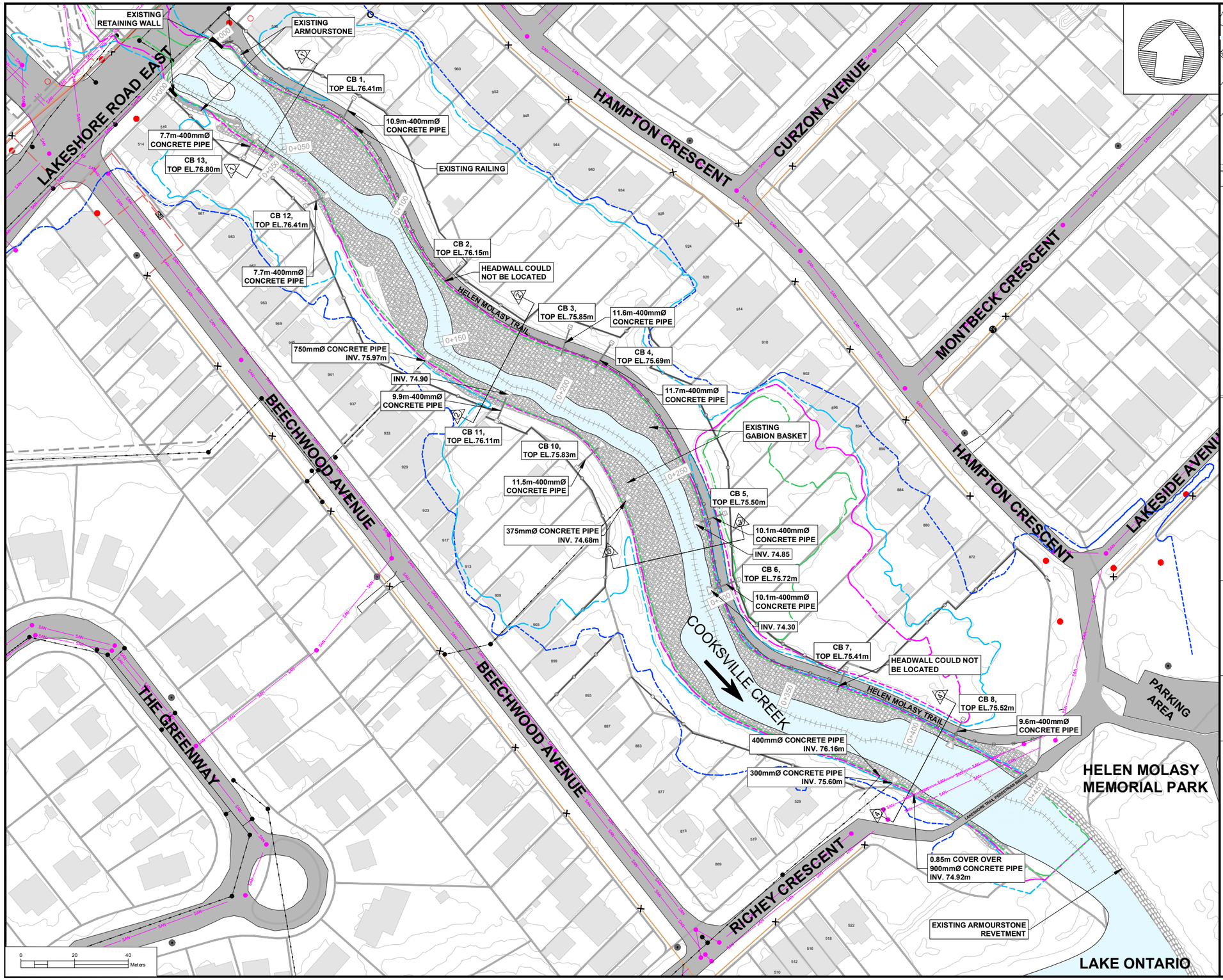
South of Lakeshore Road

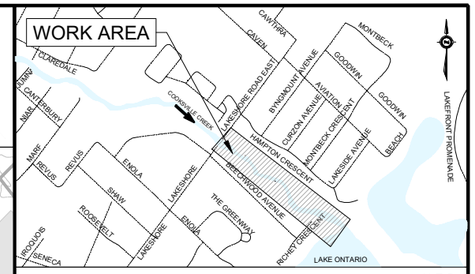
Drawing Index

Description	Drawing No.
GENERAL PLAN- EXISTING CONDITIONS	GP-EX
CHANNEL RESTORATION ALTERNATIVE 1 - DO NOTHING (UPSTREAM) TRAIL/BERM RESTORATION ALTERNATIVE 1 - DO NOTHING (UPSTREAM)	ALT1 - 1
CHANNEL RESTORATION ALTERNATIVE 1 - DO NOTHING (DOWNSTREAM) TRAIL/BERM RESTORATION ALTERNATIVE 1 - DO NOTHING (DOWNSTREAM)	ALT1 - 2
CHANNEL RESTORATION ALTERNATIVE 2 - LOCAL CHANNEL RESTORATION WORKS (UPSTREAM) TRAIL/BERM RESTORATION ALTERNATIVE 2 - LIKE-FOR-LIKE DRAINAGE (UPSTREAM)	ALT2 - 1
CHANNEL RESTORATION ALTERNATIVE 2 - LOCAL CHANNEL RESTORATION WORKS (DOWNSTREAM) TRAIL/BERM RESTORATION ALTERNATIVE 2 - LIKE-FOR-LIKE DRAINAGE (DOWNSTREAM)	ALT2 - 2
CHANNEL RESTORATION ALTERNATIVE 3 - EXTENDED CHANNEL RESTORATION WORKS (UPSTREAM) TRAIL/BERM RESTORATION ALTERNATIVE 3 - PARTIAL DRAINAGE CONSOLIDATION (UPSTREAM)	ALT3 - 1
CHANNEL RESTORATION ALTERNATIVE 3 - LOCAL CHANNEL RESTORATION WORKS (DOWNSTREAM) TRAIL/BERM RESTORATION ALTERNATIVE 3 - PARTIAL DRAINAGE CONSOLIDATION (DOWNSTREAM)	ALT3 - 2
CHANNEL RESTORATION ALTERNATIVE 3 - EXTENDED CHANNEL RESTORATION WORKS (UPSTREAM) TRAIL/BERM RESTORATION ALTERNATIVE 4 - HYBRID DRAINAGE SOLUTION (UPSTREAM)	ALT4 - 1
CHANNEL RESTORATION ALTERNATIVE 3 - LOCAL CHANNEL RESTORATION WORKS (DOWNSTREAM) TRAIL/BERM RESTORATION ALTERNATIVE 4 - HYBRID DRAINAGE SOLUTION (DOWNSTREAM)	ALT4 - 2
CROSS SECTIONS	XS
TREE IMPACT PLAN - 1	TI3 - 1
TREE IMPACT PLAN - 2	TI3 - 2
TREE IMPACT PLAN - 3	TI3 - 2



Aquafor Beech Limited
#6-202-2600 SKYMARK Ave,
MISSISSAUGA, ONTARIO, L4W 5B2
PHONE: (905) 629-0099, FAX: (905) 629-0089





KEY PLAN N.T.S.

LEGEND

- PROPERTY LINE
- EXISTING BUILDING
- FENCE LINE
- EASEMENT
- CONTOUR
- STORM SEWER
- SANITARY SEWER
- STORM MANHOLE
- SANITARY MANHOLE
- HYDRANT
- CATCH BASIN
- HEADWALL
- CVC REGULATORY FLOODLINE
- 100-YEAR FLOODLINE
- 25-YEAR FLOODLINE
- 5-YEAR FLOODLINE
- EXISTING AERIAL COAXIAL CABLE
- EXISTING AERIAL FIBRE CABLE
- EXISTING BURIED FIBRE CABLE
- EXISTING ROGERS GROUND LEVEL BOX
- EXISTING ROGERS BLDG ATTACHEMENT
- EXISTING ROGERS PEDESTAL
- ROGERS OWNED HYDRO POLE
- DUCTBANK-DIRECT BURIED
- ALECTRA OWNED POLE
- NON-ALECTRA OWNED POLE

NO.	BY	DATE	REVISIONS	CHECKED

Aquafor Beech Limited

MISSISSAUGA

Class EA for Cooksville Creek Erosion Control Project

South of Lakeshore Road

GENERAL PLAN - EXISTING CONDITION

SURVEYED BY:		DATE:	XXXXXXXX	CONTRACT NO.	
DRAWN BY:	M.J.	CHECKED BY:	R.A	DRAWING NO. GP-EX	PROJECT NO.
DESIGNED BY:	R.A.	CHECKED BY:		SHEET NO. 01 OF 14	PLAN NO.
SCALE:	1:650	DATE:	XXXXXXXX		

HAMPTON CRESCENT

LAKESHORE ROAD EAST

BEECHWOOD AVENUE

HELEN MOLASY TRAIL

COOKSVILLE CREEK

MATCHLINE

EXISTING ARMOURSTONE RETAINING WALL IN GOOD CONDITION

PEDESTRIAN SAFETY RAILING LEANING TOWARD CREEK THROUGHOUT STUDY AREA

DETERIORATED ASPHALT TRAIL SURFACE THROUGHOUT STUDY AREA

HEADWALL PARTIALLY BURIED IN SEDIMENT

HEADWALL PARTIALLY BURIED IN SEDIMENT

SLUMPED GABION BASKET

CB 1, TOP EL. 76.41m

CB 2, TOP EL. 76.15m

CB 3, TOP EL. 75.85m

CB 4, TOP EL. 75.69m

CB 10, TOP EL. 75.83m

CB 11, TOP EL. 76.11m

CB 12, TOP EL. 76.41m

CB 13, TOP EL. 76.80m

OUTLET COULD NOT BE LOCATED, LIKELY UNDER WATER

INLET BURIED IN ORGANIC DEBRIS

DETERIORATED GABION BASKET BANK AND BED PROTECTION THROUGHOUT STUDY AREA

OUTFLANKED HEADWALL STRUCTURE

0+000 0+050 0+100 0+150 0+200

0 10 20 Meters

WORK AREA

KEY PLAN N.T.S.

LEGEND

- PROPERTY LINE
- EXISTING BUILDING
- FENCE LINE
- EASEMENT
- CONTOUR
- STORM SEWER
- SANITARY SEWER
- STORM MANHOLE
- SANITARY MANHOLE
- HYDRANT
- CATCH BASIN
- HEADWALL
- CVC REGULATORY FLOODLINE
- 100-YEAR FLOODLINE
- 25-YEAR FLOODLINE
- 5-YEAR FLOODLINE
- EXISTING AERIAL COAXIAL CABLE
- EXISTING AERIAL FIBRE CABLE
- EXISTING BURIED FIBRE CABLE
- EXISTING ROGERS GROUND LEVEL BOX
- EXISTING ROGERS BLDG ATTACHEMENT
- EXISTING ROGERS PEDESTAL
- ROGERS OWNED HYDRO POLE
- DUCTBANK-DIRECT BURIED
- ALECTRA OWNED POLE
- NON-ALECTRA OWNED POLE

NO.	BY	DATE	REVISIONS	CHECKED

Aquafor Beech Limited
#A-202-2600 SKYMARK Ave.
MISSISSAUGA, ONTARIO, L4W 5B2
PHONE: (905) 629-0099, FAX: (905) 629-0089

MISSISSAUGA

Class EA for Cooksville Creek Erosion Control Project

South of Lakeshore Road

CHANNEL RESTORATION ALTERNATIVE 1
- DO NOTHING (UPSTREAM)
TRAIL/BERM RESTORATION ALTERNATIVE 1
- DO NOTHING (UPSTREAM)

SURVEYED BY:	DATE: XXXXXXXX	CONTRACT NO.	
DRAWN BY: M.J.	CHECKED BY: R.A	DRAWING NO. ALT1 – 1	PROJECT NO.
DESIGNED BY: R.A.	CHECKED BY:	SHEET NO. 02 OF 14	PLAN NO.
SCALE: 1:350	DATE: XXXXXXXX		

HAMPTON CRESCENT

PARKING AREA

HELEN MOLASY MEMORIAL PARK

HELEN MOLASY TRAIL

LAKESHORE TRAIL PEDESTRIAN BRIDGE

COOKSVILLE CREEK

RICHEY CRESCENT

BEECHWOOD AVENUE

LAKE ONTARIO

MATCHLINE

DETERIORATED ASPHALT TRAIL SURFACE THROUGHOUT STUDY AREA

FREQUENT NUISANCE FLOODING WITHIN HAMPTON CRESCENT BACKYARDS

EXISTING ARMOURSTONE REVETMENT

CB 5, TOP EL. 75.85m

CB 6, TOP EL. 75.72m

CB 7, TOP EL. 75.41m

CB 8, TOP EL. 75.52m

PEDESTRIAN SAFETY RAILING LEANING TOWARD CREEK THROUGHOUT STUDY AREA

HEADWALL BURIED IN SEDIMENT

MAX LAKE LEVEL: 75.88m
AVERAGE LAKE LEVEL: 74.70m
DEC 2023 LAKE LEVEL: 74.53m

OUTFLANKED HEADWALL STRUCTURE

DETERIORATED GABION BASKET BANK AND BED PROTECTION THROUGHOUT STUDY AREA

HEADWALL PARTIALLY BURIED IN SEDIMENT

SLUMPED GABION BASKET

0.85M COVER OVER 900MMØ CONCRETE PIPE INV. 74.92M

0+250 0+300 0+350 0+400 0+450

0 10 20 Meters

WORK AREA

KEY PLAN N.T.S.

LEGEND

- PROPERTY LINE
- EXISTING BUILDING
- FENCE LINE
- EASEMENT
- CONTOUR
- STORM SEWER
- SANITARY SEWER
- STORM MANHOLE
- SANITARY MANHOLE
- HYDRANT
- CATCH BASIN
- HEADWALL
- CVC REGULATORY FLOODLINE
- 100-YEAR FLOODLINE
- 25-YEAR FLOODLINE
- 5-YEAR FLOODLINE
- EXISTING AERIAL COAXIAL CABLE
- EXISTING AERIAL FIBRE CABLE
- EXISTING BURIED FIBRE CABLE
- EXISTING ROGERS GROUND LEVEL BOX
- EXISTING ROGERS BLDG ATTACHEMENT
- EXISTING ROGERS PEDESTAL
- ROGERS OWNED HYDRO POLE
- DUCTBANK-DIRECT BURIED
- ALECTRA OWNED POLE
- NON-ALECTRA OWNED POLE

NO.	BY	DATE	REVISIONS	CHECKED

Aquafor Beech Limited

MISSISSAUGA

Class EA for Cooksville Creek Erosion Control Project

South of Lakeshore Road

CHANNEL RESTORATION ALTERNATIVE 1
- DO NOTHING (DOWNSTREAM)
TRAIL/BERM RESTORATION ALTERNATIVE 1
- DO NOTHING (DOWNSTREAM)

SURVEYED BY:	DATE: XXXXXXXX	CONTRACT NO.	
DRAWN BY: M.J.	CHECKED BY: R.A	DRAWING NO.ALT1 – 2	PROJECT NO.
DESIGNED BY: R.A.	CHECKED BY:	SHEET NO. 03 OF 14	PLAN NO.
SCALE: 1:350	DATE: XXXXXXXX		

HAMPTON CRESCENT

LAKESHORE ROAD EAST

BEECHWOOD AVENUE

HELEN MOLASY TRAIL

COOKSVILLE CREEK

MATCHLINE

ESTABLISH A FORMAL OUTFALL CHANNEL

PROPOSED VEGETATED BUTTRESS BANK PROTECTION WITH EMBEDDED ARMOURSTONE

REPLACE CATCH BASIN, PIPE, & HEADWALL, AND INSTALL BACKFLOW VALVE, & BEEHIVE GRATE ON CATCH BASIN

CB 1, TOP EL. 76.41m

CB 2, TOP EL. 76.15m

CB 3, TOP EL. 75.85m

CB 4, TOP EL. 75.69m

REBUILD EXISTING BERM AND TRAIL CONFIGURATION WITH ENGINEERED SOIL MIX TO MATCH EXISTING GRADES

REMOVE SLUMPED GABION BASKETS AND INSTALL VEGETATED BUTTRESS BANK PROTECTION WITH EMBEDDED ARMOURSTONE

ESTABLISH A FORMAL OUTFALL CHANNEL

PROPOSED SAFETY RAILING

CB 13, TOP EL. 76.80m

CB 12, TOP EL. 76.41m

REMOVE SLUMPED GABION BASKETS AND INSTALL VEGETATED BUTTRESS BANK PROTECTION

CB 11, TOP EL. 76.11m

CB 10, TOP EL. 75.83m

RETROFIT EXISTING HEADWALL WITH ENHANCED EROSION PROTECTION

REPLACE CATCH BASIN, PIPE, & HEADWALL, AND INSTALL BACKFLOW VALVE, & BEEHIVE GRATE ON CATCH BASIN

0 10 20 Meters

WORK AREA

KEY PLAN N.T.S.

LEGEND

- PROPERTY LINE
- EXISTING BUILDING
- FENCE LINE
- EASEMENT
- CONTOUR
- STORM SEWER
- SANITARY SEWER
- STORM MANHOLE
- SANITARY MANHOLE
- HYDRANT
- CATCH BASIN
- HEADWALL
- CVC REGULATORY FLOODLINE
- 100-YEAR FLOODLINE
- 25-YEAR FLOODLINE
- 5-YEAR FLOODLINE
- EXISTING AERIAL COAXIAL CABLE
- EXISTING AERIAL FIBRE CABLE
- EXISTING BURIED FIBRE CABLE
- EXISTING ROGERS GROUND LEVEL BOX
- EXISTING ROGERS BLDG ATTACHEMENT
- EXISTING ROGERS PEDESTAL
- ROGERS OWNED HYDRO POLE
- DUCTBANK-DIRECT BURIED
- ALECTRA OWNED POLE
- NON-ALECTRA OWNED POLE

NO.	BY	DATE	REVISIONS	CHECKED

Aquafor Beech Limited
#4-202-2600 SKYMARK Ave.
MISSISSAUGA, ONTARIO, L4W 5B2
PHONE: (905) 629-9099, FAX: (905) 629-0099

MISSISSAUGA

Class EA for Cooksville Creek Erosion Control Project

South of Lakeshore Road

CHANNEL RESTORATION ALTERNATIVE 2
- LOCAL CHANNEL RESTORATION WORKS (UPSTREAM)
TRAIL/BERM RESTORATION ALTERNATIVE 2
- LIKE-FOR-LIKE DRAINAGE (UPSTREAM)

SURVEYED BY:	DATE: XXXXXXXX	CONTRACT NO.	
DRAWN BY: M.J.	CHECKED BY: R.A	DRAWING NO.ALT2 – 1	PROJECT NO.
DESIGNED BY: R.A.	CHECKED BY:	SHEET NO. 04 OF 14	PLAN NO.
SCALE: 1:350	DATE: XXXXXXXX		

HAMPTON CRESCENT

PARKING AREA

HELEN MOLASY MEMORIAL PARK

REBUILD EXISTING BERM AND TRAIL CONFIGURATION WITH ENGINEERED SOIL MIX TO MATCH EXISTING GRADES

REPLACE CATCH BASIN, PIPE, & HEADWALL, AND INSTALL BACKFLOW VALVE, & BEEHIVE GRATE ON CATCH BASIN

PROPOSED SAFETY RAILING

ESTABLISH A FORMAL OUTFALL CHANNEL

CB 5, TOP EL. 75.85m

CB 6, TOP EL. 75.72m

CB 7, TOP EL. 75.41m

CB 8, TOP EL. 75.52m

HELEN MOLASY TRAIL

LAKESHORE TRAIL PEDESTRIAN BRIDGE

MAX LAKE LEVEL: 75.88m
AVERAGE LAKE LEVEL: 74.70m
DEC 2023 LAKE LEVEL: 74.53m

MATCHLINE

COOKSVILLE CREEK

ESTABLISH A FORMAL OUTFALL CHANNEL

RETROFIT EXISTING HEADWALL WITH ENHANCED EROSION PROTECTION

MAINTAIN EXISTING COVER OVER SANITARY SEWER CROSSING

RETROFIT EXISTING HEADWALL WITH ENHANCED EROSION PROTECTION

REMOVE SLUMPED GABION BASKETS, AND INSTALL VEGETATED BUTTRESS BANK PROTECTION

RICHEY CRESCENT

BEECHWOOD AVENUE

LAKE ONTARIO

910 902 896 894 890 884 880 872 903 899 893 887 877 873 869 529 519 522 518 516 512 510

SAN SAN SAN

HAMPTON CRESCENT

LAKESHORE ROAD EAST

BEECHWOOD AVENUE

HELEN MOLASY TRAIL

COOKSVILLE CREEK

MATCHLINE

ESTABLISH A FORMAL OUTFALL CHANNEL

PROPOSED OVERLAND SWALE

TIE INTO PROPOSED ARMOURSTONE RETAINING WALL

PROPOSED ARMOURSTONE RETAINING WALL

PROPOSED DITCH INLET CATCH BASIN

PROPOSED NEW CONCRETE PIPE

PROPOSED NEW HEADWALL

PROPOSED SAFETY RAILING

PROPOSED VEGETATED BUTTRESS BANK PROTECTION WITH EMBEDDED ARMOURSTONE

PROPOSED DITCH INLET CATCH BASIN

PROPOSED NEW CONCRETE PIPE

PROPOSED NEW HEADWALL

REBUILD EXISTING BERM AND TRAIL CONFIGURATION WITH ENGINEERED SOIL MIX TO MATCH EXISTING GRADES

PROPOSED OVERLAND SWALE

PROPOSED DITCH INLET CATCH BASIN

PROPOSED NEW CONCRETE PIPE

PROPOSED NEW HEADWALL

ESTABLISH A FORMAL OUTFALL CHANNEL

CB 13, TOP EL. 76.80m

CB 12, TOP EL. 76.41m

CB 11, TOP EL. 76.11m

CB 10, TOP EL. 75.83m

ESTABLISH A FORMAL OUTFALL CHANNEL

TIE INTO EXISTING ARMOURSTONE RETAINING WALL

REPLACE CATCH BASIN, PIPE, & HEADWALL, AND INSTALL BACKFLOW VALVE, & BEEHIVE GRATE ON CATCH BASIN

0 10 20 Meters

WORK AREA

KEY PLAN N.T.S.

LEGEND

- PROPERTY LINE
- EXISTING BUILDING
- FENCE LINE
- EASEMENT
- CONTOUR
- STORM SEWER
- SANITARY SEWER
- STORM MANHOLE
- SANITARY MANHOLE
- HYDRANT
- CATCH BASIN
- HEADWALL
- CVC REGULATORY FLOODLINE
- 100-YEAR FLOODLINE
- 25-YEAR FLOODLINE
- 5-YEAR FLOODLINE
- EXISTING AERIAL COAXIAL CABLE
- EXISTING AERIAL FIBRE CABLE
- EXISTING BURIED FIBRE CABLE
- EXISTING ROGERS GROUND LEVEL BOX
- EXISTING ROGERS BLDG ATTACHEMENT
- EXISTING ROGERS PEDESTAL
- ROGERS OWNED HYDRO POLE
- DUCTBANK-DIRECT BURIED
- ALECTRA OWNED POLE
- NON-ALECTRA OWNED POLE

NO.	BY	DATE	REVISIONS	CHECKED

Aquafor Beech Limited

MISSISSAUGA

Class EA for Cooksville Creek Erosion Control Project

South of Lakeshore Road

CHANNEL RESTORATION ALTERNATIVE 3
- EXTENDED CHANNEL RESTORATION WORKS (UPSTREAM)
TRAIL/BERM RESTORATION ALTERNATIVE 3
- PARTIAL DRAINAGE CONSOLIDATION (UPSTREAM)

SURVEYED BY:		DATE: XXXXXXXX	CONTRACT NO.
DRAWN BY: M.J.	CHECKED BY: R.A	DRAWING NO. ALT3 – 1	PROJECT NO.
DESIGNED BY: R.A.	CHECKED BY:	SHEET NO. 06 OF 14	PLAN NO.
SCALE: 1:350	DATE: XXXXXXXX		

HAMPTON CRESCENT

PARKING AREA

HELEN MOLASY MEMORIAL PARK

HELEN MOLASY TRAIL

LAKESHORE TRAIL PEDESTRIAN BRIDGE

LAKESHORE TRAIL

COOKSVILLE CREEK

MATCHLINE

BEECHWOOD AVENUE

RICHEY CRESCENT

LAKE ONTARIO

910 902 896 894 890 884 880 872

903 899 893 887 883 877 873 869

529 519 522 518 516 512 510

REBUILD EXISTING BERM AND TRAIL CONFIGURATION WITH ENGINEERED SOIL MIX TO MATCH EXISTING GRADES

PROPOSED NEW HEADWALL

PROPOSED NEW CONCRETE PIPE

PROPOSED DITCH INLET CATCH BASIN

PROPOSED OVERLAND SWALE

PROPOSED SAFETY RAILING

PROPOSED OVERLAND SWALE

PROPOSED DITCH INLET CATCH BASIN

PROPOSED NEW CONCRETE PIPE

PROPOSED NEW HEADWALL

TIE INTO EXISTING ARMOURSTONE REVETMENT

MAX LAKE LEVEL: 75.88m
AVERAGE LAKE LEVEL: 74.70m
DEC 2023 LAKE LEVEL: 74.53m

ESTABLISH A FORMAL OUTFALL CHANNEL

RETROFIT EXISTING HEADWALL WITH ENHANCED EROSION PROTECTION

PROPOSED VEGETATED BUTTRESS BANK PROTECTION WITH EMBEDDED ARMOURSTONE

RETROFIT EXISTING HEADWALL WITH ENHANCED EROSION PROTECTION

TIE INTO EXISTING CONDITION

MAINTAIN EXISTING COVER OVER SANITARY SEWER CROSSING

0 10 20 Meters

WORK AREA

KEY PLAN N.T.S.

LEGEND

- PROPERTY LINE
- EXISTING BUILDING
- FENCE LINE
- EASEMENT
- CONTOUR
- STORM SEWER
- SANITARY SEWER
- STORM MANHOLE
- SANITARY MANHOLE
- HYDRANT
- CATCH BASIN
- HEADWALL
- CVC REGULATORY FLOODLINE
- 100-YEAR FLOODLINE
- 25-YEAR FLOODLINE
- 5-YEAR FLOODLINE
- EXISTING AERIAL COAXIAL CABLE
- EXISTING AERIAL FIBRE CABLE
- EXISTING BURIED FIBRE CABLE
- EXISTING ROGERS GROUND LEVEL BOX
- EXISTING ROGERS BLDG ATTACHEMENT
- EXISTING ROGERS PEDESTAL
- ROGERS OWNED HYDRO POLE
- DUCTBANK-DIRECT BURIED
- ALECTRA OWNED POLE
- NON-ALECTRA OWNED POLE

NO.	BY	DATE	REVISIONS	CHECKED

Aquafor Beech Limited

MISSISSAUGA

Class EA for Cooksville Creek Erosion Control Project

South of Lakeshore Road

CHANNEL RESTORATION ALTERNATIVE 3
- LOCAL CHANNEL RESTORATION WORKS (DOWNSTREAM)
TRAIL/BERM RESTORATION ALTERNATIVE 3
- PARTIAL DRAINAGE CONSOLIDATION (DOWNSTREAM)

SURVEYED BY:		DATE: XXXXXXXX	CONTRACT NO.
DRAWN BY: M.J.	CHECKED BY: R.A	DRAWING NO.ALT3 – 2	PROJECT NO.
DESIGNED BY: R.A.	CHECKED BY:	SHEET NO. 07 OF 14	PLAN NO.
SCALE: 1:350	DATE: XXXXXXXX		

HAMPTON CRESCENT

LAKESHORE ROAD EAST

BEECHWOOD AVENUE

HELEN MOLASY TRAIL

COOKSVILLE CREEK

MATCHLINE

ESTABLISH A FORMAL OUTFALL CHANNEL

PROPOSED VEGETATED BUTTRESS BANK PROTECTION WITH EMBEDDED ARMOURSTONE

CB 1, TOP EL. 76.41m

PROPOSED SAFETY RAILING

CB 2, TOP EL. 76.15m

RETROFIT EXISTING HEADWALL WITH ENHANCED EROSION PROTECTION

REBUILD EXISTING BERM AND TRAIL CONFIGURATION WITH ENGINEERED SOIL MIX TO MATCH EXISTING GRADES

PROPOSED OVERLAND SWALE

PROPOSED DITCH INLET CATCH BASIN

PROPOSED NEW CONCRETE PIPE

PROPOSED NEW HEADWALL

ESTABLISH A FORMAL OUTFALL CHANNEL

CB 13, TOP EL. 76.80m

CB 12, TOP EL. 76.41m

CB 10, TOP EL. 75.83m

CB 11, TOP EL. 76.11m

TIE INTO EXISTING ARMOURSTONE RETAINING WALL

REPLACE CATCH BASIN, PIPE, & HEADWALL, AND INSTALL BACKFLOW VALVE, & BEEHIVE GRATE ON CATCH BASIN

0 10 20 Meters

WORK AREA

KEY PLAN N.T.S.

LEGEND

- PROPERTY LINE
- EXISTING BUILDING
- FENCE LINE
- EASEMENT
- CONTOUR
- STORM SEWER
- SANITARY SEWER
- STORM MANHOLE
- SANITARY MANHOLE
- HYDRANT
- CATCH BASIN
- HEADWALL
- CVC REGULATORY FLOODLINE
- 100-YEAR FLOODLINE
- 25-YEAR FLOODLINE
- 5-YEAR FLOODLINE
- EXISTING AERIAL COAXIAL CABLE
- EXISTING AERIAL FIBRE CABLE
- EXISTING BURIED FIBRE CABLE
- EXISTING ROGERS GROUND LEVEL BOX
- EXISTING ROGERS BLDG ATTACHEMENT
- EXISTING ROGERS PEDESTAL
- ROGERS OWNED HYDRO POLE
- DUCTBANK-DIRECT BURIED
- ALECTRA OWNED POLE
- NON-ALECTRA OWNED POLE

NO.	BY	DATE	REVISIONS	CHECKED

Aquafor Beech Limited
#A-202-2600 SKYMARK Ave.
MISSISSAUGA, ONTARIO, L4W 5B2
PHONE: (905) 629-0099, FAX: (905) 629-0089

MISSISSAUGA

Class EA for Cooksville Creek Erosion Control Project

South of Lakeshore Road

CHANNEL RESTORATION ALTERNATIVE 3
- EXTENDED CHANNEL RESTORATION WORKS (UPSTREAM)
TRAIL/BERM RESTORATION ALTERNATIVE 4
- HYBRID DRAINAGE SOLUTION (UPSTREAM)

SURVEYED BY:	DATE: XXXXXXXX	CONTRACT NO.	
DRAWN BY: M.J.	CHECKED BY: R.A	DRAWING NO. ALT4 – 1	PROJECT NO.
DESIGNED BY: R.A.	CHECKED BY:	SHEET NO. 08 OF 14	PLAN NO.
SCALE: 1:350	DATE: XXXXXXXX		

HAMPTON CRESCENT

PARKING AREA

HELEN MOLASY MEMORIAL PARK

REBUILD EXISTING BERM AND TRAIL CONFIGURATION WITH ENGINEERED SOIL MIX TO MATCH EXISTING GRADES

PROPOSED SAFETY RAILING

REPLACE CATCH BASIN, PIPE, & HEADWALL, AND INSTALL BACKFLOW VALVE, & BEEHIVE GRATE ON CATCH BASIN

CB 5, TOP EL. 75.85m

PROPOSED DITCH INLET CATCH BASIN

PROPOSED NEW CONCRETE PIPE

PROPOSED NEW HEADWALL

ESTABLISH A FORMAL OUTFALL CHANNEL

CB 7, TOP EL. 75.41m

PROPOSED OVERLAND SWALE

PROPOSED DITCH INLET CATCH BASIN

PROPOSED NEW CONCRETE PIPE

PROPOSED NEW HEADWALL

TIE INTO EXISTING ARMOURSTONE REVETMENT

HELEN MOLASY TRAIL

LAKESHORE TRAIL PEDESTRIAN BRIDGE

MAX LAKE LEVEL: 75.88m
AVERAGE LAKE LEVEL: 74.70m
DEC 2023 LAKE LEVEL: 74.53m

COOKSVILLE CREEK

MATCHLINE

ESTABLISH A FORMAL OUTFALL CHANNEL

RETROFIT EXISTING HEADWALL WITH ENHANCED EROSION PROTECTION

RETROFIT EXISTING HEADWALL WITH ENHANCED EROSION PROTECTION

PROPOSED VEGETATED BUTTRESS BANK PROTECTION WITH EMBEDDED ARMOURSTONE

TIE INTO EXISTING CONDITION

MAINTAIN EXISTING COVER OVER SANITARY SEWER CROSSING

RICHEY CRESCENT

LAKESHORE TRAIL

LAKE ONTARIO

BEECHWOOD AVENUE

910 902 896 894 890 884 880 872 903 899 893 887 883 877 873 869 529 519 522 518 516 512 510

0 10 20 Meters

WORK AREA

KEY PLAN N.T.S.

LEGEND

- PROPERTY LINE
- EXISTING BUILDING
- FENCE LINE
- EASEMENT
- CONTOUR
- STORM SEWER
- SANITARY SEWER
- STORM MANHOLE
- SANITARY MANHOLE
- HYDRANT
- CATCH BASIN
- HEADWALL
- CVC REGULATORY FLOODLINE
- 100-YEAR FLOODLINE
- 25-YEAR FLOODLINE
- 5-YEAR FLOODLINE
- EXISTING AERIAL COAXIAL CABLE
- EXISTING AERIAL FIBRE CABLE
- EXISTING BURIED FIBRE CABLE
- EXISTING ROGERS GROUND LEVEL BOX
- EXISTING ROGERS BLDG ATTACHEMENT
- EXISTING ROGERS PEDESTAL
- ROGERS OWNED HYDRO POLE
- DUCTBANK-DIRECT BURIED
- ALECTRA OWNED POLE
- NON-ALECTRA OWNED POLE

NO.	BY	DATE	REVISIONS	CHECKED

Aquafor Beech Limited
#4-202-2800 SKYMARK Ave.
MISSISSAUGA, ONTARIO, L4W 5B2
PHONE: (905) 629-0099 FAX: (905) 629-0089

MISSISSAUGA

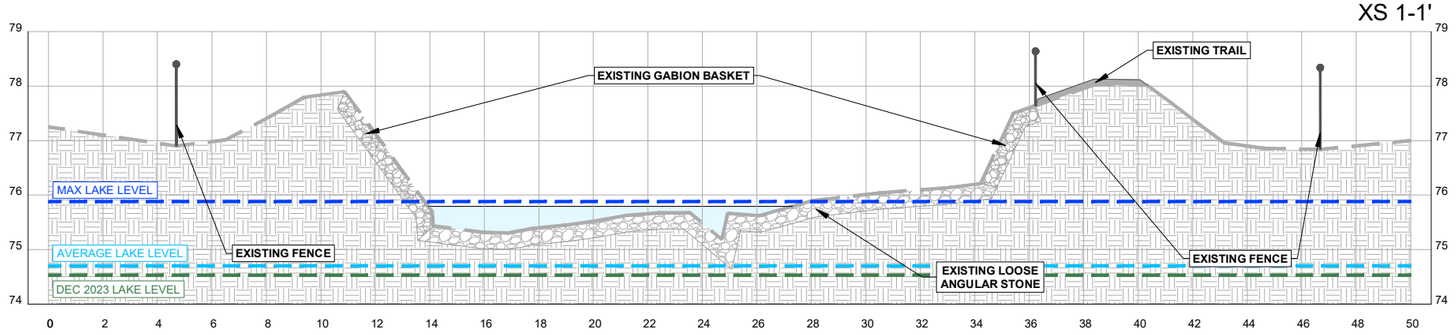
Class EA for Cooksville Creek Erosion Control Project

South of Lakeshore Road

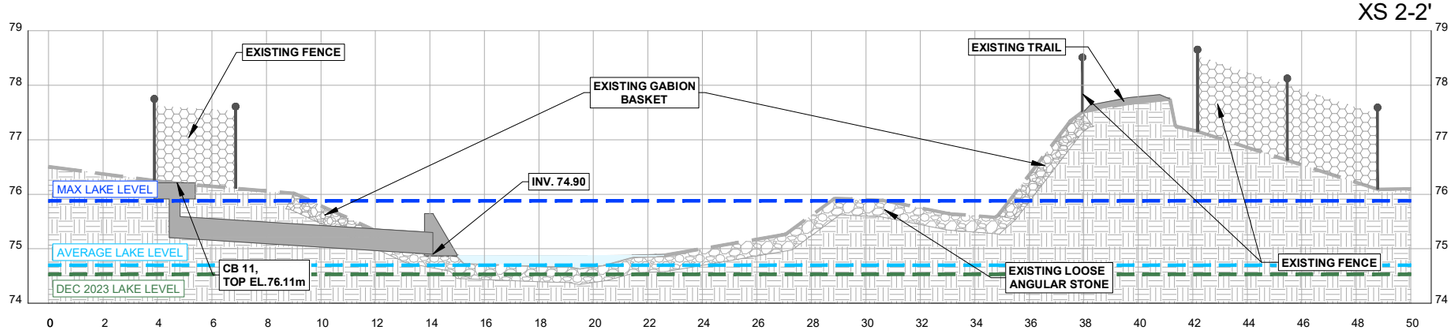
CHANNEL RESTORATION ALTERNATIVE 3
- LOCAL CHANNEL RESTORATION WORKS (DOWNSTREAM)
TRAIL/BERM RESTORATION ALTERNATIVE 4
- HYBRID DRAINAGE SOLUTION (DOWNSTREAM)

SURVEYED BY:		DATE: XXXXXXXX	CONTRACT NO.
DRAWN BY: M.J.	CHECKED BY: R.A	DRAWING NO.ALT4 – 2	PROJECT NO.
DESIGNED BY: R.A.	CHECKED BY:	SHEET NO. 09 OF 14	PLAN NO.
SCALE: 1:350	DATE: XXXXXXXX		

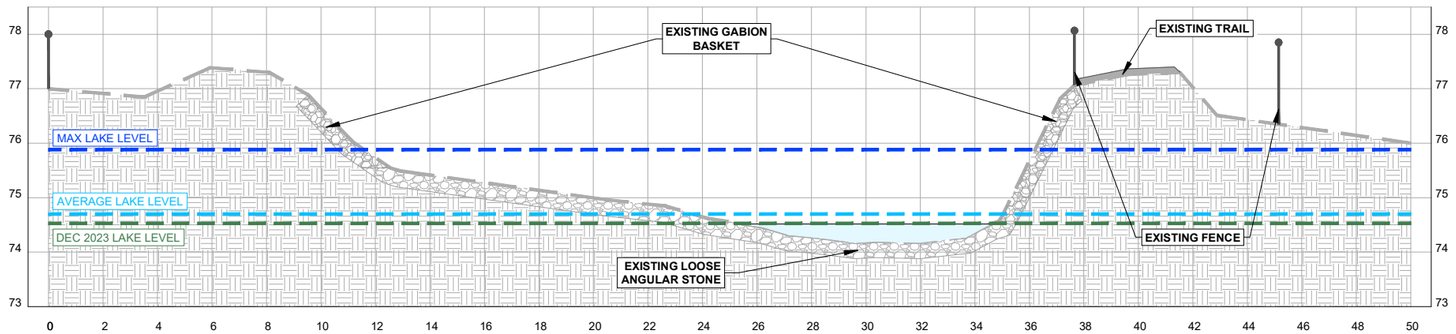
XS 1-1'



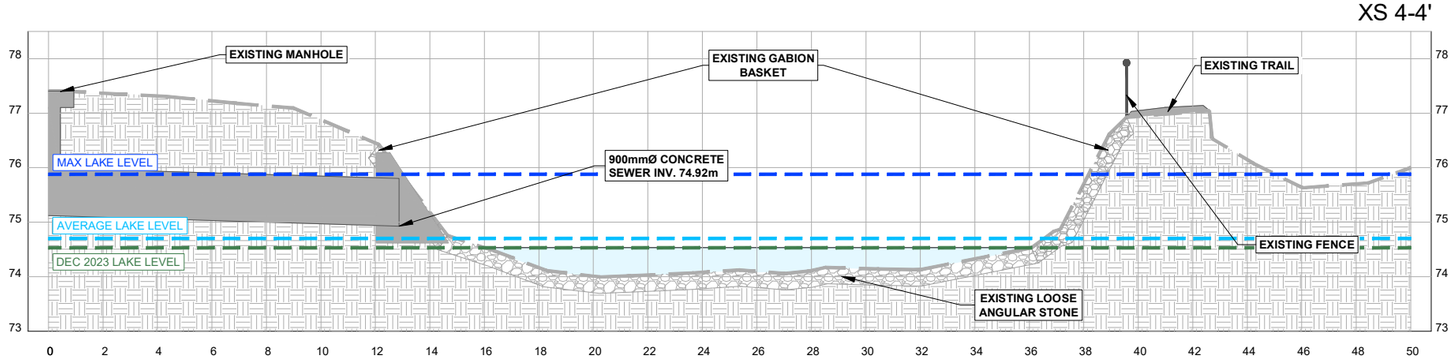
XS 2-2'

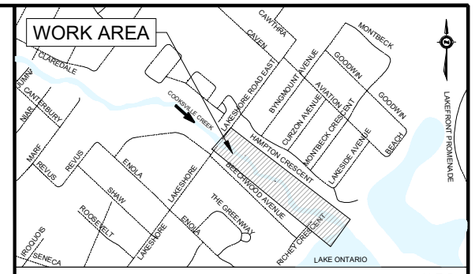


XS 3-3'



XS 4-4'





KEY PLAN N.T.S.

LEGEND

- PROPERTY LINE
- EXISTING BUILDING
- FENCE LINE
- EASEMENT
- CONTOUR
- STORM SEWER
- SANITARY SEWER
- STORM MANHOLE
- SANITARY MANHOLE
- HYDRANT
- CATCH BASIN
- HEADWALL
- CVC REGULATORY FLOODLINE
- 100-YEAR FLOODLINE
- 25-YEAR FLOODLINE
- 5-YEAR FLOODLINE
- EXISTING AERIAL COAXIAL CABLE
- EXISTING AERIAL FIBRE CABLE
- EXISTING BURIED FIBRE CABLE
- EXISTING ROGERS GROUND LEVEL BOX
- EXISTING ROGERS BLDG ATTACHEMENT
- EXISTING ROGERS PEDESTAL
- ROGERS OWNED HYDRO POLE
- DUCTBANK-DIRECT BURIED
- ALECTRA OWNED POLE
- NON-ALECTRA OWNED POLE

NO.	BY	DATE	REVISIONS	CHECKED

Aquafor Beech Limited
A6-202-2800 SKYMARK Ave.
MISSISSAUGA, ONTARIO, L4W 5B2
PHONE: (905) 629-0099, FAX: (905) 629-0089

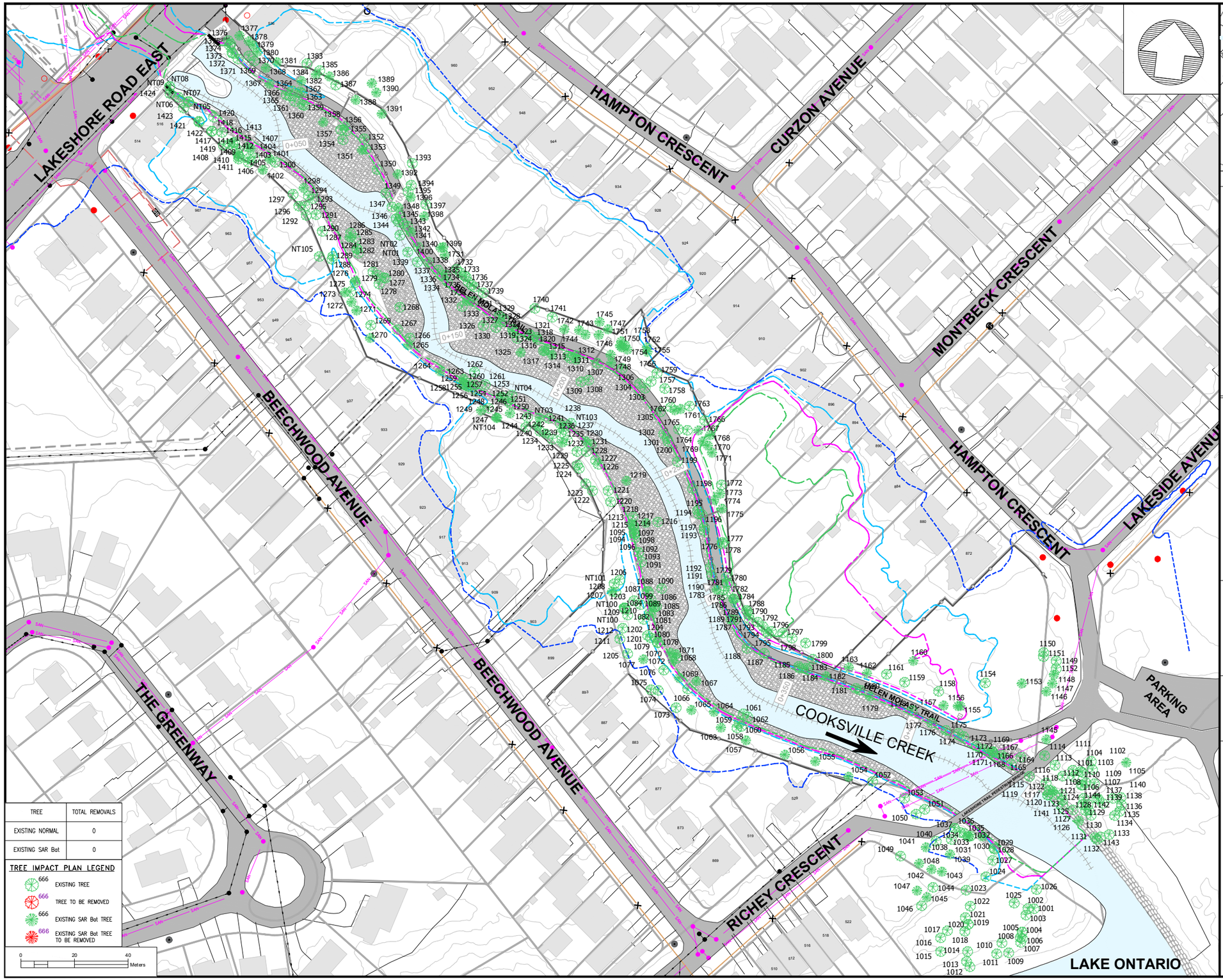
MISSISSAUGA

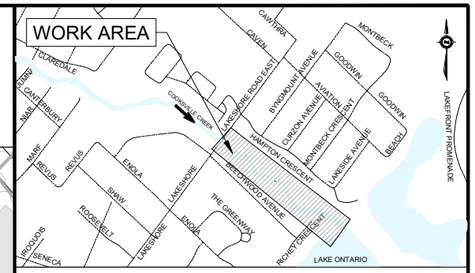
Class EA for Cooksville Creek Erosion Control Project

South of Lakeshore Road

CROSS SECTIONS

SURVEYED BY:	DATE: XXXXXXXX	CONTRACT NO.	
DRAWN BY: M.J.	CHECKED BY: R.A	DRAWING NO. XS	PROJECT NO.
DESIGNED BY: R.A.	CHECKED BY:	SHEET NO. 10 OF 14	PLAN NO.
SCALE: HOR=1:100 VER=1:50	DATE: XXXXXXXX		





KEY PLAN N.T.S.

LEGEND

- PROPERTY LINE
- EXISTING BUILDING
- FENCE LINE
- EASEMENT
- CONTOUR
- STORM SEWER
- SANITARY SEWER
- STORM MANHOLE
- SANITARY MANHOLE
- HYDRANT
- CATCH BASIN
- HEADWALL
- CVC REGULATORY FLOODLINE
- 100-YEAR FLOODLINE
- 25-YEAR FLOODLINE
- 5-YEAR FLOODLINE
- EXISTING AERIAL COAXIAL CABLE
- EXISTING AERIAL FIBRE CABLE
- EXISTING BURIED FIBRE CABLE
- EXISTING ROGERS GROUND LEVEL BOX
- EXISTING ROGERS BLDG ATTACHEMENT
- EXISTING ROGERS PEDESTAL
- ROGERS OWNED HYDRO POLE
- DUCTBANK-DIRECT BURIED
- ALECTRA OWNED POLE
- NON-ALECTRA OWNED POLE

NO.	BY	DATE	REVISIONS	CHECKED

TREE	TOTAL REMOVALS
EXISTING NORMAL	0
EXISTING SAR Bat	0

TREE IMPACT PLAN LEGEND

- 666 EXISTING TREE
- 666 TREE TO BE REMOVED
- 666 EXISTING SAR Bat TREE
- 666 EXISTING SAR Bat TREE TO BE REMOVED

0 20 40 Meters

Aquafor Beech Limited
#4-202-2400 SKYMARK Ave.
MISSISSAUGA, ONTARIO, L4W 5B2
PHONE: (905) 629-0099 FAX: (905) 629-0089

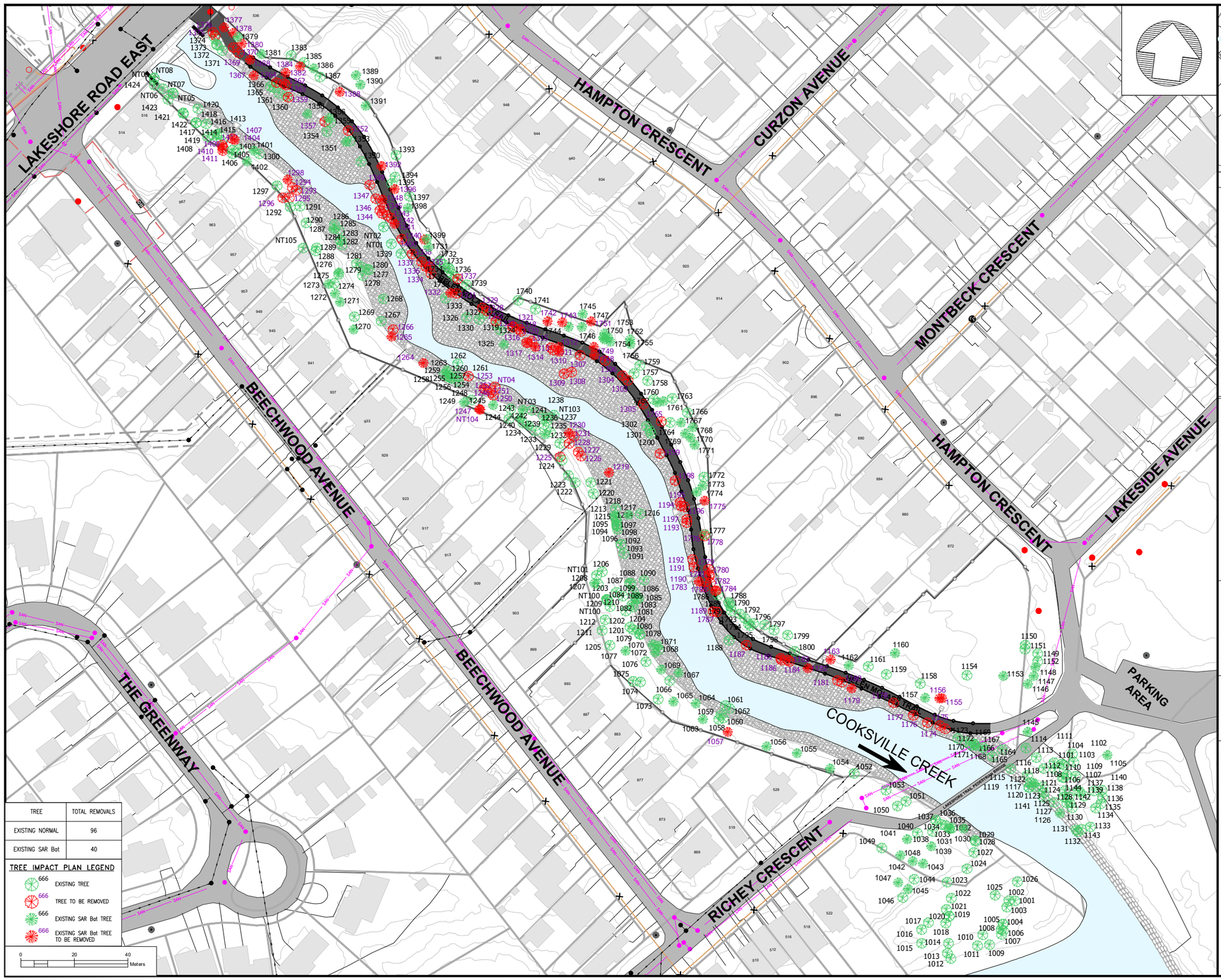
MISSISSAUGA

Class EA for Cooksville Creek Erosion Control Project

South of Lakeshore Road

TREE IMPACT PLAN ALTERNATIVE 1

SURVEYED BY:		DATE: XXXXXXXX	CONTRACT NO.
DRAWN BY: M.J.		CHECKED BY: R.A	DRAWING NO. T11 / PROJECT NO.
DESIGNED BY: R.A.		CHECKED BY:	SHEET NO. 11 OF 14 / PLAN NO.
SCALE: 1:650		DATE: XXXXXXXX	

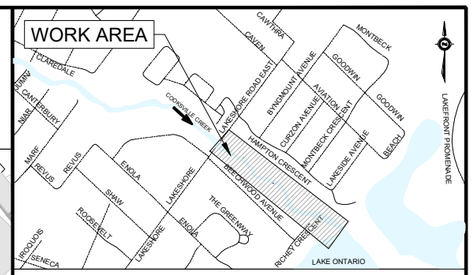


TREE	TOTAL REMOVALS
EXISTING NORMAL	96
EXISTING SAR Bat	40

TREE IMPACT PLAN LEGEND

- 666 EXISTING TREE
- 666 TREE TO BE REMOVED
- 666 EXISTING SAR Bat TREE
- 666 EXISTING SAR Bat TREE TO BE REMOVED

0 20 40 Meters



KEY PLAN N.T.S.

LEGEND

- PROPERTY LINE
- EXISTING BUILDING
- FENCE LINE
- EASEMENT
- CONTOUR
- STORM SEWER
- SANITARY SEWER
- STORM MANHOLE
- SANITARY MANHOLE
- HYDRANT
- CATCH BASIN
- HEADWALL
- CVC REGULATORY FLOODLINE
- 100-YEAR FLOODLINE
- 25-YEAR FLOODLINE
- 5-YEAR FLOODLINE
- EXISTING AERIAL COAXIAL CABLE
- EXISTING AERIAL FIBRE CABLE
- EXISTING BURIED FIBRE CABLE
- EXISTING ROGERS GROUND LEVEL BOX
- EXISTING ROGERS BLDG ATTACHEMENT
- EXISTING ROGERS PEDESTAL
- ROGERS OWNED HYDRO POLE
- DUCTBANK-DIRECT BURIED
- ALECTRA OWNED POLE
- NON-ALECTRA OWNED POLE

NO.	BY	DATE	REVISIONS	CHECKED

Aquafor Beech Limited
#4-202-2600 SKYMARK Ave.
MISSISSAUGA, ONTARIO, L4W 3B2
PHONE: (905) 629-0099 FAX: (905) 629-0089

MISSISSAUGA

Class EA for Cooksville Creek Erosion Control Project

South of Lakeshore Road

TREE IMPACT PLAN ALTERNATIVE 2

SURVEYED BY:	DATE: XXXXXXXX	CONTRACT NO.	
DRAWN BY: M.J.	CHECKED BY: R.A	DRAWING NO. T12	PROJECT NO.
DESIGNED BY: R.A.	CHECKED BY:	SHEET NO. 12 OF 14	PLAN NO.
SCALE: 1:650	DATE: XXXXXXXX		

LAKESHORE ROAD EAST
HAMPTON CRESCENT
CURZON AVENUE
MONTBECK CRESCENT
BEECHWOOD AVENUE
MATCHLINE
THE GREENWAY
RICHEY CRESCENT
LAKESIDE AVENUE
PARKING AREA
COOKSVILLE CREEK
LAKE ONTARIO
WORK AREA
LAKEFRONT PROMENADE

KEY PLAN N.T.S.

LEGEND

- PROPERTY LINE
- EXISTING BUILDING
- FENCE LINE
- EASEMENT
- CONTOUR
- STORM SEWER
- SANITARY SEWER
- STORM MANHOLE
- SANITARY MANHOLE
- HYDRANT
- CATCH BASIN
- HEADWALL
- CVC REGULATORY FLOODLINE
- 100-YEAR FLOODLINE
- 25-YEAR FLOODLINE
- 5-YEAR FLOODLINE
- EXISTING AERIAL COAXIAL CABLE
- EXISTING AERIAL FIBRE CABLE
- EXISTING BURIED FIBRE CABLE
- EXISTING ROGERS GROUND LEVEL BOX
- EXISTING ROGERS BLDG ATTACHEMENT
- EXISTING ROGERS PEDESTAL
- ROGERS OWNED HYDRO POLE
- DUCTBANK-DIRECT BURIED
- ALECTRA OWNED POLE
- NON-ALECTRA OWNED POLE

TREE	TOTAL REMOVALS
EXISTING NORMAL	212
EXISTING SAR Bat	84

TREE IMPACT PLAN LEGEND

- 666 EXISTING TREE
- 666 TREE TO BE REMOVED
- 666 EXISTING SAR Bat TREE
- 666 EXISTING SAR Bat TREE TO BE REMOVED

0 20 40 Meters

NO.	BY	DATE	REVISIONS	CHECKED

Aquafor Beech Limited
#4-202-2600 SKYMARK Ave,
MISSISSAUGA, ONTARIO, L4W 5B2
PHONE: (905) 629-0099 FAX: (905) 629-0089

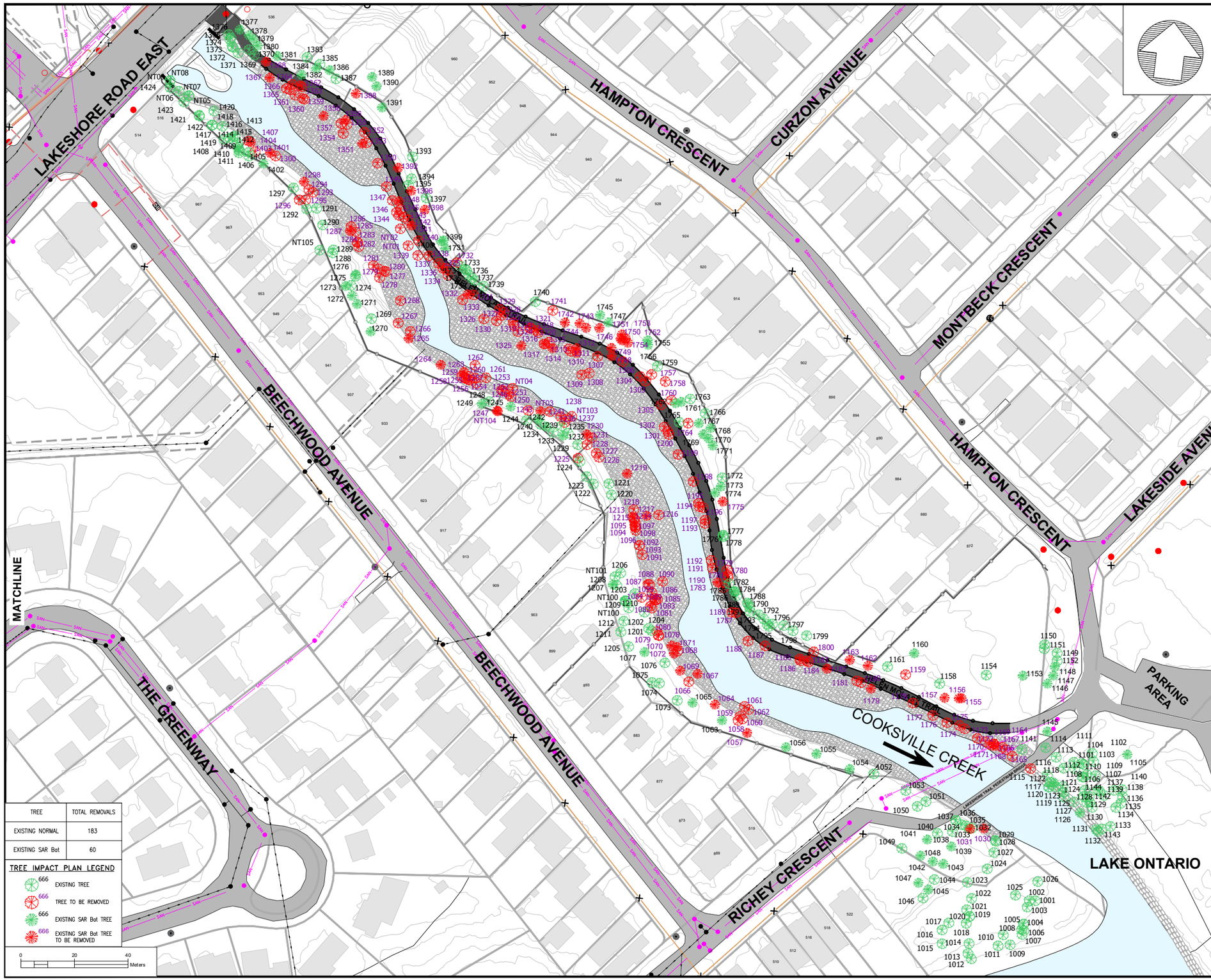
MISSISSAUGA

Class EA for Cooksville Creek Erosion Control Project

South of Lakeshore Road

TREE IMPACT PLAN ALTERNATIVE 3

SURVEYED BY:		DATE: XXXXXXXX	CONTRACT NO.
DRAWN BY:	M.J.	CHECKED BY: R.A	DRAWING NO. T13 / PROJECT NO.
DESIGNED BY:	R.A.	CHECKED BY:	SHEET NO. 13 OF 14 / PLAN NO.
SCALE:	1:650	DATE: XXXXXXXX	

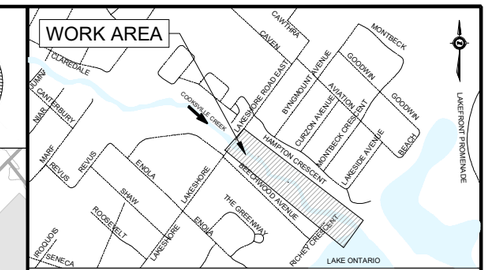


TREE	TOTAL REMOVALS
EXISTING NORMAL	183
EXISTING SAR Bat	60

TREE IMPACT PLAN LEGEND

- 666 EXISTING TREE
- 666 TREE TO BE REMOVED
- 666 EXISTING SAR Bat TREE
- 666 EXISTING SAR Bat TREE TO BE REMOVED

0 20 40 Meters



KEY PLAN N.T.S.

LEGEND

- PROPERTY LINE
- EXISTING BUILDING
- FENCE LINE
- EASEMENT
- CONTOUR
- STORM SEWER
- SANITARY SEWER
- STORM MANHOLE
- SANITARY MANHOLE
- HYDRANT
- CATCH BASIN
- HEADWALL
- CVC REGULATORY FLOODLINE
- 100-YEAR FLOODLINE
- 25-YEAR FLOODLINE
- 5-YEAR FLOODLINE
- EXISTING AERIAL COAXIAL CABLE
- EXISTING AERIAL FIBRE CABLE
- EXISTING BURIED FIBRE CABLE
- EXISTING ROGERS GROUND LEVEL BOX
- EXISTING ROGERS BLDG ATTACHEMENT
- EXISTING ROGERS PEDESTAL
- ROGERS OWNED HYDRO POLE
- DUCTBANK-DIRECT BURIED
- ALECTRA OWNED POLE
- NON-ALECTRA OWNED POLE

NO.	BY	DATE	REVISIONS	CHECKED

Aquafor Beech Limited

MISSISSAUGA

Class EA for Cooksville Creek Erosion Control Project

South of Lakeshore Road

TREE IMPACT PLAN ALTERNATIVE 4

SURVEYED BY:		DATE: XXXXXXXX		CONTRACT NO.	
DRAWN BY:	M.J.	CHECKED BY:	R.A	DRAWING NO. T14	PROJECT NO.
DESIGNED BY:	R.A.	CHECKED BY:		SHEET NO. 14 OF 14	PLAN NO.
SCALE:	1:650	DATE: XXXXXXXX			

Appendix H – First Nations Consultation Summary

Huron-Wendat Nation
Consultation - Communications Log

Date (dd/mm/yy)	From	To	Medium (e.g., email, letter, call)	Communication Description - Nature of Concern(s) or Interest(s)	Response/Follow Up
14-03-2024	**Greg Frew** Project Manager City of Mississauga **Rob Amos** Consultant Project Manager Aquafor Beech Limited	Huron-Wendat Nation	Email	Notice of Study Commencement – Introduction to the Project	**Follow-up:** City of Mississauga to provide an invitation to an open house to discuss the EA.
15-10-2024	**Rob Amos** Consultant Project Manager Aquafor Beech Limited	Huron-Wendat Nation	Email	Sharing of Stage 1 Archeological Assessment Results and Offer for Representation in Stage 2 Archeological Assessment	**Follow-up:** If Field Representation is requested for Stage 2 Archaeological Assessment, this request will be accommodated accordingly.
21-10-2024	**Didier Picard** Site Traditionnel Huron	**Rob Amos** Consultant Project Manager Aquafor Beech Limited	Email	Informing that the wendat@huron-wendat.qc.ca email address is not the correct point of contact. Recommendation that the project team contacts administration@wendake.ca instead.	**Follow-up:** Project Team to reach out to recommended contact point.
22-10-2024	**Greg Frew** Project Manager City of Mississauga **Rob Amos** Consultant Project Manager Aquafor Beech Limited	Huron-Wendat Nation	Email	Sharing of Public Information Centre details, and invitation to participate	**Follow-up:** First Nation to Attend Public Information Centre if desired.

Huron-Wendat Nation
Consultation - Communications Log

Date (dd/mm/yy)	From	To	Medium (e.g., email, letter, call)	Communication Description - Nature of Concern(s) or Interest(s)	Response/Follow Up
29-10-2024	**Benjamin Labbé** Territorial Management Advisor Huron-Wendat Nation	**Greg Frew** Project Manager City of Mississauga **Rob Amos** Consultant Project Manager Aquafor Beech Limited	Email	Expressed interest in a Field Liaison Representative in Stage 2 Archaeological Assessment.	**Follow-up:** City of Mississauga to accommodate request accordingly.
26-11-2024	**Greg Frew** Project Manager City of Mississauga	**Benjamin Labbé** Territorial Management Advisor Huron-Wendat Nation	Email	Follow-up on request for Field Liaison Representative in Stage 2 Archaeological Assessment.	**Follow-up:** First Nation to discuss details of field representation with City of Mississauga.
24-02-2025	**Greg Frew** Project Manager City of Mississauga **Rob Amos** Consultant Project Manager Aquafor Beech Limited	**Benjamin Labbé** Territorial Management Advisor Huron-Wendat Nation	Email	Notice of Study Completion.	**Follow-up:** First Nation to provide comments between February 24th 2025 and March 28th 2025 if desired.

From:	amos.r@aquaforbeech.com
To:	wendat@huron-wendat.qc.ca
Cc:	"Greg Frew"; cota.c@aquaforbeech.com; ursulak.j@aquaforbeech.com
Subject:	Cooksville Creek Erosion Control Project - Schedule B Municipal Class EA
Date:	March 14, 2024 12:47:52 PM
Attachments:	image002.png Cooksville Creek - Huron-Wendat.pdf

---

Dear Huron-Wendat First Nation,

Aquafor Beech Limited has been retained by the City of Mississauga to undertake a Schedule B Class Environmental Assessment Study for the **Cooksville Creek Erosion Control Project from Lakeshore Road to Lake Ontario**.

This project is being completed to address existing problems and risks along Cooksville Creek and the adjacent Helen Molasy Trail.

In accordance with the environmental assessment process, Aquafor is pleased to share the attached letter and Notice of Commencement. Additional information is also available from the project website at:

Project Website
Cooksville Creek Erosion Control Project south of Lakeshore Road – City of Mississauga

Should you have any questions or comments, please feel free to contact the following:

Greg Frew, P.Eng.
Project Manager
City of Mississauga
300 City Centre Dr, Suite 800
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Ltd.
2600 Skymark Avenue, Unit 6-202
Mississauga, ON, L4W 5B2
416.705.23696
Amos.R@aquaforbeech.com

We very much look forward to working with you throughout the project, and will ensure all documentation is available for your review and input.

Kind regards,

Rob

_____
Robert Amos, MASc., P.Eng.
Aquafor Beech Ltd.

☎ **416.705.2367**
✉ Amos.R@Aquaforbeech.com
www.aquaforbeech.com



March 14th, 2024

Huron-Wendat Nation
255 Place Chef Michel Laveau
Wendake, QC
G0A 4V0

Attention: Maxime Picard, Economic Development and Major Projects Director
Re: Environmental Investigations for Cooksville Creek

Dear Huron-Wendat First Nation,

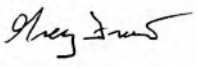
The City of Mississauga is undertaking a Schedule B Class Environmental Assessment (Class EA) Study for the Cooksville Creek Erosion Control Project South of Lakeshore Road.

The City of Mississauga recognizes that this section of Cooksville Creek has been impacted by recent storm events and high lake levels and is in need of rehabilitation. Plans will also need to consider the deteriorated condition of the adjacent city trail through Helen Molasy Memorial Park that sits above the east bank of the creek, as well as the neighbouring properties which have experienced ongoing drainage issues. The study will investigate, analyze, and assess the natural environment of the study area to identify existing erosion problems, potential future risks, and opportunities for restoration and environmental enhancement. The extents of the study area are illustrated on the following page.

A Stage 1 archaeologic investigation is also required as part of the EA. Our archaeological consultants have completed the Stage 1 archaeological investigation.

Your input is important. If you have any questions or comments, or would like to receive copies of the Stage 1 Archaeologic study, please contact myself at 905-615-3200 ext. 3362, or Greg.Frew@mississauga.ca.

Sincerely,



Greg Frew

Project Manager
City of Mississauga



Figure 1. Cooksville Creek Study Area.

CITY OF MISSISSAUGA – NOTICE OF STUDY COMMENCEMENT

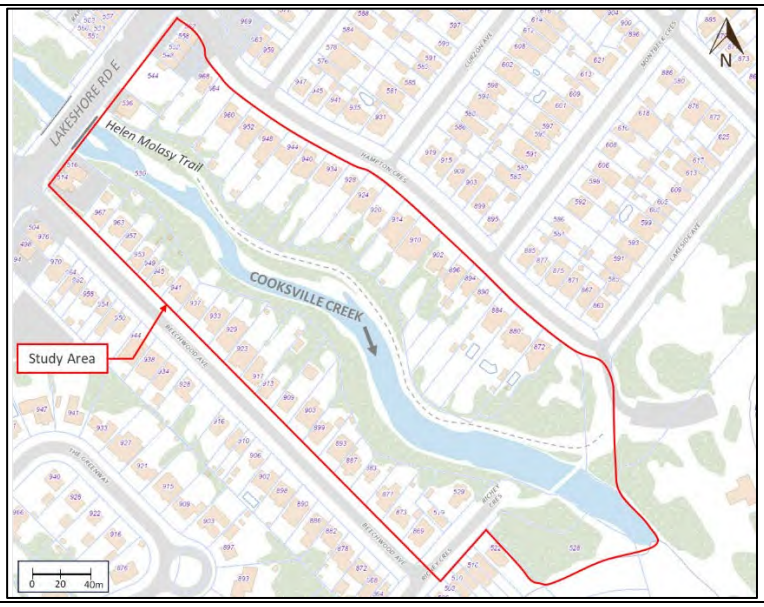
Municipal Class Environmental Assessment Study: Cooksville Creek South of Lakeshore Road

WHAT?

- The City of Mississauga is undertaking a Municipal Class Environmental Assessment (Class EA) Study for the Cooksville Creek Erosion Control Project South of Lakeshore Road.

WHY?

- The City of Mississauga recognizes that this section of Cooksville Creek has been impacted by recent storm events and high lake levels and is in need of rehabilitation. Plans will also need to consider the deteriorated condition of the adjacent city trail through Helen Molasy Memorial Park that sits above the east bank of the creek, as well as the neighbouring properties which have experienced ongoing drainage issues.



HOW?

- The study will examine this section of the Cooksville Creek and Helen Molasy Trail to identify existing problems, potential risks, and opportunities for restoration and drainage improvements.
- Through the Class EA process, the Study Team will develop and evaluate multiple alternative solutions and refine the options through public and agency consultation (see below). The Study Team will then select a Preferred Alternative.
- At the end of the study, a Project File, documenting the study process will be available for public review.
- Following completion of the Class EA Study, designs will be developed and implemented in accordance with study recommendations.

GET INVOLVED!

- Consultation is an important part of the Class EA process. Public input and comment are invited for incorporation into the planning and design of this project.
- A Public Information Centre (PIC) will be held to present the study findings, to consider alternative solutions, and to answer any questions you may have. Details regarding the PIC will be advertised publicly as the study progresses.
- Project information will be made available on the City's project website: https://www.mississauga.ca/projects-and-strategies/environmental-assessments/cooksville-creek-erosion-control-south-of-lakeshore-road/
- If you have any questions of comments regarding the study, or wish to be added or removed from the study mailing list, please contact:

Greg Frew, P.Eng.
Project Manager
City of Mississauga
300 City Centre Dr, Suite 800
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Ltd.
2600 Skymark Avenue, Unit 6-202
Mississauga, ON L4W 5B2
(905) 629-0099, ext. 294
Amos.R@aquaforbeech.com

This notice signals the commencement of the Class EA, a study which will define the problem, identify/evaluate alternative solutions, and determine a preferred design in consultation with regulatory agencies and the public. The study is being undertaken in accordance with the planning and design process for Schedule 'B' projects, as outlined in the "*Municipal Class Environmental Assessment*" document (October 2000, amended in 2015), which is approved under the Ontario *Environmental Assessment Act*.

Personal information is collected under the authority of the Environmental Assessment Act and will be used in the assessment process. With exception of personal information, all comments shall become part of the public records. Questions about this collection should be directed to the Project Manager listed above.

This notice was first issued February, 2024.

From:	amos.r@aquaforbeech.com
To:	wendat@huron-wendat.qc.ca
Cc:	"Greg Frew"; ursulak.j@aquaforbeech.com; cota.c@aquaforbeech.com
Subject:	RE: Cooksville Creek Erosion Control Project - Schedule B Municipal Class EA
Date:	October 15, 2024 1:36:30 PM
Attachments:	image002.png Cooksville Creek Erosion Control EA, Mississauga Stage 1 Archaeology Draft Report.pdf

Dear Huron-Wendat First Nation,

As a followup to the Notice of Commencement, Aquafor and the City of Mississauga have completed a Stage 1 Archeological Assessment (attached) as part of Schedule B Class Environmental Assessment Study for the **Cooksville Creek Erosion Control Project from Lakeshore Road to Lake Ontario**.

Based upon the Stage 1 recommendations, we're looking to complete a Stage 2 Archeological Assessment in the coming months, and wanted to extend the offer for review and / or Field Liaison Representation.

Please let us know how you would prefer to be involved or provide input through the next phases of the study.

Additional information is also available from the project website at:

Project Website
Cooksville Creek Erosion Control Project south of Lakeshore Road – City of Mississauga

Thanks very much, and should you have any questions or comments, please feel free to contact the following:

Greg Frew, P.Eng.
Project Manager
City of Mississauga
300 City Centre Dr, Suite 800
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Ltd.
2600 Skymark Avenue, Unit 6-202
Mississauga, ON, L4W 5B2
416.705.23696
Amos.R@aquaforbeech.com

Kind regards,

Rob

Robert Amos, MASc., P.Eng.
Aquafor Beech Ltd.

☎ **416.705.2367**
✉ Amos.R@Aquaforbeech.com
www.aquaforbeech.com

From: amos.r@aquaforbeech.com <amos.r@aquaforbeech.com>
Sent: March 14, 2024 12:48 PM
To: wendat@huron-wendat.qc.ca
Cc: 'Greg Frew' <Greg.Frew@mississauga.ca>; cota.c@aquaforbeech.com; ursulak.j@aquaforbeech.com
Subject: Cooksville Creek Erosion Control Project - Schedule B Municipal Class EA

Dear Huron-Wendat First Nation,

Aquafor Beech Limited has been retained by the City of Mississauga to undertake a Schedule B Class Environmental Assessment Study for the **Cooksville Creek Erosion Control Project from Lakeshore Road to Lake Ontario**.

This project is being completed to address existing problems and risks along Cooksville Creek and the adjacent Helen Molasy Trail.

In accordance with the environmental assessment process, Aquafor is pleased to share the attached letter and Notice of Commencement. Additional information is also available from the project website at:

> **Project Website**
> Cooksville Creek Erosion Control Project south of Lakeshore Road – City of Mississauga

Should you have any questions or comments, please feel free to contact the following:

Greg Frew, P.Eng.
Project Manager
City of Mississauga
300 City Centre Dr, Suite 800
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Ltd.
2600 Skymark Avenue, Unit 6-202
Mississauga, ON, L4W 5B2
416.705.23696
Amos.R@aquaforbeech.com

We very much look forward to working with you throughout the project, and will ensure all

documentation is available for your review and input.

Kind regards,

Rob

_____
Robert Amos, MASc., P.Eng.
Aquafor Beech Ltd.

☎ **416.705.2367**
✉ Amos.R@Aquaforbeech.com
www.aquaforbeech.com



Stage 1 Archaeological Background Study

Original Report

2023

DRAFT

Cooksville Creek Erosion Control
Part of Lot 11, Concession 3 South of Dundas Street,
(Former Township of Toronto, County of Peel),
City of Mississauga, Regional Municipality of Peel

Prepared For
Aquafor Beech Limited
Mississagua, Ontario

Project Information
Archaeological License: P1024 (Sarah MacKinnon MSc.)
MTCS PIF#: P1024-0311-2023
Corporate File #: 221-2023
Development Project Designation #: N/A

December 30th, 2023

New Era ARCHAEOLOGY
neweraarchaeology.ca
contact@neweraarchaeology.ca

EXECUTIVE SUMMARY

The City of Mississauga is addressing erosion along part of Cooksville Creek and as part of the processes New Era Archaeology Inc. was retained by Aquafor Beech Ltd. to complete a Stage 1 Archaeological Background Study and was given permission to access the project area to conduct all required archaeological fieldwork activities. This report describes the Stage 1 Archaeological Background Study for the Cooksville Creek Erosion Control within, Part of Lot 11, Concession 3 South of Dundas Street, (Former Township of Toronto, County of Peel), City of Mississauga, Regional Municipality of Peel. The study was conducted under Professional Archaeological License P1024 issued by the Minister of Citizenship and Multiculturalism (Ontario) to Sarah MacKinnon. The Stage 1 Archaeological Background Study was undertaken under the Class Environmental Assessment (1990). This report confirms that all the work conducted as part of this assessment conforms to the *Standards and Guidelines for Consultant Archaeologists* (MCM 2011) and the *Ontario Heritage Act* (MCL 2005).

The objectives of the Stage 1 Background Study are to determine if the project area has the potential to contain archaeological resources and determine if any past use activities within the project area have removed areas of potential. The *Checklist for Determining Archaeological Potential* and the 2011 *Standards and Guidelines for Consultant Archaeologists* (MCM 2011) published by the Ontario Ministry of Citizenship and Multiculturalism (MCM 2011) outlines features and the buffers around these features within which there is potential for archaeological resources. There are two groups of features, one for Indigenous (pre-contact) potential and one for Euro-Canadian (post-contact) archaeological potential. The main feature, which indicates potential for Indigenous archaeological resources, is the proximity to a potable water source. Additional features include topography, soil type and proximity to previously identified archaeological sites. Historic potential is based on proximity to historic features such as structures, roads, railways, settlements and previously identified archaeological sites.

The Stage 1 Archaeological Background Study involved the review of historical records, historic maps, current aerials, and project area inspection to confirm the current conditions of the project area. Both historic and current resources are consulted to identify areas of archaeological potential and activities conducted within the project area, which have removed potential. This information is used to determine if the project area has archaeological potential, note areas of no potential, and recommend appropriate strategies for Stage 2 for areas of archaeological potential. Prior to the site visit, it was determined that the project area has potential for both Indigenous (pre-contact) and Euro-Canadian (post-contact) archaeological resources and that past activities resulting in deep disturbance have removed potential within the project area. The site visit was completed on December 12th, 2023, to confirm the current conditions of the project area.

As a result of the Stage 1 Archaeological Background Study, it was determined that the project area has potential for both pre-contact and post-contact archaeological resources. It has also been determined that a portion of the project area has undergone significant disturbances relating to previous construction activities. Archaeological potential remains for portions of the project area, consequently, Stage 2 Archaeological Assessment by test pit survey is recommended.

DRAFT

TABLE OF CONTENTS

EXECUTIVE SUMMARY **2**

1.0 PROJECT CONTEXT **6**

1.1 DEVELOPMENT CONTEXT 6

1.2 HISTORICAL CONTEXT 6

1.2.1 Ontario Prehistory *6*

1.2.2 General Indigenous Overview *9*

1.2.3 Peel County Historic Overview *11*

1.2.4 Township of Toronto *13*

1.2.5 Historic Mapping *14*

1.3 ARCHAEOLOGICAL CONTEXT 15

1.3.1 Previously Registered Sites *15*

1.3.3 Current Land Use and Field Conditions *15*

1.3.4 Physiographic Region *15*

1.3.5 Water Resources *17*

2.0 SITE VISIT **17**

3.0 ANALYSIS AND CONCLUSIONS **18**

3.1 STAGE 1 BACKGROUND RESULTS 18

4.0 RECOMMENDATIONS **18**

5.0 ADVICE ON COMPLIANCE WITH LEGISLATION **19**

6.0 BIBLIOGRAPHY **20**

7.0 MAPS **21**

8.0 PLATES **27**

DRAFT

LIST OF MAPS

Map 1: Location of Project Area 21
Map 2: Historic Map Illustrating the Environment Surrounding the Property Area in 1859 21
Map 3: Historic Map Illustrating the Environment Surrounding the Property Area in 1877 22
Map 4: Project Area on National Topographic Survey from 1909 22
Map 5: Project Area on National Topographic Survey from 1929 23
Map 6: Project Area on Historic Aerial from 1954 23
Map 7: Project Area on Historic Aerial from 1980 24
Map 8: Project Area on Historic Aerial from 1985 24
Map 9: Project Area 25
Map 10: Stage 1 Archaeological Background Study Results 25
Map 11: Stage 1 Archaeological Background Study Results 26

LIST OF TABLES

Table 1: General Indigenous History Throughout Ontario 6
Table 2: Site Visit Documentary Record Inventory 17

LIST OF PLATES

Plate 1: Wooded Park Land 27
Plate 2: Asphalt Pathways and Two Manholes Between Them 27
Plate 3: Wooded Area Along Lake Ontario 27
Plate 4: Cooksville Creek 27
Plate 5: Cooksville Creek Emptying into Lake Ontario 27
Plate 6: Wooded Area Along the Creek and Manhole 27
Plate 7: Wooded Area Along the Creek 28
Plate 8: Wooded Area Along the Creek 28
Plate 9: Wooded Area and Gibbons Along the Creek 28
Plate 10: Wooded Area Along the Creek 28
Plate 11: Asphalt Pathway Surrounded by Mature Trees; Manhole 28
Plate 12: Sewer Outlets Emptying into Creek 28
Plate 13: Elevated Pathway Surrounded by Trees and Lawn 29
Plate 14: Elevated Pathway Surrounded by Trees and Lawn 29
Plate 15: Asphalt Pathway Surrounded by Mature Trees 29
Plate 16: Asphalt Pathway Surrounded by Mature Trees 29
Plate 17: Infrastructure Where Cooksville Creek Passes Under Lakeshore Road East 29
Plate 18: Cooksville Creek 29

DRAFT

PROJECT PERSONAL

LICENSED ARCHAEOLOGIST:
Sarah MacKinnon MSc. (P1024)

FIELD DIRECTOR:
Sarah MacKinnon MSc. (P1024)

REPORT PREPARATION:
Kayleigh MacKinnon MSc. (P384)

REPORT MAPPING:
Kayleigh MacKinnon MSc. (P384)

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1.0 PROJECT CONTEXT

1.1 DEVELOPMENT CONTEXT

The City of Mississauga is addressing erosion along part of Cooksville Creek and as part of the processes New Era Archaeology Inc. was retained by Aquafor Beech Ltd. to complete a Stage 1 Archaeological Background Study and was given permission to access the project area to conduct all required archaeological fieldwork activities. This report describes the Stage 1 Archaeological Background Study for the Cooksville Creek Erosion Control within, Part of Lot 11, Concession 3 South of Dundas Street, (Former Township of Toronto, County of Peel), City of Mississauga, Regional Municipality of Peel. The study was conducted under Professional Archaeological License P1024 issued by the Minister of Citizenship and Multiculturalism (Ontario) to Sarah MacKinnon. The Stage 1 Archaeological Background Study was undertaken under the Class Environmental Assessment (1990). This report confirms that all the work conducted as part of this assessment conforms to the *Standards and Guidelines for Consultant Archaeologists* (MCM 2011) and the *Ontario Heritage Act* (MCL 2005).

1.2 HISTORICAL CONTEXT

1.2.1 Ontario Prehistory

Table 1: General Indigenous History Throughout Ontario

Period	Date Range	Cultural Group	Diagnostic Material	Period Details
Paleo-Indian – ca. 11,000-7,500 BC				
Early	ca. 11,000-8,500 BC	Clovis, Plano	Fluted projectile points	The continental glacier covering Ontario continued to recede north exposing more habitable land for flora and fauna attracting the nomadic hunters from the south-west. These hunter-gatherers set up sites along shorelines, with fish a main dietary staple and would periodically gather into larger groups typically during the summer months when food was more abundant. The Clovis culture remained in Southern Ontario where the Plano culture moved into Northern Ontario
Late	ca. 8,500-7,500 BC		Plano, Holxombe, Hi-Lo projectile points	
Archaic – ca. 7,800-1,000 BC				
Early	ca. 7,800-6,000 BC	Shield Archaic, Laurentian Archaic	Bifurcate, nettling projectile points	Small nomadic hunter-gatherer bands slowly transition to small territorial camps. There is a continuation of gathering into larger groups in the summer and dispersing into smaller groups over the winter. Dependence on hunting meant that great distances were often covered throughout the year. There is an increase in the use of localized material and the re-purposing of stone tools. Local and long-distance trade networks appear leading to an influx of exotic material and goods, including natural copper and conch shells, often used as grave offerings. Trading often occurred in the summer months when groups came together at the mouths of rivers to take advantage of the spawning fish. The open water also allowed for easier travel over longer distances.
Middle	ca. 6,000-2,000 BC		Brewerton, Stanly, Side-notched projectile points	
Late	ca. 2,500-1000 BC		Lamoka, Adder Orchard, Genesee, Lamoka, Innes, Crawford Knoll, Innes, Hind projectile points	

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				The bow and arrow was adopted towards the end of the period, which was already in use on the east coast. The Plano cultural group are the ancestors of the Shield Archaic and the Clovis are ancestors of the Laurentian Archaic.
Woodland – ca. 1,000 BC – AD 1600				
Early	ca. 1000-400 BC	Meadowood, Middlesex	Birdstones, Cache blades, Kramer, Meadowood projectile points	Hunter-gatherer groups continue to come together in the warmer months and disperse in the fall occupying the margins of Southern Ontario. Both large and small campsites have been identified. The same trade networks are maintained. One distinguishing characteristic of this period is the introduction of pottery. Burial ceremonialism is also practiced. Late Archaic ancestors. The Meadowood culture is changed or absorbed by Point Peninsula.
Middle	ca. 400 BC - AD 700	Point Peninsula, Saugeen	Vanport, Snyder, Saugeen projectile points	Hunter-gatherers, but evidence of increased sedentism and seasonal site reuse and emergence of horticulture. Diets expanded to include the collection of wild fruits and wild rice. More intricate burial ceremonialism adopted from Hopewell culture to the south, as a result of trade networks, including the use of burial mounds. More decorative pottery techniques also appear including stamped and scalloped techniques. Items from the Ohio Valley also start to appear for the first time including stone platform pipes, copper ear spools and copper panpipes. Point Peninsula sites in the Toronto, Quebec and New York areas. Saugeen sites found in the area between Lake Huron and Lake Erie west of Toronto.
Transitional	ca. AD 600 - 1000	Princess Point, Laurel	Princess Point pottery, Triangular projectile points	Princess Point sites remain smaller in size located along the north shore of Lake Erie and the west end of Lake Ontario. They are the first to adapt corn in Ontario, which spread northeast from Mexico. Princess Point pottery decorative techniques include cord-wrapped stick and punctuates. The Shield Archaic are ancestors of the Laurel culture who occupied Northern Ontario, Western Quebec and areas to the west and received their pottery knowledge from Point Peninsula and Saugeen cultures. The Laurel also created some of the largest burial mounds.
Late - Early	ca. AD 900 - 1300	Glen Meyer, Pickering	Glen Meyer Tanged-Triangular projectile point	The Pickering culture developed out of the Point Peninsula culture and occupied an area between Lake Ontario and Georgian Bay to Lake Nipissing. The Glen Meyer culture developed out of the Princess Point culture and occupied southwestern Ontario between Long Point and Lake Huron. Small single-family houses change to larger multi-family longhouses within small village sites with the appearance of palisades at some. There is an increase in corn agriculture. Pottery vessels are thinner walled with improved manufacturing. There is a switch in burial customs to the use of burial pits, a precursor to large ossuaries. Towards the end of the period pipes become more common.
Late - Middle	ca. AD 1300 - 1400	Uren, Middleport, Lalonde	Middleport projectile points	Increase in village size and reliance on agriculture including corn, beans and squash. Farming provided increased food resources with better nutrition allowing populations to grow. Decrease in decorated pottery vessels and an increase in decorative pipes including effigy pipes. Some sites still include a palisade.

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Late - Late	ca. AD 1400 - 1600	Ontario Iroquoian	Nanticoke, Daniels Triangular projectile points	Village size increased and locations were strategically picked to ensure enough arable land as their diets were heavily dependent on agriculture. Locations were also chosen for their proximity to woodlots for both heating and building, proximity to water and a location which could be easily defended. Good hunting grounds to support the growing village population became important and as a result hostilities over these hunting grounds increased with neighboring communities. Emergence of tribes and territories. Dogs were domesticated and large ossuaries become common. Towards the end of the period the first Europeans goods appear periodically in Ontario through trade networks with groups further east who were in contact with the first French explorers who had reached the St. Lawrence.
Contact-Historic – ca. AD 1600-1800				
European Contact	AD 1600-1650	Huron, Neutral, Petun, Odawa, Ojibwa	Minimal European items	Establishment of the fur trade. Increase in warfare resulted in tribal disbursement leaving much of the area between Lake Ontario and Lake Simcoe with no permanent large villages. Many villages move north of Lake Simcoe further away from the Iroquois. Continued warfare from the Iroquois to the south resulted in the dispersal of the remaining Huron-Wendat and abandonment of their remaining villages and resettlement in Quebec at the closing of this period. The French arrive in Ontario with an increase in Jesuit missionaries and European goods.
Late	AD 1650- ca. 1800	Algonquin, 6 Nations Iroquois,	Mixture of Indigenous and European items	The Iroquoian continued to use their conquered land of Southern Ontario as mainly hunting grounds with a few settlements located along the shoreline of Lake Ontario. The Iroquoian were then challenged and pushed out of the region by the Anishinaabeg (Ojibway, Chippewa, Odawa). Trade continued with both English and French. Numerous migrations and resettlements. The end of this period there saw an influx of European and American settlers transitioning to the historic period.

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1.2.2 General Indigenous Overview

1.2.2.1 Southern Ontario

As the glaciers that covered southern Ontario began to retreat approximately 12,500 years ago, the area began to become habitable for the Paleo-Indian hunting bands arriving between 11, 000 and 10,500 years ago finding large meltwater lakes formed in the wake of the retreat. The lakes were accompanied by relatively barren tundra interspersed with areas of open boreal forest. The Paleo-Indian hunters focused on the large Pleistocene mammals including mastodon, moose, elk, and especially herds of caribou that roamed the area. Following the herds of animals, the Paleo-Indian groups travelled long distances and seldom stayed in one campsite for a significant length of time leaving behind little material culture. Stone tools and by-products of their flaked stone industry are virtually all that remains. They manufactured large distinctive spear points that have a prominent channel or groove on each face. Campsites from this period are frequently found adjacent to remnant shorelines of large post-glacial lakes indicating that camping sites were set up along the shores of lakes to intercept migrating herds. The water levels of the Lake Ontario basin fell in the early post-glacial period and subsequently rose again to modern levels resulting in these campsites now being situated more than a kilometer into the lake (Archaeological Services Inc. 2014).

The Archaic Period (7,000 B.C – 1,000 B.C) saw a mixed needle and broadleaf forest cover established in Ontario and nomadic hunter-gatherers hunted deer, moose, as well as other animals, fished and gathered plant resources while moving relatively large distances over the landscape during the year. From the archaeological record, the technological and cultural change can be identified including a wide variety of tools produced which resulted in shifts in hunting strategies to adjust to a constantly evolving environment. During the Late Archaic period hunter-gatherer bands most likely settled into familiar hunting territories. Two types of sites evolved as a result of their hunting patterns, the small inland camps that were occupied by small groups of related families during the fall and winter where they could harvest nuts and hunt deer, and the larger spring and summer settlements that were located near river mouths where groups came together to trade, exploit spawning fish resources and to bury their dead. Many of the ground stone tools have both social and symbolic functions, they had a day-to-day use, but their inclusion in burials ascribes to them a sacred intent (Archaeological Services Inc. 2014).

The Woodland Period (1,000 B.C – 1600 A.D.) is distinguished from the previous Archaic period with respect to settlement patterns and subsistence pursuits and is most specifically marked by the instruction of ceramics into Ontario. Though the appearance of these ceramics provides a temporal marker for archaeologists their use does not seem to have profoundly changed the hunter-gatherer lifestyle of the previous period. The Iroquoian society flourished in the southern Great Lakes region in the Late Woodland Period. Increasingly sophisticated burial ceremonies and an increase in the trade of exotic items developed which may have come out of the need for greater social solidarity as the population increased causing competition for resources. Trade with communities living south of the Great Lakes introduced maize and squash creating a transition to food production that then reduced reliance on naturally occurring resources and led to less movement as people tended to their crops. As sites were more intensively occupied the need for a greater degree of internal spatial organization came about which can be seen in the archaeological record (Archaeological Services Inc. 2014). The ancestors of the Neutral, Huron, and Petun resided along the central north shore of Lake Ontario and the ancestral Iroquoians became the Five Nation Iroquois (Seneca, Cayuga, Onondaga, Oneida, and Mohawk) occupied the area south of Lake Ontario in what is now central New York State. Though there were most likely interactions between these Iroquoian-speaking groups it was not until the mid to late 17th century that the Five Nation Iroquois inhabited the Toronto area. The focus on agricultural practices led to a more sedentary lifestyle with larger communities coming together and forming alliances with separate villages. Some villages were fortified with palisade walls with land cleared around them for crops. By the time European explorers and missionaries arrived in Ontario at the beginning of the 17th century the villages were

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under the direction of various chiefs elected from the principal clans and subsequently allied within powerful tribal confederacies (Archaeological Services Inc. 2014).

By 1600 most of the Lake Ontario north shore communities had moved northward joining communities in Simcoe County to form the Petun and Huron. Though the movement of these communities took place over many generations the conflict with the Five Nations Iroquois of New York State was the final impetus. The collapse and dispersal of the three Ontario Iroquoian confederacies (the Huron, the Petun, and the Neutral) during the first half of the 17th century was caused by intertribal warfare with the Five Nations Iroquois and exacerbated by the intrusion of Europeans (Archaeological Services Inc. 2014).

1.2.2.2 Peel County

While Indigenous groups have long inhabited Southern Ontario, during the 1600s it was those in the Iroquois Confederacy (also known as Five Nations) who controlled large areas, including what is now known as Peel. By the 1700s the Iroquois had become weakened by disease and warfare with the French and were pushed out of the area by the Anishinaabeg as they migrated southward to settle along the north shore of Lake Ontario. This group would later become known as the Mississaugas by European settlers (Peeling the Past, 2017).

After the Seven Years War between Britain and France ended in 1763 the overall control of the lands that now comprise Ontario and Quebec were ceded by France to the British who continued to maintain forts at Kingston and Niagara. The influx of settlers after the American Revolution and the subsequent migration of Loyalist settlers convinced the British Crown to formally acquire new lands for settlement through a series of land purchases from Indigenous groups including the Mississaugas. Between 1783 and 1818 tracts of land within Ontario were purchased and surveyed for settlement (Peeling the Past, 2017).

> *On August 2nd, 1805 the British and Mississaugas signed a treaty covering the southern portion of the "Mississauga Tract" on the Lake Ontario waterfront, reaching from the Etobicoke Creek on the east to Burlington Bay on the west, and running north to what in Peel is known as the Second Concession North of Dundas Street (also known as Eglinton Avenue). Within a year the land was surveyed and divided into "Townships" for settlement purposes. The township in the Peel area was known as Toronto Township (now the City of Mississauga). It is interesting to note that the naming of this Township predated the incorporation of the City of Toronto in 1834 (founded as the Town of York in 1793).*
>
> *When Toronto Township was purchased the Mississaugas withheld a strip of land 1 mile wide on either side of the Credit River. The rest of the land was surveyed, and settlement began in earnest. Small hamlets sprung up at crossroads throughout the Township, including Summerville and Dixie. These hamlets were usually composed of a blacksmith shop, general store, church, and perhaps an inn or hotel. By 1818 the need for more land was apparent, and negotiations were started to purchase the remaining Mississauga land north of Eglinton Avenue. That same year 648,000 additional acres were purchased* [Treaty 19]*, and by 1819 the land was surveyed and divided into Townships. The Peel area now included an enlarged Toronto Township, as well as four additional townships: Chinguacousy, Toronto Gore, Albion, and Caledon. In February 1820 the Mississaugas surrendered the last of their lands along the Credit River, only keeping a small piece for a village that they subsequently abandoned in 1847 (now the Mississaugua Golf and Country Club).*
>
> (Peeling the Past, 2017).

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The project area is located within the traditional territory of the Mississaugas of the Credit River First Nation and included within the Ajetance Purchase (Treaty No. 19), the last large tract of land they ceded. The Ajetance Purchase includes lands within the Halton and Peel Regions and Dufferin and Wellington Counties. On October 23rd, 1818, members of the Mississaugas of the River Credit and Twelve and Sixteen Mile Creeks as well as, Chief of the Eagle Tribe, Weggishigomin of the Eagle Tribe, Kawwahkitahqubi of the Otter Tribe, Cabibonike of the Otter Tribe, and Pagitaniquatoibe of the Otter Tribe met with Deputy Superintendent William Claus on behalf of His Majesty to discuss the purchase of land (Filice 2018, Mississaugas of the Credit First Nation 2017b, Surtees 1984, Crown-Indigenous Relations and Northern Affairs 2016). The treaty was signed on October 28th, 1818, and included:

> *"A tract of land in the Home District, called the Mississauga tract," bounded southerly by the purchase made in 1806; on the east by the Townships of Etobicoke, Vaughan and King; on the south-west by the Indian purchase, extending from the outlet at Burlington Bay, north forty-five degrees west fifty-miles, and from thence north seventy-four degrees east or thereabout to the north-west angle of the Township of King, containing by computation six hundred and forty-eight thousand acres; and the said Adjutant, Weggishigomin, Cabibonikem, Pagitaniquatoibe and Kawahkitahquebi, as well for themselves as for he Mississauga Nation inhabiting and claiming the said tract of land as above described, do freely, fully and voluntarily surrender and convey the same to His Majesty without reservation or limitation in perpetuity. And the said William Claus, on behalf of His Majesty does hereby, promise and agree to pay to the said Nation of Indians inhabiting as above mentioned, yearly and every year for ever the said sum of five hundred and twenty two pounds then shillings currency in goods at the Montreal price, which sum the said Principal Chiefs and people, parties hereunto, acknowledge as a full consideration for the lands hereby sold and conveyed to His Majesty.*
>
> (Crown-Indigenous Relations and Northern Affairs 2016)

The Mississaugas had negotiated the sale of all their territory with the exception of 200 acres near the mouth of the Credit River by 1820 (Filice 2018, Mississaugas of the Credit First Nation 2017b, Surtees 1984).

1.2.3 Peel County Historic Overview

In 1788 four Districts were created including the Nassau District (later the Home District) which included what would later become the County of Peel. Then in 1791, the province of Quebec was divided into Upper Canada and Lower Canada, and the Home District became part of Upper Canada with most of what is now southern Ontario (Walker & Miles, 1877, Mercer et al 1885).

Lieutenant-Colonel John Graves Simcoe was appointed the first Lieutenant-Governor of Upper Canada. He moved the capital from Newark (Niagara) to Toronto, which he renamed York in honour of the King's son Frederick the Duke of York, in order to provide it more protection. In 1792 he divided Upper Canada into 19 Counties and created a road system. To establish and open the road system Governor Simcoe brought troops over from England. He also employed them in other building operations and posted them along these roadways. The establishment of a road system prepared the Counties for an influx of settlers and aided settlers on their journey to their new home (Mercer et al 1885). The Home District, albeit with the inclusion of fewer townships, continued until the institution of districts was abolished in 1852 and as a result the united County of York, Peel and Ontario was formed. The County of Ontario was the first to separate. It was not until 1866 that Peel was separated from York. After some time, the Village of Brampton was finally selected as County Town and the County buildings were erected at a cost of over $40,000. The first council met at the Brampton Court House in January 1867 (Walker & Miles, 1877).

The County of Peel was named after Sir Robert Peel (1788-1850), a British politician who served as both Home Secretary and Prime Mister of Great Britain (Walker & Miles, 1877). Located on the north shore of Lake Ontario,

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bounded on the east by the County of York, on the north by the Counties of Simcoe and Wellington, and on the west by the Counties of Wellington and Halton, it is comprised of the Townships of Toronto, Toronto Gore, Chinguacousy, Caledon and Albion, the incorporated Town of Brampton, and the incorporated villages of Streetsville and Bolton. As a small County, it contains 293,300 acres of land measuring 37 miles in length with an average width of 15 miles. A chain of ridges runs through it dividing it into two distinct sections, entering at Caledon at a south-west angle and passing out of the County approximately midway through the eastern boundary of Albion. The two sections are distinct in character of soil and climate as well as general appearance above and below this chain. The land in the lower region is gently undulating with a gradual but continual ascent from the Lake to the base of the ridges where it then rises nearly perpendicular. In other areas, it is broken for some miles, with hills over hills making it difficult to ascertain when you have actually ascended the range with the mountain about 900 feet above the level of Lake Ontario (Walker & Miles, 1877).

Generally, the roads through Peel were considered of good quality and were opened and more or less travelled between every two concessions as well as side roads every five lots. One of the main roads, Dundas Street, passes through the front part of Toronto Township. This road was partly graveled and macadamized by grants from the Legislature in 1836. Settlement was concentrated along Dundas Street and being heavily travelled meant good business for shops and other businesses established along it. Another well-travelled road, first planked by a private company and later graveled, was Lakeshore. Hurontario Street, which runs from Port Credit north-west through the center of Toronto, Chinguacousy and Caledon, and then through to Collingwood was also well-travelled. Another key road was cut through the sixth line that extends from Dundas St. north, west to Mono Mills in Mono, on the west, and the Gore and Albion on the East. The Grand Trunk Railroad and the Toronto Grey and Bruce Railroads run through the County with the Credit Valley Railway being added shortly after (Walker & Miles, 1877). The County, like many others, benefitted economically from the railway.

The County is well watered with running streams of various sizes throughout. The Credit River, considered to be the principal River, provides an excellent stream of water which runs through the western part of the County. The numerous branches of the river provide a source of wealth for many communities, including Caledon where waterpower is supplied. The Humber River also plays an important role in the County and specifically to Albion where it provides waterpower through its tributaries. Each township had several mills which utilized the numerous waterways (Walker & Miles, 1877).

1819 and the following years saw the greater part of the County settled, though the old survey of Toronto Township was thinly settled in 1808 or 1810. Many first settlers came from New Brunswick, the United States, and other parts of Upper Canada. Some of the first settlers in the ‘New Survey’ of Toronto Township included a colony of Irish families from New York City who came to their grants of land in 1819 under the Superintendence of Messrs. Beaty and Graham. U.E. Loyalists and their descendants were the main settlers of Chinguacousy as well as a number of other inhabitants of Upper Canada. The other townships were mostly made of emigrants from the old country (Walker & Miles, 1877).

At the time the first regular organization of all the townships that became the County of Peel was made in 1821 the population was only 803, however, settlement within the County continued to grow steadily and by 1871 the population had risen to 26,011 inhabitants (Walker & Miles, 1877). By 1877 life in the County was becoming easier with fewer hardships as farms were well established and more and more shops, mills and other businesses had been opened.

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1.2.4 Township of Toronto

Toronto Township located in the southeast of Peel County was first surveyed in 1806 by Mr. Wilmost. The first survey only covered about one mile deep from each side of the Credit River. Colonel Thomas Ingersoll is thought to have been the first settler in the Township as well as the County, arriving before 1806. He kept a government storehouse and operated a ferry service at what would become Port Credit. By 1808 seven families were living in the Township including John Silverthorn, Joseph Silverthorn, Philip Cody, Daniel Harris, Allen Robinett, William Barber and Absolom Wilcox. They had settled along Dundas Street within the original survey (Walker & Miles 1877). Settlement continued to steadily increase until the War of 1812. In 1819 the remaining portion of the Township was surveyed, a large part of which was granted to a number of Irish families who had originally settled in the US before the war. Being persecuted after the war for not taking up arms with the Americans against the British led them to appeal to the British Council, in New York, for land in Canada. Twenty-six families were given land grants and in Map 1819 they began their journey to Toronto Township. Their journey was long and arduous and not made easier by the wagons they brought filled with supplies. There were not many roads open by the time they arrived in Canada and further inland they were not well maintained. Early settlers often used sleighs pulled by oxen. The sleighs were easier to maneuver around stumps, over logs and through marshy areas. Not all the covered wagons made it to their final destination, some being left in York (later Toronto). Settlement of the Toronto Township continued after the arrival of the Irish families so much so that it was incorporated by 1876 and was the first in the County to be incorporated. Several settlements started to grow up throughout the Township as settlement increased (Walker & Miles 1877).

Streetsville is the oldest settled village in the County and was ideally located along the Credit River. The Village was incorporated in 1858. The first three settlers to the area that would become Streetsville are thought to be James Glendenning, Frank Lighthearn and John Barnhart respectively. Streetsville is thought to have had the most extensive woollen factory in the province. It also boasted the largest grist mill in operation by 1876, at least in the Township. Another grist mill in the village was also large, running two stones and manufacturing flour for both local residences as well as for foreign markets. By 1876 Streetsville also had a cabinet warehouse and shop, broom factory, tub and pail factory, chair and paint shop, blacksmith, lumber businesses, a few stores, a large brick schoolhouse and four churches. The population by 1876 had risen to 678. The village after flourishing for many years began to struggle. The completion of the Credit Valley Railway was anticipated to help revive the Village Walker & Miles (1877).

Meadowvale was another village also located along the Credit River. The Village sprung up around the sawmill built in 1831 by John Crawford. By the time John Simpson built his sawmill in 1836, there were already a number of settlers there. These settlers had to travel to Toronto for supplies until 1847 when the first store in the Village was opened by Hames Ward. Having a store closer made everyday life easier for these early settlers. Life was made easier again when in 1856 Francis Silverthorn built a grist mill. The grist mill was purchased in 1860 by Gooderham and Worts who significantly increased the business. Running five stones meant that they could grind 250 barrels of flour a day and employ more hands. Gooderham and Worts being the businessmen they were also had a barrel business (among other businesses) where they manufactured their own barrels for their flour and also sold them to their grist mill customers. By 1876 Meadowvale also had a sawmill, lumber, lath and shingle factory, general store and a few other stores Walker & Miles (1877).

Port Credit was established by the Government in 1804 when they sent Thomas Ingersoll to run a storehouse and ferry. New emigrants to this part of the Country were accommodated in an inn also built by the Government. Port Credit is the only port in the County and has became one of the best shipping ports on the Lake. The opening of the Great Western Railway Station at Port Credit greatly benefitted both the Village and the shipping businesses. By 1877 Port Credit had also become a large shipper of strawberries. Over 100 acres of strawberries were cultivated, which increased each year. At one time two steamboats full of strawberries were shipped to Toronto daily. The

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harbour opened up the market for many Villagers to ship their goods further afield. Port Credit also became a sporting retreat for men from Toronto. Travellers would come by train to fish and hunt, staying in one of three hotels. Much of the surrounding area was still wild and offered great hunting Walker & Miles (1877).

Cooksville boasting a population of 300 by 1876 was located just south of the center of the Township and had a sawmill, a church, a two-story brick schoolhouse with three teachers, a baker, a waterhouse, a blacksmith and two hotels. Cooksville was named after Jacob Cook Esq. who originally owned the land which would become the location of the Village. Cooksville was ideally located along the main road between Hamilton and Toronto, flourishing as a result. Unfortunately, like so many other early settlements it was devastated by fire. The devastation of the fire in 1852 was so great that only a few houses were left standing, and the Village never fully recovered. The opening of the Grand Trunk and the Great Western Railways also took business away from the Village, having stations established elsewhere. Like Streetsville, it was hoped that the opening of the Credit Valley Railway would help. Cooksville did benefit from the establishment of the Canada Vine Growers Association in the village Walker & Miles (1877).

1.2.5 Historic Mapping

Historic maps although providing some information on historic features the inclusion of such information was often based on a subscription and the purpose of the map. Therefore, it is unknown how many features have been excluded from these early maps. Additionally, there can also be a discrepancy between the actual location of a feature and where it is depicted on the map. A site visit together with later maps can help narrow down the potential location of historic features illustrated on the early maps.

Map 2 illustrates the location of the project area and environs as of 1859. This map illustrates the project area on the shore of Lake Ontario and Cooksville Creek running through it, emptying into the Lake. The Credit River and other watercourses are also shown within the surrounding area. An unnamed toll road is illustrated adjacent to the northwestern boundary of the project area and corresponds to the current Lakeshore Road East. The Hamilton and Toronto Railway is illustrated running parallel with Lakeshore Road East further northwest of the project area. Lot 11 is shown to be owned by Wesley Watson and two structures are illustrated within the lot along Lakeshore Road East. Structures are also illustrated on the lots on the north side of Lake Shore Road East, across from the project area. The settlement of Port Credit is illustrated just west and Cooksville to the northwest. All of the lots surrounding the project area are shown to be owned, however, a structure is not illustrated on each lot. The schoolhouse to the southwest of the project area suggests the demographics of the area and the requirement for such an institution. An “Old Indian Village” is noted to the northwest of Port Credit adjacent to the Credit River. The larger area well known as being the traditional territory of the Mississaguas.

Map 3 from 1877 shows the project area within a similar environment to the 1859 map. Cooksville Creek still runs through the project area which is located on the shore of Lake Ontario. Lakeshore Road East and the Hamilton and Toronto Railway, now the Great Western Railway are located to the northwest. The Credit Valley Railway was opened north of Cooksville by 1877. Port Credit and Cooksville don’t appear to have grown much since 1859. Lot 11 is now shown to be owned by Stephen Crawford, a non-resident. Many of the lots along the water and a few others show that they were owned by non-residents. Both structures within the lot are still shown on this map. The structures to the north of the project area are illustrated with large orchards, suggesting these farms were well established by this time. The manufacturing industry growing since 1859 is shown owning several parcels of land to the west of the project area.

National topographic surveys were gathered to provide more detail about the project area and its surroundings. The survey from 1909 (Map 4) shows the project area within a rural environment with Cooksville Creek flowing through

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the it into Lake Ontario surrounded by woodlot and by wooden and brick structures. By 1929 (Map 5) urbanization had expanded around the project area.

The urbanization illustrated on the 1929 survey can be seen on the aerial from 1954 (Map 6). A structure is shown within the northern portion of the project area along Lakeshore Road East adjacent to the Creek. By 1980 (Map 7) Cooksville Creek had undergone significant changes straightening and widening it and further widening and the installation of path along the Creek by 1985 (Map 8). The structure in the northern portion of the project area was removed perhaps to allow the widening of the Creek. Prior to 1980, a portion of the Lake was filled in to extend the shoreline into the Lake southeast of the project area to create parkland. Part of the Lake in the southwest corner of the project area was also filled in by 1980 and then further into the Lake by 1989.

The project area's proximity to the historic structure and road suggests potential for Euro-Canadian archaeological resources.

1.3 ARCHAEOLOGICAL CONTEXT

1.3.1 Previously Registered Sites

According to the Minister of Citizenship and Multiculturalism Archaeological Site Database (ASD) the Adamson Estate Euro-Canadian homestead site is located within 1km of the project area.

No reports were identified that document archaeological fieldwork conducted within or adjacent to the limits of the project area.

1.3.3 Current Land Use and Field Conditions

The project area is approximately 2.88 hectares in size and consists of mainly Cooksville Creek which flows through the project area into Lake Simcoe surrounded by mature trees. The Creek has steep banks along some of it which in places have been reinforced with gibbons, large stones and concrete at the northern end where it passes under Lakeshore Road East. An asphalt path follows the east side of the Creek. Storm sewer lines are located along both sides of the Creek which empty into it. A bridge crossing the Creek is located in the southern portion of the project area. The parklands in the southern portion of the project area are mainly manmade land. Areas of lawn are located along the eastern side of the Creek where the study area crosses the rear portion of residential lots.

The project area is bounded on the northwest by Lakeshore Road East, on the northeast and southwest by residential and on the southeast by parkland and Lake Ontario. Map 10 illustrates the current land use.

1.3.4 Physiographic Region

The project area is located within the Iroquois Plain physiographic region. The lowland area bordering Lake Ontario was inundated by water when the last glacier was receding, though still within the St. Lawrence Valley, and was called Lake Iroquois. This glacial lake emptied eastward at Rome, New York State. The old shorelines with its cliffs, bars, beaches, and boulder pavements are still identifiable features with the undulating till plains above are

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contrasted by the wave smoothed lake bottom. The area of the Iroquois plain extends some 190 miles around the western part of Lake Ontario, from the Niagara River to the Trent River, with varying width from about eight miles to only a few hundred yards. A large area is located in the Trent River valley. Due to the varying conditions within the old lake plain the region has been divided into a number of sub-sections including Niagara Fruit Belt, Ontario Lakehead, Hamilton to Toronto, Toronto, Scarborough, Scarborough to Newcastle, Newcastle to Trenton, and Trent Embayment (Chapman and Putnam 1984).

Ontario Lakehead

This portion lies at the head of Lake Ontario and is a special part of the Iroquois plain. The characteristics of lake heads make them ideal for the establishments of cities and the area of glacial Lake Iroquois had some advantages. With a narrow plain between the lake and the "mountain" there is direct connection with Niagara through the old shoreline, and a corridor to the north shore was provided by the old bayhead bar. An easy grade up the escarpment to Ancaster is found through the old higher terraces inside the bar bypassing Dundas in two directions (Chapman and Putnam 1984).

Hamilton to Toronto

Occupying the northeast shore of Lake Ontario from Burlington to Toronto and beginning with a great gravel bar running through Aldershot. For about 18 miles the shoreline continues as a distinct bluff in the red shale of the Queenston Formation. The grey shale of the Georgian Bay Formation is the old shore near Clarkson and Cooksville, whereas in other places such as Toronto itself (along Davenport Road west of Yonge Street) the Iroquois shoreline is cut in Pleistocene deposits. Barrier beaches were created by the old lake at Bronte Creek, Oakville Creek, Etobicoke Creek, Credit River, Humber River, Don River, with significant sources of sand and gravel at each of the three rivers (Chapman and Putnam 1984). The shoreline of Lake Ontario provides the other boundary of the plain while the water gradually cuts into the red shale of Burlington to Oakville, grey shale at Clarkson, and the delta sands at Lorne Park. Along the shoreline the mouths of streams have been drowned and at the mouth of Twenty Mile Creek with such significance that the lagoon of Jordan Harbour has been formed by a bar. A surviving portion of the bed of Lake Iroquois is found between the two shorelines (ancient and modern), with a sloping plain at an average width of approximately two miles with varying compositions including stratified sands of varying depth, shallow cover of till over the bedrock, and in some the wave-eroded surface of red shale is the basis for soil formation. The soil of Aldershot, Bronte, Burlington, Oakville, Lorne Park, Clarkson, and Humber Bay is sandy and is preferable to the clay of the adjoining areas (Chapman and Putnam 1984).

Toronto

The waves and currents of Lake Ontario created the harbour protecting sandbar of Toronto Island by moving the sand from the Scarborough Bluffs. The area of first settlement in Toronto was once the realm of glacial Lake Iroquois which cut in previously deposited clay and till and then covered in sand deposits measuring approximately 3 miles wide with a general northward slop from the level of Lake Ontario approximately 50-60 feet per mile. Evidence of the old beach and a steep bluff or shorecliff is found along the northern border with a height of about 75 feet at Casa Loma. The deep valleys of the Don and Humber Rivers are found to the east and west of the shorecliff having been cut into early Iroquois base levels. Immense sand and gravel barriers were built across these valleys by Lake Iroquois so much so that in Iroquois times Toronto had two harbours instead of one. While the sand and gravel was deposited by Lake Iroquois, the clay was part of the pre-Iroquoian age (Chapman and Putnam 1984).

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1.3.5 Water Resources

The project area is located on the shoreline of Lake Ontario and Cooksville Creek flows through the project area emptying into Lake Ontario. Water is not only a necessity of life but it was also frequently utilized as a mode of travel for everyday life as well as for trade and communication. Watercourses were also used as landmarks by Indigenous groups as well as early settlers and explorers.

The project area is not only within proximity to water today but was also within proximity to a past water source. The project area was once covered by the waters of the Ontario Basin. Remnant shorelines are located over four kilometers inland today. As the Ontario Basin drained to present levels the project area would have become exposed.

The proximity of water to the project area suggests the potential for Indigenous occupation and land use in the area in the past.

2.0 SITE VISIT

A site visit was completed on December 12th, 2023, to obtain a better understanding of the current conditions, the topography, and the surrounding environment of the project area. The entire project area was inspected during ideal conditions. The identified features and current conditions of the property were photographed and are illustrated on Map 10.

Table 3: Site Visit Documentary Record Inventory

Type of Documentation	Description
Field Notes	1 digital file of field notes describing the daily site activities, weather, personal
Maps	1 map showing the project activities
Photographs	46 digital photographs showing the current conditions encountered during the site visit

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3.0 ANALYSIS AND CONCLUSIONS

3.1 STAGE 1 BACKGROUND RESULTS

The project area and its surroundings have a long history starting long before European settlement. The project area has been determined to have archaeological potential for Indigenous resources based on its proximity to water. Additionally, the project area has been determined to have archaeological potential for Euro-Canadian resources based on its proximity to historic a structure, historic road, and previously registered archaeological site.

The project area has undergone modern deep disturbances and as a result, archaeological potential has been removed from these areas. Additionally, there is no or low archaeological potential within the low-lying and wet areas of the Creek.

4.0 RECOMMENDATIONS

Based on the results the following recommendations are made:

1. Archaeological potential remains within the project area. Stage 2 Archaeological Assessment by test pit survey at an interval of 5 meters is recommended for these areas if impacted by the proposed restorations and prior to any ground-altering activities in these areas (see Map 10).

2. Stage 2 Archaeological Assessment is not recommended for areas of no archaeological potential including areas of modern deep disturbance and low-lying and wet areas (see Map 10).

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5.0 ADVICE ON COMPLIANCE WITH LEGISLATION

a. This report is submitted to the Minister of Tourism and Culture as a condition of licensing in accordance with Part VI of the *Ontario Heritage Act,* R.S.O. 1990, c 0.18. The report is reviewed to ensure that it complies with the standards and guidelines that are issued by the Minister, and that the archaeological fieldwork and report recommendations ensure the conservation, protection and preservation of the cultural heritage of Ontario. When all matters relating to archaeological sites within the project area of a development proposal have been addressed to the satisfaction of the Minister of Citizenship and Multiculturalism, a letter will be issued by the ministry stating that there are no further concerns with regard to alterations to archaeological sites by the proposed development.

b. It is an offence under Sections 48 and 69 of the *Ontario Heritage Act* for any party other than a licensed archaeologist to make any alteration to a known archaeological site or to remove any artifact or other physical evidence of past human use or activity from the site, until such time as a licensed archaeologist has completed archaeological fieldwork on the site, submitted a report to the Minister stating that the site has no further cultural heritage value or interest, and the report has been filed in the Ontario Public Register of Archaeological Reports referred to in Section 65.1 of the *Ontario Heritage Act.*

c. Should previously undocumented archaeological resources be discovered, they may be a new archaeological site and therefore subject to Section 48(1) of the *Ontario Heritage Act.* The proponent or person discovering the archaeological resources must cease alteration of the site immediately and engage a licensed consultant archaeologist to carry out archaeological fieldwork, in compliance with Section 48(1) of the *Ontario Heritage Act.*

d. The *Cemeteries Act,* R.S.O. 1990 c. C.4 and the *Funeral, Burial and Cremation Services Act,* 2002, S.O. 2002, c.33 (when proclaimed in force) require that any person discovering human remains must notify the police or coroner and the Registrar of Cemeteries at the Ministry of Consumer Services.

e. Archaeological sites recommended for further archaeological fieldwork or protection remain subject to Section 48 (1) of the *Ontario Heritage Act* and may not be altered, or have artifacts removed from them, except by a person holding an archaeological license.

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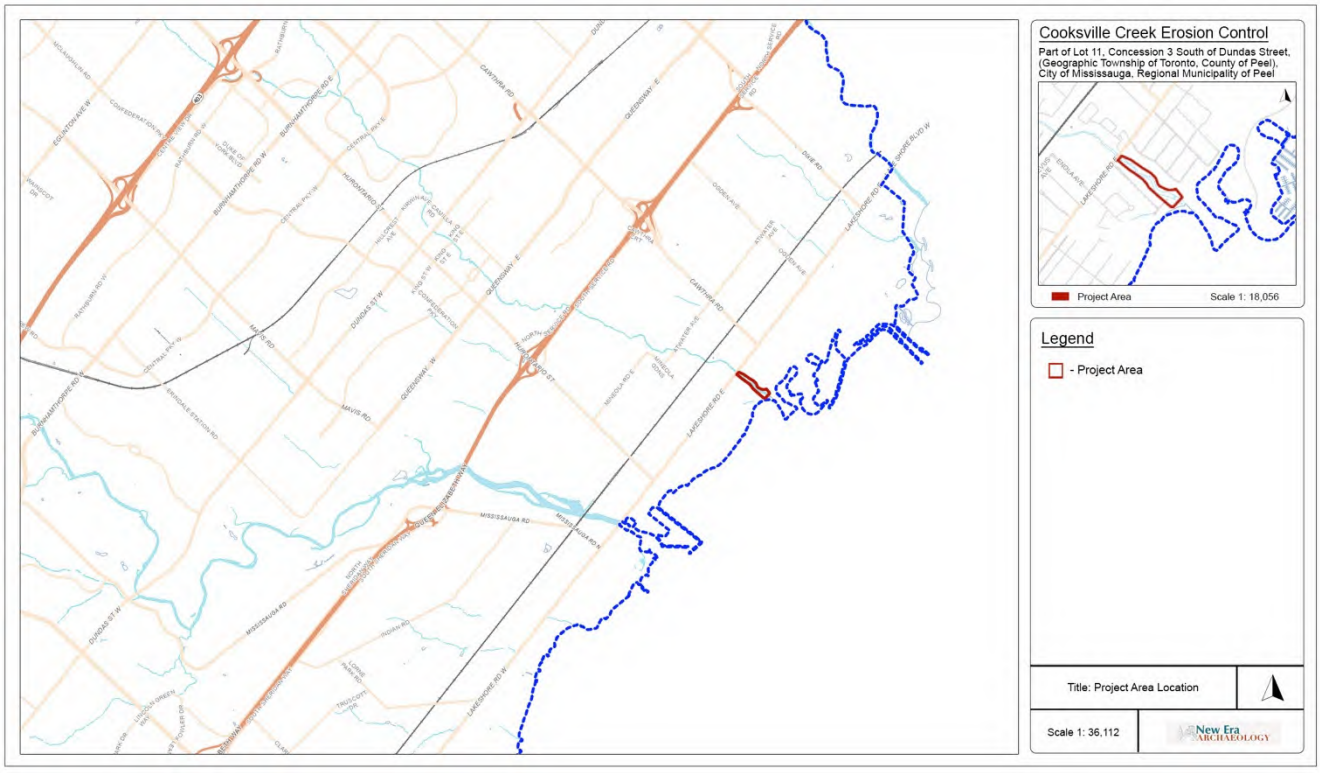
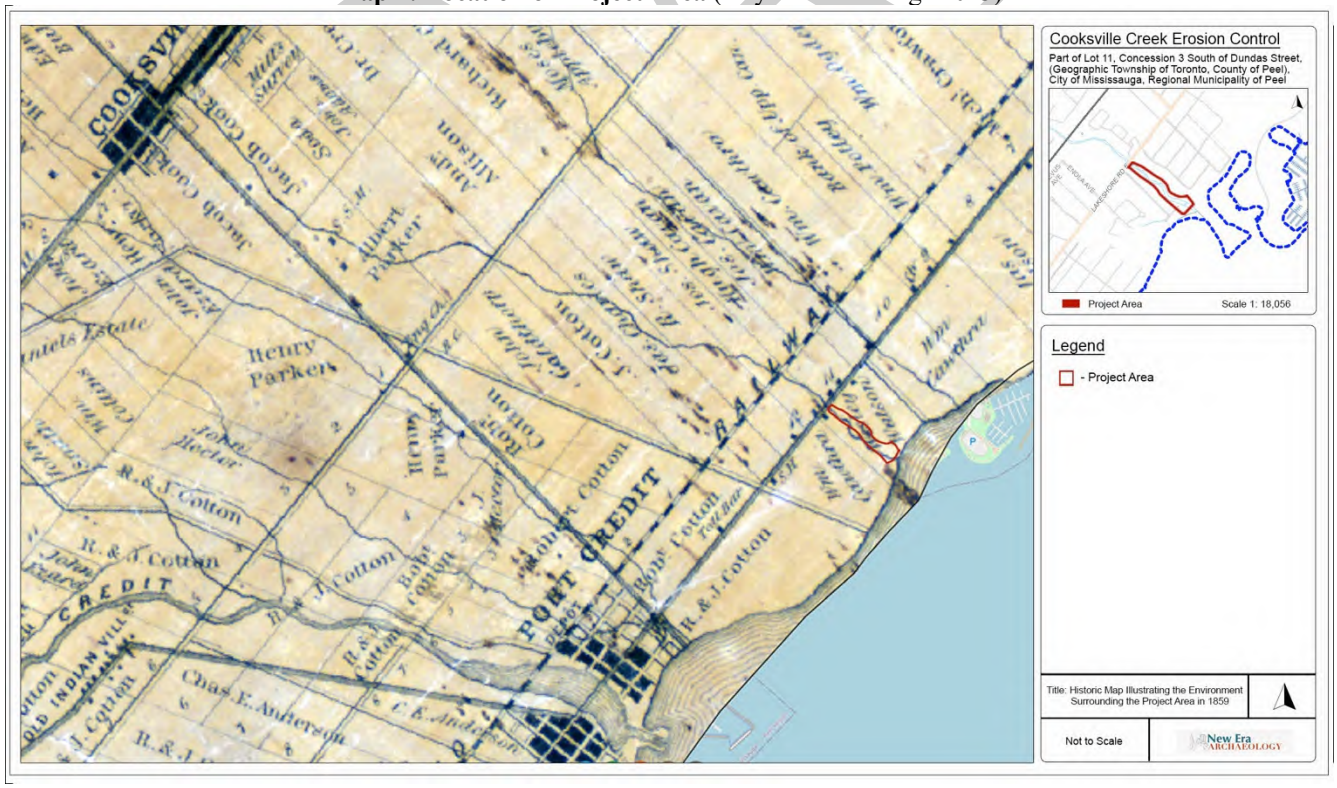
7.0 MAPS



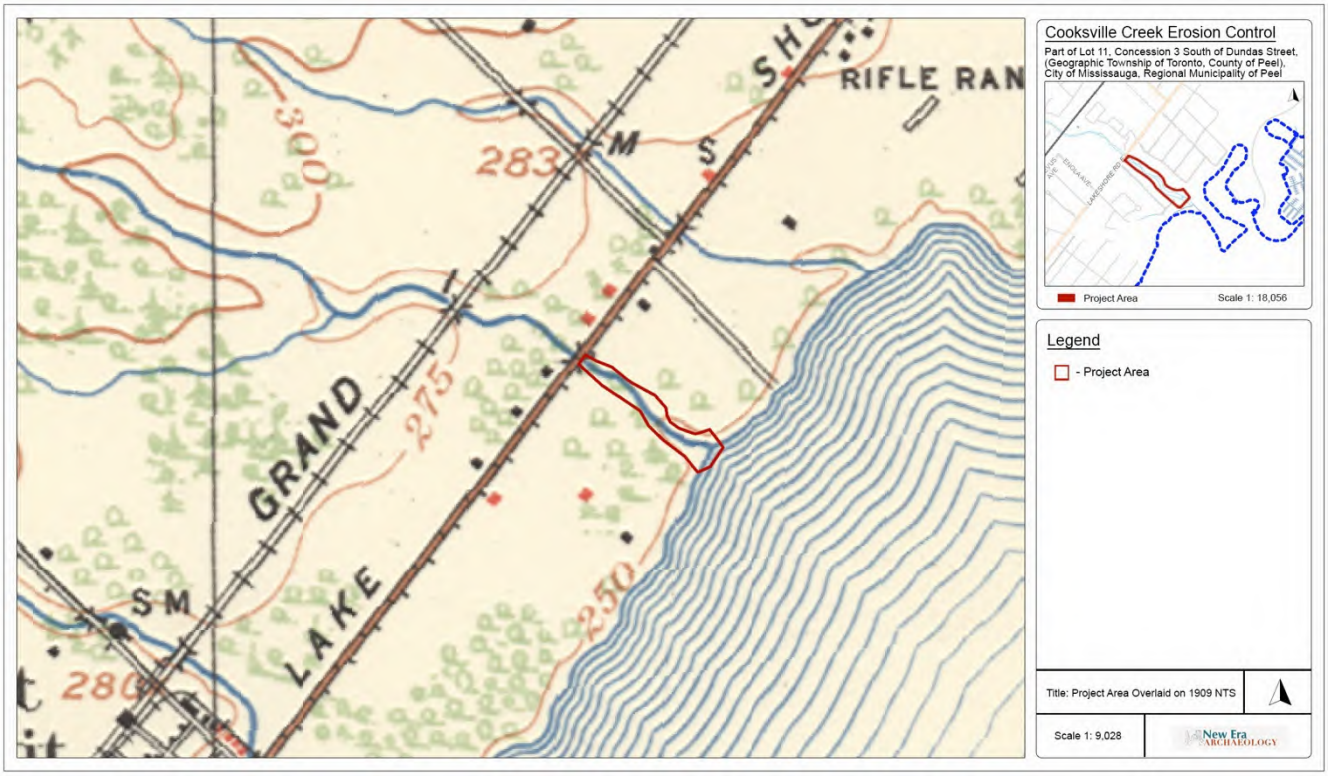
Map 1: Location of Project Area (City of Mississauga 2023)



Map 2: Historic Map Illustrating the Environment Surrounding the Property Area in 1859 (Tremaine 1859)



Map 3: Historic Map Illustrating the Environment Surrounding the Property Area in 1877
(Walker & Miles. 1877)



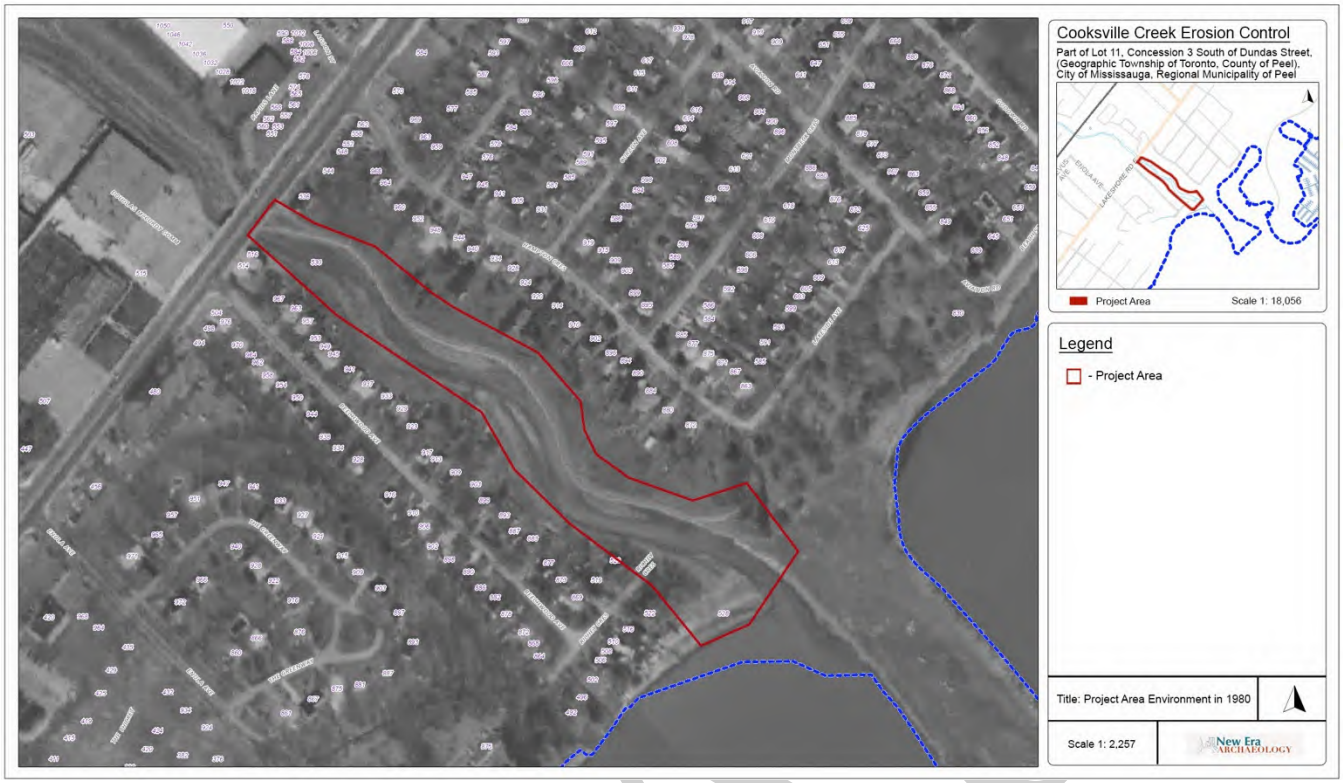
Map 4: Project Area on National Topographic Survey from 1909 (National Resources Canada)



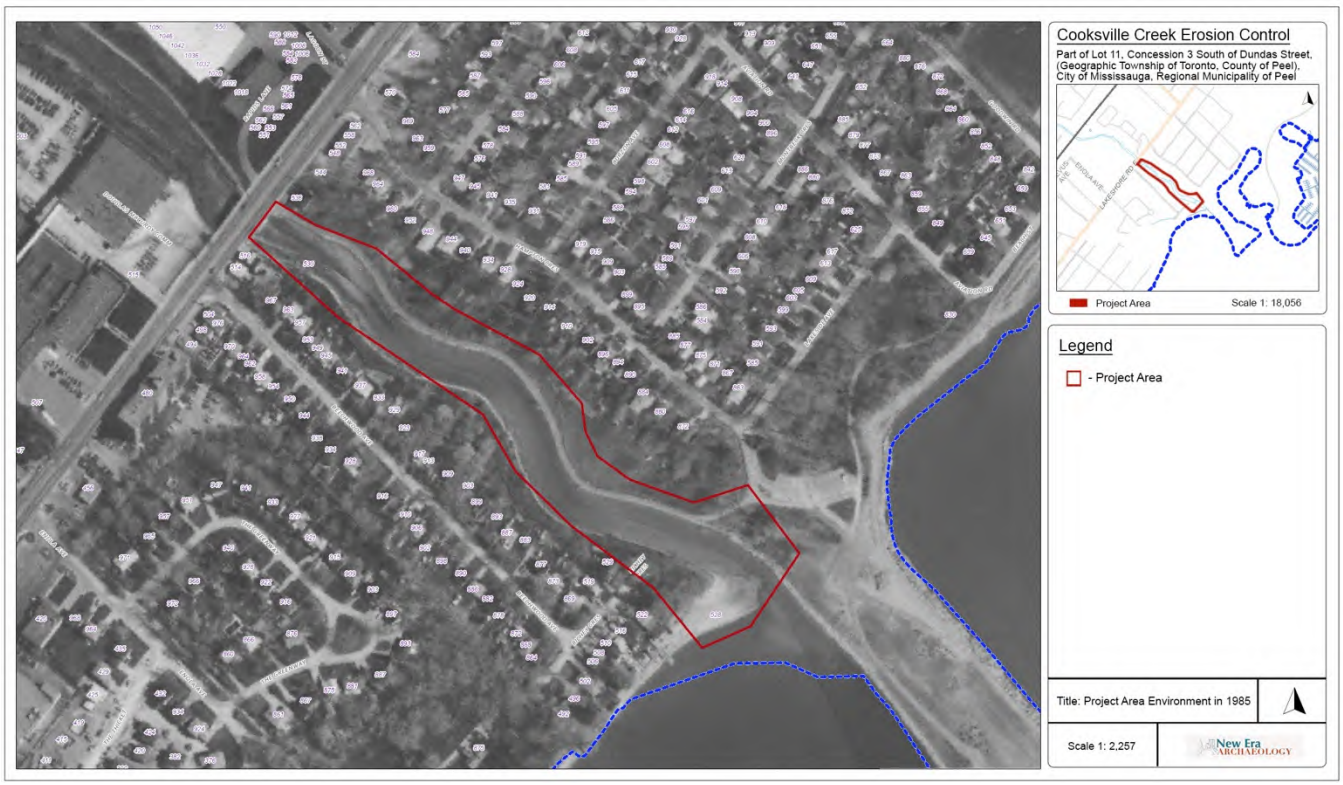
Map 5: Project Area on National Topographic Survey from 1929 (National Resources Canada)



Map 6: Project Area on Historic Aerial from 1954 (City of Mississauga 2023)



Map 7: Project Area on Historic Aerial from 1980 (City of Mississauga 2023)



Map 8: Project Area on Historic Aerial from 1985 (City of Mississauga 2023)



Map 9: Project Area (Provided by Aquafor Beech Ltd.)



Map 10: Stage 1 Archaeological Background Study Results (Base Map: City of Mississauga 2023)



Map 11: Stage 1 Archaeological Background Study Results (Base Map: City of Mississauga 2023)

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8.0 PLATES



Plate 1: Wooded Park Land



Plate 2: Asphalt Pathways and Two Manholes Between Them



Plate 3: Wooded Area Along Lake Ontario

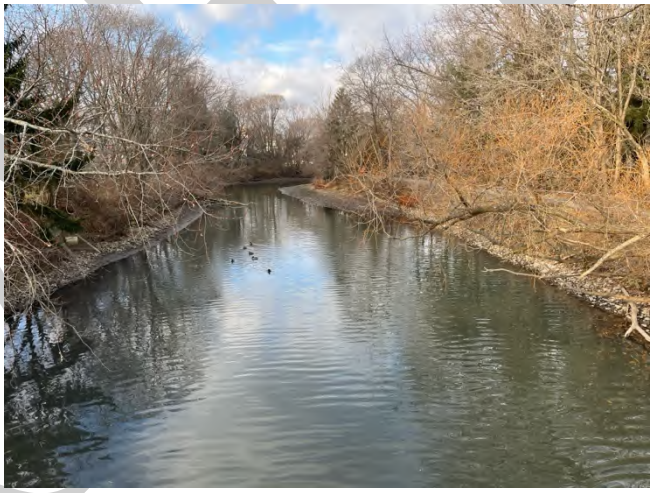

Plate 4: Cooksville Creek



Plate 5: Cooksville Creek Emptying into Lake Ontario



Plate 6: Wooded Area Along the Creek and Manhole



Plate 7: Wooded Area Along the Creek



Plate 8: Wooded Area Along the Creek



Plate 9: Wooded Area and Gibbons Along the Creek



Plate 10: Wooded Area Along the Creek



Plate 11: Asphalt Pathway Surrounded by Mature Trees; Manhole



Plate 12: Sewer Outlets Emptying into Creek



Plate 13: Elevated Pathway Surrounded by Trees and Lawn



Plate 14: Elevated Pathway Surrounded by Trees and Lawn



Plate 15: Asphalt Pathway Surrounded by Mature Trees



Plate 16: Asphalt Pathway Surrounded by Mature Trees



Plate 17: Infrastructure Where Cooksville Creek Passes Under Lakeshore Road East



Plate 18: Cooksville Creek

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From: amos.r@aquaforbeech.com
To: cota.c@aquaforbeech.com; ursulak.j@aquaforbeech.com
Subject: FW: Cooksville Creek Erosion Control Project - Schedule B Municipal Class EA
Date: October 21, 2024 3:59:52 PM
Attachments: image001.jpg
image002.png
image003.png
image004.png

CC & JU – please see below regarding Cooksville - Huron-Wendat First Nation contact.

Thanks,

Rob

_____
Robert Amos, MASc., P.Eng.
Aquafor Beech Ltd.

☎ **416.705.2367**
✉ Amos.R@Aquaforbeech.com
www.aquaforbeech.com



From: Didier Picard <d.picard@huron-wendat.qc.ca>
Sent: October 21, 2024 10:11 AM
To: amos.r@aquaforbeech.com
Subject: RE: Cooksville Creek Erosion Control Project - Schedule B Municipal Class EA

Hello Mister Amos,
We think that your message is not for us. You have to reach the Nation for that matter. We are a private owned tourism business in Wendake.
Please try administration@wendake.ca for your inquiry.
Have a great day
Best regards,

Merci de votre collaboration.
Passez une agréable journée.
Tiawenk (Merci)
Eskonyen' ! (À la prochaine)

Description : Description : Description : TESTESTESTTETS



De : amos.r@aquaforbeech.com <amos.r@aquaforbeech.com>
Envoyé : 15 octobre 2024 13:36
À : wendat@huron-wendat.qc.ca
Cc : 'Greg Frew' <Greg.Frew@mississauga.ca>; ursulak.j@aquaforbeech.com; cota.c@aquaforbeech.com
Objet : RE: Cooksville Creek Erosion Control Project - Schedule B Municipal Class EA

Dear Huron-Wendat First Nation,

As a followup to the Notice of Commencement, Aquafor and the City of Mississauga have completed a Stage 1 Archeological Assessment (attached) as part of Schedule B Class Environmental Assessment Study for the **Cooksville Creek Erosion Control Project from Lakeshore Road to Lake Ontario**.

Based upon the Stage 1 recommendations, we're looking to complete a Stage 2 Archeological Assessment in the coming months, and wanted to extend the offer for review and / or Field Liaison Representation.

Please let us know how you would prefer to be involved or provide input through the next phases of the study.

Additional information is also available from the project website at:

Project Website
Cooksville Creek Erosion Control Project south of Lakeshore Road – City of Mississauga

Thanks very much, and should you have any questions or comments, please feel free to contact the following:

Greg Frew, P.Eng.
Project Manager

Robert Amos, P.Eng.
Consultant Project Manager

City of Mississauga
300 City Centre Dr, Suite 800
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Aquafor Beech Ltd.
2600 Skymark Avenue, Unit 6-202
Mississauga, ON, L4W 5B2
416.705.23696
Amos.R@aquaforbeech.com

Kind regards,

Rob

Robert Amos, MASc., P.Eng.
Aquafor Beech Ltd.

☎ **416.705.2367**
✉ Amos.R@Aquaforbeech.com
www.aquaforbeech.com



From: amos.r@aquaforbeech.com <amos.r@aquaforbeech.com>
Sent: March 14, 2024 12:48 PM
To: wendat@huron-wendat.qc.ca
Cc: 'Greg Frew' <Greg.Frew@mississauga.ca>; cota.c@aquaforbeech.com; ursulak.j@aquaforbeech.com
Subject: Cooksville Creek Erosion Control Project - Schedule B Municipal Class EA

Dear Huron-Wendat First Nation,

Aquafor Beech Limited has been retained by the City of Mississauga to undertake a Schedule B Class Environmental Assessment Study for the **Cooksville Creek Erosion Control Project from Lakeshore Road to Lake Ontario**.

This project is being completed to address existing problems and risks along Cooksville Creek and the adjacent Helen Molasy Trail.

In accordance with the environmental assessment process, Aquafor is pleased to share the attached letter and Notice of Commencement. Additional information is also available from the project website at:

Project Website
Cooksville Creek Erosion Control Project south of Lakeshore Road – City of Mississauga

Should you have any questions or comments, please feel free to contact the following:

Greg Frew, P.Eng.
Project Manager
City of Mississauga
300 City Centre Dr, Suite 800
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Ltd.
2600 Skymark Avenue, Unit 6-202
Mississauga, ON, L4W 5B2
416.705.23696
Amos.R@aquaforbeech.com

We very much look forward to working with you throughout the project, and will ensure all documentation is available for your review and input.

Kind regards,

Rob

_____
Robert Amos, MASc., P.Eng.
Aquafor Beech Ltd.

☎ **416.705.2367**
✉ Amos.R@Aquaforbeech.com
www.aquaforbeech.com



From:	amos.r@aquaforbeech.com
To:	administration@wendake.ca
Cc:	"Greg Frew"; "Jacob Ursulak"; cota.c@aquaforbeech.com
Subject:	RE: Cooksville Creek Erosion Control Project - Schedule B Municipal Class EA
Date:	October 22, 2024 3:41:06 PM
Attachments:	image002.png Cooksville Creek Erosion Control EA, Mississauga Stage 1 Archaeology Draft Report.pdf Cooksville Creek Schedule B Municipal Class EA - Notice of Public Information Centre.pdf

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Dear Huron-Wendat First Nation,

Aquafor Beech Limited has been retained by the City of Mississauga to undertake a Schedule B Class Environmental Assessment Study for the **Cooksville Creek Erosion Control Project from Lakeshore Road to Lake Ontario**.

This project is being completed to address existing problems and risks along Cooksville Creek and the adjacent Helen Molasy Trail.

Aquafor and the City of Mississauga have completed a Stage 1 Archeological Assessment (attached). Based upon the Stage 1 recommendations, we're looking to complete a Stage 2 Archeological Assessment in the coming months, and wanted to extend the offer for review and / or Field Liaison Representation. Please let us know how you would prefer to be involved or provide input through the next phases of the study.

Additionally, Aquafor and the City of Mississauga have arranged an in-person, Public Information Centre to provide an opportunity to review and comment on the project findings to date. This includes the alternative solutions being considered, the evaluation process, the preliminary preferred solutions, and the next steps of the study.

The details of the Public Information Centre are as follows:

Date:	Tuesday, October 29th, 2024
Time:	Afternoon Session: 3 p.m. – 5 p.m. Evening Session: 6 p.m. – 8 p.m.
Location:	Small Arms Inspection Building 1352 Lakeshore Road East

Additional information is also available from the project website at:

Project Website
Cooksville Creek Erosion Control Project south of Lakeshore Road – City of Mississauga

Should you have any questions or comments, please feel free to contact the following:

Greg Frew, P.Eng.
Project Manager

Robert Amos, P.Eng.
Consultant Project Manager

City of Mississauga
300 City Centre Dr, Suite 800
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Aquafor Beech Ltd.
2600 Skymark Avenue, Unit 6-202
Mississauga, ON, L4W 5B2
416.705.23696
Amos.R@aquaforbeech.com

Kind regards,

Rob

_____
Robert Amos, MASc., P.Eng.
Aquafor Beech Ltd.

☎ **416.705.2367**
✉ Amos.R@Aquaforbeech.com
www.aquaforbeech.com



City of Mississauga
Notice of Public Information Centre

Municipal Class Environmental Assessment Study:
Cooksville Creek Erosion Control Project – South of Lakeshore Road

What?

The City of Mississauga (the City) is undertaking a Schedule B Municipal Class Environmental Assessment (Class EA) Study for erosion control and restoration of Cooksville Creek south of Lakeshore Road.



Why?

The City recognizes that this section of Cooksville Creek has been impacted by recent storm events and high lake levels and is in need of rehabilitation. Plans will also need to consider the deteriorated condition of the adjacent city trail through Helen Molasy Memorial Park that sits above the east bank of the creek, as well as the neighbouring properties which have experienced ongoing drainage issues.

How?

- The Study has examined this section of Cooksville Creek and Helen Molasy Trail and associated natural resources to identify existing problems, potential risks, and opportunities for restoration and drainage improvements.
- Through the Class EA process, various alternative solutions are being developed and evaluated by the Study Team and will be refined through public and agency consultation (see below). The Study Team will then select a preferred alternative and proceed with design of the recommended works.
- A Project File documenting the planning process will be available for public review at the end of the Study.

Public Consultation

- Consultation is an essential part of the EA process. The City would like anyone with an interest in the Study to have an opportunity to provide input and help inform the decision-making process.
- An in-person, Public Information Centre has been arranged to allow local residents and interested members of the public an opportunity to review and comment on the project findings to date, the alternative solutions being considered, the evaluation process, the preliminary preferred solution, and the next steps:

Date:	Tuesday, October 29th, 2024
Time:	afternoon: 3pm – 5pm evening: 6pm - 8pm
Location:	Small Arms Inspection Building 1352 Lakeshore Road East

- Additional project information will be made available on the City's project website:
  https://www.mississauga.ca/projects-and-strategies/environmental-assessments/cooksville-creek-erosion-control-south-of-lakeshore-road/

City of Mississauga
Notice of Public Information Centre

Municipal Class Environmental Assessment Study:
Cooksville Creek Erosion Control Project – South of Lakeshore Road

- Feedback is encouraged and comments are requested by **November 26th, 2024**. A comment form is available on the project website. Input gathered through the public consultation will be used to support the EA study.
- If you have comments or questions, require further information or would like to be added to the Study mailing list to receive future notifications, please contact:

Greg Frew, P.Eng.
City Project Manager
City of Mississauga
300 City Centre Drive, Suite 800
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Ltd.
2600 Skymark Ave.
Mississauga, ON L4W 5B2
(416) 705-2367
Amos.R@aquaforbeech.com

This notice signals the Notice of Public Information Centre for this Municipal Class Environmental Assessment, a study which will define the problem, identify/evaluate alternative solutions, and determine a preferred design in consultation with regulatory agencies and the public. The study is being undertaken in accordance with the planning and design process for Schedule 'B' projects, as outlined in the "Municipal Class Environmental Assessment" document (as amended in 2023), which is approved under the Ontario Environmental Assessment Act.

Personal information is collected under the authority of the Environmental Assessment Act and will be used in the assessment process. With exception of personal information, all comments shall become part of the public records. Questions about this collection should be directed to the Project Manager listed above.

This notice first issued on **October 21st, 2024**.

From: Benjamin Labbe
To: amos.r@aquaforbeech.com
Cc: "Greg Frew"; "Jacob Ursulak"; cota.c@aquaforbeech.com
Subject: RE: Cooksville Creek Erosion Control Project - Schedule B Municipal Class EA
Date: October 29, 2024 3:25:49 PM
Attachments: image005.png
image007.png
image008.png
image002.jpg

Kwe Robert,

Thank you for your email and invitation to participate in the Stage 2 Archaeological Assessment fieldwork. I will let my colleague Dominique Lesage coordinate our Field liaison Representation with you. Do you have an idea when the fieldwork is planned and how long it will last?

Tiawenhk,

NATION HURONNE-WENDAT
Bureau du Nionwentsïo

Benjamin Labbé, M. Sc
Conseiller en gestion du territoire

255, place Chef Michel Laveau
Wendake (QC) G0A 4V0
T : 418 843-3767
@ : Benjamin.Labbe@wendake.ca

WENDAKE.CA

De : amos.r@aquaforbeech.com <amos.r@aquaforbeech.com>
Envoyé : 22 octobre 2024 15:41
À : Administration <Administration@wendake.ca>
Cc : 'Greg Frew' <Greg.Frew@mississauga.ca>; 'Jacob Ursulak' <ursulak.j@aquaforbeech.com>; cota.c@aquaforbeech.com
Objet : RE: Cooksville Creek Erosion Control Project - Schedule B Municipal Class EA

Dear Huron-Wendat First Nation,

Aquafor Beech Limited has been retained by the City of Mississauga to undertake a Schedule B Class Environmental Assessment Study for the **Cooksville Creek Erosion Control Project from Lakeshore Road to Lake Ontario**.

This project is being completed to address existing problems and risks along Cooksville Creek and the adjacent Helen Molasy Trail.

Aquafor and the City of Mississauga have completed a Stage 1 Archeological Assessment (attached). Based upon the Stage 1 recommendations, we're looking to complete a Stage 2 Archeological Assessment in the coming months, and wanted to extend the offer for review and / or Field Liaison Representation. Please let us know how you would prefer to be involved or provide input through the next phases of the study.

Additionally, Aquafor and the City of Mississauga have arranged an in-person, Public Information Centre to provide an opportunity to review and comment on the project findings to date. This includes the alternative solutions being considered, the evaluation process, the preliminary preferred solutions, and the next steps of the study.

The details of the Public Information Centre are as follows:

Date:	Tuesday, October 29th, 2024
Time:	Afternoon Session: 3 p.m. – 5 p.m. Evening Session: 6 p.m. – 8 p.m.
Location:	Small Arms Inspection Building 1352 Lakeshore Road East

Additional information is also available from the project website at:

Project Website
Cooksville Creek Erosion Control Project south of Lakeshore Road – City of Mississauga

Should you have any questions or comments, please feel free to contact the following:

Greg Frew, P.Eng.
Project Manager
City of Mississauga
300 City Centre Dr, Suite 800
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Ltd.
2600 Skymark Avenue, Unit 6-202
Mississauga, ON, L4W 5B2
416.705.23696
Amos.R@aquaforbeech.com

Kind regards,

Rob

Robert Amos, MASc., P.Eng.
Aquafor Beech Ltd.

☎ **416.705.2367**
✉ Amos.R@Aquaforbeech.com
www.aquaforbeech.com



From:	Greg Frew
To:	Benjamin Labbe
Cc:	"Jacob Ursulak"; cota.c@aquaforbeech.com; amos.r@aquaforbeech.com
Subject:	RE: Cooksville Creek Erosion Control Project - Schedule B Municipal Class EA
Date:	November 26, 2024 10:49:23 AM
Attachments:	image001.jpg image003.png image004.jpg image005.png image006.png

Good morning Benjamin.

The City is working with Aquafor and their Archaeology subconsultant to schedule the Stage 2 work. I'll let Rob relay the details once they're known.

In the interim, are you or Dominique able to provide us with a quote for Huron-Wedant participation in the work? Please also forward any standard agreement if available.

Thanks very much,
Greg.

Greg Frew, P.Eng.
Stormwater Drainage Engineer, Environmental Services
Infrastructure Planning and Engineering Services Division
Transportation and Works Department
City of Mississauga
☎ 905.615.3200 ext. 3362
✉ greg.frew@mississauga.ca
www.mississauga.ca

From: Benjamin Labbe <Benjamin.Labbe@wendake.ca>
Sent: Tuesday, October 29, 2024 3:26 PM
To: amos.r@aquaforbeech.com
Cc: Greg Frew <Greg.Frew@mississauga.ca>; 'Jacob Ursulak' <ursulak.j@aquaforbeech.com>; cota.c@aquaforbeech.com
Subject: [EXTERNAL] RE: Cooksville Creek Erosion Control Project - Schedule B Municipal Class EA

[CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.]

Kwe Robert,

Thank you for your email and invitation to participate in the Stage 2 Archaeological

Assessment fieldwork. I will let my colleague Dominique Lesage coordinate our Field liaison Representation with you. Do you have an idea when the fieldwork is planned and how long it will last?

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NATION HURONNE-WENDAT
Bureau du Nionwentsïo

Benjamin Labbé, M. Sc
Conseiller en gestion du territoire

255, place Chef Michel Laveau
Wendake (QC) G0A 4V0
T : 418 843-3767
@ : Benjamin.Labbe@wendake.ca

WENDAKE.CA

De : amos.r@aquaforbeech.com <amos.r@aquaforbeech.com>
Envoyé : 22 octobre 2024 15:41
À : Administration <Administration@wendake.ca>
Cc : 'Greg Frew' <Greg.Frew@mississauga.ca>; 'Jacob Ursulak' <ursulak.j@aquaforbeech.com>; cota.c@aquaforbeech.com
Objet : RE: Cooksville Creek Erosion Control Project - Schedule B Municipal Class EA

Dear Huron-Wendat First Nation,

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This project is being completed to address existing problems and risks along Cooksville Creek and the adjacent Helen Molasy Trail.

Aquafor and the City of Mississauga have completed a Stage 1 Archeological Assessment (attached). Based upon the Stage 1 recommendations, we're looking to complete a Stage 2 Archeological Assessment in the coming months, and wanted to extend the offer for review and / or Field Liaison Representation. Please let us know how you would prefer to be involved or provide input through the next phases of the study.

Additionally, Aquafor and the City of Mississauga have arranged an in-person, Public Information Centre to provide an opportunity to review and comment on the project findings to date. This

includes the alternative solutions being considered, the evaluation process, the preliminary preferred solutions, and the next steps of the study.

The details of the Public Information Centre are as follows:

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Time:	Afternoon Session: 3 p.m. – 5 p.m. Evening Session: 6 p.m. – 8 p.m.
Location:	Small Arms Inspection Building 1352 Lakeshore Road East

Additional information is also available from the project website at:

Project Website
Cooksville Creek Erosion Control Project south of Lakeshore Road – City of Mississauga

Should you have any questions or comments, please feel free to contact the following:

Greg Frew, P.Eng.
Project Manager
City of Mississauga
300 City Centre Dr, Suite 800
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Ltd.
2600 Skymark Avenue, Unit 6-202
Mississauga, ON, L4W 5B2
416.705.23696
Amos.R@aquaforbeech.com

Kind regards,

Rob

Robert Amos, MASc., P.Eng.
Aquafor Beech Ltd.

☎ **416.705.2367**
✉ Amos.R@Aquaforbeech.com
www.aquaforbeech.com

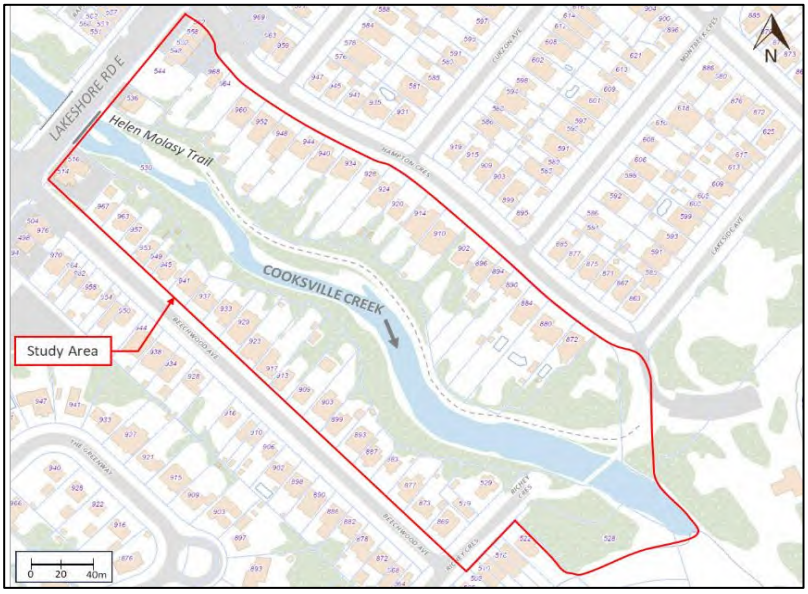
City of Mississauga
Notice of Completion

Municipal Class Environmental Assessment Study:
Cooksville Creek Erosion Control Project – South of Lakeshore Road

Project Background

The City of Mississauga (the City) has completed a Schedule B Municipal Class Environmental Assessment Study for erosion control and restoration of Cooksville Creek south of Lakeshore Road.

The City recognizes that this section of Cooksville Creek has been impacted by recent storm events and high lake levels and is in need of rehabilitation. Plans also considered the deteriorated condition of the adjacent city trail through Helen Molasy Memorial Park that sits above the east bank of the creek, as well as the neighbouring properties which experience ongoing drainage issues.



Study Completion

The Study has examined this section of Cooksville Creek and Helen Molasy Trail along with the associated natural resources to identify existing problems, potential risks, and opportunities for watercourse restoration and drainage improvements.

Through the Class EA process, various alternative solutions were developed and evaluated by the Study Team with input through public and agency consultation. The preferred watercourse erosion control strategy includes extended channel restoration works through the use of vegetated buttress bank protection treatment with embedded armourstone retaining walls. The preferred drainage restoration strategy includes the hybrid drainage solution involving the replacement and enhancement of the drainage infrastructure associated with the Helen Molasy Trail.

A Project File Report (PFR) documenting the planning process has been prepared and will be available for a comment period between **February 24th 2025** and **March 28th 2025** on the City's project webpage:

https://www.mississauga.ca/projects-and-strategies/environmental-assessments/cooksville-creek-erosion-control-south-of-lakeshore-road/

Should a member of the public request a hard copy of the report, the City will make arrangements for delivery of the PFR. If you have any questions or comments regarding the study, please contact the Project Managers listed below by March 28th 2025:

Greg Frew, P.Eng.
City Project Manager
City of Mississauga
300 City Centre Drive
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Limited
2600 Skymark Avenue
Mississauga, ON L4W 5B2
(416) 705-2367
Amos.R@aquaforbeech.com

City of Mississauga
Notice of Completion

Municipal Class Environmental Assessment Study:
Cooksville Creek Erosion Control Project – South of Lakeshore Road

In addition, a Section 16 Order request may be made to the Ministry of the Environment, Conservation and Parks (MECP or Ministry) for an order requiring a higher level of study (i.e., requiring an individual/comprehensive Environmental Assessment approval before being able to proceed), or that conditions be imposed (e.g., require further studies), only on the grounds that the requested order may prevent, mitigate or remedy adverse impacts on constitutionally protected Aboriginal and treaty rights. Requests on other grounds will not be considered. Requests are to include the requester contact information and full name.

The Section 16 Order request should be sent in writing or by email by March 28th 2025 to both contacts below with a copy to Greg Frew at the City.

Minister of the Environment, Conservation and Parks
Ministry of Environment, Conservation and Parks
777 Bay Street, 5th Floor
Toronto, Ontario M7A 2J3
minister.mecp@ontario.ca

Director, Environmental Assessment Branch
Ministry of Environment, Conservation and Parks
135 St. Clair Avenue West, 1st Floor
Toronto, Ontario M4V 1P5
EABDirector@ontario.ca

This notice signals the Notice of Completion for this Municipal Class Environmental Assessment, a study which defines the problem, identifies/evaluates alternative solutions, and recommends a preferred design in consultation with regulatory agencies and the public. The study has been undertaken in accordance with the planning and design process for Schedule 'B' projects, as outlined in the "Municipal Class Environmental Assessment" document (as amended in 2023), which is approved under the Ontario Environmental Assessment Act.

Personal information is collected under the authority of the Environmental Assessment Act and will be used in the assessment process. With exception of personal information, all comments shall become part of the public records.

This notice issued on **February 24th, 2025**.

Mississaugas of the New Credit First Nation Consultation - Communications Log

Date (dd/mm/yy)	From	To	Medium (e.g., email, letter, call)	Communication Description - Nature of Concern(s) or Interest(s)	Response/Follow Up
14-03-2024	**Greg Frew** Project Manager City of Mississauga **Rob Amos** Consultant Project Manager Aquafor Beech Limited	Mississaugas of the New Credit First Nation	Email	Notice of Study Commencement – Introduction to the Project	**Follow-up:** City of Mississauga to provide an invitation to an open house to discuss the EA.
15-10-2024	**Rob Amos** Consultant Project Manager Aquafor Beech Limited	Mississaugas of the New Credit First Nation	Email	Sharing of Stage 1 Archeological Assessment Results and Offer for Representation in Stage 2 Archeological Assessment	**Follow-up:** If Field Representation is requested for Stage 2 Archaeological Assessment, this request will be accommodated accordingly.
22-10-2024	**Greg Frew** Project Manager City of Mississauga **Rob Amos** Consultant Project Manager Aquafor Beech Limited	Mississaugas of the New Credit First Nation	Email	Sharing of Public Information Centre details, and invitation to participate	**Follow-up:** First Nation to Attend Public Information Centre if desired.
24-02-2025	**Greg Frew** Project Manager City of Mississauga **Rob Amos** Consultant Project Manager Aquafor Beech Limited	Mississaugas of the New Credit First Nation	Email	Notice of Study Completion.	**Follow-up:** First Nation to provide comments between February 24th 2025 and March 28th 2025 if desired.

From: amos.r@aquaforbeech.com
To: Abby.LaForme@mncfn.ca; Fawn.Sault@mncfn.ca
Cc: "Greg Frew"; cota.c@aquaforbeech.com; ursulak.j@aquaforbeech.com
Subject: RE: Cooksville Creek Erosion Control Project - Schedule B Municipal Class EA
Date: March 14, 2024 12:46:23 PM
Attachments: image002.png
Cooksville Creek - Mississaugas of the Credit First Nation.pdf

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Dear Mississaugas of the Credit First Nation,

Aquafor Beech Limited has been retained by the City of Mississauga to undertake a Schedule B Class Environmental Assessment Study for the **Cooksville Creek Erosion Control Project from Lakeshore Road to Lake Ontario**.

This project is being completed to address existing problems and risks along Cooksville Creek and the adjacent Helen Molasy Trail.

In accordance with the environmental assessment process, Aquafor is pleased to share the attached letter and Notice of Commencement. Additional information is also available from the project website at:

Project Website
Cooksville Creek Erosion Control Project south of Lakeshore Road – City of Mississauga

Should you have any questions or comments, please feel free to contact the following:

Greg Frew, P.Eng.
Project Manager
City of Mississauga
300 City Centre Dr, Suite 800
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Ltd.
2600 Skymark Avenue, Unit 6-202
Mississauga, ON, L4W 5B2
416.705.23696
Amos.R@aquaforbeech.com

We very much look forward to working with you throughout the project, and will ensure all documentation is available for your review and input.

Kind regards,

Rob

Robert Amos, MASc., P.Eng.
Aquafor Beech Ltd.

☎ **416.705.2367**
✉ Amos.R@Aquaforbeech.com
www.aquaforbeech.com



March 14th, 2024

Mississaugas of the Credit First Nation
Department of Consultation & Accommodation
4065 Hwy 6
Hagersville, ON N0A 1H0

Attention: Abby LaForme and Fawn Sault
Re: Environmental Investigations for Cooksville Creek

Dear Mississaugas of the Credit First Nation,

The City of Mississauga is undertaking a Schedule B Class Environmental Assessment (Class EA) Study for the Cooksville Creek Erosion Control Project South of Lakeshore Road.

The City of Mississauga recognizes that this section of Cooksville Creek has been impacted by recent storm events and high lake levels and is in need of rehabilitation. Plans will also need to consider the deteriorated condition of the adjacent city trail through Helen Molasy Memorial Park that sits above the east bank of the creek, as well as the neighbouring properties which have experienced ongoing drainage issues. The study will investigate, analyze, and assess the natural environment of the study area to identify existing erosion problems, potential future risks, and opportunities for restoration and environmental enhancement. The extents of the study area are illustrated on the following page.

A Stage 1 archaeologic investigation is also required as part of the EA. Our archaeological consultants have completed the Stage 1 archaeological investigation.

Your input is important. If you have any questions or comments, or would like to receive copies of the Stage 1 Archaeologic study, please contact myself at 905-615-3200 ext. 3362, or Greg.Frew@mississauga.ca.

Sincerely,

Greg Frew

Project Manager
City of Mississauga



Figure 1. Cooksville Creek Study Area.

CITY OF MISSISSAUGA – NOTICE OF STUDY COMMENCEMENT

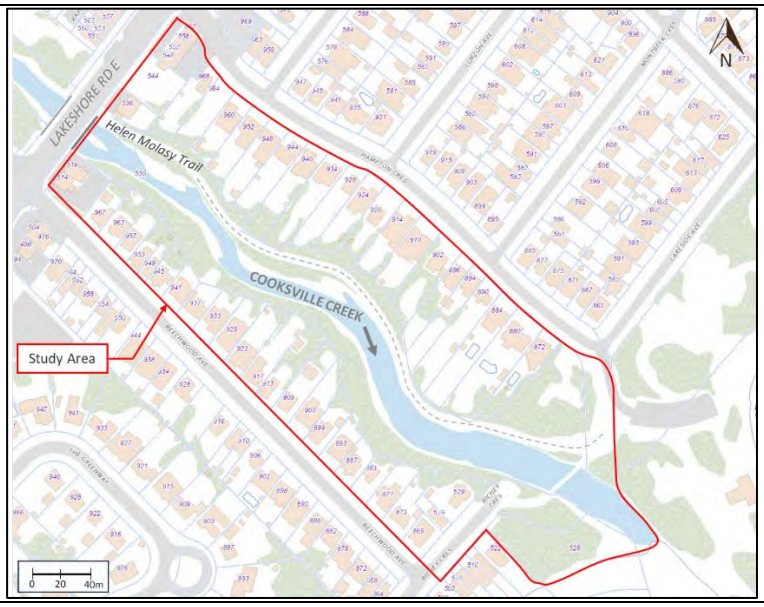
Municipal Class Environmental Assessment Study: Cooksville Creek South of Lakeshore Road

WHAT?

- The City of Mississauga is undertaking a Municipal Class Environmental Assessment (Class EA) Study for the Cooksville Creek Erosion Control Project South of Lakeshore Road.

WHY?

- The City of Mississauga recognizes that this section of Cooksville Creek has been impacted by recent storm events and high lake levels and is in need of rehabilitation. Plans will also need to consider the deteriorated condition of the adjacent city trail through Helen Molasy Memorial Park that sits above the east bank of the creek, as well as the neighbouring properties which have experienced ongoing drainage issues.



HOW?

- The study will examine this section of the Cooksville Creek and Helen Molasy Trail to identify existing problems, potential risks, and opportunities for restoration and drainage improvements.
- Through the Class EA process, the Study Team will develop and evaluate multiple alternative solutions and refine the options through public and agency consultation (see below). The Study Team will then select a Preferred Alternative.
- At the end of the study, a Project File, documenting the study process will be available for public review.
- Following completion of the Class EA Study, designs will be developed and implemented in accordance with study recommendations.

GET INVOLVED!

- Consultation is an important part of the Class EA process. Public input and comment are invited for incorporation into the planning and design of this project.
- A Public Information Centre (PIC) will be held to present the study findings, to consider alternative solutions, and to answer any questions you may have. Details regarding the PIC will be advertised publicly as the study progresses.
- Project information will be made available on the City's project website: https://www.mississauga.ca/projects-and-strategies/environmental-assessments/cooksville-creek-erosion-control-south-of-lakeshore-road/
- If you have any questions of comments regarding the study, or wish to be added or removed from the study mailing list, please contact:

Greg Frew, P.Eng.
Project Manager
City of Mississauga
300 City Centre Dr, Suite 800
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Ltd.
2600 Skymark Avenue, Unit 6-202
Mississauga, ON L4W 5B2
(905) 629-0099, ext. 294
Amos.R@aquaforbeech.com

This notice signals the commencement of the Class EA, a study which will define the problem, identify/evaluate alternative solutions, and determine a preferred design in consultation with regulatory agencies and the public. The study is being undertaken in accordance with the planning and design process for Schedule 'B' projects, as outlined in the "*Municipal Class Environmental Assessment*" document (October 2000, amended in 2015), which is approved under the Ontario *Environmental Assessment Act*.

Personal information is collected under the authority of the Environmental Assessment Act and will be used in the assessment process. With exception of personal information, all comments shall become part of the public records. Questions about this collection should be directed to the Project Manager listed above.

This notice was first issued February, 2024.

From:	amos.r@aquaforbeech.com
To:	"Abby LaForme"; "Fawn Sault"; "Adam LaForme"
Cc:	"Greg Frew"; ursulak.j@aquaforbeech.com; cota.c@aquaforbeech.com
Subject:	RE: Cooksville Creek Erosion Control Project - Schedule B Municipal Class EA
Date:	October 15, 2024 1:39:50 PM
Attachments:	image002.png Cooksville Creek Erosion Control EA, Mississauga Stage 1 Archaeology Draft Report.pdf

Dear Mississaugas of the Credit First Nation,

As a followup to the Notice of Commencement, Aquafor and the City of Mississauga have completed a Stage 1 Archeological Assessment (attached) as part of Schedule B Class Environmental Assessment Study for the **Cooksville Creek Erosion Control Project from Lakeshore Road to Lake Ontario**.

Based upon the Stage 1 recommendations, we're looking to complete a Stage 2 Archeological Assessment in the coming months, and wanted to extend the offer for review and / or Field Liaison Representation.

Please let us know how you would prefer to be involved or provide input through the next phases of the study.

Additional information is also available from the project website at:

Project Website
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Thanks very much, and should you have any questions or comments, please feel free to contact the following:

Greg Frew, P.Eng.
Project Manager
City of Mississauga
300 City Centre Dr, Suite 800
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

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Consultant Project Manager
Aquafor Beech Ltd.
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Mississauga, ON, L4W 5B2
416.705.23696
Amos.R@aquaforbeech.com

Kind regards,

Rob

Robert Amos, MASc., P.Eng.

Aquafor Beech Ltd.

☎ **416.705.2367**
✉ Amos.R@Aquaforbeech.com
www.aquaforbeech.com



From: amos.r@aquaforbeech.com <amos.r@aquaforbeech.com>
Sent: March 14, 2024 12:46 PM
To: Abby.LaForme@mncfn.ca; Fawn.Sault@mncfn.ca
Cc: 'Greg Frew' <Greg.Frew@mississauga.ca>; cota.c@aquaforbeech.com; ursulak.j@aquaforbeech.com
Subject: RE: Cooksville Creek Erosion Control Project - Schedule B Municipal Class EA

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We very much look forward to working with you throughout the project, and will ensure all documentation is available for your review and input.

Kind regards,

Rob

_____
Robert Amos, MASc., P.Eng.
Aquafor Beech Ltd.

☎ **416.705.2367**
✉ Amos.R@Aquaforbeech.com
www.aquaforbeech.com



Stage 1 Archaeological Background Study

Original Report

2023

DRAFT

Cooksville Creek Erosion Control
Part of Lot 11, Concession 3 South of Dundas Street,
(Former Township of Toronto, County of Peel),
City of Mississauga, Regional Municipality of Peel

Prepared For
Aquafor Beech Limited
Mississagua, Ontario

Project Information
Archaeological License: P1024 (Sarah MacKinnon MSc.)
MTCS PIF#: P1024-0311-2023
Corporate File #: 221-2023
Development Project Designation #: N/A

December 30th, 2023

New Era ARCHAEOLOGY
neweraarchaeology.ca
contact@neweraarchaeology.ca

EXECUTIVE SUMMARY

The City of Mississauga is addressing erosion along part of Cooksville Creek and as part of the processes New Era Archaeology Inc. was retained by Aquafor Beech Ltd. to complete a Stage 1 Archaeological Background Study and was given permission to access the project area to conduct all required archaeological fieldwork activities. This report describes the Stage 1 Archaeological Background Study for the Cooksville Creek Erosion Control within, Part of Lot 11, Concession 3 South of Dundas Street, (Former Township of Toronto, County of Peel), City of Mississauga, Regional Municipality of Peel. The study was conducted under Professional Archaeological License P1024 issued by the Minister of Citizenship and Multiculturalism (Ontario) to Sarah MacKinnon. The Stage 1 Archaeological Background Study was undertaken under the Class Environmental Assessment (1990). This report confirms that all the work conducted as part of this assessment conforms to the *Standards and Guidelines for Consultant Archaeologists* (MCM 2011) and the *Ontario Heritage Act* (MCL 2005).

The objectives of the Stage 1 Background Study are to determine if the project area has the potential to contain archaeological resources and determine if any past use activities within the project area have removed areas of potential. The *Checklist for Determining Archaeological Potential* and the 2011 *Standards and Guidelines for Consultant Archaeologists* (MCM 2011) published by the Ontario Ministry of Citizenship and Multiculturalism (MCM 2011) outlines features and the buffers around these features within which there is potential for archaeological resources. There are two groups of features, one for Indigenous (pre-contact) potential and one for Euro-Canadian (post-contact) archaeological potential. The main feature, which indicates potential for Indigenous archaeological resources, is the proximity to a potable water source. Additional features include topography, soil type and proximity to previously identified archaeological sites. Historic potential is based on proximity to historic features such as structures, roads, railways, settlements and previously identified archaeological sites.

The Stage 1 Archaeological Background Study involved the review of historical records, historic maps, current aerials, and project area inspection to confirm the current conditions of the project area. Both historic and current resources are consulted to identify areas of archaeological potential and activities conducted within the project area, which have removed potential. This information is used to determine if the project area has archaeological potential, note areas of no potential, and recommend appropriate strategies for Stage 2 for areas of archaeological potential. Prior to the site visit, it was determined that the project area has potential for both Indigenous (pre-contact) and Euro-Canadian (post-contact) archaeological resources and that past activities resulting in deep disturbance have removed potential within the project area. The site visit was completed on December 12th, 2023, to confirm the current conditions of the project area.

As a result of the Stage 1 Archaeological Background Study, it was determined that the project area has potential for both pre-contact and post-contact archaeological resources. It has also been determined that a portion of the project area has undergone significant disturbances relating to previous construction activities. Archaeological potential remains for portions of the project area, consequently, Stage 2 Archaeological Assessment by test pit survey is recommended.

DRAFT

TABLE OF CONTENTS

EXECUTIVE SUMMARY **2**

1.0 PROJECT CONTEXT **6**

1.1 DEVELOPMENT CONTEXT 6

1.2 HISTORICAL CONTEXT 6

1.2.1 Ontario Prehistory *6*

1.2.2 General Indigenous Overview *9*

1.2.3 Peel County Historic Overview *11*

1.2.4 Township of Toronto *13*

1.2.5 Historic Mapping *14*

1.3 ARCHAEOLOGICAL CONTEXT 15

1.3.1 Previously Registered Sites *15*

1.3.3 Current Land Use and Field Conditions *15*

1.3.4 Physiographic Region *15*

1.3.5 Water Resources *17*

2.0 SITE VISIT **17**

3.0 ANALYSIS AND CONCLUSIONS **18**

3.1 STAGE 1 BACKGROUND RESULTS 18

4.0 RECOMMENDATIONS **18**

5.0 ADVICE ON COMPLIANCE WITH LEGISLATION **19**

6.0 BIBLIOGRAPHY **20**

7.0 MAPS **21**

8.0 PLATES **27**

DRAFT

LIST OF MAPS

Map 1: Location of Project Area 21
Map 2: Historic Map Illustrating the Environment Surrounding the Property Area in 1859 21
Map 3: Historic Map Illustrating the Environment Surrounding the Property Area in 1877 22
Map 4: Project Area on National Topographic Survey from 1909 22
Map 5: Project Area on National Topographic Survey from 1929 23
Map 6: Project Area on Historic Aerial from 1954 23
Map 7: Project Area on Historic Aerial from 1980 24
Map 8: Project Area on Historic Aerial from 1985 24
Map 9: Project Area 25
Map 10: Stage 1 Archaeological Background Study Results 25
Map 11: Stage 1 Archaeological Background Study Results 26

LIST OF TABLES

Table 1: General Indigenous History Throughout Ontario 6
Table 2: Site Visit Documentary Record Inventory 17

LIST OF PLATES

Plate 1: Wooded Park Land 27
Plate 2: Asphalt Pathways and Two Manholes Between Them 27
Plate 3: Wooded Area Along Lake Ontario 27
Plate 4: Cooksville Creek 27
Plate 5: Cooksville Creek Emptying into Lake Ontario 27
Plate 6: Wooded Area Along the Creek and Manhole 27
Plate 7: Wooded Area Along the Creek 28
Plate 8: Wooded Area Along the Creek 28
Plate 9: Wooded Area and Gibbons Along the Creek 28
Plate 10: Wooded Area Along the Creek 28
Plate 11: Asphalt Pathway Surrounded by Mature Trees; Manhole 28
Plate 12: Sewer Outlets Emptying into Creek 28
Plate 13: Elevated Pathway Surrounded by Trees and Lawn 29
Plate 14: Elevated Pathway Surrounded by Trees and Lawn 29
Plate 15: Asphalt Pathway Surrounded by Mature Trees 29
Plate 16: Asphalt Pathway Surrounded by Mature Trees 29
Plate 17: Infrastructure Where Cooksville Creek Passes Under Lakeshore Road East 29
Plate 18: Cooksville Creek 29

DRAFT

PROJECT PERSONAL

LICENSED ARCHAEOLOGIST:
Sarah MacKinnon MSc. (P1024)

FIELD DIRECTOR:
Sarah MacKinnon MSc. (P1024)

REPORT PREPARATION:
Kayleigh MacKinnon MSc. (P384)

REPORT MAPPING:
Kayleigh MacKinnon MSc. (P384)

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1.0 PROJECT CONTEXT

1.1 DEVELOPMENT CONTEXT

The City of Mississauga is addressing erosion along part of Cooksville Creek and as part of the processes New Era Archaeology Inc. was retained by Aquafor Beech Ltd. to complete a Stage 1 Archaeological Background Study and was given permission to access the project area to conduct all required archaeological fieldwork activities. This report describes the Stage 1 Archaeological Background Study for the Cooksville Creek Erosion Control within, Part of Lot 11, Concession 3 South of Dundas Street, (Former Township of Toronto, County of Peel), City of Mississauga, Regional Municipality of Peel. The study was conducted under Professional Archaeological License P1024 issued by the Minister of Citizenship and Multiculturalism (Ontario) to Sarah MacKinnon. The Stage 1 Archaeological Background Study was undertaken under the Class Environmental Assessment (1990). This report confirms that all the work conducted as part of this assessment conforms to the *Standards and Guidelines for Consultant Archaeologists* (MCM 2011) and the *Ontario Heritage Act* (MCL 2005).

1.2 HISTORICAL CONTEXT

1.2.1 Ontario Prehistory

Table 1: General Indigenous History Throughout Ontario

Period	Date Range	Cultural Group	Diagnostic Material	Period Details
Paleo-Indian – ca. 11,000-7,500 BC				
Early	ca. 11,000-8,500 BC	Clovis, Plano	Fluted projectile points	The continental glacier covering Ontario continued to recede north exposing more habitable land for flora and fauna attracting the nomadic hunters from the south-west. These hunter-gatherers set up sites along shorelines, with fish a main dietary staple and would periodically gather into larger groups typically during the summer months when food was more abundant. The Clovis culture remained in Southern Ontario where the Plano culture moved into Northern Ontario
Late	ca. 8,500-7,500 BC		Plano, Holxombe, Hi-Lo projectile points	
Archaic – ca. 7,800-1,000 BC				
Early	ca. 7,800-6,000 BC	Shield Archaic, Laurentian Archaic	Bifurcate, nettling projectile points	Small nomadic hunter-gatherer bands slowly transition to small territorial camps. There is a continuation of gathering into larger groups in the summer and dispersing into smaller groups over the winter. Dependence on hunting meant that great distances were often covered throughout the year. There is an increase in the use of localized material and the re-purposing of stone tools. Local and long-distance trade networks appear leading to an influx of exotic material and goods, including natural copper and conch shells, often used as grave offerings. Trading often occurred in the summer months when groups came together at the mouths of rivers to take advantage of the spawning fish. The open water also allowed for easier travel over longer distances.
Middle	ca. 6,000-2,000 BC		Brewerton, Stanly, Side-notched projectile points	
Late	ca. 2,500-1000 BC		Lamoka, Adder Orchard, Genesee, Lamoka, Innes, Crawford Knoll, Innes, Hind projectile points	

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				The bow and arrow was adopted towards the end of the period, which was already in use on the east coast. The Plano cultural group are the ancestors of the Shield Archaic and the Clovis are ancestors of the Laurentian Archaic.
Woodland – ca. 1,000 BC – AD 1600				
Early	ca. 1000-400 BC	Meadowood, Middlesex	Birdstones, Cache blades, Kramer, Meadowood projectile points	Hunter-gatherer groups continue to come together in the warmer months and disperse in the fall occupying the margins of Southern Ontario. Both large and small campsites have been identified. The same trade networks are maintained. One distinguishing characteristic of this period is the introduction of pottery. Burial ceremonialism is also practiced. Late Archaic ancestors. The Meadowood culture is changed or absorbed by Point Peninsula.
Middle	ca. 400 BC - AD 700	Point Peninsula, Saugeen	Vanport, Snyder, Saugeen projectile points	Hunter-gatherers, but evidence of increased sedentism and seasonal site reuse and emergence of horticulture. Diets expanded to include the collection of wild fruits and wild rice. More intricate burial ceremonialism adopted from Hopewell culture to the south, as a result of trade networks, including the use of burial mounds. More decorative pottery techniques also appear including stamped and scalloped techniques. Items from the Ohio Valley also start to appear for the first time including stone platform pipes, copper ear spools and copper panpipes. Point Peninsula sites in the Toronto, Quebec and New York areas. Saugeen sites found in the area between Lake Huron and Lake Erie west of Toronto.
Transitional	ca. AD 600 - 1000	Princess Point, Laurel	Princess Point pottery, Triangular projectile points	Princess Point sites remain smaller in size located along the north shore of Lake Erie and the west end of Lake Ontario. They are the first to adapt corn in Ontario, which spread northeast from Mexico. Princess Point pottery decorative techniques include cord-wrapped stick and punctuates. The Shield Archaic are ancestors of the Laurel culture who occupied Northern Ontario, Western Quebec and areas to the west and received their pottery knowledge from Point Peninsula and Saugeen cultures. The Laurel also created some of the largest burial mounds.
Late - Early	ca. AD 900 - 1300	Glen Meyer, Pickering	Glen Meyer Tanged-Triangular projectile point	The Pickering culture developed out of the Point Peninsula culture and occupied an area between Lake Ontario and Georgian Bay to Lake Nipissing. The Glen Meyer culture developed out of the Princess Point culture and occupied southwestern Ontario between Long Point and Lake Huron. Small single-family houses change to larger multi-family longhouses within small village sites with the appearance of palisades at some. There is an increase in corn agriculture. Pottery vessels are thinner walled with improved manufacturing. There is a switch in burial customs to the use of burial pits, a precursor to large ossuaries. Towards the end of the period pipes become more common.
Late - Middle	ca. AD 1300 - 1400	Uren, Middleport, Lalonde	Middleport projectile points	Increase in village size and reliance on agriculture including corn, beans and squash. Farming provided increased food resources with better nutrition allowing populations to grow. Decrease in decorated pottery vessels and an increase in decorative pipes including effigy pipes. Some sites still include a palisade.

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Late - Late	ca. AD 1400 - 1600	Ontario Iroquoian	Nanticoke, Daniels Triangular projectile points	Village size increased and locations were strategically picked to ensure enough arable land as their diets were heavily dependent on agriculture. Locations were also chosen for their proximity to woodlots for both heating and building, proximity to water and a location which could be easily defended. Good hunting grounds to support the growing village population became important and as a result hostilities over these hunting grounds increased with neighboring communities. Emergence of tribes and territories. Dogs were domesticated and large ossuaries become common. Towards the end of the period the first Europeans goods appear periodically in Ontario through trade networks with groups further east who were in contact with the first French explorers who had reached the St. Lawrence.
Contact-Historic – ca. AD 1600-1800				
European Contact	AD 1600-1650	Huron, Neutral, Petun, Odawa, Ojibwa	Minimal European items	Establishment of the fur trade. Increase in warfare resulted in tribal disbursement leaving much of the area between Lake Ontario and Lake Simcoe with no permanent large villages. Many villages move north of Lake Simcoe further away from the Iroquois. Continued warfare from the Iroquois to the south resulted in the dispersal of the remaining Huron-Wendat and abandonment of their remaining villages and resettlement in Quebec at the closing of this period. The French arrive in Ontario with an increase in Jesuit missionaries and European goods.
Late	AD 1650- ca. 1800	Algonquin, 6 Nations Iroquois,	Mixture of Indigenous and European items	The Iroquoian continued to use their conquered land of Southern Ontario as mainly hunting grounds with a few settlements located along the shoreline of Lake Ontario. The Iroquoian were then challenged and pushed out of the region by the Anishinaabeg (Ojibway, Chippewa, Odawa). Trade continued with both English and French. Numerous migrations and resettlements. The end of this period there saw an influx of European and American settlers transitioning to the historic period.

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1.2.2 General Indigenous Overview

1.2.2.1 Southern Ontario

As the glaciers that covered southern Ontario began to retreat approximately 12,500 years ago, the area began to become habitable for the Paleo-Indian hunting bands arriving between 11, 000 and 10,500 years ago finding large meltwater lakes formed in the wake of the retreat. The lakes were accompanied by relatively barren tundra interspersed with areas of open boreal forest. The Paleo-Indian hunters focused on the large Pleistocene mammals including mastodon, moose, elk, and especially herds of caribou that roamed the area. Following the herds of animals, the Paleo-Indian groups travelled long distances and seldom stayed in one campsite for a significant length of time leaving behind little material culture. Stone tools and by-products of their flaked stone industry are virtually all that remains. They manufactured large distinctive spear points that have a prominent channel or groove on each face. Campsites from this period are frequently found adjacent to remnant shorelines of large post-glacial lakes indicating that camping sites were set up along the shores of lakes to intercept migrating herds. The water levels of the Lake Ontario basin fell in the early post-glacial period and subsequently rose again to modern levels resulting in these campsites now being situated more than a kilometer into the lake (Archaeological Services Inc. 2014).

The Archaic Period (7,000 B.C – 1,000 B.C) saw a mixed needle and broadleaf forest cover established in Ontario and nomadic hunter-gatherers hunted deer, moose, as well as other animals, fished and gathered plant resources while moving relatively large distances over the landscape during the year. From the archaeological record, the technological and cultural change can be identified including a wide variety of tools produced which resulted in shifts in hunting strategies to adjust to a constantly evolving environment. During the Late Archaic period hunter-gatherer bands most likely settled into familiar hunting territories. Two types of sites evolved as a result of their hunting patterns, the small inland camps that were occupied by small groups of related families during the fall and winter where they could harvest nuts and hunt deer, and the larger spring and summer settlements that were located near river mouths where groups came together to trade, exploit spawning fish resources and to bury their dead. Many of the ground stone tools have both social and symbolic functions, they had a day-to-day use, but their inclusion in burials ascribes to them a sacred intent (Archaeological Services Inc. 2014).

The Woodland Period (1,000 B.C – 1600 A.D.) is distinguished from the previous Archaic period with respect to settlement patterns and subsistence pursuits and is most specifically marked by the instruction of ceramics into Ontario. Though the appearance of these ceramics provides a temporal marker for archaeologists their use does not seem to have profoundly changed the hunter-gatherer lifestyle of the previous period. The Iroquoian society flourished in the southern Great Lakes region in the Late Woodland Period. Increasingly sophisticated burial ceremonies and an increase in the trade of exotic items developed which may have come out of the need for greater social solidarity as the population increased causing competition for resources. Trade with communities living south of the Great Lakes introduced maize and squash creating a transition to food production that then reduced reliance on naturally occurring resources and led to less movement as people tended to their crops. As sites were more intensively occupied the need for a greater degree of internal spatial organization came about which can be seen in the archaeological record (Archaeological Services Inc. 2014). The ancestors of the Neutral, Huron, and Petun resided along the central north shore of Lake Ontario and the ancestral Iroquoians became the Five Nation Iroquois (Seneca, Cayuga, Onondaga, Oneida, and Mohawk) occupied the area south of Lake Ontario in what is now central New York State. Though there were most likely interactions between these Iroquoian-speaking groups it was not until the mid to late 17th century that the Five Nation Iroquois inhabited the Toronto area. The focus on agricultural practices led to a more sedentary lifestyle with larger communities coming together and forming alliances with separate villages. Some villages were fortified with palisade walls with land cleared around them for crops. By the time European explorers and missionaries arrived in Ontario at the beginning of the 17th century the villages were

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under the direction of various chiefs elected from the principal clans and subsequently allied within powerful tribal confederacies (Archaeological Services Inc. 2014).

By 1600 most of the Lake Ontario north shore communities had moved northward joining communities in Simcoe County to form the Petun and Huron. Though the movement of these communities took place over many generations the conflict with the Five Nations Iroquois of New York State was the final impetus. The collapse and dispersal of the three Ontario Iroquoian confederacies (the Huron, the Petun, and the Neutral) during the first half of the 17th century was caused by intertribal warfare with the Five Nations Iroquois and exacerbated by the intrusion of Europeans (Archaeological Services Inc. 2014).

1.2.2.2 Peel County

While Indigenous groups have long inhabited Southern Ontario, during the 1600s it was those in the Iroquois Confederacy (also known as Five Nations) who controlled large areas, including what is now known as Peel. By the 1700s the Iroquois had become weakened by disease and warfare with the French and were pushed out of the area by the Anishinaabeg as they migrated southward to settle along the north shore of Lake Ontario. This group would later become known as the Mississaugas by European settlers (Peeling the Past, 2017).

After the Seven Years War between Britain and France ended in 1763 the overall control of the lands that now comprise Ontario and Quebec were ceded by France to the British who continued to maintain forts at Kingston and Niagara. The influx of settlers after the American Revolution and the subsequent migration of Loyalist settlers convinced the British Crown to formally acquire new lands for settlement through a series of land purchases from Indigenous groups including the Mississaugas. Between 1783 and 1818 tracts of land within Ontario were purchased and surveyed for settlement (Peeling the Past, 2017).

> *On August 2nd, 1805 the British and Mississaugas signed a treaty covering the southern portion of the "Mississauga Tract" on the Lake Ontario waterfront, reaching from the Etobicoke Creek on the east to Burlington Bay on the west, and running north to what in Peel is known as the Second Concession North of Dundas Street (also known as Eglinton Avenue). Within a year the land was surveyed and divided into "Townships" for settlement purposes. The township in the Peel area was known as Toronto Township (now the City of Mississauga). It is interesting to note that the naming of this Township predated the incorporation of the City of Toronto in 1834 (founded as the Town of York in 1793).*
>
> *When Toronto Township was purchased the Mississaugas withheld a strip of land 1 mile wide on either side of the Credit River. The rest of the land was surveyed, and settlement began in earnest. Small hamlets sprung up at crossroads throughout the Township, including Summerville and Dixie. These hamlets were usually composed of a blacksmith shop, general store, church, and perhaps an inn or hotel. By 1818 the need for more land was apparent, and negotiations were started to purchase the remaining Mississauga land north of Eglinton Avenue. That same year 648,000 additional acres were purchased* [Treaty 19]*, and by 1819 the land was surveyed and divided into Townships. The Peel area now included an enlarged Toronto Township, as well as four additional townships: Chinguacousy, Toronto Gore, Albion, and Caledon. In February 1820 the Mississaugas surrendered the last of their lands along the Credit River, only keeping a small piece for a village that they subsequently abandoned in 1847 (now the Mississaugua Golf and Country Club).*
>
> (Peeling the Past, 2017).

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The project area is located within the traditional territory of the Mississaugas of the Credit River First Nation and included within the Ajetance Purchase (Treaty No. 19), the last large tract of land they ceded. The Ajetance Purchase includes lands within the Halton and Peel Regions and Dufferin and Wellington Counties. On October 23rd, 1818, members of the Mississaugas of the River Credit and Twelve and Sixteen Mile Creeks as well as, Chief of the Eagle Tribe, Weggishigomin of the Eagle Tribe, Kawwahkitahqubi of the Otter Tribe, Cabibonike of the Otter Tribe, and Pagitaniquatoibe of the Otter Tribe met with Deputy Superintendent William Claus on behalf of His Majesty to discuss the purchase of land (Filice 2018, Mississaugas of the Credit First Nation 2017b, Surtees 1984, Crown-Indigenous Relations and Northern Affairs 2016). The treaty was signed on October 28th, 1818, and included:

> *"A tract of land in the Home District, called the Mississauga tract," bounded southerly by the purchase made in 1806; on the east by the Townships of Etobicoke, Vaughan and King; on the south-west by the Indian purchase, extending from the outlet at Burlington Bay, north forty-five degrees west fifty-miles, and from thence north seventy-four degrees east or thereabout to the north-west angle of the Township of King, containing by computation six hundred and forty-eight thousand acres; and the said Adjutant, Weggishigomin, Cabibonikem, Pagitaniquatoibe and Kawahkitahquebi, as well for themselves as for he Mississauga Nation inhabiting and claiming the said tract of land as above described, do freely, fully and voluntarily surrender and convey the same to His Majesty without reservation or limitation in perpetuity. And the said William Claus, on behalf of His Majesty does hereby, promise and agree to pay to the said Nation of Indians inhabiting as above mentioned, yearly and every year for ever the said sum of five hundred and twenty two pounds then shillings currency in goods at the Montreal price, which sum the said Principal Chiefs and people, parties hereunto, acknowledge as a full consideration for the lands hereby sold and conveyed to His Majesty.*
>
> (Crown-Indigenous Relations and Northern Affairs 2016)

The Mississaugas had negotiated the sale of all their territory with the exception of 200 acres near the mouth of the Credit River by 1820 (Filice 2018, Mississaugas of the Credit First Nation 2017b, Surtees 1984).

1.2.3 Peel County Historic Overview

In 1788 four Districts were created including the Nassau District (later the Home District) which included what would later become the County of Peel. Then in 1791, the province of Quebec was divided into Upper Canada and Lower Canada, and the Home District became part of Upper Canada with most of what is now southern Ontario (Walker & Miles, 1877, Mercer et al 1885).

Lieutenant-Colonel John Graves Simcoe was appointed the first Lieutenant-Governor of Upper Canada. He moved the capital from Newark (Niagara) to Toronto, which he renamed York in honour of the King's son Frederick the Duke of York, in order to provide it more protection. In 1792 he divided Upper Canada into 19 Counties and created a road system. To establish and open the road system Governor Simcoe brought troops over from England. He also employed them in other building operations and posted them along these roadways. The establishment of a road system prepared the Counties for an influx of settlers and aided settlers on their journey to their new home (Mercer et al 1885). The Home District, albeit with the inclusion of fewer townships, continued until the institution of districts was abolished in 1852 and as a result the united County of York, Peel and Ontario was formed. The County of Ontario was the first to separate. It was not until 1866 that Peel was separated from York. After some time, the Village of Brampton was finally selected as County Town and the County buildings were erected at a cost of over $40,000. The first council met at the Brampton Court House in January 1867 (Walker & Miles, 1877).

The County of Peel was named after Sir Robert Peel (1788-1850), a British politician who served as both Home Secretary and Prime Mister of Great Britain (Walker & Miles, 1877). Located on the north shore of Lake Ontario,

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bounded on the east by the County of York, on the north by the Counties of Simcoe and Wellington, and on the west by the Counties of Wellington and Halton, it is comprised of the Townships of Toronto, Toronto Gore, Chinguacousy, Caledon and Albion, the incorporated Town of Brampton, and the incorporated villages of Streetsville and Bolton. As a small County, it contains 293,300 acres of land measuring 37 miles in length with an average width of 15 miles. A chain of ridges runs through it dividing it into two distinct sections, entering at Caledon at a south-west angle and passing out of the County approximately midway through the eastern boundary of Albion. The two sections are distinct in character of soil and climate as well as general appearance above and below this chain. The land in the lower region is gently undulating with a gradual but continual ascent from the Lake to the base of the ridges where it then rises nearly perpendicular. In other areas, it is broken for some miles, with hills over hills making it difficult to ascertain when you have actually ascended the range with the mountain about 900 feet above the level of Lake Ontario (Walker & Miles, 1877).

Generally, the roads through Peel were considered of good quality and were opened and more or less travelled between every two concessions as well as side roads every five lots. One of the main roads, Dundas Street, passes through the front part of Toronto Township. This road was partly graveled and macadamized by grants from the Legislature in 1836. Settlement was concentrated along Dundas Street and being heavily travelled meant good business for shops and other businesses established along it. Another well-travelled road, first planked by a private company and later graveled, was Lakeshore. Hurontario Street, which runs from Port Credit north-west through the center of Toronto, Chinguacousy and Caledon, and then through to Collingwood was also well-travelled. Another key road was cut through the sixth line that extends from Dundas St. north, west to Mono Mills in Mono, on the west, and the Gore and Albion on the East. The Grand Trunk Railroad and the Toronto Grey and Bruce Railroads run through the County with the Credit Valley Railway being added shortly after (Walker & Miles, 1877). The County, like many others, benefitted economically from the railway.

The County is well watered with running streams of various sizes throughout. The Credit River, considered to be the principal River, provides an excellent stream of water which runs through the western part of the County. The numerous branches of the river provide a source of wealth for many communities, including Caledon where waterpower is supplied. The Humber River also plays an important role in the County and specifically to Albion where it provides waterpower through its tributaries. Each township had several mills which utilized the numerous waterways (Walker & Miles, 1877).

1819 and the following years saw the greater part of the County settled, though the old survey of Toronto Township was thinly settled in 1808 or 1810. Many first settlers came from New Brunswick, the United States, and other parts of Upper Canada. Some of the first settlers in the ‘New Survey’ of Toronto Township included a colony of Irish families from New York City who came to their grants of land in 1819 under the Superintendence of Messrs. Beaty and Graham. U.E. Loyalists and their descendants were the main settlers of Chinguacousy as well as a number of other inhabitants of Upper Canada. The other townships were mostly made of emigrants from the old country (Walker & Miles, 1877).

At the time the first regular organization of all the townships that became the County of Peel was made in 1821 the population was only 803, however, settlement within the County continued to grow steadily and by 1871 the population had risen to 26,011 inhabitants (Walker & Miles, 1877). By 1877 life in the County was becoming easier with fewer hardships as farms were well established and more and more shops, mills and other businesses had been opened.

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1.2.4 Township of Toronto

Toronto Township located in the southeast of Peel County was first surveyed in 1806 by Mr. Wilmost. The first survey only covered about one mile deep from each side of the Credit River. Colonel Thomas Ingersoll is thought to have been the first settler in the Township as well as the County, arriving before 1806. He kept a government storehouse and operated a ferry service at what would become Port Credit. By 1808 seven families were living in the Township including John Silverthorn, Joseph Silverthorn, Philip Cody, Daniel Harris, Allen Robinett, William Barber and Absolom Wilcox. They had settled along Dundas Street within the original survey (Walker & Miles 1877). Settlement continued to steadily increase until the War of 1812. In 1819 the remaining portion of the Township was surveyed, a large part of which was granted to a number of Irish families who had originally settled in the US before the war. Being persecuted after the war for not taking up arms with the Americans against the British led them to appeal to the British Council, in New York, for land in Canada. Twenty-six families were given land grants and in Map 1819 they began their journey to Toronto Township. Their journey was long and arduous and not made easier by the wagons they brought filled with supplies. There were not many roads open by the time they arrived in Canada and further inland they were not well maintained. Early settlers often used sleighs pulled by oxen. The sleighs were easier to maneuver around stumps, over logs and through marshy areas. Not all the covered wagons made it to their final destination, some being left in York (later Toronto). Settlement of the Toronto Township continued after the arrival of the Irish families so much so that it was incorporated by 1876 and was the first in the County to be incorporated. Several settlements started to grow up throughout the Township as settlement increased (Walker & Miles 1877).

Streetsville is the oldest settled village in the County and was ideally located along the Credit River. The Village was incorporated in 1858. The first three settlers to the area that would become Streetsville are thought to be James Glendenning, Frank Lighthearn and John Barnhart respectively. Streetsville is thought to have had the most extensive woollen factory in the province. It also boasted the largest grist mill in operation by 1876, at least in the Township. Another grist mill in the village was also large, running two stones and manufacturing flour for both local residences as well as for foreign markets. By 1876 Streetsville also had a cabinet warehouse and shop, broom factory, tub and pail factory, chair and paint shop, blacksmith, lumber businesses, a few stores, a large brick schoolhouse and four churches. The population by 1876 had risen to 678. The village after flourishing for many years began to struggle. The completion of the Credit Valley Railway was anticipated to help revive the Village Walker & Miles (1877).

Meadowvale was another village also located along the Credit River. The Village sprung up around the sawmill built in 1831 by John Crawford. By the time John Simpson built his sawmill in 1836, there were already a number of settlers there. These settlers had to travel to Toronto for supplies until 1847 when the first store in the Village was opened by Hames Ward. Having a store closer made everyday life easier for these early settlers. Life was made easier again when in 1856 Francis Silverthorn built a grist mill. The grist mill was purchased in 1860 by Gooderham and Worts who significantly increased the business. Running five stones meant that they could grind 250 barrels of flour a day and employ more hands. Gooderham and Worts being the businessmen they were also had a barrel business (among other businesses) where they manufactured their own barrels for their flour and also sold them to their grist mill customers. By 1876 Meadowvale also had a sawmill, lumber, lath and shingle factory, general store and a few other stores Walker & Miles (1877).

Port Credit was established by the Government in 1804 when they sent Thomas Ingersoll to run a storehouse and ferry. New emigrants to this part of the Country were accommodated in an inn also built by the Government. Port Credit is the only port in the County and has became one of the best shipping ports on the Lake. The opening of the Great Western Railway Station at Port Credit greatly benefitted both the Village and the shipping businesses. By 1877 Port Credit had also become a large shipper of strawberries. Over 100 acres of strawberries were cultivated, which increased each year. At one time two steamboats full of strawberries were shipped to Toronto daily. The

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harbour opened up the market for many Villagers to ship their goods further afield. Port Credit also became a sporting retreat for men from Toronto. Travellers would come by train to fish and hunt, staying in one of three hotels. Much of the surrounding area was still wild and offered great hunting Walker & Miles (1877).

Cooksville boasting a population of 300 by 1876 was located just south of the center of the Township and had a sawmill, a church, a two-story brick schoolhouse with three teachers, a baker, a waterhouse, a blacksmith and two hotels. Cooksville was named after Jacob Cook Esq. who originally owned the land which would become the location of the Village. Cooksville was ideally located along the main road between Hamilton and Toronto, flourishing as a result. Unfortunately, like so many other early settlements it was devastated by fire. The devastation of the fire in 1852 was so great that only a few houses were left standing, and the Village never fully recovered. The opening of the Grand Trunk and the Great Western Railways also took business away from the Village, having stations established elsewhere. Like Streetsville, it was hoped that the opening of the Credit Valley Railway would help. Cooksville did benefit from the establishment of the Canada Vine Growers Association in the village Walker & Miles (1877).

1.2.5 Historic Mapping

Historic maps although providing some information on historic features the inclusion of such information was often based on a subscription and the purpose of the map. Therefore, it is unknown how many features have been excluded from these early maps. Additionally, there can also be a discrepancy between the actual location of a feature and where it is depicted on the map. A site visit together with later maps can help narrow down the potential location of historic features illustrated on the early maps.

Map 2 illustrates the location of the project area and environs as of 1859. This map illustrates the project area on the shore of Lake Ontario and Cooksville Creek running through it, emptying into the Lake. The Credit River and other watercourses are also shown within the surrounding area. An unnamed toll road is illustrated adjacent to the northwestern boundary of the project area and corresponds to the current Lakeshore Road East. The Hamilton and Toronto Railway is illustrated running parallel with Lakeshore Road East further northwest of the project area. Lot 11 is shown to be owned by Wesley Watson and two structures are illustrated within the lot along Lakeshore Road East. Structures are also illustrated on the lots on the north side of Lake Shore Road East, across from the project area. The settlement of Port Credit is illustrated just west and Cooksville to the northwest. All of the lots surrounding the project area are shown to be owned, however, a structure is not illustrated on each lot. The schoolhouse to the southwest of the project area suggests the demographics of the area and the requirement for such an institution. An “Old Indian Village” is noted to the northwest of Port Credit adjacent to the Credit River. The larger area well known as being the traditional territory of the Mississaguas.

Map 3 from 1877 shows the project area within a similar environment to the 1859 map. Cooksville Creek still runs through the project area which is located on the shore of Lake Ontario. Lakeshore Road East and the Hamilton and Toronto Railway, now the Great Western Railway are located to the northwest. The Credit Valley Railway was opened north of Cooksville by 1877. Port Credit and Cooksville don’t appear to have grown much since 1859. Lot 11 is now shown to be owned by Stephen Crawford, a non-resident. Many of the lots along the water and a few others show that they were owned by non-residents. Both structures within the lot are still shown on this map. The structures to the north of the project area are illustrated with large orchards, suggesting these farms were well established by this time. The manufacturing industry growing since 1859 is shown owning several parcels of land to the west of the project area.

National topographic surveys were gathered to provide more detail about the project area and its surroundings. The survey from 1909 (Map 4) shows the project area within a rural environment with Cooksville Creek flowing through

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the it into Lake Ontario surrounded by woodlot and by wooden and brick structures. By 1929 (Map 5) urbanization had expanded around the project area.

The urbanization illustrated on the 1929 survey can be seen on the aerial from 1954 (Map 6). A structure is shown within the northern portion of the project area along Lakeshore Road East adjacent to the Creek. By 1980 (Map 7) Cooksville Creek had undergone significant changes straightening and widening it and further widening and the installation of path along the Creek by 1985 (Map 8). The structure in the northern portion of the project area was removed perhaps to allow the widening of the Creek. Prior to 1980, a portion of the Lake was filled in to extend the shoreline into the Lake southeast of the project area to create parkland. Part of the Lake in the southwest corner of the project area was also filled in by 1980 and then further into the Lake by 1989.

The project area's proximity to the historic structure and road suggests potential for Euro-Canadian archaeological resources.

1.3 ARCHAEOLOGICAL CONTEXT

1.3.1 Previously Registered Sites

According to the Minister of Citizenship and Multiculturalism Archaeological Site Database (ASD) the Adamson Estate Euro-Canadian homestead site is located within 1km of the project area.

No reports were identified that document archaeological fieldwork conducted within or adjacent to the limits of the project area.

1.3.3 Current Land Use and Field Conditions

The project area is approximately 2.88 hectares in size and consists of mainly Cooksville Creek which flows through the project area into Lake Simcoe surrounded by mature trees. The Creek has steep banks along some of it which in places have been reinforced with gibbons, large stones and concrete at the northern end where it passes under Lakeshore Road East. An asphalt path follows the east side of the Creek. Storm sewer lines are located along both sides of the Creek which empty into it. A bridge crossing the Creek is located in the southern portion of the project area. The parklands in the southern portion of the project area are mainly manmade land. Areas of lawn are located along the eastern side of the Creek where the study area crosses the rear portion of residential lots.

The project area is bounded on the northwest by Lakeshore Road East, on the northeast and southwest by residential and on the southeast by parkland and Lake Ontario. Map 10 illustrates the current land use.

1.3.4 Physiographic Region

The project area is located within the Iroquois Plain physiographic region. The lowland area bordering Lake Ontario was inundated by water when the last glacier was receding, though still within the St. Lawrence Valley, and was called Lake Iroquois. This glacial lake emptied eastward at Rome, New York State. The old shorelines with its cliffs, bars, beaches, and boulder pavements are still identifiable features with the undulating till plains above are

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contrasted by the wave smoothed lake bottom. The area of the Iroquois plain extends some 190 miles around the western part of Lake Ontario, from the Niagara River to the Trent River, with varying width from about eight miles to only a few hundred yards. A large area is located in the Trent River valley. Due to the varying conditions within the old lake plain the region has been divided into a number of sub-sections including Niagara Fruit Belt, Ontario Lakehead, Hamilton to Toronto, Toronto, Scarborough, Scarborough to Newcastle, Newcastle to Trenton, and Trent Embayment (Chapman and Putnam 1984).

Ontario Lakehead

This portion lies at the head of Lake Ontario and is a special part of the Iroquois plain. The characteristics of lake heads make them ideal for the establishments of cities and the area of glacial Lake Iroquois had some advantages. With a narrow plain between the lake and the "mountain" there is direct connection with Niagara through the old shoreline, and a corridor to the north shore was provided by the old bayhead bar. An easy grade up the escarpment to Ancaster is found through the old higher terraces inside the bar bypassing Dundas in two directions (Chapman and Putnam 1984).

Hamilton to Toronto

Occupying the northeast shore of Lake Ontario from Burlington to Toronto and beginning with a great gravel bar running through Aldershot. For about 18 miles the shoreline continues as a distinct bluff in the red shale of the Queenston Formation. The grey shale of the Georgian Bay Formation is the old shore near Clarkson and Cooksville, whereas in other places such as Toronto itself (along Davenport Road west of Yonge Street) the Iroquois shoreline is cut in Pleistocene deposits. Barrier beaches were created by the old lake at Bronte Creek, Oakville Creek, Etobicoke Creek, Credit River, Humber River, Don River, with significant sources of sand and gravel at each of the three rivers (Chapman and Putnam 1984). The shoreline of Lake Ontario provides the other boundary of the plain while the water gradually cuts into the red shale of Burlington to Oakville, grey shale at Clarkson, and the delta sands at Lorne Park. Along the shoreline the mouths of streams have been drowned and at the mouth of Twenty Mile Creek with such significance that the lagoon of Jordan Harbour has been formed by a bar. A surviving portion of the bed of Lake Iroquois is found between the two shorelines (ancient and modern), with a sloping plain at an average width of approximately two miles with varying compositions including stratified sands of varying depth, shallow cover of till over the bedrock, and in some the wave-eroded surface of red shale is the basis for soil formation. The soil of Aldershot, Bronte, Burlington, Oakville, Lorne Park, Clarkson, and Humber Bay is sandy and is preferable to the clay of the adjoining areas (Chapman and Putnam 1984).

Toronto

The waves and currents of Lake Ontario created the harbour protecting sandbar of Toronto Island by moving the sand from the Scarborough Bluffs. The area of first settlement in Toronto was once the realm of glacial Lake Iroquois which cut in previously deposited clay and till and then covered in sand deposits measuring approximately 3 miles wide with a general northward slop from the level of Lake Ontario approximately 50-60 feet per mile. Evidence of the old beach and a steep bluff or shorecliff is found along the northern border with a height of about 75 feet at Casa Loma. The deep valleys of the Don and Humber Rivers are found to the east and west of the shorecliff having been cut into early Iroquois base levels. Immense sand and gravel barriers were built across these valleys by Lake Iroquois so much so that in Iroquois times Toronto had two harbours instead of one. While the sand and gravel was deposited by Lake Iroquois, the clay was part of the pre-Iroquoian age (Chapman and Putnam 1984).

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1.3.5 Water Resources

The project area is located on the shoreline of Lake Ontario and Cooksville Creek flows through the project area emptying into Lake Ontario. Water is not only a necessity of life but it was also frequently utilized as a mode of travel for everyday life as well as for trade and communication. Watercourses were also used as landmarks by Indigenous groups as well as early settlers and explorers.

The project area is not only within proximity to water today but was also within proximity to a past water source. The project area was once covered by the waters of the Ontario Basin. Remnant shorelines are located over four kilometers inland today. As the Ontario Basin drained to present levels the project area would have become exposed.

The proximity of water to the project area suggests the potential for Indigenous occupation and land use in the area in the past.

2.0 SITE VISIT

A site visit was completed on December 12th, 2023, to obtain a better understanding of the current conditions, the topography, and the surrounding environment of the project area. The entire project area was inspected during ideal conditions. The identified features and current conditions of the property were photographed and are illustrated on Map 10.

Table 3: Site Visit Documentary Record Inventory

Type of Documentation	Description
Field Notes	1 digital file of field notes describing the daily site activities, weather, personal
Maps	1 map showing the project activities
Photographs	46 digital photographs showing the current conditions encountered during the site visit

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3.0 ANALYSIS AND CONCLUSIONS

3.1 STAGE 1 BACKGROUND RESULTS

The project area and its surroundings have a long history starting long before European settlement. The project area has been determined to have archaeological potential for Indigenous resources based on its proximity to water. Additionally, the project area has been determined to have archaeological potential for Euro-Canadian resources based on its proximity to historic a structure, historic road, and previously registered archaeological site.

The project area has undergone modern deep disturbances and as a result, archaeological potential has been removed from these areas. Additionally, there is no or low archaeological potential within the low-lying and wet areas of the Creek.

4.0 RECOMMENDATIONS

Based on the results the following recommendations are made:

1. Archaeological potential remains within the project area. Stage 2 Archaeological Assessment by test pit survey at an interval of 5 meters is recommended for these areas if impacted by the proposed restorations and prior to any ground-altering activities in these areas (see Map 10).

2. Stage 2 Archaeological Assessment is not recommended for areas of no archaeological potential including areas of modern deep disturbance and low-lying and wet areas (see Map 10).

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5.0 ADVICE ON COMPLIANCE WITH LEGISLATION

a. This report is submitted to the Minister of Tourism and Culture as a condition of licensing in accordance with Part VI of the *Ontario Heritage Act,* R.S.O. 1990, c 0.18. The report is reviewed to ensure that it complies with the standards and guidelines that are issued by the Minister, and that the archaeological fieldwork and report recommendations ensure the conservation, protection and preservation of the cultural heritage of Ontario. When all matters relating to archaeological sites within the project area of a development proposal have been addressed to the satisfaction of the Minister of Citizenship and Multiculturalism, a letter will be issued by the ministry stating that there are no further concerns with regard to alterations to archaeological sites by the proposed development.

b. It is an offence under Sections 48 and 69 of the *Ontario Heritage Act* for any party other than a licensed archaeologist to make any alteration to a known archaeological site or to remove any artifact or other physical evidence of past human use or activity from the site, until such time as a licensed archaeologist has completed archaeological fieldwork on the site, submitted a report to the Minister stating that the site has no further cultural heritage value or interest, and the report has been filed in the Ontario Public Register of Archaeological Reports referred to in Section 65.1 of the *Ontario Heritage Act.*

c. Should previously undocumented archaeological resources be discovered, they may be a new archaeological site and therefore subject to Section 48(1) of the *Ontario Heritage Act.* The proponent or person discovering the archaeological resources must cease alteration of the site immediately and engage a licensed consultant archaeologist to carry out archaeological fieldwork, in compliance with Section 48(1) of the *Ontario Heritage Act.*

d. The *Cemeteries Act,* R.S.O. 1990 c. C.4 and the *Funeral, Burial and Cremation Services Act,* 2002, S.O. 2002, c.33 (when proclaimed in force) require that any person discovering human remains must notify the police or coroner and the Registrar of Cemeteries at the Ministry of Consumer Services.

e. Archaeological sites recommended for further archaeological fieldwork or protection remain subject to Section 48 (1) of the *Ontario Heritage Act* and may not be altered, or have artifacts removed from them, except by a person holding an archaeological license.

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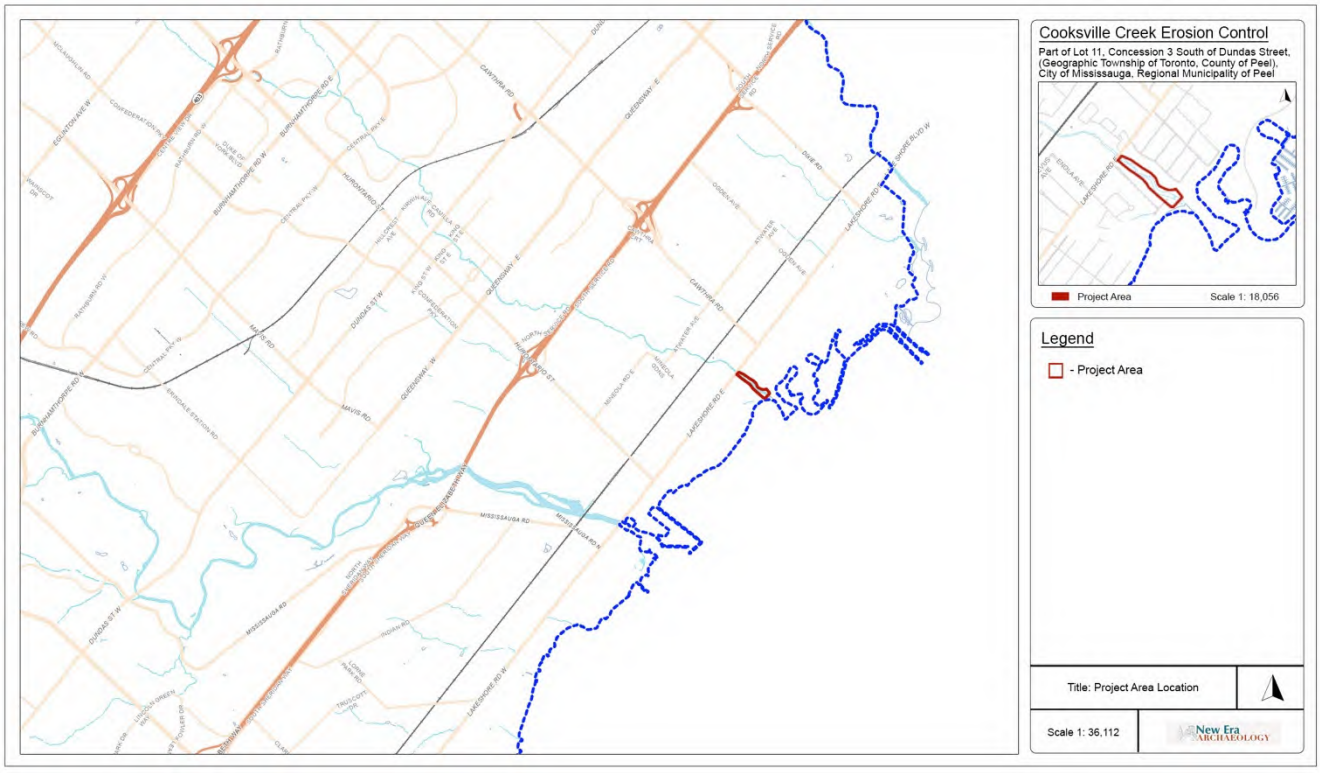
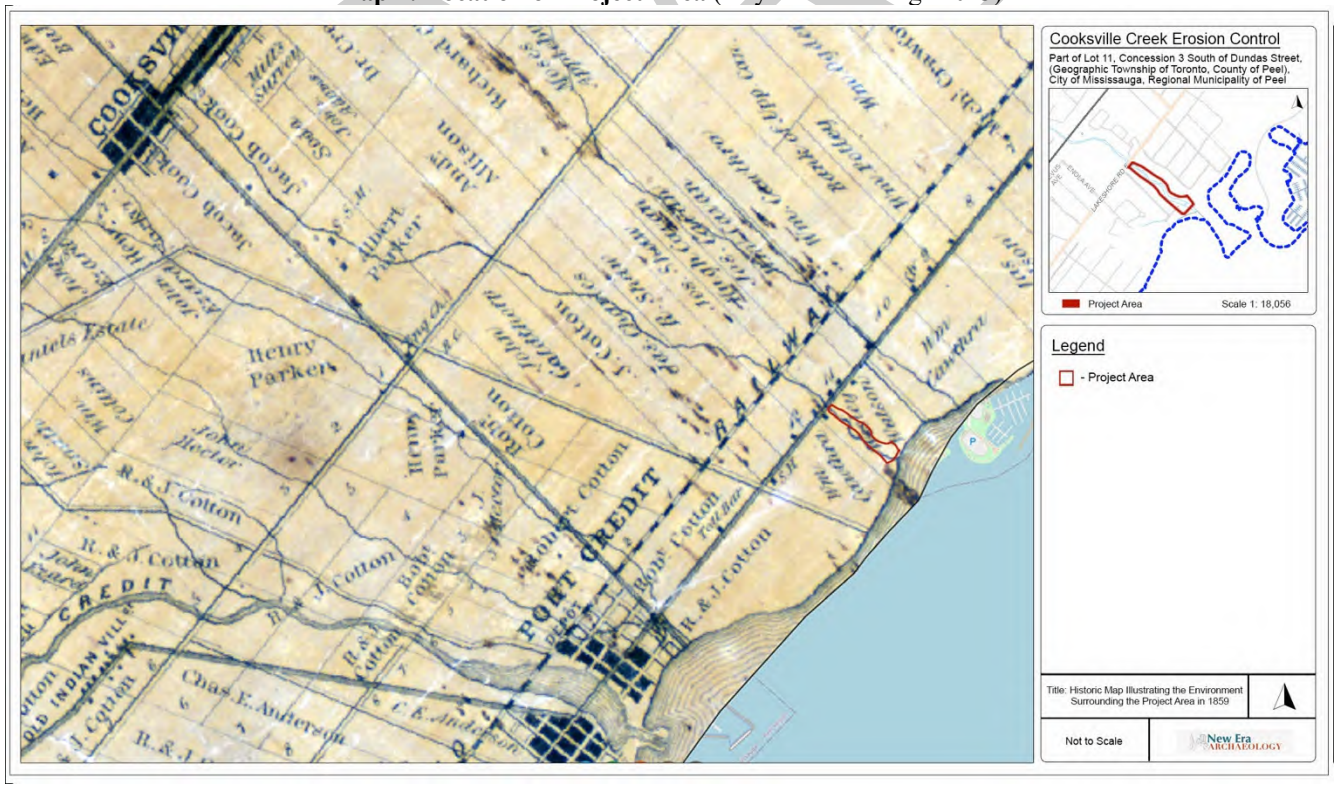
7.0 MAPS



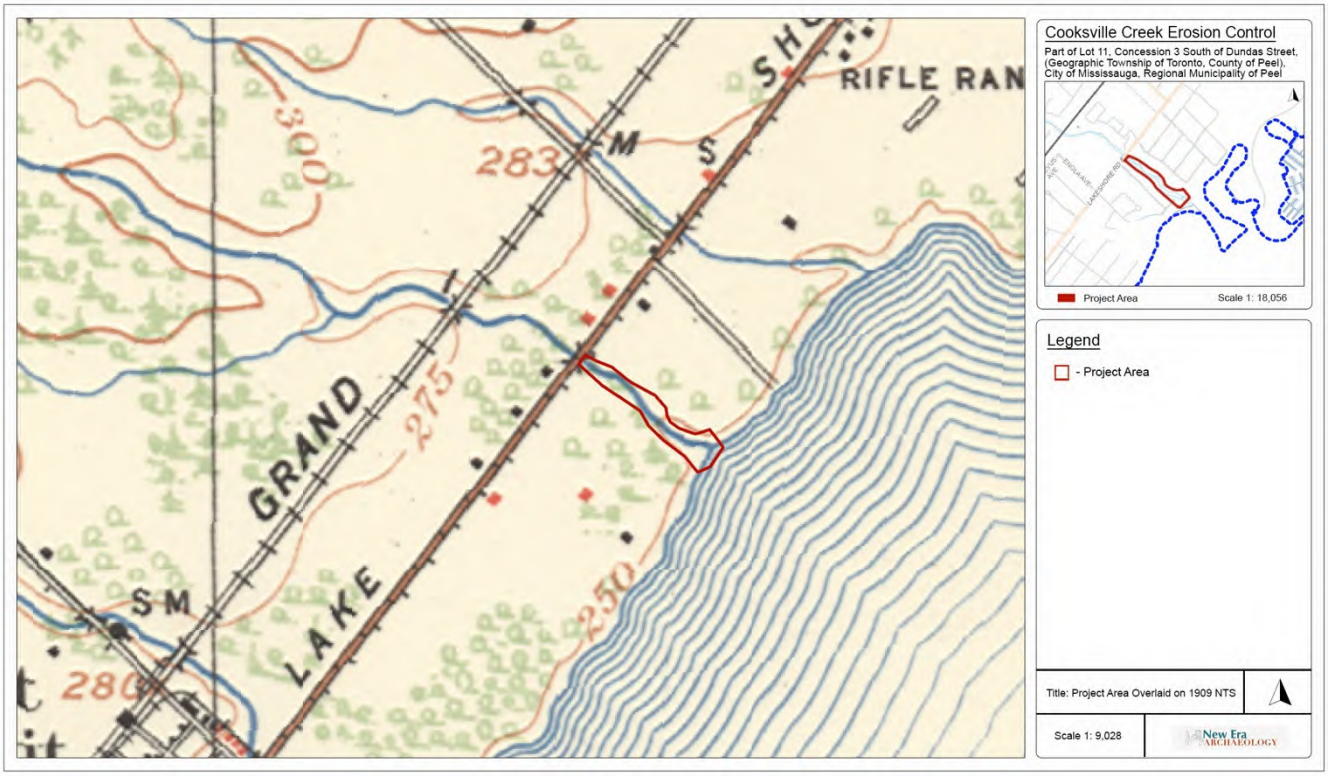
Map 1: Location of Project Area (City of Mississauga 2023)



Map 2: Historic Map Illustrating the Environment Surrounding the Property Area in 1859 (Tremaine 1859)



Map 3: Historic Map Illustrating the Environment Surrounding the Property Area in 1877
(Walker & Miles. 1877)



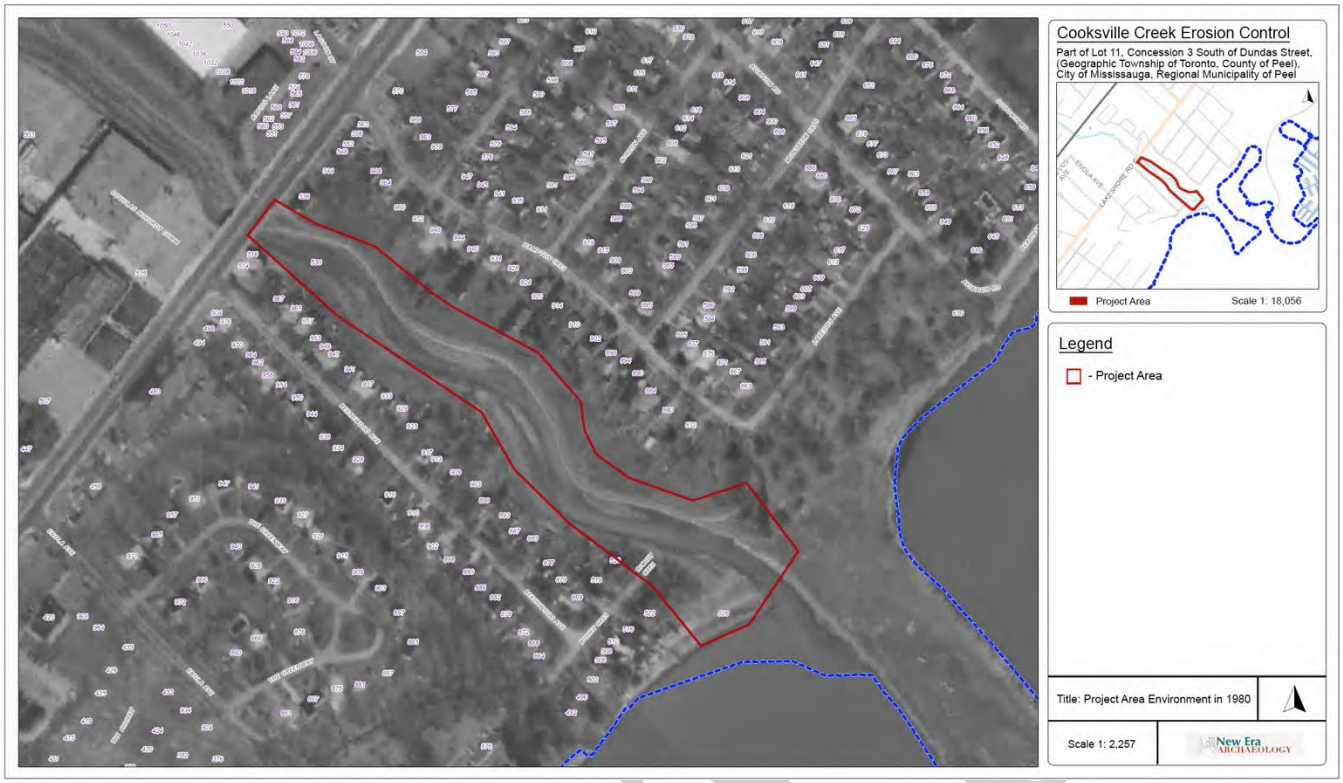
Map 4: Project Area on National Topographic Survey from 1909 (National Resources Canada)



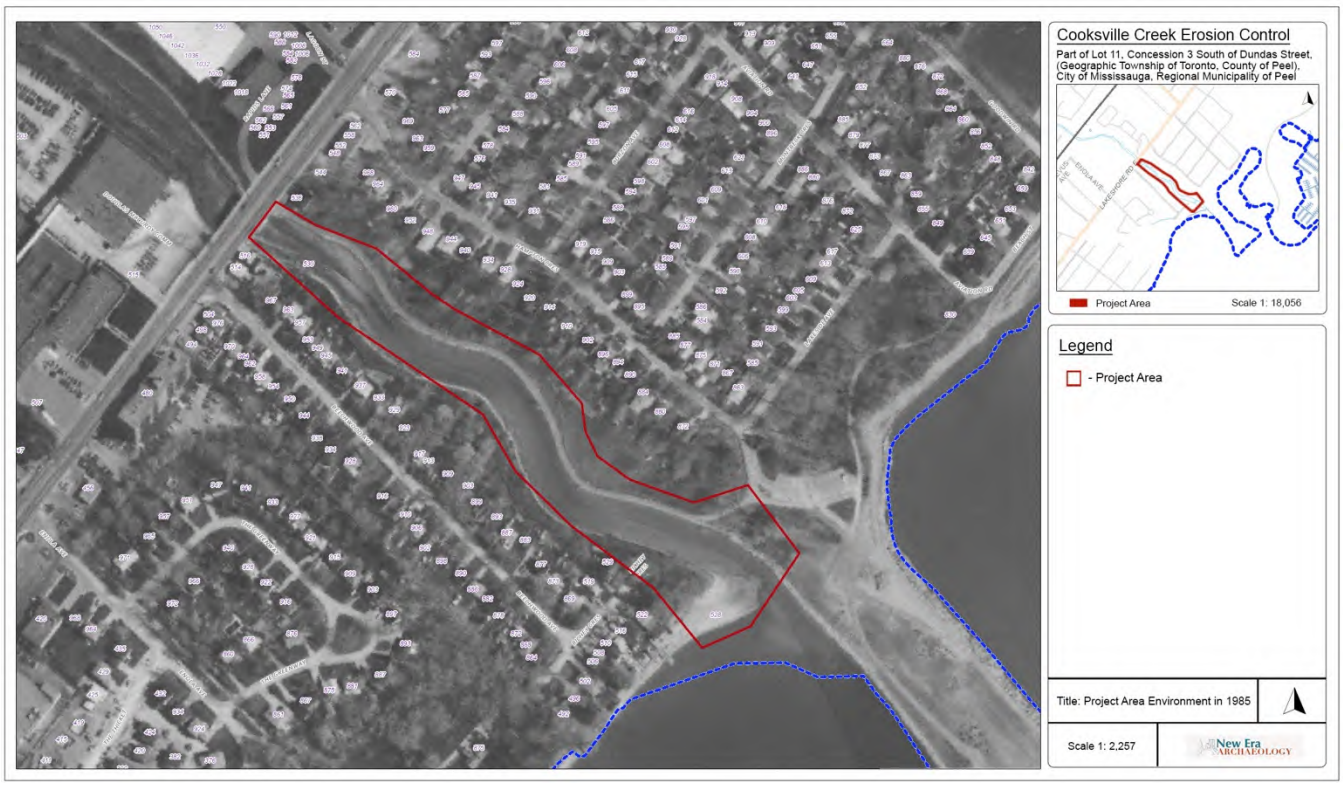
Map 5: Project Area on National Topographic Survey from 1929 (National Resources Canada)



Map 6: Project Area on Historic Aerial from 1954 (City of Mississauga 2023)



Map 7: Project Area on Historic Aerial from 1980 (City of Mississauga 2023)



Map 8: Project Area on Historic Aerial from 1985 (City of Mississauga 2023)



Map 9: Project Area (Provided by Aquafor Beech Ltd.)



Map 10: Stage 1 Archaeological Background Study Results (Base Map: City of Mississauga 2023)



Map 11: Stage 1 Archaeological Background Study Results (Base Map: City of Mississauga 2023)

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8.0 PLATES



Plate 1: Wooded Park Land



Plate 2: Asphalt Pathways and Two Manholes Between Them



Plate 3: Wooded Area Along Lake Ontario

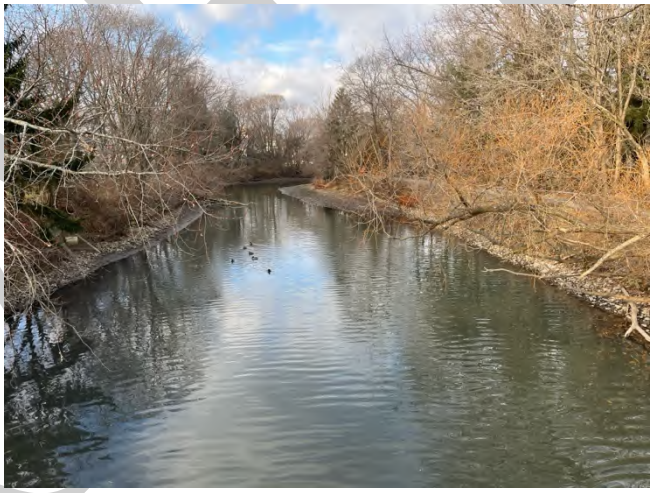

Plate 4: Cooksville Creek



Plate 5: Cooksville Creek Emptying into Lake Ontario



Plate 6: Wooded Area Along the Creek and Manhole



Plate 7: Wooded Area Along the Creek



Plate 8: Wooded Area Along the Creek



Plate 9: Wooded Area and Gibbons Along the Creek



Plate 10: Wooded Area Along the Creek



Plate 11: Asphalt Pathway Surrounded by Mature Trees; Manhole



Plate 12: Sewer Outlets Emptying into Creek



Plate 13: Elevated Pathway Surrounded by Trees and Lawn



Plate 14: Elevated Pathway Surrounded by Trees and Lawn



Plate 15: Asphalt Pathway Surrounded by Mature Trees



Plate 16: Asphalt Pathway Surrounded by Mature Trees



Plate 17: Infrastructure Where Cooksville Creek Passes Under Lakeshore Road East



Plate 18: Cooksville Creek

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From:	amos.r@aquaforbeech.com
To:	"Abby LaForme"; "Fawn Sault"; "Adam LaForme"
Cc:	ursulak.j@aquaforbeech.com; cota.c@aquaforbeech.com; "Greg Frew"
Subject:	RE: Cooksville Creek Erosion Control Project - Schedule B Municipal Class EA
Date:	October 22, 2024 3:42:39 PM
Attachments:	image002.png Cooksville Creek Schedule B Municipal Class EA - Notice of Public Information Centre.pdf

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Dear Mississaugas of the Credit First Nation,

As a follow-up to the Stage 1 Archaeological Assessment, Aquafor and the City of Mississauga have arranged an in-person, Public Information Centre to provide an opportunity to review and comment on the project findings to date. This includes the alternative solutions being considered, the evaluation process, the preliminary preferred solutions, and the next steps of the study.

The details of the Public Information Centre are as follows:

Date:	Tuesday, October 29th, 2024
Time:	Afternoon Session: 3 p.m. – 5 p.m. Evening Session: 6 p.m. – 8 p.m.
Location:	Small Arms Inspection Building 1352 Lakeshore Road East

Additional information is also available from the project website at:

Project Website
Cooksville Creek Erosion Control Project south of Lakeshore Road – City of Mississauga

Thanks very much, and should you have any questions or comments, please feel free to contact the following:

Greg Frew, P.Eng.
Project Manager
City of Mississauga
300 City Centre Dr, Suite 800
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Ltd.
2600 Skymark Avenue, Unit 6-202
Mississauga, ON, L4W 5B2
416.705.23696
Amos.R@aquaforbeech.com

Kind regards,

Rob

Robert Amos, MASc., P.Eng.

Aquafor Beech Ltd.

☎ **416.705.2367**
✉ Amos.R@Aquaforbeech.com
www.aquaforbeech.com



From: amos.r@aquaforbeech.com <amos.r@aquaforbeech.com>
Sent: October 15, 2024 1:40 PM
To: 'Abby LaForme' <Abby.LaForme@mncfn.ca>; 'Fawn Sault' <Fawn.Sault@mncfn.ca>; 'Adam LaForme' <Adam.LaForme@mncfn.ca>
Cc: 'Greg Frew' <Greg.Frew@mississauga.ca>; ursulak.j@aquaforbeech.com; cota.c@aquaforbeech.com
Subject: RE: Cooksville Creek Erosion Control Project - Schedule B Municipal Class EA

Dear Mississaugas of the Credit First Nation,

As a followup to the Notice of Commencement, Aquafor and the City of Mississauga have completed a Stage 1 Archeological Assessment (attached) as part of Schedule B Class Environmental Assessment Study for the **Cooksville Creek Erosion Control Project from Lakeshore Road to Lake Ontario**.

Based upon the Stage 1 recommendations, we're looking to complete a Stage 2 Archeological Assessment in the coming months, and wanted to extend the offer for review and / or Field Liaison Representation.

Please let us know how you would prefer to be involved or provide input through the next phases of the study.

Additional information is also available from the project website at:

> **Project Website**
> Cooksville Creek Erosion Control Project south of Lakeshore Road – City of Mississauga

Thanks very much, and should you have any questions or comments, please feel free to contact the following:

Greg Frew, P.Eng.
Project Manager
City of Mississauga

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Ltd.

300 City Centre Dr, Suite 800
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

2600 Skymark Avenue, Unit 6-202
Mississauga, ON, L4W 5B2
416.705.23696
Amos.R@aquaforbeech.com

Kind regards,

Rob

Robert Amos, MASc., P.Eng.
Aquafor Beech Ltd.

☎ **416.705.2367**
✉ Amos.R@Aquaforbeech.com
www.aquaforbeech.com



From: amos.r@aquaforbeech.com <amos.r@aquaforbeech.com>
Sent: March 14, 2024 12:46 PM
To: Abby.LaForme@mncfn.ca; Fawn.Sault@mncfn.ca
Cc: 'Greg Frew' <Greg.Frew@mississauga.ca>; cota.c@aquaforbeech.com; ursulak.j@aquaforbeech.com
Subject: RE: Cooksville Creek Erosion Control Project - Schedule B Municipal Class EA

Dear Mississaugas of the Credit First Nation,

Aquafor Beech Limited has been retained by the City of Mississauga to undertake a Schedule B Class Environmental Assessment Study for the **Cooksville Creek Erosion Control Project from Lakeshore Road to Lake Ontario**.

This project is being completed to address existing problems and risks along Cooksville Creek and the adjacent Helen Molasy Trail.

In accordance with the environmental assessment process, Aquafor is pleased to share the attached letter and Notice of Commencement. Additional information is also available from the project website at:

Project Website
Cooksville Creek Erosion Control Project south of Lakeshore Road – City of Mississauga

Should you have any questions or comments, please feel free to contact the following:

Greg Frew, P.Eng.
Project Manager
City of Mississauga
300 City Centre Dr, Suite 800
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Ltd.
2600 Skymark Avenue, Unit 6-202
Mississauga, ON, L4W 5B2
416.705.23696
Amos.R@aquaforbeech.com

We very much look forward to working with you throughout the project, and will ensure all documentation is available for your review and input.

Kind regards,

Rob

_____
Robert Amos, MASc., P.Eng.
Aquafor Beech Ltd.

☎ **416.705.2367**
✉ Amos.R@Aquaforbeech.com
www.aquaforbeech.com



City of Mississauga
Notice of Public Information Centre

Municipal Class Environmental Assessment Study:
Cooksville Creek Erosion Control Project – South of Lakeshore Road

What?

The City of Mississauga (the City) is undertaking a Schedule B Municipal Class Environmental Assessment (Class EA) Study for erosion control and restoration of Cooksville Creek south of Lakeshore Road.



Why?

The City recognizes that this section of Cooksville Creek has been impacted by recent storm events and high lake levels and is in need of rehabilitation. Plans will also need to consider the deteriorated condition of the adjacent city trail through Helen Molasy Memorial Park that sits above the east bank of the creek, as well as the neighbouring properties which have experienced ongoing drainage issues.

How?

- The Study has examined this section of Cooksville Creek and Helen Molasy Trail and associated natural resources to identify existing problems, potential risks, and opportunities for restoration and drainage improvements.
- Through the Class EA process, various alternative solutions are being developed and evaluated by the Study Team and will be refined through public and agency consultation (see below). The Study Team will then select a preferred alternative and proceed with design of the recommended works.
- A Project File documenting the planning process will be available for public review at the end of the Study.

Public Consultation

- Consultation is an essential part of the EA process. The City would like anyone with an interest in the Study to have an opportunity to provide input and help inform the decision-making process.
- An in-person, Public Information Centre has been arranged to allow local residents and interested members of the public an opportunity to review and comment on the project findings to date, the alternative solutions being considered, the evaluation process, the preliminary preferred solution, and the next steps:

Date:	Tuesday, October 29th, 2024
Time:	afternoon: 3pm – 5pm evening: 6pm - 8pm
Location:	Small Arms Inspection Building 1352 Lakeshore Road East

- Additional project information will be made available on the City's project website:
  https://www.mississauga.ca/projects-and-strategies/environmental-assessments/cooksville-creek-erosion-control-south-of-lakeshore-road/

City of Mississauga
Notice of Public Information Centre

Municipal Class Environmental Assessment Study:
Cooksville Creek Erosion Control Project – South of Lakeshore Road

- Feedback is encouraged and comments are requested by **November 26th, 2024**. A comment form is available on the project website. Input gathered through the public consultation will be used to support the EA study.
- If you have comments or questions, require further information or would like to be added to the Study mailing list to receive future notifications, please contact:

Greg Frew, P.Eng.
City Project Manager
City of Mississauga
300 City Centre Drive, Suite 800
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Ltd.
2600 Skymark Ave.
Mississauga, ON L4W 5B2
(416) 705-2367
Amos.R@aquaforbeech.com

This notice signals the Notice of Public Information Centre for this Municipal Class Environmental Assessment, a study which will define the problem, identify/evaluate alternative solutions, and determine a preferred design in consultation with regulatory agencies and the public. The study is being undertaken in accordance with the planning and design process for Schedule 'B' projects, as outlined in the "Municipal Class Environmental Assessment" document (as amended in 2023), which is approved under the Ontario Environmental Assessment Act.

Personal information is collected under the authority of the Environmental Assessment Act and will be used in the assessment process. With exception of personal information, all comments shall become part of the public records. Questions about this collection should be directed to the Project Manager listed above.

This notice first issued on **October 21st, 2024**.

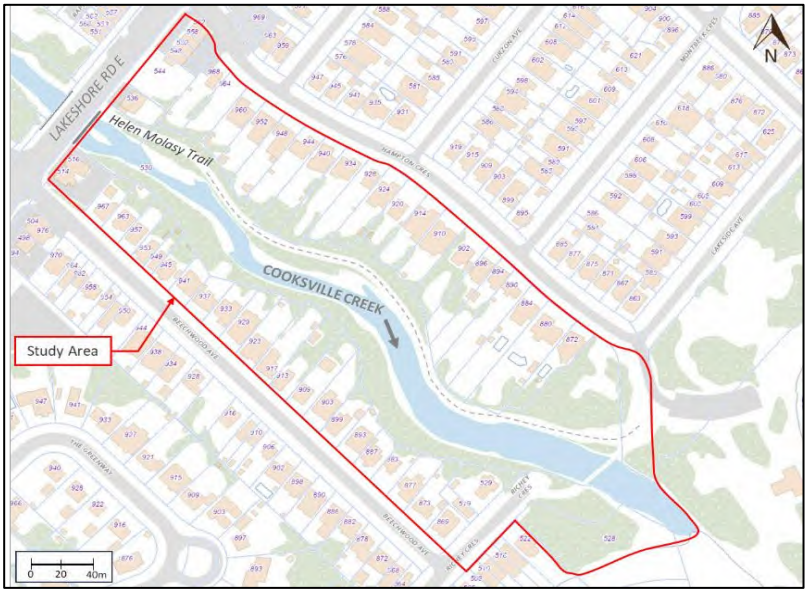
City of Mississauga
Notice of Completion

Municipal Class Environmental Assessment Study:
Cooksville Creek Erosion Control Project – South of Lakeshore Road

Project Background

The City of Mississauga (the City) has completed a Schedule B Municipal Class Environmental Assessment Study for erosion control and restoration of Cooksville Creek south of Lakeshore Road.

The City recognizes that this section of Cooksville Creek has been impacted by recent storm events and high lake levels and is in need of rehabilitation. Plans also considered the deteriorated condition of the adjacent city trail through Helen Molasy Memorial Park that sits above the east bank of the creek, as well as the neighbouring properties which experience ongoing drainage issues.



Study Completion

The Study has examined this section of Cooksville Creek and Helen Molasy Trail along with the associated natural resources to identify existing problems, potential risks, and opportunities for watercourse restoration and drainage improvements.

Through the Class EA process, various alternative solutions were developed and evaluated by the Study Team with input through public and agency consultation. The preferred watercourse erosion control strategy includes extended channel restoration works through the use of vegetated buttress bank protection treatment with embedded armourstone retaining walls. The preferred drainage restoration strategy includes the hybrid drainage solution involving the replacement and enhancement of the drainage infrastructure associated with the Helen Molasy Trail.

A Project File Report (PFR) documenting the planning process has been prepared and will be available for a comment period between **February 24th 2025** and **March 28th 2025** on the City's project webpage:

https://www.mississauga.ca/projects-and-strategies/environmental-assessments/cooksville-creek-erosion-control-south-of-lakeshore-road/

Should a member of the public request a hard copy of the report, the City will make arrangements for delivery of the PFR. If you have any questions or comments regarding the study, please contact the Project Managers listed below by March 28th 2025:

Greg Frew, P.Eng.
City Project Manager
City of Mississauga
300 City Centre Drive
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Limited
2600 Skymark Avenue
Mississauga, ON L4W 5B2
(416) 705-2367
Amos.R@aquaforbeech.com

City of Mississauga
Notice of Completion

Municipal Class Environmental Assessment Study:
Cooksville Creek Erosion Control Project – South of Lakeshore Road

In addition, a Section 16 Order request may be made to the Ministry of the Environment, Conservation and Parks (MECP or Ministry) for an order requiring a higher level of study (i.e., requiring an individual/comprehensive Environmental Assessment approval before being able to proceed), or that conditions be imposed (e.g., require further studies), only on the grounds that the requested order may prevent, mitigate or remedy adverse impacts on constitutionally protected Aboriginal and treaty rights. Requests on other grounds will not be considered. Requests are to include the requester contact information and full name.

The Section 16 Order request should be sent in writing or by email by March 28th 2025 to both contacts below with a copy to Greg Frew at the City.

Minister of the Environment, Conservation and Parks
Ministry of Environment, Conservation and Parks
777 Bay Street, 5th Floor
Toronto, Ontario M7A 2J3
minister.mecp@ontario.ca

Director, Environmental Assessment Branch
Ministry of Environment, Conservation and Parks
135 St. Clair Avenue West, 1st Floor
Toronto, Ontario M4V 1P5
EABDirector@ontario.ca

This notice signals the Notice of Completion for this Municipal Class Environmental Assessment, a study which defines the problem, identifies/evaluates alternative solutions, and recommends a preferred design in consultation with regulatory agencies and the public. The study has been undertaken in accordance with the planning and design process for Schedule 'B' projects, as outlined in the "Municipal Class Environmental Assessment" document (as amended in 2023), which is approved under the Ontario Environmental Assessment Act.

Personal information is collected under the authority of the Environmental Assessment Act and will be used in the assessment process. With exception of personal information, all comments shall become part of the public records.

This notice issued on **February 24th, 2025**.

Six Nations of the Grand River
Consultation - Communications Log

Date (dd/mm/yy)	From	To	Medium (e.g., email, letter, call)	Communication Description - Nature of Concern(s) or Interest(s)	Response/Follow Up
14-03-2024	**Greg Frew** Project Manager City of Mississauga **Rob Amos** Consultant Project Manager Aquafor Beech Limited	Six Nations of the Grand River	Email	Notice of Study Commencement – Introduction to the Project	**Follow-up:** City of Mississauga to provide an invitation to an open house to discuss the EA.
15-10-2024	**Rob Amos** Consultant Project Manager Aquafor Beech Limited	Six Nations of the Grand River	Email	Sharing of Stage 1 Archeological Assessment Results and Offer for Representation in Stage 2 Archeological Assessment	**Follow-up:** If Field Representation is requested for Stage 2 Archaeological Assessment, this request will be accommodated accordingly.
22-10-2024	**Greg Frew** Project Manager City of Mississauga **Rob Amos** Consultant Project Manager Aquafor Beech Limited	Six Nations of the Grand River	Email	Sharing of Public Information Centre details, and invitation to participate	**Follow-up:** First Nation to Attend Public Information Centre if desired.
24-02-2025	**Greg Frew** Project Manager City of Mississauga **Rob Amos** Consultant Project Manager Aquafor Beech Limited	Six Nations of the Grand River	Email	Notice of Study Completion.	**Follow-up:** First Nation to provide comments between February 24th 2025 and March 28th 2025 if desired.

From:	amos.r@aquaforbeech.com
To:	rvanstone@sixnations.ca
Cc:	"Greg Frew"; ursulak.j@aquaforbeech.com; cota.c@aquaforbeech.com
Subject:	FW: Cooksville Creek Erosion Control Project - Schedule B Municipal Class EA
Date:	March 14, 2024 12:48:37 PM
Attachments:	image002.png Cooksville Creek - Six Nations of the Grand River.pdf

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Dear Six Nations of the Grand River,

Aquafor Beech Limited has been retained by the City of Mississauga to undertake a Schedule B Class Environmental Assessment Study for the **Cooksville Creek Erosion Control Project from Lakeshore Road to Lake Ontario**.

This project is being completed to address existing problems and risks along Cooksville Creek and the adjacent Helen Molasy Trail.

In accordance with the environmental assessment process, Aquafor is pleased to share the attached letter and Notice of Commencement. Additional information is also available from the project website at:

Project Website
Cooksville Creek Erosion Control Project south of Lakeshore Road – City of Mississauga

Should you have any questions or comments, please feel free to contact the following:

Greg Frew, P.Eng.
Project Manager
City of Mississauga
300 City Centre Dr, Suite 800
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Ltd.
2600 Skymark Avenue, Unit 6-202
Mississauga, ON, L4W 5B2
416.705.23696
Amos.R@aquaforbeech.com

We very much look forward to working with you throughout the project, and will ensure all documentation is available for your review and input.

Kind regards,

Rob

Robert Amos, MASc., P.Eng.
Aquafor Beech Ltd.

☎ **416.705.2367**

✉ Amos.R@Aquaforbeech.com
www.aquaforbeech.com



March 14th, 2024

Six Nations of the Grand River
Lands & Resources Department
2498 Chiefswood Road
P.O. Box 5000
Oshweken, ON N0A 1M0

Attention: Robbin Vanstone
Re: Environmental Investigations for Cooksville Creek

Dear Six Nations of the Grand River,

The City of Mississauga is undertaking a Schedule B Class Environmental Assessment (Class EA) Study for the Cooksville Creek Erosion Control Project South of Lakeshore Road.

The City of Mississauga recognizes that this section of Cooksville Creek has been impacted by recent storm events and high lake levels and is in need of rehabilitation. Plans will also need to consider the deteriorated condition of the adjacent city trail through Helen Molasy Memorial Park that sits above the east bank of the creek, as well as the neighbouring properties which have experienced ongoing drainage issues. The study will investigate, analyze, and assess the natural environment of the study area to identify existing erosion problems, potential future risks, and opportunities for restoration and environmental enhancement. The extents of the study area are illustrated on the following page.

A Stage 1 archaeologic investigation is also required as part of the EA. Our archaeological consultants have completed the Stage 1 archaeological investigation.

Your input is important. If you have any questions or comments, or would like to receive copies of the Stage 1 Archaeologic study, please contact myself at 905-615-3200 ext. 3362, or Greg.Frew@mississauga.ca.

Sincerely,

Greg Frew

Project Manager
City of Mississauga



Figure 1. Cooksville Creek Study Area.

CITY OF MISSISSAUGA – NOTICE OF STUDY COMMENCEMENT

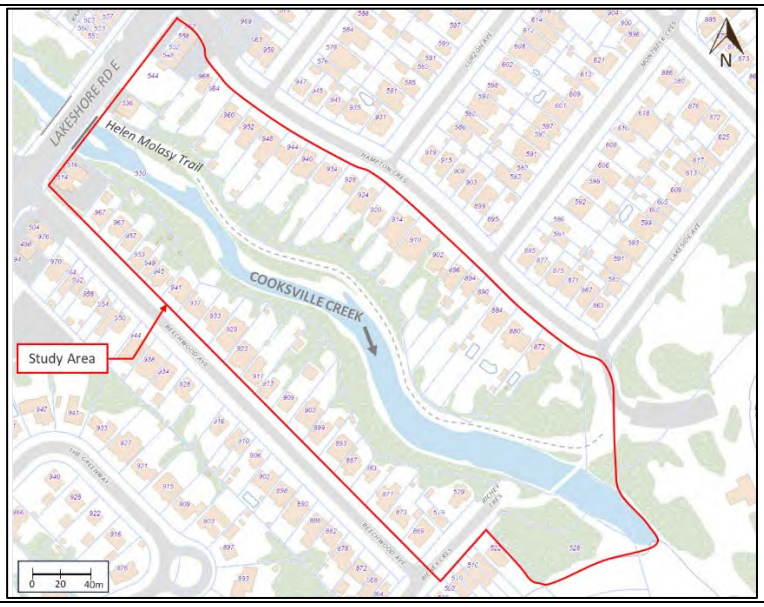
Municipal Class Environmental Assessment Study: Cooksville Creek South of Lakeshore Road

WHAT?

- The City of Mississauga is undertaking a Municipal Class Environmental Assessment (Class EA) Study for the Cooksville Creek Erosion Control Project South of Lakeshore Road.

WHY?

- The City of Mississauga recognizes that this section of Cooksville Creek has been impacted by recent storm events and high lake levels and is in need of rehabilitation. Plans will also need to consider the deteriorated condition of the adjacent city trail through Helen Molasy Memorial Park that sits above the east bank of the creek, as well as the neighbouring properties which have experienced ongoing drainage issues.



HOW?

- The study will examine this section of the Cooksville Creek and Helen Molasy Trail to identify existing problems, potential risks, and opportunities for restoration and drainage improvements.
- Through the Class EA process, the Study Team will develop and evaluate multiple alternative solutions and refine the options through public and agency consultation (see below). The Study Team will then select a Preferred Alternative.
- At the end of the study, a Project File, documenting the study process will be available for public review.
- Following completion of the Class EA Study, designs will be developed and implemented in accordance with study recommendations.

GET INVOLVED!

- Consultation is an important part of the Class EA process. Public input and comment are invited for incorporation into the planning and design of this project.
- A Public Information Centre (PIC) will be held to present the study findings, to consider alternative solutions, and to answer any questions you may have. Details regarding the PIC will be advertised publicly as the study progresses.
- Project information will be made available on the City's project website: https://www.mississauga.ca/projects-and-strategies/environmental-assessments/cooksville-creek-erosion-control-south-of-lakeshore-road/
- If you have any questions of comments regarding the study, or wish to be added or removed from the study mailing list, please contact:

Greg Frew, P.Eng.
Project Manager
City of Mississauga
300 City Centre Dr, Suite 800
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Ltd.
2600 Skymark Avenue, Unit 6-202
Mississauga, ON L4W 5B2
(905) 629-0099, ext. 294
Amos.R@aquaforbeech.com

This notice signals the commencement of the Class EA, a study which will define the problem, identify/evaluate alternative solutions, and determine a preferred design in consultation with regulatory agencies and the public. The study is being undertaken in accordance with the planning and design process for Schedule 'B' projects, as outlined in the "*Municipal Class Environmental Assessment*" document (October 2000, amended in 2015), which is approved under the Ontario *Environmental Assessment Act*.

Personal information is collected under the authority of the Environmental Assessment Act and will be used in the assessment process. With exception of personal information, all comments shall become part of the public records. Questions about this collection should be directed to the Project Manager listed above.

This notice was first issued February, 2024.

From:	amos.r@aquaforbeech.com
To:	"Robin Vanstone"
Cc:	"Greg Frew"; ursulak.j@aquaforbeech.com; cota.c@aquaforbeech.com
Subject:	RE: Cooksville Creek Erosion Control Project - Schedule B Municipal Class EA
Date:	October 15, 2024 1:34:48 PM
Attachments:	image002.png Cooksville Creek Erosion Control EA, Mississauga Stage 1 Archaeology Draft Report.pdf

Dear Six Nations of the Grand River,

As a followup to the Notice of Commencement, Aquafor and the City of Mississauga have completed a Stage 1 Archeological Assessment (attached) as part of Schedule B Class Environmental Assessment Study for the **Cooksville Creek Erosion Control Project from Lakeshore Road to Lake Ontario**.

Based upon the Stage 1 recommendations, we're looking to complete a Stage 2 Archeological Assessment in the coming months, and wanted to extend the offer for review and / or Field Liaison Representation.

Please let us know how you would prefer to be involved or provide input through the next phases of the study.

Additional information is also available from the project website at:

Project Website
Cooksville Creek Erosion Control Project south of Lakeshore Road – City of Mississauga

Thanks very much, and should you have any questions or comments, please feel free to contact the following:

Greg Frew, P.Eng.
Project Manager
City of Mississauga
300 City Centre Dr, Suite 800
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Ltd.
2600 Skymark Avenue, Unit 6-202
Mississauga, ON, L4W 5B2
416.705.23696
Amos.R@aquaforbeech.com

Kind regards,

Rob

Robert Amos, MASc., P.Eng.
Aquafor Beech Ltd.

☎ **416.705.2367**
✉ Amos.R@Aquaforbeech.com
www.aquaforbeech.com

From: amos.r@aquaforbeech.com <amos.r@aquaforbeech.com>
Sent: March 14, 2024 12:49 PM
To: rvanstone@sixnations.ca
Cc: 'Greg Frew' <Greg.Frew@mississauga.ca>; ursulak.j@aquaforbeech.com; cota.c@aquaforbeech.com
Subject: FW: Cooksville Creek Erosion Control Project - Schedule B Municipal Class EA

Dear Six Nations of the Grand River,

Aquafor Beech Limited has been retained by the City of Mississauga to undertake a Schedule B Class Environmental Assessment Study for the **Cooksville Creek Erosion Control Project from Lakeshore Road to Lake Ontario**.

This project is being completed to address existing problems and risks along Cooksville Creek and the adjacent Helen Molasy Trail.

In accordance with the environmental assessment process, Aquafor is pleased to share the attached letter and Notice of Commencement. Additional information is also available from the project website at:

> **Project Website**
> Cooksville Creek Erosion Control Project south of Lakeshore Road – City of Mississauga

Should you have any questions or comments, please feel free to contact the following:

Greg Frew, P.Eng.
Project Manager
City of Mississauga
300 City Centre Dr, Suite 800
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Ltd.
2600 Skymark Avenue, Unit 6-202
Mississauga, ON, L4W 5B2
416.705.23696
Amos.R@aquaforbeech.com

We very much look forward to working with you throughout the project, and will ensure all

documentation is available for your review and input.

Kind regards,

Rob

_____
Robert Amos, MASc., P.Eng.
Aquafor Beech Ltd.

☎ **416.705.2367**
✉ Amos.R@Aquaforbeech.com
www.aquaforbeech.com



Stage 1 Archaeological Background Study

Original Report

2023

DRAFT

Cooksville Creek Erosion Control
Part of Lot 11, Concession 3 South of Dundas Street,
(Former Township of Toronto, County of Peel),
City of Mississauga, Regional Municipality of Peel

Prepared For
Aquafor Beech Limited
Mississagua, Ontario

Project Information
Archaeological License: P1024 (Sarah MacKinnon MSc.)
MTCS PIF#: P1024-0311-2023
Corporate File #: 221-2023
Development Project Designation #: N/A

December 30th, 2023

New Era ARCHAEOLOGY
neweraarchaeology.ca
contact@neweraarchaeology.ca

EXECUTIVE SUMMARY

The City of Mississauga is addressing erosion along part of Cooksville Creek and as part of the processes New Era Archaeology Inc. was retained by Aquafor Beech Ltd. to complete a Stage 1 Archaeological Background Study and was given permission to access the project area to conduct all required archaeological fieldwork activities. This report describes the Stage 1 Archaeological Background Study for the Cooksville Creek Erosion Control within, Part of Lot 11, Concession 3 South of Dundas Street, (Former Township of Toronto, County of Peel), City of Mississauga, Regional Municipality of Peel. The study was conducted under Professional Archaeological License P1024 issued by the Minister of Citizenship and Multiculturalism (Ontario) to Sarah MacKinnon. The Stage 1 Archaeological Background Study was undertaken under the Class Environmental Assessment (1990). This report confirms that all the work conducted as part of this assessment conforms to the *Standards and Guidelines for Consultant Archaeologists* (MCM 2011) and the *Ontario Heritage Act* (MCL 2005).

The objectives of the Stage 1 Background Study are to determine if the project area has the potential to contain archaeological resources and determine if any past use activities within the project area have removed areas of potential. The *Checklist for Determining Archaeological Potential* and the 2011 *Standards and Guidelines for Consultant Archaeologists* (MCM 2011) published by the Ontario Ministry of Citizenship and Multiculturalism (MCM 2011) outlines features and the buffers around these features within which there is potential for archaeological resources. There are two groups of features, one for Indigenous (pre-contact) potential and one for Euro-Canadian (post-contact) archaeological potential. The main feature, which indicates potential for Indigenous archaeological resources, is the proximity to a potable water source. Additional features include topography, soil type and proximity to previously identified archaeological sites. Historic potential is based on proximity to historic features such as structures, roads, railways, settlements and previously identified archaeological sites.

The Stage 1 Archaeological Background Study involved the review of historical records, historic maps, current aerials, and project area inspection to confirm the current conditions of the project area. Both historic and current resources are consulted to identify areas of archaeological potential and activities conducted within the project area, which have removed potential. This information is used to determine if the project area has archaeological potential, note areas of no potential, and recommend appropriate strategies for Stage 2 for areas of archaeological potential. Prior to the site visit, it was determined that the project area has potential for both Indigenous (pre-contact) and Euro-Canadian (post-contact) archaeological resources and that past activities resulting in deep disturbance have removed potential within the project area. The site visit was completed on December 12th, 2023, to confirm the current conditions of the project area.

As a result of the Stage 1 Archaeological Background Study, it was determined that the project area has potential for both pre-contact and post-contact archaeological resources. It has also been determined that a portion of the project area has undergone significant disturbances relating to previous construction activities. Archaeological potential remains for portions of the project area, consequently, Stage 2 Archaeological Assessment by test pit survey is recommended.

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TABLE OF CONTENTS

EXECUTIVE SUMMARY **2**

1.0 PROJECT CONTEXT **6**

1.1 DEVELOPMENT CONTEXT 6

1.2 HISTORICAL CONTEXT 6

1.2.1 Ontario Prehistory *6*

1.2.2 General Indigenous Overview *9*

1.2.3 Peel County Historic Overview *11*

1.2.4 Township of Toronto *13*

1.2.5 Historic Mapping *14*

1.3 ARCHAEOLOGICAL CONTEXT 15

1.3.1 Previously Registered Sites *15*

1.3.3 Current Land Use and Field Conditions *15*

1.3.4 Physiographic Region *15*

1.3.5 Water Resources *17*

2.0 SITE VISIT **17**

3.0 ANALYSIS AND CONCLUSIONS **18**

3.1 STAGE 1 BACKGROUND RESULTS 18

4.0 RECOMMENDATIONS **18**

5.0 ADVICE ON COMPLIANCE WITH LEGISLATION **19**

6.0 BIBLIOGRAPHY **20**

7.0 MAPS **21**

8.0 PLATES **27**

DRAFT

LIST OF MAPS

Map 1: Location of Project Area 21
Map 2: Historic Map Illustrating the Environment Surrounding the Property Area in 1859 21
Map 3: Historic Map Illustrating the Environment Surrounding the Property Area in 1877 22
Map 4: Project Area on National Topographic Survey from 1909 22
Map 5: Project Area on National Topographic Survey from 1929 23
Map 6: Project Area on Historic Aerial from 1954 23
Map 7: Project Area on Historic Aerial from 1980 24
Map 8: Project Area on Historic Aerial from 1985 24
Map 9: Project Area 25
Map 10: Stage 1 Archaeological Background Study Results 25
Map 11: Stage 1 Archaeological Background Study Results 26

LIST OF TABLES

Table 1: General Indigenous History Throughout Ontario 6
Table 2: Site Visit Documentary Record Inventory 17

LIST OF PLATES

Plate 1: Wooded Park Land 27
Plate 2: Asphalt Pathways and Two Manholes Between Them 27
Plate 3: Wooded Area Along Lake Ontario 27
Plate 4: Cooksville Creek 27
Plate 5: Cooksville Creek Emptying into Lake Ontario 27
Plate 6: Wooded Area Along the Creek and Manhole 27
Plate 7: Wooded Area Along the Creek 28
Plate 8: Wooded Area Along the Creek 28
Plate 9: Wooded Area and Gibbons Along the Creek 28
Plate 10: Wooded Area Along the Creek 28
Plate 11: Asphalt Pathway Surrounded by Mature Trees; Manhole 28
Plate 12: Sewer Outlets Emptying into Creek 28
Plate 13: Elevated Pathway Surrounded by Trees and Lawn 29
Plate 14: Elevated Pathway Surrounded by Trees and Lawn 29
Plate 15: Asphalt Pathway Surrounded by Mature Trees 29
Plate 16: Asphalt Pathway Surrounded by Mature Trees 29
Plate 17: Infrastructure Where Cooksville Creek Passes Under Lakeshore Road East 29
Plate 18: Cooksville Creek 29

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PROJECT PERSONAL

LICENSED ARCHAEOLOGIST:
Sarah MacKinnon MSc. (P1024)

FIELD DIRECTOR:
Sarah MacKinnon MSc. (P1024)

REPORT PREPARATION:
Kayleigh MacKinnon MSc. (P384)

REPORT MAPPING:
Kayleigh MacKinnon MSc. (P384)

DRAFT

1.0 PROJECT CONTEXT

1.1 DEVELOPMENT CONTEXT

The City of Mississauga is addressing erosion along part of Cooksville Creek and as part of the processes New Era Archaeology Inc. was retained by Aquafor Beech Ltd. to complete a Stage 1 Archaeological Background Study and was given permission to access the project area to conduct all required archaeological fieldwork activities. This report describes the Stage 1 Archaeological Background Study for the Cooksville Creek Erosion Control within, Part of Lot 11, Concession 3 South of Dundas Street, (Former Township of Toronto, County of Peel), City of Mississauga, Regional Municipality of Peel. The study was conducted under Professional Archaeological License P1024 issued by the Minister of Citizenship and Multiculturalism (Ontario) to Sarah MacKinnon. The Stage 1 Archaeological Background Study was undertaken under the Class Environmental Assessment (1990). This report confirms that all the work conducted as part of this assessment conforms to the *Standards and Guidelines for Consultant Archaeologists* (MCM 2011) and the *Ontario Heritage Act* (MCL 2005).

1.2 HISTORICAL CONTEXT

1.2.1 Ontario Prehistory

Table 1: General Indigenous History Throughout Ontario

Period	Date Range	Cultural Group	Diagnostic Material	Period Details
Paleo-Indian – ca. 11,000-7,500 BC				
Early	ca. 11,000-8,500 BC	Clovis, Plano	Fluted projectile points	The continental glacier covering Ontario continued to recede north exposing more habitable land for flora and fauna attracting the nomadic hunters from the south-west. These hunter-gatherers set up sites along shorelines, with fish a main dietary staple and would periodically gather into larger groups typically during the summer months when food was more abundant. The Clovis culture remained in Southern Ontario where the Plano culture moved into Northern Ontario
Late	ca. 8,500-7,500 BC		Plano, Holxombe, Hi-Lo projectile points	
Archaic – ca. 7,800-1,000 BC				
Early	ca. 7,800-6,000 BC	Shield Archaic, Laurentian Archaic	Bifurcate, nettling projectile points	Small nomadic hunter-gatherer bands slowly transition to small territorial camps. There is a continuation of gathering into larger groups in the summer and dispersing into smaller groups over the winter. Dependence on hunting meant that great distances were often covered throughout the year. There is an increase in the use of localized material and the re-purposing of stone tools. Local and long-distance trade networks appear leading to an influx of exotic material and goods, including natural copper and conch shells, often used as grave offerings. Trading often occurred in the summer months when groups came together at the mouths of rivers to take advantage of the spawning fish. The open water also allowed for easier travel over longer distances.
Middle	ca. 6,000-2,000 BC		Brewerton, Stanly, Side-notched projectile points	
Late	ca. 2,500-1000 BC		Lamoka, Adder Orchard, Genesee, Lamoka, Innes, Crawford Knoll, Innes, Hind projectile points	

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				The bow and arrow was adopted towards the end of the period, which was already in use on the east coast. The Plano cultural group are the ancestors of the Shield Archaic and the Clovis are ancestors of the Laurentian Archaic.
Woodland – ca. 1,000 BC – AD 1600				
Early	ca. 1000-400 BC	Meadowood, Middlesex	Birdstones, Cache blades, Kramer, Meadowood projectile points	Hunter-gatherer groups continue to come together in the warmer months and disperse in the fall occupying the margins of Southern Ontario. Both large and small campsites have been identified. The same trade networks are maintained. One distinguishing characteristic of this period is the introduction of pottery. Burial ceremonialism is also practiced. Late Archaic ancestors. The Meadowood culture is changed or absorbed by Point Peninsula.
Middle	ca. 400 BC - AD 700	Point Peninsula, Saugeen	Vanport, Snyder, Saugeen projectile points	Hunter-gatherers, but evidence of increased sedentism and seasonal site reuse and emergence of horticulture. Diets expanded to include the collection of wild fruits and wild rice. More intricate burial ceremonialism adopted from Hopewell culture to the south, as a result of trade networks, including the use of burial mounds. More decorative pottery techniques also appear including stamped and scalloped techniques. Items from the Ohio Valley also start to appear for the first time including stone platform pipes, copper ear spools and copper panpipes. Point Peninsula sites in the Toronto, Quebec and New York areas. Saugeen sites found in the area between Lake Huron and Lake Erie west of Toronto.
Transitional	ca. AD 600 - 1000	Princess Point, Laurel	Princess Point pottery, Triangular projectile points	Princess Point sites remain smaller in size located along the north shore of Lake Erie and the west end of Lake Ontario. They are the first to adapt corn in Ontario, which spread northeast from Mexico. Princess Point pottery decorative techniques include cord-wrapped stick and punctuates. The Shield Archaic are ancestors of the Laurel culture who occupied Northern Ontario, Western Quebec and areas to the west and received their pottery knowledge from Point Peninsula and Saugeen cultures. The Laurel also created some of the largest burial mounds.
Late - Early	ca. AD 900 - 1300	Glen Meyer, Pickering	Glen Meyer Tanged-Triangular projectile point	The Pickering culture developed out of the Point Peninsula culture and occupied an area between Lake Ontario and Georgian Bay to Lake Nipissing. The Glen Meyer culture developed out of the Princess Point culture and occupied southwestern Ontario between Long Point and Lake Huron. Small single-family houses change to larger multi-family longhouses within small village sites with the appearance of palisades at some. There is an increase in corn agriculture. Pottery vessels are thinner walled with improved manufacturing. There is a switch in burial customs to the use of burial pits, a precursor to large ossuaries. Towards the end of the period pipes become more common.
Late - Middle	ca. AD 1300 - 1400	Uren, Middleport, Lalonde	Middleport projectile points	Increase in village size and reliance on agriculture including corn, beans and squash. Farming provided increased food resources with better nutrition allowing populations to grow. Decrease in decorated pottery vessels and an increase in decorative pipes including effigy pipes. Some sites still include a palisade.

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Late - Late	ca. AD 1400 - 1600	Ontario Iroquoian	Nanticoke, Daniels Triangular projectile points	Village size increased and locations were strategically picked to ensure enough arable land as their diets were heavily dependent on agriculture. Locations were also chosen for their proximity to woodlots for both heating and building, proximity to water and a location which could be easily defended. Good hunting grounds to support the growing village population became important and as a result hostilities over these hunting grounds increased with neighboring communities. Emergence of tribes and territories. Dogs were domesticated and large ossuaries become common. Towards the end of the period the first Europeans goods appear periodically in Ontario through trade networks with groups further east who were in contact with the first French explorers who had reached the St. Lawrence.
Contact-Historic – ca. AD 1600-1800				
European Contact	AD 1600-1650	Huron, Neutral, Petun, Odawa, Ojibwa	Minimal European items	Establishment of the fur trade. Increase in warfare resulted in tribal disbursement leaving much of the area between Lake Ontario and Lake Simcoe with no permanent large villages. Many villages move north of Lake Simcoe further away from the Iroquois. Continued warfare from the Iroquois to the south resulted in the dispersal of the remaining Huron-Wendat and abandonment of their remaining villages and resettlement in Quebec at the closing of this period. The French arrive in Ontario with an increase in Jesuit missionaries and European goods.
Late	AD 1650- ca. 1800	Algonquin, 6 Nations Iroquois,	Mixture of Indigenous and European items	The Iroquoian continued to use their conquered land of Southern Ontario as mainly hunting grounds with a few settlements located along the shoreline of Lake Ontario. The Iroquoian were then challenged and pushed out of the region by the Anishinaabeg (Ojibway, Chippewa, Odawa). Trade continued with both English and French. Numerous migrations and resettlements. The end of this period there saw an influx of European and American settlers transitioning to the historic period.

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1.2.2 General Indigenous Overview

1.2.2.1 Southern Ontario

As the glaciers that covered southern Ontario began to retreat approximately 12,500 years ago, the area began to become habitable for the Paleo-Indian hunting bands arriving between 11, 000 and 10,500 years ago finding large meltwater lakes formed in the wake of the retreat. The lakes were accompanied by relatively barren tundra interspersed with areas of open boreal forest. The Paleo-Indian hunters focused on the large Pleistocene mammals including mastodon, moose, elk, and especially herds of caribou that roamed the area. Following the herds of animals, the Paleo-Indian groups travelled long distances and seldom stayed in one campsite for a significant length of time leaving behind little material culture. Stone tools and by-products of their flaked stone industry are virtually all that remains. They manufactured large distinctive spear points that have a prominent channel or groove on each face. Campsites from this period are frequently found adjacent to remnant shorelines of large post-glacial lakes indicating that camping sites were set up along the shores of lakes to intercept migrating herds. The water levels of the Lake Ontario basin fell in the early post-glacial period and subsequently rose again to modern levels resulting in these campsites now being situated more than a kilometer into the lake (Archaeological Services Inc. 2014).

The Archaic Period (7,000 B.C – 1,000 B.C) saw a mixed needle and broadleaf forest cover established in Ontario and nomadic hunter-gatherers hunted deer, moose, as well as other animals, fished and gathered plant resources while moving relatively large distances over the landscape during the year. From the archaeological record, the technological and cultural change can be identified including a wide variety of tools produced which resulted in shifts in hunting strategies to adjust to a constantly evolving environment. During the Late Archaic period hunter-gatherer bands most likely settled into familiar hunting territories. Two types of sites evolved as a result of their hunting patterns, the small inland camps that were occupied by small groups of related families during the fall and winter where they could harvest nuts and hunt deer, and the larger spring and summer settlements that were located near river mouths where groups came together to trade, exploit spawning fish resources and to bury their dead. Many of the ground stone tools have both social and symbolic functions, they had a day-to-day use, but their inclusion in burials ascribes to them a sacred intent (Archaeological Services Inc. 2014).

The Woodland Period (1,000 B.C – 1600 A.D.) is distinguished from the previous Archaic period with respect to settlement patterns and subsistence pursuits and is most specifically marked by the instruction of ceramics into Ontario. Though the appearance of these ceramics provides a temporal marker for archaeologists their use does not seem to have profoundly changed the hunter-gatherer lifestyle of the previous period. The Iroquoian society flourished in the southern Great Lakes region in the Late Woodland Period. Increasingly sophisticated burial ceremonies and an increase in the trade of exotic items developed which may have come out of the need for greater social solidarity as the population increased causing competition for resources. Trade with communities living south of the Great Lakes introduced maize and squash creating a transition to food production that then reduced reliance on naturally occurring resources and led to less movement as people tended to their crops. As sites were more intensively occupied the need for a greater degree of internal spatial organization came about which can be seen in the archaeological record (Archaeological Services Inc. 2014). The ancestors of the Neutral, Huron, and Petun resided along the central north shore of Lake Ontario and the ancestral Iroquoians became the Five Nation Iroquois (Seneca, Cayuga, Onondaga, Oneida, and Mohawk) occupied the area south of Lake Ontario in what is now central New York State. Though there were most likely interactions between these Iroquoian-speaking groups it was not until the mid to late 17th century that the Five Nation Iroquois inhabited the Toronto area. The focus on agricultural practices led to a more sedentary lifestyle with larger communities coming together and forming alliances with separate villages. Some villages were fortified with palisade walls with land cleared around them for crops. By the time European explorers and missionaries arrived in Ontario at the beginning of the 17th century the villages were

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under the direction of various chiefs elected from the principal clans and subsequently allied within powerful tribal confederacies (Archaeological Services Inc. 2014).

By 1600 most of the Lake Ontario north shore communities had moved northward joining communities in Simcoe County to form the Petun and Huron. Though the movement of these communities took place over many generations the conflict with the Five Nations Iroquois of New York State was the final impetus. The collapse and dispersal of the three Ontario Iroquoian confederacies (the Huron, the Petun, and the Neutral) during the first half of the 17th century was caused by intertribal warfare with the Five Nations Iroquois and exacerbated by the intrusion of Europeans (Archaeological Services Inc. 2014).

1.2.2.2 Peel County

While Indigenous groups have long inhabited Southern Ontario, during the 1600s it was those in the Iroquois Confederacy (also known as Five Nations) who controlled large areas, including what is now known as Peel. By the 1700s the Iroquois had become weakened by disease and warfare with the French and were pushed out of the area by the Anishinaabeg as they migrated southward to settle along the north shore of Lake Ontario. This group would later become known as the Mississaugas by European settlers (Peeling the Past, 2017).

After the Seven Years War between Britain and France ended in 1763 the overall control of the lands that now comprise Ontario and Quebec were ceded by France to the British who continued to maintain forts at Kingston and Niagara. The influx of settlers after the American Revolution and the subsequent migration of Loyalist settlers convinced the British Crown to formally acquire new lands for settlement through a series of land purchases from Indigenous groups including the Mississaugas. Between 1783 and 1818 tracts of land within Ontario were purchased and surveyed for settlement (Peeling the Past, 2017).

> *On August 2nd, 1805 the British and Mississaugas signed a treaty covering the southern portion of the "Mississauga Tract" on the Lake Ontario waterfront, reaching from the Etobicoke Creek on the east to Burlington Bay on the west, and running north to what in Peel is known as the Second Concession North of Dundas Street (also known as Eglinton Avenue). Within a year the land was surveyed and divided into "Townships" for settlement purposes. The township in the Peel area was known as Toronto Township (now the City of Mississauga). It is interesting to note that the naming of this Township predated the incorporation of the City of Toronto in 1834 (founded as the Town of York in 1793).*
>
> *When Toronto Township was purchased the Mississaugas withheld a strip of land 1 mile wide on either side of the Credit River. The rest of the land was surveyed, and settlement began in earnest. Small hamlets sprung up at crossroads throughout the Township, including Summerville and Dixie. These hamlets were usually composed of a blacksmith shop, general store, church, and perhaps an inn or hotel. By 1818 the need for more land was apparent, and negotiations were started to purchase the remaining Mississauga land north of Eglinton Avenue. That same year 648,000 additional acres were purchased* [Treaty 19]*, and by 1819 the land was surveyed and divided into Townships. The Peel area now included an enlarged Toronto Township, as well as four additional townships: Chinguacousy, Toronto Gore, Albion, and Caledon. In February 1820 the Mississaugas surrendered the last of their lands along the Credit River, only keeping a small piece for a village that they subsequently abandoned in 1847 (now the Mississaugua Golf and Country Club).*
>
> (Peeling the Past, 2017).

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The project area is located within the traditional territory of the Mississaugas of the Credit River First Nation and included within the Ajetance Purchase (Treaty No. 19), the last large tract of land they ceded. The Ajetance Purchase includes lands within the Halton and Peel Regions and Dufferin and Wellington Counties. On October 23rd, 1818, members of the Mississaugas of the River Credit and Twelve and Sixteen Mile Creeks as well as, Chief of the Eagle Tribe, Weggishigomin of the Eagle Tribe, Kawwahkitahqubi of the Otter Tribe, Cabibonike of the Otter Tribe, and Pagitaniquatoibe of the Otter Tribe met with Deputy Superintendent William Claus on behalf of His Majesty to discuss the purchase of land (Filice 2018, Mississaugas of the Credit First Nation 2017b, Surtees 1984, Crown-Indigenous Relations and Northern Affairs 2016). The treaty was signed on October 28th, 1818, and included:

> *"A tract of land in the Home District, called the Mississauga tract," bounded southerly by the purchase made in 1806; on the east by the Townships of Etobicoke, Vaughan and King; on the south-west by the Indian purchase, extending from the outlet at Burlington Bay, north forty-five degrees west fifty-miles, and from thence north seventy-four degrees east or thereabout to the north-west angle of the Township of King, containing by computation six hundred and forty-eight thousand acres; and the said Adjutant, Weggishigomin, Cabibonikem, Pagitaniquatoibe and Kawahkitahquebi, as well for themselves as for he Mississauga Nation inhabiting and claiming the said tract of land as above described, do freely, fully and voluntarily surrender and convey the same to His Majesty without reservation or limitation in perpetuity. And the said William Claus, on behalf of His Majesty does hereby, promise and agree to pay to the said Nation of Indians inhabiting as above mentioned, yearly and every year for ever the said sum of five hundred and twenty two pounds then shillings currency in goods at the Montreal price, which sum the said Principal Chiefs and people, parties hereunto, acknowledge as a full consideration for the lands hereby sold and conveyed to His Majesty.*
>
> (Crown-Indigenous Relations and Northern Affairs 2016)

The Mississaugas had negotiated the sale of all their territory with the exception of 200 acres near the mouth of the Credit River by 1820 (Filice 2018, Mississaugas of the Credit First Nation 2017b, Surtees 1984).

1.2.3 Peel County Historic Overview

In 1788 four Districts were created including the Nassau District (later the Home District) which included what would later become the County of Peel. Then in 1791, the province of Quebec was divided into Upper Canada and Lower Canada, and the Home District became part of Upper Canada with most of what is now southern Ontario (Walker & Miles, 1877, Mercer et al 1885).

Lieutenant-Colonel John Graves Simcoe was appointed the first Lieutenant-Governor of Upper Canada. He moved the capital from Newark (Niagara) to Toronto, which he renamed York in honour of the King's son Frederick the Duke of York, in order to provide it more protection. In 1792 he divided Upper Canada into 19 Counties and created a road system. To establish and open the road system Governor Simcoe brought troops over from England. He also employed them in other building operations and posted them along these roadways. The establishment of a road system prepared the Counties for an influx of settlers and aided settlers on their journey to their new home (Mercer et al 1885). The Home District, albeit with the inclusion of fewer townships, continued until the institution of districts was abolished in 1852 and as a result the united County of York, Peel and Ontario was formed. The County of Ontario was the first to separate. It was not until 1866 that Peel was separated from York. After some time, the Village of Brampton was finally selected as County Town and the County buildings were erected at a cost of over $40,000. The first council met at the Brampton Court House in January 1867 (Walker & Miles, 1877).

The County of Peel was named after Sir Robert Peel (1788-1850), a British politician who served as both Home Secretary and Prime Mister of Great Britain (Walker & Miles, 1877). Located on the north shore of Lake Ontario,

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bounded on the east by the County of York, on the north by the Counties of Simcoe and Wellington, and on the west by the Counties of Wellington and Halton, it is comprised of the Townships of Toronto, Toronto Gore, Chinguacousy, Caledon and Albion, the incorporated Town of Brampton, and the incorporated villages of Streetsville and Bolton. As a small County, it contains 293,300 acres of land measuring 37 miles in length with an average width of 15 miles. A chain of ridges runs through it dividing it into two distinct sections, entering at Caledon at a south-west angle and passing out of the County approximately midway through the eastern boundary of Albion. The two sections are distinct in character of soil and climate as well as general appearance above and below this chain. The land in the lower region is gently undulating with a gradual but continual ascent from the Lake to the base of the ridges where it then rises nearly perpendicular. In other areas, it is broken for some miles, with hills over hills making it difficult to ascertain when you have actually ascended the range with the mountain about 900 feet above the level of Lake Ontario (Walker & Miles, 1877).

Generally, the roads through Peel were considered of good quality and were opened and more or less travelled between every two concessions as well as side roads every five lots. One of the main roads, Dundas Street, passes through the front part of Toronto Township. This road was partly graveled and macadamized by grants from the Legislature in 1836. Settlement was concentrated along Dundas Street and being heavily travelled meant good business for shops and other businesses established along it. Another well-travelled road, first planked by a private company and later graveled, was Lakeshore. Hurontario Street, which runs from Port Credit north-west through the center of Toronto, Chinguacousy and Caledon, and then through to Collingwood was also well-travelled. Another key road was cut through the sixth line that extends from Dundas St. north, west to Mono Mills in Mono, on the west, and the Gore and Albion on the East. The Grand Trunk Railroad and the Toronto Grey and Bruce Railroads run through the County with the Credit Valley Railway being added shortly after (Walker & Miles, 1877). The County, like many others, benefitted economically from the railway.

The County is well watered with running streams of various sizes throughout. The Credit River, considered to be the principal River, provides an excellent stream of water which runs through the western part of the County. The numerous branches of the river provide a source of wealth for many communities, including Caledon where waterpower is supplied. The Humber River also plays an important role in the County and specifically to Albion where it provides waterpower through its tributaries. Each township had several mills which utilized the numerous waterways (Walker & Miles, 1877).

1819 and the following years saw the greater part of the County settled, though the old survey of Toronto Township was thinly settled in 1808 or 1810. Many first settlers came from New Brunswick, the United States, and other parts of Upper Canada. Some of the first settlers in the ‘New Survey’ of Toronto Township included a colony of Irish families from New York City who came to their grants of land in 1819 under the Superintendence of Messrs. Beaty and Graham. U.E. Loyalists and their descendants were the main settlers of Chinguacousy as well as a number of other inhabitants of Upper Canada. The other townships were mostly made of emigrants from the old country (Walker & Miles, 1877).

At the time the first regular organization of all the townships that became the County of Peel was made in 1821 the population was only 803, however, settlement within the County continued to grow steadily and by 1871 the population had risen to 26,011 inhabitants (Walker & Miles, 1877). By 1877 life in the County was becoming easier with fewer hardships as farms were well established and more and more shops, mills and other businesses had been opened.

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1.2.4 Township of Toronto

Toronto Township located in the southeast of Peel County was first surveyed in 1806 by Mr. Wilmost. The first survey only covered about one mile deep from each side of the Credit River. Colonel Thomas Ingersoll is thought to have been the first settler in the Township as well as the County, arriving before 1806. He kept a government storehouse and operated a ferry service at what would become Port Credit. By 1808 seven families were living in the Township including John Silverthorn, Joseph Silverthorn, Philip Cody, Daniel Harris, Allen Robinett, William Barber and Absolom Wilcox. They had settled along Dundas Street within the original survey (Walker & Miles 1877). Settlement continued to steadily increase until the War of 1812. In 1819 the remaining portion of the Township was surveyed, a large part of which was granted to a number of Irish families who had originally settled in the US before the war. Being persecuted after the war for not taking up arms with the Americans against the British led them to appeal to the British Council, in New York, for land in Canada. Twenty-six families were given land grants and in Map 1819 they began their journey to Toronto Township. Their journey was long and arduous and not made easier by the wagons they brought filled with supplies. There were not many roads open by the time they arrived in Canada and further inland they were not well maintained. Early settlers often used sleighs pulled by oxen. The sleighs were easier to maneuver around stumps, over logs and through marshy areas. Not all the covered wagons made it to their final destination, some being left in York (later Toronto). Settlement of the Toronto Township continued after the arrival of the Irish families so much so that it was incorporated by 1876 and was the first in the County to be incorporated. Several settlements started to grow up throughout the Township as settlement increased (Walker & Miles 1877).

Streetsville is the oldest settled village in the County and was ideally located along the Credit River. The Village was incorporated in 1858. The first three settlers to the area that would become Streetsville are thought to be James Glendenning, Frank Lighthearn and John Barnhart respectively. Streetsville is thought to have had the most extensive woollen factory in the province. It also boasted the largest grist mill in operation by 1876, at least in the Township. Another grist mill in the village was also large, running two stones and manufacturing flour for both local residences as well as for foreign markets. By 1876 Streetsville also had a cabinet warehouse and shop, broom factory, tub and pail factory, chair and paint shop, blacksmith, lumber businesses, a few stores, a large brick schoolhouse and four churches. The population by 1876 had risen to 678. The village after flourishing for many years began to struggle. The completion of the Credit Valley Railway was anticipated to help revive the Village Walker & Miles (1877).

Meadowvale was another village also located along the Credit River. The Village sprung up around the sawmill built in 1831 by John Crawford. By the time John Simpson built his sawmill in 1836, there were already a number of settlers there. These settlers had to travel to Toronto for supplies until 1847 when the first store in the Village was opened by Hames Ward. Having a store closer made everyday life easier for these early settlers. Life was made easier again when in 1856 Francis Silverthorn built a grist mill. The grist mill was purchased in 1860 by Gooderham and Worts who significantly increased the business. Running five stones meant that they could grind 250 barrels of flour a day and employ more hands. Gooderham and Worts being the businessmen they were also had a barrel business (among other businesses) where they manufactured their own barrels for their flour and also sold them to their grist mill customers. By 1876 Meadowvale also had a sawmill, lumber, lath and shingle factory, general store and a few other stores Walker & Miles (1877).

Port Credit was established by the Government in 1804 when they sent Thomas Ingersoll to run a storehouse and ferry. New emigrants to this part of the Country were accommodated in an inn also built by the Government. Port Credit is the only port in the County and has became one of the best shipping ports on the Lake. The opening of the Great Western Railway Station at Port Credit greatly benefitted both the Village and the shipping businesses. By 1877 Port Credit had also become a large shipper of strawberries. Over 100 acres of strawberries were cultivated, which increased each year. At one time two steamboats full of strawberries were shipped to Toronto daily. The

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harbour opened up the market for many Villagers to ship their goods further afield. Port Credit also became a sporting retreat for men from Toronto. Travellers would come by train to fish and hunt, staying in one of three hotels. Much of the surrounding area was still wild and offered great hunting Walker & Miles (1877).

Cooksville boasting a population of 300 by 1876 was located just south of the center of the Township and had a sawmill, a church, a two-story brick schoolhouse with three teachers, a baker, a waterhouse, a blacksmith and two hotels. Cooksville was named after Jacob Cook Esq. who originally owned the land which would become the location of the Village. Cooksville was ideally located along the main road between Hamilton and Toronto, flourishing as a result. Unfortunately, like so many other early settlements it was devastated by fire. The devastation of the fire in 1852 was so great that only a few houses were left standing, and the Village never fully recovered. The opening of the Grand Trunk and the Great Western Railways also took business away from the Village, having stations established elsewhere. Like Streetsville, it was hoped that the opening of the Credit Valley Railway would help. Cooksville did benefit from the establishment of the Canada Vine Growers Association in the village Walker & Miles (1877).

1.2.5 Historic Mapping

Historic maps although providing some information on historic features the inclusion of such information was often based on a subscription and the purpose of the map. Therefore, it is unknown how many features have been excluded from these early maps. Additionally, there can also be a discrepancy between the actual location of a feature and where it is depicted on the map. A site visit together with later maps can help narrow down the potential location of historic features illustrated on the early maps.

Map 2 illustrates the location of the project area and environs as of 1859. This map illustrates the project area on the shore of Lake Ontario and Cooksville Creek running through it, emptying into the Lake. The Credit River and other watercourses are also shown within the surrounding area. An unnamed toll road is illustrated adjacent to the northwestern boundary of the project area and corresponds to the current Lakeshore Road East. The Hamilton and Toronto Railway is illustrated running parallel with Lakeshore Road East further northwest of the project area. Lot 11 is shown to be owned by Wesley Watson and two structures are illustrated within the lot along Lakeshore Road East. Structures are also illustrated on the lots on the north side of Lake Shore Road East, across from the project area. The settlement of Port Credit is illustrated just west and Cooksville to the northwest. All of the lots surrounding the project area are shown to be owned, however, a structure is not illustrated on each lot. The schoolhouse to the southwest of the project area suggests the demographics of the area and the requirement for such an institution. An “Old Indian Village” is noted to the northwest of Port Credit adjacent to the Credit River. The larger area well known as being the traditional territory of the Mississaguas.

Map 3 from 1877 shows the project area within a similar environment to the 1859 map. Cooksville Creek still runs through the project area which is located on the shore of Lake Ontario. Lakeshore Road East and the Hamilton and Toronto Railway, now the Great Western Railway are located to the northwest. The Credit Valley Railway was opened north of Cooksville by 1877. Port Credit and Cooksville don’t appear to have grown much since 1859. Lot 11 is now shown to be owned by Stephen Crawford, a non-resident. Many of the lots along the water and a few others show that they were owned by non-residents. Both structures within the lot are still shown on this map. The structures to the north of the project area are illustrated with large orchards, suggesting these farms were well established by this time. The manufacturing industry growing since 1859 is shown owning several parcels of land to the west of the project area.

National topographic surveys were gathered to provide more detail about the project area and its surroundings. The survey from 1909 (Map 4) shows the project area within a rural environment with Cooksville Creek flowing through

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the it into Lake Ontario surrounded by woodlot and by wooden and brick structures. By 1929 (Map 5) urbanization had expanded around the project area.

The urbanization illustrated on the 1929 survey can be seen on the aerial from 1954 (Map 6). A structure is shown within the northern portion of the project area along Lakeshore Road East adjacent to the Creek. By 1980 (Map 7) Cooksville Creek had undergone significant changes straightening and widening it and further widening and the installation of path along the Creek by 1985 (Map 8). The structure in the northern portion of the project area was removed perhaps to allow the widening of the Creek. Prior to 1980, a portion of the Lake was filled in to extend the shoreline into the Lake southeast of the project area to create parkland. Part of the Lake in the southwest corner of the project area was also filled in by 1980 and then further into the Lake by 1989.

The project area's proximity to the historic structure and road suggests potential for Euro-Canadian archaeological resources.

1.3 ARCHAEOLOGICAL CONTEXT

1.3.1 Previously Registered Sites

According to the Minister of Citizenship and Multiculturalism Archaeological Site Database (ASD) the Adamson Estate Euro-Canadian homestead site is located within 1km of the project area.

No reports were identified that document archaeological fieldwork conducted within or adjacent to the limits of the project area.

1.3.3 Current Land Use and Field Conditions

The project area is approximately 2.88 hectares in size and consists of mainly Cooksville Creek which flows through the project area into Lake Simcoe surrounded by mature trees. The Creek has steep banks along some of it which in places have been reinforced with gibbons, large stones and concrete at the northern end where it passes under Lakeshore Road East. An asphalt path follows the east side of the Creek. Storm sewer lines are located along both sides of the Creek which empty into it. A bridge crossing the Creek is located in the southern portion of the project area. The parklands in the southern portion of the project area are mainly manmade land. Areas of lawn are located along the eastern side of the Creek where the study area crosses the rear portion of residential lots.

The project area is bounded on the northwest by Lakeshore Road East, on the northeast and southwest by residential and on the southeast by parkland and Lake Ontario. Map 10 illustrates the current land use.

1.3.4 Physiographic Region

The project area is located within the Iroquois Plain physiographic region. The lowland area bordering Lake Ontario was inundated by water when the last glacier was receding, though still within the St. Lawrence Valley, and was called Lake Iroquois. This glacial lake emptied eastward at Rome, New York State. The old shorelines with its cliffs, bars, beaches, and boulder pavements are still identifiable features with the undulating till plains above are

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contrasted by the wave smoothed lake bottom. The area of the Iroquois plain extends some 190 miles around the western part of Lake Ontario, from the Niagara River to the Trent River, with varying width from about eight miles to only a few hundred yards. A large area is located in the Trent River valley. Due to the varying conditions within the old lake plain the region has been divided into a number of sub-sections including Niagara Fruit Belt, Ontario Lakehead, Hamilton to Toronto, Toronto, Scarborough, Scarborough to Newcastle, Newcastle to Trenton, and Trent Embayment (Chapman and Putnam 1984).

Ontario Lakehead

This portion lies at the head of Lake Ontario and is a special part of the Iroquois plain. The characteristics of lake heads make them ideal for the establishments of cities and the area of glacial Lake Iroquois had some advantages. With a narrow plain between the lake and the "mountain" there is direct connection with Niagara through the old shoreline, and a corridor to the north shore was provided by the old bayhead bar. An easy grade up the escarpment to Ancaster is found through the old higher terraces inside the bar bypassing Dundas in two directions (Chapman and Putnam 1984).

Hamilton to Toronto

Occupying the northeast shore of Lake Ontario from Burlington to Toronto and beginning with a great gravel bar running through Aldershot. For about 18 miles the shoreline continues as a distinct bluff in the red shale of the Queenston Formation. The grey shale of the Georgian Bay Formation is the old shore near Clarkson and Cooksville, whereas in other places such as Toronto itself (along Davenport Road west of Yonge Street) the Iroquois shoreline is cut in Pleistocene deposits. Barrier beaches were created by the old lake at Bronte Creek, Oakville Creek, Etobicoke Creek, Credit River, Humber River, Don River, with significant sources of sand and gravel at each of the three rivers (Chapman and Putnam 1984). The shoreline of Lake Ontario provides the other boundary of the plain while the water gradually cuts into the red shale of Burlington to Oakville, grey shale at Clarkson, and the delta sands at Lorne Park. Along the shoreline the mouths of streams have been drowned and at the mouth of Twenty Mile Creek with such significance that the lagoon of Jordan Harbour has been formed by a bar. A surviving portion of the bed of Lake Iroquois is found between the two shorelines (ancient and modern), with a sloping plain at an average width of approximately two miles with varying compositions including stratified sands of varying depth, shallow cover of till over the bedrock, and in some the wave-eroded surface of red shale is the basis for soil formation. The soil of Aldershot, Bronte, Burlington, Oakville, Lorne Park, Clarkson, and Humber Bay is sandy and is preferable to the clay of the adjoining areas (Chapman and Putnam 1984).

Toronto

The waves and currents of Lake Ontario created the harbour protecting sandbar of Toronto Island by moving the sand from the Scarborough Bluffs. The area of first settlement in Toronto was once the realm of glacial Lake Iroquois which cut in previously deposited clay and till and then covered in sand deposits measuring approximately 3 miles wide with a general northward slop from the level of Lake Ontario approximately 50-60 feet per mile. Evidence of the old beach and a steep bluff or shorecliff is found along the northern border with a height of about 75 feet at Casa Loma. The deep valleys of the Don and Humber Rivers are found to the east and west of the shorecliff having been cut into early Iroquois base levels. Immense sand and gravel barriers were built across these valleys by Lake Iroquois so much so that in Iroquois times Toronto had two harbours instead of one. While the sand and gravel was deposited by Lake Iroquois, the clay was part of the pre-Iroquoian age (Chapman and Putnam 1984).

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1.3.5 Water Resources

The project area is located on the shoreline of Lake Ontario and Cooksville Creek flows through the project area emptying into Lake Ontario. Water is not only a necessity of life but it was also frequently utilized as a mode of travel for everyday life as well as for trade and communication. Watercourses were also used as landmarks by Indigenous groups as well as early settlers and explorers.

The project area is not only within proximity to water today but was also within proximity to a past water source. The project area was once covered by the waters of the Ontario Basin. Remnant shorelines are located over four kilometers inland today. As the Ontario Basin drained to present levels the project area would have become exposed.

The proximity of water to the project area suggests the potential for Indigenous occupation and land use in the area in the past.

2.0 SITE VISIT

A site visit was completed on December 12th, 2023, to obtain a better understanding of the current conditions, the topography, and the surrounding environment of the project area. The entire project area was inspected during ideal conditions. The identified features and current conditions of the property were photographed and are illustrated on Map 10.

Table 3: Site Visit Documentary Record Inventory

Type of Documentation	Description
Field Notes	1 digital file of field notes describing the daily site activities, weather, personal
Maps	1 map showing the project activities
Photographs	46 digital photographs showing the current conditions encountered during the site visit

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3.0 ANALYSIS AND CONCLUSIONS

3.1 STAGE 1 BACKGROUND RESULTS

The project area and its surroundings have a long history starting long before European settlement. The project area has been determined to have archaeological potential for Indigenous resources based on its proximity to water. Additionally, the project area has been determined to have archaeological potential for Euro-Canadian resources based on its proximity to historic a structure, historic road, and previously registered archaeological site.

The project area has undergone modern deep disturbances and as a result, archaeological potential has been removed from these areas. Additionally, there is no or low archaeological potential within the low-lying and wet areas of the Creek.

4.0 RECOMMENDATIONS

Based on the results the following recommendations are made:

1. Archaeological potential remains within the project area. Stage 2 Archaeological Assessment by test pit survey at an interval of 5 meters is recommended for these areas if impacted by the proposed restorations and prior to any ground-altering activities in these areas (see Map 10).

2. Stage 2 Archaeological Assessment is not recommended for areas of no archaeological potential including areas of modern deep disturbance and low-lying and wet areas (see Map 10).

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5.0 ADVICE ON COMPLIANCE WITH LEGISLATION

a. This report is submitted to the Minister of Tourism and Culture as a condition of licensing in accordance with Part VI of the *Ontario Heritage Act,* R.S.O. 1990, c 0.18. The report is reviewed to ensure that it complies with the standards and guidelines that are issued by the Minister, and that the archaeological fieldwork and report recommendations ensure the conservation, protection and preservation of the cultural heritage of Ontario. When all matters relating to archaeological sites within the project area of a development proposal have been addressed to the satisfaction of the Minister of Citizenship and Multiculturalism, a letter will be issued by the ministry stating that there are no further concerns with regard to alterations to archaeological sites by the proposed development.

b. It is an offence under Sections 48 and 69 of the *Ontario Heritage Act* for any party other than a licensed archaeologist to make any alteration to a known archaeological site or to remove any artifact or other physical evidence of past human use or activity from the site, until such time as a licensed archaeologist has completed archaeological fieldwork on the site, submitted a report to the Minister stating that the site has no further cultural heritage value or interest, and the report has been filed in the Ontario Public Register of Archaeological Reports referred to in Section 65.1 of the *Ontario Heritage Act.*

c. Should previously undocumented archaeological resources be discovered, they may be a new archaeological site and therefore subject to Section 48(1) of the *Ontario Heritage Act.* The proponent or person discovering the archaeological resources must cease alteration of the site immediately and engage a licensed consultant archaeologist to carry out archaeological fieldwork, in compliance with Section 48(1) of the *Ontario Heritage Act.*

d. The *Cemeteries Act,* R.S.O. 1990 c. C.4 and the *Funeral, Burial and Cremation Services Act,* 2002, S.O. 2002, c.33 (when proclaimed in force) require that any person discovering human remains must notify the police or coroner and the Registrar of Cemeteries at the Ministry of Consumer Services.

e. Archaeological sites recommended for further archaeological fieldwork or protection remain subject to Section 48 (1) of the *Ontario Heritage Act* and may not be altered, or have artifacts removed from them, except by a person holding an archaeological license.

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6.0 BIBLIOGRAPHY

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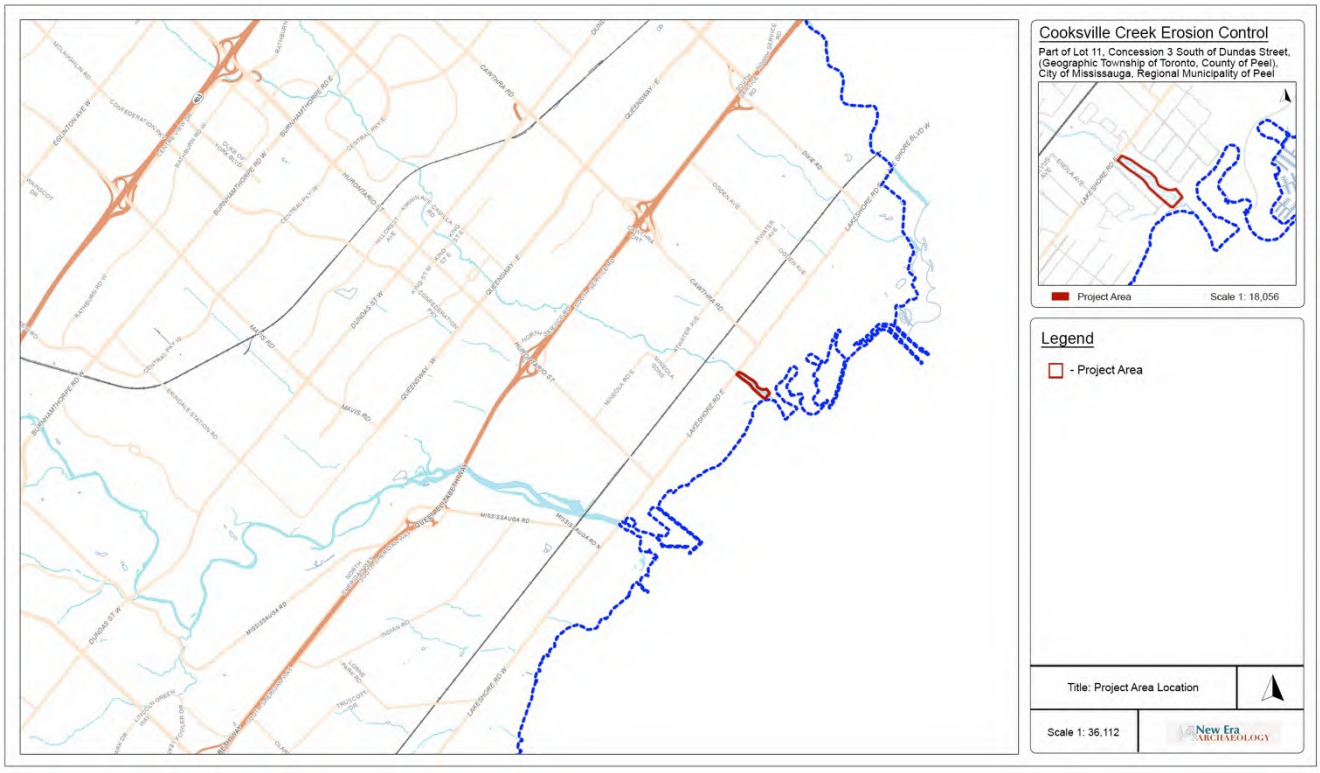
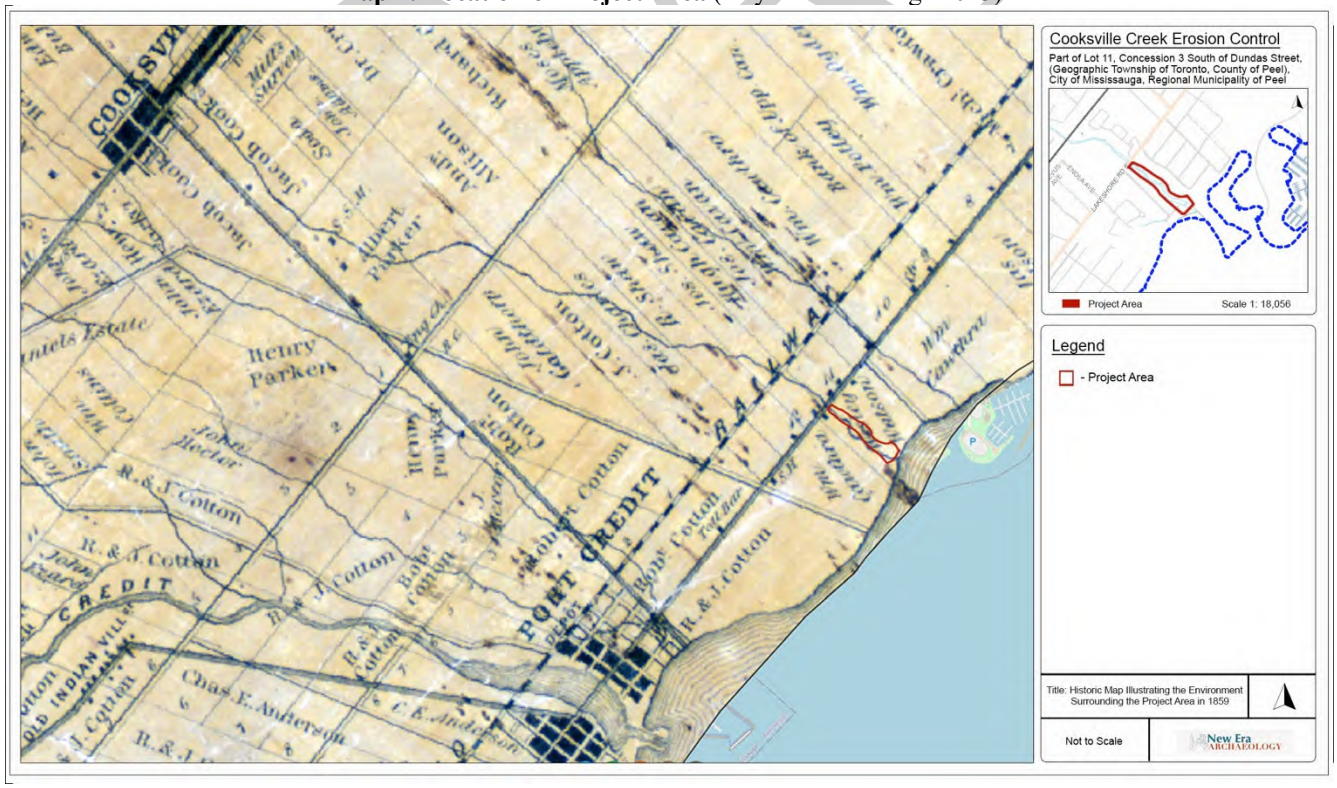
7.0 MAPS



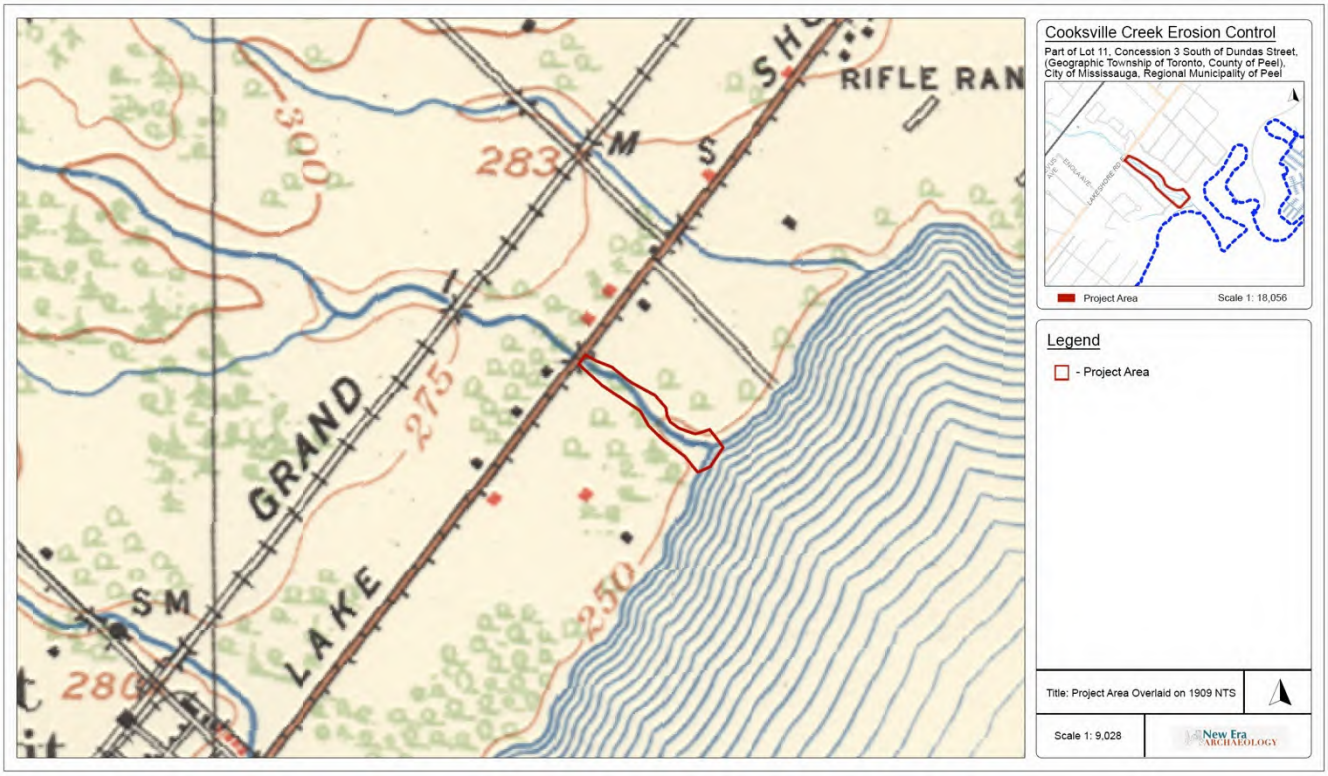
Map 1: Location of Project Area (City of Mississauga 2023)



Map 2: Historic Map Illustrating the Environment Surrounding the Property Area in 1859 (Tremaine 1859)



Map 3: Historic Map Illustrating the Environment Surrounding the Property Area in 1877
(Walker & Miles. 1877)



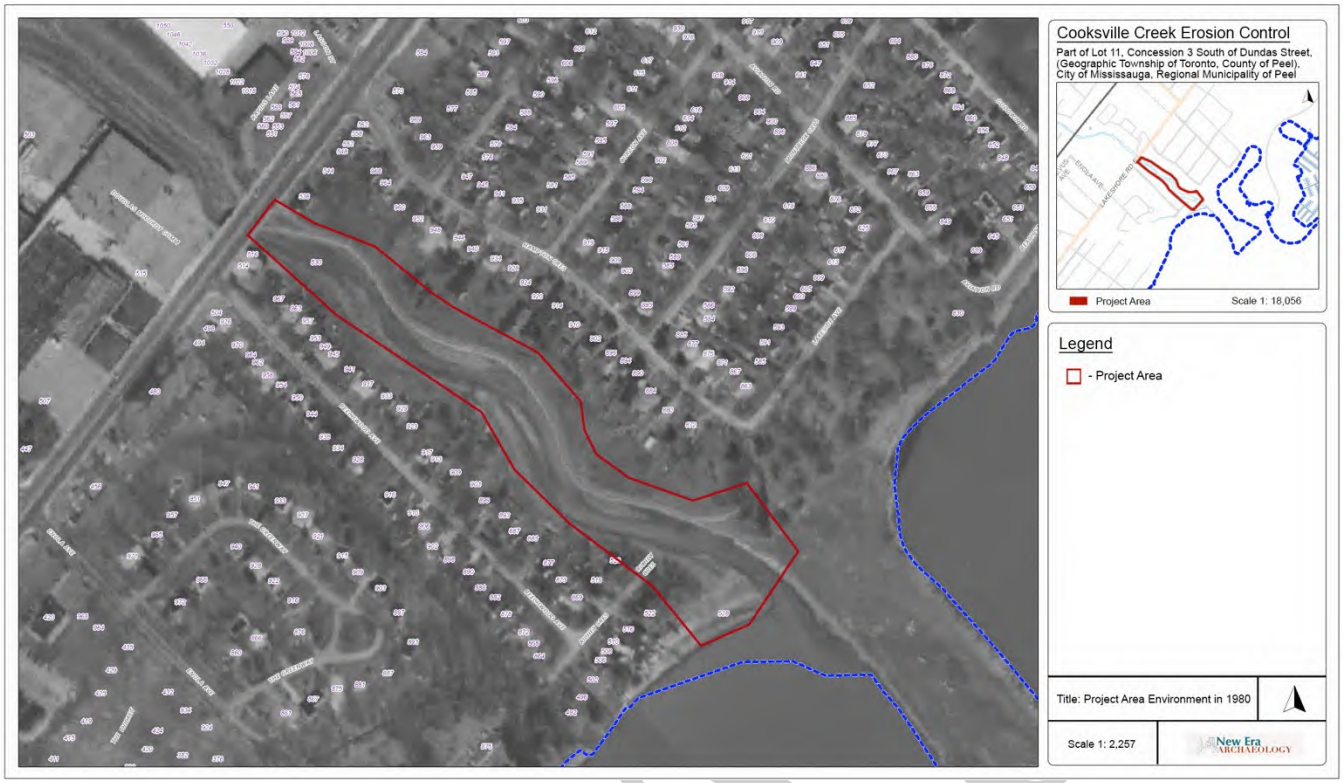
Map 4: Project Area on National Topographic Survey from 1909 (National Resources Canada)



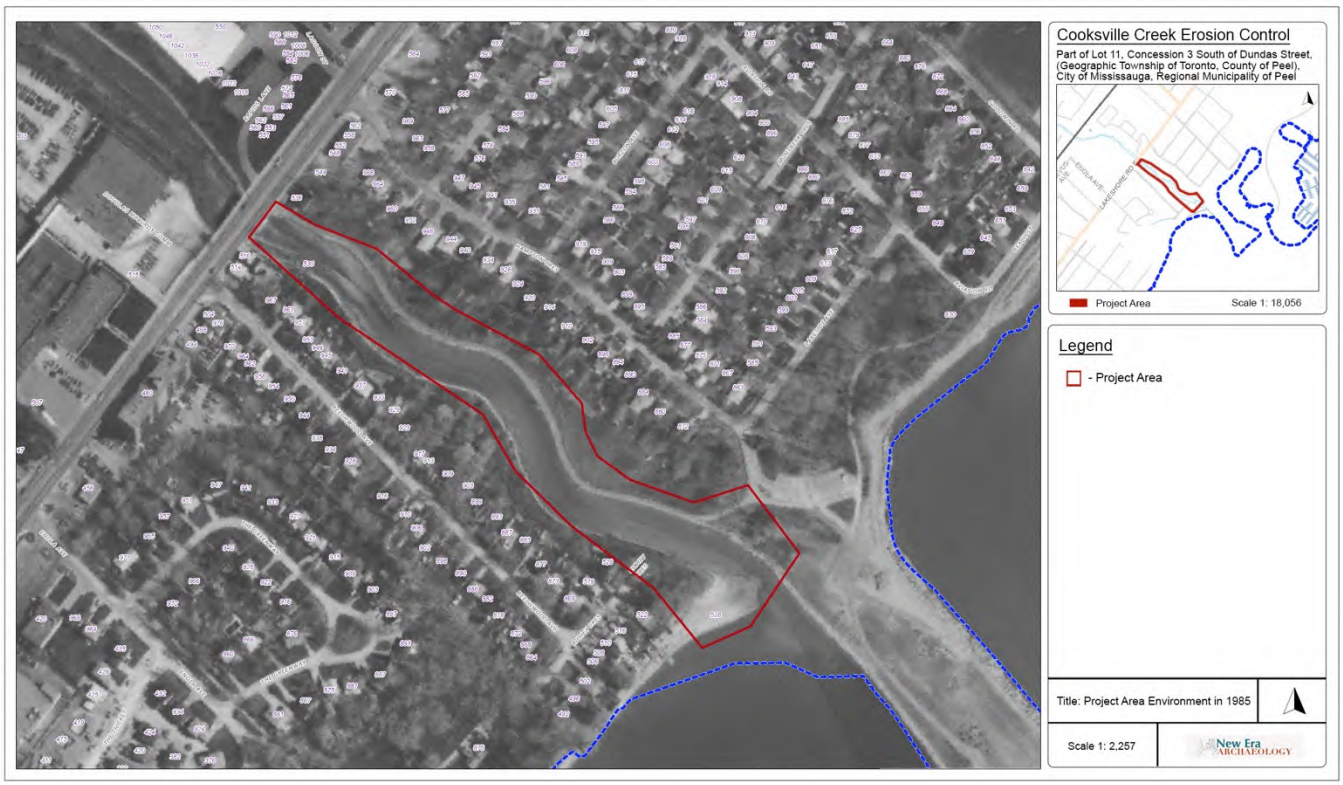
Map 5: Project Area on National Topographic Survey from 1929 (National Resources Canada)



Map 6: Project Area on Historic Aerial from 1954 (City of Mississauga 2023)



Map 7: Project Area on Historic Aerial from 1980 (City of Mississauga 2023)



Map 8: Project Area on Historic Aerial from 1985 (City of Mississauga 2023)



Map 9: Project Area (Provided by Aquafor Beech Ltd.)



Map 10: Stage 1 Archaeological Background Study Results (Base Map: City of Mississauga 2023)



Map 11: Stage 1 Archaeological Background Study Results (Base Map: City of Mississauga 2023)

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8.0 PLATES



Plate 1: Wooded Park Land



Plate 2: Asphalt Pathways and Two Manholes Between Them



Plate 3: Wooded Area Along Lake Ontario

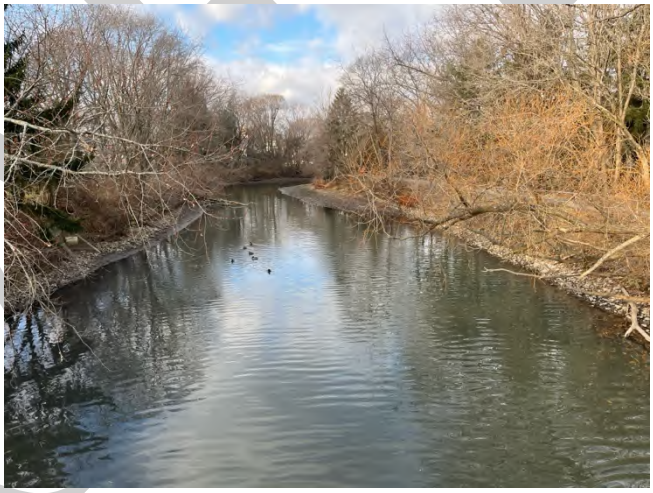

Plate 4: Cooksville Creek



Plate 5: Cooksville Creek Emptying into Lake Ontario



Plate 6: Wooded Area Along the Creek and Manhole



Plate 7: Wooded Area Along the Creek



Plate 8: Wooded Area Along the Creek



Plate 9: Wooded Area and Gibbons Along the Creek



Plate 10: Wooded Area Along the Creek



Plate 11: Asphalt Pathway Surrounded by Mature Trees; Manhole



Plate 12: Sewer Outlets Emptying into Creek



Plate 13: Elevated Pathway Surrounded by Trees and Lawn



Plate 14: Elevated Pathway Surrounded by Trees and Lawn



Plate 15: Asphalt Pathway Surrounded by Mature Trees



Plate 16: Asphalt Pathway Surrounded by Mature Trees



Plate 17: Infrastructure Where Cooksville Creek Passes Under Lakeshore Road East



Plate 18: Cooksville Creek

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From:	amos.r@aquaforbeech.com
To:	"Robin Vanstone"
Cc:	ursulak.j@aquaforbeech.com; cota.c@aquaforbeech.com; "Greg Frew"
Subject:	RE: Cooksville Creek Erosion Control Project - Schedule B Municipal Class EA
Date:	October 22, 2024 3:43:39 PM
Attachments:	image002.png Cooksville Creek Schedule B Municipal Class EA - Notice of Public Information Centre.pdf

Dear Six Nations of the Grand River,

As a follow-up to the Stage 1 Archaeological Assessment, Aquafor and the City of Mississauga have arranged an in-person, Public Information Centre to provide an opportunity to review and comment on the project findings to date. This includes the alternative solutions being considered, the evaluation process, the preliminary preferred solutions, and the next steps of the study.

The details of the Public Information Centre are as follows:

Date:	Tuesday, October 29th, 2024
Time:	Afternoon Session: 3 p.m. – 5 p.m. Evening Session: 6 p.m. – 8 p.m.
Location:	Small Arms Inspection Building 1352 Lakeshore Road East

Additional information is also available from the project website at:

Project Website
Cooksville Creek Erosion Control Project south of Lakeshore Road – City of Mississauga

Thanks very much, and should you have any questions or comments, please feel free to contact the following:

Greg Frew, P.Eng.
Project Manager
City of Mississauga
300 City Centre Dr, Suite 800
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Ltd.
2600 Skymark Avenue, Unit 6-202
Mississauga, ON, L4W 5B2
416.705.23696
Amos.R@aquaforbeech.com

Kind regards,

Rob

Robert Amos, MASc., P.Eng.

Aquafor Beech Ltd.

☎ **416.705.2367**
✉ Amos.R@Aquaforbeech.com
www.aquaforbeech.com



From: amos.r@aquaforbeech.com <amos.r@aquaforbeech.com>
Sent: October 15, 2024 1:35 PM
To: 'Robin Vanstone' <rvanstone@sixnations.ca>
Cc: 'Greg Frew' <Greg.Frew@mississauga.ca>; ursulak.j@aquaforbeech.com; cota.c@aquaforbeech.com
Subject: RE: Cooksville Creek Erosion Control Project - Schedule B Municipal Class EA

Dear Six Nations of the Grand River,

As a followup to the Notice of Commencement, Aquafor and the City of Mississauga have completed a Stage 1 Archeological Assessment (attached) as part of Schedule B Class Environmental Assessment Study for the **Cooksville Creek Erosion Control Project from Lakeshore Road to Lake Ontario**.

Based upon the Stage 1 recommendations, we're looking to complete a Stage 2 Archeological Assessment in the coming months, and wanted to extend the offer for review and / or Field Liaison Representation.

Please let us know how you would prefer to be involved or provide input through the next phases of the study.

Additional information is also available from the project website at:

> **Project Website**
> Cooksville Creek Erosion Control Project south of Lakeshore Road – City of Mississauga

Thanks very much, and should you have any questions or comments, please feel free to contact the following:

Greg Frew, P.Eng.
Project Manager
City of Mississauga
300 City Centre Dr, Suite 800

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Ltd.
2600 Skymark Avenue, Unit 6-202

Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Mississauga, ON, L4W 5B2
416.705.23696
Amos.R@aquaforbeech.com

Kind regards,

Rob

_____
Robert Amos, MASc., P.Eng.
Aquafor Beech Ltd.

☎ **416.705.2367**
✉ Amos.R@Aquaforbeech.com
www.aquaforbeech.com



From: amos.r@aquaforbeech.com <amos.r@aquaforbeech.com>
Sent: March 14, 2024 12:49 PM
To: rvanstone@sixnations.ca
Cc: 'Greg Frew' <Greg.Frew@mississauga.ca>; ursulak.j@aquaforbeech.com; cota.c@aquaforbeech.com
Subject: FW: Cooksville Creek Erosion Control Project - Schedule B Municipal Class EA

Dear Six Nations of the Grand River,

Aquafor Beech Limited has been retained by the City of Mississauga to undertake a Schedule B Class Environmental Assessment Study for the **Cooksville Creek Erosion Control Project from Lakeshore Road to Lake Ontario**.

This project is being completed to address existing problems and risks along Cooksville Creek and the adjacent Helen Molasy Trail.

In accordance with the environmental assessment process, Aquafor is pleased to share the attached letter and Notice of Commencement. Additional information is also available from the project website at:

Project Website

Cooksville Creek Erosion Control Project south of Lakeshore Road – City of Mississauga

Should you have any questions or comments, please feel free to contact the following:

Greg Frew, P.Eng.
Project Manager
City of Mississauga
300 City Centre Dr, Suite 800
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Ltd.
2600 Skymark Avenue, Unit 6-202
Mississauga, ON, L4W 5B2
416.705.23696
Amos.R@aquaforbeech.com

We very much look forward to working with you throughout the project, and will ensure all documentation is available for your review and input.

Kind regards,

Rob

_____
Robert Amos, MASc., P.Eng.
Aquafor Beech Ltd.

☎ **416.705.2367**
✉ Amos.R@Aquaforbeech.com
www.aquaforbeech.com

City of Mississauga
Notice of Public Information Centre

Municipal Class Environmental Assessment Study:
Cooksville Creek Erosion Control Project – South of Lakeshore Road

What?

The City of Mississauga (the City) is undertaking a Schedule B Municipal Class Environmental Assessment (Class EA) Study for erosion control and restoration of Cooksville Creek south of Lakeshore Road.



Why?

The City recognizes that this section of Cooksville Creek has been impacted by recent storm events and high lake levels and is in need of rehabilitation. Plans will also need to consider the deteriorated condition of the adjacent city trail through Helen Molasy Memorial Park that sits above the east bank of the creek, as well as the neighbouring properties which have experienced ongoing drainage issues.

How?

- The Study has examined this section of Cooksville Creek and Helen Molasy Trail and associated natural resources to identify existing problems, potential risks, and opportunities for restoration and drainage improvements.
- Through the Class EA process, various alternative solutions are being developed and evaluated by the Study Team and will be refined through public and agency consultation (see below). The Study Team will then select a preferred alternative and proceed with design of the recommended works.
- A Project File documenting the planning process will be available for public review at the end of the Study.

Public Consultation

- Consultation is an essential part of the EA process. The City would like anyone with an interest in the Study to have an opportunity to provide input and help inform the decision-making process.
- An in-person, Public Information Centre has been arranged to allow local residents and interested members of the public an opportunity to review and comment on the project findings to date, the alternative solutions being considered, the evaluation process, the preliminary preferred solution, and the next steps:

Date:	Tuesday, October 29th, 2024
Time:	afternoon: 3pm – 5pm evening: 6pm - 8pm
Location:	Small Arms Inspection Building 1352 Lakeshore Road East

- Additional project information will be made available on the City's project website:
  https://www.mississauga.ca/projects-and-strategies/environmental-assessments/cooksville-creek-erosion-control-south-of-lakeshore-road/

City of Mississauga
Notice of Public Information Centre

Municipal Class Environmental Assessment Study:
Cooksville Creek Erosion Control Project – South of Lakeshore Road

- Feedback is encouraged and comments are requested by **November 26th, 2024**. A comment form is available on the project website. Input gathered through the public consultation will be used to support the EA study.
- If you have comments or questions, require further information or would like to be added to the Study mailing list to receive future notifications, please contact:

Greg Frew, P.Eng.
City Project Manager
City of Mississauga
300 City Centre Drive, Suite 800
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Ltd.
2600 Skymark Ave.
Mississauga, ON L4W 5B2
(416) 705-2367
Amos.R@aquaforbeech.com

This notice signals the Notice of Public Information Centre for this Municipal Class Environmental Assessment, a study which will define the problem, identify/evaluate alternative solutions, and determine a preferred design in consultation with regulatory agencies and the public. The study is being undertaken in accordance with the planning and design process for Schedule 'B' projects, as outlined in the "Municipal Class Environmental Assessment" document (as amended in 2023), which is approved under the Ontario Environmental Assessment Act.

Personal information is collected under the authority of the Environmental Assessment Act and will be used in the assessment process. With exception of personal information, all comments shall become part of the public records. Questions about this collection should be directed to the Project Manager listed above.

This notice first issued on **October 21st, 2024**.

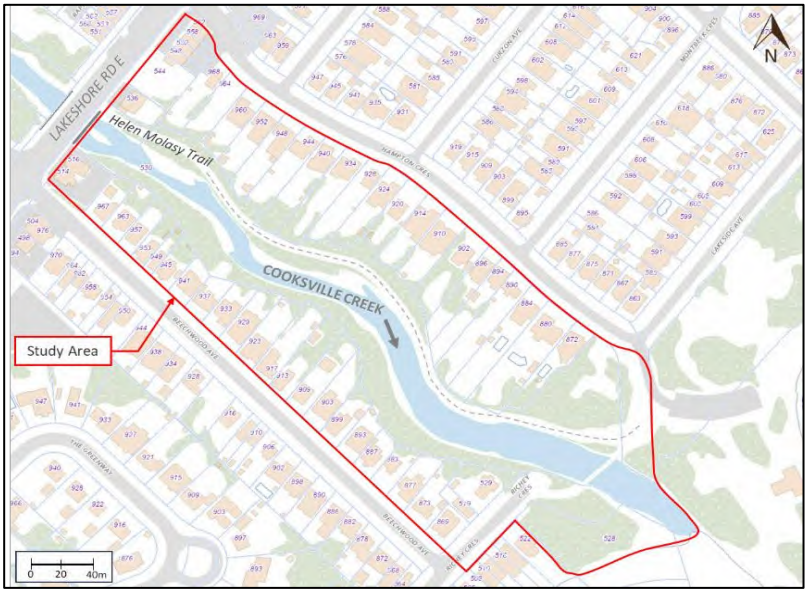
City of Mississauga
Notice of Completion

Municipal Class Environmental Assessment Study:
Cooksville Creek Erosion Control Project – South of Lakeshore Road

Project Background

The City of Mississauga (the City) has completed a Schedule B Municipal Class Environmental Assessment Study for erosion control and restoration of Cooksville Creek south of Lakeshore Road.

The City recognizes that this section of Cooksville Creek has been impacted by recent storm events and high lake levels and is in need of rehabilitation. Plans also considered the deteriorated condition of the adjacent city trail through Helen Molasy Memorial Park that sits above the east bank of the creek, as well as the neighbouring properties which experience ongoing drainage issues.



Study Completion

The Study has examined this section of Cooksville Creek and Helen Molasy Trail along with the associated natural resources to identify existing problems, potential risks, and opportunities for watercourse restoration and drainage improvements.

Through the Class EA process, various alternative solutions were developed and evaluated by the Study Team with input through public and agency consultation. The preferred watercourse erosion control strategy includes extended channel restoration works through the use of vegetated buttress bank protection treatment with embedded armourstone retaining walls. The preferred drainage restoration strategy includes the hybrid drainage solution involving the replacement and enhancement of the drainage infrastructure associated with the Helen Molasy Trail.

A Project File Report (PFR) documenting the planning process has been prepared and will be available for a comment period between **February 24th 2025** and **March 28th 2025** on the City's project webpage:

https://www.mississauga.ca/projects-and-strategies/environmental-assessments/cooksville-creek-erosion-control-south-of-lakeshore-road/

Should a member of the public request a hard copy of the report, the City will make arrangements for delivery of the PFR. If you have any questions or comments regarding the study, please contact the Project Managers listed below by March 28th 2025:

Greg Frew, P.Eng.
City Project Manager
City of Mississauga
300 City Centre Drive
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Limited
2600 Skymark Avenue
Mississauga, ON L4W 5B2
(416) 705-2367
Amos.R@aquaforbeech.com

City of Mississauga
Notice of Completion

Municipal Class Environmental Assessment Study:
Cooksville Creek Erosion Control Project – South of Lakeshore Road

In addition, a Section 16 Order request may be made to the Ministry of the Environment, Conservation and Parks (MECP or Ministry) for an order requiring a higher level of study (i.e., requiring an individual/comprehensive Environmental Assessment approval before being able to proceed), or that conditions be imposed (e.g., require further studies), only on the grounds that the requested order may prevent, mitigate or remedy adverse impacts on constitutionally protected Aboriginal and treaty rights. Requests on other grounds will not be considered. Requests are to include the requester contact information and full name.

The Section 16 Order request should be sent in writing or by email by March 28th 2025 to both contacts below with a copy to Greg Frew at the City.

Minister of the Environment, Conservation and Parks
Ministry of Environment, Conservation and Parks
777 Bay Street, 5th Floor
Toronto, Ontario M7A 2J3
minister.mecp@ontario.ca

Director, Environmental Assessment Branch
Ministry of Environment, Conservation and Parks
135 St. Clair Avenue West, 1st Floor
Toronto, Ontario M4V 1P5
EABDirector@ontario.ca

This notice signals the Notice of Completion for this Municipal Class Environmental Assessment, a study which defines the problem, identifies/evaluates alternative solutions, and recommends a preferred design in consultation with regulatory agencies and the public. The study has been undertaken in accordance with the planning and design process for Schedule 'B' projects, as outlined in the "Municipal Class Environmental Assessment" document (as amended in 2023), which is approved under the Ontario Environmental Assessment Act.

Personal information is collected under the authority of the Environmental Assessment Act and will be used in the assessment process. With exception of personal information, all comments shall become part of the public records.

This notice issued on **February 24th, 2025**.

Appendix I – Public Consultation Summary

Public Consultation - Communications Log

Date (yyyy/mm/dd)	From	To	Medium (e.g., email, letter, call)	Communication Description - Nature of Concern(s) or Interest(s)	Response/Follow Up
2024-02-20	**Greg Frew** Project Manager City of Mississauga **Rob Amos** Consultant Project Manager Aquafor Beech Limited	Local Residents as Defined in the Project Stakeholder List	In person letter delivery	Notice of Study Commencement – Introduction to the Project	**Follow-up:** City of Mississauga to invite residents to an open house to discuss the EA.
2024-03-19	[redacted] Local Resident	**Greg Frew** Project Manager City of Mississauga **Rob Amos** Consultant Project Manager Aquafor Beech Limited	Email	Indicated interest in being involved in the upcoming public consultation for the study	**Follow-up:** Proponent and consultant team has added resident to the stakeholder contact list to receive updates on upcoming public consultation activities
2024-04-26	[redacted] Local Resident	**Greg Frew** Project Manager City of Mississauga **Rob Amos** Consultant Project Manager Aquafor Beech Limited	Email	Indicated interest in being involved in the upcoming public consultation for the study	**Follow-up:** Proponent and consultant team has added resident to the stakeholder contact list to receive updates on upcoming public consultation activities
2024-10-21	**Greg Frew** Project Manager City of Mississauga **Rob Amos** Consultant Project Manager Aquafor Beech Limited	Stakeholders as Defined in the Project Stakeholder List	Email, posting on City Website	Notice of Public Information Centre	**Follow-up:** Interested parties to attend PIC, to gain additional information about the project, and provide feedback to be incorporated into the EA process.

Public Consultation - Communications Log

Date (yyyy/mm/dd)	From	To	Medium (e.g., email, letter, call)	Communication Description - Nature of Concern(s) or Interest(s)	Response/Follow Up
2024-10-21	**Greg Frew** Project Manager City of Mississauga **Rob Amos** Consultant Project Manager Aquafor Beech Limited	Local Residents as Defined in the Project Stakeholder List	In person letter delivery	Notice of Public Information Centre	**Follow-up:** Interested parties to attend PIC, to gain additional information about the project, and provide feedback to be incorporated into the EA process.
2024-02-24	**Greg Frew** Project Manager City of Mississauga **Rob Amos** Consultant Project Manager Aquafor Beech Limited	Stakeholders as Defined in the Project Stakeholder List	Email, posting on City Website	Notice of Study Completion	**Follow-up:** Stakeholders to provide comments between February 24th 2025 and March 28th 2025 on the City's project webpage if desired.
2025-02-24	**Greg Frew** Project Manager City of Mississauga **Rob Amos** Consultant Project Manager Aquafor Beech Limited	Local Residents as Defined in the Project Stakeholder List	In person letter delivery	Notice of Study Completion	**Follow-up:** Local residents to provide comments between February 24th 2025 and March 28th 2025 on the City's project webpage if desired.

CITY OF MISSISSAUGA – NOTICE OF STUDY COMMENCEMENT

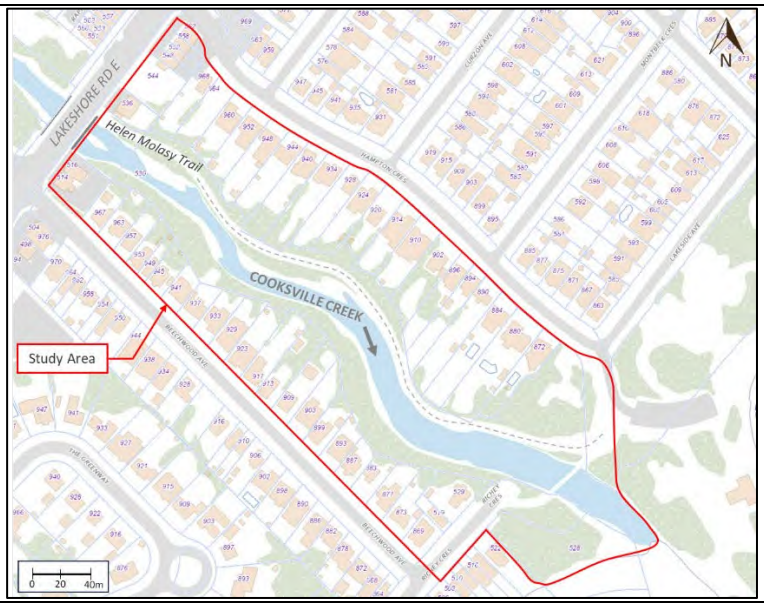
Municipal Class Environmental Assessment Study: Cooksville Creek South of Lakeshore Road

WHAT?

- The City of Mississauga is undertaking a Municipal Class Environmental Assessment (Class EA) Study for the Cooksville Creek Erosion Control Project South of Lakeshore Road.

WHY?

- The City of Mississauga recognizes that this section of Cooksville Creek has been impacted by recent storm events and high lake levels and is in need of rehabilitation. Plans will also need to consider the deteriorated condition of the adjacent city trail through Helen Molasy Memorial Park that sits above the east bank of the creek, as well as the neighbouring properties which have experienced ongoing drainage issues.



HOW?

- The study will examine this section of the Cooksville Creek and Helen Molasy Trail to identify existing problems, potential risks, and opportunities for restoration and drainage improvements.
- Through the Class EA process, the Study Team will develop and evaluate multiple alternative solutions and refine the options through public and agency consultation (see below). The Study Team will then select a Preferred Alternative.
- At the end of the study, a Project File, documenting the study process will be available for public review.
- Following completion of the Class EA Study, designs will be developed and implemented in accordance with study recommendations.

GET INVOLVED!

- Consultation is an important part of the Class EA process. Public input and comment are invited for incorporation into the planning and design of this project.
- A Public Information Centre (PIC) will be held to present the study findings, to consider alternative solutions, and to answer any questions you may have. Details regarding the PIC will be advertised publicly as the study progresses.
- Project information will be made available on the City's project website: https://www.mississauga.ca/projects-and-strategies/environmental-assessments/cooksville-creek-erosion-control-south-of-lakeshore-road/
- If you have any questions of comments regarding the study, or wish to be added or removed from the study mailing list, please contact:

Greg Frew, P.Eng.
Project Manager
City of Mississauga
300 City Centre Dr, Suite 800
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Ltd.
2600 Skymark Avenue, Unit 6-202
Mississauga, ON L4W 5B2
(905) 629-0099, ext. 294
Amos.R@aquaforbeech.com

This notice signals the commencement of the Class EA, a study which will define the problem, identify/evaluate alternative solutions, and determine a preferred design in consultation with regulatory agencies and the public. The study is being undertaken in accordance with the planning and design process for Schedule 'B' projects, as outlined in the "*Municipal Class Environmental Assessment*" document (October 2000, amended in 2015), which is approved under the Ontario *Environmental Assessment Act*.

Personal information is collected under the authority of the Environmental Assessment Act and will be used in the assessment process. With exception of personal information, all comments shall become part of the public records. Questions about this collection should be directed to the Project Manager listed above.

This notice was first issued February, 2024.

From: Greg Frew
To: Rob Amos (amos.r@aquaforbeech.com)
Cc: ursulak.j (ursulak.j@aquaforbeech.com); cota.c@aquaforbeech.com
Subject: FW: [EXTERNAL] Cooksville Creek Erosion Control Project south of Lakeshore Road
Date: March 19, 2024 10:19:39 AM

Hi Rob

Please add [redacted] to our project contact list, if he's not already on.
He's at [redacted].

Thanks,
Greg.

-----Original Message-----
From: Greg Frew
Sent: Tuesday, March 19, 2024 10:15 AM
To: [redacted]' <[redacted]>
Cc: Rob Amos (amos.r@aquaforbeech.com) <amos.r@aquaforbeech.com>; ursulak.j (ursulak.j@aquaforbeech.com) <ursulak.j@aquaforbeech.com>; cota.c@aquaforbeech.com
Subject: RE: [EXTERNAL] Cooksville Creek Erosion Control Project south of Lakeshore Road

Good morning [redacted].

Thanks very much for your interest in our Cooksville Creek Erosion Control Project. We'll be sure to add you to our contact list so that you receive further updates as the study progresses, including the timing for a planned Public Information Centre expected later this year.

We too recognize the value of the trees along the trail. Ultimately, some trees may need to be removed as they are growing through the banks of the creek and the slopes adjacent to the trail - both of which are in need of repairs. However, we'll be working closely with the City's parks department and the Credit Valley Conservation authority to develop the necessary tree preservation plans and restoration/replacement plans as part of the project.

Thanks again,
Greg.

Greg Frew, P.Eng.
Stormwater Drainage Engineer, Environmental Services Infrastructure Planning and Engineering Services Division
Transportation and Works Department City of Mississauga
CC905.615.3200 ext. 3362
greg.frew@mississauga.ca
www.mississauga.ca

-----Original Message-----
From: [redacted] <[redacted]>
Sent: Monday, March 18, 2024 5:30 PM
To: Greg Frew <Greg.Frew@mississauga.ca>
Subject: [EXTERNAL] Cooksville Creek Erosion Control Project south of Lakeshore Road

_____
[CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.] _____

Hello,

I would like to be kept up to date on this project. I have lived on Montbeck Cres in the neighbourhood on the east side of this section of the creek for over 40 years. I don't want to lose the delightful shaded walking path on the east side of the creek. Saving all the trees possible to maintain shade on the path is also a concern.

Thank you,

[redacted]

From: Greg Frew
To: Rob Amos (amos.r@aquaforbeech.com)
Cc: ursulak.j (ursulak.j@aquaforbeech.com); cota.c@aquaforbeech.com
Subject: FW: Addition to Mailing List for Cooksville Creek Erosion Project
Date: April 26, 2024 9:36:58 AM
Attachments: image001.jpg

Hi Rob.

Please add [redacted] to our project mailing list.

Thanks,
Greg.

From: Greg Frew
Sent: Friday, April 26, 2024 9:20 AM
To: '[redacted]' <[redacted]>
Subject: RE: Addition to Mailing List for Cooksville Creek Erosion Project

Good morning [redacted].

Thanks very much for your interest in this important City project.

Currently, our engineering consultant is undertaking the necessary environmental inventories and surveys. Once complete, we'll develop a series of options to restore the creek and invite input from interested landowners such as yourself before selecting a preferred option.

We'll be sure to add you to the project contact list.

Thanks again,
Greg.

Greg Frew, P.Eng.
Stormwater Drainage Engineer, Environmental Services
Infrastructure Planning and Engineering Services Division
Transportation and Works Department
City of Mississauga
☎ 905.615.3200 ext. 3362
✉ greg.frew@mississauga.ca
www.mississauga.ca

From: [redacted] <[redacted]>
Sent: Friday, April 26, 2024 8:03 AM
To: Greg Frew <Greg.Frew@mississauga.ca>
Subject: [EXTERNAL] Addition to Mailing List for Cooksville Creek Erosion Project

[CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.]

Hi Greg,

My house is [redacted] along Cooksville Creek [redacted] and I would like to be as involved as I can be in the project.

Thanks!

[redacted]

This message and any attachments contain confidential information and are solely for the intended recipient. If you are not the intended recipient, any dissemination, review, disclosure, forwarding, distribution, copying or reliance on the contents of this message is strictly prohibited. Please notify the sender immediately by email if you have received this message in error and delete this message immediately from your system.

City of Mississauga
Notice of Public Information Centre

Municipal Class Environmental Assessment Study:
Cooksville Creek Erosion Control Project – South of Lakeshore Road

What?

The City of Mississauga (the City) is undertaking a Schedule B Municipal Class Environmental Assessment (Class EA) Study for erosion control and restoration of Cooksville Creek south of Lakeshore Road.



Why?

The City recognizes that this section of Cooksville Creek has been impacted by recent storm events and high lake levels and is in need of rehabilitation. Plans will also need to consider the deteriorated condition of the adjacent city trail through Helen Molasy Memorial Park that sits above the east bank of the creek, as well as the neighbouring properties which have experienced ongoing drainage issues.

How?

- The Study has examined this section of Cooksville Creek and Helen Molasy Trail and associated natural resources to identify existing problems, potential risks, and opportunities for restoration and drainage improvements.
- Through the Class EA process, various alternative solutions are being developed and evaluated by the Study Team and will be refined through public and agency consultation (see below). The Study Team will then select a preferred alternative and proceed with design of the recommended works.
- A Project File documenting the planning process will be available for public review at the end of the Study.

Public Consultation

- Consultation is an essential part of the EA process. The City would like anyone with an interest in the Study to have an opportunity to provide input and help inform the decision-making process.
- An in-person, Public Information Centre has been arranged to allow local residents and interested members of the public an opportunity to review and comment on the project findings to date, the alternative solutions being considered, the evaluation process, the preliminary preferred solution, and the next steps:

Date:	Tuesday, October 29th, 2024
Time:	afternoon: 3pm – 5pm evening: 6pm - 8pm
Location:	Small Arms Inspection Building 1352 Lakeshore Road East

- Additional project information will be made available on the City's project website:
  https://www.mississauga.ca/projects-and-strategies/environmental-assessments/cooksville-creek-erosion-control-south-of-lakeshore-road/

City of Mississauga
Notice of Public Information Centre

Municipal Class Environmental Assessment Study:
Cooksville Creek Erosion Control Project – South of Lakeshore Road

- Feedback is encouraged and comments are requested by **November 26th, 2024**. A comment form is available on the project website. Input gathered through the public consultation will be used to support the EA study.
- If you have comments or questions, require further information or would like to be added to the Study mailing list to receive future notifications, please contact:

Greg Frew, P.Eng.
City Project Manager
City of Mississauga
300 City Centre Drive, Suite 800
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Ltd.
2600 Skymark Ave.
Mississauga, ON L4W 5B2
(416) 705-2367
Amos.R@aquaforbeech.com

This notice signals the Notice of Public Information Centre for this Municipal Class Environmental Assessment, a study which will define the problem, identify/evaluate alternative solutions, and determine a preferred design in consultation with regulatory agencies and the public. The study is being undertaken in accordance with the planning and design process for Schedule 'B' projects, as outlined in the "Municipal Class Environmental Assessment" document (as amended in 2023), which is approved under the Ontario Environmental Assessment Act.

Personal information is collected under the authority of the Environmental Assessment Act and will be used in the assessment process. With exception of personal information, all comments shall become part of the public records. Questions about this collection should be directed to the Project Manager listed above.

This notice first issued on **October 21st, 2024**.

Please sign in

Cooksville Creek Erosion Control Project – South of Lakeshore Road

Personal information is collected under the authority of the Environmental Assessment Act and will be used in the assessment process. With exception of personal information, all comments shall become part of the public records. Questions about this collection should be directed to the Project Manager at **greg.frew@mississauga.ca**.

Name (please print)	**Email address**	**Address/Postal code**	**Affiliation** (if applicable)	**Email list** ✓
[redacted]	[redacted]	[redacted]		✓
[redacted]	[redacted]	[redacted]		✓
[redacted]	[redacted]	[redacted]		✓



WELCOME

Class Environmental Assessment for Cooksville Creek South of Lakeshore Road

PUBLIC INFORMATION CENTRE

October 29th, 2024

Your comments are encouraged and appreciated, as this will provide us an opportunity to address project issues and concerns.

Aquafor Beech Limited

MISSISSAUGA

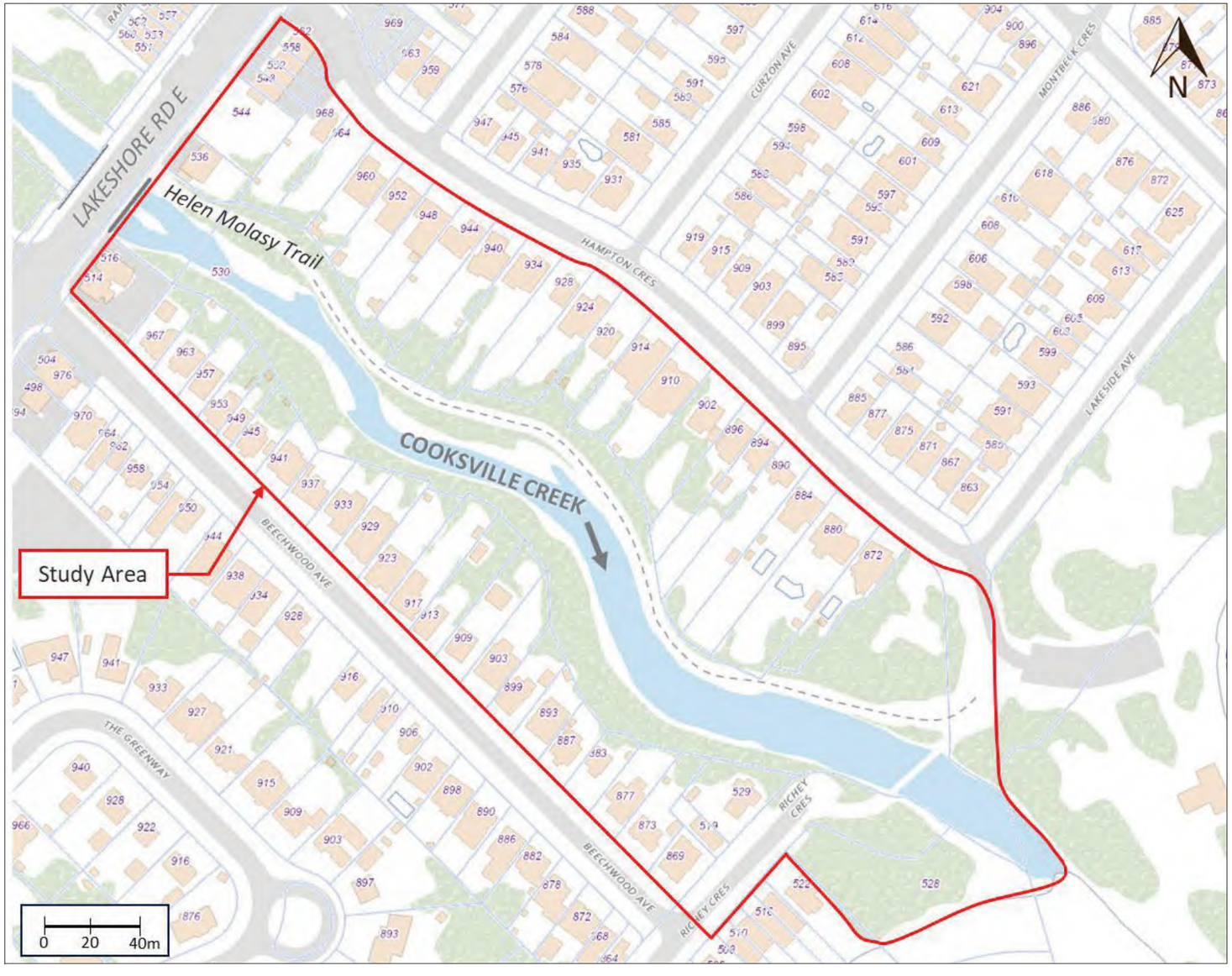
LAND ACKNOWLEDGEMENT

We acknowledge the lands which constitute the present-day City of Mississauga as being part of the Treaty and Traditional Territory of the Mississaugas of the Credit First Nation, The Haudenosaunee Confederacy, the Huron-Wendat and Wyandot Nations. We recognize these peoples and their ancestors as peoples who inhabited these lands since time immemorial. The City of Mississauga is home to many global Indigenous Peoples.

As a municipality, the City of Mississauga is actively working towards reconciliation by confronting our past and our present, providing space for Indigenous peoples within their territory, to recognize and uphold their Treaty Rights and to support Indigenous Peoples. We formally recognize the Anishinaabe origins of our name and continue to make Mississauga a safe space for all Indigenous peoples.

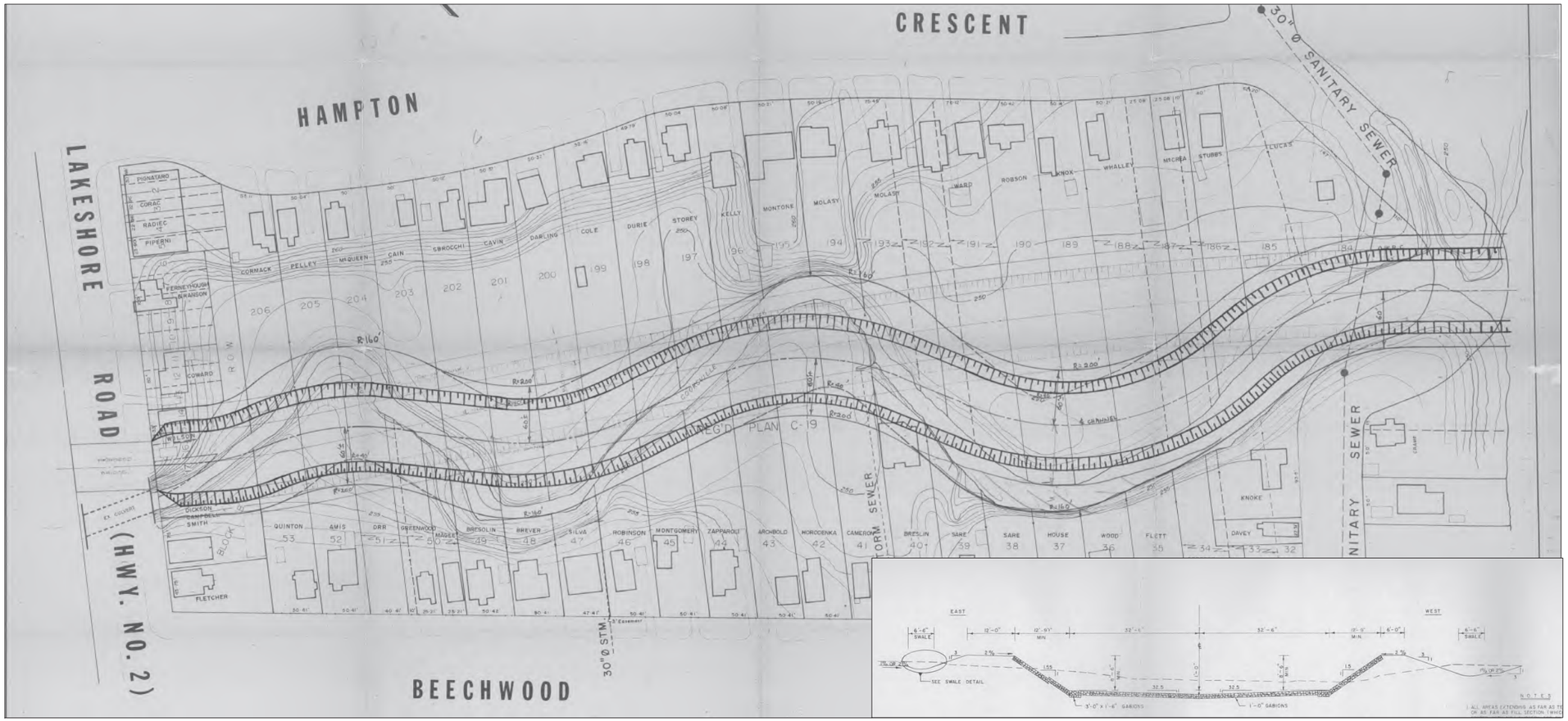
STUDY AREA

The study area includes the Cooksville Creek corridor from Lakeshore Road East to Lake Ontario, as well as adjacent segments of the Helen Molasy Trail.



CVC's HISTORICAL CHANNELIZATION

Within the study area, Credit Valley Conservation (CVC) undertook the Channelization of Cooksville Creek in the 1970s. The channel was straightened, and lined with stone filled wire gabion baskets to provide erosion protection.



Historic Engineering Drawing of the Cooksville Creek Channel Realignment (1975)

CVC's HISTORICAL CHANNELIZATION

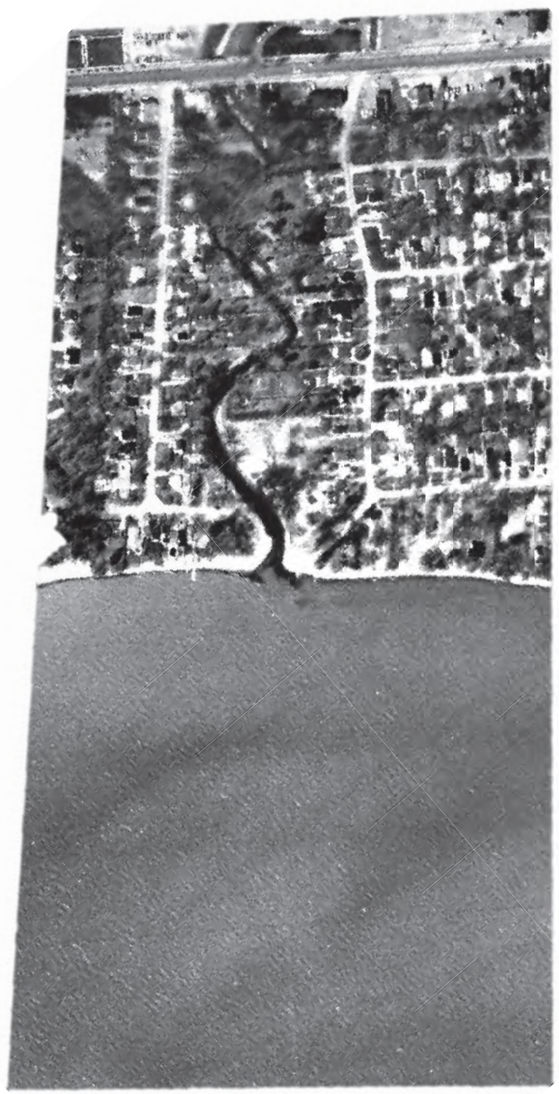
Ariel view of channelization a few years after channel realignment. The Helen Molasy Trail is clearly visible, which runs from Lakeshore Road to Lake Ontario



Study Area Conditions After Creek Realignment (1981)

HISTORICAL IMAGE COMPARISON

The below images show the changes to the Creek's planform as part of CVC's historical channelization project.



Study Area Conditions in 1975
(Before Realignment)



Study Area Conditions in 1977
(During Realignment)



Study Area Conditions in 1980
(After Realignment)

STUDY AREA IMAGES

Presently, the study area experiences widespread erosion, with deteriorated erosion protection measures such as gabion baskets. Erosion within the Creek has placed the trail system at an elevated risk.



Trail Conditions Along Helen Molasy Trail



Creek Conditions at Lake Ontario



Deteriorated Gabion Baskets Throughout Study Area



Armourstone Retaining Wall Along Trail

STUDY PURPOSE / PROBLEM DEFINITION

The City of Mississauga is undertaking a Municipal Class Environmental Assessment (Class EA) Study for the Cooksville Creek Erosion Control Project South of Lakeshore Road.

The City of Mississauga recognizes that this section of Cooksville Creek has been impacted by recent storm events and high lake levels and is in need of rehabilitation. Plans will also need to consider the deteriorated condition of the adjacent city trail through Helen Molasy Memorial Park that sits above the east bank of the creek, as well as the neighboring properties which have experienced ongoing drainage issues.

PUBLIC INFORMATION CENTRE PURPOSE



This Public Information Centre (PIC) is Designed to:

- Present information on existing conditions
- Present alternative approaches to erosion protection



To Gain Community Input on:

- Existing conditions information
- Alternative evaluation criteria and scoring
- Selection of preferred solutions

MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT PROCESS

CLASS EA PROCESS - SCHEDULE B

Many projects related to municipal systems that are similar in nature, are carried out routinely, and have predictable and mitigatable environmental effects are addressed in accordance with the Municipal Engineers Association "Municipal Class Environmental Assessment" (October 2000, as amended in 2007, 2011, 2015 & 2023).

This study is being undertaken as a "Schedule B" project under the Municipal Class Environmental Assessment process. The flow chart below illustrates the key steps to be undertaken as part of the EA process.

Phase 1 – Identify Problems

- ✓ Identify Problem or Opportunity
- ✓ Public Consultation



We Are Here →

Phase 2 – Alternate Solutions

- ✓ Identify Alternative Solutions
- ✓ Inventory Natural, Social, Economic Environment
- ✓ Environmental Impacts and Mitigation
- ✓ Alternatives Evaluation
- Review Agency and Public Consultation
- Select Preferred Solution
- Review and Confirm Choice of Schedule
- Notice of Completion to Review Agency & Public
- Implementation

NATURAL HERITAGE ASSESSMENT

The existing natural environment within the study area was reviewed through preliminary studies and background data, with the intention of identifying high-level constraints and sensitivities. The current scope of work included:

- Review and confirmation of prior vegetation community classification (Ecological Land Classification protocol);
- Terrestrial wildlife and habitat assessment;
- Species at Risk (SAR) screening and habitat assessment;
- Significant wildlife habitat (SWH) screening and assessment;
- Aquatic habitat and fish community characterization

More detailed field assessments are scheduled to be undertaken within the proposed mitigation project areas.



SPECIES AT RISK

For the purpose of this study, Species at Risk (SAR) and Species of Conservation Concern (SOCC) are defined as species listed as Endangered (END), Threatened (THR), or Special Concern (SC) under the Provincial Endangered Species Act (ESA) and/or the Federal Species at Risk Act (SARA).

Species included in the screening assessment include those provided by secondary sources and those documented via direct observations by Aquafor Beech Limited. **A total of 15 SAR and SOCC were determined to be present or have some potential to be present in the study area.** These species include:

1. Barn Swallow – Threatened
2. Bald Eagle – Special Concern
3. Eastern Wood-Pewee – Special Concern
4. Monarch Butterfly – Special Concern
5. Eastern Red Bat – Endangered
6. Eastern Small Footed Myotis – Endangered
7. Hoary Bat – Endangered
8. Little Brown Myotis – Endangered
9. Northern Myotis - Endangered
10. Silver Haired Bat – Endangered
11. Tricoloured Bat – Endangered
12. Eastern Milksnake – Special Concern
13. Midland Painted Turtle – Special Concern
14. Northern Map Turtle – Special Concern
15. Snapping Turtle – Special Concern

VEGETATION COMMUNITY CLASSIFICATION



Ecological Land Classification (ELC) is a standard practice used to describe, identify, classify and map vegetation communities on the landscape.

In total, 3 vegetation communities are within the study area. The 3 vegetation community types are included within the categories summarized in the table below.

Code	Vegetation Community
FOD7-3	Fresh-Moist Willow Lowland Deciduous Forest
OAO	Open Water
BBO1	Mineral Open Beach/Bar

FISHERIES & AQUATIC HABITAT

To assess the existing fisheries and aquatic habitat within the study area the following studies were undertaken:

- Aquatic community assessments of historic data;
- SAR screening and potential habitat identification; and,
- Field confirmation of site conditions.

Summary of Fish Community Assessment

Scientific Name	Common Name (Family)
Rhinichthys atratulus	Blacknose dace
Pimephales notatus	Bluntnose minnow
Culaea inconstans	Brook stickleback
Salmo trutta	Brown trout
Cyprinidae and Leuciscidae	Carps and Minnows
Luxiulus cornutus	Common Shiner
Semotilus atromaculatus	Creek chub
Pimephales promelas	Fathead minnow
Carassius auratus	Goldfish
Couesius plumbeus	Lake chub
Rhinichthys cataractae	Longnose dace
Oncorhynchus mykiss	Rainbow trout
Neogobius melanostomus	Round goby
Catostomus commersonii	White sucker

Key Findings:

- The fish species present within the study area are quite diverse and predominantly warmwater species.
- No records of Aquatic Species at Risk within the Study Area
- Habitat quality and quantity vary throughout the study area and is largely dependent on surrounding land uses.
- No fish barriers were observed throughout the study area.



Representative Aquatic Habitat

HYDROLOGY AND EXISTING FLOODING CONDITIONS

Flooding within the study area and surrounding properties is caused by the following factors:

- **High Flows within Cooksville Creek** spilling over into the surrounding areas
- **High Water Levels within Lake Ontario** causing backwatering effect within Creek
- **Precipitation and Snowmelt Events** unable to drain below trail berm



Ponded Water in Backyards After Spring Snowmelt

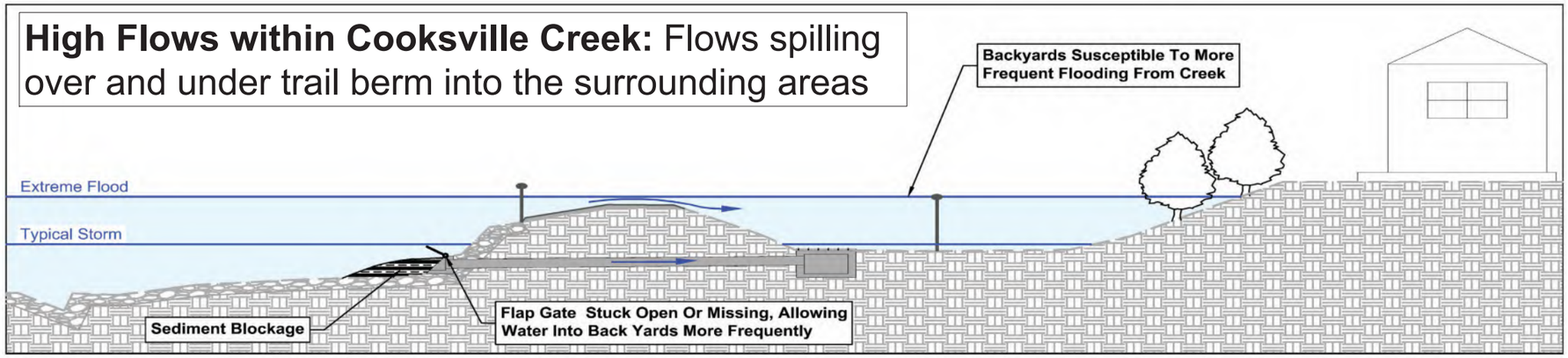


Evidence of Ponded Water After July 16th Storm Event

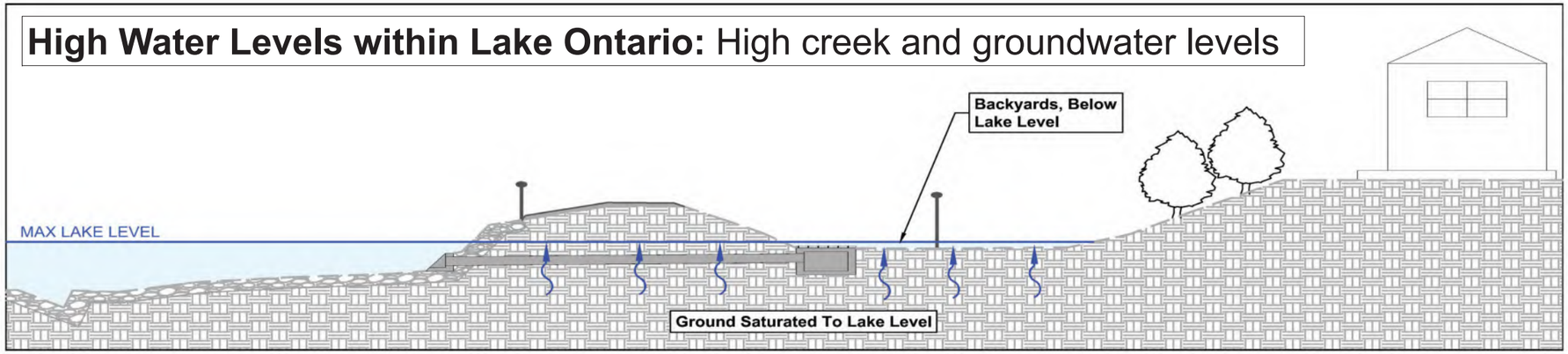
HYDROLOGY AND EXISTING FLOODING CONDITIONS

Current Operational Conditions

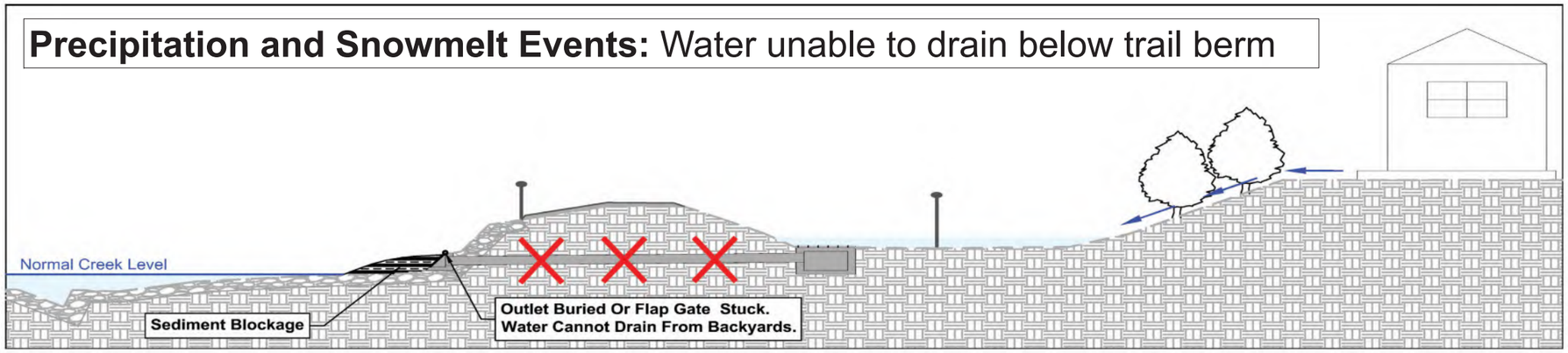
High Flows within Cooksville Creek: Flows spilling over and under trail berm into the surrounding areas



High Water Levels within Lake Ontario: High creek and groundwater levels



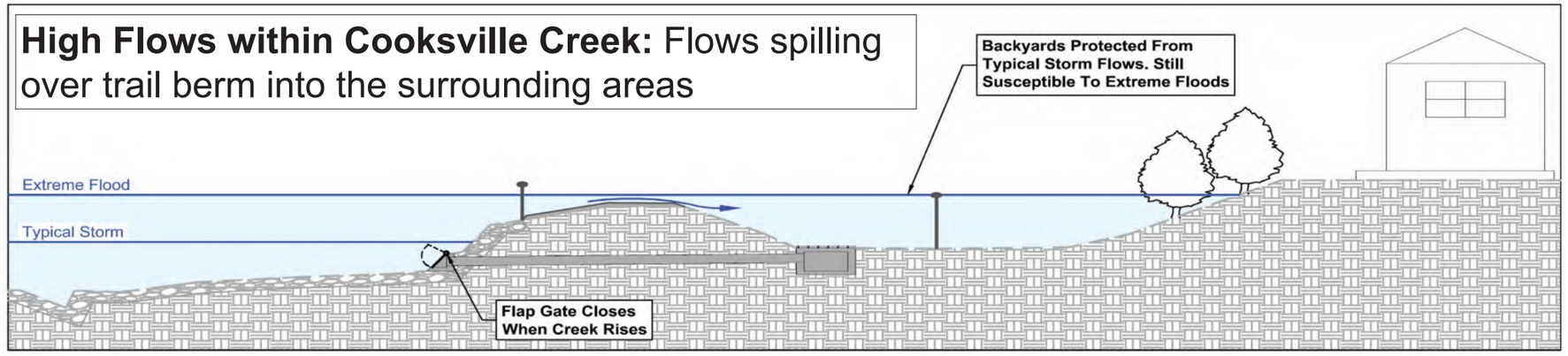
Precipitation and Snowmelt Events: Water unable to drain below trail berm



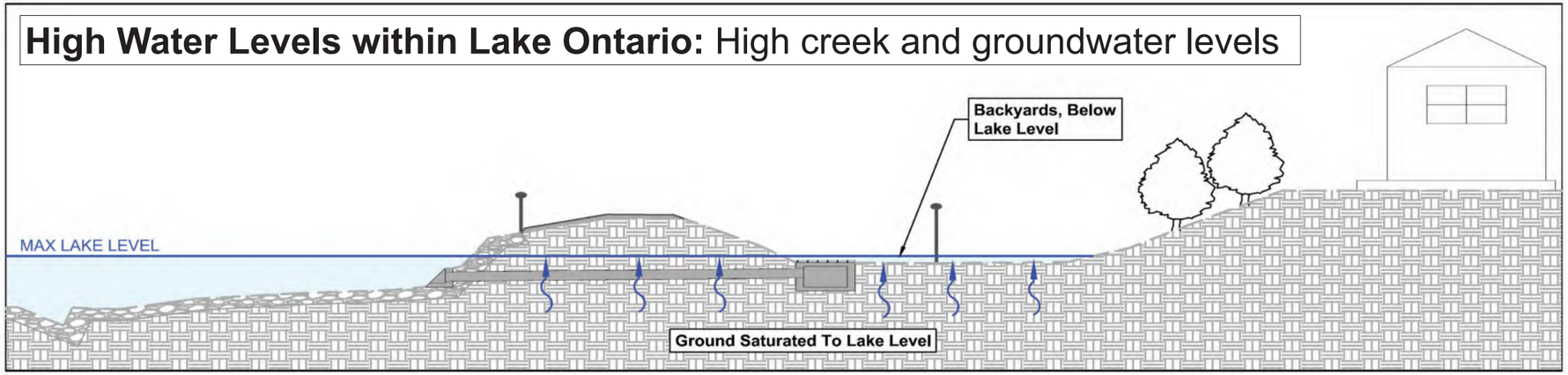
HYDROLOGY AND EXISTING FLOODING CONDITIONS

Intended Operational Conditions

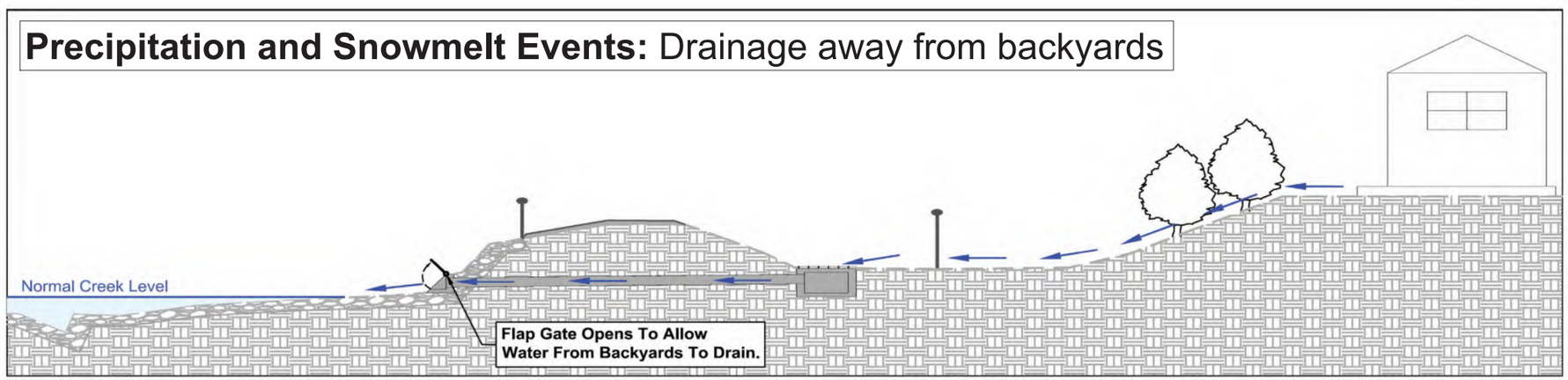
High Flows within Cooksville Creek: Flows spilling over trail berm into the surrounding areas



High Water Levels within Lake Ontario: High creek and groundwater levels

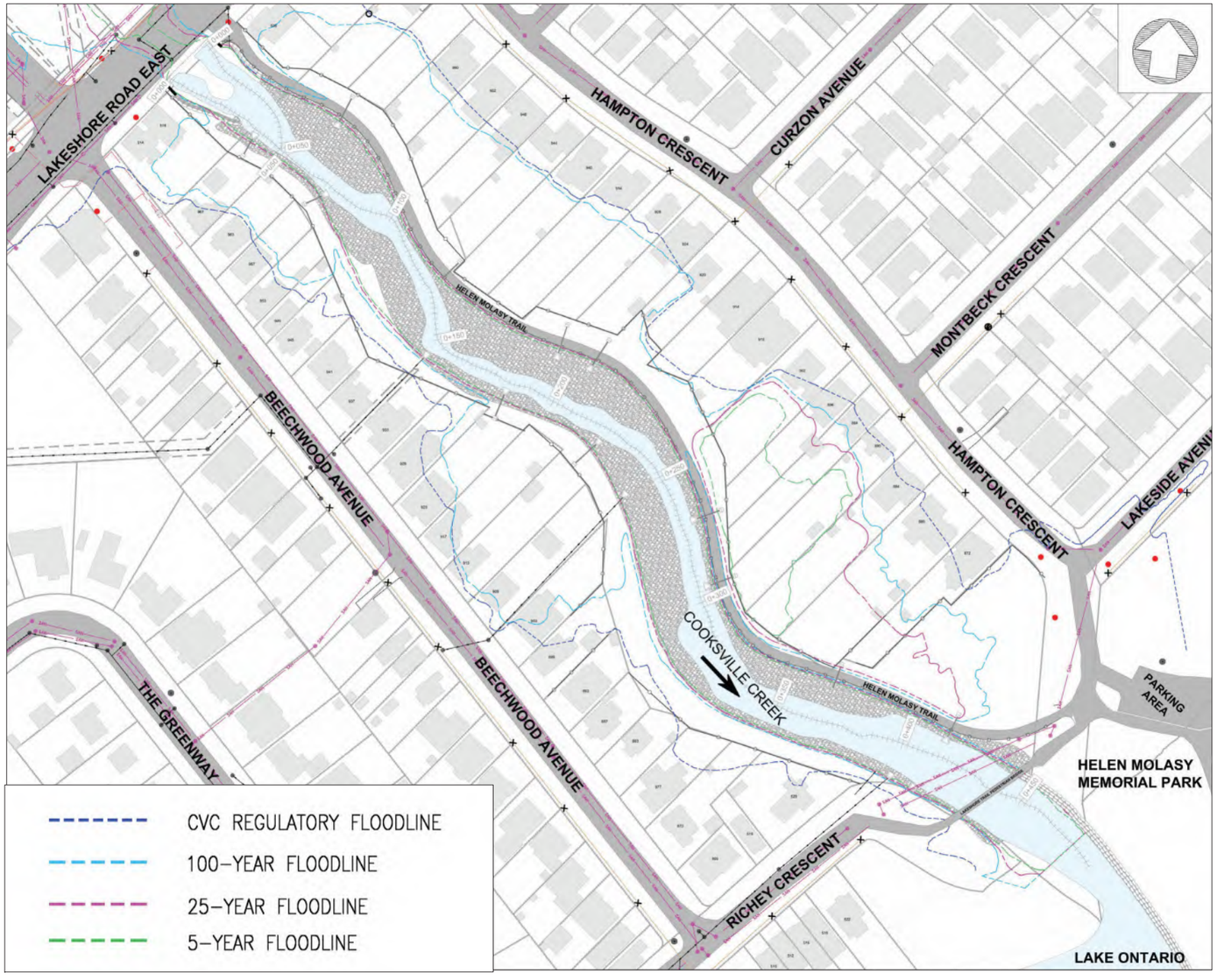


Precipitation and Snowmelt Events: Drainage away from backyards



HYDROLOGY AND EXISTING FLOODING CONDITIONS

- The existing berm below Helen Molasy Trail only provides a limited amount of flood protection under less extreme storm events
- The existing modelled floodlines are shown in the below image



ARCHAEOLOGY

- A Stage 1 Archaeological Assessment was completed for the Study Area, to determine areas of Archaeological potential

- The locations within the study area which contain archaeological potential will have a Stage 2 assessment completed prior to any proposed construction



EVALUATION CRITERIA

The following criteria are used to evaluate each alternative. It will help determine which alternative should be selected as the preliminary preferred alternative.

Comment sheets are provided to collect public feedback on the evaluation criteria and preliminary evaluation.

Physical and Natural Criteria

Erosion	Rate of Erosion, slope failures, and loss of tablelands
Water Quality	Impact on water quality
Aquatic Habitat	Impact on contributing aquatic habitat and linkage
Terrestrial Habitat	Impact on connectivity, diversity, and quantity/quality of habitat
Terrestrial Vegetation	Impact on existing riparian vegetation and mature trees

Technical and Engineering Criteria

Impact on Existing Infrastructure	Protection or potential failure of infrastructure (bridges, trails, storm outfalls)
Constructability	Easiness to access, move equipment and construct
Lifespan of Works	Expected lifespan / years of works before intervention needs to be repeated

Social and Cultural Criteria

Public Safety	Impact on public safety
Landowner Impacts	Impact on adjacent private properties and the City-owned Park
Benefit to Community	Access to trails, enjoyment of surrounding lands
Aesthetic Value	Impact on existing and proposed aesthetic value
Archaeology and Cultural Heritage	Impact on lands that have archaeological or heritage resources

Economic Criteria

Capital Costs	One time cost to City
Operations & Maintenance Costs	Requirement for regular, irregular or no maintenance activities and ensure effectiveness of implemented measures

EVALUATION APPROACH

The evaluation uses a ranking scheme which accounts for Physical and Natural Environment, Social / Cultural Environment, Economic Environment and Technical / Engineering Considerations.

A preliminary ranking has been applied to each alternative. The alternative with the highest score will define which alternative is preferred within the study area.

The ranking score has been normalized to provide equal weighting for each category of evaluation criteria, with a maximum score of 25 per category, and a maximum total score of 100.

Comment Sheets are provided to gain public input on the preliminary ranking. The ranking will be finalized once public input has been incorporated.

An example is illustrated in the adjacent table:

Ranking Scale						
Unideal / Most Negative Impact	0	1	2	3	4	Ideal / Most Positive Impact

Evaluation Criteria	Alternative 1 - Do Nothing	Alternative 2 - Local Channel Restoration Works	Alternative 3 - Extended Channel Restoration Works
Erosion	0	1	4
Water Quality	1	2	3
Aquatic Habitat	1	2	3
Terrestrial Habitat	3	2	1
Terrestrial Vegetation	3	2	1
Flooding	1	3	4
Criteria Subtotal	*9.00*	*12.00*	*16.00*
Weighted Score (maximum of 25 points)	*9.38*	*12.50*	*16.67*
Public Safety	1	2	2
Landowner Impacts	0	1	2
Benefit to Community	0	2	3
Aesthetic Value	2	3	3
Archaeological Impacts	4	2	2
Criteria Subtotal	*7.00*	*10.00*	*12.00*
Weighted Score (maximum of 25 points)	*11.25*	*12.50*	*15.00*
Impact on Existing Infrastructure	0	3	4
Constructability	4	3	2
Lifespan of Works	0	3	4
Criteria Subtotal	*4.00*	*9.00*	*10.00*
Weighted Score (maximum of 25 points)	*8.33*	*18.75*	*20.83*
Capital Costs	4	3	2
Operations & Maintenance Costs	0	3	4
Criteria Subtotal	*4.00*	*6.00*	*6.00*
Weighted Score (maximum of 25 points)	*12.50*	*18.75*	*18.75*
Total Score (maximum of 100 points)	41.46	62.50	71.25

Highest Score = Preferred Alternative

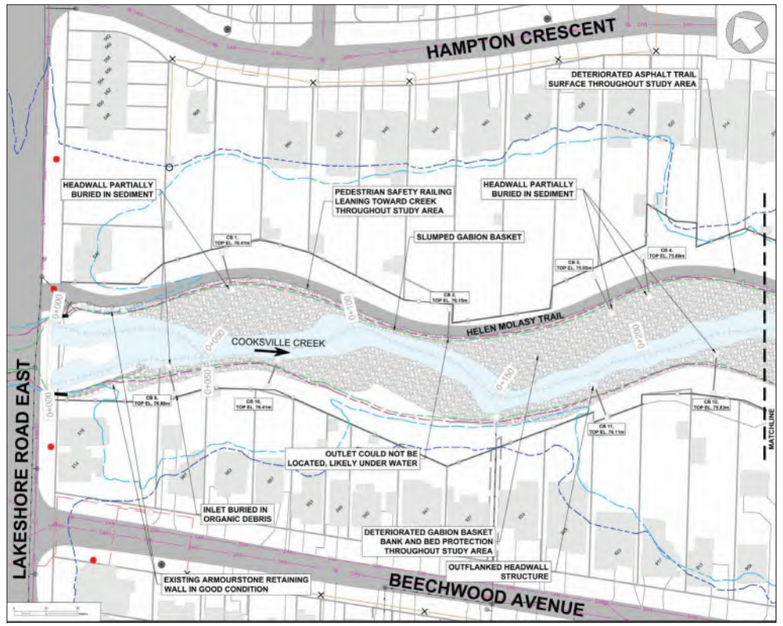
Alternative 1 – Do Nothing

Creek Restoration Alternative – Do Nothing

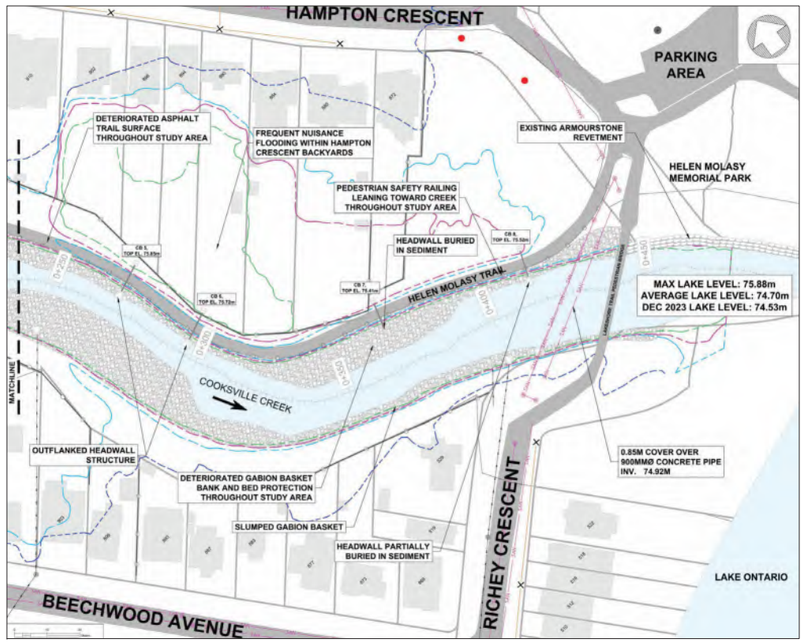
- Continued failure of existing bank protection measures, leading to continued erosion and deterioration of the stormwater infrastructure within the study area.

Drainage Alternative – Do Nothing

- Continued deterioration of the Helen Molasy Trail, and the associated risks to public safety within the study area.
- The drainage concerns resulting in ponding water in the adjacent properties will not be resolved.
- Continued maintenance activities will be required, including patching the deteriorating asphalt surface, and pumping standing water out of the residential backyards.



Alternative #1: Do Nothing – Upstream Segment



Alternative #1: Do Nothing – Downstream Segment

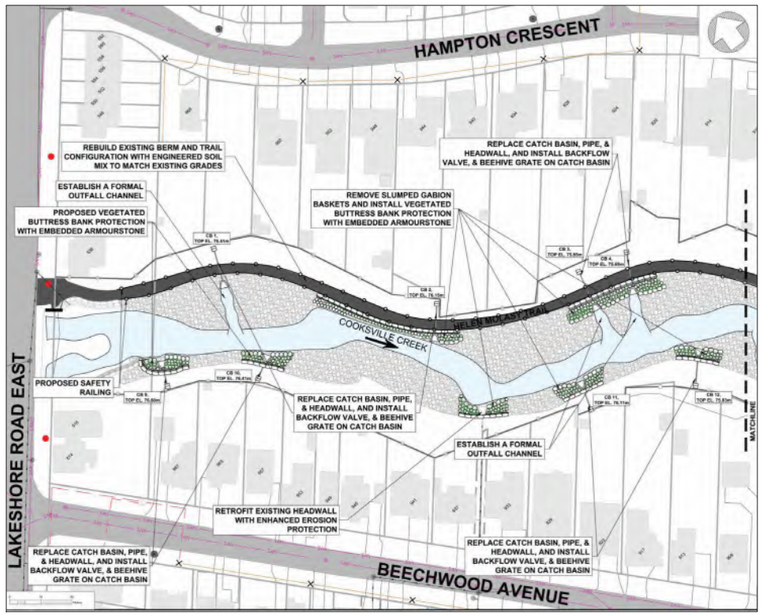
Alternative 2 – Local Channel Restoration Works & Like For Like Drainage Replacement

Creek Restoration Alternative – Local Channel Restoration Works

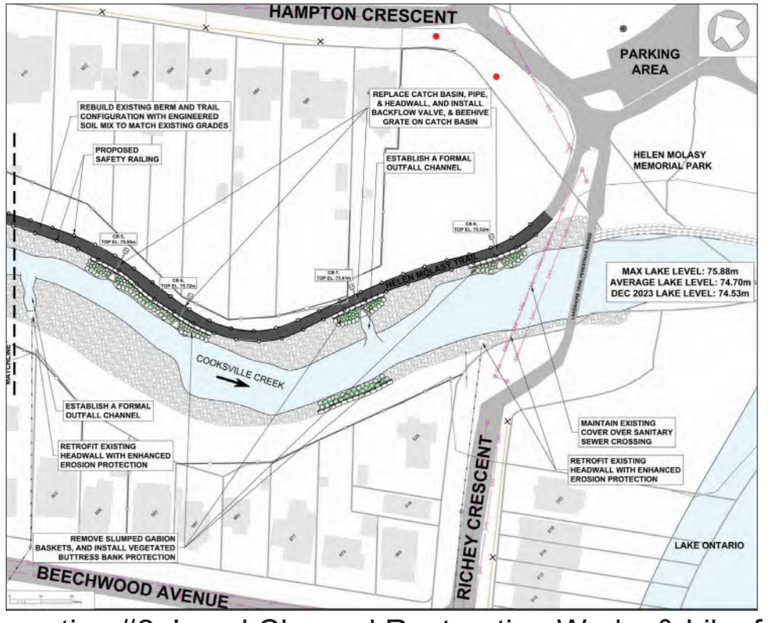
- Localized protection of stormwater infrastructure within the study area
- Restoration of a few key areas of severe bank protection failure, through the use of vegetated buttress bank protection treatment with embedded armourstone retaining walls

Drainage Alternative – Like for Like Drainage Replacement

- Like-for like replacement of the drainage infrastructure that connects the backyards within the adjacent residential neighborhoods to Cooksville Creek, including the eight (x8) catchbasin-outfall pairs along the East Bank, and the four (x4) catchbasin-outfall pairs along the West Bank
- Full depth restoration of the berm with engineered materials



Alternative #2: Local Channel Restoration Works & Like for Like Drainage Replacement – Upstream Segment



Alternative #2: Local Channel Restoration Works & Like for Like Drainage Replacement – Downstream Segment

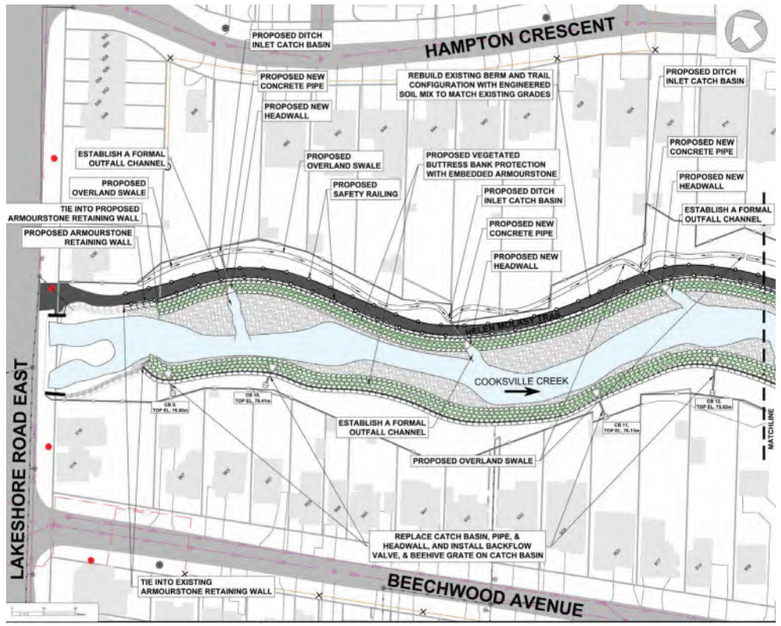
Alternative 3 – Extended Channel Restoration Works & Partial Drainage Consolidation

Creek Restoration Alternative – Extended Channel Restoration Works

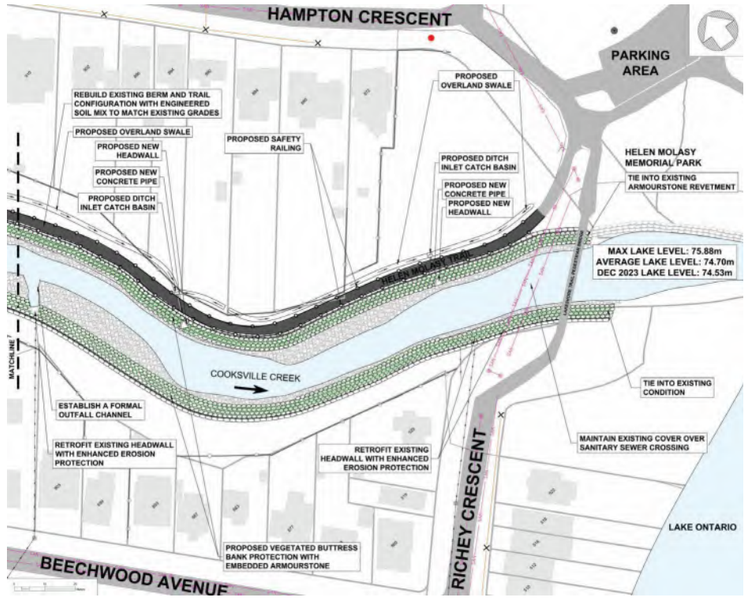
- Continuous bank restoration to provide comprehensive erosion protection within the entire study area, through the use of vegetated buttress bank protection treatment with embedded armourstone retaining walls

Drainage Alternative – Partial Drainage Consolidation

- This alternative would consist of the consolidation of drainage infrastructure within the study area,
- Reducing the catchbasin-outfall pairs on the East Side from eight (x8) to four (x4), through regrading of the drainage swales
- Full depth restoration of the berm with engineered materials



Alternative #3: Extended Channel Restoration Works & Partial Drainage Consolidation - Upstream Segment



Alternative #3: Extended Channel Restoration Works & Partial Drainage Consolidation – Downstream Segment

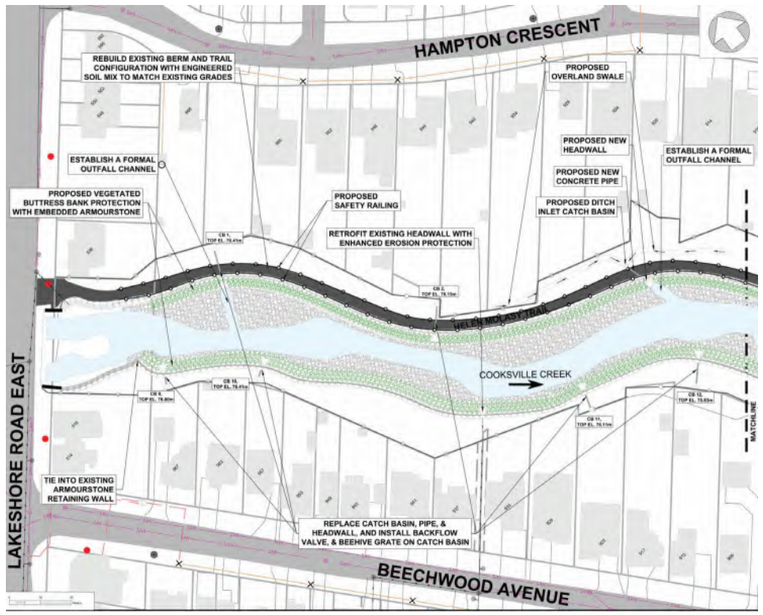
Alternative 4 – Extended Channel Restoration Works & Hybrid Drainage Solution

Creek Restoration Alternative – Extended Channel Restoration Works

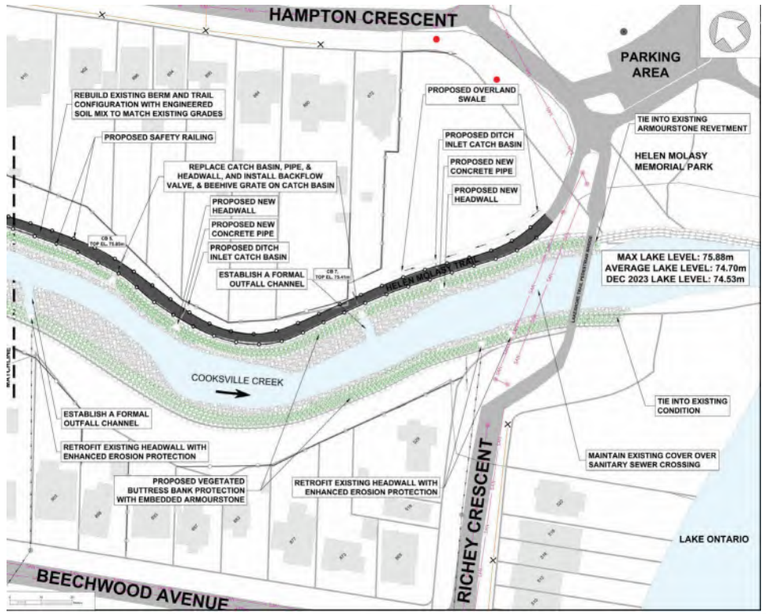
- Continuous bank restoration to provide comprehensive erosion protection within the entire study area, through the use of vegetated buttress bank protection treatment with embedded armourstone retaining walls

Drainage Alternative – Hybrid Drainage Solution

- Combination of like-for-like replacement and partial consolidation, recognizing the unique conditions and constraints throughout the study area
- Drainage swales will be regraded and optimized, and pipes will be upsized where required
- Full depth restoration of the berm with engineered materials



Alternative #4: Extended Channel Restoration Works & Hybrid Drainage Solution – Upstream Segment



Alternative #4: Extended Channel Restoration Works & Hybrid Drainage Solution – Downstream Segment

EVALUATION OF CREEK RESTORATION ALTERNATIVES

Cooksville Creek - Lakeshore Road to Lake Ontario Evaluation Matrix - Channel Restoration					
Category	**Evaluation Criteria**	**Indicator**	**Alternative 1 - Do Nothing**	**Alternative 2 - Local Channel Restoration Works**	**Alternative 3 - Extended Channel Restoration Works**
Physical and Natural Criteria	Erosion	Rate of erosion, slope failures, and loss of tablelands	**0**	**1**	**4**
	Water Quality	Impact on water quality	**1**	**2**	**3**
	Aquatic Habitat	Impact on contributing aquatic habitat	**1**	**2**	**3**
	Terrestrial Habitat	Impact on connectivity, diversity and quantity/quality of habitat	**3**	**2**	**1**
	Terrestrial Vegetation	Impact on existing riparian vegetation and mature trees	**3**	**2**	**1**
	Creek/Lake Flooding	Impact on flooding caused by high water levels from Cooksville Creek and Lake Ontario	**1**	**1**	**1**
		Criteria Subtotal	***9.00***	***10.00***	***13.00***
		Weighted Score (maximum of 25 points)	***9.38***	***10.42***	***13.54***
Social and Cultural Criteria	Public Safety	Impact on public safety	**1**	**2**	**2**
	Landowner Impacts	Impacts to adjacent private property	**0**	**1**	**2**
	Benefit to Community	Enjoyment of surrounding parkland, improvement to shared spaces	**0**	**2**	**3**
	Aesthetic Value	Impact on existing and proposed aesthetic value	**2**	**3**	**3**
	Archaeological Impacts	Impact on lands that have archaeological potentials	**4**	**2**	**2**
		Criteria Subtotal	***7.00***	***10.00***	***12.00***
		Weighted Score (maximum of 25 points)	***11.25***	***12.50***	***15.00***
Technical and Engineering Criteria	Impact on Existing Infrastructure	Protection of infrastructure (bridge, trail, and storm outfalls)	**0**	**3**	**4**
	Constructability	Easiness to access, move equipment and construct	**4**	**3**	**2**
	Lifespan of Works	Expected lifespan / years of works before intervention needs to be repeated	**0**	**3**	**4**
		Criteria Subtotal	***4.00***	***9.00***	***10.00***
		Weighted Score (maximum of 25 points)	***8.33***	***18.75***	***20.83***
Economic Criteria	Capital Costs	One time cost to City	**4**	**3**	**2**
	Operations & Maintenance Costs	Requirement for regular, irregular or no maintenance activities and ensure effectiveness of implemented measures	**0**	**3**	**4**
		Criteria Subtotal	***4.00***	***6.00***	***6.00***
		Weighted Score (maximum of 25 points)	***12.50***	***18.75***	***18.75***
Total Score (maximum of 100 points)			**41.46**	**60.42**	**68.13**

Highest Score = Preferred Alternative

EVALUATION OF DRAINAGE ALTERNATIVES

Aquafor Beech Limited | MISSISSAUGA

Cooksville Creek Environmental Assessment
Lakeshore Road to Lake Ontario

Cooksville Creek - Lakeshore Road to Lake Ontario Evaluation Matrix - Drainage						
Category	**Evaluation Criteria**	**Indicator**	**Alternative 1 - Do Nothing**	**Alternative 2 - Like-for-Like Drainage Replacement**	**Alternative 3 - Partial Drainage Consolidation**	**Alternative 4 - Hybrid Drainage Solution**
Physical and Natural Criteria	Erosion	Rate of erosion, slope failures, and loss of tablelands	0	1	2	2
	Water Quality	Impact on water quality	1	2	2	2
	Aquatic Habitat	Impact on contributing aquatic habitat	1	2	3	3
	Terrestrial Habitat	Impact on connectivity, diversity and quantity/quality of habitat	4	3	1	2
	Terrestrial Vegetation	Impact on existing riparian vegetation and mature trees	4	3	1	2
	Backyard Drainage	Impact on flooding caused by flow conveyance under berm	1	3	4	4
	Criteria Subtotal		*11.00*	*14.00*	*13.00*	*15.00*
	Weighted Score (maximum of 25 points)		*11.46*	*14.58*	*13.54*	*15.63*
Social and Cultural Criteria	Public Safety	Impact on public safety	1	4	4	4
	Landowner Impacts	Impacts to adjacent private property	0	4	2	3
	Benefit to Community	Enjoyment of surrounding parkland, improvement to shared spaces	0	4	4	4
	Aesthetic Value	Impact on existing and proposed aesthetic value	2	3	3	3
	Archaeological Impacts	Impact on lands that have archaeological potentials	4	2	2	2
	Criteria Subtotal		*7.00*	*17.00*	*15.00*	*16.00*
	Weighted Score (maximum of 25 points)		*13.75*	*21.25*	*18.75*	*20.00*
Technical and Engineering Criteria	Impact on Existing Infrastructure	Protection of infrastructure (bridge, trail, and storm outfalls)	0	3	4	4
	Constructability	Easiness to access, move equipment and construct	4	2	2	2
	Lifespan of Works	Expected lifespan / years of works before intervention needs to be repeated	0	2	3	3
	Criteria Subtotal		*4.00*	*7.00*	*9.00*	*9.00*
	Weighted Score (maximum of 25 points)		*8.33*	*14.58*	*18.75*	*18.75*
Economic Criteria	Capital Costs	One time cost to City	4	3	2	2
	Operations & Maintenance Costs	Requirement for regular, irregular or no maintenance activities and ensure effectiveness of implemented measures	0	2	3	3
	Criteria Subtotal		*4.00*	*5.00*	*5.00*	*5.00*
	Weighted Score (maximum of 25 points)		*12.50*	*15.63*	*15.63*	*15.63*
Total Score (maximum of 100 points)			**46.04**	**66.04**	**66.67**	**70.00**

Highest Score = Preferred Alternative

EXAMPLES OF RESTORATION SOLUTIONS



Example of Vegetated Buttress with Embedded Armourstone Retaining Wall



Example of Asphalt Trail Restoration with Safety Fencing



Example of Headwall Replacement with Enhanced Erosion Protection



Example of Vegetated Drainage Swale

NEXT STEPS

PUBLIC CONSULTATION – Fall 2024

- PIC commenting window is open for 30 day period. Comment submission deadline is November 26th, 2024
- Receive PIC feedback, incorporate input and update results
- Compile and review feedback. Confirm or adapt preliminary preferred alternatives.

SUBMIT EA PROJECT FILE – Winter/Spring 2025

- EA Project file posted for 30 day review period.

DETAILED DESIGN & IMPLEMENTATION

- Detailed design and permitting to proceed in 2025/2026.
- Construction timing dependant on City of Mississauga capital program

TO PROVIDE COMMENT, OR TO BE ADDED TO THE STUDY STAKEHOLDER LIST, PLEASE CONTACT:

Greg Frew, P.Eng.
City Project Manager
City of Mississauga
300 City Centre Drive
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
greg.frew@mississauga.ca

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Ltd.
2600 Skymark Avenue, Unit 6-202
Mississauga, Ontario
(416) 705-2367
amos.r@aquaforbeech.com

THANK YOU

FOR PARTICIPATING IN THE COOKSVILLE CREEK SOUTH OF LAKESHORE ROAD CLASS ENVIRONMENTAL ASSESSMENT

Class Environmental Assessment for Cooksville Creek South of Lakeshore Road Public Information Centre

COMMENT FORM

Contact Information (optional):

Name: [redacted]

Address: [redacted]

Telephone Number: [redacted]

Email: [redacted]

☑ Add my Email Address to the Project Notification List

1. Do you have any other questions or concerns about the existing conditions of the study area?
   - Erosion issues
   - Trail concerns
   - Fisheries conditions
   - Terrestrial ecology
   - Hydrology and hydraulics

Many of the trees need to cut/trim along the trail and new ones planted.

2. Do you have any questions or comments about the criteria used to evaluation the four alternatives?
   - Physical and Natural Criteria
   - Social and Cultural Criteria
   - Technical and Engineering Criteria
   - Economic Criteria

3. Do you have any feedback on the preliminary scoring of the alternatives or the commentary provided by the project team?

✓

4. The preliminary scoring of the alternatives by the project team suggests the following preliminary preferred alternatives:

   - Channel Restoration: Extended Channel Restoration Works
   - Trail Restoration: Hybrid Drainage Solution

   Do you support this outcome? Why or why not?

Yes - improved drainage would very much be appreciated.

5. Do you have any additional comments that you have regarding any aspect of the study?

If possible, put a "word" into the city to manage the amount of rain water from SQ1 currently being directed into the creek.

6. Was the information provided helpful to you?
   Yes
   No

7. Was the information provided:
   Too technical
   About right
   Not detailed enough

Thank you for your comments!

Please return completed forms by November 26th, 2024 to either contact listed below:

Greg Frew, P.Eng.
Project Manager
City of Mississauga
300 City Centre Drive
Mississauga, ON L5B 3C1
905-615-3200 Ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng
Project Manager
Aquafor Beech Limited
2600 Skymark Avenue, Unit 6-202
Mississauga, ON L4W 5B2
416-705-2367
amos.r@aquaforbeech.com

This notice signals the commencement of the Class EA, a study which will define the problem, identify/evaluate alternative solutions, and determine a preferred design in consultation with regulatory agencies and the public. The study is being undertaken in accordance with the planning and design process for Schedule 'B' projects, as outlined in the "Municipal Class Environmental Assessment" document (October 2000, amended in 2015), which is approved under the Ontario Environmental Assessment Act. Personal information is collected under the authority of the Environmental Assessment Act and will be used in the assessment process. With exception of personal information, all comments shall become part of the public records. Questions about this collection should be directed to the Project Manager listed above

Class Environmental Assessment for Cooksville Creek South of Lakeshore Road Public Information Centre

COMMENT FORM

Contact Information (optional):

Name: [redacted]

Address: [redacted]

Telephone Number: [redacted]

Email: [redacted]

☒ Add my Email Address to the Project Notification List

1. Do you have any other questions or concerns about the existing conditions of the study area?
   - Erosion issues
   - Trail concerns
   - Fisheries conditions
   - Terrestrial ecology
   - Hydrology and hydraulics

No

2. Do you have any questions or comments about the criteria used to evaluation the four alternatives?
   - Physical and Natural Criteria
   - Social and Cultural Criteria
   - Technical and Engineering Criteria
   - Economic Criteria

No

3. Do you have any feedback on the preliminary scoring of the alternatives or the commentary provided by the project team?

TO LEAVE CATCH BASIN #7 ON ANY ONE OF THE STUDY'S YOU CHOSE.

4. The preliminary scoring of the alternatives by the project team suggests the following preliminary preferred alternatives:

   - Channel Restoration: Extended Channel Restoration Works
   - Trail Restoration: Hybrid Drainage Solution

   Do you support this outcome? Why or why not?

YES, ALL NEED WORK.

5. Do you have any additional comments that you have regarding any aspect of the study?

NO

6. Was the information provided helpful to you?
   (Yes)
   No

7. Was the information provided:
   Too technical
   (About right)
   Not detailed enough

Thank you for your comments!

Please return completed forms by November 26th, 2024 to either contact listed below:

Greg Frew, P.Eng.
Project Manager
City of Mississauga
300 City Centre Drive
Mississauga, ON L5B 3C1
905-615-3200 Ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng
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amos.r@aquaforbeech.com

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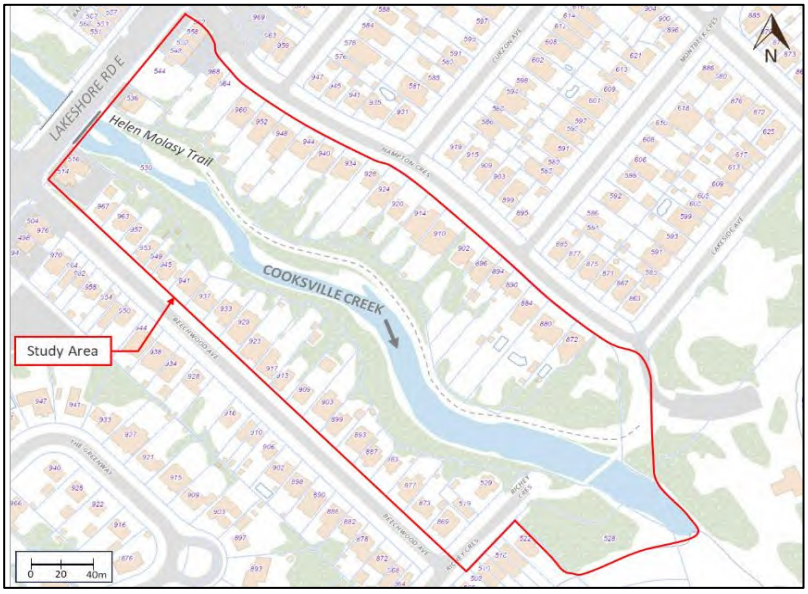
City of Mississauga
Notice of Completion

Municipal Class Environmental Assessment Study:
Cooksville Creek Erosion Control Project – South of Lakeshore Road

Project Background

The City of Mississauga (the City) has completed a Schedule B Municipal Class Environmental Assessment Study for erosion control and restoration of Cooksville Creek south of Lakeshore Road.

The City recognizes that this section of Cooksville Creek has been impacted by recent storm events and high lake levels and is in need of rehabilitation. Plans also considered the deteriorated condition of the adjacent city trail through Helen Molasy Memorial Park that sits above the east bank of the creek, as well as the neighbouring properties which experience ongoing drainage issues.



Study Completion

The Study has examined this section of Cooksville Creek and Helen Molasy Trail along with the associated natural resources to identify existing problems, potential risks, and opportunities for watercourse restoration and drainage improvements.

Through the Class EA process, various alternative solutions were developed and evaluated by the Study Team with input through public and agency consultation. The preferred watercourse erosion control strategy includes extended channel restoration works through the use of vegetated buttress bank protection treatment with embedded armourstone retaining walls. The preferred drainage restoration strategy includes the hybrid drainage solution involving the replacement and enhancement of the drainage infrastructure associated with the Helen Molasy Trail.

A Project File Report (PFR) documenting the planning process has been prepared and will be available for a comment period between **February 24th 2025** and **March 28th 2025** on the City's project webpage:

https://www.mississauga.ca/projects-and-strategies/environmental-assessments/cooksville-creek-erosion-control-south-of-lakeshore-road/

Should a member of the public request a hard copy of the report, the City will make arrangements for delivery of the PFR. If you have any questions or comments regarding the study, please contact the Project Managers listed below by March 28th 2025:

Greg Frew, P.Eng.
City Project Manager
City of Mississauga
300 City Centre Drive
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Limited
2600 Skymark Avenue
Mississauga, ON L4W 5B2
(416) 705-2367
Amos.R@aquaforbeech.com

City of Mississauga
Notice of Completion

Municipal Class Environmental Assessment Study:
Cooksville Creek Erosion Control Project – South of Lakeshore Road

In addition, a Section 16 Order request may be made to the Ministry of the Environment, Conservation and Parks (MECP or Ministry) for an order requiring a higher level of study (i.e., requiring an individual/comprehensive Environmental Assessment approval before being able to proceed), or that conditions be imposed (e.g., require further studies), only on the grounds that the requested order may prevent, mitigate or remedy adverse impacts on constitutionally protected Aboriginal and treaty rights. Requests on other grounds will not be considered. Requests are to include the requester contact information and full name.

The Section 16 Order request should be sent in writing or by email by March 28th 2025 to both contacts below with a copy to Greg Frew at the City.

Minister of the Environment, Conservation and Parks
Ministry of Environment, Conservation and Parks
777 Bay Street, 5th Floor
Toronto, Ontario M7A 2J3
minister.mecp@ontario.ca

Director, Environmental Assessment Branch
Ministry of Environment, Conservation and Parks
135 St. Clair Avenue West, 1st Floor
Toronto, Ontario M4V 1P5
EABDirector@ontario.ca

This notice signals the Notice of Completion for this Municipal Class Environmental Assessment, a study which defines the problem, identifies/evaluates alternative solutions, and recommends a preferred design in consultation with regulatory agencies and the public. The study has been undertaken in accordance with the planning and design process for Schedule 'B' projects, as outlined in the "Municipal Class Environmental Assessment" document (as amended in 2023), which is approved under the Ontario Environmental Assessment Act.

Personal information is collected under the authority of the Environmental Assessment Act and will be used in the assessment process. With exception of personal information, all comments shall become part of the public records.

This notice issued on **February 24th, 2025**.

Appendix J – Consultation with Regulatory Authorities

Consultation with Regulatory Authorities - Communications Log

Date (yyyy/mm/dd)	From	To	Medium (e.g., email, letter, call)	Communication Description - Nature of Concern(s) or Interest(s)	Response/Follow Up
2024-02-16	**Greg Frew** Project Manager City of Mississauga **Rob Amos** Consultant Project Manager Aquafor Beech Limited	Stakeholders as Defined in the Project Stakeholder List.	Email, posting on City Website	Notice of Study Commencement – Introduction to the Project	**Follow-up:** City of Mississauga to invite stakeholders to an open house to discuss the EA.
2024-02-20	**Iftekhar Ahmad** Planner Credit Valley Conservation	**Greg Frew** Project Manager City of Mississauga **Rob Amos** Consultant Project Manager Aquafor Beech Limited	Email	Acknowledgment of receipt of the Notice of Commencement	**Follow-up:** Credit Valley Conservation to review Notice of Commencement and provide a response.
2024-02-21	**Jesse de Jager** Senior Manager Credit Valley Conservation	**Greg Frew** Project Manager City of Mississauga **Rob Amos** Consultant Project Manager Aquafor Beech Limited	Email	Request that Jesse de Jager be added to the Stakeholder list, as the representative for CVC, as landowner of the subject lands	**Follow-up:** Stakeholder list updated accordingly
2024-02-21	**Chunmei Li** Regional Environmental Planner Ministry of the Environment, Conservation and Parks	**Greg Frew** Project Manager City of Mississauga **Rob Amos** Consultant Project Manager Aquafor Beech Limited	Email	Provided MECP Comments on the EA Circulation	**Follow-up:** Proponent and their agents to ensure MECP comments are addressed / taken into account through the EA process. Proponent and their agents to coordinate Consultation with Aboriginal Communities

Consultation with Regulatory Authorities - Communications Log

Date (yyyy/mm/dd)	From	To	Medium (e.g., email, letter, call)	Communication Description - Nature of Concern(s) or Interest(s)	Response/Follow Up
2024-03-12	**Iftekhar Ahmad** Planner Credit Valley Conservation	**Greg Frew** Project Manager City of Mississauga **Rob Amos** Consultant Project Manager Aquafor Beech Limited	Email	Provided initial CVC comments in response to the letter of commencement	**Follow-up:** Consulting team to incorporate CVC feedback into future phases of the study
2024-03-13	**Liam Smythe** Heritage Planner Ministry of Citizenship and Multiculturalism	**Greg Frew** Project Manager City of Mississauga **Rob Amos** Consultant Project Manager Aquafor Beech Limited	Email	Provided Initial Feedback on the Notice of Commencement, including the requirement for a cultural heritage assessment	**Follow-up:** Proponent to undertake cultural heritage assessment pending City's approval
2024-07-08	**Iftekhar Ahmad** Planner Credit Valley Conservation	**Greg Frew** Project Manager City of Mississauga **Rob Amos** Consultant Project Manager Aquafor Beech Limited	Email	Provided initial CVC comments in response to initial onsite meeting. Indicated CVC's interest in narrowing the width of the trail to support a more stable slope along some of the steeper sections.	**Follow-up:** Consulting team to discuss comments with City
2024-10-21	**Greg Frew** Project Manager City of Mississauga **Rob Amos** Consultant Project Manager Aquafor Beech Limited	Stakeholders as Defined in the Project Stakeholder List	Email, posting on City Website	Notice of Public Information Centre	**Follow-up:** Interested parties to attend PIC, to gain additional information about the project, and provide feedback to be incorporated into the EA process.

Consultation with Regulatory Authorities - Communications Log

Date (yyyy/mm/dd)	From	To	Medium (e.g., email, letter, call)	Communication Description - Nature of Concern(s) or Interest(s)	Response/Follow Up
2024-10-23	**Asha Saddi** Technical Analyst Region of Peel	**Greg Frew** Project Manager City of Mississauga **Rob Amos** Consultant Project Manager Aquafor Beech Limited	Email	Receipt of the PIC notice, and indication that the Region will provide comments on PIC materials by Friday, November 8th, 2024.	**Follow-up:** Region will provide comments on PIC materials by Friday, November 8th, 2024.
2024-11-12	**Iftekhar Ahmad** Planner Credit Valley Conservation	**Greg Frew** Project Manager City of Mississauga **Rob Amos** Consultant Project Manager Aquafor Beech Limited	Email	Provided CVC comments in response to submission of draft project file report.	**Follow-up:** Consulting team to discuss comments with City, and meet with CVC to discuss.
2025-02-24	**Greg Frew** Project Manager City of Mississauga **Rob Amos** Consultant Project Manager Aquafor Beech Limited	Stakeholders as Defined in the Project Stakeholder List.	Email, posting on City Website	Notice of Study Completion.	**Follow-up:** Stakeholders to provide comments between February 24th 2025 and March 28th 2025 if desired.

From:	amos.r@aquaforbeech.com
To:	eanotification.cregion@ontario.ca
Cc:	"Greg Frew"; cota.c@aquaforbeech.com; ursulak.j@aquaforbeech.com
Subject:	FW: City of Mississauga, Schedule B Class EA, Cooksville Creek Erosion Control
Date:	February 16, 2024 12:49:50 PM
Attachments:	Cooksville Creek Schedule B Municipal Class EA - Notice of Commencement.pdf Cooksville Creek Erosion Control - Schedule B EA - Project Information Form.xlsx

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To Whom it May Concern,

Aquafor Beech Limited has been retained by the City of Mississauga to undertake a Schedule B Municipal Class Environmental Assessment to complete the **Cooksville Creek Erosion Control Project** in the City of Mississauga. The objective of the study is to develop restoration design alternatives to mitigate existing erosion problems within the study area.

In accordance with the streamlined class environmental assessment process, Aquafor would like to submit the Notice of Commencement and Project Information Form for this project as per the attached.

Should you have any questions or comments please feel free to the contact the following:

Greg Frew, P.Eng.
Project Manager
City of Mississauga
300 City Centre Dr, Suite 800
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Ltd.
2600 Skymark Avenue, Unit 6-202
Mississauga, ON, L4W 5B2
416.705.23696
Amos.R@aquaforbeech.com

Thanks very much,

Rob Amos, MASc,. P.Eng.
Aquafor Beech Ltd.
Mobile: 416.705.2367

CITY OF MISSISSAUGA – NOTICE OF STUDY COMMENCEMENT

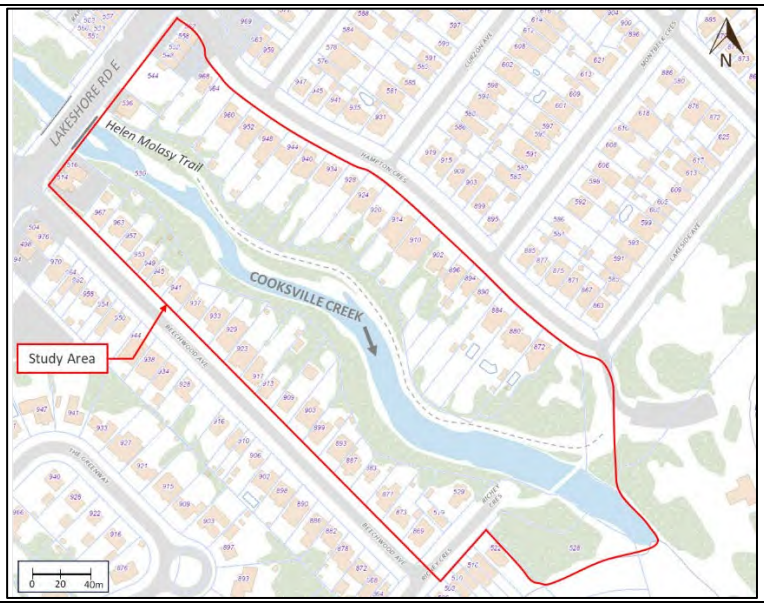
Municipal Class Environmental Assessment Study: Cooksville Creek South of Lakeshore Road

WHAT?

- The City of Mississauga is undertaking a Municipal Class Environmental Assessment (Class EA) Study for the Cooksville Creek Erosion Control Project South of Lakeshore Road.

WHY?

- The City of Mississauga recognizes that this section of Cooksville Creek has been impacted by recent storm events and high lake levels and is in need of rehabilitation. Plans will also need to consider the deteriorated condition of the adjacent city trail through Helen Molasy Memorial Park that sits above the east bank of the creek, as well as the neighbouring properties which have experienced ongoing drainage issues.



HOW?

- The study will examine this section of the Cooksville Creek and Helen Molasy Trail to identify existing problems, potential risks, and opportunities for restoration and drainage improvements.
- Through the Class EA process, the Study Team will develop and evaluate multiple alternative solutions and refine the options through public and agency consultation (see below). The Study Team will then select a Preferred Alternative.
- At the end of the study, a Project File, documenting the study process will be available for public review.
- Following completion of the Class EA Study, designs will be developed and implemented in accordance with study recommendations.

GET INVOLVED!

- Consultation is an important part of the Class EA process. Public input and comment are invited for incorporation into the planning and design of this project.
- A Public Information Centre (PIC) will be held to present the study findings, to consider alternative solutions, and to answer any questions you may have. Details regarding the PIC will be advertised publicly as the study progresses.
- Project information will be made available on the City's project website: https://www.mississauga.ca/projects-and-strategies/environmental-assessments/cooksville-creek-erosion-control-south-of-lakeshore-road/
- If you have any questions of comments regarding the study, or wish to be added or removed from the study mailing list, please contact:

Greg Frew, P.Eng.
Project Manager
City of Mississauga
300 City Centre Dr, Suite 800
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Ltd.
2600 Skymark Avenue, Unit 6-202
Mississauga, ON L4W 5B2
(905) 629-0099, ext. 294
Amos.R@aquaforbeech.com

This notice signals the commencement of the Class EA, a study which will define the problem, identify/evaluate alternative solutions, and determine a preferred design in consultation with regulatory agencies and the public. The study is being undertaken in accordance with the planning and design process for Schedule 'B' projects, as outlined in the "*Municipal Class Environmental Assessment*" document (October 2000, amended in 2015), which is approved under the Ontario *Environmental Assessment Act*.

Personal information is collected under the authority of the Environmental Assessment Act and will be used in the assessment process. With exception of personal information, all comments shall become part of the public records. Questions about this collection should be directed to the Project Manager listed above.

This notice was first issued February, 2024.

What to do:
Step 1: Look for the type of EA project in column B that applies to you.
Step 2: Complete columns C to J for that project.
Step 3: Send this form in Excel format to the MECP regional office email address where the project is located.
MECP regional office email addresses are listed at www.ontario.ca/page/preparing-environmental-assessments

	Class EA/Streamlined EA	Proponent Name	Proponent Contact	Project Name	Project Schedule	Project Type	Project Location	MOECC Region	Project Initiation Date
1	CO - Remedial flood and erosion control project								
2	GO Transit - Class EA								
3	Hydro One - Minor transmission facilities								
4	MEA - Class EA for municipal infrastructure projects	City of Mississauga	Greg Frew, Greg.Frew@mississauga.ca	Cooksville Creek Erosion Control Project	Schedule B	Municipal water and wastewater projects	Mississauga, City of	Central	2024-02-16
5	Ministry of Infrastructure - Public work								
6	MNDM - Activities of the Ministry of Northern Development and Mines under the Mining A								
7	MNRF - Provincial parks and conservation reserve								
8	MNRF - Resource stewardship and facility development projec								
9	MTO - Provincial transportation facilities								
10	O. Reg. 101/07 - Waste management projects								
11	O. Reg. 116/01 - Electricity projects								
12	OWA - Waterpower projects								
		Enter the proponent's name.	Enter the name and email address of the person who the MECP should contact about your project. This should be the same contact person who is listed on the notice.	Enter the project name as it appears on the notice.	Select the project schedule from the drop-down menu.	Select the project type from the drop-down menu.	Select the name of the municipality or unorganized/unsurveyed area where your project is located from the drop-down menu.	Select the MECP region from the drop down menu. Read the "MECP regions" worksheet to find the MECP region where your project is located.	Enter the date that the streamlined EA process was initiated (e.g. notice of commencement). This date may be when the project notice was first published.

From: amos.r@aquaforbeech.com
To: "Greg Frew"
Subject: Cooksville Creek Erosion Control Project - Notice of Study Commencement
Date: February 16, 2024 1:04:37 PM
Attachments: image001.png
Cooksville Creek Schedule B Municipal Class EA - Notice of Commencement.pdf

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Dear Stakeholder,

Please find attached a Notice of Study Commencement for the City of Mississauga – Cooksville Creek Erosion Control Class Environmental Assessment.

The next point of contact will include a Public Information Centre (PIC) to discuss matters related to the study, including problems, opportunities, alternative solutions, evaluation criteria, environmental impacts and mitigation measures.

The PIC date and details will be advertised as the Study progresses.

Thanks very much for your interest and input, we look forward to hearing from you throughout the duration of the project.

Best Regards,

Rob

_____
Robert Amos, MASc., P.Eng.
Aquafor Beech Ltd.

☎ **416.705.2367**
✉ Amos.R@Aquaforbeech.com
www.aquaforbeech.com

CITY OF MISSISSAUGA – NOTICE OF STUDY COMMENCEMENT

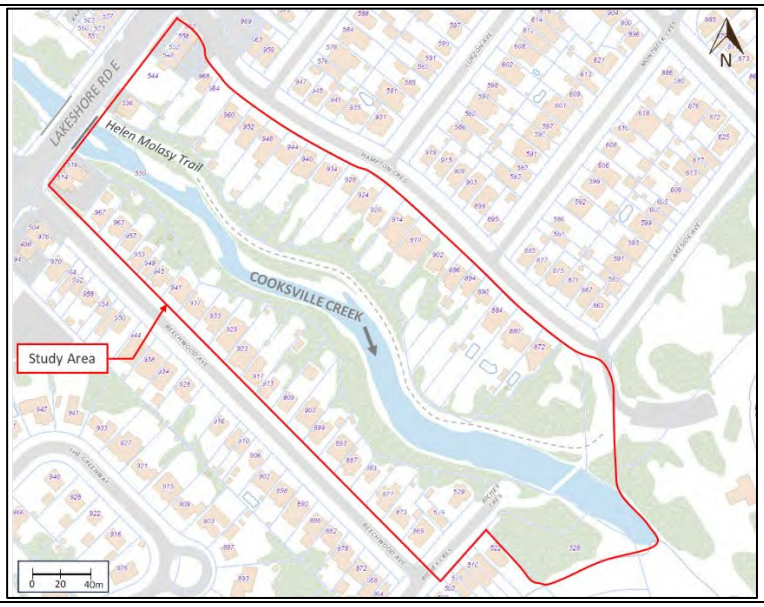
Municipal Class Environmental Assessment Study: Cooksville Creek South of Lakeshore Road

WHAT?

- The City of Mississauga is undertaking a Municipal Class Environmental Assessment (Class EA) Study for the Cooksville Creek Erosion Control Project South of Lakeshore Road.

WHY?

- The City of Mississauga recognizes that this section of Cooksville Creek has been impacted by recent storm events and high lake levels and is in need of rehabilitation. Plans will also need to consider the deteriorated condition of the adjacent city trail through Helen Molasy Memorial Park that sits above the east bank of the creek, as well as the neighbouring properties which have experienced ongoing drainage issues.



HOW?

- The study will examine this section of the Cooksville Creek and Helen Molasy Trail to identify existing problems, potential risks, and opportunities for restoration and drainage improvements.
- Through the Class EA process, the Study Team will develop and evaluate multiple alternative solutions and refine the options through public and agency consultation (see below). The Study Team will then select a Preferred Alternative.
- At the end of the study, a Project File, documenting the study process will be available for public review.
- Following completion of the Class EA Study, designs will be developed and implemented in accordance with study recommendations.

GET INVOLVED!

- Consultation is an important part of the Class EA process. Public input and comment are invited for incorporation into the planning and design of this project.
- A Public Information Centre (PIC) will be held to present the study findings, to consider alternative solutions, and to answer any questions you may have. Details regarding the PIC will be advertised publicly as the study progresses.
- Project information will be made available on the City's project website: https://www.mississauga.ca/projects-and-strategies/environmental-assessments/cooksville-creek-erosion-control-south-of-lakeshore-road/
- If you have any questions of comments regarding the study, or wish to be added or removed from the study mailing list, please contact:

Greg Frew, P.Eng.
Project Manager
City of Mississauga
300 City Centre Dr, Suite 800
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Ltd.
2600 Skymark Avenue, Unit 6-202
Mississauga, ON L4W 5B2
(905) 629-0099, ext. 294
Amos.R@aquaforbeech.com

This notice signals the commencement of the Class EA, a study which will define the problem, identify/evaluate alternative solutions, and determine a preferred design in consultation with regulatory agencies and the public. The study is being undertaken in accordance with the planning and design process for Schedule 'B' projects, as outlined in the "*Municipal Class Environmental Assessment*" document (October 2000, amended in 2015), which is approved under the Ontario *Environmental Assessment Act*.

Personal information is collected under the authority of the Environmental Assessment Act and will be used in the assessment process. With exception of personal information, all comments shall become part of the public records. Questions about this collection should be directed to the Project Manager listed above.

This notice was first issued February, 2024.

From: amos.r@aquaforbeech.com
To: ursulak.j@aquaforbeech.com; cota.c@aquaforbeech.com
Subject: FW: [External] Cooksville Creek Erosion Control Project south of Lakeshore Rd - Notice of Study Commencement
Date: February 20, 2024 4:32:19 PM
Attachments: image002.png
image003.png

FYI

_____
Robert Amos, MASc., P.Eng.
Aquafor Beech Ltd.

☎ **416.705.2367**
✉ Amos.R@Aquaforbeech.com
www.aquaforbeech.com



From: Ahmad, Iftekhar <Iftekhar.Ahmad@cvc.ca>
Sent: February 20, 2024 9:42 AM
To: amos.r@aquaforbeech.com
Cc: Greg Frew <greg.frew@mississauga.ca>
Subject: RE: [External] Cooksville Creek Erosion Control Project south of Lakeshore Rd - Notice of Study Commencement

Good Morning Rob,

Hope you had a nice weekend.

Thank you for providing the information. We will review it and get back to you with our response as soon as possible.

Best regards,
Iftekhar

Iftekhar Ahmad | MES | he/him/his
Planner, Environmental Assessment | Planning and Development Services | Credit Valley Conservation
905-670-1615 ext. 296 | M: 647-449-5962
iftekhar.ahmad@cvc.ca | cvc.ca

Our working hours may be different. Please do not feel obligated to reply outside of your scheduled working hours. Let's work together to help foster healthy work-life boundaries.



View our privacy statement

From: amos.r@aquaforbeech.com <amos.r@aquaforbeech.com>
Sent: Friday, February 16, 2024 1:05 PM
To: Greg Frew <greg.frew@mississauga.ca>
Subject: [External] Cooksville Creek Erosion Control Project - Notice of Study Commencement

[CAUTION] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe. If in doubt contact help211@cvc.ca

Dear Stakeholder,

Please find attached a Notice of Study Commencement for the City of Mississauga – Cooksville Creek Erosion Control Class Environmental Assessment.

The next point of contact will include a Public Information Centre (PIC) to discuss matters related to the study, including problems, opportunities, alternative solutions, evaluation criteria, environmental impacts and mitigation measures.

The PIC date and details will be advertised as the Study progresses.

Thanks very much for your interest and input, we look forward to hearing from you throughout the duration of the project.

Best Regards,

Rob

Robert Amos, MASc., P.Eng.
Aquafor Beech Ltd.

☎ **416.705.2367**
✉ Amos.R@Aquaforbeech.com
www.aquaforbeech.com



From:	Rob Amos
To:	cota.c@aquaforbeech.com; ursulak.j@aquaforbeech.com
Cc:	amos.r@aquaforbeech.com
Subject:	FW: [External] Cooksville Creek Erosion Control Project - Notice of Study Commencement
Date:	February 21, 2024 7:20:00 AM
Attachments:	image002.png image003.png Cooksville Creek Schedule B Municipal Class EA - Notice of Commencement.pdf

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CC - please update the EA outlook group as per below.

Rob Amos
Aquafor Beech Ltd
Mobile: 416.705.2367

-------- Original message --------
From: "DeJager, Jesse" <Jesse.DeJager@cvc.ca>
Date: 2024-02-21 7:10 a.m. (GMT-05:00)
To: amos.r@aquaforbeech.com
Cc: Greg Frew <greg.frew@mississauga.ca>
Subject: FW: [External] Cooksville Creek Erosion Control Project - Notice of Study Commencement

Hi Robert,

As representative for CVC as landowner of the subject lands (leased to City) please include me in all correspondence involving CVC.

Greg: can you confirm that you have obtained the necessary files from our transfer of historical property and engineering data?

Thanks,

- Jesse

Jesse de Jager | he/him/his

Senior Manager, Land Planning and Capital Projects

Credit Valley Conservation

416-277-9314 | jesse.dejager@cvc.ca | cvc.ca

Our working hours may be different. Please do not feel obligated to reply outside of your scheduled working hours. Let's work together to help foster healthy work-life boundaries.

View our privacy statement

From: amos.r@aquaforbeech.com
Sent: Friday, February 16, 2024 1:05 PM
To: Greg Frew <greg.frew@mississauga.ca>
Subject: [External] Cooksville Creek Erosion Control Project - Notice of Study Commencement

[CAUTION] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe. If in doubt contact help211@cvc.ca

Dear Stakeholder,

Please find attached a Notice of Study Commencement for the City of Mississauga – Cooksville Creek Erosion Control Class Environmental Assessment.

The next point of contact will include a Public Information Centre (PIC) to discuss matters related to the study, including problems, opportunities, alternative solutions, evaluation criteria, environmental impacts and mitigation measures.

The PIC date and details will be advertised as the Study progresses.

Thanks very much for your interest and input, we look forward to hearing from you throughout the duration of the project.

Best Regards,

Rob

Robert Amos, MASc., P.Eng.

Aquafor Beech Ltd.

☎ **416.705.2367**

✉ Amos.R@Aquaforbeech.com

www.aquaforbeech.com

From:	EA Notices to CRegion (MECP)
To:	amos.r@aquaforbeech.com; "Greg Frew"; cota.c@aquaforbeech.com; ursulak.j@aquaforbeech.com
Cc:	EA Notices to CRegion (MECP); Battarino, Gavin (MECP); Panko, Dan (MECP)
Subject:	RE: City of Mississauga, Schedule B Class EA, Cooksville Creek Erosion Control
Date:	February 21, 2024 11:01:31 AM
Attachments:	MECP Acknowledgement of NOC-MEA Sch B-Mississaqua Cooksville Creek Erosion Control.pdf Supporting Attachment - Proponent"s Intro to Delegation of Procedural Aspects of Consultation with Aboriginal Communities.pdf Supporting Attachment - Species at Risk Proponents Guide to Preliminary Screening (May 2019).pdf

Dear Project Team, hope you're all doing well

Attached please find the ministry's acknowledge letter and relevant supporting information shared with your team. If you have any questions regarding the information shared, please let us know.

Many thanks,

Chunmei Liu (she/her) | Regional Environmental Planner
Environmental Assessments Branch, Ontario Ministry of the Environment, Conservation and Parks |7th Flr, 135 St Clair Ave W, Toronto, ON M4V 1P5 | Chunmei.Liu@ontario.ca | 437-249-3102

From: amos.r@aquaforbeech.com <amos.r@aquaforbeech.com>
Sent: Friday, February 16, 2024 12:50 PM
To: EA Notices to CRegion (MECP) <eanotification.cregion@ontario.ca>
Cc: 'Greg Frew' <Greg.Frew@mississauga.ca>; cota.c@aquaforbeech.com; ursulak.j@aquaforbeech.com
Subject: FW: City of Mississauga, Schedule B Class EA, Cooksville Creek Erosion Control

CAUTION -- EXTERNAL E-MAIL - Do not click links or open attachments unless you recognize the sender.

To Whom it May Concern,

Aquafor Beech Limited has been retained by the City of Mississauga to undertake a Schedule B Municipal Class Environmental Assessment to complete the **Cooksville Creek Erosion Control Project** in the City of Mississauga. The objective of the study is to develop restoration design alternatives to mitigate existing erosion problems within the study area.

In accordance with the streamlined class environmental assessment process, Aquafor would like to submit the Notice of Commencement and Project Information Form for this project as per the attached.

Should you have any questions or comments please feel free to the contact the following:

Greg Frew, P.Eng.
Project Manager
City of Mississauga
300 City Centre Dr, Suite 800

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Ltd.
2600 Skymark Avenue, Unit 6-202

Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Mississauga, ON, L4W 5B2
416.705.23696
Amos.R@aquaforbeech.com

Thanks very much,

Rob Amos, MASc,. P.Eng.
Aquafor Beech Ltd.
Mobile: 416.705.2367

Ministry of the Environment, Conservation and Parks

Environmental Assessment Branch

7th Floor
135 St. Clair Avenue W
Toronto ON M4V 1P5
Tel.: 416 314-8001
Fax.: 416 314-8452

Ministère de l'Environnement, de la Protection de la nature et des Parcs

Direction des évaluations environnementales

7ème étage
135, avenue St. Clair Ouest
Toronto ON M4V 1P5
Tél.: 416 314-8001
Téléc.: 416 314-8452

February 21, 2024

Greg Frew
Project Manager
City of Mississauga
300 City Centre Dr, Suite 800
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca
***BY EMAIL ONLY

Re: **Cooksville Creek South of Lakeshore Road**
City of Mississauga
Municipal Class Environmental Assessment, Schedule B
Acknowledgement of Notice of Commencement

Dear Greg Frew,

This letter is in response to the Notice of Commencement for the above noted project. The Ministry of the Environment, Conservation and Parks (MECP) acknowledges that the City of Mississauga (proponent) has indicated that the study is following the approved environmental planning process for a Schedule B project under the Municipal Class Environmental Assessment (Class EA).

The attached "Areas of Interest" document provides guidance regarding the ministry's interests with respect to the Class EA process. Please address all areas of interest in the EA documentation at an appropriate level for the EA study. Proponents who address all the applicable areas of interest can minimize potential delays to the project schedule. Further information is provided at the end of the Areas of Interest document relating to recent changes to the Environmental Assessment Act through Bill 197, Covid-19 Economic Recovery Act 2020.

The Crown has a legal duty to consult Aboriginal communities when it has knowledge, real or constructive, of the existence or potential existence of an Aboriginal or treaty right and contemplates conduct that may adversely impact that right. Before authorizing this project, the Crown must ensure that its duty to consult has been fulfilled, where such a duty is triggered.

Although the duty to consult with Aboriginal peoples is a duty of the Crown, the Crown may delegate procedural aspects of this duty to project proponents while retaining oversight of the consultation process.

The proposed project may have the potential to affect Aboriginal or treaty rights protected under Section 35 of Canada's *Constitution Act* 1982. Where the Crown's duty to consult is triggered in relation to the proposed project**, the MECP is delegating the procedural aspects of rights-based consultation to the proponent through this letter.** The Crown intends to rely on the delegated consultation process in discharging its duty to consult and maintains the right to participate in the consultation process as it sees fit.

The study area is located in Treaty 13a, 1805w/Mississaugas, within the traditional territory and claim of the Mississaugas of the Credit, within an area of archaeological interest to the Huron-Wendat, and within the 1701 Nanfan Deed which allows for the harvesting activities of the Six Nations. Based on information provided to date and the Crown`s preliminary assessment the proponent is required to consult with the following communities who have been identified as potentially affected by the proposed project:

- **Mississaugas of the Credit First Nation**
- **Six Nations of the Grand River (elected council and traditional council-HCCC)**
- If there is anticipated impacts to archaeological resources, the **Huron-Wendat** may have an interest.

Steps that the proponent may need to take in relation to Aboriginal consultation for the proposed project are outlined in the "Code of Practice for Consultation in Ontario's Environmental Assessment Process". Additional information related to Ontario's Environmental Assessment Act is available online at: www.ontario.ca/environmentalassessments.

Please also refer to the attached document "A Proponent's Introduction to the Delegation of Procedural Aspects of consultation with Aboriginal Communities" for further information, including the MECP's expectations for EA report documentation related to consultation with communities.

The proponent must contact the Director of Environmental Assessment Branch (EABDirector@ontario.ca) under the following circumstances after initial discussions with the communities identified by the MECP:

- Aboriginal or treaty rights impacts are identified to you by the communities;
- You have reason to believe that your proposed project may adversely affect an Aboriginal or treaty right;
- Consultation with Indigenous communities or other stakeholders has reached an impasse; or
- A Section 16 Order request is expected based on impacts to Aboriginal or treaty rights.

The MECP will then assess the extent of any Crown duty to consult for the circumstances and will consider whether additional steps should be taken, including what role you will be asked to play should additional steps and activities be required.

Please ensure a copy of the final notice and the project file report are sent to the ministry's Central Region EA notification email account (eanotification.cregion@ontario.ca) for filing.

Should you or any members of your project team have any questions regarding the material above, please contact me at chunmei.liu@ontario.ca.

Sincerely,



Chunmei Liu
Regional Environmental Planner –Central Region
Project Review Unit, Environmental Assessment Branch

Cc: Gavin Battarino, Supervisor, Project Review Unit, MECP
Dan Panko, Manager, Halton-Peel District Office, MECP
Robert Amos, Consultant Project Manager, Aquafor Beech Ltd.

Enclosed: Areas of Interest

Attached: Client's Guide to Preliminary Screening for Species at Risk

A Proponent's Introduction to the Delegation of Procedural Aspects of Consultation with Aboriginal Communities

AREAS OF INTEREST (v. August 2022)

It is suggested that you check off each section after you have considered / addressed it.

Planning and Policy

- Applicable plans and policies should be identified in the report, and the proponent should describe how the proposed project adheres to the relevant policies in these plans.
    - Projects located in MECP Central, Eastern or West Central Region may be subject to **A Place to Grow: Growth Plan for the Greater Golden Horseshoe (2020)**.
    - Projects located in MECP Central or Eastern Region may be subject to the **Oak Ridges Moraine Conservation Plan (2017)** or the **Lake Simcoe Protection Plan (2014)**.
    - Projects located in MECP Central, Southwest or West Central Region may be subject to the **Niagara Escarpment Plan (2017)**.
    - Projects located in MECP Central, Eastern, Southwest or West Central Region may be subject to the **Greenbelt Plan (2017)**.
    - Projects located in MECP Northern Region may be subject to the **Growth Plan for Northern Ontario (2011).**

- The **Provincial Policy Statement (2020)** contains policies that protect Ontario's natural heritage and water resources. Applicable policies should be referenced in the report, and the proponent should describe how the proposed project is consistent with these policies.

- In addition to the provincial planning and policy level, the report should also discuss the planning context at the municipal and federal levels, as appropriate.

Source Water Protection

The *Clean Water Act*, 2006 (CWA) aims to protect existing and future sources of drinking water. To achieve this, several types of vulnerable areas have been delineated around surface water intakes and wellheads for every municipal residential drinking water system that is located in a source protection area. These vulnerable areas are known as a Wellhead Protection Areas (WHPAs) and surface water Intake Protection Zones (IPZs). Other vulnerable areas that have been delineated under the CWA include Highly Vulnerable Aquifers (HVAs), Significant Groundwater Recharge Areas (SGRAs), Event-based modelling areas (EBAs), and Issues Contributing Areas (ICAs). Source protection plans have been developed that include policies to address existing and future risks to sources of municipal drinking water within these vulnerable areas.

Projects that are subject to the Environmental Assessment Act that fall under a Class EA, or one of the Regulations, have the potential to impact sources of drinking water if they occur in designated vulnerable areas or in the vicinity of other at-risk drinking water systems (i.e. systems that are not municipal residential systems). MEA Class EA projects may include

activities that, if located in a vulnerable area, could be a threat to sources of drinking water (i.e. have the potential to adversely affect the quality or quantity of drinking water sources) and the activity could therefore be subject to policies in a source protection plan. Where an activity poses a risk to drinking water, policies in the local source protection plan may impact how or where that activity is undertaken. Policies may prohibit certain activities, or they may require risk management measures for these activities. Municipal Official Plans, planning decisions, Class EA projects (where the project includes an activity that is a threat to drinking water) and prescribed instruments must conform with policies that address significant risks to drinking water and must have regard for policies that address moderate or low risks.

- In October 2015, the MEA Parent Class EA document was amended to include reference to the Clean Water Act (Section A.2.10.6) and indicates that proponents undertaking a Municipal Class EA project must identify early in their process whether a project is or could potentially be occurring with a vulnerable area. **Given this requirement, please include a section in the report on source water protection.**

    - The proponent should identify the source protection area and should clearly document how the proximity of the project to sources of drinking water (municipal or other) and any delineated vulnerable areas was considered and assessed. Specifically, the report should discuss whether or not the project is located in a vulnerable area and provide applicable details about the area.

    - If located in a vulnerable area, proponents should document whether any project activities are prescribed drinking water threats and thus pose a risk to drinking water (this should be consulted on with the appropriate Source Protection Authority). Where an activity poses a risk to drinking water, the proponent must document and discuss in the report how the project adheres to or has regard to applicable policies in the local source protection plan. This section should then be used to inform and be reflected in other sections of the report, such as the identification of net positive/negative effects of alternatives, mitigation measures, evaluation of alternatives etc.

- While most source protection plans focused on including policies for significant drinking water threats in the WHPAs and IPZs it should be noted that even though source protection plan policies may not apply in HVAs, these are areas where aquifers are sensitive and at risk to impacts and within these areas, activities may impact the quality of sources of drinking water for systems other than municipal residential systems.

- In order to determine if this project is occurring within a vulnerable area, proponents can use Source Protection Information Atlas, which is an online mapping tool available to the public. Note that various layers (including WHPAs, WHPA-Q1 and WHPA-Q2, IPZs, HVAs, SGRAs, EBAs, ICAs) can be turned on through the “Map Legend” bar on the left. The mapping tool will also provide a link to the appropriate source protection plan in order to identify what policies may be applicable in the vulnerable area.

- For further information on the maps or source protection plan policies which may relate to their project, proponents must contact the appropriate source protection authority. **Please consult with the local source protection authority to discuss potential impacts on drinking water. Please document the results of that consultation within the report and include all communication documents/correspondence.**

More Information

For more information on the *Clean Water Act*, source protection areas and plans, including specific information on the vulnerable areas and drinking water threats, please refer to Conservation Ontario's website where you will also find links to the local source protection plan/assessment report.

A list of the prescribed drinking water threats can be found in section 1.1 of Ontario Regulation 287/07 made under the *Clean Water Act*. In addition to prescribed drinking water threats, some source protection plans may include policies to address additional "local" threat activities, as approved by the MECP.

Climate Change

The document "Considering Climate Change in the Environmental Assessment Process" (Guide) is now a part of the Environmental Assessment program's Guides and Codes of Practice. The Guide sets out the MECP's expectation for considering climate change in the preparation, execution and documentation of environmental assessment studies and processes. The guide provides examples, approaches, resources, and references to assist proponents with consideration of climate change in EA. Proponents should review this Guide in detail.

- **The MECP expects proponents of Class EA projects to:**

1. Consider during the assessment of alternative solutions and alternative designs, the following:
    a. the project's expected production of greenhouse gas emissions and impacts on carbon sinks (climate change mitigation); and
    b. resilience or vulnerability of the undertaking to changing climatic conditions (climate change adaptation).
2. Include a discrete section in the report detailing how climate change was considered in the EA.

How climate change is considered can be qualitative or quantitative in nature and should be scaled to the project's level of environmental effect. In all instances, both a project's impacts on climate change (mitigation) and impacts of climate change on a project (adaptation) should be considered.

- The MECP has also prepared another guide to support provincial land use planning direction related to the completion of energy and emission plans. The "Community Emissions Reduction Planning: A Guide for Municipalities" document is designed to educate stakeholders on the municipal opportunities to reduce energy and greenhouse gas emissions, and to provide guidance on methods and techniques to incorporate consideration of energy and greenhouse gas emissions into municipal activities of all types. We encourage you to review the Guide for information.

Air Quality, Dust and Noise

- If there are sensitive receptors in the surrounding area of this project, a quantitative air quality/odour impact assessment will be useful to evaluate alternatives, determine impacts and identify appropriate mitigation measures. The scope of the assessment can be determined based on the potential effects of the proposed alternatives, and typically includes source and receptor characterization and a quantification of local air quality impacts on the sensitive receptors and the environment in the study area. The assessment will compare to all applicable standards or guidelines for all contaminants of concern. **Please contact this office for further consultation on the level of Air Quality Impact Assessment required for this project if not already advised.**

- If a quantitative Air Quality Impact Assessment is not required for the project, the MECP expects that the report contain a qualitative assessment which includes:

    - A discussion of local air quality including existing activities/sources that significantly impact local air quality and how the project may impact existing conditions;
    - A discussion of the nearby sensitive receptors and the project's potential air quality impacts on present and future sensitive receptors;
    - A discussion of local air quality impacts that could arise from this project during both construction and operation; and
    - A discussion of potential mitigation measures.

- As a common practice, "air quality" should be used an evaluation criterion for all road projects.

- Dust and noise control measures should be addressed and included in the construction plans to ensure that nearby residential and other sensitive land uses within the study area are not adversely affected during construction activities.

- The MECP recommends that non-chloride dust-suppressants be applied. For a comprehensive list of fugitive dust prevention and control measures that could be applied, refer to *Cheminfo Services Inc. Best Practices for the Reduction of Air Emissions from Construction and Demolition Activities* report prepared for Environment Canada. March 2005.

- The report should consider the potential impacts of increased noise levels during the operation of the completed project. The proponent should explore all potential measures to mitigate significant noise impacts during the assessment of alternatives.

Ecosystem Protection and Restoration

- Any impacts to ecosystem form and function must be avoided where possible. The report should describe any proposed mitigation measures and how project planning will protect and enhance the local ecosystem.

- Natural heritage and hydrologic features should be identified and described in detail to assess potential impacts and to develop appropriate mitigation measures. The following sensitive environmental features may be located within or adjacent to the study area:
    - Key Natural Heritage Features: Habitat of endangered species and threatened species, fish habitat, wetlands, areas of natural and scientific interest (ANSIs), significant valleylands, significant woodlands; significant wildlife habitat (including habitat of special concern species); sand barrens, savannahs, and tallgrass prairies; and alvars.
    - Key Hydrologic Features: Permanent streams, intermittent streams, inland lakes and their littoral zones, seepage areas and springs, and wetlands.
    - Other natural heritage features and areas such as: vegetation communities, rare species of flora or fauna, Environmentally Sensitive Areas, Environmentally Sensitive Policy Areas, federal and provincial parks and conservation reserves, Greenland systems etc.

We recommend consulting with the Ministry of Natural Resources and Forestry (MNRF), Fisheries and Oceans Canada (DFO) and your local conservation authority to determine if special measures or additional studies will be necessary to preserve and protect these sensitive features. In addition, for projects located in Central Region you may consider the provisions of the Rouge Park Management Plan if applicable.

Species at Risk

- The Ministry of the Environment, Conservation and Parks has now assumed responsibility of Ontario's Species at Risk program. Information, standards, guidelines, reference materials and technical resources to assist you are found at https://www.ontario.ca/page/species-risk.

- The Client's Guide to Preliminary Screening for Species at Risk (Draft May 2019) has been attached to the covering email for your reference and use. Please review this document for next steps.

- For any questions related to subsequent permit requirements, please contact SAROntario@ontario.ca.

Surface Water

- The report must include enough information to demonstrate that there will be no negative impacts on the natural features or ecological functions of any watercourses within the study area. Measures should be included in the planning and design process to ensure that any impacts to watercourses from construction or operational activities (e.g. spills, erosion, pollution) are mitigated as part of the proposed undertaking.

- Additional stormwater runoff from new pavement can impact receiving watercourses and flood conditions. Quality and quantity control measures to treat stormwater runoff should be considered for all new impervious areas and, where possible, existing surfaces. The ministry's Stormwater Management Planning and Design Manual (2003) should be referenced in the report and utilized when designing stormwater control methods. **A Stormwater Management Plan should be prepared as part of the Class EA process** that includes:

    - Strategies to address potential water quantity and erosion impacts related to stormwater draining into streams or other sensitive environmental features, and to ensure that adequate (enhanced) water quality is maintained
    - Watershed information, drainage conditions, and other relevant background information
    - Future drainage conditions, stormwater management options, information on erosion and sediment control during construction, and other details of the proposed works
    - Information on maintenance and monitoring commitments.

- Ontario Regulation 60/08 under the *Ontario Water Resources Act* (OWRA) applies to the Lake Simcoe Basin, which encompasses Lake Simcoe and the lands from which surface water drains into Lake Simcoe. If a proposed sewage treatment plant is listed in Table 1 of the regulation, the report should describe how the proposed project and its mitigation measures are consistent with the requirements of this regulation and the OWRA.

- Any potential approval requirements for surface water taking or discharge should be identified in the report. A Permit to Take Water (PTTW) under the OWRA will be required for any water takings that exceed 50,000 L/day, except for certain water taking activities that have been prescribed by the Water Taking EASR Regulation – *O. Reg. 63/16*. These prescribed water-taking activities require registration in the EASR instead of a PTTW. Please review the Water Taking User Guide for EASR for more information. Additionally, an

Environmental Compliance Approval under the OWRA is required for municipal stormwater management works.

Groundwater

- The status of, and potential impacts to any well water supplies should be addressed. If the project involves groundwater takings or changes to drainage patterns, the quantity and quality of groundwater may be affected due to drawdown effects or the redirection of existing contamination flows. In addition, project activities may infringe on existing wells such that they must be reconstructed or sealed and abandoned. Appropriate information to define existing groundwater conditions should be included in the report.

- If the potential construction or decommissioning of water wells is identified as an issue, the report should refer to Ontario Regulation 903, Wells, under the OWRA.

- Potential impacts to groundwater-dependent natural features should be addressed. Any changes to groundwater flow or quality from groundwater taking may interfere with the ecological processes of streams, wetlands or other surficial features. In addition, discharging contaminated or high volumes of groundwater to these features may have direct impacts on their function. Any potential effects should be identified, and appropriate mitigation measures should be recommended. The level of detail required will be dependent on the significance of the potential impacts.

- Any potential approval requirements for groundwater taking or discharge should be identified in the report. A Permit to Take Water (PTTW) under the OWRA will be required for any water takings that exceed 50,000 L/day, with the exception of certain water taking activities that have been prescribed by the Water Taking EASR Regulation – *O. Reg. 63/16*. These prescribed water-taking activities require registration in the EASR instead of a PTTW. Please review the Water Taking User Guide for EASR for more information.

- Consultation with the railroad authorities is necessary wherever there is a plan to use construction dewatering in the vicinity of railroad lines or where the zone of influence of the construction dewatering potentially intercepts railroad lines.

Excess Materials Management

- In December 2019, MECP released a new regulation under the Environmental Protection Act, titled "On-Site and Excess Soil Management" (O. Reg. 406/19) to support improved management of excess construction soil. This regulation is a key step to support proper management of excess soils, ensuring valuable resources don't go to waste and to provide clear rules on managing and reusing excess soil. New risk-based standards referenced by

this regulation help to facilitate local beneficial reuse which in turn will reduce greenhouse gas emissions from soil transportation, while ensuring strong protection of human health and the environment. The new regulation is being phased in over time, with the first phase in effect on January 1, 2021. For more information, please visit https://www.ontario.ca/page/handling-excess-soil.

- The report should reference that activities involving the management of excess soil should be completed in accordance with O. Reg. 406/19 and the MECP's current guidance document titled "Management of Excess Soil – A Guide for Best Management Practices" (2014).

- All waste generated during construction must be disposed of in accordance with ministry requirements.

Contaminated Sites

- Any current or historical waste disposal sites should be identified in the report. The status of these sites should be determined to confirm whether approval pursuant to Section 46 of the EPA may be required for land uses on former disposal sites. We recommend referring to the MECP's D-4 guideline for land use considerations near landfills and dumps.
    - Resources available may include regional/local municipal official plans and data; provincial data on large landfill sites and small landfill sites; Environmental Compliance Approval information for waste disposal sites on Access Environment.

- Other known contaminated sites (local, provincial, federal) in the study area should also be identified in the report (Note – information on federal contaminated sites is found on the Government of Canada's website).

- The location of any underground storage tanks should be investigated in the report. Measures should be identified to ensure the integrity of these tanks and to ensure an appropriate response in the event of a spill. The ministry's Spills Action Centre must be contacted in such an event.

- Since the removal or movement of soils may be required, appropriate tests to determine contaminant levels from previous land uses or dumping should be undertaken. If the soils are contaminated, you must determine how and where they are to be disposed of, consistent with *Part XV.1 of the Environmental Protection Act* (EPA) and Ontario Regulation 153/04, Records of Site Condition, which details the new requirements related to site assessment and clean up. Please contact the appropriate MECP District Office for further consultation if contaminated sites are present.

Servicing, Utilities and Facilities

- The report should identify any above or underground utilities in the study area such as transmission lines, telephone/internet, oil/gas etc. The owners should be consulted to discuss impacts to this infrastructure, including potential spills.

- The report should identify any servicing infrastructure in the study area such as wastewater, water, stormwater that may potentially be impacted by the project.

- Any facility that releases emissions to the atmosphere, discharges contaminants to ground or surface water, provides potable water supplies, or stores, transports or disposes of waste must have an Environmental Compliance Approval (ECA) before it can operate lawfully. Please consult with MECP's Environmental Permissions Branch to determine whether a new or amended ECA will be required for any proposed infrastructure.

- We recommend referring to the ministry's environmental land use planning guides to ensure that any potential land use conflicts are considered when planning for any infrastructure or facilities related to wastewater, pipelines, landfills or industrial uses.

Mitigation and Monitoring

- Contractors must be made aware of all environmental considerations so that all environmental standards and commitments for both construction and operation are met. Mitigation measures should be clearly referenced in the report and regularly monitored during the construction stage of the project. In addition, we encourage proponents to conduct post-construction monitoring to ensure all mitigation measures have been effective and are functioning properly.

- Design and construction reports and plans should be based on a best management approach that centres on the prevention of impacts, protection of the existing environment, and opportunities for rehabilitation and enhancement of any impacted areas.

- The proponent's construction and post-construction monitoring plans must be documented in the report, as outlined in Section A.2.5 and A.4.1 of the MEA Class EA parent document.

Consultation

- The report must demonstrate how the consultation provisions of the Class EA have been fulfilled, including documentation of all stakeholder consultation efforts undertaken during the planning process. This includes a discussion in the report that identifies concerns that were raised and **describes how they have been addressed by the proponent** throughout

the planning process. The report should also include copies of comments submitted on the project by interested stakeholders, and the proponent's responses to these comments (as directed by the Class EA to include full documentation).

- Please include the full stakeholder distribution/consultation list in the documentation.

Class EA Process

- If this project is a Master Plan: there are several different approaches that can be used to conduct a Master Plan, examples of which are outlined in Appendix 4 of the Class EA. **The Master Plan should clearly indicate the selected approach for conducting the plan**, by identifying whether the levels of assessment, consultation and documentation are sufficient to fulfill the requirements for Schedule B or C projects. Please note that any Schedule B or C projects identified in the plan would be subject to Part II Order Requests under the Environmental Assessment Act, although the plan itself would not be. **Please include a description of the approach being undertaken (use Appendix 4 as a reference).**

- If this project is a Master Plan: Any identified projects should also include information on the MCEA schedule associated with the project.

- The report should provide clear and complete documentation of the planning process in order to allow for transparency in decision-making.

- The Class EA requires the consideration of the effects of each alternative on all aspects of the environment (including planning, natural, social, cultural, economic, technical). The report should include a level of detail (e.g. hydrogeological investigations, terrestrial and aquatic assessments, cultural heritage assessments) such that all potential impacts can be identified, and appropriate mitigation measures can be developed. Any supporting studies conducted during the Class EA process should be referenced and included as part of the report.

- Please include in the report a list of all subsequent permits or approvals that may be required for the implementation of the preferred alternative, including but not limited to, MECP's PTTW, EASR Registrations and ECAs, conservation authority permits, species at risk permits, MTO permits and approvals under the *Impact Assessment Act*, 2019.

- Ministry guidelines and other information related to the issues above are available at http://www.ontario.ca/environment-and-energy/environment-and-energy. We encourage you to review all the available guides and to reference any relevant information in the report.

Amendments to the EAA through the Covid-19 Economic Recovery Act, 2020
Once the EA Report is finalized, the proponent must issue a Notice of Completion providing a minimum 30-day period during which documentation may be reviewed and comment and input can be submitted to the proponent. The Notice of Completion must be sent to the appropriate MECP Regional Office email address.

The public can request a higher level of assessment on a project if they are concerned about potential adverse impacts to constitutionally protected Aboriginal and treaty rights. In addition, the Minister may issue an order on his or her own initiative within a specified time period. The Director (of the Environmental Assessment Branch) will issue a Notice of Proposed Order to the proponent if the Minister is considering an order for the project within 30 days after the conclusion of the comment period on the Notice of Completion. At this time, the Director may request additional information from the proponent. Once the requested information has been received, the Minister will have 30 days within which to make a decision or impose conditions on your project.

Therefore, the proponent cannot proceed with the project until at least 30 days after the end of the comment period provided for in the Notice of Completion. Further, the proponent may not proceed after this time if:

- a Section 16 Order request has been submitted to the ministry regarding potential adverse impacts to constitutionally protected Aboriginal and treaty rights, or
- the Director has issued a Notice of Proposed order regarding the project.

Please ensure that the Notice of Completion advises that outstanding concerns are to be directed to the proponent for a response, and that in the event there are outstanding concerns regarding potential adverse impacts to constitutionally protected Aboriginal and treaty rights, Section 16 Order requests on those matters should be addressed in writing to:

Minister of the Environment, Conservation and Parks
Ministry of the Environment, Conservation and Parks
777 Bay Street, 5th Floor
Toronto ON M7A 2J3
minister.mecp@ontario.ca

and

Director, Environmental Assessment Branch
Ministry of the Environment, Conservation and Parks
135 St. Clair Ave. W, 1st Floor
Toronto ON, M4V 1P5
EABDirector@ontario.ca

Client's Guide to Preliminary Screening for Species at Risk

Ministry of the Environment, Conservation and Parks

Species at Risk Branch, Permissions and Compliance

DRAFT - May 2019

Table of Contents

1.0 Purpose, Scope, Background and Context 3
1.1 Purpose of this Guide 3
1.2 Scope 3
1.3 Background and Context 4
2.0 Roles and Responsibilities 5
3.0 Information Sources 6
3.1 Make a Map: Natural Heritage Areas 7
3.2 Land Information Ontario (LIO) 7
3.3 Additional Species at Risk Information Sources 8
3.4 Information Sources to Support Impact Assessments 8
4.0 Check-List 9

1.0 Purpose, Scope, Background and Context

1.1 Purpose of this Guide

This guide has been created to:

- help clients better understand their obligation to gather information and complete a preliminary screening for species at risk before contacting the ministry,
- outline guidance and advice clients can expect to receive from the ministry at the preliminary screening stage,
- help clients understand how they can gather information about species at risk by accessing publicly available information housed by the Government of Ontario, and
- provide a list of other potential sources of species at risk information that exist outside the Government of Ontario.

It remains the client's responsibility to:

- carry out a preliminary screening for their projects,
- obtain best available information from all applicable information sources,
- conduct any necessary field studies or inventories to identify and confirm the presence or absence of species at risk or their habitat,
- consider any potential impacts to species at risk that a proposed activity might cause, and
- comply with the *Endangered Species Act* (ESA).

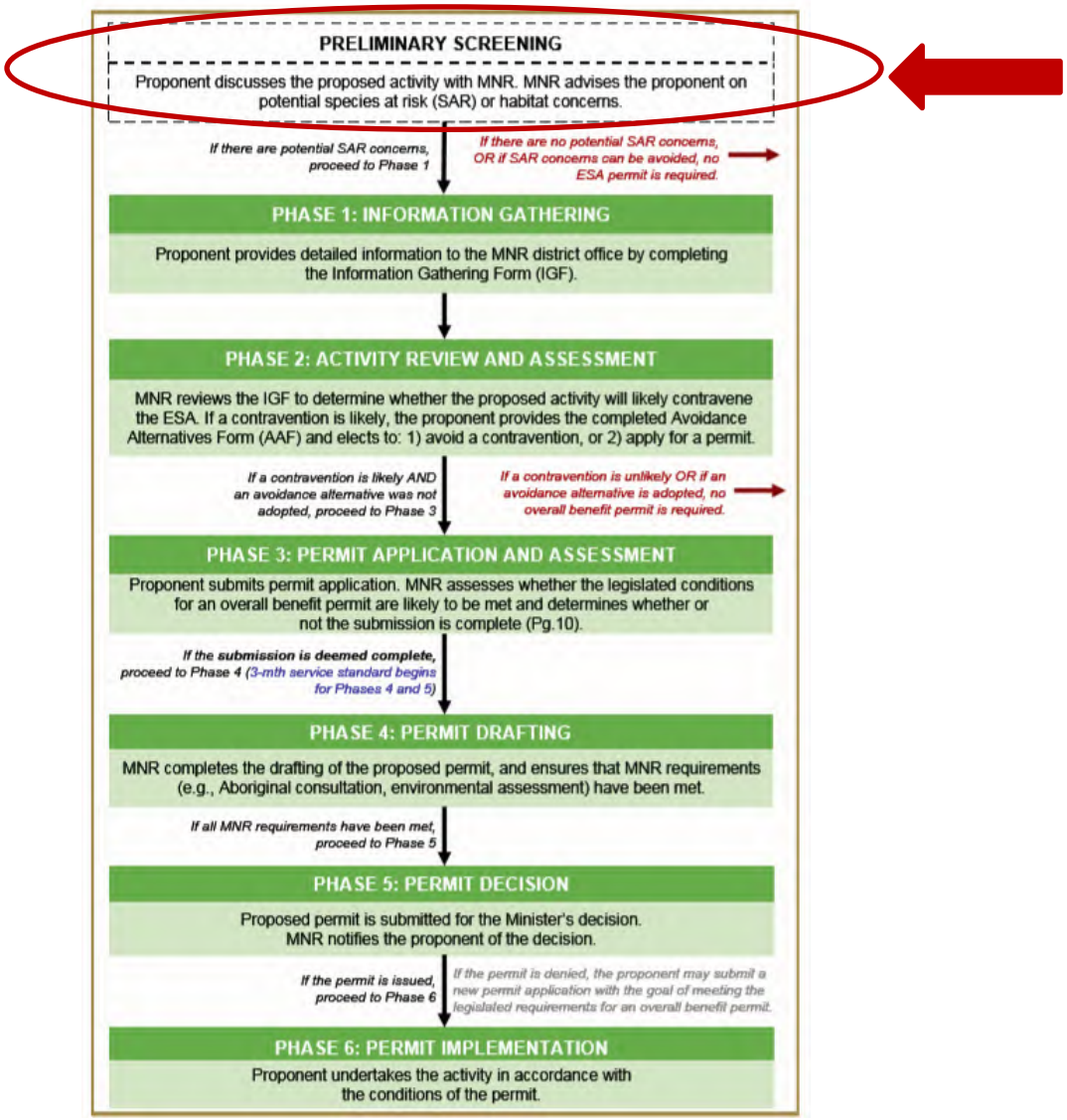
To provide the most efficient service, clients should initiate species at risk screenings and seek information from all applicable information sources identified in this guide, at a minimum, prior to contacting Government of Ontario ministry offices for further information or advice.

1.2 Scope

This guide is a resource for clients seeking to understand if their activity is likely to impact species at risk or if they are likely to trigger the need for an authorization under the ESA. It is not intended to circumvent any detailed site surveys that may be necessary to document species at risk or their habitat nor to circumvent the need to assess the impacts of a proposed activity on species at risk or their habitat. This guide is not an exhaustive list of available information sources for any given area as the availability of information on species at risk and their habitat varies across the province. This guide is intended to support projects and activities carried out on Crown and private land, by private landowners, businesses, other provincial ministries and agencies, or municipal government.

1.3 Background and Context

To receive advice on their proposed activity, clients must first determine whether any species at risk or their habitat exist or are likely to exist at or near their proposed activity, and whether their proposed activity is likely to contravene the ESA. Once this step is complete, clients may contact the ministry at SAROntario@ontario.ca to discuss the main purpose, general methods, timing and location of their proposed activity as well as information obtained about species at risk and their habitat at, or near, the site. At this stage, the ministry can provide advice and guidance to the client about potential species at risk or habitat concerns, measures that the client is considering to avoid adverse effects on species at risk or their habitat and whether additional field surveys are advisable. This is referred to as the "Preliminary Screening" stage. For more information on additional phases in the diagram below, please refer to the *Endangered Species Act Submission Standards for Activity Review and 17(2)(c) Overall Benefit Permits* policy available online at https://www.ontario.ca/page/species-risk-overall-benefit-permits



2.0 Roles and Responsibilities

To provide the most efficient service, clients should initiate species at risk screenings and seek information from all applicable information sources identified in this guide prior to contacting Government of Ontario ministry offices for further information or advice.

Step 1: Client seeks information regarding species at risk or their habitat that exist, or are likely to exist, at or near their proposed activity by referring to all applicable information sources identified in this guide.

Step 2: Client reviews and consider guidance on whether their proposed activity is likely to contravene the ESA (see section 3.4 of this guide for guidance on what to consider).

Step 3: Client gathers information identified in the checklist in section 4 of this guide.

Step 4: Client contacts the ministry at SAROntario@ontario.ca to discuss their preliminary screening. Ministry staff will ask the client questions about the main purpose, general methods, timing and location of their proposed activity as well as information obtained about species at risk and their habitat at, or near, the site. Ministry staff will also ask the client for their interpretation of the impacts of their activity on species at risk or their habitat as well as measures the client has considered to avoid any adverse impacts.

Step 5: Ministry staff will provide advice on next steps.

Option A: Ministry staff may advise the client they can proceed with their activity without an authorization under the ESA where the ministry is confident that:

- no protected species at risk or habitats are likely to be present at or near the proposed location of the activity; or
- protected species at risk or habitats are known to be present but the activity is not likely to contravene the ESA; or
- through the adoption of avoidance measures, the modified activity is not likely to contravene the ESA.

Option B: Ministry staff may advise the client to proceed to Phase 1 of the overall benefit permitting process (i.e. Information Gathering in the previous diagram), where:

- there is uncertainty as to whether any protected species at risk or habitats are present at or near the proposed location of the activity; or
- the potential impacts of the proposed activity are uncertain; or
- ministry staff anticipate the proposed activity is likely to contravene the ESA.

3.0 Information Sources

Land Information Ontario (LIO) and the Natural Heritage Information Centre (NHIC) maintain and provide information about species at risk, as well as related information about fisheries, wildlife, crown lands, protected lands and more. This information is made available to organizations, private individuals, consultants, and developers through online sources and is often considered under various pieces of legislation or as part of regulatory approvals and planning processes.

The information available from LIO or NHIC and the sources listed in this guide should not be considered as a substitute for site visits and appropriate field surveys. Generally, this information can be regarded as a starting point from which to conduct further field surveys, if needed. While this data represents best available current information, it is important to note that a lack of information for a site does not mean that species at risk or their habitat are not present. There are many areas where the Government of Ontario does not currently have information, especially in more remote parts of the province. The absence of species at risk location data at or near your site does not necessarily mean no species at risk are present at that location. On-site assessments can better verify site conditions, identify and confirm presence of species at risk and/or their habitats.

Information on the location (i.e. observations and occurrences) of species at risk is considered sensitive and therefore publicly available only on a 1km square grid as opposed to as a detailed point on a map. This generalized information can help you understand which species at risk are in the general vicinity of your proposed activity and can help inform field level studies you may want to undertake to confirm the presence, or absence of species at risk at or near your site.

Should you require specific and detailed information pertaining to species at risk observations and occurrences at or near your site on a finer geographic scale; you will be required to demonstrate your need to access this information, to complete data sensitivity training and to obtain a Sensitive Data Use License from the NHIC. Information on how to obtain a license can be found online at https://www.ontario.ca/page/get-natural-heritage-information.

Many organizations (e.g. other Ontario ministries, municipalities, conservation authorities) have ongoing licensing to access this data so be sure to check if your organization has this access and consult this data as part of your preliminary screening if your organization already has a license.

3.1 Make a Map: Natural Heritage Areas

The Make a Natural Heritage Area Map (available online at http://www.gisapplication.lrc.gov.on.ca/mamnh/Index.html?site=MNR_NHLUPS_NaturalHeritage&viewer=NaturalHeritage&locale=en-US provides public access to natural heritage information, including species at risk, without the user needing to have Geographic Information System (GIS) capability. It allows users to view and identify generalized species at risk information, mark areas of interest, and create and print a custom map directly from the web application. The tool also shows topographic information such as roads, rivers, contours and municipal boundaries.

Users are advised that sensitive information has been removed from the natural areas dataset and the occurrences of species at risk has been generalized to a 1-kilometre grid to mitigate the risks to the species (e.g. illegal harvest, habitat disturbance, poaching).

The web-based mapping tool displays natural heritage data, including:

- Generalized Species at risk occurrence data (based on a 1-km square grid),
- Natural Heritage Information Centre data.

Data cannot be downloaded directly from this web map; however, information included in this application is available digitally through Land Information Ontario (LIO) at https://www.ontario.ca/page/land-information-ontario.

3.2 Land Information Ontario (LIO)

Most natural heritage data is publicly available. This data is managed in a large provincial corporate database called the LIO Warehouse and can be accessed online through the LIO Metadata Management Tool at https://www.javacoeapp.lrc.gov.on.ca/geonetwork/srv/en/main.home. This tool provides descriptive information about the characteristics, quality and context of the data. Publicly available geospatial data can be downloaded directly from this site.

While most data are publicly available, some data may be considered highly sensitive (i.e. nursery areas for fish, species at risk observations) and as such, access to some data maybe restricted.

3.3 Additional Species at Risk Information Sources

- The Breeding Bird Atlas can be accessed online at http://www.birdsontario.org/atlas/index.jsp?lang=en
- eBird can be accessed online at https://ebird.org/home
- iNaturalist can be accessed online at https://www.inaturalist.org/
- The Ontario Reptile and Amphibian Atlas can be accessed online at https://ontarionature.org/programs/citizen-science/reptile-amphibian-atlas
- Your local Conservation Authority. Information to help you find your local Conservation Authority can be accessed online at https://conservationontario.ca/conservation-authorities/find-a-conservation-authority/

  Local naturalist groups or other similar community-based organizations
- Local Indigenous communities
- Local land trusts or other similar Environmental Non-Government Organizations
- Field level studies to identify if species at risk, or their habitat, are likely present or absent at or near the site.
- When an activity is proposed within one of the continuous caribou ranges, please be sure to consider the caribou Range Management Policy. This policy includes figures and maps of the continuous caribou range, can be found online at https://www.ontario.ca/page/range-management-policy-support-woodland-caribou-conservation-and-recovery

3.4 Information Sources to Support Impact Assessments

- Guidance to help you understand if your activity is likely to adversely impact species at risk or their habitat can be found online at https://www.ontario.ca/page/policy-guidance-harm-and-harass-under-endangered-species-act and https://www.ontario.ca/page/categorizing-and-protecting-habitat-under-endangered-species-act
- A list of species at risk in Ontario is available online at https://www.ontario.ca/page/species-risk-ontario. On this webpage, you can find out more about each species, including where is lives, what threatens it and any specific habitat protections that apply to it by clicking on the photo of the species.

4.0 Check-List

Please feel free to use the check list below to help you confirm you have explored all applicable information sources and to support your discussion with Ministry staff at the preliminary screening stage.

- ✓ Land Information Ontario (LIO)
- ✓ Natural Heritage Information Centre (NHIC)
- ✓ The Breeding Bird Atlas
- ✓ eBird
- ✓ iNaturalist
- ✓ Ontario Reptile and Amphibian Atlas
- ✓ List Conservation Authorities you contacted:_____

  _____
- ✓ List local naturalist groups you contacted:_____

  _____
- ✓ List local Indigenous communities you contacted:_____

  _____
- ✓ List any other local land trusts or Environmental Non-Government Organizations you contacted:_____

  _____
- ✓ List and field studies that were conducted to identify species at risk, or their habitat, likely to be present or absent at or near the site: _____

  _____
- ✓ List what you think the likely impacts of your activity are on species at risk and their habitat (e.g. damage or destruction of habitat, killing, harming or harassing species at risk):_____

  _____

Ontario

A PROPONENT'S INTRODUCTION TO THE DELEGATION OF PROCEDURAL ASPECTS OF CONSULTATION WITH ABORIGINAL COMMUNITIES

DEFINITIONS

The following definitions are specific to this document and may not apply in other contexts:

Aboriginal communities – the First Nation or Métis communities identified by the Crown for the purpose of consultation.

Consultation – the Crown's legal obligation to consult when the Crown has knowledge of an established or asserted Aboriginal or treaty right and contemplates conduct that might adversely impact that right. This is the type of consultation required pursuant to s. 35 of the *Constitution Act, 1982*. Note that this definition does not include consultation with Aboriginal communities for other reasons, such as regulatory requirements.

Crown – the Ontario Crown, acting through a particular ministry or ministries.

Procedural aspects of consultation – those portions of consultation related to the process of consultation, such as notifying an Aboriginal community about a project, providing information about the potential impacts of a project, responding to concerns raised by an Aboriginal community and proposing changes to the project to avoid negative impacts.

Proponent – the person or entity that wants to undertake a project and requires an Ontario Crown decision or approval for the project.

I. PURPOSE

The Crown has a legal duty to consult Aboriginal communities when it has knowledge of an existing or asserted Aboriginal or treaty right and contemplates conduct that may adversely impact that right. In outlining a framework for the duty to consult, the Supreme Court of Canada has stated that the Crown may delegate procedural aspects of consultation to third parties. This document provides general information about the Ontario Crown's approach to delegation of the procedural aspects of consultation to proponents.

This document is not intended to instruct a proponent about an individual project, and it does not constitute legal advice.

II. WHY IS IT NECESSARY TO CONSULT WITH ABORIGINAL COMMUNITIES?

The objective of the modern law of Aboriginal and treaty rights is the *reconciliation* of Aboriginal peoples and non-Aboriginal peoples and their respective rights, claims and interests. Consultation is an important component of the reconciliation process.

The Crown has a legal duty to consult Aboriginal communities when it has knowledge of an existing or asserted Aboriginal or treaty right and contemplates conduct that might adversely impact that right. For example, the Crown's duty to consult is triggered when it considers

issuing a permit, authorization or approval for a project which has the potential to adversely impact an Aboriginal right, such as the right to hunt, fish, or trap in a particular area.

The scope of consultation required in particular circumstances ranges across a spectrum depending on both the nature of the asserted or established right and the seriousness of the potential adverse impacts on that right.

Depending on the particular circumstances, the Crown may also need to take steps to accommodate the potentially impacted Aboriginal or treaty right. For example, the Crown may be required to avoid or minimize the potential adverse impacts of the project.

III. THE CROWN'S ROLE AND RESPONSIBILITIES IN THE DELEGATED CONSULTATION PROCESS

The Crown has the responsibility for ensuring that the duty to consult, and accommodate where appropriate, is met. However, the Crown may delegate the procedural aspects of consultation to a proponent.

There are different ways in which the Crown may delegate the procedural aspects of consultation to a proponent, including through a letter, a memorandum of understanding, legislation, regulation, policy and codes of practice.

If the Crown decides to delegate procedural aspects of consultation, the Crown will generally:

- Ensure that the delegation of procedural aspects of consultation and the responsibilities of the proponent are clearly communicated to the proponent;
- Identify which Aboriginal communities must be consulted;
- Provide contact information for the Aboriginal communities;
- Revise, as necessary, the list of Aboriginal communities to be consulted as new information becomes available and is assessed by the Crown;
- Assess the scope of consultation owed to the Aboriginal communities;
- Maintain appropriate oversight of the actions taken by the proponent in fulfilling the procedural aspects of consultation;
- Assess the adequacy of consultation that is undertaken and any accommodation that may be required;
- Provide a contact within any responsible ministry in case issues arise that require direction from the Crown; and
- Participate in the consultation process as necessary and as determined by the Crown.

IV. THE PROPONENT'S ROLE AND RESPONSIBILITIES IN THE DELEGATED CONSULTATION PROCESS

Where aspects of the consultation process have been delegated to a proponent, the Crown, in meeting its duty to consult, will rely on the proponent's consultation activities and documentation of those activities. The consultation process informs the Crown's decision of whether or not to approve a proposed project or activity.

A proponent's role and responsibilities will vary depending on a variety of factors including the extent of consultation required in the circumstance and the procedural aspects of consultation the Crown has delegated to it. Proponents are often in a better position than the Crown to discuss a project and its potential impacts with Aboriginal communities and to determine ways to avoid or minimize the adverse impacts of a project.

A proponent can raise issues or questions with the Crown at any time during the consultation process. If issues or concerns arise during the consultation that cannot be addressed by the proponent, the proponent should contact the Crown.

a) What might a proponent be required to do in carrying out the procedural aspects of consultation?

Where the Crown delegates procedural aspects of consultation, it is often the proponent's responsibility to provide notice of the proposed project to the identified Aboriginal communities. The notice should indicate that the Crown has delegated the procedural aspects of consultation to the proponent and should include the following information:

- a description of the proposed project or activity;
- mapping;
- proposed timelines;
- details regarding anticipated environmental and other impacts;
- details regarding opportunities to comment; and
- any changes to the proposed project that have been made for seasonal conditions or other factors, where relevant.

Proponents should provide enough information and time to allow Aboriginal communities to provide meaningful feedback regarding the potential impacts of the project. Depending on the nature of consultation required for a project, a proponent also may be required to:

- provide the Crown with copies of any consultation plans prepared and an opportunity to review and comment;
- ensure that any necessary follow-up discussions with Aboriginal communities take place in a timely manner, including to confirm receipt of information, share and update information and to address questions or concerns that may arise;

- as appropriate, discuss with Aboriginal communities potential mitigation measures and/or changes to the project in response to concerns raised by Aboriginal communities;
- use language that is accessible and not overly technical, and translate material into Aboriginal languages where requested or appropriate;
- bear the reasonable costs associated with the consultation process such as, but not limited to, meeting hall rental, meal costs, document translation(s), or to address technical & capacity issues;
- provide the Crown with all the details about potential impacts on established or asserted Aboriginal or treaty rights, how these concerns have been considered and addressed by the proponent and the Aboriginal communities and any steps taken to mitigate the potential impacts;
- provide the Crown with complete and accurate documentation from these meetings and communications; and
- notify the Crown immediately if an Aboriginal community not identified by the Crown approaches the proponent seeking consultation opportunities.

b) What documentation and reporting does the Crown need from the proponent?

Proponents should keep records of all communications with the Aboriginal communities involved in the consultation process and any information provided to these Aboriginal communities.

As the Crown is required to assess the adequacy of consultation, it needs documentation to satisfy itself that the proponent has fulfilled the procedural aspects of consultation delegated to it. The documentation required would typically include:

- the date of meetings, the agendas, any materials distributed, those in attendance and copies of any minutes prepared;
- the description of the proposed project that was shared at the meeting;
- any and all concerns or other feedback provided by the communities;
- any information that was shared by a community in relation to its asserted or established Aboriginal or treaty rights and any potential adverse impacts of the proposed activity, approval or disposition on such rights;
- any proposed project changes or mitigation measures that were discussed, and feedback from Aboriginal communities about the proposed changes and measures;
- any commitments made by the proponent in response to any concerns raised, and feedback from Aboriginal communities on those commitments;
- copies of correspondence to or from Aboriginal communities, and any materials distributed electronically or by mail;

- information regarding any financial assistance provided by the proponent to enable participation by Aboriginal communities in the consultation;
- periodic consultation progress reports or copies of meeting notes if requested by the Crown;
- a summary of how the delegated aspects of consultation were carried out and the results; and
- a summary of issues raised by the Aboriginal communities, how the issues were addressed and any outstanding issues.

In certain circumstances, the Crown may share and discuss the proponent's consultation record with an Aboriginal community to ensure that it is an accurate reflection of the consultation process.

c) Will the Crown require a proponent to provide information about its commercial arrangements with Aboriginal communities?

The Crown may require a proponent to share information about aspects of commercial arrangements between the proponent and Aboriginal communities where the arrangements:

- include elements that are directed at mitigating or otherwise addressing impacts of the project;
- include securing an Aboriginal community's support for the project; or
- may potentially affect the obligations of the Crown to the Aboriginal communities.

The proponent should make every reasonable effort to exempt the Crown from confidentiality provisions in commercial arrangements with Aboriginal communities to the extent necessary to allow this information to be shared with the Crown.

The Crown cannot guarantee that information shared with the Crown will remain confidential. Confidential commercial information should not be provided to the Crown as part of the consultation record if it is not relevant to the duty to consult or otherwise required to be submitted to the Crown as part of the regulatory process.

V. WHAT ARE THE ROLES AND RESPONSIBILITIES OF ABORIGINAL COMMUNITIES' IN THE CONSULTATION PROCESS?

Like the Crown, Aboriginal communities are expected to engage in consultation in good faith. This includes:

- responding to the consultation notice;
- engaging in the proposed consultation process;
- providing relevant documentation;

- clearly articulating the potential impacts of the proposed project on Aboriginal or treaty rights; and
- discussing ways to mitigates any adverse impacts.

Some Aboriginal communities have developed tools, such as consultation protocols, policies or processes that provide guidance on how they would prefer to be consulted. Although not legally binding, proponents are encouraged to respect these community processes where it is reasonable to do so. Please note that there is no obligation for a proponent to pay a fee to an Aboriginal community in order to enter into a consultation process.

To ensure that the Crown is aware of existing community consultation protocols, proponents should contact the relevant Crown ministry when presented with a consultation protocol by an Aboriginal community or anyone purporting to be a representative of an Aboriginal community.

VI. WHAT IF MORE THAN ONE PROVINCIAL CROWN MINISTRY IS INVOLVED IN APPROVING A PROPONENT'S PROJECT?

Depending on the project and the required permits or approvals, one or more ministries may delegate procedural aspects of the Crown's duty to consult to the proponent. The proponent may contact individual ministries for guidance related to the delegation of procedural aspects of consultation for ministry-specific permits/approvals required for the project in question. Proponents are encouraged to seek input from all involved Crown ministries sooner rather than later.

From:	amos.r@aquaforbeech.com
To:	cota.c@aquaforbeech.com; ursulak.j@aquaforbeech.com
Subject:	FW: CVC Comments (Notice of Commencement) - EA 24/001 - Cooksville Creek Erosion Control Project (south of Lakeshore Rd East)
Date:	March 12, 2024 12:31:38 PM
Attachments:	image001.png image002.png rpt_TechnicalGuidelines-Floodproofing_v2_20201112_na.pdf Slope-Stability-Determination-Guidelines_na.pdf rpt_CVCEcoOffset_FINAL_20200313_na.pdf Plant-Selection-Guideline-FINAL-APRIL-24th-2018.pdf

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JU & CC – please find comments attached / below.

_____

Robert Amos, MASc., P.Eng.
Aquafor Beech Ltd.

☎ **416.705.2367**
✉ Amos.R@Aquaforbeech.com
www.aquaforbeech.com

From: Ahmad, Iftekhar <Iftekhar.Ahmad@cvc.ca>
Sent: March 12, 2024 12:24 PM
To: Rob Amos <amos.r@aquaforbeech.com>
Cc: Greg Frew <greg.frew@mississauga.ca>
Subject: CVC Comments (Notice of Commencement) - EA 24/001 - Cooksville Creek Erosion Control Project (south of Lakeshore Rd East)

Hi Rob,

CVC staff have now had the opportunity to review the Notice of Study Commencement (February 2024) and provide these high-level preliminary comments for your consideration.

CVC Comments

1. It is our understanding that the City through its ongoing erosion monitoring program recognizes the need for rehabilitation of the section of Cooksville Creek south of Lakeshore Road East to address the existing erosion issues and therefore is currently undertaking the Schedule B Municipal Class Environmental Assessment study for the proposed erosion control and restoration works including Helen Molasy trail within the specified reach.

2. Here are the site characteristics of the subject study area based on CVC mapping. A site visit will be required to review/confirm the existing site conditions. Please let us know

when the site visit can be scheduled.

a. REGULATED AREA - The study area is located entirely within CVC's regulated area. A permit from CVC will be required for any grading or construction works within this area.

b. WATERCOURSE - The study area is traversed by Cooksville Creek. Any alteration to a watercourse requires a permit from CVC. Our concerns for new construction would be to address the existing channel bank erosion and sediment control during construction.

c. FLOODPLAIN - The study area is located within the regulatory storm floodplain associated with Cooksville Creek. A permit will be required from CVC for any construction activity in this area. Our primary concern is the protection of life and property from the flood hazard. We have specific criteria and requirements for construction in the floodplain.

d. VALLEY SLOPE - The study area is traversed by the valley slope associated with Cooksville Creek. Our primary concerns are to protect the environmental integrity of the valley system and to ensure that slope stability is addressed in the proposed erosion control works if any disturbance to the valley slope is proposed.

e. WETLANDS - There appears to be wetlands within the valley limits and these areas should be confirmed during the site visit, and staked if necessary. Any proposed works should avoid working in or near wetlands to protect these sensitive features.

f. LAKE ONTARIO SHORELINE - The study area is located adjacent to the Lake Ontario on the downstream limit of the reach, and is therefore subject to the Lake Ontario Shoreline flooding and erosion hazards.

g. CVC LAND – The study area is located within CVC land. Our lands division staff will be engaged throughout the planning and design process for both permitting and landowner consent for the channel alterations, as well as for integrating the coastal wetland resilience opportunities in the project to leverage the Environment and Climate Change Canada (ECCC) funding to help complete the works.

3. The extent of the proposed erosion control works is unclear at this time (based on the limited information provided in the notice). Please note that the hydraulic analysis demonstrating no negative impact to the floodplain on private properties will be required in support of the proposed erosion control works that will involve alteration (cut/fill) within the floodplain and/or channel. The hydraulic analysis will be completed by a qualified water resources engineer and will include the following:

a. Cut/fill balance calculations.

b. CVC's HEC-RAS model for the existing conditions with a comparison to the updated existing and the modelled proposed conditions.

c. Technical memo summarizing the findings of the cut/fill balance and hydraulic assessment, modifications made to the model, and comparison tables between the existing and the proposed conditions.

The detailed requirements about the above can be found in CVC's Technical Guidelines

for Floodproofing (attached). It is recommended that pre-consultation with CVC staff be completed prior to commencing any hydraulic analysis to discuss the submission expectations.

4. There are valley slopes which have slope heights greater than 2 m with slope inclinations shallower than 3:1. Please identify the current state of toe erosion through the study reach, and any associated locations susceptible to slope failure. Please note that the geotechnical investigation and slope stability analysis would be required if the proposed works involve disturbing or altering the valley slope, and/or altering the slope hazard (by any potential channel restoration works). A slope stability analysis is to be completed in accordance with CVC's Slope Stability Guideline (attached). The geotechnical investigation and slope stability analysis must support any proposed modifications to the slope inclination or toe of slope. A new long term stable slope line should be delineated based on any modification to ensure that there are no impacts to the residential properties at the top of the valley slope. Additional comments regarding the slope stability may be provided at the detailed design stage. It is recommended that pre-consultation with CVC staff be completed prior to commencing any geotechnical/slope stability work.

5. At this time, it is unclear whether the proposed erosion control works would involve any channel realignment and/or significant bank modification. Please note that an erosion hazard assessment may be required depending on the extent of the proposed erosion control works. Please note that the erosion assessment is to establish both the existing and proposed conditions erosion hazard limits to demonstrate that the proposed works do not result in the offsite impacts to the neighboring properties. Please also consider how the proposed erosion control works will be tied in at the downstream limit of the study area at the confluence of the Lake Ontario shoreline. The flooding and erosion hazards associated with Lake Ontario shoreline must be considered at the tie in location. It is recommended to consult with CVC staff prior to commencing the erosion hazard assessment for the submission expectations.

6. CVC highlights the need to protect and enhance the existing valley vegetation which provides natural resistance against erosion. Where it is possible, the softer bank stabilization techniques (bioengineering treatment) should be used to protect and build on the existing natural banks, reducing slope steepness and maintaining fluvial processes.

7. The proposed works should be completed within the warmwater timing window (July 1 to March 31), in dry weather, and with a comprehensive Erosion and Sediment Control (ESC) plan in place.

8. CVC strongly recommends that the project footprint be minimized to the extent possible, and trees not be removed within the regulated area. Any ecological loss of the trees will be offset using CVC's Ecosystem Offsetting Guideline (attached). Please consult CVC's Plant Selection Guideline (attached) and indicate the location of the plantings on the applicable restoration plans at the detailed design stage. CVC strongly recommends that any trees that are removed be re-planted along the riparian edge to increase canopy cover and contribute to stream shading.

9. It is recommended that evaluation of the alternatives include a section that speaks to the lifespan of each alternative and future maintenance needs/costs.

10. Please be aware of the updates to and requirements of the Migratory Birds Convention Act which governs the protection and conservation of migratory birds within Canada. It is the proponent's responsibility to adhere to all pertinent laws, regulations and permit requirements including but not restricted to the Migratory Birds Convention Act and the Migratory Birds Regulations. To protect birds and bats and avoid contravention of the Migratory Birds Convention Act and Endangered Species Act, CVC recommends that vegetation clearing be avoided between April 1 and September 30 of a given year. Further information on the general nesting periods of migratory birds in Canada can be found at https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/general-nesting-periods/nesting-periods.html.

11. Given that the works are proposed in or near water, it is the responsibility of the proponent to ensure that works, undertakings or activities do not cause the death of fish or cause the harmful alteration, disruption or destruction of fish habitat under the *Fisheries Act*. Please review the complete list of measures to avoid harm at http://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures-eng.html and implement those that are applicable to the proposed works. If it is not possible to avoid or mitigate impacts, the proponent can submit a request for review form to its region's Fish and Fish Habitat Protection Program office (via fisheriesprotection@dfo-mpo.gc.ca or 1 855 852-8320). Please refer to the Fisheries and Oceans Canada (DFO) website for additional information.

12. Please contact the relevant agencies (MNRF, MECP, DFO) for any necessary mitigation opportunities and permit requirements regarding fish, wildlife, and Species at Risk, as appropriate.

13. Please reference the relevant CVC's technical guidelines in the project file report.

14. Please document easement or permission to enter agreements with any private property owners to facilitate the proposed works in the project file report.

Given our interest in the proposed project, CVC staff would like to be kept informed of future meetings and proceedings throughout the EA study. We also request to be invited to participate on any Technical Advisory Committee (TAC) that may be formed for this EA. Please forward any information or reports when available to ensure that CVC's policy and program interests are reflected in the planning and design components of the project. CVC's EA review fee for this project is $6,038 plus permit fee. CVC will issue an invoice of this amount to the attention of City's PM (Greg Frew) shortly.

If you have any questions, please contact me.

Thanks,

Best regards,
Iftekhar

Iftekhar Ahmad | MES | he/him/his

Planner, Environmental Assessment | Planning and Development Services | Credit Valley Conservation
905-670-1615 ext. 296 | M: 647-449-5962
iftekhar.ahmad@cvc.ca | cvc.ca

Our working hours may be different. Please do not feel obligated to reply outside of your scheduled working hours. Let's work together to help foster healthy work-life boundaries.



View our privacy statement

From: amos.r@aquaforbeech.com <amos.r@aquaforbeech.com>
Sent: Friday, February 16, 2024 1:05 PM
To: Greg Frew <greg.frew@mississauga.ca>
Subject: [External] Cooksville Creek Erosion Control Project - Notice of Study Commencement

[CAUTION] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe. If in doubt contact help211@cvc.ca

Dear Stakeholder,

Please find attached a Notice of Study Commencement for the City of Mississauga – Cooksville Creek Erosion Control Class Environmental Assessment.

The next point of contact will include a Public Information Centre (PIC) to discuss matters related to the study, including problems, opportunities, alternative solutions, evaluation criteria, environmental impacts and mitigation measures.

The PIC date and details will be advertised as the Study progresses.

Thanks very much for your interest and input, we look forward to hearing from you throughout the duration of the project.

Best Regards,

Rob

Robert Amos, MASc., P.Eng.
Aquafor Beech Ltd.

☎ **416.705.2367**

✉ Amos.R@Aquaforbeech.com
www.aquaforbeech.com



Credit Valley Conservation
inspired by nature



Plant Selection Guideline

Species List for Planting Plans within the Credit River Watershed

Document Contents:

Section 1: CVC Species List for Planting Plans within the Credit River Watershed
Section 2: CVC Seed Mixes
Section 3: CVC Cover Crop Selection Guideline

Prepared by: Credit Valley Conservation
April 2018

Section 1: CVC Species List for Planting Plans within the Credit River Watershed

Version 2.0 – April 2017

Credit Valley Conservation (CVC) promotes native plant biodiversity. CVC mandates the use of native species that are common within CVC's jurisdiction in regulated areas and recommends them in non-regulated areas.

The following guideline is used to select species for planting plans for natural restoration projects, mitigation plans and stormwater management pond blocks. This list ensures that restoration plantings, required by the planning and development process, enhance the ecological function of the natural heritage system of the Credit River Watershed. The Plant Selection Guideline also includes a coefficient of wetness to provide guidance on the soil moisture preferences of each species. Please refer to Table 1 for further details on species coefficient of wetness codes.

Table 1: Coefficient of Wetness and Related Soil Moisture Regime Preferences

Coefficient of Wetness	Soil Moisture Regime Preference
5	Almost always occur on uplands
4 3 2	Usually occur on uplands
1 0 -1	Found on uplands and in wetlands
-2 -3 -4	Usually occur in wetlands
-5	Almost always in wetlands

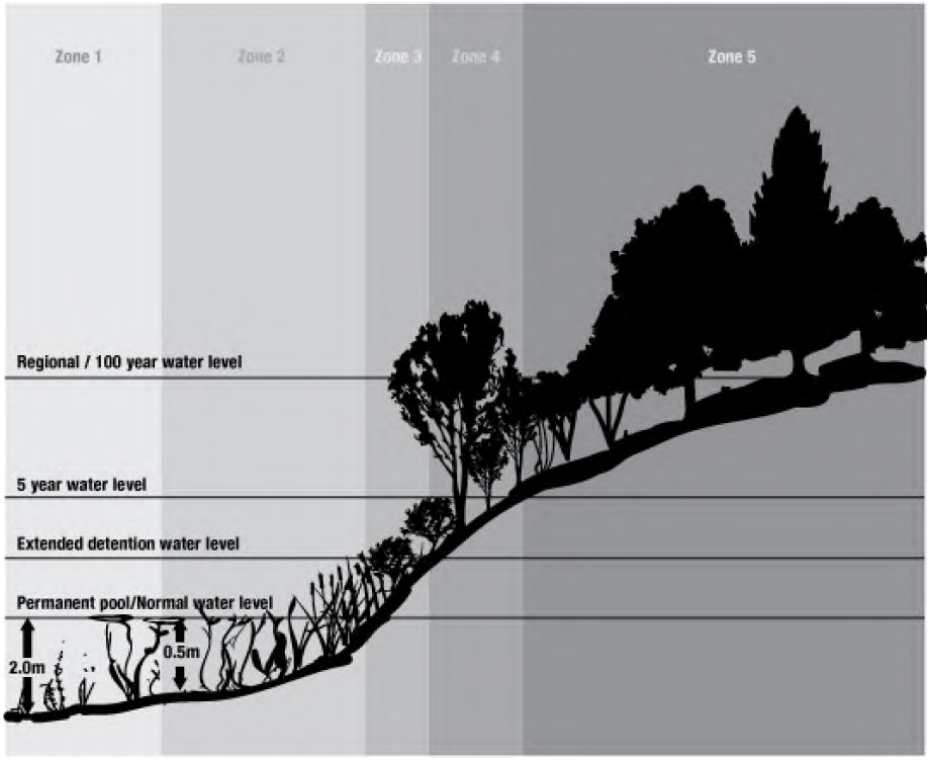
Note: Coefficient of Wetness taken from the Floristic Assessment System for Southern Ontario (Oldham et al, 1995).

There are two ecoregions within the Credit River Watershed: 6E - Lake Simcoe-Rideau Ecoregion and 7E – Lake Erie-Lake Ontario Ecoregion. Each ecoregion is characterized by a distinct biological response (i.e. species and communities) to environmental conditions (i.e. climate and geology) associated with that region. This list provides guidance on which species are appropriate for planting in each of these ecoregions. To simplify implementation and ensure consistency within individual municipalities, the watershed has been divided into two zones (upper and lower watershed) that roughly correspond to the boundaries of the ecoregions. Within this document, species identified with "**YES**" are suitable for planting in both the upper and lower watershed, "**U**" is suitable for **upper watershed only** and "**L**" is suitable for **lower watershed only**. The lower watershed includes the City of Mississauga, City of Brampton, Town of Oakville and Town of Milton. The upper watershed includes the Town of Halton Hills, Town of Caledon, Town of Orangeville, Town of Erin, Township of East Garafraxa, Township of Amaranth, and Town of Mono.

CVC staff have identified a selection of herbaceous, sedges, rushes, emergent and aquatic plants that appear to be successful in Stormwater Management (SWM) ponds, based on a review of SWM ponds within our watershed and the following reports: Performance Assessment of a Highway Stormwater Quality Detention Pond (SWAMP 2003) and Town of Aurora Stormwater Ponds Vegetation & Wildlife Study (Aurora Environmental Advisory Committee 2007). These species are **highlighted in green** in the Plant Selection Guideline List provided below. The column titled "SWM Pond Planting Zone" should be used in conjunction with Figure 1 to determine in which area of a SWM pond the species may be suitable. Species marked "NR" within this column are not recommended for planting in SWM ponds as a result of characteristics which deem them unsuitable (i.e. potential confusion with non-native species, site specific needs for growth). Please note that woody vines are not included in the calculation of shrub material to meet CVCs SWM Planting Guidelines but can be included to add diversity.

For information on how Wildlife Use, Characteristic and LID Codes were determined please refer to the definitions at the end of this document. A list of acceptable cover crops is included at the end of the plant list. To obtain a workable version of this document in excel format please contact a CVC Planning Ecologist.

Figure 1: SWM Pond Planting Zones



This document and the recommendations provided herein were developed based on the most recent scientific research available to CVC as well as professional opinion and experience. Please note that this list is not exhaustive and other species may be suitable. As a result, CVC will review any proposed species and rationale for use provided by the proponent or their consultants in support of their specific project. If you have any questions regarding the guidelines, contact a CVC Planning Ecologist.

Plant Selection Guideline List - Version 2.0

Species Use Codes:

- Breeding and migratory birds
- Pollinators
- Mast species providing wildlife foraging opportunities

LID Codes:

BR Bioretention
DS Dry swale
ES Enhanced grass swale
F Filter strips

Characteristics Codes:

- Not recommended for planting due to recent population decline or confusion/ hybridization with non-native sources
- Prefers full sun
- Prefers shade
- Salt tolerant
- Drought tolerant
- Suitable for bioengineering
- Susceptible to wind throw damage; plant away from lot lines, infrastructure and trails

Scientific Name	Common Name	Coefficient of Wetness	Upper/Lower Watershed	SWM Pond Planting Zone	Wildlife Use Codes	Characteristic Codes	LID Codes
Trees							
Abies balsamea	Balsam Fir	-3	U	3, 4			
Acer nigrum	Black Maple	3	Yes	5			
Acer rubrum	Red Maple	0	Yes	3, 4			BR, DS, F
Acer saccharinum	Silver Maple	-3	Yes	3, 4			F
Acer saccharum	Sugar Maple	3	Yes	5			BR, F
Acer x freemanii	Hybrid Maple	N/A	Yes	3, 4			BR, DS, F
Betula alleghaniensis	Yellow Birch	0	Yes	4			
Betula papyrifera	Paper Birch	2	Yes	4, 5			BR, DS
Carya cordiformis	Bitternut Hickory	0	Yes	4			F
Carya ovata	Shagbark Hickory	3	L	5			F
Fagus grandifolia	American Beech	3	Yes	NR			

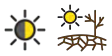
Scientific Name	Common Name	Coefficient of Wetness	Upper/Lower Watershed	SWM Pond Planting Zone	Wildlife Use Codes	Characteristic Codes	LID Codes
Fraxinus americana	White Ash	3	Yes	NR		⊘	BR, DS
Fraxinus nigra	Black Ash	-4	Yes	NR		⊘	BR, DS, F
Fraxinus pennsylvanica	Green Ash	-3	Yes	NR		⊘	F
Juglans nigra	Black Walnut	3	**L**	5			BR, DS, F
Larix laricina	American Larch	-3	**U**	3, 4			BR, DS, F
Ostrya virginiana	Eastern Hop-hornbeam	4	Yes	5			
Picea glauca	White Spruce	3	**U**	5			BR, F
Pinus strobus	Eastern White Pine	3	Yes	5			F
Populus balsamifera	Balsam Poplar	-3	Yes	3, 4			BR, DS
Populus deltoides ssp. *deltoides*	Eastern Cottonwood	-1	Yes	4			BR, DS, F
Populus grandidentata	Large-toothed Aspen	3	Yes	5			BR, DS, F
Populus tremuloides	Trembling Aspen	0	Yes	4			BR,DS
Prunus serotina	Black Cherry	3	Yes	5			BR, DS, F
Quercus alba	White Oak	3	Yes	5			BR, DS, F
Quercus macrocarpa	Bur Oak	1	Yes	4, 5			BR, DS
Quercus rubra	Northern Red Oak	3	Yes	5			BR, DS, F
Salix amygdaloides	Peach-leaved Willow	-3	Yes	3,4			BR, DS,

Scientific Name	Common Name	Coefficient of Wetness	Upper/Lower Watershed	SWM Pond Planting Zone	Wildlife Use Codes	Characteristic Codes	LID Codes
Salix nigra	Black Willow	-5	**L**	NR		⊘	
Thuja occidentalis	Eastern White Cedar	-3	Yes	3, 4			BR, F
Tilia americana	American Basswood	3	Yes	5			F
Tsuga canadensis	Eastern Hemlock	3	Yes	NR			
Ulmus americana	American Elm	-2	Yes	NR		⊘	
Ulmus rubra	Slippery Elm	0	Yes	NR		⊘	
Shrubs							
Acer spicatum	Mountain Maple	3	Yes	NR			
Alnus incana	Speckled Alder	-5	**U**	NR			
Amelanchier arborea	Downy Serviceberry	3	Yes	5			
Amelanchier laevis	Smooth Serviceberry	5	Yes	5			BR, DS
Aronia melanocarpa	Black Chokeberry	-3	**U**	NR		⊘	
Carpinus caroliniana	Blue-beech	0	Yes	4			
Cornus alternifolia	Alternate-leaved Dogwood	5	Yes	5			DS
Cornus canadensis	Bunchberry	0	**U**	NR			
Cornus obliqua	Pale Dogwood	-4	**U**	3,4			
Cornus racemosa	Gray Dogwood	-2	Yes	4			BR, DS, F
Cornus rugosa	Round-leaved Dogwood	5	Yes	5			
Cornus sericea	Red-osier Dogwood	-3	Yes	3,4			
Corylus cornuta	Beaked Hazelnut	5	Yes	5			F

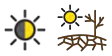
Scientific Name	Common Name	Coefficient of Wetness	Upper/Lower Watershed	SWM Pond Planting Zone	Wildlife Use Codes	Characteristic Codes	LID Codes
Crataegus punctata	Dotted Hawthorn	5	Yes	NR			
Diervilla lonicera	Northern Bush-honeysuckle	5	Yes	5			DS,F
Euonymus obovatus	Running Strawberry Bush	5	**L**	NR			
Gaultheria procumbens	Eastern Teaberry	3	Yes	NR			
Hamamelis virginiana	American Witch-hazel	3	**L**	5			DS,F
Ilex verticillata	Black Holly	-4	**U**	3			
Lonicera canadensis	Canada Fly Honeysuckle	3	Yes	5			
Mitchella repens	Partridge-berry	2	**U**	NR			
Prunus pensylvanica	Pin Cherry	4	Yes	5			BR,DS
Prunus virginiana	Choke Cherry	1	Yes	4, 5			BR,DS, F
Rhus typhina	Staghorn Sumac	5	Yes	5			BR, DS, F
Ribes americanum	Wild Black Currant	-3	Yes	3,4			
Ribes cynosbati	Prickly Gooseberry	5	Yes	5			DS, F
Ribes triste	Swamp Red Currant	-5	**U**	3			F
Rosa blanda	Smooth Rose	3	Yes	5			F
Rubus allegheniensis	Allegheny Blackberry	2	Yes	4, 5			DS, F
Rubus idaeus ssp. *strigosus*	Wild Red Raspberry	-2	Yes	4			BR, DS, F
Rubus occidentalis	Black Raspberry	5	Yes	5			
Rubus odoratus	Purple-flowering Raspberry	5	Yes	5			BR, DS

Scientific Name	Common Name	Coefficient of Wetness	Upper/Lower Watershed	SWM Pond Planting Zone	Wildlife Use Codes	Characteristic Codes	LID Codes
Rubus pubescens	Dewberry	-4	Yes	NR			F
Salix bebbiana	Bebb's Willow	-4	Yes	3			DS
Salix discolor	Pussy Willow	-3	Yes	3,4			BR,DS, F
Salix eriocephala	Heart-leaved Willow	-3	Yes	3,4			BR, DS
Salix interior	Sandbar Willow	-5	Yes	3,4			BR, F
Salix lucida	Shining Willow	-4	**U**	3,4			F
Salix petiolaris	Meadow Willow	-4	**U**	3			BR, DS, F
Sambucus canadensis	Common Elderberry	-2	Yes	4			DS, F
Sambucus racemosa	Red Elderberry	2	Yes	4, 5			BR, DS, F
Spiraea alba	White Meadowsweet	-4	**U**	3			
Symphoricarpos albus ssp.. *albus*	Common Snowberry	4	Yes	5			
Taxus canadensis	Canadian Yew	3	Yes	NR			
Viburnum acerifolium	Maple-leaved Viburnum	5	Yes	5			
Viburnum lentago	Nannyberry	-1	Yes	4			BR, DS, F
Viburnum opulus ssp. *trilobum*	Highbush Cranberry	-3	Yes	NR			
Woody Vines							
Celastrus scandens	Climbing Bittersweet	3	Yes	NR			
Clematis Virginiana	Virginia Virgin's-bower	0	Yes	4			BR
Lonicera dioica	Limber Honeysuckle	3	Yes	5			

Scientific Name	Common Name	Coefficient of Wetness	Upper/Lower Watershed	SWM Pond Planting Zone	Wildlife Use Codes	Characteristic Codes	LID Codes
Parthenocissus quinquefolia	Virginia Creeper	3	Yes	5			
Parthenocissus viacea	Thicket Creeper	3	Yes	5			
Smilax tamnoides	Hispid Greenbrier	0	Yes	4			
Vitis riparia	Riverbank Grape	-2	Yes	4			
Ferns							
Adiantum pedatum	Northern Maidenhair Fern	1	**U**	NR			
Athyrium filix-femina ssp.. *angustum*	Northeastern Lady Fern	0	Yes	NR			
Botrypus virginianus	Rattlesnake Fern	3	**U**	NR			
Cystopteris bulbifera	Bulblet Fern	-2	Yes	NR			
Cystopteris tenuis	Mackay's Bladder Fern	5	**U**	NR			
Dendrolycopodium dendroideum	Round-branched Tree-clubmoss	0	**U**	NR			
Diphasiastrum digitatum	Southern Ground-cedar	5	**U**	NR			
Dryopteris carthusiana	Spinulose Wood Fern	-2	Yes	NR			
Dryopteris cristata	Crested Wood Fern	-5	**U**	NR			
Dryopteris intermedia	Evergreen Wood Fern	0	Yes	NR			
Dryopteris marginalis	Marginal Wood Fern	3	Yes	NR			
Equisetum arvense	Field Horsetail	0	Yes	NR			
Equisetum hyemale	Common Scouring-rush	-2	Yes	NR			
Gymnocarpium dryopteris	Common Oak Fern	0	**U**	NR			

Scientific Name	Common Name	Coefficient of Wetness	Upper/Lower Watershed	SWM Pond Planting Zone	Wildlife Use Codes	Characteristic Codes	LID Codes
Huperzia lucidula	Shining Firmoss	-1	**U**	NR			
Matteuccia struthiopteris	Ostrich Fern	-3	Yes	3,4			F
Onoclea sensibilis	Sensitive Fern	-3	Yes	NR			F
Osmundastrum cinnamomeum	Cinnamon Fern	-3	Yes	NR			
Polystichum acrostichoides	Christmas Fern	5	Yes	NR			
Pteridium aquilinum	Bracken Fern	3	Yes	5			
Thelypteris palustris	Marsh Fern	-4	Yes	NR			F
Herbaceous							
Acalypha rhomboidea	Common Three-seeded Mercury	3	Yes	5			
Actaea pachypoda	White Baneberry	NR	Yes				
Actaea rubra	Red Baneberry	NR	Yes				
Ageratina altissima	White Snakeroot	3	Yes	5			
Agrimonia gryposepala	Hooked Agrimony	2	Yes	4, 5			
Allium tricoccum ssp.. *tricoccum*	Wild Leek	2	Yes	NR			
Ambrosia artemisiifolia	Annual Ragweed	3	Yes	NR			
Ambrosia trifida	Great Ragweed	-1	Yes	NR			
Anaphalis margaritacea	Pearly Everlasting	5	**U**	5			
Anemone acutiloba	Sharp-lobed Hepatica	5	Yes	NR			
Anemone canadensis	Canada Anemone	-3	Yes	3,4			BR, DS, F
Anemone quinquefolia	Wood Anemone	0	**L**	NR			
Anemone virginiana ssp.. *virginiana*	Tall Anemone	5	Yes	5			

Scientific Name	Common Name	Coefficient of Wetness	Upper/Lower Watershed	SWM Pond Planting Zone	Wildlife Use Codes	Characteristic Codes	LID Codes
Antennaria neglecta	Field Pussytoes	5	Yes	Yes			
Apocynum androsaemifolium	Spreading Dogbane	5	Yes	4			
Apocynum cannabinum ssp.. *cannabinum*	Hemp Dogbane	0	Yes	4			
Aquilegia canadensis	Wild Columbine	1	Yes	NR			DS, F
Aralia nudicaulis	Wild Sarsaparilla	3	Yes	NR			
Arisaema triphyllum	Jack-in-the-pulpit	-2	Yes	NR			
Asarum canadense	Canada Wild-ginger	5	Yes	NR			
Asclepias incarnata	Swamp Milkweed	-5	Yes	3			BR, DS
Asclepias syriaca	Common Milkweed	5	Yes	5			
Bidens cernua	Nodding Beggarticks	-5	Yes	3			BR
Bidens frondosa	Devils Beggarticks	-3	Yes	3,4			BR
Boehmeria cylindrica	False Nettle	-5	Yes	3			
Calystegia sepium ssp. *americana*	American False Bindweed	0	Yes	4			
Cardamine concatenata	Cut-leaved Toothwort	3	Yes	NR			
Cardamine diphylla	Two-leaved Toothwort	5	Yes	NR			
Cardamine pensylvanica	Pennsylvania Bittercress	-4	**U**	NR			
Caulophyllum giganteum	Giant Blue Cohosh	5	Yes	NR			
Chelone glabra	White Turtlehead	-5	Yes	3			
Chenopodiastrum simplex	Maple-leaved Goosefoot	5	Yes	5			
Circaea alpina	Small Enchanters Nightshade	-3	**U**	NR			

Scientific Name	Common Name	Coefficient of Wetness	Upper/Lower Watershed	SWM Pond Planting Zone	Wildlife Use Codes	Characteristic Codes	LID Codes
Circaea canadensis	Broad-leaved Enchanters Nightshade	3	Yes	5			
Claytonia virginica	Narrow-leaved Spring Beauty	3	**L**	NR			
Clinopodium vulgare	Field Basil	5	Yes	5			
Clintonia borealis	Blue Bead-lily	-1	**U**	NR			
Coptis trifolia	Goldthread	-3	**U**	NR			
Cryptotaenia canadensis	Canada Honewort	0	Yes	4			
Dicentra canadensis	Squirrel-corn	5	**U**	NR			
Epifagus virginiana	Beechdrops	5	Yes	NR			
Epilobium ciliatum ssp. *ciliatum*	Northern Willowherb	3	Yes	5			
Erigeron annuus	Annual Fleabane	1	Yes	4, 5			
Erigeron canadensis	Canada Horseweed	1	Yes	4, 5			
Erigeron philadelphicus	Philadelphia Fleabane	-3	Yes	3,4			
Erigeron strigosus	Rough Fleabane	1	Yes	4, 5			
Erythronium americanum	Yellow Trout-lily	5	Yes	NR			
Eupatorium perfoliatum	Common Boneset	-4	Yes	3			F
Eurybia macrophylla	Large-leaved Aster	5	Yes	NR			
Euthamia graminifolia	Grass-leaved Goldenrod	-2	Yes	4			BR, DS, F
Eutrochium maculatum ssp.. *maculatum*	Spotted Joe Pye Weed	-5	Yes	3			
Fragaria vesca ssp. *americana*	American Woodland Strawberry	4	Yes	NR			

Scientific Name	Common Name	Coefficient of Wetness	Upper/Lower Watershed	SWM Pond Planting Zone	Wildlife Use Codes	Characteristic Codes	LID Codes
Fragaria virginiana	Wild Strawberry	1	Yes	4, 5			BR, DS
Galium asprellum	Rough Bedstraw	-5	Yes	NR			
Galium palustre	Marsh Bedstraw	-5	Yes	NR			
Galium triflorum	Three-flowered Bedstraw	2	Yes	NR			
Geranium maculatum	Spotted Geranium	3	**L**	NR			ES
Geum aleppicum	Yellow Avens	-1	Yes	4			
Geum canadense	White Avens	0	Yes	4			
Geum fragarioides	Barren Strawberry	5	Yes	NR			
Geum laciniatum	Rough Avens	-3	**L**	3,4			
Hackelia virginiana	Virginia Stickseed	1	Yes	4, 5			
Hydrocotyle americana	American Water-pennywort	-5	**U**	NR			
Hydrophyllum virginianum	Virginia Waterleaf	-2	Yes	NR			F
Impatiens capensis	Spotted Jewelweed	-3	Yes	3,4			
Lactuca canadensis	Canada Lettuce	2	Yes	NR			
Laportea canadensis	Wood Nettle	-3	Yes	NR			
Lilium michiganense	Michigan Lily	-1	**L**	4			
Lobelia inflata	Indian-tobacco	4	Yes	5			
Lobelia siphilitica	Great Blue Lobelia	-4	Yes	3			F
Lycopus americanus	American Water-horehound	-5	Yes	3			
Lycopus uniflorus	Northern Water-horehound	-5	Yes	3			
Lysimachia borealis	Northern Starflower	-1	Yes	NR			
Lysimachia ciliata	Fringed Loosestrife	-3	Yes	3,4			F

Scientific Name	Common Name	Coefficient of Wetness	Upper/Lower Watershed	SWM Pond Planting Zone	Wildlife Use Codes	Characteristic Codes	LID Codes
Maianthemum canadense	Wild Lily-of-the-valley	0	Yes	NR			
Maianthemum racemosum	False Solomons-seal	3	Yes	NR			
Maianthemum stellatum	Star-flowered False Solomons-seal	1	Yes	NR			
Mentha canadensis	Canada Mint	-3	Yes	3,4			
Mimulus ringens	Square-stemmed Monkeyflower	-5	Yes	3			
Mitella diphylla	Two-leaved Mitrewort	2	Yes	NR			
Mitella nuda	Naked Mitrewort	-3	Yes	NR			
Monarda fistulosa ssp.. *fistulosa*	Wild Bergamot	3	Yes	5			BR, F
Monotropa uniflora	Indian-pipe	3	Yes	NR			
Myosotis laxa	Small Forget-me-not	-5	Yes	NR			
Nabalus albus	White Rattlesnake-root	3	Yes	NR			
Nabalus altissimus	Tall Rattlesnake-root	3	Yes	NR			
Oenothera biennis	Common Evening Primrose	3	Yes	5			
Oenothera parviflora	Small-flowered Evening Primrose	3	Yes	5			
Osmorhiza claytonii	Hairy Sweet Cicely	4	Yes	NR			
Penthorum sedoides	Ditch-stonecrop	-5	Yes	3			
Persicaria lapathifolia	Pale Smartweed	-4	Yes	3			
Phryma leptostachya	Lopseed	5	Yes	5			
Pilea pumila	Canada Clearweed	-3	Yes	NR			
Plantago rugelii	Rugels Plantain	0	Yes	NR			

Scientific Name	Common Name	Coefficient of Wetness	Upper/Lower Watershed	SWM Pond Planting Zone	Wildlife Use Codes	Characteristic Codes	LID Codes
Platanthera aquilonis	Tall Northern Green Orchid	-4	**U**	NR			
Podophyllum peltatum	May-apple	3	Yes	NR			F
Polygaloides paucifolia	Gay-wing Milkwort	3	**U**	NR			
Polygonatum pubescens	Hairy Solomons Seal	5	Yes	NR			
Potentilla norvegica	Norwegian Cinquefoil	0	Yes	4			
Prunella vulgaris ssp. *lanceolata*	Lance-leaved Self-heal	5	Yes	NR			
Pyrola asarifolia	Pink Pyrola	-3	**U**	NR			
Pyrola elliptica	Shinleaf	5	Yes	NR			
Ranunculus abortivus	Kidney-leaved Buttercup	-2	Yes	NR			
Ranunculus hispidus ssp.. *caricetorum*	Northern Swamp Buttercup	-5	Yes	3			
Ranunculus recurvatus	Hooked Buttercup	-3	Yes	3,4			
Rorippa palustris ssp. *hispida*	Hispid Marsh Yellowcress	-5	Yes	3			
Rudbeckia hirta	Black-eyed Susan	3	Yes	5			BR, DS
Rudbeckia laciniata	Cut-leaved Coneflower	-4	**L**	3			BR, DS,F
Sanguinaria canadensis	Bloodroot	4	Yes	NR			
Sanicula marilandica	Maryland Sanicle	3	Yes	5			
Scutellaria galericulata	Hooded Skullcap	-5	Yes	3			
Scutellaria lateriflora	Mad Dog Skullcap	-5	Yes	3			
Solanum ptychanthum	Black Nightshade	5	Yes	NR			
Solidago altissima ssp.. *altissima*	Eastern Tall Goldenrod	3	Yes	5			BR, DS, F

Scientific Name	Common Name	Coefficient of Wetness	Upper/Lower Watershed	SWM Pond Planting Zone	Wildlife Use Codes	Characteristic Codes	LID Codes
Solidago caesia	Blue-stemmed Goldenrod	3	Yes	NR			
Solidago canadensis ssp.. *canadensis*	Canada Goldenrod	3	Yes	5			BR, DS,F
Solidago flexicaulis	Zigzag Goldenrod	3	Yes	NR			BR, DS
Solidago gigantea	Giant Goldenrod	-3	Yes	3,4			
Solidago juncea	Early Goldenrod	5	Yes	5			
Solidago nemoralis ssp. *nemoralis*	Gray-stemmed Goldenrod	5	Yes	5			BR, DS
Solidago rugosa ssp. *rugosa*	Northern Rough-stemmed Goldenrod	-1	**U**	4			BR, DS,F
Streptopus lanceolatus ssp.. *lanceolatus*	Eastern Rose Twisted-stalk	0	**U**	NR			
Symphyotrichum cordifolium	Heart-leaved Aster	5	Yes	NR			BR, DS
Symphyotrichum ericoides ssp.. *ericoides*	White Heath Aster	4	Yes	5			BR
Symphyotrichum lanceolatum ssp. *lanceolatum*	Panicled Aster	-3	Yes	3,4			BR, DS
Symphyotrichum lateriflorum	Calico Aster	-2	Yes	4			
Symphyotrichum novae-angliae	New England Aster	-3	Yes	3,4			BR, DS,F
Symphyotrichum puniceum	Swamp Aster	-5	Yes	3			BR, DS, F
Thalictrum dioicum	Early Meadow-rue	2	Yes	NR			
Thalictrum pubescens	Tall Meadow-rue	-2	Yes	4			BR, DS, F
Tiarella cordifolia	Heart-leaved Foam-flower	1	Yes	NR			

Scientific Name	Common Name	Coefficient of Wetness	Upper/Lower Watershed	SWM Pond Planting Zone	Wildlife Use Codes	Characteristic Codes	LID Codes
Trientalis borealis	Northern Starflower	-1	Yes	NR			
Trillium erectum	Red Trillium	1	Yes	NR			
Trillium grandiflorum	White Trillium	5	Yes	NR			
Urtica dioica ssp. *gracilis*	Slender Stinging Nettle	-1	Yes	4			
Uvularia grandiflora	Large-flowered Bellwort	5	Yes	NR			
Verbena hastata	Blue Vervain	-4	Yes	3			BR, DS
Verbena urticifolia	White Vervain	-1	Yes	4			BR, DS, F
Veronica americana	American Speedwell	-5	**U**	NR			
Viola affinis	Le Conte's Violet	-3	Yes	NR			
Viola blanda	Sweet White Violet	-2	**U**	NR			
Viola canadensis ssp.. *canadensis*	Canada Violet	5	Yes	NR			
Viola labradorica	Labrador Violet	-2	Yes	NR			
Viola pubescens	Yellow Violet	4	Yes	5			
Viola rostrata	Long-spurred Violet	3	**U**	NR			
Viola sororia	Woolly Blue Violet	1	Yes	4, 5			
Xanthium strumarium	Rough Cocklebur	0	Yes	4			
Grasses							
Bromus ciliatus	Fringed Brome	-3	**U**	3,4			
Bromus latiglumis	Broad-glumed Brome	-2	**L**	4			BR, DS, F
Calamagrostis canadensis ssp.. *canadensis*	Bluejoint Reedgrass	-5	Yes	3			BR, DS, F
Danthonia spicata	Poverty Oatgrass	5	Yes	5			BR, ES, DS

Scientific Name	Common Name	Coefficient of Wetness	Upper/Lower Watershed	SWM Pond Planting Zone	Wildlife Use Codes	Characteristic Codes	LID Codes
Dichanthelium acuminatum	Hairy Panicgrass	N/A	Yes	4			
Elymus hystrix	Bottlebrush Grass	5	Yes	5			
Elymus riparius	Eastern Riverbank Wildrye	-3	**U**	3,4			BR, ES, DS, F
Elymus virginicus ssp.. *virginicus*	Virginia Wildrye	-2	Yes	4			BR, DS
Festuca subverticillata	Nodding Fescue	2	Yes	NR			
Glyceria striata	Fowl Mannagrass	-5	Yes	3			
Leersia oryzoides	Rice Cutgrass	-5	Yes	3			
Muhlenbergia mexicana ssp.. *mexicana*	Mexican Muhly	-3	Yes	3,4			BR, DS
Oryzopsis asperifolia	White-grained Mountain-ricegrass	5	Yes	NR			
Panicum acuminatum ssp.. *acuminatum*	Tapered Rosette Grass	0	Yes	4			
Panicum capillare	Common Panicgrass	5	Yes	5			
Phalaris arundinacea ssp.. *arundinacea*	Reed Canary Grass	-4	Yes	NR			
Poa palustris	Fowl Bluegrass	-4	Yes	3			
Schizachne purpurascens	Purple False Melic	2		NR			
Sphenopholis intermedia	Slender Wedge Grass	0	Yes	4			
Sedges							
Carex arctata	Drooping Woodland Sedge	5	Yes	5			
Carex aurea	Golden Sedge	-4	Yes	3			

Scientific Name	Common Name	Coefficient of Wetness	Upper/Lower Watershed	SWM Pond Planting Zone	Wildlife Use Codes	Characteristic Codes	LID Codes
Carex bebbii	Bebbs Sedge	-5	Yes	3			BR, DS, F
Carex blanda	Woodland Sedge	0	Yes	NR			
Carex communis	Fibrous-root Sedge	5	Yes	5			
Carex crinita	Fringed Sedge	-4	**U**	3			ES
Carex cristatella	Crested Sedge	-4	Yes	3			
Carex deweyana	Deweys Sedge	4	Yes	5			
Carex disperma	Two-seeded Sedge	-5	**U**	3			
Carex gracillima	Graceful Sedge	3	Yes	5			
Carex granularis	Limestone Meadow Sedge	-4	Yes	3			
Carex hystericina	Porcupine Sedge	-5	Yes	3			BR,ES, DS
Carex interior	Inland Sedge	-5	**U**	3			
Carex intumescens	Bladder Sedge	-4	Yes	3			F
Carex leptalea	Bristle-stalked Sedge	-5	**U**	3			
Carex lupulina	Hop Sedge	-5	Yes	3			F
Carex peckii	Pecks Sedge	5	Yes	NR			
Carex pedunculata	Long-stalked Sedge	5	Yes	NR			
Carex pensylvanica	Pennsylvania Sedge	5	Yes	NR			BR, ES, DS
Carex plantaginea	Plantain-leaved Sedge	5	Yes	NR			
Carex platyphylla	Broad-leaved Sedge	5	Yes	NR			
Carex pseudocyperus	Cyperus-like Sedge	-5	Yes	3			
Carex radiata	Eastern Star Sedge	5	Yes	5			

Scientific Name	Common Name	Coefficient of Wetness	Upper/Lower Watershed	SWM Pond Planting Zone	Wildlife Use Codes	Characteristic Codes	LID Codes
Carex retrorsa	Retrorse Sedge	-5	Yes	3			
Carex rosea	Rosy Sedge	5	Yes	NR			
Carex sparganioides	Burreed Sedge	0	Yes	4			
Carex stipata	Awl-fruited Sedge	-5	Yes	3			BR, ES
Carex vulpinoidea	Fox Sedge	-5	Yes	3			DS
Eleocharis erythropoda	Red-stemmed Spikerush	-5	Yes	3			
Eleocharis obtusa	Blunt Spikerush	-5	**U**	3			
Scirpus atrovirens	Dark-green Bulrush	-5	Yes	3			BR
Scirpus microcarpus	Red-tinged Bulrush	-5	Yes	3			
Rushes							
Juncus articulatus	Jointed Rush	-5	Yes	3			
Juncus dudleyi	Dudleys Rush	0	Yes	4			
Juncus effusus	Soft Rush	-5	Yes	3			BR, F
Juncus nodosus	Knotted Rush	-5	Yes	3			
Juncus tenuis	Path Rush	0	Yes	4			BR, DS, F
Juncus torreyi	Torreys Rush	-3	Yes	3,4			
Emergents							
Alisma triviale/subcordatum (A. plantago-aquatica)	Water-plantain species	-5	Yes	2, 3			BR, F
Calla palustris	Wild Calla	-5	**U**	NR			
Caltha palustris	Yellow Marsh Marigold	-5	Yes	NR			F
Carex lacustris	Lake Sedge	-5	Yes	2, 3			
Carex stricta	Tussock Sedge	-5	**U**	2, 3			

Scientific Name	Common Name	Coefficient of Wetness	Upper/Lower Watershed	SWM Pond Planting Zone	Wildlife Use Codes	Characteristic Codes	LID Codes
Cicuta bulbifera	Bulb-bearing Water-hemlock	-5	**U**	NR			
Cicuta maculata ssp.. *maculata*	Spotted Water-hemlock	-5	Yes	NR			
Glyceria grandis	Tall Mannagrass	-5	Yes	2, 3			
Iris versicolor	Harlequin Blue Flag	-5	Yes	2, 3			
Sagittaria latifolia	Broad-leaved Arrowhead	-5	Yes	2, 3			
Schoenoplectus tabernaemontani	Soft-stemmed Bulrush	-5	Yes	2, 3			BR, DS, F
Scirpus cyperinus	Cottongrass Bulrush	-5	Yes	2, 3			BR, DS, F
Sium suave	Hemlock Water-parsnip	-5	Yes	2, 3			
Sparganium emersum	Green-fruited Burreed	-5	**U**	2, 3			
Sparganium eurycarpum	Broad-fruited Burreed	-5	Yes	2, 3			BR, DS
Typha latifolia	Broad-leaved Cattail	-5	Yes	FB*			BR
Submergent Aquatics							
Ceratophyllum demersum	Common Hornwort	-5	Yes	1			
Elodea canadensis	Broad Waterweed	-5	Yes	1			
Myriophyllum sibiricum	Siberian Water-milfoil	-5	Yes	1			
Najas flexilis	Slender Naiad	-5	Yes	1			
Potamogeton foliosus	Leafy Pondweed	-5	Yes	1			
Potamogeton pusillus ssp. *pusillus*	Small Pondweed	-5	Yes	1			
Potamogeton pusillus ssp. *tenuissimus*	Narrow-leaved Small Pondweed	-5	Yes	1			

Scientific Name	Common Name	Coefficient of Wetness	Upper/Lower Watershed	SWM Pond Planting Zone	Wildlife Use Codes	Characteristic Codes	LID Codes
Potamogeton richardsonii	Richardsons Pondweed	-5	Yes	1			
Ranunculus aquatilis	White Water Buttercup	-5	Yes	1			
Stuckenia pectinata	Sago Pondweed	-5	Yes	1			
Floating Aquatics							
Lemna minor	Lesser Duckweed	-5	Yes	1			
Nuphar ssp.iegata	Ssp.iegated Pond-lily	-5	Yes	1			
Nymphaea odorata ssp. *odorata*	Fragrant Water-lily	-5	Yes	1			
Persicaria amphibia	Water Smartweed	-5	**U**	1			
Potamogeton natans	Floating Pondweed	-5	Yes	1			
Spirodela polyrhiza	Great Duckweed	-5	**U**	1			

*Please note *Typha latifolia* (broad-leaved cattail) is only recommended within the forebay of SWM ponds only.

Species use and characteristic codes were developed using current research and expert knowledge. This list is not intended to be exhaustive and is subject to change as a result of evolving information. A general description of the criteria that went into the assessment of each species use or characteristic code is as follows:

1. **Breeding and Migratory Birds**: Adapted from *CVC Native Plant List for Breeding and Migratory Birds*. These reflect ideal species for native bird breeding, nesting and foraging. Please note that other species of trees and shrubs may also provide nesting opportunities and utilization. If vegetation removals are required for a project, the absence of species identified on the above list does not negate the need for proper nesting surveys and assessments.

2. **Pollinators:** Includes species that attract or are utilized by various types of insect pollinators (bees, butterflies, moths etc.) during various life stages. This may include food and/ or habitat for larvae or adults.

3. **Mast Species:** Mast is considered the edible reproductive part (i.e. nuts and berries) produced by woody species of plants which are consumed by wildlife. Species on the list were identified to provide mast and foraging opportunities to native wildlife.

4. **Salt Tolerance**: Identifies species that can withstand some salinity in the soil around their root system. Please note that no species within the list is considered a halophyte (ability thrive in high salinity). All species listed are susceptible to decline or mortality in highly saline conditions. As a result, urban and roadside plantings may require additional mitigation measures to limit potential impacts of salt exposure.

5. **Drought Tolerance**: Identifies species that can tolerate dry to average-dry soil conditions. This may include mid to upper slopes, exposed flat sites, roadside edges and sites with shallow or highly modified soils (e.g. mixed with non-native material such as gravel). Please note that some species identified can tolerate dry periods, but do not prefer dry soils as a long-term growing condition.

6. **Light Tolerance:** Identifies species that prefer full sun (SU) or fully shaded sites (SH). The list does not presently indicate species which are tolerant to both sun and shade or part shade conditions.

7. **LID Codes**: Species identified for various LID features were adapted directly from the CVC *Low Impact Development Stormwater Management Planning and Design Guide, Appendix B: Landscape Design Guide for LID.*

Section 2: CVC Seed Mixes

Version 2 – April 2018

In partnership with Ontario Seed Company (OSC), CVC has developed a selection of seed mixes that are appropriate for use within the Credit River watershed. These seed mixes are suitable for restoration and naturalization projects, as well as for planting plans for stormwater management facilities. For complex sites a qualified professional should review the site conditions to determine an appropriate seed mix.

These mixes have been designed to be used in a variety of soil and moisture conditions. Proponents can select any supplier to purchase their seed mixes but CVC recommends proponents select suppliers who obtain/ source seeds locally.

If specific habitat or ecological community targets are being pursued for a project (e.g. grasslands, prairie, pollinator habitat or a specific wetland community type), contact a CVC Planning Ecologist for additional input.

Application Rate
These seed mixes should be applied at a rate of 22 - 25 kg/ha (21-23 lbs/acre) or at a rate of 250g/90m2 (1/2lb/1000 sq. ft) for smaller areas. Seed mixes should be used in conjunction with an appropriate cover crop (refer to Section 3 below)

CVC 1 – Upland Mix

Generally moist to dry upper slope and tableland sites and soils or SWM pond zones 3 to 5.

Scientific Name	Common Name	%
Anemone canadensis	Canada Anemone	1
Asclepias syriaca	Common Milkweed	2
Carex granularis	Limestone Meadow Sedge	15
Elymus virginicus var. virginicus	Virginia Wildrye	40
Euthamia graminifolia	Grass-leaved Goldenrod	1
Monarda fistulosa var. fistulosa	Wild Bergamot	1
Oenothera biennis	Common Evening Primrose	25
Rudbeckia hirta	Black Eyed Susan	10
Solidago canadensis var. canadensis	Canada Goldenrod	1
Solidago juncea	Early Goldenrod	1
Solidago nemoralis ssp. nemoralis	Gray-stemmed Goldenrod	1
Symphyotrichum novae-angliae	New England Aster	1
Verbena urticifolia	White Vervain	1

CVC 2 – Lowland Mix

Generally wet to moist sites and soils including floodplain/ riparian areas or SWM pond zones 2-3.

Scientific Name	Common Name	%
Carex vulpinoidea	Fox Sedge	25
Elymus virginicus var. virginicus	Virginia Wildrye	35
Juncus tenuis	Path Rush	5
Poa palustris	Fowl Bluegrass	25
Scirpus atrovirens	Dark-green Bulrush	5
Verbena hastata	Blue Vervain	5

CVC 3 – Lowland Restoration Mix

Wet to moist sites and soils including riparian areas where restoration or enhancement of an existing natural community is required. Typically not required for SWM ponds.

Scientific Name	Common Name	%
Anemone canadensis	Canada Anemone	1
Bidens cernua	Nodding Beggarticks	1
Carex vulpinoidea	Fox Sedge	25
Elymus virginicus var. virginicus	Virginia Wildrye	25
Eutrochium maculatum var. maculatum	Spotted Joe Pye Weed	1
Juncus effusus ssp. solutus	Soft Rush	5
Juncus tenuis	Path Rush	5
Poa palustris	Fowl Bluegrass	25
Scirpus atrovirens	Dark-green Bulrush	5
Symphyotrichum novae-angliae	New England Aster	1
Symphyotrichum puniceum	Swamp Aster	1
Verbena hastata	Blue Vervain	5

*% of seed mix refers to % by weight

Section 3: CVC Cover Crop Selection Guideline

Version 1.0 – April 2018

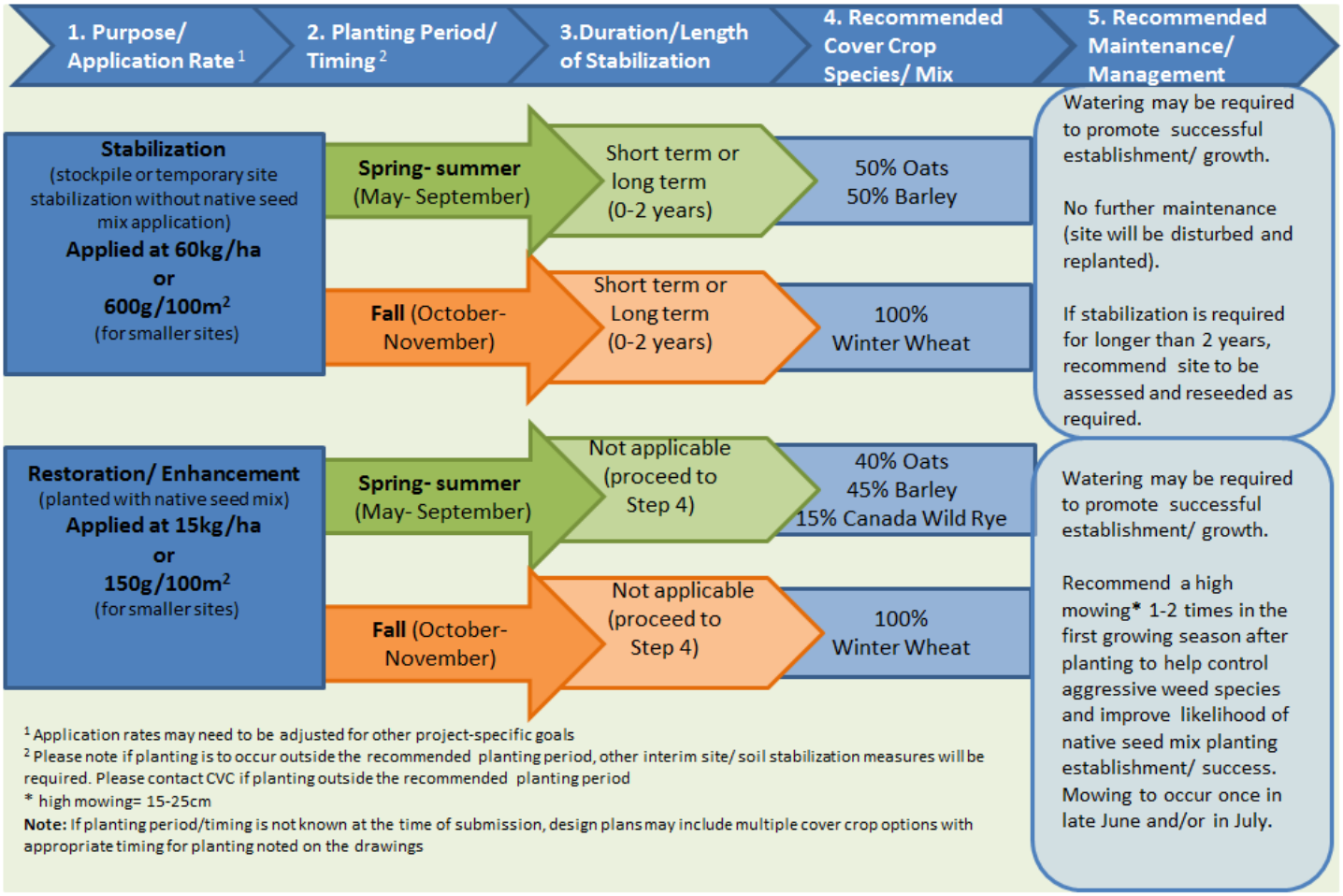
The following cover crop species recommendations were developed in consultation with Ontario Seed Company (OSC), review of relevant scientific information and expert knowledge. The purpose of this guideline is to provide direction on the selection of cover crop species for use in development and restoration projects within the Credit River watershed. Cover crop application is an important aspect of development and restoration projects, providing multiple ecological functions including soil stabilization and erosion prevention as well as soil compaction reduction. When applied with an appropriate native seed mix, the recommended cover crops may also act as a nurse crop; suppressing weed species and providing nutrient supply to the soil for improved native seed mix establishment and growth. Alternative non-invasive cover crop species that are not in the guideline may be suitable to meet project specific goals. Further consultation with CVC, prior to submission of restoration plans, is recommended in such cases.

Exposed sites should be stabilized as soon after completion of land disturbance as possible. Please refer to applicable municipal guidelines for stabilization requirements of exposed sites. Please note that cover crop and native seed mix application is not recommended in mid-summer (July-August) unless appropriate maintenance (i.e. regular watering in dry conditions) can be provided. Interim erosion protection may be required for some projects.

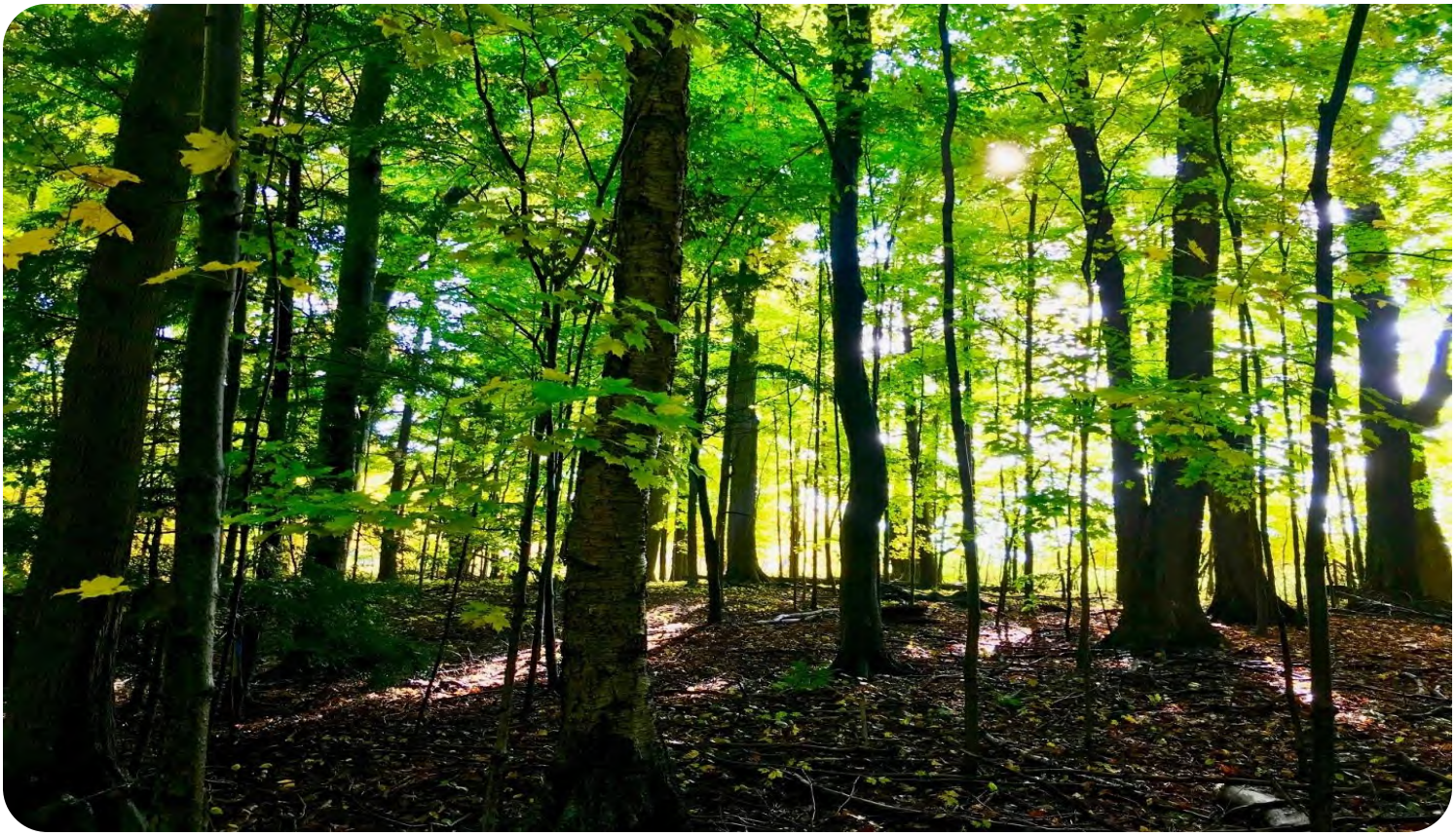
Site preparation and assessment is also recommended prior to application. Ensuring that soils are of sufficient quality and depth (i.e. a healthy topsoil layer is present, top and sub soils are not heavily compacted) to receive cover crop and seed mix application is imperative for supporting growth and establishment. Management of cover crop plantings is also integral to the success of naturalization, restoration and compensation efforts. Improper management can result in increased mortality of planted shrub, herbaceous and tree species which may increase project costs as a result of stock replacement or reseeding efforts. Management recommendations are provided in the cover crop selection tool below. Please refer to the Cover Crop Selection Tool below to determine which cover crop species or species mix is suitable for project specific requirements and goals. The list below is provided to ensure accurate sourcing of cover crop species based on scientific and common names:

Common Name	Scientific Name
Oats	*Avena sativa*
Barley	*Hordeum vulgare*
Canada Wild Rye	*Elymus canadensis*
Winter Wheat	*Triticum aestivum*

CVC Cover Crop Selection Tool



Credit Valley Conservation
inspired by nature



Ecosystem Offsetting Guidelines

Prepared by: Credit Valley Conservation

March 13, 2020

1255 Old Derry Road, Mississauga, Ontario L5N 6R4 | cvc.ca | T 905-670-1615 | TF 800-668-5557 | F 905-670-2210

Document prepared by Scott Sampson, Manager, Natural Heritage Management and Joshua Campbell, Director, Planning and Development Services.

For additional information regarding this document, please contact:

Joshua Campbell, Director
Planning and Development Services
Credit Valley Conservation (www.cvc.ca)
Email: Joshua.campbell@cvc.ca , Phone: 905-670-1615 ext. 289

This document contains material directly from Toronto and Region Conservation Authority's *Guideline for Determining Ecosystem Compensation* (June 2018). CVC would like to thank TRCA staff for all their hard work on the development of their guideline. This document is as consistent as possible with TRCA's guideline; however, there are changes to speak to CVC specific policies and programs. In addition, there are a couple of new requirements or methods intended to provide more clarity and consistency between projects.

The authors would also like to thank the following CVC staff for the input, contributions, and review of this document: Gary Murphy, Aviva Patel, Bob Morris, Liam Marray, Jakub Kilis, Kate Hayes, Rod Krick, Aaron Day, Brian Boyd, Sherwin Watson-Leung, Christine Wilson, Charlotte Cox, and Laura Timms.

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- Leslie Matich and Holly Anderson from Conservation Halton.

This document should be referenced as:

Credit Valley Conservation. 2020. Ecosystem Offsetting Guidelines, Credit Valley Conservation. March 2020.

This guideline was approved by Credit Valley Conservation's Board of Directors under Resolution 29/20 on 13 March 2020.

RESOLUTION:

WHEREAS *natural systems continue to often be adversely impacted by development and infrastructure projects throughout the Credit River watershed (and area) despite Credit Valley Conservation's (CVC) and partner municipalities' commitment to natural heritage protection and adherence to a strong provincial policy and regulatory regime; and*

WHEREAS *past approaches to ecosystem compensation have only been partially successful at replacing lost ecosystem features and functions; and*

WHEREAS *the land use planning, environmental assessment and permitting process determines when impacts from development on ecosystems are appropriate; and*

WHEREAS *CVC Watershed Planning and Regulation Policies (April 2010) recommend that "CVC will encourage all planning and permit applications to achieve an ecological gain. Where it has been demonstrated an ecological gain is not feasible, CVC will promote the principle of no net loss of ecological functions and hydrologic functions"; and*

WHEREAS *there is a lack of transparent, consistent and replicable technical guidance on determining what is required to effectively replace ecosystem losses; and*

WHEREAS *based on their expertise and experience, staff have developed a technical guideline that outlines a best practice to compensate for losses to natural features - after the decision to compensate has been made by the approval authority; and*

WHEREAS *in some instances, CVC may accept funds from development proponents to undertake compensation works on their behalf, recognizing they may not have the resources and CVC may be better positioned;*

THEREFORE BE IT RESOLVED THAT *the report entitled "Ecosystem Offsetting Guideline" be received and appended to the minutes of this meeting as Schedule "F"; and further*

THAT *the Board of Directors endorses the CVC Ecosystem Offsetting Guidelines and its implementation/distribution through CVC's Planning and Development Services processes, where appropriate*

THAT *the Board of Directors directs staff to establish a reserve to accept, track and manage cash-in-lieu payments associated with offsetting projects to support CVC's commitment to transparency and accountability;*

THAT *the Board of Directors directs staff to develop a database to track and manage offsetting projects and their associated losses; and*

THAT *the Board of Directors directs staff to provide a report annually on the application of Ecosystem Offsetting in the Credit River Watershed.*

CONTENTS

1 INTRODUCTION 1

1.1 Ecosystem Offsetting and Ecological (Net) Gain 2

1.1.1 Ecosystem Offsetting 2

1.1.2 Ecological (Net) Gain 3

1.2 Setting Principles and Standards 4

1.3 Municipal and Other Public Agency Adaptation 5

1.4 Plan Review and Approval Processes 5

1.5 Purpose and Scope of the Guideline 7

1.5.1 What the Guideline Is Not 7

1.6 Role of Municipalities, CVC and Proponents in Ecosystem Offsetting 8

1.6.1 Municipalities 8

1.6.2 Credit Valley Conservation 8

1.6.3 Private Proponents 9

1.7 Guideline Applicability 9

1.7.1 Exceptions 9

1.7.2 Green Infrastructure 10

1.7.3 Other Compensation or Offsetting Programs 10

1.8 CVC's Principles of Ecosystem Offsetting 11

2 COMPONENTS OF AN OFFSETTING PROJECT 12

2.1 Inventory and Assessment Requirements for Ecosystem Offsetting 13

2.2 Maintaining the Land Base & Natural Heritage System Form 16

2.2.1 Land Base Offsets for Development Projects 16

2.2.2 Land Base Offsets for Public Infrastructure Projects (Authorized under an Environmental Assessment) 17

2.2.3 Land Base for Private Infrastructure Projects 18

2.3 Replicating Ecosystem Structure and NHS Function 18

2.3.1 Offsetting for Trees in Forests, Woodlands and Swamp Communities (with Greater than 35% Tree Cover) 19

2.3.2 Offsetting for Woodland Understory Vegetation, and Vegetation in Communities with Less than 35% Tree Cover 21

2.3.3 Habitat Features and Structures 23

2.3.4 Considerations for Offset Adjustments for Invasive Species 23
3 OFFSET DESIGN AND PLANNING 26
3.1 Developing an Offsetting Plan 27
3.1.1 Offset Design and Planning Considerations 28
3.1.2 Natural Heritage System Function 29
3.1.3 Ecosystem Configuration 31
3.1.4 Ecosystem Connectivity 32
3.1.5 Location of Offset 32
3.1.6 Proximity to Loss 32
3.1.7 Land Availability 32
3.1.8 Land Ownership and Designation 33
3.1.9 Ecosystem Type 33
3.1.10 Project-Specific Requirements 33
3.1.11 Planting trees in communities with less than 35 per cent tree cover ... 34
3.1.12 Use of Understory Vegetation 34
3.1.13 Ecological (Net) Gain 34
3.1.14 Ecosystem Restoration Guidelines and Tools 35
3.1.15 Restoration Services 35
3.1.16 Offset Implementer 36
3.1.17 Considerations for Monitoring and Maintenance 36
3.1.18 Contingency 37
4 OFFSET DESIGN REVIEW AND APPROVAL 38
5 AGREEMENTS 39
5.1 Agreements and Public Agencies as Proponents 40
5.2 Cash-in-Lieu 40
5.3 Transparency and Accountability 41
6 CONCLUSIONS AND RECOMMENDATIONS 42
7 GLOSSARY 43
8 REFERENCES 47

APPENDICES

Appendix A: Considerations for Offset Adjustments for Invasive Species 52
Appendix B: Offsetting Tool Box 55
Appendix C: Calculating Basal Area 58
Appendix D: Individual Tree Replacement Table 61
Appendix E: Area Percentage Charts 62
Appendix F: Offsetting Examples 63
Appendix G: Method for Calculating the Volume of Downed Wood in Vegetation Communities 66
Appendix H: Assessing Wildlife Habitat Features and Structures 70

FIGURES

Figure 1: Mitigation hierarchy 3
Figure 2: Offset and review and approval processes 6
Figure 3: Ecosystem Offsetting Process 12
Figure 4: Progress in the Ecosystem Offsetting Process 26

TABLES

Table 1: Definitions and Descriptions of Vegetation Layers 15
Table 2: Offset ratios based on the basal area of the impacted site..... 20
Table 3: Form for calculating offset for replacing larger trees in sparsely treed vegetation communities based on diameter at breast height (dbh)..... 22
Table 4: Form for calculating offset requirements for woodland understory and vegetation in non-woodland communities (except trees > 5cm dbh) 23
Table 5: Offsetting Discount for Percentage of High Threat Invasive Species by Vegetation Layer..... 25
Table 6: Example of Offsetting Adjustment for Percentage of High Threat Invasive Species by Vegetation Layer 25
Table 7: Natural Heritage System Metrics and their use in Ecosystem Offsetting .. 30

1 INTRODUCTION

Ecosystem offsetting is an approach to offset the adverse impacts of land use change on the natural heritage system through the creation or restoration of natural features.

Increased stress is placed on natural heritage systems and on their ability to provide the same benefits to the population as the Greater Golden Horseshoe region continues to grow. Conservation in an urban context is challenging because of the finite space available to fit all basic needs of communities, including homes, workplaces, amenities, infrastructure and natural features and areas. Issues at a larger scale, such as global climate change, add to the complexity of addressing the local challenges. These pressures should result in increased support for conservation; however, despite a strong protective policy and regulatory regime, natural features and the functions and services they provide continue to decline in some areas within the Credit River watershed and the Greater Golden Horseshoe region.

Within this context, ecosystem offsetting becomes an important tool to help ensure that the critical ecosystem functions and services lost through development and site alteration related activities are restored on the landscape for the betterment of our watershed and its communities. Credit Valley Conservation (CVC) and our municipal partners are dedicated to the protection, restoration and enhancement of the natural heritage system, its features and functions, and the valuable ecosystem services that the system provides to residents. Our agencies' ecological restoration programs and the strong environmental objectives and policies contained in municipal official plans, and in CVC's Watershed Planning and Regulation Policies, clearly demonstrate this commitment.

Compensation for the loss of natural features has been occurring in Ontario for a long time. This compensation has lacked standards or guidance. This lack of guidance has produced long negotiations, inconsistent results, and inadequate compensation for the loss of ecological features and functions. CVC has developed ecosystem offsetting guidelines to improve and streamline the approval process, clarify expectations, and achieve better ecological outcomes for the health of the Credit River Watershed. The guideline provides a consistent, fair and transparent process informed by science and best practices.

This guideline applies only after the decision to offset has been made by the approval authority. Offsetting is often applied to planning and development activities or infrastructure projects that produce losses or impacts on the natural heritage system. The application of offsetting shall be consistent with relevant provincial, municipal and other approval authority natural heritage system planning policies, legislation and regulations. Offsetting may not be appropriate or permitted

in all cases. Proponents are encouraged to consult the appropriate approval authority to discuss the applicability of ecosystem offsetting to your project. These guidelines are intended to ensure offsetting activities remain a last resort and that all efforts for protection on site have been considered before contemplating removals.

1.1 Ecosystem Offsetting and Ecological (Net) Gain

In accordance with the Provincial Policy Statement and Provincial Plans, municipal official plans contain policies for the protection of natural heritage systems, natural features and areas, lands containing natural hazards and water resources. Through the development process, there may be a need to modify, move or remove natural areas on the landscape to achieve overall planning objectives.

Where avoidance and mitigation measures are not possible or financially feasible, offsetting may be considered where the approval authority deems it possible and the plan continues to conform with federal, provincial, municipal and conservation authority requirements. In addition, natural heritage features and areas may be impacted through the construction or expansion of infrastructure through the environmental assessment process – including other development-related activities requiring permitting pursuant to Section 28 of the Conservation Authorities Act.

1.1.1 Ecosystem Offsetting

Municipalities and CVC have used compensation in the past to address unavoidable losses to the natural heritage system. Compensation frequently occurred with little or no guidance to ensure full compensation for the loss. In many cases, the goal of the compensation was to only mitigate impacts to an acceptable level. As a result, these compensation projects typically only partially replaced the lost ecosystem services they remove.

Compensation activities have also been applied inconsistently across the watershed and typically do not address risks and uncertainties associated with impacting complex ecosystems or consider cumulative impacts, climate change, time lag and other unanticipated or unmeasurable impacts.

Alternatively, ecosystem offsetting is a methodical, consistent approach in which adverse impacts on natural features are offset by the intentional restoration or creation of new features - providing positive environmental outcomes of an equivalent or greater magnitude and kind. Offsetting policies and programs have been developed in Canada (Alberta, and British Columbia), the United States and Australia, and have been generating interest in the business community through the development of the Business and Biodiversity Offset Programme (BBOP). Governments and agencies in Ontario are currently exploring, developing, or adopting offsetting approaches (City of Pickering, Toronto and Region Conservation

Authority, Lake Simcoe Region Conservation Authority, and the Province's *Considerations for the Development of a Wetland Offsetting Policy for Ontario*).

Offsetting activities are typically embedded within the mitigation hierarchy (Figure 1) where the offsetting phase of the sequence is considered only after a thorough assessment of impact avoidance, minimization and mitigation alternatives have been considered and where policy permits.

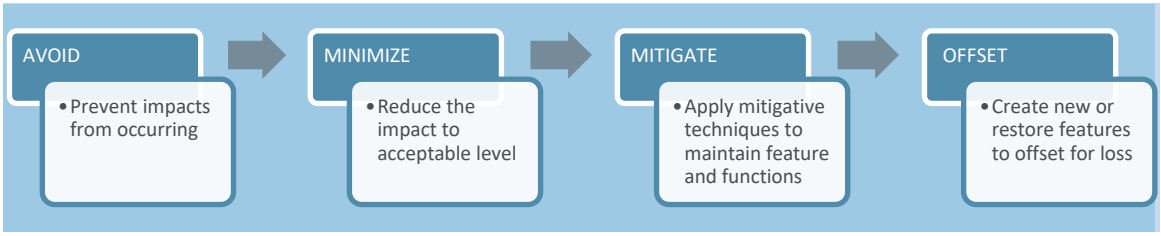


Figure 1: Mitigation hierarchy

In updating official plans and other environmental policies, some municipalities and agencies have included provisions that address limited instances where impacts to natural heritage features and areas may be permitted on condition that appropriate mitigation or offsetting be provided. Credit Valley Conservation recognizes that impacts on natural heritage features and areas, in specific circumstances, may be permitted through the planning and development processes – consistent with federal, provincial, municipal and CVC policy.

1.1.2 Ecological (Net) Gain

Credit Valley Conservation continues to use a "protection first" approach to natural heritage protection and management. The development of this guideline does in no way diminish CVC's commitment, or the commitment of its member municipalities, to the protection of the natural features, functions and services of natural heritage systems.

As planning and development activities occur throughout CVC's watersheds, we strive to ensure positive environmental outcomes by implementing the concept of ecological (net) gain:

> *"CVC will encourage all planning and permit applications to achieve an ecological gain. Where it has been demonstrated an ecological gain is not feasible, CVC will promote the principle of no net loss of ecological functions and hydrologic functions." (CVC Watershed Planning and Regulation Policies April 2010)*

Each natural area provides a specific set of ecological functions and services related to the natural area's ecological composition and structure. Offsetting programs as a principle recommend that offsetting should strive to achieve some equivalency

between the ecological conditions and functions at the development and offset site to achieve no net loss in ecological form and function, and preferably an ecological (net) gain. It is recognized that this is challenging due to the unique conditions at each site, so characteristics and functions will need to be identified and prioritized. Two priority considerations for offsetting in the Credit River watershed are to create an ecological community similar to what was lost (like-for-like) and to provide the equivalent land base. CVC also acknowledges there are some circumstances (limited) when greater ecological outcomes can be achieved by creating ecosystem components or functions different from those lost to development. The decision to deviate from "like-for-like" offsetting should be guided by large scale environmental reports and a thorough technical analysis.

Land Base Offsetting

The overall size of a natural heritage system and its features determines what ecosystem functions and services the system and the features can provide. Offsetting strives to achieve a net gain in both ecosystem form and function to offset the adverse impacts of development on the natural heritage system. A **land base offset** replaces the land removed from the natural heritage system by a development project. The land base offset is also important to provide a place for the planting of vegetation associated with the offset.

Best practice for deviating from "like-for-like" offsetting is to document the ecological justification, identify objectives, set clear measurable targets, and monitor to inform future offsets.

1.2 Setting Principles and Standards

To date, the application of compensation has resulted in some success at replacing lost natural features and the ecosystem functions they provide. However, there are several challenges, such as the limited availability of land for restoration, the risks and complexities associated with restoration, lengthy negotiations, lack of transparency, inconsistent results and, in many instances, an inability to fully replace the complex ecosystem functions of many natural heritage features and areas.

Some of these challenges are difficult, if not impossible to fully address. However, it is intended that establishing a guideline outlining principles and standards for offsetting will assist in addressing many of them. The principles and standards established in this guideline are intended to ensure offsetting activities remain a last resort and that all efforts for protection on site have been considered before

contemplating removals. Standards of practice can also help ensure that offset projects are adequately financed and successfully implemented for the long term.

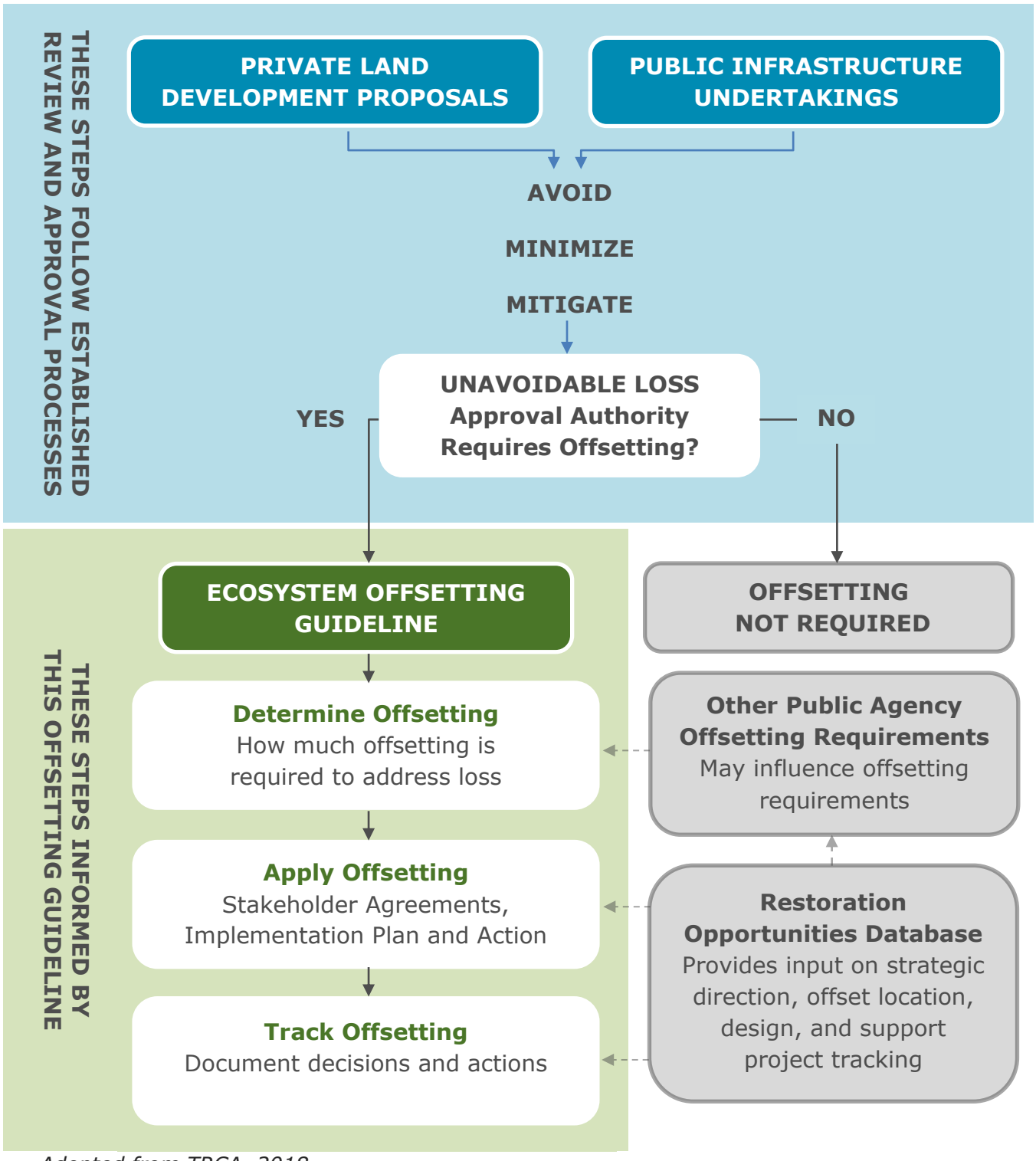
1.3 Municipal and Other Public Agency Adaptation

It is recognized that each municipality has its own unique goals, objectives and policy approaches to ecosystem offsetting. This guideline outlines the key principles and methods needed for improved ecosystem offsetting outcomes, while recognizing municipalities or other public agencies may wish to adapt them to their own needs and/or circumstances.

1.4 Plan Review and Approval Processes

Figure 2 illustrates where ecosystem offsetting fits within the existing plan review and approval processes. In addition, the figure illustrates how this guideline may be a tool for use only after the decision to permit impacts to natural heritage systems, features and areas has been made. It should be noted that CVC's Watershed Planning and Regulation Policies recommends that works within, or modifications to the natural heritage system, features and areas take place at the appropriate stage of the planning and development processes and is supported by an approved environmental assessment, comprehensive environmental study or technical report, as appropriate.

As indicated by the box on the lower left in Figure 2, this guideline has been organized to address each technical aspect of the offsetting approach, from determining what is required to replace the impacted ecosystem, to strategic application of offsetting, to monitoring and tracking outcomes.



Adopted from TRCA, 2018.

Figure 2: Offset and review and approval processes

1.5 Purpose and Scope of the Guideline

The purpose of this Guideline is to guide how to determine the total amount of offsetting required to replace lost or altered ecosystems in a repeatable and transparent manner after it has been decided that offsetting is required through the land use planning or environmental assessment process. As previously stated, offsetting may not be appropriate or permitted under specific policies, legislation and regulations. The Guideline is written to assist planners, ecologists, landscape architects, landowners, other practitioners and interested parties in understanding how CVC recommends approaching offsetting for ecosystem losses. Promoting strategic and effective implementation of offsetting, the Guideline attempts to provide a standard and consistent approach, informed by science and decades of experience in the application of natural heritage planning and ecological restoration.

Ecosystem Structure, Functions and Services

This Guideline determines requirements for replacing the structure and the land base of a natural feature lost to development or infrastructure. Once established and over time, the restored ecosystem structure provides renewed ecosystem functions, which provides the foundation for the provision of ecosystem services. There are a number of risks and uncertainties associated with attempting to replace complex ecosystems. The re-establishment of similar ecosystem functions and associated services is far from certain and can take a significant amount of time. Adhering to the standards in this Guideline (along with long term protection, management, and the passage of time) can lead to the replacement of similar ecosystem functions and services.

1.5.1 What the Guideline Is Not

The Guideline does not provide guidance on when removals are appropriate with associated offsetting. Rather, this determination is made through the planning, environmental assessment or permit processes, and guided by policy addressing offsetting, where such policy exists.

This Guideline does not replace, or in any way negate the requirements of other legislation applicable to impacts to species or ecosystems at the municipal, provincial or federal levels. Protection, and ideally enhancement of the existing natural system remains a primary goal of natural heritage systems planning. The intent of this Guideline is not to weaken this goal or diminish the ability to protect ecosystems in situ.

The Guideline is not suggesting any modifications to the existing planning, environmental assessment or permitting processes leading up to the decision to allow ecological impacts with offsetting. However, the decision will be better informed by the information in the Guideline given that it articulates what is warranted when the decision is made.

This Guideline does not directly address offsetting for aquatic ecosystems, nor does it determine offsetting requirements for stormwater management. Indirectly, this guideline will help offset natural features that contribute to the health and function of aquatic ecosystems. CVC does have other guidelines that are related to hydrologic offsetting and the mitigation hierarchy, including the *Water Balance Guidelines for the Protection of Natural Features* in CVC's Stormwater Management Criteria (2012), and CVC's *Evaluation, Classification and Management of Headwater Drainage Features Guidelines* (2014). The Department of Fisheries and Oceans' *Policy for Applying Measures to Offset Adverse Effects on Fish and Fish Habitat Under the Fisheries Act* (2019) also guides measures to offset impacts to fisheries. In the coming years, CVC will work with other conservation authorities and stakeholders to determine the need for aquatic ecosystem offsetting guidelines.

1.6 Role of Municipalities, CVC and Proponents in Ecosystem Offsetting

1.6.1 Municipalities

Municipalities are the approval authorities under the Planning Act and may or may not have official plan policies, by-laws, or other mechanisms for requiring offsetting or other forms of ecosystem replacements. As approval authorities, municipalities can refuse or approve impacts to natural features as part of a Planning Act application. Once that decision has been made, municipalities share with CVC the assessment of offsetting projects proposed by private development proponents.

As proponents of their municipal infrastructure projects, municipalities may put forward their offsetting projects to replace lost ecosystem structure as described in Section 2.3. Section 2.2.2 of this Guideline speaks to municipal infrastructure projects and special considerations for the lost land base. For all municipal projects affecting CVC Regulated Areas and/or CVC owned or managed lands, municipalities and CVC routinely work together to achieve provincial, municipal and CVC shared objectives for natural heritage systems planning and sustainable communities.

1.6.2 Credit Valley Conservation

As a conservation authority, CVC is a public commenting body under the planning and environmental assessment (EA) processes (delegated by the Province to represent the provincial interest in managing natural hazards) - acting as a resource management agency and service provider to approval authorities through service agreements and/or memorandums of understanding. In its regulatory role,

CVC is the decision-maker for permits issued under section 28 of the Conservation Authorities Act, as well as a landowner and proponent when undertaking works requiring planning and development approvals.

In participating in the review of development applications under the Planning Act and reports under the Environmental Assessment Act, CVC ensures that applicants and approval authorities are aware of any regulatory requirements, where applicable. Further, CVC assists in the coordination of these applications to avoid conflict and unnecessary delay or duplication in the planning and permitting processes. As a proponent of its own projects, CVC may put forward its own offsetting projects to replace lost ecosystem structure and land base.

1.6.3 Private Proponents

As a proponent of private development directed to offset for an impact through the above-noted processes, landowners must be willing to provide and implement an offset project that will adequately address the loss of the impacted ecosystem. The implementation plan must be designed, installed, monitored and maintained in accordance with any conditions or agreements established between the proponent and the public agencies.

1.7 Guideline Applicability

This guideline may be applied to natural heritage features (e.g., forests, woodlands, wetlands, thickets and meadows) and areas within the natural heritage system, or other features that have been determined by the approval authority to require ecosystem offsetting through the review of applications for planning, infrastructure or CVC permitting processes. Restoration or enhancement areas that fall within the natural heritage system, that may not already contain natural heritage features or areas, can also have the land base portion of the guideline applied if determined to require offsetting.

1.7.1 Exceptions

The application of offsetting is determined by the appropriate approval authority and shall be consistent with all applicable policies and exemptions. This guideline is not intended to be applied to small, isolated and/or low functioning natural features or areas where it has been determined their protection can be mitigated and/or is not necessary to meet environmental protection goals and objectives.

Ecosystem offsetting will not be applied to applications that facilitate permitted agricultural uses or the construction of accessory structures (e.g. garages) or a single-family dwelling on an existing lot of record.

1.7.2 Green Infrastructure

Offsetting requirements determined through the use of this Guideline should be applied to the re-establishment of natural ecosystems and not used to install or otherwise improve engineered green infrastructure or community amenities. The Guideline does not apply to individual trees located in parks or along roadsides not associated with natural features.

1.7.3 Other Compensation or Offsetting Programs

For impacts to individual park, yard or street trees, municipalities may have by-laws containing provisions for tree replacements. CVC will continue to support the application of these municipal mechanisms by providing technical guidance in their application, coordinating with municipal staff to avoid duplication, and assist in the development of new or updated by-laws as needed. In this way, the two separate processes of the guideline and individual tree replacement programs work together for a comprehensive approach to restoring losses.

Another mechanism for restoring lost habitat is the Ministry of Environment, Conservation and Parks' (MECP) Overall Benefit Permit (OBP) process under the *Endangered Species Act*. Where an OBP is required, CVC defers to MECP for their requirements under their species-specific permit process. However, there may be cases where a portion of the impact on habitat is offset through one mechanism while the remaining impact is offset through a different mechanism. For example, off-setting required through the *Endangered Species Act* may address impacts to one particular species but may not offset for all of the lost structure and function provided by the impacted ecosystem. In these cases, determining what is required to offset for the remaining impact can be accomplished through the Guideline.

This Guideline does not contain provisions for determining offsetting requirements for the loss of fish habitat and defers to provincial and federal ministries (e.g., Fisheries and Oceans Canada) that direct compensation for impacts to aquatic species and their habitat. For direction on addressing any type of alteration, restoration or removal of a headwater drainage feature, the Evaluation, Classification and Management of Headwater Drainage Features Guideline (TRCA and CVC, 2014) should be used.

1.8 CVC's Principles of Ecosystem Offsetting

The following principles represent the framework and express the intent of this guideline:

1. Consideration for offsetting may only be applicable where it is consistent with the appropriate legislation, regulations and supporting policies and guidelines.

2. Offsetting must follow the mitigation hierarchy of Avoid, Minimize, Mitigate, then Offset. Offsetting should only be applied after a detailed analysis has determined that avoidance, minimization and mitigation of loss is not possible or feasible.

3. The offsetting process should be transparent ensuring accountability of all parties involved.

4. The offsetting process should be consistent and replicable.

5. Offsetting activities should target an ecological (net) gain. Where determined to not be feasible, they should ensure no-net-loss and fully replace the same level of lost ecosystem structure and function in proximity to where the loss occurs.

6. Offsetting should be directed to on-the-ground ecosystem restoration and be informed by strategic watershed and restoration planning.

7. Implementation of offsetting activities should be completed promptly so ecosystem functions are re-established as soon as possible after (or even before) losses occur.

8. The offsetting process should use an adaptive management approach incorporating monitoring, tracking and evaluation to gauge success and inform improvements.

This guide does recognize that there are limits to offsetting and recommends that decision-makers avoid using offsetting to justify the removal of features that are difficult or impossible to replicate due to their complexity, vulnerability, and sensitivity (e.g. bogs and fens). Offsetting for these features is unlikely to replace the functions lost, nor demonstrate a no net loss. Decision-makers should consider this during the planning process and avoid impacts to or losses of these features whenever possible.

2 COMPONENTS OF AN OFFSETTING PROJECT

The offsetting process and the application of this guideline begins with the decision by the approval authority to require offsetting as a condition for the removal of natural features or impacts to the natural heritage system. Figure 3 illustrates the Ecosystem Offsetting Process and directs the user through the various steps in the process and to its location in the guideline.

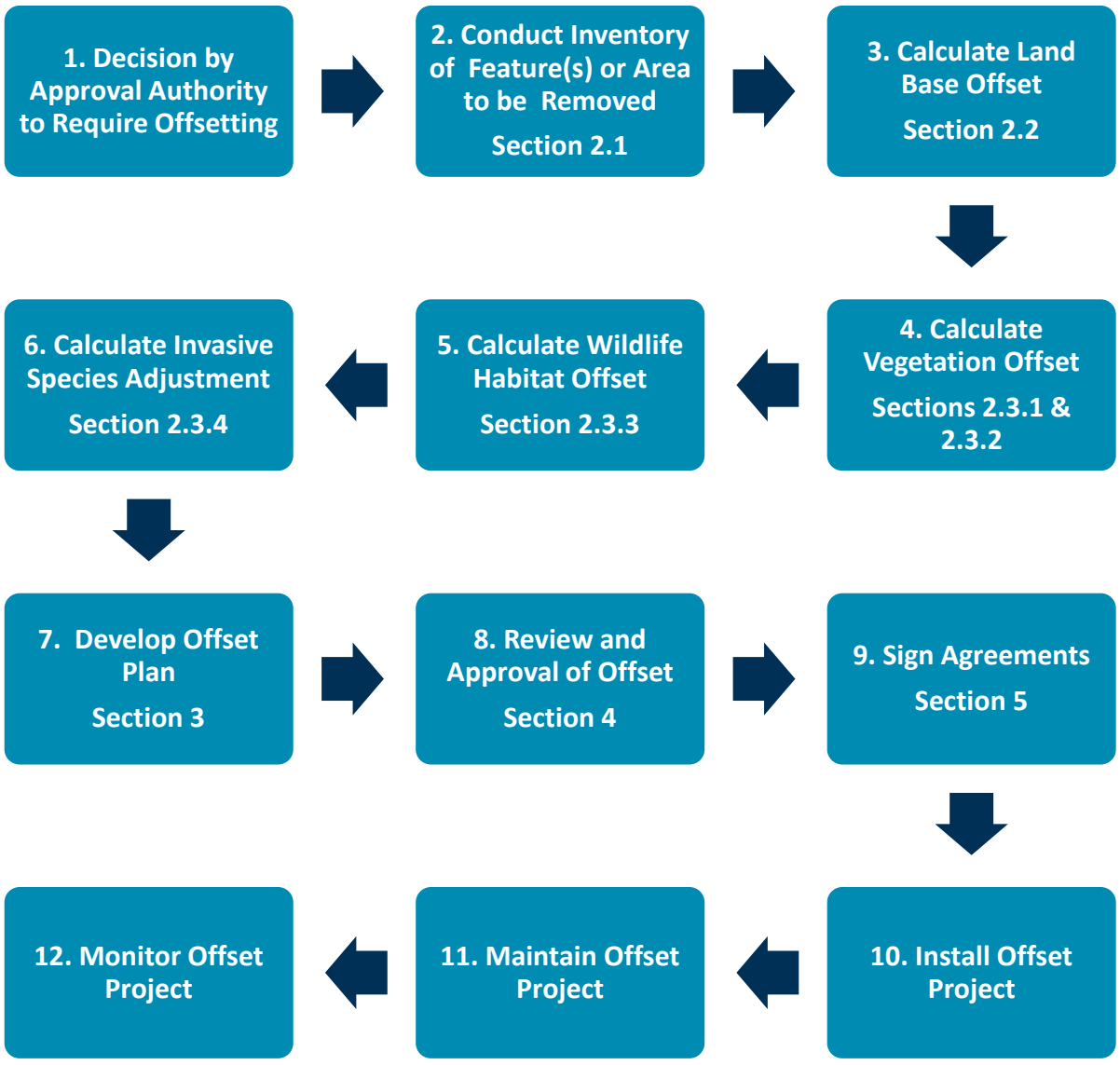


Figure 3: Ecosystem Offsetting Process

Section 2 of the guideline provides direction for the inventory and documentation of the ecological structure, composition and function of the natural feature/area(s) being removed and calculating the amount of land and vegetation that is required to offset that loss.

2.1 Inventory and Assessment Requirements for Ecosystem Offsetting

As ecosystem offsetting strives to achieve a no net loss and preferably an ecological (net) gain, it is essential to have a qualified expert (e.g. ecologist, biologist or forester) conduct a detailed inventory of the natural features and areas to be removed, and their associated functions. The information collected under this section will be used to calculate the amount of offsetting required, guide the design of the offset, and compare the offset to the lost to ensure that there is an ecological (net) gain in ecosystem composition, structure and functions.

In the interest of saving time, the percent cover of the vegetation layers (i.e. canopy trees, sub-canopy trees, tall shrubs, low shrubs, forb and graminoid, floating–leaved aquatic, free-floating aquatic plants, submergent plants, and open water can be estimated based on field observations. Aerial photography can be used to assist with estimations where appropriate, but field surveys are still necessary. These estimations of vegetation cover shall be verified by qualified municipal or conservation authority staff (i.e. ecologist, biologist, or forester).

If cover estimates are disputed, a more quantitative approach, such as the Ontario Ministry of Natural Resources' Vegetation Sampling Protocol (VSP) (Puric-Mladenovic et al., 2010), can be used to resolve the disagreement. The VSP uses a fixed-area method for sampling vegetation types that is practical, easy, and replicable while being scientifically rigorous.

Information required for <u>each</u> vegetation type/community within the feature that is proposed to be removed or impacted:

a. Mapping of the vegetation type's boundaries;
b. Mapping of the proposed area of removal;
c. Classification of community to vegetation type (or Ecosite);
d. Estimation of percent cover (refer to Appendix C of Ecological Land Classification for Southern Ontario (Lee *et al.* 1997) for guidance) and height for each vegetation layer present. Vegetation layers (Table 1) include *canopy trees, sub-canopy trees, tall shrubs, low shrubs, forb, graminoid, floating–leaved aquatic, free-floating aquatic plants, submergent plants, and open water*;
e. List of four most abundant species in each vegetation layer;
f. Complete plant species list with abundance codes for each species in each vegetation layer;

g. Percent cover of each vegetation layer occupied by invasive species, and the percent cover (i.e. None, ≤ 50%, or > 50%) of that vegetation that is high-threat' invasive species
h. Soil classification (texture, moisture, depth of organics);
i. For each treed vegetation type with greater than 35% canopy cover that is going to be removed or impacted, conduct wedge prism sweeps according to the ELC (refer to Appendix D of ELC for guidance), including
    - Basal area of living trees by species;
    - Basal area of dead trees;
j. For each treed vegetation type with less than 35% canopy cover, linear feature or edge, provide a tree inventory plan illustrating the location and diameter of the trees [greater than 5 cm diameter at breast height (dbh)] to be removed;
k. The abundance of downed wood using transects (Appendix G) or plots;
l. Evidence of wildlife habitat structures (cavities trees, dens, nests, hibernacula, roosts, vernal pools, etc.) (Appendix H);
m. Bathymetry/topography for wetlands;
n. Hydrologic characterization for wetlands;
o. Identification of associated watercourses;
p. Identification of hydrologically connected wetlands and watercourses; and
q. An assessment of the natural area's relationship to the natural heritage system. Suggested natural area metrics – size, shape, contribution to interior habitat, proximity or connectedness, matrix quality, patch habitat/species diversity.

Table 1: Definitions and Descriptions of Vegetation Layers

Vegetation Layer	Definition/Description
Canopy Trees	Trees greater than six meters in height whose leaves and branches receive direct sunlight.
Sub-Canopy Trees	Trees greater than six meters in height whose leaves and branches do not receive direct sunlight due to the canopy trees.
Saplings and Tall Shrubs	Trees and shrubs between one and six meters in height
Seedling and Low Shrubs	Trees and shrubs less than one meter in height
Forbs and Graminoids	Forbs are non-woody, broad-leaved plants that are not a graminoid. Graminoids are grass-like, narrow-leaved monocot plants including grasses and sedges
Emergent Plants	Plants that have a photosynthetic surface extending above the normal water level (Lee et al. 1997). Includes cattails, rushes, pickerelweed, bur-reeds, sweet flag, water plantain.
Floating–Leaved Aquatic Plants	Rooted wetland plants with leaves that float on the surface of the water, includes water-lilies, pondweeds, water-shield, etc.
Free-Floating Aquatic Plants	Non-rooted wetland plants that float on the surface of the water, includes duckweeds, watermeals, aquatic liverworts.
Submergent Plants	Wetland plants that normally lie entirely beneath the water, includes coontails, water-milfoils, bladderworts, stonewort.
Open Water	Aquatic communities in permanent water that is generally greater than two meters deep and total vegetation cover is less than 25 per cent (Lee et al. 1997).
Tree	A woody plant usually with a single main stem and capable, under the right conditions, of reaching heights of several meters or more (Lee et al. 1997), examples include Sugar Maple, Eastern White Cedar, ashes, oaks, American Beech, poplars, and birches.
Shrub	A perennial plant often with a multiple woody stem base, examples include Red-osier Dogwood, raspberries, Chokecherry, shrub willows, viburnums, sumacs

Additionally, some information may be extracted from existing comprehensive environmental studies (e.g. EIS, EIR, EIA, etc.); however, additional surveys may be required to gather information specific to the feature or area being removed as determined by the approval authority. Proponents shall consult with the approval authority to determine the scope of the study before study commencement.

2.2 Maintaining the Land Base & Natural Heritage System Form

The overall size of a natural heritage system and its features determines what ecosystem functions and services the system and the features can provide. Larger natural heritage systems are generally more biologically diverse, provide greater levels of ecosystem functions and are better able to withstand the stresses of urbanization and climate change. It is therefore critical to ensure that any losses to the land area of the natural heritage system due to removals be addressed by adding new lands back into the natural heritage system such that the overall physical extent of the natural heritage system is not reduced.

Lands added back into the natural heritage system must be configured in such a way as to improve the overall ecological function of the natural heritage system. Additional direction on land base configuration is provided in Section 3.0.

When replicating the land base for off-site projects, there are two important considerations:

- The offset lands should be located as close as possible to the location of the loss to help ensure the restored ecosystem functions and services remain accessible to the local community. For more guidance see Section 3.1.1. Methods of calculating the land value must consider the cost of securing or acquiring land within the same municipality and sub-watershed as the land removed.
- Secondly, lands secured for offsetting should be located outside of (but connected to) the identified natural heritage system of the municipality so that they can ultimately be added to the system to make up the loss. Securing or purchasing land for offsetting that is already identified as part of the natural heritage system would result in a net loss to the overall area of the natural heritage system.

2.2.1 Land Base Offsets for Development Projects

Approval authorities may require development projects to offset the loss of area of the natural heritage system. Development projects are activities resulting in the creation of a new lot, a change in land use, or the construction of buildings and structures requiring approval under the Planning Act (MMAH, 2014). In addition, development projects may also include activities requiring approvals under other pieces of legislation including, but not limited to, the Conservation Authorities Act

and the Aggregate Resources Act. These projects should, at a minimum, replace the land base removed at a one to one ratio.

Land Base Offsetting

Land removed from the natural heritage system should be offset at a 1:1 ratio.

In other words, one hectare of land removed should be offset by adding one hectare back into the natural heritage system, either on the same site or on another site.

For the purposes of this guideline, development projects do not include activities undertaken by public authorities that create or maintain infrastructure as authorized under an environmental assessment process. For this guideline, there are two approaches to addressing the land base of an offset associated with infrastructure projects. One for public infrastructure projects (2.2.2), and the other for private infrastructure (2.2.3).

2.2.2 Land Base Offsets for Public Infrastructure Projects (Authorized under an Environmental Assessment)

Infrastructure projects are completed by several different public agencies/proponents making a standard approach to land base offsetting difficult. CVC will work with municipal and other public agency partners undertaking infrastructure works to help ensure the land base component of offsetting is appropriately considered. Where municipalities or other agencies have established conservation land acquisition programs, the land base component of offsetting will be addressed comprehensively and not on a project by project basis. Where no conservation land acquisition program is established or the number of projects in the area is limited (e.g. Metrolinx, MTO etc.), land base offsetting should be considered on a project by project basis.

Both investments in infrastructure and the protection of natural heritage systems contribute to the public good. The environmental assessment process for public projects helps to ensure investments in infrastructure minimize impacts to natural features and the functions they provide. However, when impacts cannot be eliminated, offsetting action should be taken to ensure the public benefits provided by the natural heritage system are not diminished.

The requirements for an offsetting project as outlined in the guideline represent the best available practice for the restoration of lost features and for "adding back" to the natural heritage system. In its roles as a public commenting body under the planning and environmental processes, as a regulator, and at times as a landowner,

CVC routinely works with infrastructure providers to seek offsetting to the extent feasible for lost features due to infrastructure projects (new or upgrades) that cannot avoid natural areas, or are already located within them.

The guideline provides guidance to further aid in these review and approval processes by providing a rationale as to why the land base of the natural heritage system is critical to its continued function. The full land base requirements determined by the guideline for a feature lost to infrastructure may not be achievable given that municipalities typically own right-of-way lands sized only to accommodate the infrastructure itself with little surplus land remaining, (see Municipal Infrastructure diagrammatic example in Appendix). In these cases, the land area removed from the natural heritage system from all municipal infrastructure projects can be tracked by CVC and the municipality and compiled together so that cumulative losses to the land base of the natural heritage system can be quantified. Municipalities and CVC can work together to understand how these cumulative losses are impacting the function of the natural heritage system and explore avenues to offset these losses through existing municipal land acquisition and ecological restoration programs or other means.

2.2.3 Land Base for Private Infrastructure Projects

Since private utility companies do not have public conservation land securement programs to offset the losses associated with their activities, this Guideline encourages environmental assessments for private infrastructure projects (e.g. projects carried out by private utility, pipeline and telecommunication companies, etc.) to consider following the same offsetting approach as other types of private development.

Single infrastructure projects that involve the removal of large portions (multiple hectares) of the natural heritage system, or when CVC-owned lands are impacted, may warrant discussions regarding compensating land base on a case-by-case basis.

2.3 Replicating Ecosystem Structure and NHS Function

Ecosystems are complex and dynamic systems. Regardless of the approach to determining the level of offsetting required, attempts to replace lost ecosystem structure and functions will fall short in many instances, at least in the short term. Understanding this limitation, the Guideline establishes an approach that attempts to replicate, to the extent possible and without significant delay or lag time, the same ecosystem structure and associated level of ecosystem functions that are to be lost.

The ability to re-establish generally the same structure in a reasonable time frame is in part dependent on the type of ecosystem being restored. Some functions of

some ecosystem types such as cultural meadows and some marshes can be established relatively quickly since their rate of vegetation growth does not have a significant lag time. This is not to suggest that these ecosystem types are less complex or less important than others, or that restoration of these ecosystems is without risk and uncertainty. It simply recognizes that the vegetation in non-treed ecosystems can be established relatively quickly.

It takes much longer to re-establish treed ecosystems due to their long developmental periods and the limited potential to plant fully grown trees. This Guideline attempts to partially address this issue by prescribing that the loss of a mature forest requires replacement with a larger, young forest.

2.3.1 Offsetting for Trees in Forests, Woodlands and Swamp Communities (with Greater than 35% Tree Cover)

This Guideline uses basal area to establish ecosystem restoration replacement ratios (in hectares) for forests, woodlands, and swamps with greater than 35% tree cover. Basal area is a standard forestry measurement, included in the Ecological Land Classification for Southern Ontario and is a widely used standard practice easily determined using simple equipment (See

Appendix : Calculating Basal Area).

A wedge prism will not be an effective approach in sparsely treed communities (i.e. tree cover less than 35%). This Guideline uses a different approach to assess tree cover in sparsely treed communities (e.g. savannahs, meadows, thickets, some swamps, etc.), go to Section 2.3.2.

For linear infrastructure projects (e.g. roads, pipelines, etc.) where access to the entire vegetation community may not be possible, go to Section 2.3.2.

Basal area is the common term used to describe the cross-sectional area occupied by tree stems. Stand basal area is defined as the total cross-sectional area of all stems in an ecosystem measured at breast height (1.3 m) and expressed as a unit of land area (m^2/ha). In general terms, older and higher functioning treed ecosystems will have a greater basal area. Basal area also loosely equates to and can be used as a surrogate for, biomass of the canopy and sub-canopy trees within a treed ecosystem. Biomass, in turn, correlates to some of the ecosystem functions and services (e.g. carbon sequestration, water management) that a treed ecosystem can provide. Therefore, attempting to re-establish the same basal area in the newly restored treed ecosystem as was lost, helps, in part, to ensure that the same level of some ecosystem functions is maintained.

The objective for treed ecosystems is to re-establish the same level of basal area within 10 years of implementing the offset project. Toronto and Region Conservation Authority has advised that based on the survival and growth rates of their previous restoration projects, it is typical to achieve a basal area of 5 m^2/ha at the 10-year mark. Therefore, as an example, to achieve basal area equivalency at the 10-year mark (5m^2/ha) for an impacted site with an average basal area of 25 m^2/ha, a 5:1 restoration ratio must be used. In other words, 5 hectares of new habitat must be restored for every one hectare removed. For this guideline, the trees to be planted are branched whips at a minimum height of 1.5 – 2.5m. Table 2 (below) is used to determine the offsetting ratios for various basal area categories.

Steps 1 to 5 that follow outline the procedure for calculating replacement ratios.

Table 2: Offset ratios based on the basal area of the impacted site

	Basal area range (m^2/ha)	Average basal area (m^2/ha)	Lag time factor – Basal area of 10-year-old restoration site (m^2/ha)	Offset Ratio
1	0 – 10	5	5	1:1
2	10.1 – 20	15	5	3:1
3	20.1 – 30	25	5	5:1
4	30.1 -50+	40	5	8:1

Procedure for Determining Replacement Ratios with Basal Area

1. Determine the vegetation type(s) for the area being impacted using the Ecological Land Classification for Southern Ontario (ELC) system. If more than one ecosystem type is being impacted, then the vegetation type must be determined for each.
2. Determine the amount (in hectares) of each vegetation type being removed.
3. Determine the basal area for each woodland vegetation type being impacted. (See: Calculating Basal Area). In narrow linear features (less than 30 m wide) or edges of features, a tree inventory plan illustrating the location and diameter of the trees [greater than 5 cm diameter at breast height (dbh)] to be removed is required.
4. Using Table 2, determine the offset ratio for each forest or woodland vegetation type being removed
5. Based on the amount of each vegetation type being removed and the offset ratio for each, determine the total size of the restoration required for each vegetation type.
6. Go to Section 2.3.2 to calculate the offset for the woodland's understory.

In some instances, there may be particular ecosystem functions (e.g. wildlife habitat, topographic, or hydrologic features and functions) provided by the impacted ecosystem that are identified and required through the planning or infrastructure review process to be addressed as part of the restoration implementation. These conditions may influence the ecosystem restoration requirements. Additional information is provided in Section 3 regarding project-specific requirements.

Dead and Dying Trees

For the purposes of the Offsetting Guideline, dead trees are included in the basal area calculations. Dead trees contribute to the function of forested ecosystems in important ways and therefore should be considered in assessing the feature that is being lost. This in turn informs the restoration requirements to replace the lost feature. This is particularly relevant at this time, given that a number of ash trees are dying due to the Emerald Ash Borer.

2.3.2 Offsetting for Woodland Understory Vegetation, and Vegetation in Communities with Less than 35% Tree Cover

The understory of a woodland (forests, cultural woodlands and treed swamps) contains tree saplings, shrubs, seedlings herbaceous vegetation, logs, and fine

woody material that contribute to the ecological and hydrological functions and services provided by our woodlands. The understory represents the future of our woodlands and contributes to the maintenance of biodiversity, soil development, hydrologic functions, and the air quality and climate regulation values associated with woodlands. To achieve a no net loss and preferably an ecological (net) gain, offsetting should account for these components, structures, and functions of a woodland.

Communities with less than 35% tree cover include sparsely treed swamps, shrub swamps, marshes, shrublands (thickets), prairies (including tallgrass savannah and woodlands), meadows, rocklands, bluffs, and beaches. Their functions are defined by the dominance of shrubs, grasses, herbaceous vegetation with some sparse tree cover.

Most of the vegetation associated with communities can be restored without significant issues associated with a time lag (i.e. how long it takes to grow mature trees and the conditions capable of sustaining the flora and fauna associated with mature treed communities). However, a compensation ratio is still used to offset the loss of the larger trees and their services in these communities.

The approach for inventorying trees in communities with less than 35 per cent tree cover is different because, as previously stated, the wedge prism is not an effective method where tree cover is scattered or sparse. For these sparsely treed communities, a tree inventory plan illustrating the location and diameter of the trees greater than 5 cm diameter at breast height (dbh) to be removed is required. A tree inventory plan illustrating the location and diameter of the trees [greater than 5 cm diameter at breast height (dbh)] to be removed should be used in narrow linear features (less than 30 m wide), or edges of features. This plan will provide a count of trees that can be organized into different size classes and placed into Table 3 to calculate the required offset for the loss of those trees. These offsetting ratios were developed based on the i-Tree-Eco analysis model developed by the USDA Forestry Service to help provide relevant, empirical values for some ecosystem services based on tree diameter; these include carbon sequestration and pollution removal.

Table 3: Form for calculating offset for replacing larger trees in sparsely treed vegetation communities based on diameter at breast height (dbh)

DBH Range (cm)	Count	Offsetting Ratio	Offset Required
>5 – 10		1:1	
10.1 – 20		1:3	
20.1 – 30		1:10	
30.1 – 40		1:15	
40.1 – 50		1:20	
50.1 – 60		1:30	
60.1 – 70		1:40	

70.1 +		1:50	
		Total	

Calculating the amount of offsetting required for the woodland understory and non-forest community vegetation relies on the information collected under the Section 2.1 Inventory and Assessment section of this guideline. Section 3.1.1.10 guides the planting of trees to offset for vegetation communities with less than 35% tree canopy cover.

The approach for calculating the amount of vegetation offsetting required for the loss of a forest's understory, or the non-tree component of non-forested communities is based on the following calculation:

Per cent cover of layer at the impact site (e.g. tall shrubs)	X	Area Removed (ha)	X	Recommended Planting Density (#/ha)

Appendix provides area percentage charts to assist in estimating the per cent cover for each vegetation layer.

The recommended planting densities are based on advice from CVC's Ecosystem Restoration Program and through discussions with Foresters from the Ontario Ministry of Natural Resources and Forestry. Table 4 provides a form for calculating the offset requirements for woodland understory and vegetation in non-woodland communities.

Table 4: Form for calculating offset requirements for woodland understory and vegetation in non-woodland communities (except trees > 5cm dbh)

Layer	Cover %	Recommended Planting Density (units per hectare)	Total Area Removed (ha)	Required Offset
	A	B	C	(A x B) x C
Trees (<5cm dbh)		1200		
White Cedar (<5cm dbh)		4350 [a]		
Tall shrubs		2750		
Low shrubs		11000		
Graminoids and Forbs		25 kg		
Emergent		110,000		
Floating–leaved aquatic		110,000		
Free-floating		N/A		
Submergent		110,000		
Open water		N/A		

[a] *Based-on planting density of 1.5 metres on centre.*

2.3.3 Habitat Features and Structures

Natural features and areas provide habitat for our local plants, animals and other organisms and contribute to the health and function of our watershed and ecosystem. These habitats are where they find adequate amounts of food, water, shelter, and space needed to sustain their populations. It is recommended that the impact site be assessed for wildlife habitat features and attempt to replicate these habitat features based on their abundance and distribution at the impact site.

Habitat features of the impact site should have been identified in Section 2.1 Inventory and Assessment, including:

- Cavity trees
- Rock piles
- Basking logs
- Vernal Pools
- Standing water
- Seepage or high water table
- Dead standing trees
- Mast trees (nut-producing)

Appendix H provides a list of references for documents that can assist with the identification of wildlife habitat features and structures.

2.3.4 Considerations for Offset Adjustments for Invasive Species

Invasive species are generally non-native plant, animal or pest species that outcompete native species for resources and dominate space. They may directly kill other species, introduce disease or hybridize with native species. Threats posed by invasive species are now considered one of the most serious threats to global biodiversity, as recognized by the UN Convention on Biological Diversity, the International Union for Conservation of Nature, the Invasive Alien Species Strategy for Canada, and the Ontario Biodiversity Strategy. (CVC, 2018a)

While invasive species pose a significant threat to biodiversity and the health of our environment, they can also provide some important ecological functions and services (e.g. habitat for native species, natural hazard regulation, water cycling, carbon, and nutrient sequestration) particularly in urban areas where there is little remaining natural vegetation.

To recognize the positive functions and the adverse impacts of invasive species, this guideline is adopting a portion of the Habitat-Hectare Approach used in Australia as an offsetting tool (Parkes *et al.* 2003). Offset projects will receive a deduction based on the per cent cover of invasive species at the impact site, and the per cent of that amount that are identified as high threat invasive species. High threat invasive species are those species identified by Donna Havinga and the Ontario Invasive Plants Working Group's Sustaining Biodiversity: A Strategic Plan for

Managing Invasive Plants in Southern Ontario. (2000) as Category 1 or 2 invasive species (Appendix)

To calculate the offset adjustment for invasive species. Based on the data collection record:

1. For each vegetation layer identify the percentage of the area to be removed that is covered by invasive species based on the data collection record (Section 2.1);
2. For each vegetation layer identify the percentage of those invasive species (Step 1) that are high-threat' invasive species (Appendix A);
3. Identify the discount (Table 5) for that vegetation layer based attributes of Step 1 and 2;
4. Subtract the discount from the required offset for the associated strata. An example application is provided in Table 6.

Table 5: Offsetting Discount for Percentage of High Threat Invasive Species by Vegetation Layer

Per cent cover of invasive species of the area to be removed	Per cent of invasive species cover that is 'high-threat' invasive species		
	None	≤ 50%	> 50%
	Discount on Only Vegetation Offset		
> 50%	-11 %	-13 %	-15 %
25–50%	-7 %	-9 %	-11 %
5–25%	-4 %	-6 %	-7 %
< 5%	0 %	-2 %	-4 %

Modified from Parkes *et al.* 2003

Table 6: Example of Offsetting Adjustment for Percentage of High Threat Invasive Species by Vegetation Layer

Layer	Invasive Species Cover (%)	High Threat Invasive Species (%)	Offset Discount by Strata	Before Discount Offset	Final Offset
Canopy trees	0	None	0	0	0
Sub-canopy	15	≤ 50%	-6 %	641	603
Tall shrubs	50	> 50%	-11 %	4450	3961
Low shrubs	0	None	0	0	0
Graminoids and Forbs	45	> 50%	-11 %	40 kg	36
Emergent	0	None	0	0	0
Floating–leaved aquatic	0	None	0	0	0
Free-floating	0	None	0	0	0
Submergent	0	None	0	0	0
Open water	0	None	0	0	0

CVC has developed other tools to suggest approaches to addressing common issues associated with the calculation and implementation of an offset. These tools can be found in Appendix B: The Offset Tool Box. The application of these tools is considered **optional**.

3 OFFSET DESIGN AND PLANNING

Section 2 guided the documentation of the ecological structure, composition and function of the natural feature/area(s) being removed, and the calculation of the amount of land and vegetation that is required to offset that loss. Offset designers and planners should use that information to design an ecosystem creation or restoration project that replicates the ecological structure, composition and function of the natural feature/area(s) removed by the development project. Figure 4 illustrates the progress through the Ecosystem Offsetting Process thus far.

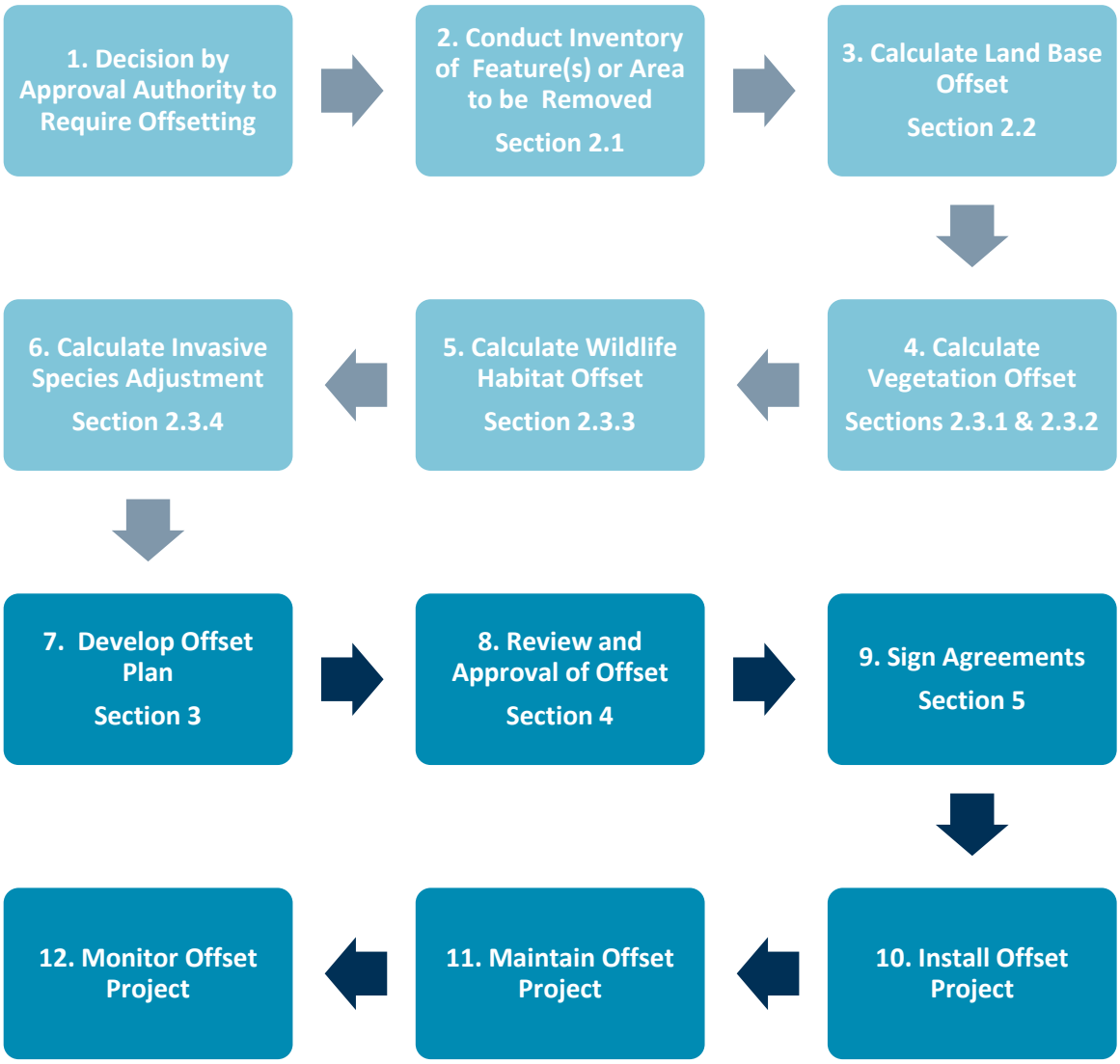


Figure 4: Progress in the Ecosystem Offsetting Process

Section 3 provides suggestions and considerations to help offset designers and planners ensure that the design of an offset adequately replaces the form and function of the lost feature and adheres to the ecosystem offsetting principles.

The guideline provides two approaches to the offset design and implementation process, including:

- a proponent led design and implementation approach, and
- a cash-in-lieu approach for CVC to lead the offset design and implementation.

This cash-in-lieu option helps proponents that may not have the resources to implement offsetting without support.

3.1 Developing an Offsetting Plan

Documentation is essential to successfully designing and implementing an ecological offset project, demonstrating no net loss and an ecological (net) gain, and providing transparency. As such, an offset plan report is required for each offset project. The report shall document the losses to the natural heritage system associated with the development, include calculations of offset requirements, clearly define goals, measurable ecological objectives and targets, and provide an implementation plan including maintenance and monitoring timelines and methods. This report will enable decision-makers to use adaptive environmental management approaches to ensure that we learn from our experiences (i.e. what works and does not work). This approach will provide transparency, improve project outcomes, and produce efficiencies in offset implementation and management.

It is recommended that approval agencies update their Environmental Impact Study (EIS) Guidelines to outline the data required to support the design, implementation and monitoring for implementation of the mitigation hierarchy, in particular, ecosystem offsetting as appropriate.

For each offsetting project, the specific actions proposed to address the required offset must be documented in a report by those implementing the work (or an agent acting on their behalf). The report must document how the offset:

- Adheres to Ecosystem Offsetting Principles (Section 1.8);
- Provides a record and characterization of the features being removed (Section 2.1)
- Replaces the land base (Section 2.2);
- Replaces the lost vegetation communities/type(s) (Section 2.1);
- Adequately compensates for mature trees (Section 2.3.1);
- Replaces understory and shrubs and herbaceous vegetation (Section 2.3.2);

- Replaces the habitat features and functions (2.3.3);
- Provides equal natural heritage system function (2.1.1 and 3.1.1)

In addition, the report must document the following:

- A description of the impacted ecosystem based on the information collected under the guidance of Section 2.1;
- Rationale for the removal of the natural features or area;
- A brief description of the proposed offset location(s) and a rationale for their selection;
- A proposed work plan;
- Detailed design drawings;
- Material costs;
- Equipment and labour costs;
- Construction phasing plan;
- Maintenance and monitoring plan and costs; and
- Any other relevant details as required through agreements between the proponent and the approval authority based on site-specific/file-specific circumstances.

Ultimately, the documentation must show that projects are designed to take advantage of existing site conditions and will provide the agreed to deliverables.

3.1.1 Offset Design and Planning Considerations

Once the appropriate amount of offsetting has been determined and agreed to by the parties involved, the next step is the development and execution of a land securement (if applicable) and ecosystem restoration implementation plan. The execution of the plan will be dependent on the location of the offset and who will complete the works. However, regardless of these, some fundamental considerations apply, including project-specific information, ecosystem restoration principles, and broader CVC or municipal program direction. In addition to the guidelines outlined herein (Section 3.1), CVC has developed several tools to help identify potential restoration sites (e.g. CVC's Restoration Opportunities Database) and guide ecosystem restoration decision making, as referenced in Section 3.1.1.14 of the Guideline.

Offsetting activities should result in a reinvestment into local ecosystem restoration and the lands required for those works and should be guided by strategic watershed and/or natural heritage system management and restoration planning documents and priorities. Offset actions should be directed to new projects (or extensions of existing projects) that require investment and resources.

The following provides considerations to help offset designers and planners improve their design, implementation and outcomes of their ecosystem offsetting project.

3.1.2 Natural Heritage System Function

A natural heritage system (NHS) is a system of connected or to be connected green and natural areas that provide ecological functions over the longer term and to enable the movement of species across the landscape (Ontario Ministry of Natural Resources, 2010). The primary objectives of the natural heritage system are to protect, restore, or enhance the ecological and hydrological health and function of the Credit River watershed.

The natural heritage system assessment and metrics produced under Section 2.1 will help planners and designers understand the relationship of the feature to the system. That assessment should have identified the function of the natural area within the context of the NHS (e.g. core, corridor, steppingstone, buffer) and its metrics (Table 8). Offset designers and planners should use these metrics to ensure that the offset provides equal or greater quality function within the natural heritage system.

Offsetting should strive to provide at least an equivalent quality and quantity in both form and function. The size of the offset should not be compromised for improved function, as the size of the natural heritage system is critical to the function of the system. Ecosystem form and function are both important, and both need to be addressed adequately in the design of the offset.

Table 7: Natural Heritage System Metrics and their use in Ecosystem Offsetting

Metric	Impact of Removal	Suggested Remedies for Consideration
Size	Reduces the size of remaining natural area Or Reduces the amount of natural vegetation cover in the catchment or subwatershed	• Add offset back to the remaining natural area in a different location, • Add to another higher functioning natural area within the same catchment or subwatershed, or • Consider increasing compensation ratio
Shape	Negatively affects the shape of the remaining natural area	• Use the offset to improve the shape of the remaining natural area in a different location, or • Improve the shape of another higher functioning natural area, • Consider increasing compensation ratio
Interior habitat Habitat that is 100 meters from the edge	Reduces the amount of interior habitat	• Use the offset in a different location to restore the interior habitat of the same natural area • Use the offset to increase the interior habitat of another higher functioning natural area, or • Consider increasing compensation ratio
Proximity to other natural areas	Increases the distance between the natural area to other natural areas	• Reduce the distance between these natural areas in a different location • Improve the proximity or connectivity of another higher functioning natural area, or • Consider increasing compensation ratio
Corridor	Negatively affects a corridor or linkage within the provincial, regional or local natural heritage system	• Improve the quality of the same corridor in a different location • Improve the quality of a different but similar corridor

Metric	Impact of Removal	Suggested Remedies for Consideration
		• Improve the quality of a higher priority corridor • Construct an eco-passage, or • Consider increasing compensation ratio
Proximity and relationship to hydrologic features or areas	Negatively affects associated wetland, watercourse, recharge area, discharge area, or floodplain	• Use the offset to restore or enhance the same hydrologic feature or area • Use the offset to restore or enhance a different, but similar hydrologic feature or area in the same catchment or subwatershed, or • Consider increasing compensation ratio
Matrix quality	Negatively affects the matrix quality for the remaining or adjacent natural areas	• Locate the offset within 2 km of the loss, preferably towards the NHS • Improve the proximity or connectivity of the remaining or adjacent natural areas, or • Consider increasing compensation ratio
Habitat and species diversity	Reduces the diversity of the habitats or species of the remaining or adjacent natural areas	• Use the offset in a different location to restore the habitat and/or species diversity of the same natural area, • Use the offset to restore the habitat and/or species diversity of a different higher functioning natural area, or • Consider increasing compensation ratio

3.1.3 Ecosystem Configuration

Ecosystem restoration should be configured in such a way as to improve the size and shape of the natural heritage system, improving both the local ecosystem function and the larger natural heritage system as a whole. Newly restored ecosystems must also be situated to help ensure they are protected from the effects of adjacent land use

3.1.4 Ecosystem Connectivity

When determining the location of restoration areas and land securement, ecosystem connectivity must be considered and maximized to the extent possible; for example, where east-west connectivity could enhance cross-watershed functions.

3.1.5 Location of Offset

Offset projects may be located on-site, off-site, or a combination of both.

On-site	Offset occurs on the same site that the ecosystem impact is taking place;
Off-site	Offset occurs in a different location from where the impact is taking place.

On-site offsetting is preferred as it is in proximity to where the loss occurs; it also removes the complexity of finding new lands in proximity to the loss. Some options to consider allowing on-site offsetting are to adjust alignment (straightening) of rear lot lines, filling in gaps and edges of natural areas, and naturalizing corridors and buffers.

3.1.6 Proximity to Loss

The location of the offset project (both land securement and ecosystem restoration) should be within the same geographic area as the ecosystem that was removed (same neighbourhood, subwatershed, or municipality). This helps to ensure that the restored ecosystem functions and services contribute to the same area. For those circumstances where land acquisition is part of the required offset, the lands to be acquired and the land to be restored do not need to be on the same site. There may be instances where previously identified and secured lands can be restored to address the ecosystem restoration component of the offset and separate lands acquired to address the land base offset component. However, they should both be located within the same geographic area (ideally in the same neighbourhood or subwatershed) as the impacted site. The appropriateness of the location for ecosystem restoration may also be influenced by the requirement to restore a particular ecosystem type or to achieve a specific natural heritage objective.

3.1.7 Land Availability

In highly urbanized watersheds adding lands to the natural heritage system may not always be feasible due to the limited availability of land. In these cases, the municipality, CVC, and the proponent may consider working together to find lands that are perhaps within the natural heritage system but need restoration to compensate for permitted losses. However, this should be the exception to the rule,

given that this scenario would result in a net loss in the amount of land within the natural heritage system. Alternatively, lands can be secured outside of the impacted municipality but within the upper portion of the same watershed, helping to ensure that the downstream municipality will benefit from many of the ecosystem services in the long term.

3.1.8 Land Ownership and Designation

Lands secured for offsetting should be placed in public ownership and designated and zoned in an environmental protection category. They should also be in proximity and preferably contiguous to currently held public lands and be accessible, enabling their effective long-term protection and management.

3.1.9 Ecosystem Type

In most instances, it will be appropriate to restore the same ecosystem type as was lost, e.g., restoring a forest for losing a forest. However, there may be other cases where this is not achievable due to the specific site conditions of the restoration location, or not desirable based on strategic restoration priorities. Site conditions including soil type, drainage, exposure and aspect will dictate which ecosystem types are suitable for a particular location. Additional guidance to help refine the restoration goals and ecosystem type to be restored can be based on the type of restoration that best achieves the natural heritage system strategies and municipal objectives. There may also be site-specific/file-specific circumstances that dictate special technical direction that deviates from a typical "like for like" approach. Nevertheless, in all cases, the type of feature to be restored will be guided by CVC, provincial and municipal natural heritage objectives, restoration programs and strategic ecosystem management priorities.

3.1.10 Project-Specific Requirements

Some offset projects may have specific requirements and deliverables associated with them as part of the offset agreement. These could include restoration of a particular ecosystem type or the need to re-use soil or woody material or perform a plant rescue from the lost ecosystem. In addition, the impacted ecosystem may have been providing a particular function that warrants consideration in the design and implementation of the restoration works. For example, habitat for a particular species or group of species may need to be incorporated into restoration projects to help address the loss of this habitat as a result of the ecosystem removal. These requirements must be adhered to, planned for, and documented through implementation.

3.1.11 Planting trees in communities with less than 35 per cent tree cover

The approach used in Section 2.3.1 (for determining the appropriate offset for larger trees in communities with less than 35 per cent tree cover) uses compensation ratios based on the diameter at breast height of the trees removed. This offset requirement will likely produce more trees than what should be planted at the offsetting site to replicate the feature that was lost (e.g. savannah to replace a savannah). This Guideline recommends planting the approximately the same number of trees (1:1 or 1.5:1) at the offset site as were removed from the impact site to replicate the composition and structure of the lost feature. Over planting the offset site could produce a different community type than what was intended or desired. If there is residual plant material not used at the offset site, then it should be redirected to be incorporated into other natural area restoration projects (see illustrative examples of on-site and off-site offsetting in Appendix) to make up for the functions and services lost to the development.

Frequently, sparsely treed or successional vegetation communities are treated as poor quality woodlands. However, these communities have their unique values and support a unique group of plants, animals and functions. A healthy, functioning natural heritage system should have a diversity of vegetation types and ages. In addition, the successional process helps to build soils and modify site conditions that sustain healthier forests in the long-term. As such, this guideline encourages offset designers to consider replacing what was lost as opposed to converting the offset into forests.

3.1.12 Use of Understory Vegetation

When creating new natural features as part of an offset, the environmental conditions at the offset site are likely going to be hostile (e.g. too much sun, wind, frost, etc.) to the plants typically associated with a forest understory.

As such, this Guideline recommends using the understory vegetation required for an offset to restore older reforestation projects by underplanting plantations, or to help repair damage from invasive species, Emerald Ash Borer, and poor land-use practices or encroachments.

There are other instances and restoration techniques that would allow the understory vegetation to be planted at the same location and time as the trees and shrubs (e.g. planting herbaceous vegetation in sparsely treed swamp).

3.1.13 Ecological (Net) Gain

The principles of offsetting state the offset projects should target an ecological (net) gain. This section offers some suggestions for planners and designers to consider in the design of their project to help achieve an ecological (net) gain.

- Increasing the size of the offset;
- Improving the quality habitat of the offset beyond what is required;
- Improving ecological connectivity or linkages to other natural areas and the natural heritage system;
- Securing other lands beyond those required;
- Connecting the offset to other (different) habitat types to improve habitat and biological diversity;
- Addressing ecosystem stressors outside of those produced by the development;
- Supporting long-term management of the offset beyond what is required under a condition of approval;
- Combining the offset with other restoration projects;
- Implementing measures to protect the function and condition of the offset (e.g. invasive species management, vegetated buffers, hydrologic restoration, fencing, boardwalks).

3.1.14 Ecosystem Restoration Guidelines and Tools

CVC has developed guidelines and tools that can help with the design and implementation of ecosystem offsetting projects, including:

- Healthy Soil Guidelines for Natural Heritage Systems;
- Credit River Watershed Natural Heritage System;
- CVC Fish and Wildlife Crossing Guidelines;
- Plant Selection Guideline – Species List for Planting Plants within the Credit River Watershed;
- Ecological Restoration Strategy and Guidelines [Draft];
- Restoration Cost Calculation Tool [Draft]; and
- Restoration Opportunities Database [Draft].

These draft guidelines and tools will be finalized available shortly.

3.1.15 Restoration Services

CVC has expertise and programs that can help advise, design or implement offset projects, including:

- Reforestation and Naturalization Services;
- Wetland and Stream Management Services;
- Invasive Species Management Services;
- Native Grassland and Habitat Restoration Services;
- Ecological Monitoring Program;
- Land Securement Services; and
- Restoration Performance Monitoring Services.

3.1.16 Offset Implementer

The offset may be installed by:

- The proponent and contractors;
- CVC's Restoration and Management Services;
- Other public agencies (municipalities, provincial or federal); or,
- Non-government organizations (e.g. Ducks Unlimited Canada, Trout Unlimited Canada)

The implementer of the project is responsible for ensuring that the offset project is planned, designed, implemented, monitored and maintained according to approved restoration guidelines and offset requirements stated in the applicable agreements. Roles, responsibilities and timelines should be clearly defined through agreements (see Section 5) between the agency requiring the offset, the proponent, and the implementer.

3.1.17 Considerations for Monitoring and Maintenance

Monitoring outcomes are a critical component of the offsetting process. Regardless of who is implementing the work, it is the responsibility of the implementer to undertake the monitoring and any required remedial actions. The key to achieving the goals of the agreed-upon offsetting plan is ensuring the success of the individual project, which in turn will help guide the improvement of the overall offsetting program over time.

Monitoring should be undertaken at the 1, 3, and 5-year points after construction and or planting is complete, to allow for early detection and correction of any planting or construction failures. Documentation should be uploaded into the CVC Restoration Opportunities Database if implemented by CVC, or provided to the public agency overseeing proponent-led implementation for review.

Monitoring and maintenance of forest offset projects will take longer – the proponent should pay for long term monitoring and maintenance (e.g. thinning if applicable).

Monitoring and maintenance will typically be the responsibility of those undertaking the restoration work. This responsibility will be confirmed and documented as part of the agreements outlined in Section 5. Monitoring reports will be written to document project results. Where projects are not functioning as designed and approved, investigations will be undertaken to understand why. Further, modifications may be required to ensure that the project is successful; the need for these can be stipulated in an agreement and assured through securities held by the public agencies (see Section 5 Agreements). Monitoring and maintenance often

constitutes a learning process that can inform future offsetting decisions and implementation plans.

As a standard best management practice, a 25% planting replacement cost should be built into all project budgets regardless of who is implementing the work. This planting replacement is informed by the experience of the conservation authority and reflects typical restoration replanting rates.

3.1.18 Contingency

The plan shall include a fund to address unforeseen issues that may develop during the implementation of the offset project. Contingency is typically 10 percent of the project's value (excluding the land base costs).

4 OFFSET DESIGN REVIEW AND APPROVAL

CVC Planning and Development Services, with input from the affected municipality(ies) and other relevant agencies, will use the following guidelines to inform and review the design of the proposed offset:

- Ecological Offset Report and Plan;
- Healthy Soil Guidelines for Natural Heritage Systems;
- Credit River Watershed Natural Heritage System;
- CVC Fish and Wildlife Crossing Guidelines;
- Plant Selection Guideline – Species List for Planting Plants within the Credit River Watershed;
- Ecological Restoration Strategy and Guidelines [Draft];
- Restoration Cost Calculation Tool [Draft]; and
- Restoration Opportunities Database [Draft].

As per the usual plan review process, all comments from the CVC technical review team will be conveyed to the proponent by the CVC Planner on the file.

In the instances that the proponent or another public agency will be undertaking the offset project, the approval authority will review the proposed offset project to ensure the intent of the guideline is being adhered to and the quality of the restoration plan is acceptable.

5 AGREEMENTS

Agreements are required after the approval authority has approved the offsetting plan. Agreements will differ from situation to situation, dependent on the offsetting approach applied and on which party will undertake the implementation. Examples of agreements may be within:

- the conditions of draft plan approval for a subdivision,
- a site plan agreement, or
- the commitments of an Environmental Assessment.

Alternatively, there may be a stand-alone agreement for the offset plan signed by all the parties (proponent, municipality and conservation authority). The parties involved in offsetting decisions will ultimately determine the terms and conditions of any subsequent legal agreements. The following are factors to be considered when contemplating agreements:

- Agreements of conditional approval should cite that current costs to restore and current land values (at the time of receipt of the funds) should be used in calculating the offset funds.
- Offsetting funds transferred to a public agency must be applied to the installation of the agreed-upon ecosystem type, including land acquisition (when applicable), helping to ensure the funds are directed to the replacement of lost ecosystem functions and services.
- Funds (when being transferred to a public agency) should be received before the removal of features.
- A timeline for implementation may be determined to ensure the ecosystem is replaced as soon as possible and ideally before the impact occurs.
- If the proponent implements offset actions, a security should be held until the warranty's expiration. Warranty periods will vary but should be consistent with the determined monitoring period. Security amounts and holding periods will also vary depending on perceived risks and the complexity of restoration actions. Phased release of securities may be negotiated depending on the nature of the project to ensure development applicants undertake the required offset work.
- If upon review by the senior leadership of the agency issuing the approval it is found that an agreement is not being followed, the proponent will be provided with written notice to bring the project into compliance by a specified date.
- If the project is not brought into compliance by the specified date, the proponent will be advised in writing and the agency staff may cash the security and use the funds to undertake the necessary work. This ensures

that the appropriate funding is available should the applicant fail to undertake or complete the agreed-upon offset.

In addition to the considerations listed above, there may be circumstances that warrant additional measures to help reduce risk to an acceptable level. The following provides some possible actions:

- Requiring greater financial securities to support possible mitigation measures and contingencies;
- Requiring financial securities to be held for longer periods to ensure the establishment of newly restored ecosystems;
- Increasing the size of the ecosystem required to be restored; and
- Using CVC to undertake ecosystem restoration, land securement, monitoring and any remedial works required.

5.1 Agreements and Public Agencies as Proponents

Securities/letters of credit are generally not applied where the proponent is another public agency such as a municipality. As per current practice, CVC and the public proponent will work together, transparently and consistently, to agree on the best approach to implementing offsetting that meets the principles of the Guideline. Nonetheless, if implementation is being undertaken by a public agency, that agency (municipality, CVC or other) accepts responsibility for the effective implementation and monitoring of the offset works, unless otherwise arranged between agencies. For example, in the case of public-private partnerships, securities may be required.

5.2 Cash-in-Lieu

When an impacted feature cannot be offset on-site and another parcel of land is not readily available off-site, to compensate for the lost land base associated with the impact, the proponent should provide cash-in-lieu that accounts for acquiring land elsewhere to add back to the natural heritage system. The value of purchasing a comparable parcel of land to add to the natural heritage system elsewhere can be determined either through recent comparable sales data (i.e., similarly designated and zoned development parcels with no pre-existing encumbrances, located within 2km of the subject site) by an appraisal or as negotiated where parcels of similar characteristics may already be targeted for acquisition.

Other methods of calculating land costs could be supported, subject to the satisfaction of CVC and/or the appropriate approval authority. In any case, the fair market value of the development site should be determined using generally accepted appraisal principles. Appraisal costs and other fees associated with determining land base replacement costs will be the responsibility of the proponent.

In the instances that CVC or another public agency implements an offset project, private proponents provide funds to CVC or the public agency instead of undertaking the offset project themselves. The amount of the cash-in-lieu is based on the cost to restore the impacted ecosystem's structure (Section 2.3), replace the land base (Section 2.2), and to monitor and maintain the project according to the conditions of the permit and/or agreement.

5.3 Transparency and Accountability

As part of our commitment to transparency and accountability, CVC will establish a financial reserve to manage and track funds associated with offset projects and a database to track the location and status of those projects. Staff will provide a report to the Board of Directors every three years on the application of offsetting in the Credit River watershed.

6 CONCLUSIONS AND RECOMMENDATIONS

This Ecosystem Offsetting Guideline presents a consistent approach for replacing natural features lost to development, site alteration, or infrastructure projects after the decision to offset has been made by the appropriate approval authority.

The Guideline provides an approach to natural heritage system planning and management that provides flexibility while meeting provincial and municipal planning policy requirements. This approach can produce better development and ecological outcomes if all of the guidelines are followed.

The successful implementation of these guidelines will require a collaboration between the proponent and an integrated team of planners, ecologists, restoration specialists and other technical experts depending on the nature of the offset project. These Guidelines should be updated as CVC, municipalities and proponents gain more experience from the design, implementation and monitoring of offset projects. Other tools and products will be produced to improve the efficiency and effectiveness of offsetting projects in the future.

7 GLOSSARY

Conservation Banking	A conservation bank is a parcel of land managed for its conservation values. In exchange for permanently protecting the land, the bank owner is allowed to sell credits to parties who need them to satisfy legal requirements for compensating for the environmental impacts of development projects. (Carroll et al. 2008)
Ecological (Net) Gain	a working principle by which CVC strives to build upon natural features and areas requiring protection under CVC, municipal or provincial policy, and enhances or restores the ecological functions and hydrologic functions of the natural heritage system in both the short term and long term as a result of the approval of an application. Enhancements or restoration may include, but are not limited to, on-site and off-site works that will result in one or more of the following: a) increases in the spatial extent of the natural heritage system; b) increases in biological and habitat diversity; c) enhancement or restoration of ecological functions and hydrological functions; d) enhancement or restoration of wildlife habitat; e) enhancement of natural succession; f) creation of wetlands, water systems or woodlands; g) enhancement or restoration of riparian corridors; h) enhancement or restoration of groundwater features; and i) establishment, enhancement or restoration of linkages between natural features and areas. (Credit Valley Conservation, 2010)
Ecological Land Classification System for Southern Ontario	The Ministry of Natural Resources and Forestry's Southern Ontario system of classification of lands from an ecological perspective; an approach that attempts to identify and classify ecologically similar areas; published in 1998, and as may be updated from time to time.
Ecological Restoration	The process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. - Society for Ecological Restoration

Ecosystem Function	The natural processes, products or services that living and non-living environments provide or perform within or between species, ecosystems, and landscapes. These may include biological, physical, and socio-economic interactions.
Ecosystem goods and services	The benefits to humans and other species, provided by nature.
Ecosystem structure	The biotic (living) and abiotic (non-living) form and composition (e.g. dominant plant species, size of vegetation, soil type and topography) of ecosystems that give each ecosystem its definition and function.
Green infrastructure	Natural vegetation, vegetative technologies, soil in volumes and qualities adequate to sustain vegetation and absorb water, and supportive green technologies that replicate ecosystem functions and that collectively provide society with a multitude of environmental, social and economic benefits.
Headwater Drainage Features	Ill-defined, non-permanently flowing drainage features that may not have defined bed or banks; they are zero-order intermittent and ephemeral channels, swales and rivulets, but do not include rills or furrows. Headwater drainage features that have been assessed through CVC's Evaluation, Classification and Management of Headwater Drainage Features Guideline, as "protection" and "conservation" are subject to CVC's Regulation; those assessed as "mitigation" may be subject to CVC's Regulation.
Invasive plants	Non-native floral species which displace native species, dominate ecosystems and impact ecological integrity and ecosystem services for humans.
Lag Time	In the context of this Guideline, lag time refers to the time required for a newly restored ecosystem to reach a similar level of function as the impacted ecosystem it is attempting to replace.
Land Base Offset	Land that is provided by a development proponent as an offset to replace the land removed from the natural heritage system by a development project. The land can be provided on the same site or a different site as where the development is to occur. Land is replaced at a one to one ratio; in other words, the replacement

	area is equal to the area removed by the development.
Low shrubs	*Rubus sp*. (Raspberry), *Spiraea alba* (Narrow-leaved Meadowsweet), *Clematis virginiana* (Virgins Bower), *Cornus canadensis* (Bunchberry), *Euonymous obovatus* (Running Strawberry Bush), *Menispermum canadense* (Canada Moonseed Vine), *Rhamnus alnifolia* (Alder-leaved Buckthorn), *Ribes americanum* (Wild Black Currant), *Ribes cynosbati* (Prickly Gooseberry), *Ribes triste* (Swamp Red Currant), *Rubus pubescens* (Dwarf Raspberry), *Vitis riparia* (Riverbank Grape/Frost Grape). All other shrubs are considered tall shrubs for this document.
Market Value	The most probable price, as of a specified date, in cash, or in terms equivalent to cash, or in other precisely revealed terms, for which the specified property rights should sell after reasonable exposure in a competitive market under all conditions requisite to a fair sale, with the buyer and seller each acting prudently, knowledgeably, and for self-interest, and assuming that neither is under undue duress. (Appraisal Institute of Canada)
Mitigate	The prevention, modification or alleviation of negative effects on the environment. It also includes any action with the intent to enhance beneficial effects.
Mitigation Hierarchy	Avoid, minimize, mitigate, compensate (offset).
Natural Cover	The land occupied by naturally and culturally occurring native or non-native vegetation that is not characterized as agricultural or urban land uses.
Natural Heritage System	Natural heritage system means "a system made up of natural heritage features and areas, and linkages intended to provide connectivity (at the regional or site level) and support natural processes which are necessary to maintain biological and geological diversity, natural functions, viable populations of indigenous species, and ecosystems. These systems can include natural heritage features and areas, federal and provincial parks and conservation reserves, other natural heritage features, lands that have been restored or have the potential to be restored to a natural state, areas that support

	hydrologic functions, and working landscapes that enable ecological functions to continue." (OMMAH, 2014)
No-Net-Loss	A working principle by which CVC strives to balance unavoidable negative impacts on the natural heritage system with replacement of those ecological functions and hydrologic functions on a project-by-project basis so that further reductions to the natural heritage system may be avoided. (Credit Valley Conservation, 2010)
Vegetation Type/ Vegetation Community	An ecosystem as described by its vegetation composition and form. For example, an oak-maple forest. The level of mapping detail for the "Vegetation Type" is defined by the Ecological Land Classification System for Southern Ontario.

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Appendices

Appendix A: Considerations for Offset Adjustments for Invasive Species

Section 2.3.4 provided an approach to recognize both the positive functions and the adverse impacts of invasive species on the ecosystem. This approach provides offset deductions based on the per cent cover of invasive species at the impact site, and the per cent of that amount that are identified as high threat invasive species. High threat invasive species are those species identified by Donna Havinga and the Ontario Invasive Plants Working Group's Sustaining Biodiversity: A Strategic Plan for Managing Invasive Plants in Southern Ontario (2000) as Category 1 or 2 invasive species (below).

High Threat Invasive Species for Adjusting Offset Calculations

Category 1 — Species that exclude all other species and dominate sites indefinitely. They are the top priority for control, but control may be difficult. Plants in this category are a threat to natural areas wherever they occur because they tend to disperse widely (for example, through transport by birds or water).

Scientific Name	Common Name	Effect on Natural Area
*Acer negundo**	Manitoba maple	invades all habitat types
Aegopodium podagraria	Goutweed	dominates forest understorey
Alliaria petiolate	Garlic mustard	dominates forest herb layer
Alnus glutinosa	Black alder	dominates wetlands
Butomus umbellatus	Flowering rush	dominates open marshes
Cirsium arvense	Canada thistle	dominates meadows/prairies and forest edges
Coronilla varia	Crown vetch	dominates meadows
Cynanchum nigrum	Black swallow-wort	dominates meadows and forest edges
Cynanchum rossicum	Pale swallow-wort	dominates meadows and forest edges
Elaeagnus umbellate	Autumn olive	dominates forest edges
Glyceria maxima	Rough manna grass	dominates wet meadows
Hesperis matronalis	Dames rocket	dominates open forest understorey and meadows
Hydrocharis morsus-ranae	European frog-bit	dominates open water habitats
Impatiens glandulifera	Himalayan balsam	dominates forests and wet meadows
Lonicera japonica	Japanese honeysuckle	dominates forest understorey
Lonicera maackii	Amur honeysuckle	invades meadows and forest edges
Lonicera morrow	Morrow's honeysuckle	invades meadows and forest edges

Lonicera tatarica	Tartarian honeysuckle	invades meadows and forest edges
Lonicera xylosteum	Euro. fly honeysuckle	invades meadows and forest edges
Lythrum salicaria	Purple loosestrife	dominates wetlands
Morus alba	White mulberry	hybridizes with rare *M. rubra*
Myriophyllum spicatum	Eurasian watermilfoil	dominates open water habitats
Nymphoides peltatum	Floating heart	dominates open water habitats
*Phragmites australis**	Common reed	dominates wetlands and wet meadows
Potamogeton crispus	Curly pondweed	dominates open water habitats in SW Ontario
Rhamnus cathartica	Common buckthorn	dominates forest understorey/ meadows and prairies
Rhamnus frangula	Glossy buckthorn	dominates wetlands
Rosa multiflora	Multiflora rose	dominates forest edges

** hardy native species that can become invasive given certain conditions*

Category 2 — Species that are highly invasive but tend to dominate only certain niches or do not spread rapidly from major concentrations. Many spreads by vegetative means or seeds that drop close to the parent plant. Most persist in dense populations for long periods. Control where necessary and limit their spread into other areas.

Scientific Name	Common Name	Effect on Natural Area
Acer platanoides	Norway maple	dominates forest canopy
Acer pseudoplatanus	Sycamore maple	dominates forest canopy
Ailanthus altissima	Tree of Heaven	dominates early successional forest
Betula pendula	European birch	dominates open wetlands
Celastrus orbiculatus	Oriental bittersweet	now more common than native C. scandens
Galium mollugo	White bedstraw	invades meadows
Lotus corniculatus	Bird-foot trefoil	dominates meadows and prairies
Lysimachia nummularia	Moneywort	dominates wet forest understorey
Melilotus alba	White sweet clover	dominates meadows and prairies
Melilotus officinalis	Yellow sweet clover	dominates meadows and prairies
Pinus sylvestris	Scots pine	invades meadows
Poa pratensis	Kentucky bluegrass	dominates prairies
Polygonum cuspidatum	Japanese knotweed	dominates wet meadows and moist forests
Populus alba	White poplar	invades meadows

Robinia pseudo-acacia	Black locust	invades meadows
Scilla siberica	Scilla	dominates forest understorey
Syringa vulgaris	Lilac	dominates shallow limestone areas
Ulmus pumila	Siberian elm	invades prairies
Vicia cracca	Cow vetch	dominates meadows and prairies
Vinca minor	Periwinkle	dominates forest understorey

Havinga, D. and the Ontario Invasive Plants Working Group. 2000. Sustaining Biodiversity: A Strategic Plan for Managing Invasive Plants in Southern Ontario. Society for Ecological Restoration – Ontario Chapter. http://chapter.ser.org/ontario/files/2012/08/Sustaining-Biodiversity.pdf Accessed 12 October 2018.

Appendix B: Offsetting Tool Box

The following tools are not a formal part of this Ecosystem Offsetting Guideline. These tools have been developed to offer suggested approaches to address soil conditions, ecological net gain, and ecological services issues that may relate to an offset project. The application of these tools is optional and can be adjusted to meet the needs of an offset project.

1. Soil and Microtopography Recommendation

Offsetting projects are most likely to be implemented on lands previously used for other land-use practices that can produce problems with soil compaction, loss of organic matter, loss of microtopography, and alteration of site hydrology and soil moisture. These impacts on the soil can significantly affect the eventual species richness, diversity and evenness of the restored site.

As a result, this guideline recommends that decision-makers consider incorporating topsoil, leaf litter, and coarse woody debris from the impact site to the offset site to help to address limiting factors associated with the soils. Adding this organic material will also inoculate the site with mycorrhiza fungi, mould, bacteria and invertebrates that are critical to supporting nutrient cycling and soil development and maintenance processes. This approach will also create habitat structure and microtopography to assist in the restoration and maintenance of biodiversity and hydrologic characteristics associated with restoring the ecosystem.

Other practices to help improve soil health can and should be considered when reviewing offsetting plans or determining the required costs.

2. Suggested approach to achieving an Ecological (Net) Gain

The objective of a net gain is that the development leaves the natural environment in a better condition than before the development started (Figure A-1). A net gain should be pursued to address adverse residual and cumulative impacts, inherent risks and uncertainties, and our incomplete understanding of ecosystem functions and services.

The activities to achieve a net gain must produce a measurable and quantifiable ecological net gain in terms of their improvement to the ecological composition, structure and function of the natural heritage system.

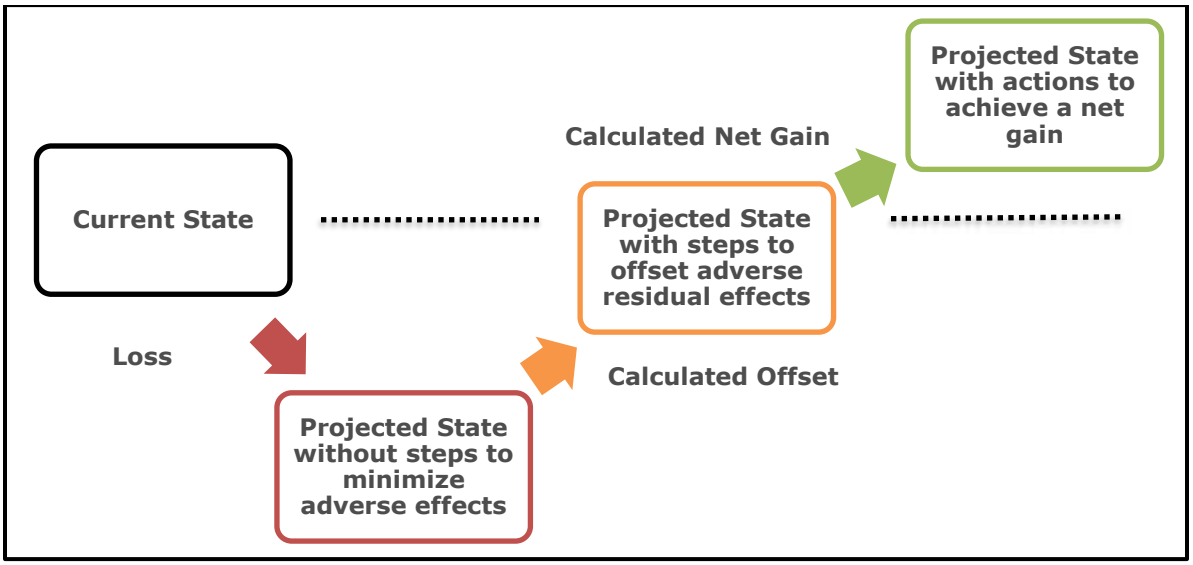
This tool recommends an approach that calculates the required vegetation, labour and materials (i.e. soil, wood chips, stakes, tree guards, etc.) offset for the loss of produced by the development and simply adds 10 percent to the total offset. Ten

percent was selected simply because it is large enough to produce a measurable effect, and not too large as to be unreasonable.

There is no additional offsetting required for the land-based offset (i.e. land base is still 1:1).

Surplus offset vegetation and materials that cannot be applied to the development site will be used in other restoration projects in the municipality or watershed. CVC or municipal restoration or land management programs may be able to assist in the implementation of these surplus offsets.

Figure A-1. Net Ecological Gain Concept



Other approaches that can demonstrate a measurable and quantifiable long-term ecological net gain are appropriate if approved by the agency requiring the offset as a condition of their plan approval or permit.

3. Off-site Offsets and the Loss of Ecological Services

This tool is an optional approach intended to address losses that cannot be offset near the site where the loss occurred, and where it has been determined by the permitting agency that the proposed offsetting plan produces unacceptable residual impacts on the local community or subwatershed.

In most cases, on-site offsetting is the preferred option as it is in proximity to where the loss occurs; it also removes the complexity of finding new lands in proximity to the loss. On-site offsetting should be explored as a priority option before contemplating off-site options. Ideally, the implementation guidance in

Section 3 should be adhered to when determining the appropriateness of on-site offset.

If on-site restoration is not possible, offsetting should be pursued within the same neighbourhood and subwatershed. As last resort, offsets shall occur within the same municipality and watershed (i.e. Credit River watershed). When the offset is located off-site, the municipality may require an Ecological Services Surcharge to mitigate the social impact of the loss on the community.

The Ecological Services Surcharge is calculated based on a percentage of the vegetation component of the offset (Table A-). This surcharge (or its monetary equivalent) will remain with the impacted community and should be used to mitigate the loss of ecological services and quality of life impacts on the local community. Some ideas for applying this surcharge include planting natural vegetation in parks, community centres or near schools, street tree replacement, invasive species management, low impact development projects and or repairing damage to other natural features and areas in the community.

Land base replacement value is not used in calculating the Ecological Service Surcharge.

Table A-1. Ecological Services Surcharge.

Offset Location relative to Loss Location	Ecological Service Surcharge Additional Percent of Required Vegetation Offset
Off-Site - Same Neighbourhood[1] and Catchment[2]	10%
Off-Site - Different Neighbourhood[1] and Catchment[2]	20%
Off-Site - Different Municipality or Subwatershed[3]	50%

[1] Neighbourhood boundaries determined by the impacted municipality

[2] Catchment determined by the Conservation Authority

[3] Subwatershed determined by the Conservation Authority

The values of Ecological Services Surcharge in Table A- are suggested to encourage proponents to address the losses on their properties or locally to avoid or minimize impacts to the community being impacted by the loss. These values can be negotiated between the proponent and the approval agency requiring the offset.

Appendix C: Calculating Basal Area

General guidance on how to perform the basal area calculation can be sought from the Ecological Land Classification for Southern Ontario Field Guide or the Ontario Tree Marking Guide. The following recommendations are provided to standardize the collection and submission of basal area calculations related to CVC's Ecosystem Offsetting.

Please consult with CVC staff before deviating from the ideal data collection recommendations.

- Basal area should be collected from the contiguous ecosystem type (Ecological Land Classification polygon) from which the unavoidable loss or impact to natural feature has been identified.
- Use a BAF 2 metric prism.
- Use fixed area plots in circumstances where the prism provides less accuracy (such as in young plantations or dense hardwood stands where it is not possible to distinguish individual stems).
    - In these circumstances circular plots are recommended; for a 200 m^2 plot the plot radius is 7.99 m.
- A minimum of 3 plots (either prism sweeps or fixed area plots) should be taken within the ecosystem type impacted, with a minimum sample size of 10% coverage.
- Ideally, plots are to be located 40 meters from an edge of the polygon to avoid edge bias. At minimum plots should be located so that they do not solely include the edge of the ecosystem type.
- Ideally, there should be a minimum of 80 meters between sweeps/plots.
- Where appropriate a grid pattern should be used and marked in the office before field data collection.
- The centre of each sweep/plot should be marked on the ground and recorded with GPS, for staff verification, if necessary. This information should be mapped and provided with the data collection sheets to CVC staff.
- Basal area to be recorded by tree species. All dead trees are to be included in the basal area calculation.
- Diameter measurements are to be recorded for all borderline trees. A plot radius table can be used to determine whether the tree is in a plot. A Plot Radius Factor Table can be found in Appendix D of the Ontario Tree Marking Guide.

References:

Lee, H.T., W.D. Bakawsky, J.Reily, J. Bowles, M. Puddister, P. Uhlig and S. McMurray. 1998. Ecological Land Classification for Southern Ontario: First Approximation and Its Application. Ontario Ministry of Natural Resources, Southcentral science Section, Science Development and Transfer Branch. SCSS Field Guide FG-02.

OMNR. 2004. Ontario Tree Marking Guide, Version 1.1. Ont. Min. Nat. Resour. Queen's Printer for Ontario. Toronto. p. 252

Basal Area Collection Form

ECOSYSTEM TYPE CHARACTERISTICS	SITE:
	Ecosystem Type:
	DATE:
	SURVEYOR(S):

TREE TALLY BY SPECIES:

PRISM FACTOR

SPECIES	TALLY 1	TALLY 2	TALLY 3	TALLY 4	TALLY 5	TOTAL	REL. AVG

DEAD							
TOTAL							100
BASAL AREA (BA)							

STAND COMPOSITION:

COMMUNITY PROFILE DIAGRAM



Adapted from the Ecological Land Classification for Southern Ontario (Lee et al, 1998)

Appendix D: Individual Tree Replacement Table

When the basal area approach is not suitable for determining offsetting, as may be the case with individual trees where no municipal tree by-laws apply, tree replacement ratios can be a helpful tool. The following provides information on tree replacement ratios as well as typical costing when planting individual trees.

The data collected as part of municipal Urban Forest Studies conducted by TRCA and the i-Tree-Eco analysis model developed by the U.S.D.A. Forestry Service help to provide CVC-relevant, empirical values for some ecosystem services based on tree diameter; these include carbon sequestration and pollution removal. The i-Tree-Eco data, the basal area information used for natural feature offset as well as current municipal tree by-law requirements were all used to inform the suggested tree replacement ratios outlined in Table D-1 below. In general, older or more significant trees are replaced at higher ratios than smaller ones.

Table D-1: Replication Tree (Planting) Ratio by Diameter at Breast Height (DBH)

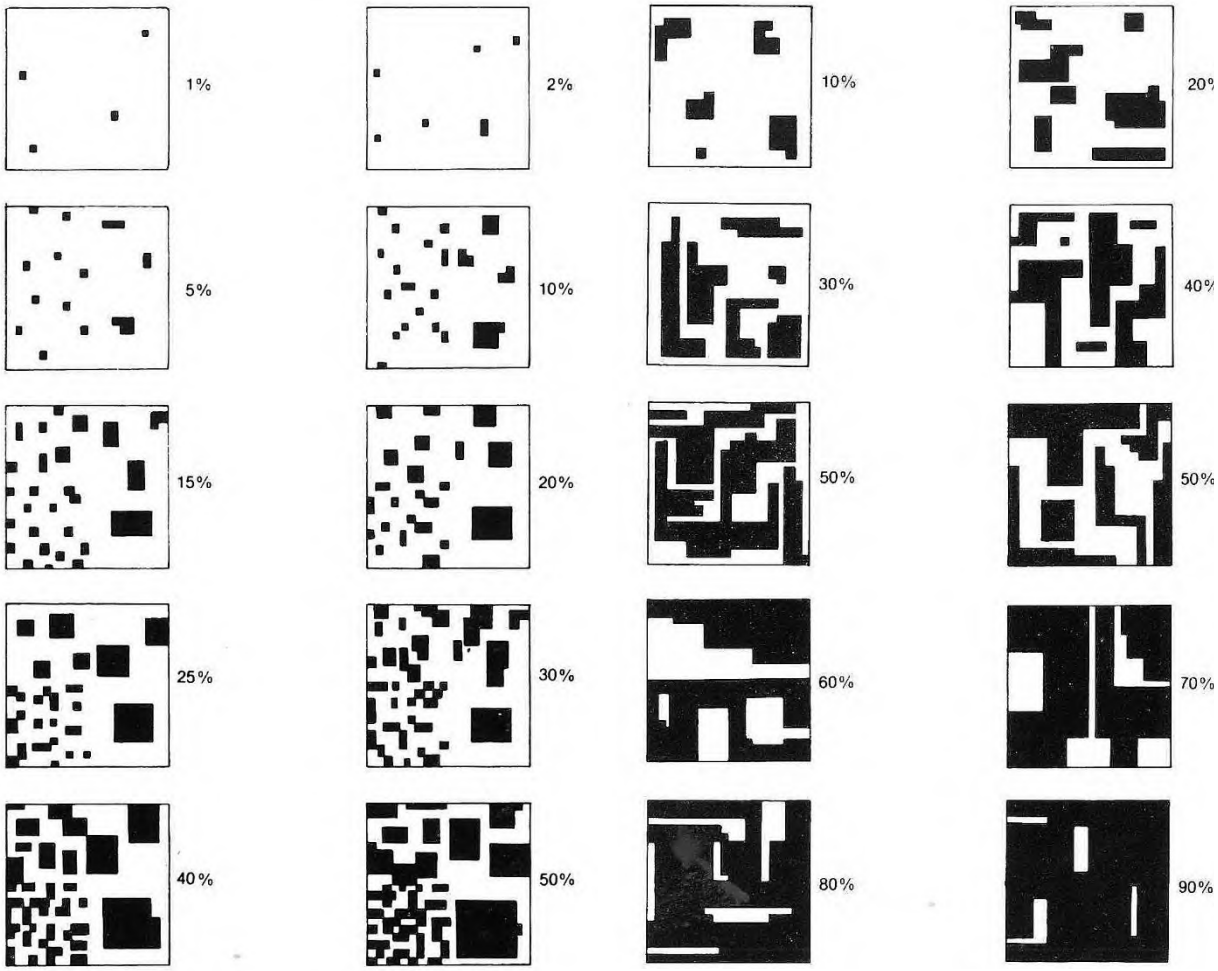
	DBH Range (cm)	Replication Ratio
1	0 – 10	1:1
2	10.1 – 20	1:3
3	20.1 – 30	1:10
4	30.1 – 40	1:15
5	40.1 – 50	1:20
6	50.1 – 60	1:30
7	60.1 – 70	1:40
8	70.1 +	1:50

Improved efficiency would be achieved if a large number of trees would be implemented under one contract. For this Guideline, the following assumptions were made:

1. Replacement of individual trees will have a replacement requirement of minimum 60 mm wire basket calliper tree;
2. Costing will include maintenance and monitoring with a minimum 2-year warranty; and
3. Costing is based on typical industry standards and planting within parkland settings.

Costs associated with these plantings are subject to market changes for fuel, materials, etc., and are therefore not listed. For the most current costs, please contact CVC staff.

Appendix E: Area Percentage Charts

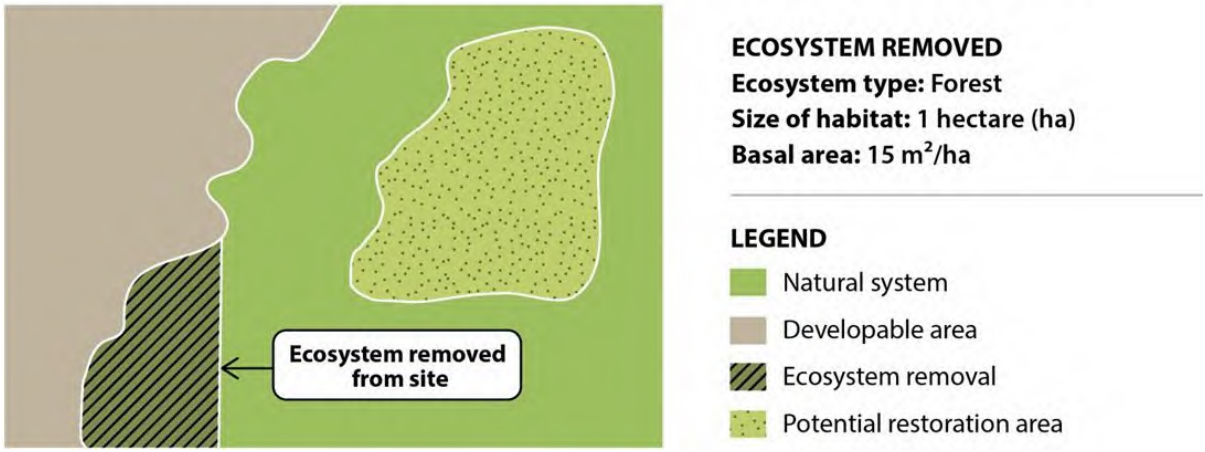


Adopted from Denholm, K. A., L. W. Schut, and D. E. Irvine. 1993. Field manual for describing soils in Ontario, 4th ed. Ontario Centre for Soil Resource Evaluation. Guelph: Land Resource Science, University of Guelph.

Appendix F: Offsetting Examples

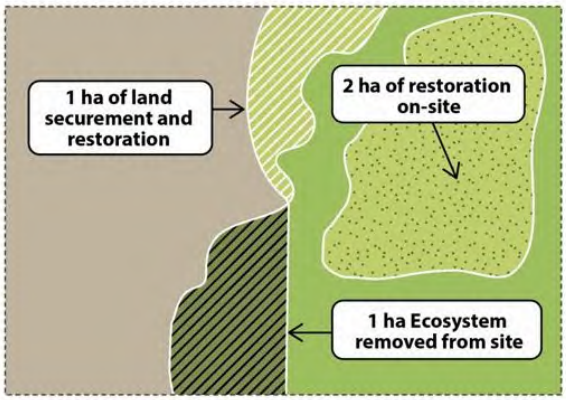
Simple examples are provided in this appendix that helps to illustrate the application of the offsetting approaches described within the Guideline. The examples are not meant to exclude other options of offsetting but to demonstrate some of the more common scenarios.

DESCRIPTION OF THE IMPACTED SITE AND ECOSYSTEM PROPOSED TO BE REMOVED





OPTION 1 - ON-SITE COMPENSATION



ECOSYSTEM STRUCTURE

Basal area of 15 m^2/ha equates to a replacement ratio of 1:3. Total size of ecosystem restoration required = 1 ha x 3 = 3 ha

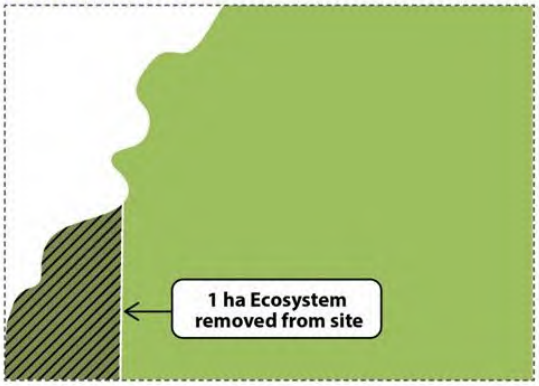
One hectare of restoration can occur on site within the area required to compensate for the lost land base. The remaining two hectares of restoration can occur within the potential restoration area on site.

LAND BASE

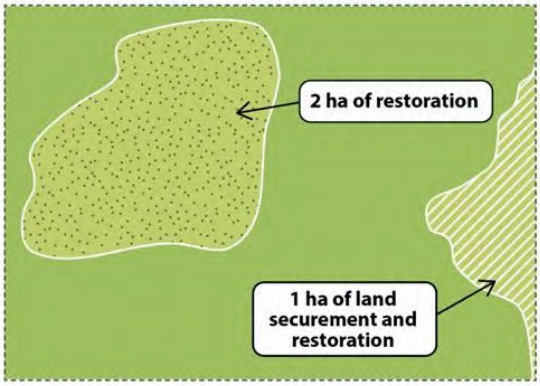
Ratio = 1:1 = one ha removed from the natural system = one hectare added back on the same site
(as illustrated in light green hatching)

OPTION 2 - OFF-SITE COMPENSATION WITH AGENCY-LED IMPLEMENTATION

DEVELOPMENT SITE



OFF-SITE LOCATION



ECOSYSTEM STRUCTURE

Basal area of 15 m^2/ha equates to a replacement ratio of 1:3. Total size of ecosystem restoration required = 1 ha x 3 = 3 ha. If cash-in-lieu option is being used, funds transferred to implementation agency depends on the cost to restore 3 ha of habitat. Cost to restore can be obtained on request.

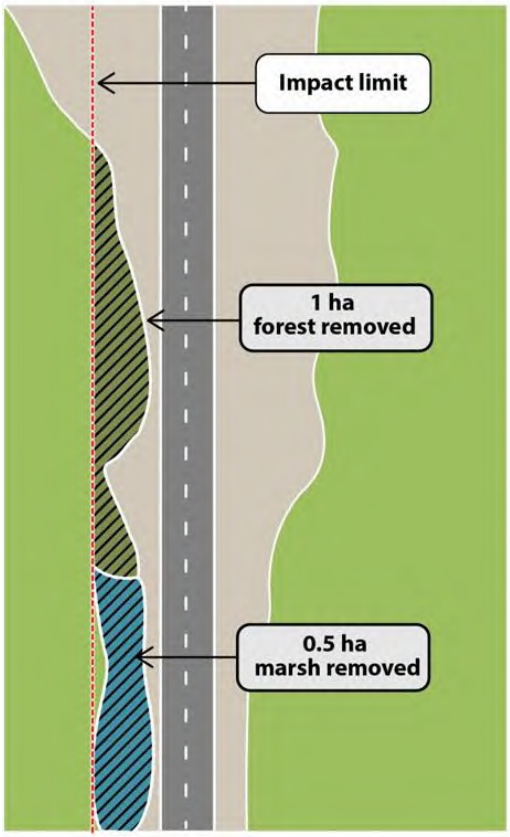
LAND BASE

Ratio = 1:1 = one ha removed from the natural system = one hectare added back off-site. If cash-in-lieu option is being used, land value of one ha determined using guidance from Section 2.2.

TOTAL COST UNDER CASH-IN-LIEU

The total funds to be transferred is the sum of the cost to restore three hectares of habitat and land value for one hectare of land.

MUNICIPAL INFRASTRUCTURE EXAMPLE



ECOSYSTEM REMOVED

Ecosystem type: Forest
Size of habitat: 1 hectare (ha)
Basal area: 15 m^2/hectare

Ecosystem type: Marsh
Size of habitat: 0.5 ha

ECOSYSTEM STRUCTURE

Forest
Assuming a forest basal area of 15 m2/ha, a 3ha:1ha replacement ratio is required. One ha of forest removed requires restoration of three ha.

Marsh
Marsh habitat is restored at a 1ha:1ha ratio. Therefore, 0.5 ha of marsh habitat must be restored to address the removal.

Restoration can occur on site to the extent possible with the remaining restoration being implemented elsewhere in proximity to the impact

LAND BASE

Land base compensation does not need to be addressed on an individual project basis. TRCA and the Municipality can track the land area removed from the natural system from all infrastructure projects and work together to explore avenues to off-set these losses through existing municipal land acquisition and ecological restoration programs or other means.

Appendix G: Method for Calculating the Volume of Downed Wood in Vegetation Communities

The purpose of this document is to provide a standardized approach to collecting Downed Woody Debris (DWD) data to support Ecosystem Offsetting.

Ecosystem offsetting is an approach to offset the adverse impacts of development on the natural heritage system through the creation or restoration of natural features. Offsetting should achieve a net gain in ecosystem function - or at least no net loss where a net gain is not feasible. As ecosystem offsetting strives to achieve an ecological (net) gain or no net loss, it is essential to have a detailed inventory of the natural area to be removed, including its features and associated functions.

Downed Woody Debris provides important ecosystem functions including water retention, nutrient cycling, soil development, carbon sequestration, erosion protection, nurse logs for young trees and important wildlife habitat for a wide range of flora and fauna (Bellhouse and Naylor 1996). Offsetting should account for the functions provided by DWD. For this method downed woody debris includes branches, portions of trees, and entire trees with a diameter greater than 7.5 centimetres (Bellhouse and Naylor 1996).

The protocols within this methodology are based on those established by Credit Valley Conservation's Integrated Watershed Monitoring Program (2018), the Ecological Monitoring and Assessment Network (Robert-Pichette and Gillespie, 1999; Sajan, 2000), those adapted from the USGS (Woodward et. al, 2009).

Equipment

Geographic Positioning System (GPS)
Compass
50-meter measuring tape
Tree callipers or diameter tape
Pigtails with flagging tape

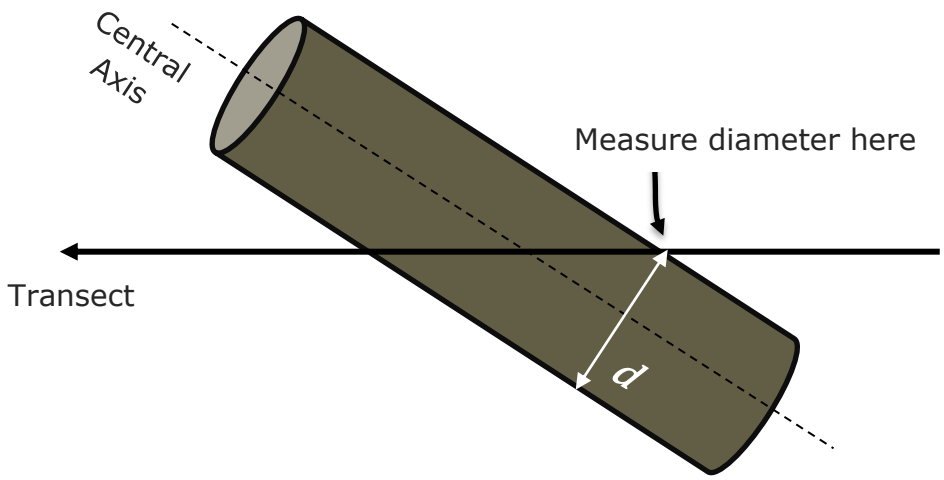
Method

This method should be applied separately to each vegetation community that is being proposed for removal and that is subject to offsetting requirements.

1. Select a representative point in the vegetation community and record the location using a GPS.
2. At that representative point, temporarily anchor the 50 m tape measure using a pigtail.
3. The surveyor runs the entire tape out in the direction of North, ensuring that the tape remains as straight as possible.

4. With the tape left laid out over the entire Downed Woody Debris transect, the surveyor begins walking along the length of the tape until the first piece of applicable downed wood is encountered. Table G-1 reviews the characteristics used to determine if a piece of downed wood is included in surveys.
5. Measure and record the diameter of the piece at the tape interaction point using callipers.

Figure G-1. Measuring the diameter of DWD along a transect.



6. If the transect crosses the end of a piece, tally only if the central axis of the log is crossed.
7. If the transect passes exactly through the end of a piece's central axis, tally every second such piece.
8. Continue along the length of the tape and repeat steps 5-7 for each additional piece encountered along the transect until the surveyor reaches the end of the transect at the 50-meter mark.
9. Repeat steps 2 through 8 along a transect that runs East from the established representative point. This method requires multiple transects to work per community being removed.

Table G-1: Characteristics used to determine if a piece of downed wood is included in surveys (Woodward et. al, 2009).

Characteristic or Situation	Include	Do Not Include
Diameter	7.5 cm or greater	< 7.5 cm
Living material	No	Yes
Roots	No	Yes
Detached bark	No	Yes
Dead stump	Fully uprooted	Fully or partially rooted
Leaning uprooted dead stem	Lean > 45 degrees from vertical	Lean ≤ 45 degrees from vertical
Supported on ground but elevated at tape intersection	The elevation height still allows for other downed wood measurements to be made accurately and safely	The elevation height does not allow for other downed wood measurements to be made accurately and safely
Submerged	Piece is not rooted and downed wood measurements can be made accurately and safely	Cannot determine if piece is rooted and/or downed wood measurements cannot be made accurately and safely

If a single piece of downed wood intersects a transect at more than one distance, treat each applicable stem or branch that crosses the tape as a separate piece of downed wood, regardless of whether or not an attached portion crosses the tape at another distance.

Calculating Volume

The volume (m^3) per hectare of DWD is based on the methods of Van Wagner (1968).

$$V = \frac{\pi^2 \Sigma d^2}{8L}$$

V is the volume of wood m^3/ha

d is piece diameter in centimetres

L is the length of the transect in meters

The results of this assessment provide a measurement of the volume of downed woody debris within a vegetation community. This volume measurement can be used to replicate the DWD functions for an offset project. Designers should incorporate an equal or greater amount of DWD into their offset design.

References:

Bellhouse, T. and B. Naylor. 1996. The Ecological Function of Down Woody Debris in the Forests of Central Ontario. Version 2.0 Ont. Min. Nat. Res., CRST Tech. Rpt. No 43, revised. 29pp.

Credit Valley Conservation. 2018. IWMP Reference Document: Volume 2 Data Standards and Information Management: Forest Downed Woody Debris Data Collection. Mississauga, Ontario.

Robert-Pichette, P., and L. Gillespie. 1999. Terrestrial vegetation biodiversity monitoring protocols. EMAN Occasional Paper Series, Report No. 9. Ecological Monitoring Coordinating Office, Burlington, Ontario. http://www.eman-rese.ca/eman/ecotools/protocols/terrestrial/vegetation/toc_section_3.html

Sajan, R. 2000. Community Based Tree Health Monitoring, Draft unpublished manuscript. Canadian Forest Service, Sault Ste Marie, Ontario.

Van Wagner, C.E. 1968. The Line Intersect Method in Forest Fuel Sampling. Forest Science. Vol. 14, No. 1, 1968.

Woodward, Andrea, K.M. Hutten, J.R. Boetsch, S.A. Acker, R.M. Rochefort, M.M. Bivin, and L.L. Kurth. 2009. Forest vegetation monitoring protocol for national parks in the North Coast and Cascades Network: U.S. Geological Survey Techniques and Methods 2-A8, 228 p.

Appendix H: Assessing Wildlife Habitat Features and Structures

Section 2.1 of the guideline requires the inventory and documentation of the ecological structure, composition and function of the natural feature/area being removed. Wildlife habitat features and structures are included in that requirement. Inventories of the natural features and areas being removed should document the types of wildlife habitat features and structures present and provide a characterization of each type of feature/structure. The characterization should note the feature/structure type, size, abundance, percent cover, and distribution pattern (e.g. localized or widespread). This information will be used to help design the offset project.

The following documents provide methods on identifying, inventorying and monitoring different types of wildlife habitat features and structures. These documents also offer information to be considered in the design of projects to offset the removal of wildlife habitat features and functions. In addition, these documents provide additional lists of references that may be applicable and useful.

Bird Studies Canada. 2009. Marsh Monitoring Program Participant's Handbook for Surveying Amphibians. 2009 Edition. 13 pp.

Commission for Environmental Cooperation (CEC). 2009. Monarch butterfly monitoring in North America: Overview of initiatives and protocols. Available online: http://www.mlmp.org/Resources/pdf/Monarch-Monitoring_en.pdf Accessed 25 February 2020

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Credit Valley Conservation
inspired by nature

Re: Addendum to the CVC Technical Guidelines for Floodproofing

Issue Date: November 12, 2020

This Addendum modifies the freeboard criteria provided in CVC's Technical Guidelines for Floodproofing and should be read in conjunction with the guideline.
The freeboard is used to compensate for unknown factors which could contribute to flood elevations greater than the estimated flood hazard. The Government of Canada recognizes integration of future climate conditions into floodplain using freeboard (NRC, 2019).

The climate change model results indicate that frequency of flooding is estimated to increase by three-fold. For example, an event with a current return period of 1:350 years will have a future return period of 1:100 years, and an event with a current return period of 1:100 years will have a future return period of 1:30 years (Institute for Catastrophic Loss Reduction (ICLR) based at Western University).

At this time CVC is waiting for Provincial direction on how climate change should be accounted for in flood hazard mapping. In the interim, we rely on federal guidance that recommends adding a freeboard to flood elevations in order to account for uncertainty with respect to the ultimate impact of climate change. Once the Provincial guidelines are updated and approved, CVC will review our approach to flood hazard mapping from a climate change perspective.

In the interim, CVC's Board of Directors (meeting date: June 12, 2020) approved the following changes to the freeboard criteria in CVC's Technical Guidelines for Floodproofing to address climate change:

- Where the Regional flood event is used for generating the flood hazard, no change to the existing freeboard criteria of 0.3 metres is proposed.
- Where the 1:100-year flood event is used for generating the flood hazard, CVC will require building openings located within the floodplain to be 0.3 to 0.6 metres above the regulatory flood elevation. The actual required freeboard value will depend on local considerations such as site constraints, the projected future flood elevations and the consequence of the increase. Consultation with CVC's technical staff is encouraged at the project outset to confirm site specific requirements.

Reference:

NRC, 2019. Federal Hydrologic and Hydraulic Procedures for Flood hazard Delineation, Version 1.0, 2019. Natural Resources Canada General Information Product 113e.

CREDIT VALLEY CONSERVATION
TECHNICAL GUIDELINES FOR FLOODPROOFING

1) INTRODUCTION

Floodproofing incorporates the use of designed structural treatments to render structures flood free, impervious and/or immovable. Dry, passive floodproofing to the level of the Regulatory Flood is the preferred approach and shall be given primary consideration for all new construction (CVCA 1990). Ancillary structures such as garages and sheds (usually without basements) are wet-floodproofed to allow free flow and equalized pressure of water through the structure, while also being rendered immovable. Designing floodproofing for a given structure must consider the hydrotechnical effects of the flood. The *Flood Plain Planning Policy Statement Implementation Guidelines*, July 1986 and the *Credit Valley Conservation Authority Policies for Floodproofing of Buildings and Structures*, June 1990, have established threshold criteria for velocity and depth of flooding. Dry-floodproofing is acceptable up to a maximum velocity of 1.7m/sec. and a flood depth from existing grade of 0.8m plus a 0.3m contingency freeboard. These criteria are implemented as upper limits to which flood damages can be acceptably reduced within feasible economic limits. Above and beyond these limits it is argued that uncertainty replaces effectiveness in the design of floodproofing. There are no explicit policy criteria for wet-floodproofing but the above noted figures are reasonable benchmarks.

2) HYDROTECHNICAL DESIGN CONSIDERATIONS

The following phenomena occur during flooding:

- Hydrostatic pressure
- Velocity - Hydrodynamic load
- Velocity - Shear stress
- Frequency of flooding
- Duration of flooding
- Ice jamming effects

Hydrostatic pressure is the single most important consideration in floodproofing design. Hydrostatic pressure is directly correlated with flood depth and saturated soil depth in contact with a structure. Hydrostatic pressure is equal in all directions and acts perpendicular to a given surface. It can be further defined into vertical or down, horizontal or lateral, and uplift or buoyant pressures. The imposition of an enclosed structure in flood waters (including basements below saturated grade) unbalances localized hydrostatic pressures. The tendency of lateral pressure is to overturn, shear, or displace an enclosed structure or vertical elements thereof. The tendency of buoyant pressure is to differentially heave, rupture, or float an enclosed structure or horizontal elements thereof.

For conservative design purposes a fully saturated soil profile, irrespective of soil type, should be assumed to exist at the time of flooding. Hydrostatic pressures should as a result be considered both above and below grade. Below grade hydrostatic pressure is determined by isolating the volume of available water from the volume of soil. In addition, standard foundation design considers lateral earth pressures. For floodproofing, lateral earth pressure should be considered using the submerged unit weight of soil. Total pressure below

grade will be a combination of the above considerations.

Saturated subgrade and the bearing capacity (compressive strength) and settlement failure potential in various soil types must also be clearly considered. Note that bearing and settlement design must also respect the extra load induced by the monolithic nature of reinforced foundation walls and floor slabs, that are a design response to the hydrostatic pressures.

Hydrodynamic load is a manifestation of the pressure moment induced on an object by the depth of flood waters in 'motion'. This can also apply below grade if significant piping of water exists. It is assumed, however, that under fully saturated soil conditions subsurface movement is nominal. The dynamic effect of water in motion can be converted into a correspondent hydrostatic pressure but within the allowable velocity range defined by policy the additional pressure due to hydrodynamic load is minor and further consideration is unwarranted.

Sheer stress is a manifestation of the tractive or constant force required to move an object and keep it in motion. It is a commonly analyzed variable in watercourse erosion study and applies to floodproofing consideration from the perspective of potential scour damage around a structure triggering structural failure. It is a function of water depth, slope and resultant velocity. It is sufficient to say that fill pads, berms, and floodwalls must be designed to be erosion resistant under identified velocities.

Frequency of flooding is a reflection of the observed or statistical recurrence interval of various stages of flooding. Headwater areas, smaller watersheds, and urbanized watersheds may produce a larger peak flow in response to the rainfall distribution of a 1:100 year storm compared to the peak generated from a Regional Storm. Downstream in a major system such as the Credit River the Regional Storm peak will supersede the 1:100 year. Flood susceptible areas under worse case peak flow scenarios (or in other words the Regulatory Flood) will have different recurrence probabilities. It is assumed that no explicit floodproofing design modifications can be made for the above considerations.

Duration of flooding is the result of a complex interaction between runoff response, channel conveyance and storage. Runoff volumes, peak flows, and channel hydraulics can be either calculated or derived from a combination of empirical and gauged data. Generally, the higher the rainfall intensity, and the shorter the catchment length, the quicker the response or rise in flood waters. The change in rainfall intensity over time and the downstream tributary inputs then influence the duration of inundation and recession of the hydrograph. It is assumed that detailed analysis of flooding duration is not a practical requirement that can be incorporated into floodproofing design criteria.

Ice Jam effects are local or reach specific influences creating backwater impoundment and downstream surges upon break-up. Generally, ice jamming is only a significant concern on the main branch, of the Credit downstream of Cataract ie. below the 'Forks'. There is no known quantitative way to analyze the specific hydraulic effects or statistical frequency of ice jamming in correlation to the Regulatory flood or any lesser flood stage. It is assumed that detailed analysis of ice jam effects is not a practical design consideration.

3) DRY-FLOODPROOFING

3.1 STRUCTURAL

Standard wall construction such as siding on frame, brick veneer on frame, solid brick, and concrete block, provides inferior defence against flooding. Standard techniques are extremely susceptible to leakage damage, hydrostatic pressures, and consequential structural failure.

The most common structural approach to dry-floodproofing a building involves waterproofed monolithic foundation walls i.e. reinforced and extended above grade, reinforced gravity slab basement floors, or slab-on-grade with no basement, and some consideration for subsurface drainage. Floodproofing treatment should respect the structural requirements of the Ontario Building Code 1990, the National Building Code, and the National Standard for Masonry Design (C.S.A. CAN3-S304-M84) as applicable.

The tensile strength of standard masonry block basement walls 8”-10” thick is limited against lateral hydrostatic pressures. The use of cast in place concrete and/or high slump grouting of masonry blocks combined with steel bar grid reinforcement is a traditional consideration to support extra vertical load, and for horizontal temperature and shrinkage control. This style of reinforcement has been translated to floodproofing design. Likewise, the thickening and reinforcement of basement floors has been a simple extension of ‘bigger is stronger’ thinking for floodproofing against buoyant pressures. Reinforced walls must be securely anchored to both the basement floor, typically by cast in place re-bar, and the first floor sill plate, typically by anchor bolts. The first floor header joist should be mechanically anchored to the sill plate or alternatively the first floor joists can be embedded in concrete if a cast foundation wall is used. The use of pilaster wall support for long spans and the use of intermediate structural walls and/or steel post tensioning to transfer loads are additional sound ideas, that have not seen wide use however.

Reinforcement can also be addressed by pressure relief through subdrainage. There are two schools of thought on this subject. The first is to use clay surface caps and/or clay backfill around the foundation to prevent or slow infiltration of rain and/or the capillary rise of groundwater. In a sense this represents the use of relatively impervious soil to 'fatten' the foundation. The argument against clay backfill is that depending on the actual soil grain size and shape some clays are plastic and expansive, meaning that they actually absorb water and swell thus adding to or maintaining the hydrostatic pressure against the wall. Clay backfill can only be used if good quality control exists and if appropriate waterproofing of the foundation is used.

The second and more widely accepted concept is to incorporate a subdrain system with mechanical pumping to alleviate pressure (also to lessen potential frost effects as in a typical gravity subdrain system). The sump system should collect water from free draining backfill along the walls and tinder the slab using perforated pipe surrounding the footings. An automatic submersible pump should be placed in a covered sump pit. The basement floor should have a positive slope to a floor drain connected to the sump pit. The pump can be sized to have adequate capacity in balance with the inflow of water. A flow net analysis will help determine

the pumping rate. A continuous source of power and separated operating switch is required for the pump and should be located above the contingency freeboard above the flood elevation. Gravity draining sump systems are often not feasible under flood conditions. Municipal services do not generally exist in rural flood damage areas and as a result a free draining outlet would likely be in the flood plain downslope towards the watercourse. In addition, gravity systems may not be able to discharge water as fast as it inflows. The pumped system should have an outflow pipe located to discharge above the flood elevation or can be connected to municipal storm sewers if a backwater valve is installed in the service connection at the lot line (if allowed by municipal standards).

Foundations should be waterproofed to the flood elevation with an appropriate 'flexible' coating i.e. gap and crack filling synthetic or asphaltic hardening liquid. Geotechnical membrane coatings for waterproofing have also been used but they require high quality placement for a good seal and are susceptible to damage upon backfilling. Uncoated cast in place concrete can be considered waterproofed if certain admixtures or treatments have been included and if watertight expansion joints are used.

The final structural consideration for dry-floodproofing is the use of watertight seals and closures on doors and windows located below the flood elevation. These options are considered active approaches in that they require human intervention at the time of the flood to ensure closure. These treatments do not have a proven record even at less than worse case scenario flooding due to failure under hydrostatic pressure and incomplete seals from negligent maintenance or poor product quality. They are generally not considered acceptable for dry-floodproofing and therefore no openings are allowed below upper threshold policy criteria.

3.2 COLUMNS AND EXTENDED FOUNDATION

Construction on columns (posts, piers, piles) is a consideration for basement free lightly loaded frame structures such as cottages. Heavier load structures such as 1 or 2 story dwellings without basements are more appropriately built on extended foundation walls that create a crawl space. Columns and crawl space foundations are useful on moderately sloping land where a slab-on-grade floor cannot be conveniently located. Column and extended foundation construction cannot be subject to depths and velocity higher than policy criteria. Analysis of hydrostatic pressures cannot be effectively undertaken for columns and/or crawl space foundations and associated footings. There is relatively little water displaced by a column array or flooded crawl space and as a result the free movement of water around respective structural elements equalizes pressures. Buoyant pressures acting on large spread footings may be the only design calculation that can be done.

General principles to be followed for column construction include using only concrete for below grade components and backfilling with compacted free draining material. Lateral knee or cross-bracing between columns and anchoring the column securely to the footing and floor construction adds stability in the face of uncertain hydrostatic effects. The disturbed ground surface around each column should be stabilized for potential scour at flood velocities.

Extended foundation walls must be wet-floodproofed as per the appropriate details in section 4) WET-FLOODPROOFNG.

3.3 FILL PADS

Fill pads are used to raise grades to flood free construction elevations or to at least lower the potential depth of flooding against a proposed structure. Fill pads must be built with appropriate compaction, drainage, side slope stability, and erosion protection. A fill pad does not necessarily require an impervious core. Fill pads cannot be built higher than 1.1m above existing grade i.e. 0.8 m flood depth + 0.3 m freeboard as per policy. Fill pads are not appropriate over deep organic soils. Shallow organic soils can be removed to achieve a sound foundation for a fill pad. It is assumed that hydrostatic pressures are in equilibrium with saturated earth pressures around a fill pad.

Fill pads should be built using well drained clean material compacted for integrity and stability. Existing vegetation and topsoil should be scraped and dry fills should be placed in 0.3m lifts. Compaction to 95% Standard Proctor Density, as per standard practice, is required. Side slopes should be built to 3:1 (h:v) or flatter unless specified differently by the engineer. Well graded sand and gravel with a small fraction of clay (granular 'B') is considered most appropriate for compaction while topsoil coverage should achieve final grades. Fill pads should be planted and rehabilitated with seed/sod and/or native vegetation as appropriate. Only at velocities higher than 1 m/sec should erosion protection of the wet face of a fill pad be considered, with vegetative bioengineered options taking precedence.

3.4 BERMS AND WALLS

Berms and walls are essentially freestanding impervious dams used to hold back or divert flood waters. They differ from fill pads in that hydrostatic pressure will act on the wet face, and potentially on wall foundations, due to the artificially created dry side. They can be used independently or in association, e.g. a berm (with impervious core), a wall, or a berm graded up to a wall. Berms and walls are structures by definition and cannot be subject to flooding greater than policy criteria. Special consideration for drainage on the dry side must be made.

Floodproofing berms can be made impervious by compaction of non-swelling, non-plastic cohesive clayfills. It is usually appropriate to use cohesive and relatively impervious till in the berm core which can be keyed into a deeper excavation to improve the cut-off effect. Surrounding fill quality and placement should follow the guidelines noted for fill pads.

Floodproofing walls must respect the same structural considerations as reinforced foundation walls described for dry-floodproofing, e.g. cast in place concrete or grouted and reinforced masonry block. Design variations from standard gravity wall construction can include cantilevered or expanded spread footings, and tapered or flared wall faces to enhance integrity. The use of precast interlocking 'designer' block walls or armourstone walls can only be considered in combination with impervious fill bermed on the flood side.

Subdrainage and local surface drainage must be considered for berm and wall construction. Conventional subdrains will be inundated during flooding. A sump pit constructed behind a flood wall with either conventional piping or filter/blanket drain ditches would require water to be mechanically pumped away. A deep cut-off wall e.g. sheet pile, sunk below either a berm or wall is an option to help block subsurface water. If a berm or wall will have the effect of ponding surface drainage on the flood free side the sump pit may be enlarged appropriately or grading changes to divert runoff may be made. Flap gates installed on surface drainage pipes put through a berm or wall tend to leak and fail when inundated under flood conditions and are not recommended.

4) WET-FLOODPROOFING

Wet-floodproofing allows water to enter, move within, and exit a structure to prevent differential hydrostatic pressures (lateral and buoyant). Wet-floodproofing is generally only acceptable for non-habitable structures such as garages and sheds. As noted earlier, the hydrodynamic load of flood waters in motion is minimal within policy criteria. As a result, detailed structural treatments designed to transfer the hydrodynamic load of water within a structure to a foundation are not required. Conversely, when a structure is inundated the buoyant hydrostatic pressure is in balance with the vertical or down pressure. Standard construction practice of anchor bolt attachment between wall sills and foundations is adequate. It should be noted, however, that quickly peaking flood waters can rise against a structure faster than the rate of inundation.

A temporary imbalance in hydrostatic pressure may lift or heave light load frame structures such as sheds. This can be overcome by building a concrete slab foundation (instead of wood) with standard anchoring or by sinking foundation posts below grade, e.g. ‘sonotubes’, with standard anchoring. Irregardless of the type of wet-floodproofed structure, every attempt to orient a principal opening to the direction of the flood, to prevent differential change in water levels inside and out, should be made. In turn there should be ideally a second opening opposite to the principal opening to allow flow through of flood water. Openings do not necessarily need to be of equal size.

Building materials subject to water damage, e.g. drywall, panelling, insulation, should not be used within wet-floodproofed structures. Walls should be unfinished concrete or wood. Concrete block walls should be filled with grout to prevent air pockets and ingress of water. Wet-floodproofed structures should not be serviced with anything more than electricity, meeting the specific requirements noted in the following section.

5) ADDITIONAL DESIGN CONSIDERATIONS

A complete analysis of flood conditions must also consider the following points, as appropriate:

- hydraulic grade of existing municipal sewers and the potential to back-up to foundations and basements
- potential for impact to and back-up of private septic systems
- affects to private wells

- maintaining internal building services such as central heating, gas, electricity, water, and telephone
- site design to limit flood 'exposure'

Check valves or gate valves are options that prevent pressure siphoning of piped sewer flows from reaching private homes.

Septic systems may be subject to lateral and buoyant pressures and may be damaged in a flood. A watertight cap be used to prevent ingress of flood waters to the main tank and appropriate valves can be used to prevent back-up into a structure.

Drilled well casings can be extended to a height above the flood.

Incoming electricity and telephone lines can generally be located above the flood elevation. Electrical control panels, wiring, and outlets must always be above the flood and freeboard elevation. No electrical equipment or appliances should be below the flood elevation except a submersible sump pump with protected wiring. Underground gas and water lines can be served by check valves for closure. If these services enter the structure below the flood elevation a protected waterproof utility shaft can be designed to convey them above the flood. Note that the above considerations are contingencies against leakage and failure of dry-floodproofing treatments that would result in basement flooding.

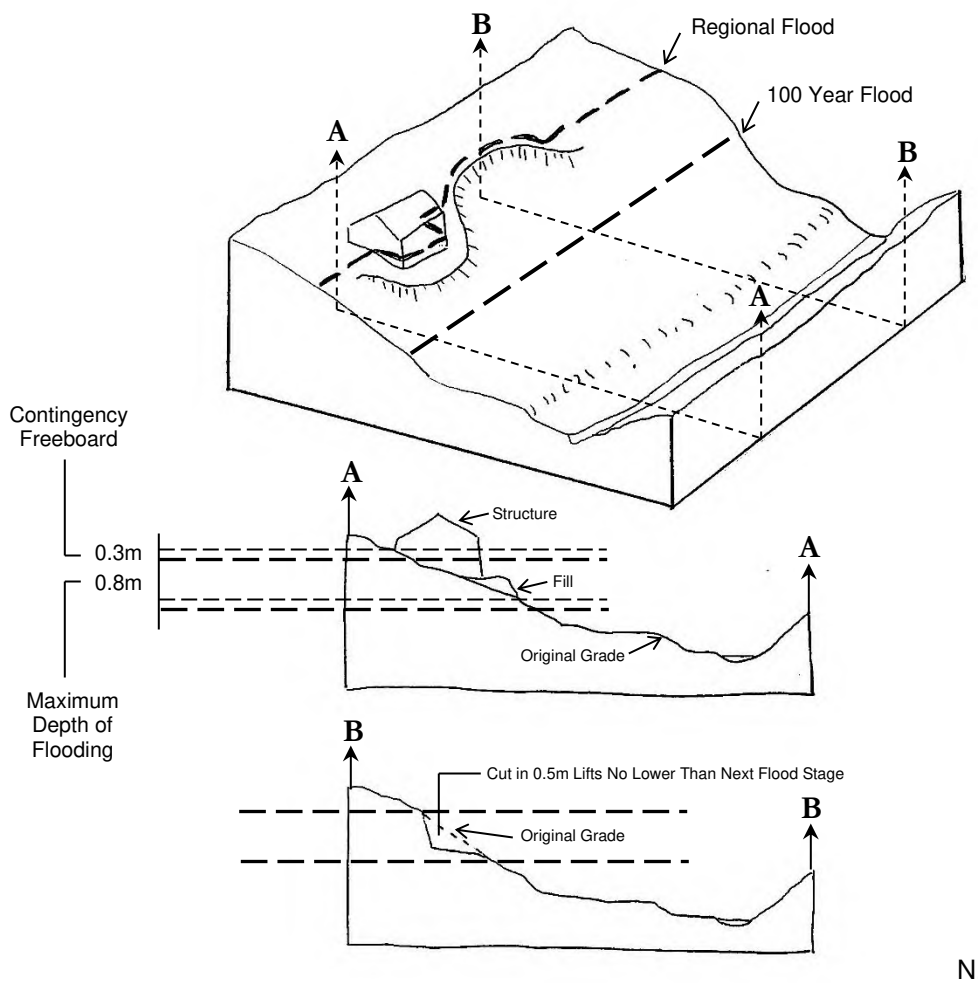
Site design considerations for new construction include orienting and designing a structure so that it presents as small a face as possible to the flood. Deflector berms or planting vegetation to redirect major flows and/or potential debris can also be considered. However, no adverse impact to neighbouring properties or flood plain storage will be allowed.

6) FLOOD PLAIN ALTERATION

Construction and fill placement in the flood plain might have the affect of altering the hydraulic parameters of storage, conveyance, and water level.

Loss of flood plain storage is not acceptable. It is required that a balanced cut be undertaken to offset fill volume and/or and increase in structural intrusion. The cut and fill must occur at essentially equal elevations. The balanced cut must be in lifts of no more than 0.5m equaling the fill/structural volume per lift. The cut can only cross the elevation of lower design flood stages, i.e. 100 yr., 50 yr., 25 yr., 10 yr., 5 yr., 2 yr., if the fill/structural loss of storage falls below these stages. The cut cannot go lower than the next lowest flood stage below these stages. The cut cannot go lower than the next lowest flood stage below the lowest point of intrusion. No alteration as low as the bankfull channel is allowed. See Figure 1 for an example application. An unbalanced cut and fill. i.e. net fill, may have the effect of increasing local flood plain reach water levels and will contribute to cumulative loss of storage and conveyance change throughout the flood plain system.

Figure 1: Cut & Fill



Even if a balanced cut can be achieved it is not acceptable to alter the cross-section of the flood plain such that conveyance is changed by a pinching or deepened channelization affect. This might result in increased downstream velocity and/or water levels and may increase upstream backwater levels, with adverse effects on neighbouring properties. Generally, the cut must occur on the same side of the flood plain in close proximity to the fill/intrusion to limit the change in cross-section.

Hydraulic modelling study (e.g. HEC 2) will not be acceptable to support significant flood plain alterations involving cut and fill volumes equal to or greater than hundreds of cubic metres. Balanced cut and fills are

restricted to relatively small sites and small fill volumes. Relatively small net fill volumes will only be acceptable at the discretion of the Authority if overriding hydraulic conditions exist in the flood plain. Hydraulic modelling may be required to determine if overriding local conditions exist.

Flood plain alteration guidelines do not supersede or replace the current version of the C.V.C.A. Watercourse and Valleyland Protection Policies and requirements thereof.

7) SUBMISSION REQUIREMENTS

The submission package must include the following engineering/architectural plans:

- Site Plan & Grading Sections with existing and proposed geodetic elevations confirmed by an 0.L.S. or P. Eng.
- Foundation Sections
- Building Elevations
- Site Servicing

showing floodproofing details

The submission drawings must clearly quote the flood depth and velocity criteria, thus acknowledging that the design addresses the relative severity of the flood. It is also recommended that the submission package include the following:

- Soils Report
- Hydrostatic Pressure calculations
- Bearing Capacity calculations

Specific submission packages will require the following:

- Cut and Fill volume calculations
- Hydraulic Modelling HEC 2 Report including discussion, summary tables, mapping, and hard copy of all input and output data

All plans and supporting reports/correspondence must be stamped and signed by the design engineer.

8) CONCLUSIONS

Floodproofing design must respect many variables including a degree of uncertainty. Existing floodproofed structures have not been widely 'field tested' under worse case scenario flooding. Observations from significant post flood events also suggest that phenomena such as surge waves, uneven forces in eddies, backwaters, and secondary flow channels, erosion scour, and debris or ice load impact, are factors with poorly predictable qualities.

Short of not building in the flood plain at all, the safest forms of construction will be those that eliminate

the ingress of water and limit the adverse effect of hydrostatic pressures. It has been argued that the economy of scale dictates what can be reasonably achieved in structural treatment for floodproofing. Compromises in structures may be a design decision. For example, eliminating basements is a clear way to reduce the effect of hydrostatic pressure and simplify design. This document does not attempt to support or discount any specific opinion. The intent of this document is to give guidance towards the significant factors of design.

Floodproofing is a viable component of overall flood plain management. These guidelines meet the need to improve the consistency and reliability of implementation.

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SLOPE STABILITY DEFINITION & DETERMINATION GUIDELINE

LONG TERM STABLE SLOPE LINE: consists of the **Stability Component** and the **Erosion Component**

STABILITY COMPONENT

Definition: The setback gradient line measured from the toe of the slope, or channel assuming the location of the toe remains fixed with time. (See Figures 1, 3 and 4b and 4c).

Factors for Consideration:

- soil strength
- groundwater conditions
- slope geometry
- condition of vegetation
- changing load conditions
- weathering of slope face
- increases in surface runoff over slope

Method of Calculation:

- There are three methods of establishing this component. Each method is progressively more involved as indicated in Figure 2.

Factor of Safety:

- Minimum Factor of safety of 1.5 is required.

EROSION COMPONENT

Definition: The regression of the slope toe/channel bank due to erosion over the design life of the structure at the crest of the slope and is measured as a horizontal distance. (See Figures 1, 4b, and 4c).

Factors for Consideration:

- proximity of the slope toe to the watercourse
- average and peak flow rates and velocities of the watercourse
- susceptibility of the soils to erosion
- type and extent of vegetation
- sediment load carried by the watercourse
- fluvial geomorphological processes affecting the reach within which the site is located.
- increases in surface runoff over slope
- weathering of slope face

Method of Calculation:

- As outlined in Figure 4a, the distance from the toe of the valley wall to the watercourse channel bank as well as the design erosion allowance must be determined. The erosion is measured horizontally from the top of the channel bank or the location of the bankfull flow, whichever is lower in elevation (Figure 4c).

DEVELOPMENT SETBACK COMPONENT

Definition: A minimum allowance from the identified slope hazard area to take into account external conditions which could have an adverse effect on the existing natural conditions of the slope. This setback distance maybe superseded by more stringent municipal or provincial requirements. For minimum allowance refer to CVC's Watershed Planning and Regulation Policies (2010).

Factors for Consideration:

- provide an access point along the crest of the slope
- keep heavy equipment away from the slope
- allow for the redirection of surface flows away form the slope hazard area
- allow for the placement of sediment control measures and limit of working easement if necessary.
- provide tableland area for potential future revegetation and/or reforestation (e.g. Credit Valley Conservation Authority planting programme)

Method of Calculation:

- Measured as the horizontal distance from the approved top of bank or from the combined distance derived from the Stability and Erosion Components whichever is the greater. (see Figure 1).

SLOPE STABILITY DEFINITION & DETERMINATION GUIDELINE

Figure 1. Typical Valley Wall Slopes

FIGURE 1a: STABLE WELL VEGETATED VALLEY WALL SLOPE WITH WIDE FLOODPLAIN OR EROSION PROTECTION

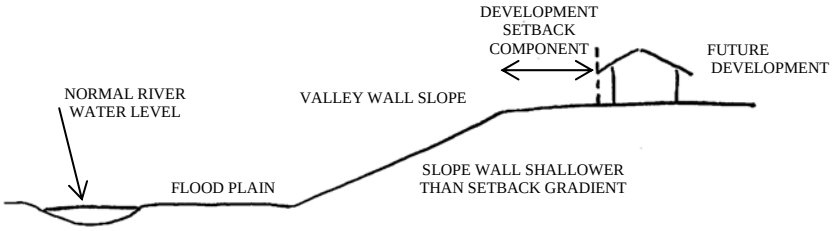


FIGURE 1b: OVERSTEEPENED VALLEY WALL SLOPE WITH WIDE FLOOD PLAIN OR EROSION PROTECTION

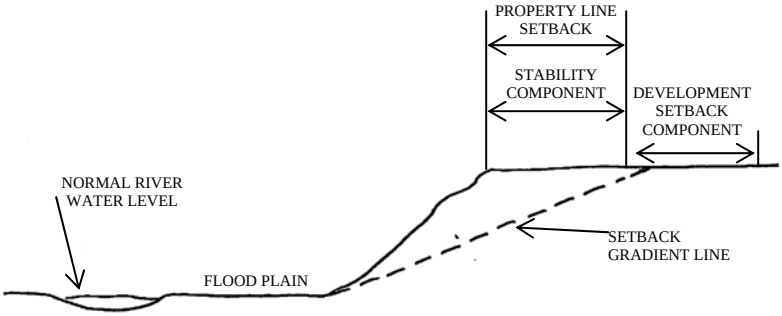
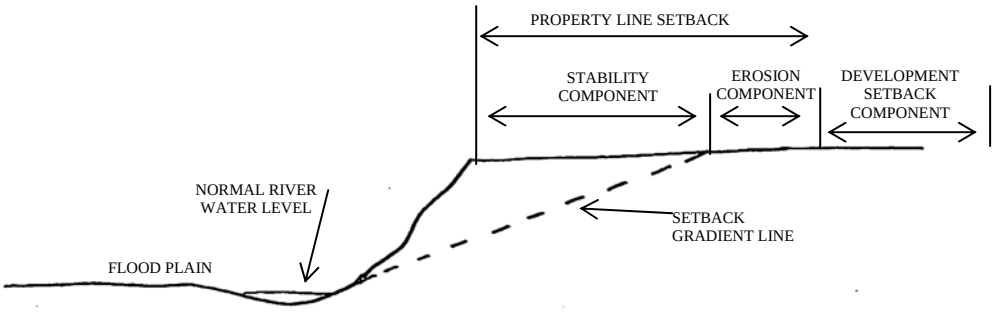


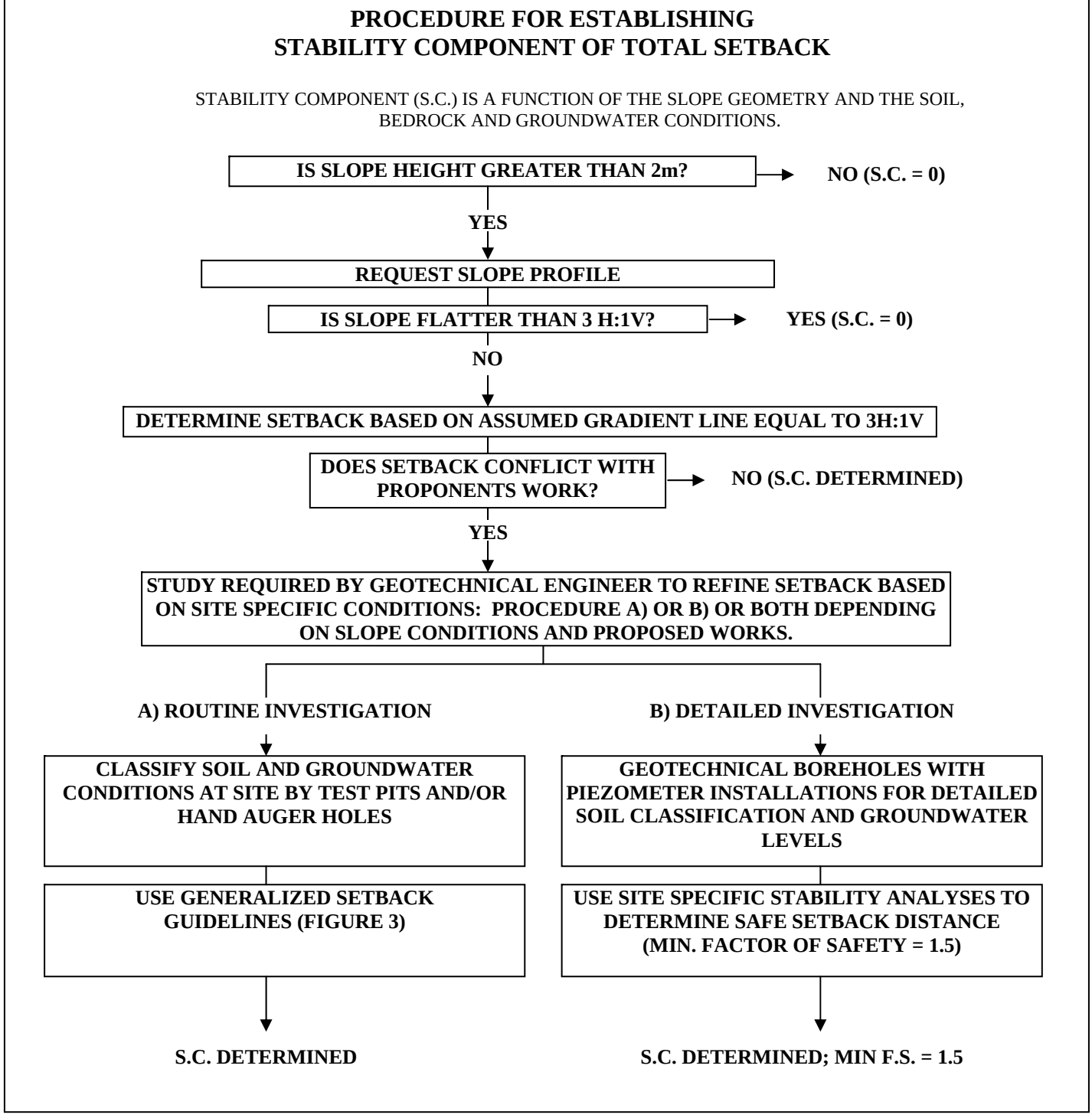
FIGURE 1c: OVERSTEEPENED VALLEY WALL SLOPE SUBJECT TO TOE EROSION



N.T.S.

SLOPE STABILITY DEFINITION & DETERMINATION GUIDELINE

Figure 2. Stability Component Determination

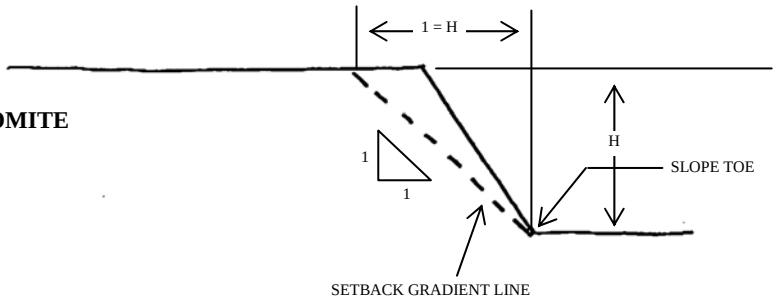


SLOPE STABILITY DEFINITION & DETERMINATION GUIDELINE

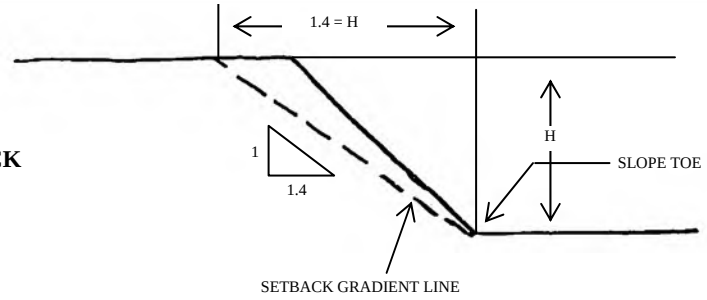
Figure 3. Generalized Stability Setback Guidelines

GUIDELINES FOR ESTABLISHING STABILITY COMPONENT OF TOTAL SETBACK FOR TYPICAL BEDROCK / SOIL CLASSIFICATIONS WITHIN THE CREDIT RIVER WATERSHED

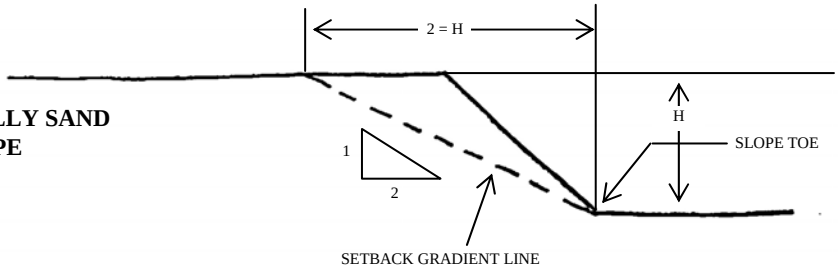
LIMESTONE / DOLOMITE BEDROCK



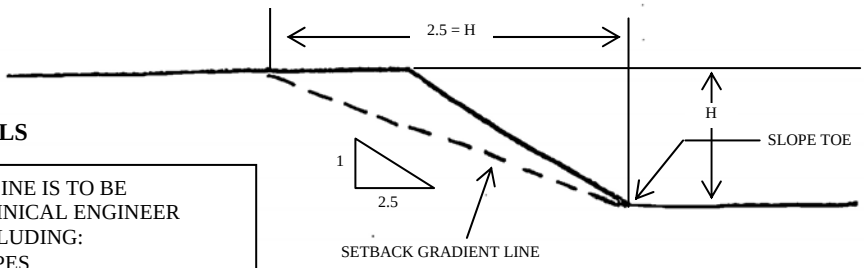
SHALE BEDROCK



SAND AND GRAVELLY SAND "DRY" SLOPE



CLAY TILLS



THE SETBACK GRADIENT LINE IS TO BE DETERMINED BY GEOTECHNICAL ENGINEER FOR ALL OTHER SOILS INCLUDING:

- CLAY (NON TILL) SLOPES
- SAND SLOPES WITH WATER SEEPAGE
- FILL SLOPES

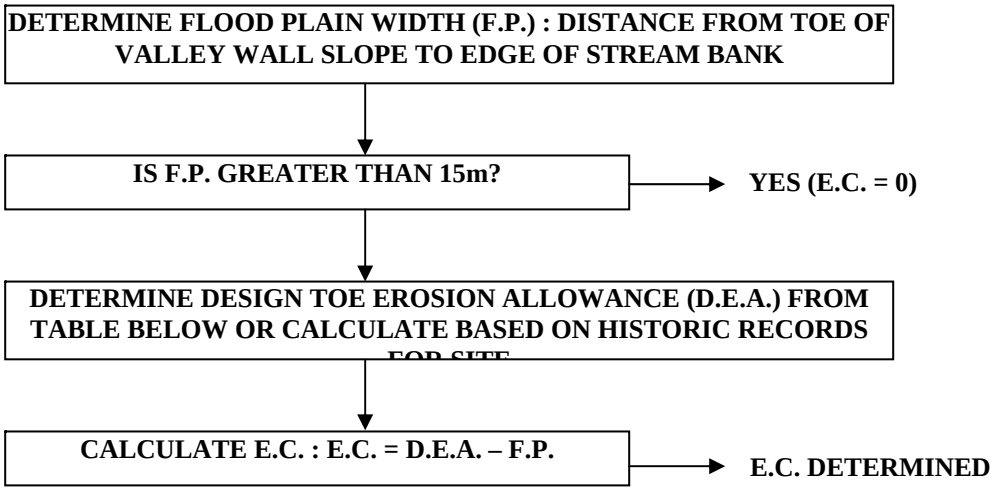
N.T.S.

SLOPE STABILITY DEFINITION & DETERMINATION GUIDELINE

Figure 4a. Erosion Component Determination

PROCEDURE FOR ESTABLISHING EROSION COMPONENT OF TOTAL SETBACK

EROSION COMPONENT (E.C.) IS A FUNCTION OF THE RATE OF EROSION OF THE STREAM BANK OR VALLEY WALL SLOPE.



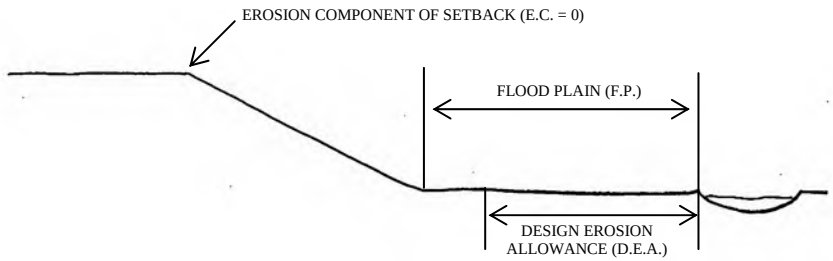
Notes: - E.C. cannot be less than zero
- if F.P. is greater than D.E.A. then E.C. = 0

SUGGESTED DESIGN TOE EROSION ALLOWANCE

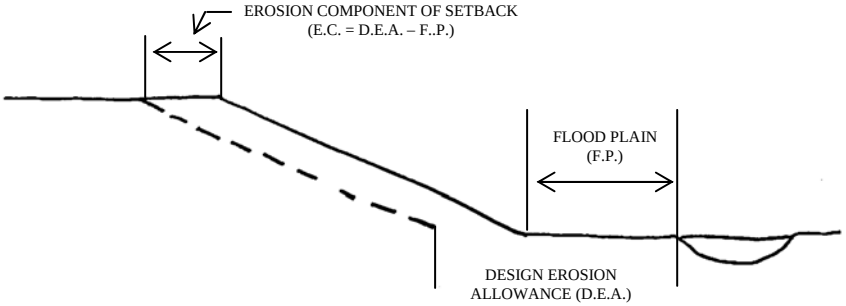
BANK CONDITION / MATERIAL AT CHANNEL BANK OR BANK FULL	ACTIVE EROSION OF BANK	EROSION CURRENTLY NOT EVIDENT	EXISTING EROSION PROTECTION IN PLACE AND MAINTAINED ALONG BANK
LIMESTONE DOLOSTONE	2m	1m	0
SHALE	5m	2m	0
COHESIVE SOILS; SILTY CLAYS, CLAYEY SILTS	8m	4m	0
COHESIONLESS SOILS; SILTS, SANDS	15m	7m	0

Figure 4b. Calculation of Erosion Component of Total Setback with Defined Valley Slope

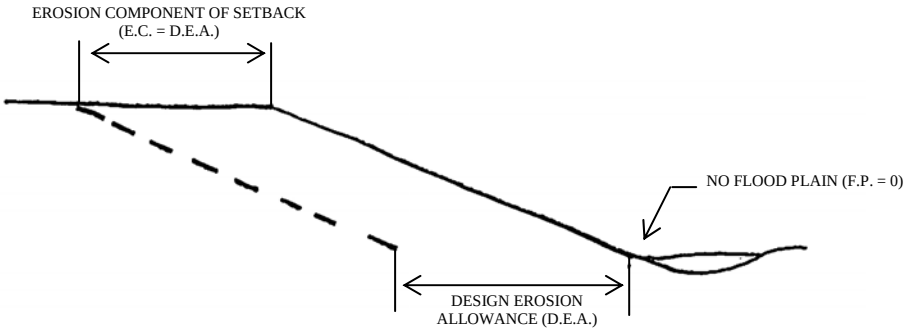
(A) FLOOD PLAIN WIDTH GREATER THAN DESIGN EROSION ALLOWANCE



(B) FLOOD PLAIN WIDTH LESS THAN DESIGN EROSION ALLOWANCE



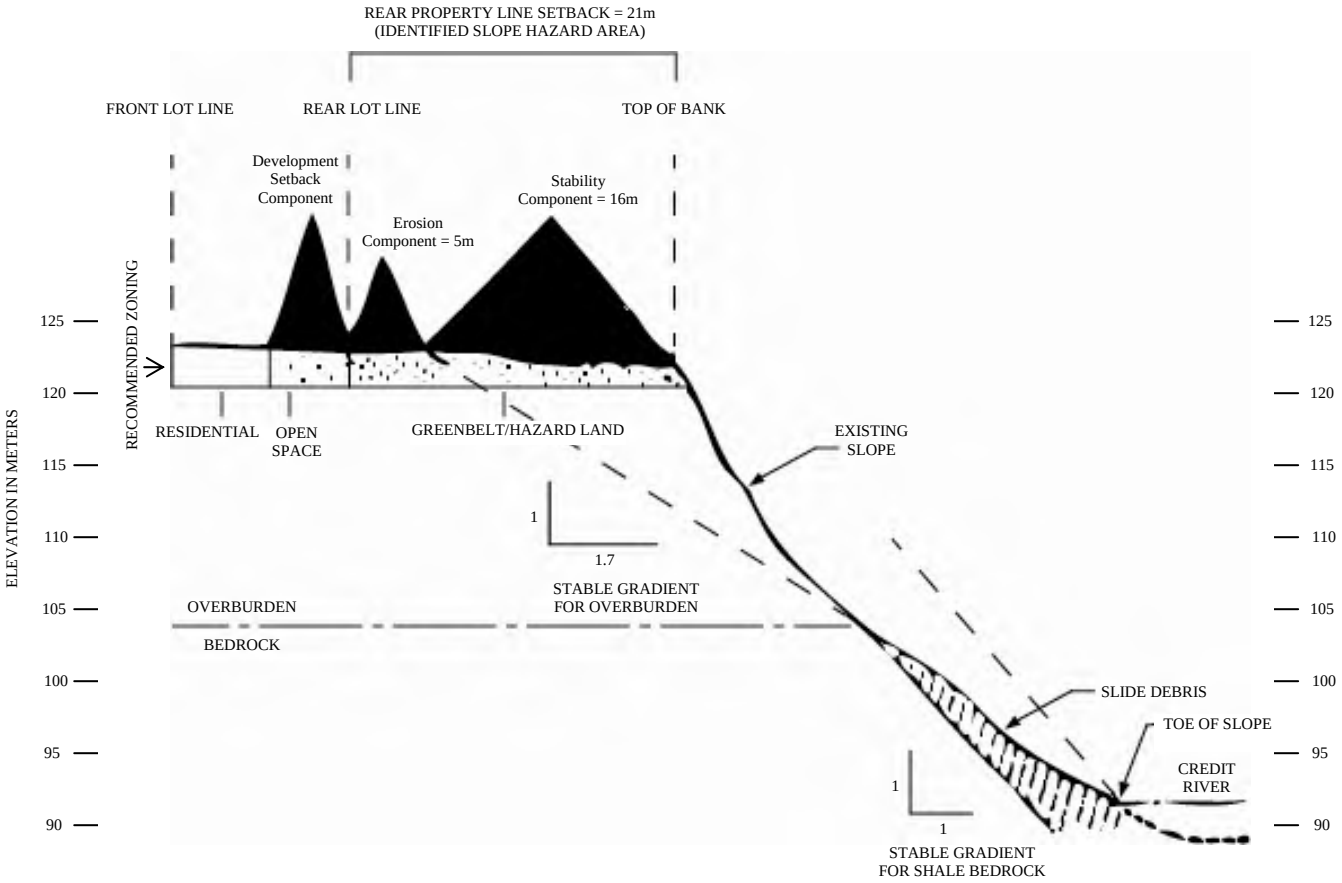
(C) NO FLOOD PLAIN AT THE TOE OF SLOPE



N.T.S.

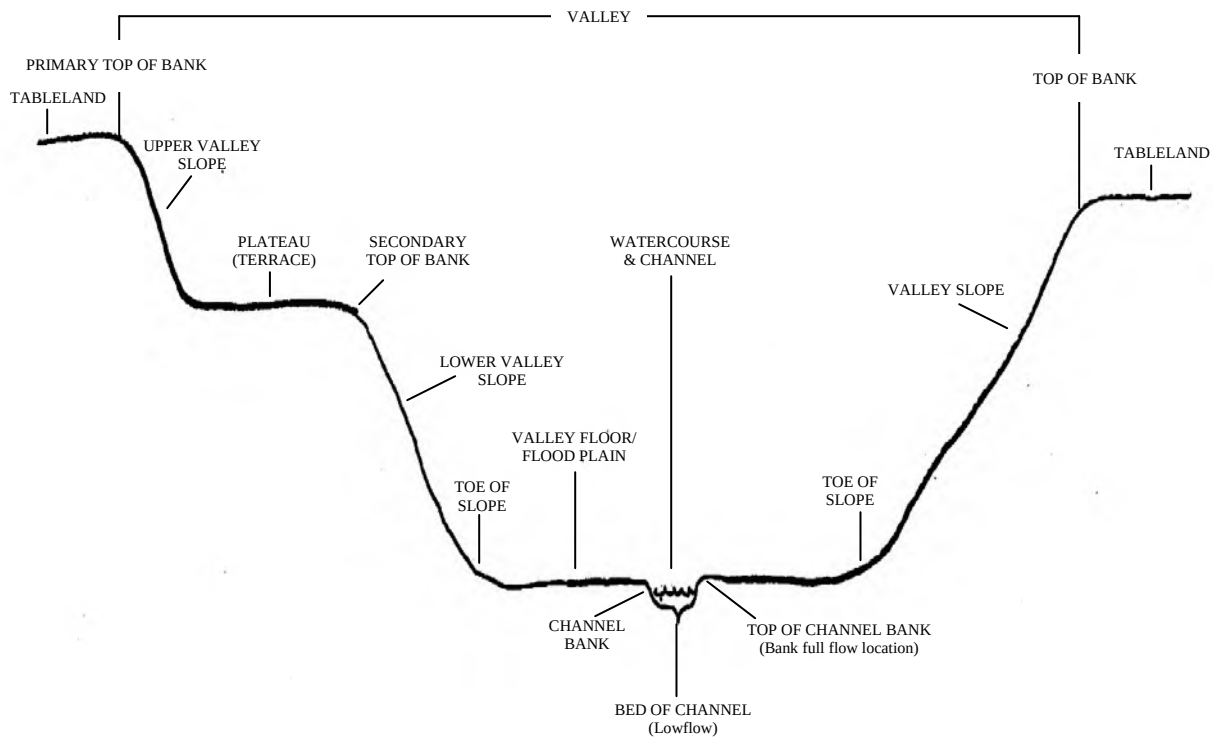
SLOPE STABILITY DEFINITION & DETERMINATION GUIDELINE

Figure 5. Example of Stability, Erosion and Development Setback Components



N.T.S.

Figure 6. The Physical Features of a Typical Valley



N.T.S.

From:	Rob Amos
To:	cota.c@aquaforbeech.com; ursulak.j@aquaforbeech.com
Cc:	amos.r@aquaforbeech.com
Subject:	FW: MCM Response - Cooksville Creek Erosion Control Project - Notice of Study Commencement [MCM File # 0021064]
Date:	March 19, 2024 11:41:50 AM
Attachments:	image002.jpg image004.png 2024-03-13_TIP_CooksvilleCreek_MCM_InitialLetter.pdf

---

Rob Amos
Aquafor Beech Ltd
Mobile: 416.705.2367

-------- Original message --------
From: Greg Frew <Greg.Frew@mississauga.ca>
Date: 2024-03-19 11:37 a.m. (GMT-05:00)
To: "Rob Amos (amos.r@aquaforbeech.com)" <amos.r@aquaforbeech.com>
Subject: FW: MCM Response - Cooksville Creek Erosion Control Project - Notice of Study Commencement [MCM File # 0021064]

Hi Rob.

As you expected, MCM is recommending that we complete a Cultural Heritage Assessment for our Cooksville Creek project. Please take this email as approval to undertake this provisional task per Aquafor's proposal.

Thanks,

Greg.

Greg Frew, P.Eng.

Stormwater Drainage Engineer, Environmental Services

Infrastructure Planning and Engineering Services Division

Transportation and Works Department

City of Mississauga

☎ 905.615.3200 ext. 3362

✉ greg.frew@mississauga.ca

www.mississauga.ca

From: Smythe, Liam (He/Him) (MCM) <Liam.Smythe@ontario.ca>
Sent: Wednesday, March 13, 2024 2:22 PM
To: amos.r@aquaforbeech.com
Cc: Greg Frew <Greg.Frew@mississauga.ca>; Barboza, Karla (She/Her) (MCM) <Karla.Barboza@ontario.ca>
Subject: [EXTERNAL] MCM Response - Cooksville Creek Erosion Control Project - Notice of Study Commencement [MCM File # 0021064]

[CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.]

Good afternoon Rob,

Thank you for providing the Ministry of Citizenship and Multiculturalism (MCM) with the Notice of Study Commencement for the City of Mississauga's Cooksville Creek Erosion Control Class Environmental Assessment.

Please find MCM's initial letter on this project attached.

Do not hesitate to contact us if you have any questions or require further information.

Best regards,

Liam Smythe | Heritage Planner

Citizenship, Inclusion and Heritage Division | Heritage Branch | Heritage Planning Unit

Ministry of Citizenship and Multiculturalism

416.301.4797

Liam.Smythe@ontario.ca

From: amos.r@aquaforbeech.com <amos.r@aquaforbeech.com>
Sent: February 16, 2024 1:05 PM
To: 'Greg Frew' <Greg.Frew@mississauga.ca>
Subject: Cooksville Creek Erosion Control Project - Notice of Study Commencement

CAUTION -- EXTERNAL E-MAIL - Do not click links or open attachments unless you recognize the sender.

Dear Stakeholder,

Please find attached a Notice of Study Commencement for the City of Mississauga – Cooksville Creek Erosion Control Class Environmental Assessment.

The next point of contact will include a Public Information Centre (PIC) to discuss matters related to the study, including problems, opportunities, alternative solutions, evaluation criteria, environmental impacts and mitigation measures.

The PIC date and details will be advertised as the Study progresses.

Thanks very much for your interest and input, we look forward to hearing from you throughout the duration of the project.

Best Regards,

Rob

Robert Amos, MASc., P.Eng.

Aquafor Beech Ltd.

☎ **416.705.2367**

✉ Amos.R@Aquaforbeech.com

www.aquaforbeech.com



Ministry of Citizenship and Multiculturalism

Heritage Planning Unit
Heritage Branch
Citizenship, Inclusion and Heritage Division
5th Flr, 400 University Ave
Tel.: 416-301-4797

Ministère des Affaires civiques et du Multiculturalisme

Unité de la planification relative au patrimoine
Direction du patrimoine
Division des affaires civiques, de l'inclusion et du patrimoine
Tél.: 416-301-4797

March 13, 2024 EMAIL ONLY

Robert Amos
Consultant Project Manager
Aquafor Beech Ltd.
2600 Skymark Avenue, Unit 6-202
Mississauga, ON L4W 5B2
Amos.R@aquaforbeech.com

MCM File	**:**	**0021064**
Proponent	**:**	**City of Mississauga**
Subject	**:**	**Municipal Class Environmental Assessment – Schedule B – Notice of Study Commencement**
Project Location	**:**	**Cooksville Creek Erosion Control Project South of Lakeshore Road City of Mississauga, Peel Region, Ontario**

Dear Robert Amos:

Thank you for providing the Ministry of Citizenship and Multiculturalism (MCM) with the Notice of Study Commencement for the above-referenced project.

MCM's interest in this project relates to its mandate of conserving Ontario's cultural heritage, which includes:

- archaeological resources, including land and marine;
- built heritage resources, including bridges and monuments; and
- cultural heritage landscapes.

Under the EA process, the proponent is required to determine a project's potential impact on known (previously recognized) and potential cultural heritage resources.

Project Summary
The City of Mississauga is undertaking a Schedule 'B' Municipal Class Environmental Assessment (Class EA) Study for the *Cooksville Creek Erosion Control Project South of Lakeshore Road*. This section of Cooksville Creek has been impacted by recent storm events and high lake levels and is in need of rehabilitation. The study will examine this section of Cooksville Creek and the adjacent Helen Molasy Trail to identify existing problems, potential risks, and opportunities for restoration and drainage improvements.

Identifying Cultural Heritage Resources
While some cultural heritage resources may have already been formally identified, others may be identified through screening and evaluation.

Archaeological Resources
This EA project may impact archaeological resources and should be screened using the Ministry's *Criteria for Evaluating Archaeological Potential* and *Criteria for Evaluating Marine Archaeological Potential* (if shoreline or in-water works are proposed) to determine if an archaeological assessment is needed. MCM archaeological sites data are available at *archaeology@ontario.ca*.

If the EA project area exhibits archaeological potential, then an archaeological assessment (AA) shall be undertaken by an archaeologist licenced under the *Ontario Heritage Act (OHA)*, who is responsible for submitting the report directly to MCM for review. Proponents should wait to receive the MCM's review letter indicating that the report(s) has been entered into the Register before issuing a decision or proceeding with any ground disturbing activities.

Proponents must follow the recommendations of the archaeological assessment report(s). MCM recommends that further stages of archaeological assessment (if recommended) be undertaken as early as possible during detailed design and prior to any ground disturbing activities.

Built Heritage Resources and Cultural Heritage Landscapes
The Ministry's *Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes* should be completed to help determine whether this EA project may impact known or potential built heritage resources and/or cultural heritage landscapes.

If any municipal bridges may be impacted by this project, the Municipal Heritage Bridges: Criteria for Evaluating Potential for Cultural Heritage Resources (*checklist* and *background information*) should be completed. The checklist was developed by the Municipal Engineers Association in consultation with MCM.

If there is potential for built heritage resources and/or cultural heritage landscapes within the project area, then a *Cultural Heritage Report: Existing Conditions and Preliminary Impact Assessment* should be undertaken for the entire study area during the planning phase and will be summarized in the EA Report. This study will:

1. Describe the existing baseline cultural heritage conditions within the study area by identifying all known or potential built heritage resources and cultural heritage landscapes, including a historical summary of the study area. The Ministry has developed a screening checklist that may assist with this exercise: *Criteria for Evaluating for Potential Built Heritage Resources and Cultural Heritage Landscapes*.

2. Identify preliminary potential project-specific impacts on the known and potential built heritage resources and cultural heritage landscapes that have been identified. The report should include a description of the anticipated impact to each known or potential built heritage resource or cultural heritage landscape that has been identified.

3. Recommend measures to avoid or mitigate potential negative impacts to known or potential built heritage resources and cultural heritage landscapes. The proposed mitigation measures are to inform the next steps of project planning and design.

Given that this project covers a large study area, MCM recommends that the Cultural Heritage Report is carried out so that step 1 described above is undertaken early in the planning process. Then, steps 2 and 3 can be undertaken once the preferred alternatives have been selected.

Cultural Heritage Reports will be undertaken by a qualified person who has expertise, recent experience, and knowledge relevant to the type of cultural heritage resources being considered and the nature of the activity being proposed.

Community input should be sought to identify locally recognized and potential cultural heritage resources. Sources include, but are not limited to, municipal heritage committees, historical societies and other local heritage organizations.

Cultural heritage resources are often of critical importance to Indigenous communities. Indigenous communities may have knowledge that can contribute to the identification of cultural heritage resources, and we suggest that any engagement with Indigenous communities includes a discussion about known or potential cultural heritage resources that are of value to them.

Environmental Assessment Reporting
All technical cultural heritage studies and their recommendations are to be addressed and incorporated into EA projects. Please advise MCM whether any technical cultural heritage studies will be completed for this EA project, and provide them to MCM before issuing a Notice of Completion or commencing any work on the site. If screening has identified no known or potential cultural heritage resources, or no impacts to these resources, please include the completed checklists and supporting documentation in the EA report or file.

Please note that the responsibility for administration of the *Ontario Heritage Act* and matters related to cultural heritage have been transferred from the Ministry of Tourism, Culture and Sport (MTCS) to the Ministry of Citizenship and Multiculturalism (MCM). Individual staff roles and contact information remain unchanged. Please continue to send any notices, report and/or documentation **via email only** to both Karla Barboza and myself.

- Karla Barboza, Team Lead - Heritage | Heritage Planning Unit (Citizenship and Multiculturalism) | 416-660-1027 | karla.barboza@ontario.ca
- Liam Smythe, Heritage Planner | Heritage Planning Unit (Citizenship and Multiculturalism) | 416-301-4797 | Liam.Smythe@ontario.ca

Thank you for consulting MCM on this project and please continue to do so throughout the EA process. If you have any questions or require clarification, please do not hesitate to contact me.

Sincerely,

Liam Smythe
Heritage Planner
Liam.Smythe@ontario.ca

Copied to: Greg Frew, City of Mississauga
Karla Barboza, MCM

It is the sole responsibility of proponents to ensure that any information and documentation submitted as part of their EA report or file is accurate. The Ministry of Citizenship and Multiculturalism (MCM) makes no representation or warranty as to the completeness, accuracy or quality of the any checklists, reports or supporting documentation submitted as part of the EA process, and in no way shall MCM be liable for any harm, damages, costs, expenses, losses, claims or actions that may result if any checklists, reports or supporting documents are discovered to be inaccurate, incomplete, misleading or fraudulent.

Should previously undocumented archaeological resources be discovered, they may be a new archaeological site and therefore subject to Section 48(1) of the *Ontario Heritage Act*. The proponent or person discovering the archaeological resources must cease alteration of the site immediately and engage a licensed consultant archaeologist to carry out an archaeological assessment, in compliance with Section 48(1) of the *Ontario Heritage Act*.

The *Funeral, Burial and Cremation Services Act, 2002, S.O. 2002, c.33* requires that any person discovering human remains must cease all activities immediately and notify the police or coroner. If the coroner does not suspect foul play in the disposition of the remains, in accordance with *Ontario Regulation 30/11* the coroner shall notify the Registrar, Ontario Ministry of Public and Business Service Delivery, which administers provisions of that Act related to burial sites. In situations where human remains are associated with archaeological resources, the Ministry of Citizenship and Multiculturalism should also be notified (at archaeology@ontario.ca) to ensure that the archaeological site is not subject to unlicensed alterations which would be a contravention of the *Ontario Heritage Act*.

From:	Ahmad, Iftekhar
To:	ursulak.j@aquaforbeech.com
Cc:	Greg Frew; "Rob Amos"; cota.c@aquaforbeech.com; "Raymond Lau"; "Tad Makula"; "Simon Latam"; Paul Tripodo; "Jeffrey Driscoll"
Subject:	CVC feedback (site meeting minutes) - EA 24/001 - Cooksville Creek Erosion Control Project (south of Lakeshore Rd)
Date:	July 8, 2024 6:41:02 PM
Attachments:	2024_05_24 - Class EA for Cooksville Creek South of Lakeshore Road - Meeting with CVC & City - Minutes.docx

Hi Jacob,

CVC staff have now had the opportunity to review the attached minutes of the site meeting and provide these comments for your consideration.

1) Please consider among the alternatives to narrow the width of the trail in order to support a more stable slope along the steeper sections.
2) Please include any draft technical studies completed in support of the preliminary preferred alternative and conceptual drawings for the alternatives at the time of submitting the field surveys and alternatives evaluation criteria/matrix.

Thanks,

Best regards,
Iftekhar

Iftekhar Ahmad | MES-Planning | he/him/his
Planner, Environmental Assessment | Credit Valley Conservation
905-670-1615 ext. 2960 | M: 647-449-5962
iftekhar.ahmad@cvc.ca | cvc.ca

Our working hours may be different. Please do not feel obligated to reply outside of your scheduled working hours. Let's work together to help foster healthy work-life boundaries.

View our privacy statement

-----Original Message-----
From: ursulak.j@aquaforbeech.com <ursulak.j@aquaforbeech.com>
Sent: Friday, June 21, 2024 1:16 PM
To: Greg Frew <greg.frew@mississauga.ca>; 'Rob Amos' <amos.r@aquaforbeech.com>; cota.c@aquaforbeech.com; Ahmad, Iftekhar <Iftekhar.Ahmad@cvc.ca>; De Stefano, Matteo <matteo.destefano@cvc.ca>; Leiderman, Meidan <meidan.leiderman@cvc.ca>; 'Raymond Lau' <Raymond.Lau@mississauga.ca>; 'Tad Makula' <Tad.Makula@mississauga.ca>; 'Simon Latam' <Simon.Latam@mississauga.ca>; Paul Tripodo <paul.tripodo@mississauga.ca>; 'Jeffrey Driscoll' <Jeffrey.Driscoll@mississauga.ca>
Subject: [External] RE: site meeting - Cooksville Creek Erosion Control Project (south of Lakeshore Rd)

[CAUTION] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe. If in doubt contact help211@cvc.ca

Hi All,

As a follow-up to our onsite Meeting on May 24th for the Cooksville Creek Erosion Control Project South of Lakeshore Road, please find attached meeting minutes for your records.

If you have any questions or comments related to the attached, please let us know.

Thanks,

Jacob Ursulak (he/him), MASc., EIT
Aquafor Beech Limited
2600 Skymark Avenue, Unit 6, Suite 202
Mississauga, ON
L4W 5B2

Tel: 226.606.2703
Email: ursulak.j@aquaforbeech.com
http://www.aquaforbeech.com/

-----Original Appointment-----
From: Greg Frew <Greg.Frew@mississauga.ca>
Sent: May 13, 2024 1:38 PM
To: Greg Frew; Rob Amos (amos.r@aquaforbeech.com); ursulak.j (ursulak.j@aquaforbeech.com); cota.c@aquaforbeech.com; Iftekhar Ahmad (Iftekhar.ahmad@cvc.ca); Matteo De Stefano (matteo.destefano@cvc.ca); Meidan Leiderman (meidan.leiderman@cvc.ca); Raymond Lau; Tad Makula; Simon Latam; Paul Tripodo; Jeffrey Driscoll
Subject: site meeting - Cooksville Creek Erosion Control Project (south of Lakeshore Rd)
When: May 24, 2024 10:30 AM-12:00 PM (UTC-05:00) Eastern Time (US & Canada).
Where: Helen Molasy Memorial Park - lot at end of Hampton Cres

Site meeting with the City's consultant, Aquafor, to review the site conditions and discuss options for the creek, trail and backyard drainage.

City of Mississauga

Cooksville Creek EA South of Lakeshore Road

Meeting with CVC and City

Date/Time: Friday, May 24th, 2024 10:30 am – 12:00 pm
Location: Onsite - Helen Molasy Park
Aquafor Ref: 67489
Consultant: Aquafor Beech Ltd

Prepared by: Aquafor Beech Ltd - C. Cota

Attendees

Name	Company	Telephone	Email
Greg Frew (GF)	City of Mississauga	905.615.3200 x 3362	Greg.Frew@mississauga.ca
Raymond Lau (RL)	City of Mississauga		Raymond.Lau@mississauga.ca
Tad Makula (TM)	City of Mississauga		Tad.Makula@mississauga.ca
Jeffery Driscoll (JD)	City of Mississauga		Jeffery.Driscoll@mississauga.ca
Rob Amos (RA)	Aquafor Beech	416.705.2367	Amos.R@aquaforbeech.com
Jacob Ursulak (JU)	Aquafor Beech	226.606.2703	Ursulak.J@aquaforbeech.com
Chad Cota (CC)	Aquafor Beech	519.697.0324	Cota.C@aquaforbeech.com
Iftekhar Ahmad (IA)	CVC	647.449.5962	Iftekhar.Ahmad@cvc.ca
Matteo De Stefano (MS)	CVC		Matteo. DeStefano@cvc.ca
Meidan Leiderman (ML)	CVC		Meidan.Leiderman@cvc.ca

Objective of Meeting: Pre-Consultation with CVC and City

Minutes / Notes

	Topic/Comments	Action By:	Deliverable Date
1	**Roles and Introductions** **Greg Frew** will be the City Project Manager, and the primary contact for the City of Mississauga **Raymond Lau** and **Tad Makula** will represent the City's Parks Department for this project. **Jeffery Driscoll** will represent the City's Natural Heritage Department for this project **Rob Amos** with be the Consultant Project Manager, and the primary contact for ABL **Jacob Ursulak** and **Chad Cota** will provide engineering support for ABL **Iftekhar Ahmad** will the primary contact from CVC **Matteo De Stefano** will provide technical engineering review for CVC **Meidan Leiderman** will provide ecological review for CVC		
2	**Study Area** RA: The study area is located along Cooksville Creek, from Lakeshore Road East to its confluence with Lake Ontario. GF: The lands within the study area are owned by CVC, but leased to the City of Mississauga GF: City of Mississauga Parks department is interesting in restoring the trail within the study area, but is waiting for the results of this study to develop trail restoration alternatives. RA: This section of creek was realigned in the 70s, through a project lead by the CVC RA: Many of the gabion baskets are failing, causing parts of the trail to slump towards the water.		
3	**Project Goals and Objectives** RA: As defined in the RFP, "The City intends to undertake a Municipal Class Schedule B EA in order to develop restoration design alternatives to mitigate the existing erosion problems for this section of Cooksville Creek and provide long-term stability to the creek corridor. In doing so, the City will also be looking to develop related alternatives to restore the Helen Molasy Trail and berm that sits atop the eastern creek bank." RA: There will also be some focus on evaluating and possibly providing a solution to the flooding problems in the adjacent private properties on Hampton Cresent and Beachwood Avenue		

4	**Site Walk and Feedback from City and CVC** TM/RL: The pedestrian bridge within the study area conveys the Lakeshore Trail, which should not be blocked or closed as part of this project. RA: Noted. The staging area will likely be within the Helen Molasy Parking lot, and access will be along the trail berm. Closure of the Lakeshore trail will be avoided whenever possible. TM/RL: The new trail would require pedestrian safety railings on both sides, ensuring that backyard gate access is not negatively impacted. Also, the new trail alternative will need to allow for winter maintenance vehicles. JD: The City would be looking to reduce impacts to mature vegetation wherever possible. RA: Noted, we will include this preference within the evaluation of alternatives. GF: Previously, this area experienced significantly high-water levels around 2017 - 2019. I have photos of this time, and will share with the ABL team. RA: Aquafor has completed field terrestrial and aquatic field inventories for the study area. We are currently compiling the results of the assessments. Bat acoustic monitoring is scheduled for the June 2024. RA: Aquafor has developed three preliminary restoration alternatives for the trail drainage and three preliminary restoration alternatives for the creek, as shown in the drawing package provided. RA/GF: It should be noted that in all alternatives, the berm alignment (including height and width) will stay the same. MS: Would there be any consideration given to a hybrid solution, where a combination of watercourse restoration / trail drainage alternatives is used? RA: Aquafor can give some consideration to this. IA: CVC is interested in seeing the evaluation of alternatives, and the results of the field and aquatic inventories. GF: Some of these alternatives require minor grading work on private properties. This will require easement agreements with the private landowners, which could be a lengthy process. RA: Aquafor will distribute these materials to the CVC for review when available. GF: The City is planning public consultation to occur in the Fall of 2024, and the City will share the consultation materials with CVC in advance.	City ABL ABL/City	Completed When Available When Available
5	**Action Items** City to share 2017 High water photos with ABL ABL to compile the results of the ecological field inventories and share with CVC for review ABL to evaluate the preliminary alternatives, and share the results with CVC ABL/City to develop public consultation materials, and share with CVC in advance of the public consultation session.	City ABL ABL ABL/City	Completed When Available When Available When Available

From:	amos.r@aquaforbeech.com
Cc:	"Greg Frew"; "ursulak.j"; cota.c@aquaforbeech.com
Subject:	Cooksville Creek Erosion Control Project - Notice of Public Information Centre
Date:	October 21, 2024 4:25:01 PM
Attachments:	image001.png Cooksville Creek Schedule B Municipal Class EA - Notice of Public Information Centre.pdf

Dear Stakeholder,

Please find attached a Notice of Public Information Centre for the City of Mississauga – Cooksville Creek Erosion Control Class Environmental Assessment.

An in-person, Public Information Centre has been arranged to allow residents and interested members of the public an opportunity to review and comment on the project findings to date. This includes the alternative solutions being considered, the evaluation process, the preliminary preferred solutions, and the next steps of the study.

The details of the Public Information Centre are as follows:

Date:	Tuesday, October 29th, 2024
Time:	Afternoon Session: 3 p.m. – 5 p.m. Evening Session: 6 p.m. – 8 p.m.
Location:	Small Arms Inspection Building 1352 Lakeshore Road East

Thanks very much for your interest and input, we look forward to hearing from you throughout the duration of the project.

Best Regards,

Rob

Robert Amos, MASc., P.Eng.
Aquafor Beech Ltd.

☎ **416.705.2367**
✉ Amos.R@Aquaforbeech.com
www.aquaforbeech.com

City of Mississauga
Notice of Public Information Centre

Municipal Class Environmental Assessment Study:
Cooksville Creek Erosion Control Project – South of Lakeshore Road

What?

The City of Mississauga (the City) is undertaking a Schedule B Municipal Class Environmental Assessment (Class EA) Study for erosion control and restoration of Cooksville Creek south of Lakeshore Road.



Why?

The City recognizes that this section of Cooksville Creek has been impacted by recent storm events and high lake levels and is in need of rehabilitation. Plans will also need to consider the deteriorated condition of the adjacent city trail through Helen Molasy Memorial Park that sits above the east bank of the creek, as well as the neighbouring properties which have experienced ongoing drainage issues.

How?

- The Study has examined this section of Cooksville Creek and Helen Molasy Trail and associated natural resources to identify existing problems, potential risks, and opportunities for restoration and drainage improvements.
- Through the Class EA process, various alternative solutions are being developed and evaluated by the Study Team and will be refined through public and agency consultation (see below). The Study Team will then select a preferred alternative and proceed with design of the recommended works.
- A Project File documenting the planning process will be available for public review at the end of the Study.

Public Consultation

- Consultation is an essential part of the EA process. The City would like anyone with an interest in the Study to have an opportunity to provide input and help inform the decision-making process.
- An in-person, Public Information Centre has been arranged to allow local residents and interested members of the public an opportunity to review and comment on the project findings to date, the alternative solutions being considered, the evaluation process, the preliminary preferred solution, and the next steps:

Date:	Tuesday, October 29th, 2024
Time:	afternoon: 3pm – 5pm evening: 6pm - 8pm
Location:	Small Arms Inspection Building 1352 Lakeshore Road East

- Additional project information will be made available on the City's project website:
  https://www.mississauga.ca/projects-and-strategies/environmental-assessments/cooksville-creek-erosion-control-south-of-lakeshore-road/

City of Mississauga
Notice of Public Information Centre

Municipal Class Environmental Assessment Study:
Cooksville Creek Erosion Control Project – South of Lakeshore Road

- Feedback is encouraged and comments are requested by **November 26th, 2024**. A comment form is available on the project website. Input gathered through the public consultation will be used to support the EA study.
- If you have comments or questions, require further information or would like to be added to the Study mailing list to receive future notifications, please contact:

Greg Frew, P.Eng.
City Project Manager
City of Mississauga
300 City Centre Drive, Suite 800
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Ltd.
2600 Skymark Ave.
Mississauga, ON L4W 5B2
(416) 705-2367
Amos.R@aquaforbeech.com

This notice signals the Notice of Public Information Centre for this Municipal Class Environmental Assessment, a study which will define the problem, identify/evaluate alternative solutions, and determine a preferred design in consultation with regulatory agencies and the public. The study is being undertaken in accordance with the planning and design process for Schedule 'B' projects, as outlined in the "Municipal Class Environmental Assessment" document (as amended in 2023), which is approved under the Ontario Environmental Assessment Act.

Personal information is collected under the authority of the Environmental Assessment Act and will be used in the assessment process. With exception of personal information, all comments shall become part of the public records. Questions about this collection should be directed to the Project Manager listed above.

This notice first issued on **October 21st, 2024**.

From: Greg Frew
To: Rob Amos (amos.r@aquaforbeech.com)
Cc: ursulak.j (ursulak.j@aquaforbeech.com); cota.c@aquaforbeech.com
Subject: FW: Cooksville Creek Erosion Control Project - Notice of Public Information Centre
Date: October 25, 2024 3:59:57 PM
Attachments: image001.png
image002.png
image003.png
image004.png
image005.png
image006.png

Hi Rob

FYI – a response from the Region for your EA files.

Thanks,
Greg.

From: Saddi, Asha <asha.saddi@peelregion.ca>
Sent: Wednesday, October 23, 2024 4:02 PM
To: Greg Frew <Greg.Frew@mississauga.ca>
Subject: [EXTERNAL] FW: Cooksville Creek Erosion Control Project - Notice of Public Information Centre

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[CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.]

Hi Greg,
Thank you for the Notice of PIC. We will provide any comments on the PIC materials by Friday, November 8, 2024.

Regards,

Asha Saddi, BA(Hons), PMP
Technical Analyst, Transportation Development
Transportation Division, Public Works
10 Peel Centre Drive, Suite B, 4th Floor
Brampton, ON L6T 4B9
Tel: 905 791 7800 ext. 7794

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From: amos.r@aquaforbeech.com <amos.r@aquaforbeech.com>
Sent: Monday, October 21, 2024 4:25 PM
Cc: 'Greg Frew' <Greg.Frew@mississauga.ca>; 'ursulak.j' <ursulak.j@aquaforbeech.com>; cota.c@aquaforbeech.com
Subject: Cooksville Creek Erosion Control Project - Notice of Public Information Centre

CAUTION: EXTERNAL MAIL. DO NOT CLICK ON LINKS OR OPEN ATTACHMENTS YOU DO NOT TRUST.

Dear Stakeholder,

Please find attached a Notice of Public Information Centre for the City of Mississauga – Cooksville Creek Erosion Control Class Environmental Assessment.

An in-person, Public Information Centre has been arranged to allow residents and interested members of the public an opportunity to review and comment on the project findings to date. This includes the alternative solutions being considered, the evaluation process, the preliminary preferred solutions, and the next steps of the study.

The details of the Public Information Centre are as follows:

Date:	Tuesday, October 29th, 2024
Time:	Afternoon Session: 3 p.m. – 5 p.m. Evening Session: 6 p.m. – 8 p.m.
Location:	Small Arms Inspection Building 1352 Lakeshore Road East

Thanks very much for your interest and input, we look forward to hearing from you throughout the duration of the project.

Best Regards,

Rob

Robert Amos, MASc., P.Eng.

Aquafor Beech Ltd.

☎ **416.705.2367**
✉ Amos.R@Aquaforbeech.com
www.aquaforbeech.com



From:	Ahmad, Iftekhar
To:	Rob Amos
Cc:	Greg Frew; Raymond Lau; Simon Latam; "Tad Makula"; Jeffrey Driscoll; Cc: "ursulak.j"; cota.c@aquaforbeech.com
Subject:	CVC Comments (Draft PFR) - EA 24/001 - Cooksville Creek Erosion Control - South of Lakeshore Road East
Date:	November 12, 2024 4:29:04 PM
Attachments:	image002.png image003.png image001.png Technical-Guidelines-For-Flood-Hazard-Mapping-March-2017-Final.pdf rpt_Buffer Planting Guide_CVC_v1_2023.pdf Plant-Selection-Guideline-FINAL-APRIL-24th-2018.pdf CVC-Healthy-Soils-Guidelines-NHS-Web-V5.pdf rpt_CVCEcoOffset_FINAL_20200313_na.pdf

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Hi Rob,

Apologies for the late response.

CVC staff have now had the opportunity to review the draft project file report (undated), responses to our comments in the letter dated September 6, 2024, and PIC information noted in your below email and provide these comments for your consideration. Please include responses to these comments in the next submission.

General Comment

1. Please document the permissions/consents to enter agreements with the private landowners and land authorization from CVC's land planning group to facilitate the proposed works in the PFR.

Engineering Comments

2. Please clarify the description of flooding in Table 4-1 in the draft PFR. There should be no confusion that the works will reduce the 100-year or regulatory floodlines for Cooksville Creek. Instead, the works will mitigate the nuisance flood occurring on the adjacent properties on the east side of the trail by facilitating the improved drainage.

3. The impacts of the proposed alternatives on the existing flood hazard must be quantified to support the evaluation/decision criteria matrix scoring for 'flooding.' They should be discussed in the PFR. The hydraulic modelling and floodline delineation are expected as the support material.

4. The proposed works are located within the regulatory floodplain associated with Cooksville Creek. It must be demonstrated that there are no negative impacts to the existing flood hazard as a result of the proposed erosion protection works. This is to be confirmed through a hydraulic analysis for the reach accompanied by a technical memo stating any assumptions, modelling inputs, and results. Floodlines for the existing and proposed conditions are to be delineated for comparison, as part of the hydraulic analysis.

5. Please refer to the attached CVC's Technical Guidelines for Flood Hazard Mapping when delineating the proposed floodlines.

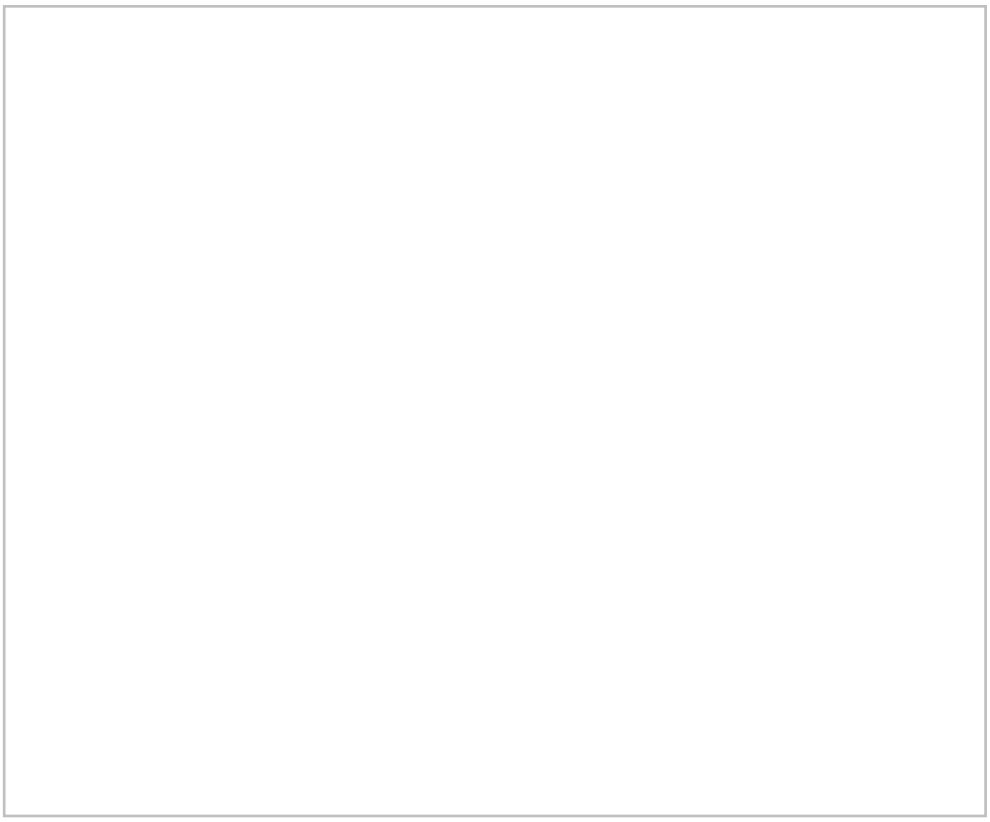
6. The existing erosion hazard must not be negatively impacted by the proposed

works. The existing erosion hazard has been delineated for the east side of the watercourse through the meander belt assessment; however, please confirm if the erosion hazard for the confined portion of the system on the west side of the creek has been assessed.

7. The preferred alternatives scored the most favourable in terms of the required maintenance; however, more detail should be provided on what maintenance is required. Does this refer to pumping ponded water from the residents' backyards, ensuring the outfalls remain operable, or both? Since lack of maintenance led to the current state of disrepair for the storm sewer outfall, it is assumed that some degree of maintenance will be required as sediment continues to be deposited from the upstream reaches of Cooksville Creek.

Ecology Comments

8. As noted in the draft PFR, the limited availability of the riparian buffer is due to the close proximity of residential development, Helen Molasy Trail, and wide channel width at this stretch of Cooksville Creek. We appreciate the consideration for narrowing the width of the trail to accommodate more buffer space to the watercourse. We also continue to highlight the importance of the wider and functional riparian buffers in reducing erosive forces and helping to protect City's managed property and residential properties along Cooksville Creek. As such, we would like to recommend that in addition to channel stabilization works and full depth restoration of the berm and trail, the southern part of the trail be rerouted to provide space for the greater riparian buffer where possible. Please consider the below trail rerouting option (shown in red) which will provide greater buffer area and potentially reduce the cost and scope of the riparian works while maintaining City's trail operations.



9. It is noted that the extended channel works will likely result in larger impact to terrestrial areas riparian vegetation. Please consider a cautious approach, prioritize avoidance and mitigation of impact to the adjacent riparian habitat by reducing bank works where possible, reducing the sizing and area of hardened solutions such as rocky buttresses, armourstone retaining walls, catch basins, and storm outfalls.

10. Due to the likelihood of the tree removal, please submit an arborist report quantifying the impacts and highlighting species, removal quantities and sizes at the detailed design stage. This will help guide any tree compensation needs.

11. Please follow the attached CVC's Ecosystem Offsetting Guidelines (Table 3) for direction on the appropriate tree replacement ratios to offset the functional loss of the regulated feature in CVC's regulated areas at the detailed design stage. Please reference this guideline in the PFR.

12. All disturbed areas should be restored using self-sustaining, native riparian vegetation. Please also consider the following CVC's guidelines and reference them in the PFR:

    a. Plant Selection Guidelines.

    b. Guidelines for Designing Enhancement Plans within Setbacks and Buffers for determining species and planting densities.

    c. Healthy Soil Guidelines for any necessary soil amendments.

Geomorphology Comments

13. Please demonstrate that there is no increase to the erosion hazard as a result of the proposed works. CVC questions the suitability of the meander belt analysis given the conditions of the site notably the backwatering effects from the lake, the channel realignment and floodplain fill, the presence of the berm, channel armouring and sections of the confined channel conditions. Please either (1) provide more clarity and detail to support the current erosion hazard work including a description of how the 100-year erosion rates were calculated, justification for classifying the channel as unconfined etc. or (2) provide an assessment to demonstrate that the proposed works will not increase the erosion hazard.

14. CVC is supportive of the reach-based solution. However, it is CVC's opinion that a less intrusive solution that gives the channel more space would be possible and preferable. Please add an alternative that meets the intent of the preferred solution to provide comprehensive erosion protection within the entire study area, but that minimizes the amount of armouring and sets it back as far as possible.

15. Please provide the proposed conditions cross sections to demonstrate that the proposed works do not encroach into the existing channel cross sections.

16. Please consider removing the berm to address the drainage issues and lowering the path. This would remove assets (the berm and outfalls) requiring management. Please consider giving the channel more space by setting the armourstone wall and trail back as far as possible.

17. There are flood concerns in the area and opportunities to improve flood risk as well as erosion protection should be pursued. Setting the trail back and giving the channel more space, potentially including cut, as suggested in comment 14 may be one way to achieve this but it would need to be modelled.

Land Planning Comments

18. At the detailed design stage, please ensure that an AutoCad file (.dwg) that is projected to NAD_1983_UTM_Zone_17N is submitted for a more fulsome review of the proposed design.

19. Please note that CVC is working with Region of Peel with regard to the Beach Street Sewage Pumping Station Project which is currently at the detailed design stage (EA completed). CVC is flagging the symmetries in geography and potential timelines of both projects. It would be best to reach out to Region of Peel project lead (see below contact details) to discuss any potential implications.

Ajay Puri - Senior Project Manager, Engineering
Ajay.Puri@peelregion.ca

If you have any questions, please contact me.

Thanks,

Best regards,
Iftekhar

Iftekhar Ahmad | MES (Pl.), RPP | he/him/his
Planner, Environmental Assessment | Watershed Management and Development Services | Credit Valley Conservation
905-670-1615 ext. 2960 | M: 647-449-5962
iftekhar.ahmad@cvc.ca | cvc.ca

Our working hours may be different. Please do not feel obligated to reply outside of your scheduled working hours. Let's work together to help foster healthy work-life boundaries.



View our privacy statement

From: amos.r@aquaforbeech.com <amos.r@aquaforbeech.com>
Sent: Wednesday, September 25, 2024 3:47 PM
To: Greg Frew <greg.frew@mississauga.ca>; Ahmad, Iftekhar <Iftekhar.Ahmad@cvc.ca>; De Stefano, Matteo <matteo.destefano@cvc.ca>; Leiderman, Meidan <meidan.leiderman@cvc.ca>; 'Raymond Lau' <Raymond.Lau@mississauga.ca>; 'Simon Latam' <Simon.Latam@mississauga.ca>; 'Tad Makula' <Tad.Makula@mississauga.ca>; 'Jeffrey Driscoll' <Jeffrey.Driscoll@mississauga.ca>
Cc: 'ursulak.j' <ursulak.j@aquaforbeech.com>; cota.c@aquaforbeech.com
Subject: [External] RE: Cooksville Creek Erosion Control EA - south of Lakeshore

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Hi All,

Thanks for the great meeting and input to the Cooksville Creek Erosion Control EA project.

Please find draft materials available for your review, including:

1 – Draft Project File
2 – PIC Materials
3 – Response to CVC Comments

Cooksville Creek CVC Deliverables
https://www.dropbox.com/scl/fo/9wo6puvgqhhaesd32ayzv/AHMQbw7WAM6Nu-zjux5aCnk?rlkey=g6lfj5nzku960ih5nxa9enmhe&st=54nxzq7p&dl=0

Upon your review, we'll look forward to feedback and additional comments.

We'll also be working with the City to plan the PIC in the coming weeks.

Thanks,

Rob

Robert Amos, MASc., P.Eng.
Aquafor Beech Ltd.

☎ **416.705.2367**
✉ Amos.R@Aquaforbeech.com
www.aquaforbeech.com



-----Original Appointment-----
From: Greg Frew <Greg.Frew@mississauga.ca>
Sent: September 12, 2024 2:31 PM
To: Greg Frew; Rob Amos (amos.r@aquaforbeech.com); ursulak.j (ursulak.j@aquaforbeech.com); cota.c@aquaforbeech.com; Iftekhar Ahmad (Iftekhar.ahmad@cvc.ca); Matteo De Stefano (matteo.destefano@cvc.ca); Meidan Leiderman (meidan.leiderman@cvc.ca); Raymond Lau; Simon Latam; Tad Makula; Jeffrey Driscoll
Subject: Cooksville Creek Erosion Control EA - south of Lakeshore
When: September 25, 2024 2:00 PM-4:00 PM (UTC-05:00) Eastern Time (US & Canada).
Where: Webex

Meeting to provide a project update and review draft project materials ahead of a fall PIC, including:

- Study background and findings
- Potential solutions and evaluation
- Preliminary preferred solutions
- Draft PIC material
- Responses to prior CVC comments

-- Do not delete or change any of the following text. --

When it's time, join your Webex meeting here.

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Meeting number (access code): 2313 764 6244

Meeting password: PuAFZTwK539 (78239895 from video systems)

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1-647-484-1596 CANADA Toll

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Credit Valley Conservation



Healthy Soils Guideline

For the Natural Heritage System

CVC | CREDIT VALLEY CONSERVATION

June 29, 2017

Acknowledgements

We would like to sincerely thank the following organizations and their dedicated staff for contributing to the development and review of this guideline:

City of Brampton
City of Mississauga
Conservation Halton
Dougan & Associates
Erica Ali (York University)
Halton Region
Ontario Ministry of Natural Resources and Forestry
Savanta Inc.
Schollen & Company
Toronto Region Conservation Authority

This document was developed based on the most recent scientific research available to Credit Valley Conservation (CVC), as well as professional opinion and experience. CVC recognizes new information may become available over time and will review any new information or techniques provided by a proponent or his/her consultants in support of a project. For questions related to this guideline, please contact a CVC Planning Ecologist.

This document can be cited as:
Credit Valley Conservation. (2017). Healthy Soils Guideline for the Natural Heritage System, Version 1.0.

Table of Contents

1 Overview 4

2 Soil Management Recommendations 4

2.1 Protect and Preserve Existing Soil 6

2.2 Amend Existing Soil 8

2.3 Import Healthy Topsoil 11

2.4 Preserve Soil Health, Install Healthy Soil 12

3 Glossary 16

4 Bibliography 18

Appendix A 20

1 Overview

Healthy soils are thriving ecosystems that support a wide variety of plants and animals both above and below ground. These plants sequester atmospheric carbon, and in turn, other organisms return this carbon to the soil as organic matter when plant matter decomposes; these natural processes reduce greenhouse gases and reduce the impacts of climate change. Healthy soils also help mitigate the impacts of weather extremes to our communities by attenuating, infiltrating and storing stormwater, which reduces runoff and improves water quality. Soil health is therefore strongly linked with ecosystem health, climate change and water quality. Wise management of soils ensures these essential services are maintained and enhanced.

This document provides guidelines and recommendations to protect, preserve, and restore healthy soils in areas impacted by development or site alteration within or directly adjacent to natural and restored features. It sets minimum standards for soil health and quantity to ensure suitable growing conditions for vegetation. By providing healthy soils within restoration areas there is greater success and less need for maintenance or replacement of plant material.

Terms in bold and italics are defined in the glossary in section 3.

Soil management decisions must be informed by an understanding of soil health on development and restoration sites in order to achieve a target ecological goal. These guidelines are intended to be applied to projects involving soil management in a ***natural heritage system (NHS)***, (e.g. existing ***natural heritage features***, ***ecological buffers*** and ***restoration areas)*** where an upland treed ecosystem is the ultimate ecological community target. In instances where non-treed ecosystems or wetlands are targets (e.g. marsh) or where work is proposed on slopes steeper than 3-to-1, further consultation with Credit Valley Conservation (CVC) is advised.

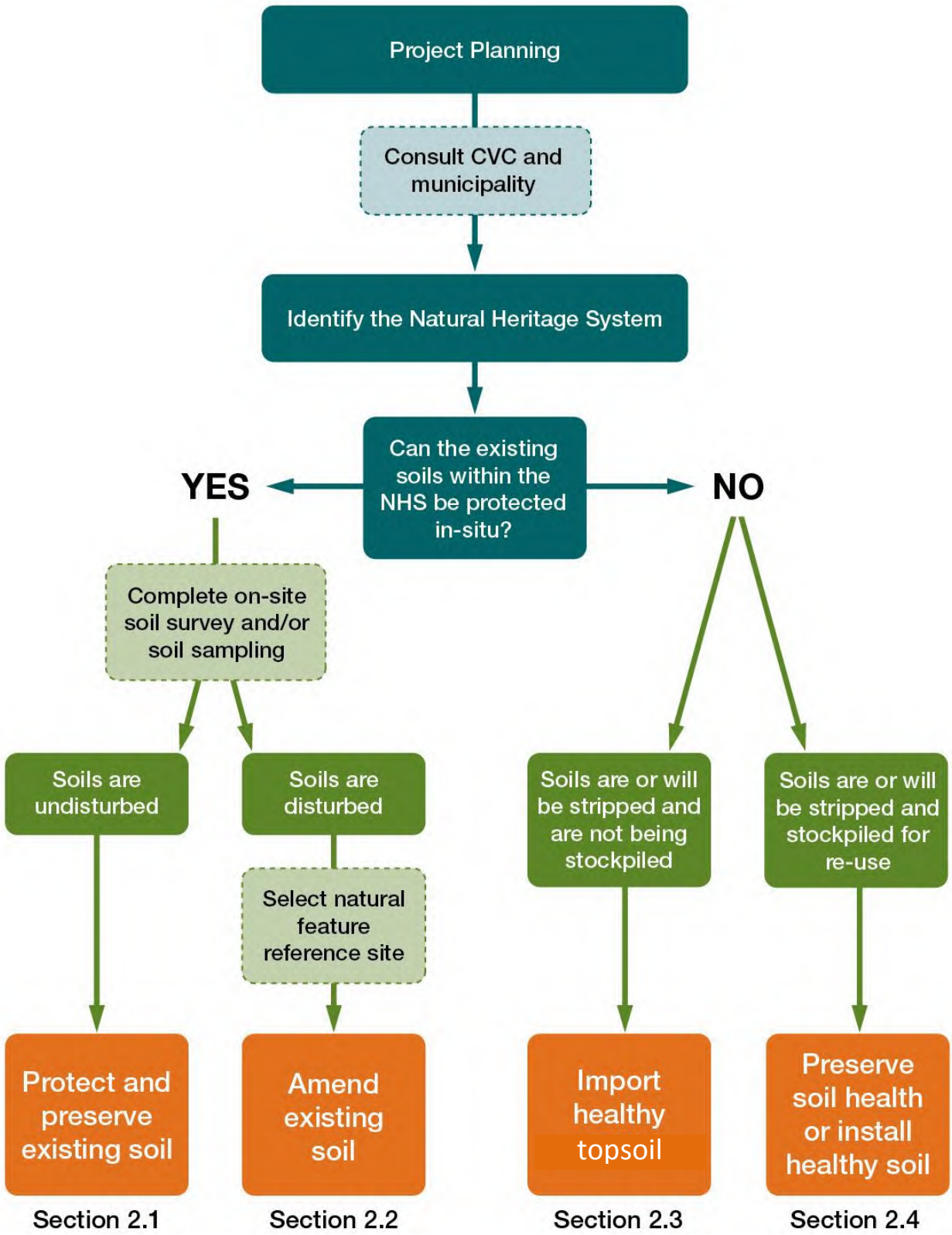
This guideline does not act as a blueprint for all projects. Proper consultation with all involved agencies is still recommended. It is intended that the recommendations contained in this guideline will be reflected in environmental impact studies/environmental assessments, detailed construction drawings and project specifications. Incorporating these recommendations within a project proposal will result in fewer revisions and a more timely review.

This guideline is not intended to address or replace soil management recommendations on contaminated sites or sites requiring further study/action under the *Ontario Environmental Protection Act*.

2 Soil Management Recommendations

Consultation with CVC and the local municipality is important at the initial phases of a project in order to identify the affected portions of the natural heritage system. Appropriate actions can then be taken to preserve, protect and restore sensitive features and adjacent lands throughout subsequent phases. The flow chart shown in Figure 1 can then be used to determine which soil management recommendations may apply to a project based on the existing and proposed conditions on a project site. Multiple soil management recommendations may apply to any particular project.

Figure 1: Decision matrix for determining soil management recommendations


Project Planning
Consult CVC and municipality
Identify the Natural Heritage System
Can the existing soils within the NHS be protected in-situ?
YES
NO
Complete on-site soil survey and/or soil sampling
Soils are undisturbed
Soils are disturbed
Soils are or will be stripped and are not being stockpiled
Soils are or will be stripped and stockpiled for re-use
Select natural feature reference site
Protect and preserve existing soil
Amend existing soil
Import healthy topsoil
Preserve soil health or install healthy soil
Section 2.1
Section 2.2
Section 2.3
Section 2.4

Recommendations are based on an ***on-site soil survey*** which allows a proponent to determine whether existing soils within the NHS are disturbed or undisturbed and whether amendments are necessary. An on-site soil survey should involve the following:

- Test pits in each target area of the NHS to determine the presence of soil, depth of soil horizons, and texture of soil horizons.
- Visual inspection for signs of compaction and/or contamination (current or presumed)
- Visual inspection to determine vegetation growth and health (from a qualified person such as a biologist or ecologist).
- Searches of historic land use changes on the site to determine the potential for contamination and disturbance.

Where the on-site soil survey indicates or confirms the possibility of disturbance within the NHS, soil testing – on-site and/or laboratory analysis – may be required to confirm existing soil parameters: **compaction, organic matter content, pH, and depth.** Acceptable ranges/values for each parameter are listed in Table 2 of Appendix A. Soils outside of the range/value for a parameter may be classified as disturbed. Table 2 was developed through a review of best practices in the field of soil health.

If laboratory testing is required, soil samples must be sent to an accredited soil testing laboratory (see Appendix A). Existing soil should be tested via multiple samples taken at evenly distributed locations throughout the target area (i.e. NHS). A minimum of five measurements per hectare is recommended. If the area is smaller than 1 ha, a minimum of five samples should be taken.

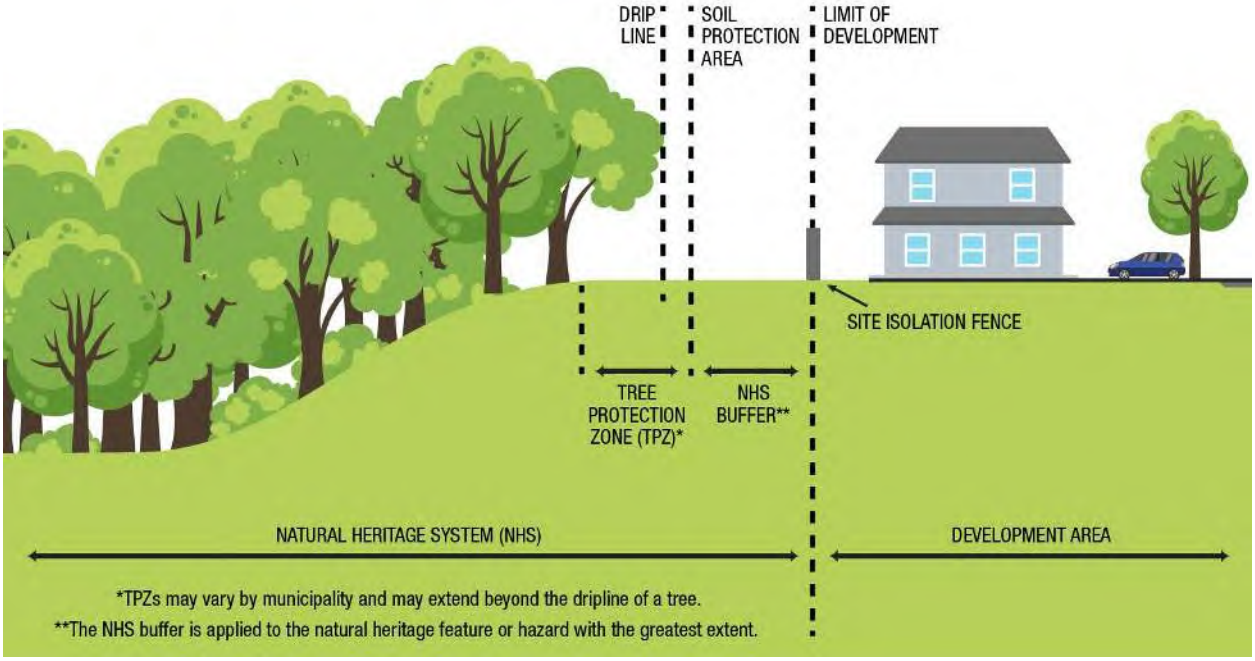
2.1 Protect and Preserve Existing Soil

Condition of Soil	Management Option	Applicable to:
Existing topsoil and subsoil undisturbed	Protect and preserve existing soil	• Existing natural heritage features • Existing buffers to natural heritage features • Proposed restoration areas

General Recommendations:

1. After verifying the soils are ***undisturbed***, a ***soil protection area*** should be delineated with isolation fencing. This can be coordinated with other required fencing as set out by the local municipality or CVC such as tree hoarding, erosion and sediment control or other barrier fencing to provide design efficiencies. Fencing, as depicted in Figure 2, must encompass the area at the *greatest limit* of:
    a) the ecological buffer to any recognized natural heritage feature/system or natural hazard as delineated and prescribed by a municipality, Conservation Authority or other agency (e.g. woodland dripline, wildlife habitat, top of bank, top of slope, *etc.*); or
    b) the tree protection zone which may be outlined by municipal tree protection standards (where they exist).

Figure 2: Limit of Site Isolation Fencing



2. Within the soil protection area, traffic, parking, stockpiling, staging and material storage are not permitted.

3. Ensure fencing is coordinated among site plan, grading plans, erosion/sediment control plans and restoration plans.

4. Fencing should be informed by/comply with Erosion and Sediment Control and/or tree protection guidelines as set out by local municipality and/or CVC.

5. Areas within the soil protection area that are bare at the time of project initiation should be seeded with an appropriate seed mix for the site conditions to discourage non-native plant establishment, promote ecological function and prevent soil loss. See CVC's Seed Mix Guidelines: http://www.creditvalleyca.ca/wp-content/uploads/2013/05/planning-seedmix-flyer-may-20131.pdf.

6. If work has been prescribed *within* the soil protection area that would impact existing vegetation (e.g. invasive species removal), a mitigation plan is recommended and further consultation with CVC and the local municipality is advised. Examples of mitigation considerations include: appropriate timing of work to minimize compaction, using no or low pressure machinery, using soil mats or mulch to reduce compaction, *etc*.

2.2 Amend Existing Soil

Condition of Soil	Management Option	Applicable to:
Existing topsoil and/or subsoil disturbed	Amend existing soil	• Existing buffers to natural heritage features • Proposed restoration areas

Process Recommendations:

1. The results of the on-site soil survey and/or laboratory testing should be evaluated against acceptable ranges for soil health parameters indicated in Table 2 of Appendix A. This will determine if amendments are necessary prior to landscaping and restoration work.

2. Disturbed sites should also be evaluated against a ***natural feature reference site*** to determine if the existing depth of topsoil is sufficient to promote the long-term growth and establishment of the target ecological community. The selection of a natural feature reference site should be done in consultation with CVC and the local municipality.

3. **For topsoil depth deficiencies:** Where deficiencies are identified, a plan must be developed in concert with CVC and the local municipality to achieve the target. The recommended depth will vary depending on the natural feature reference site and target ecological community.

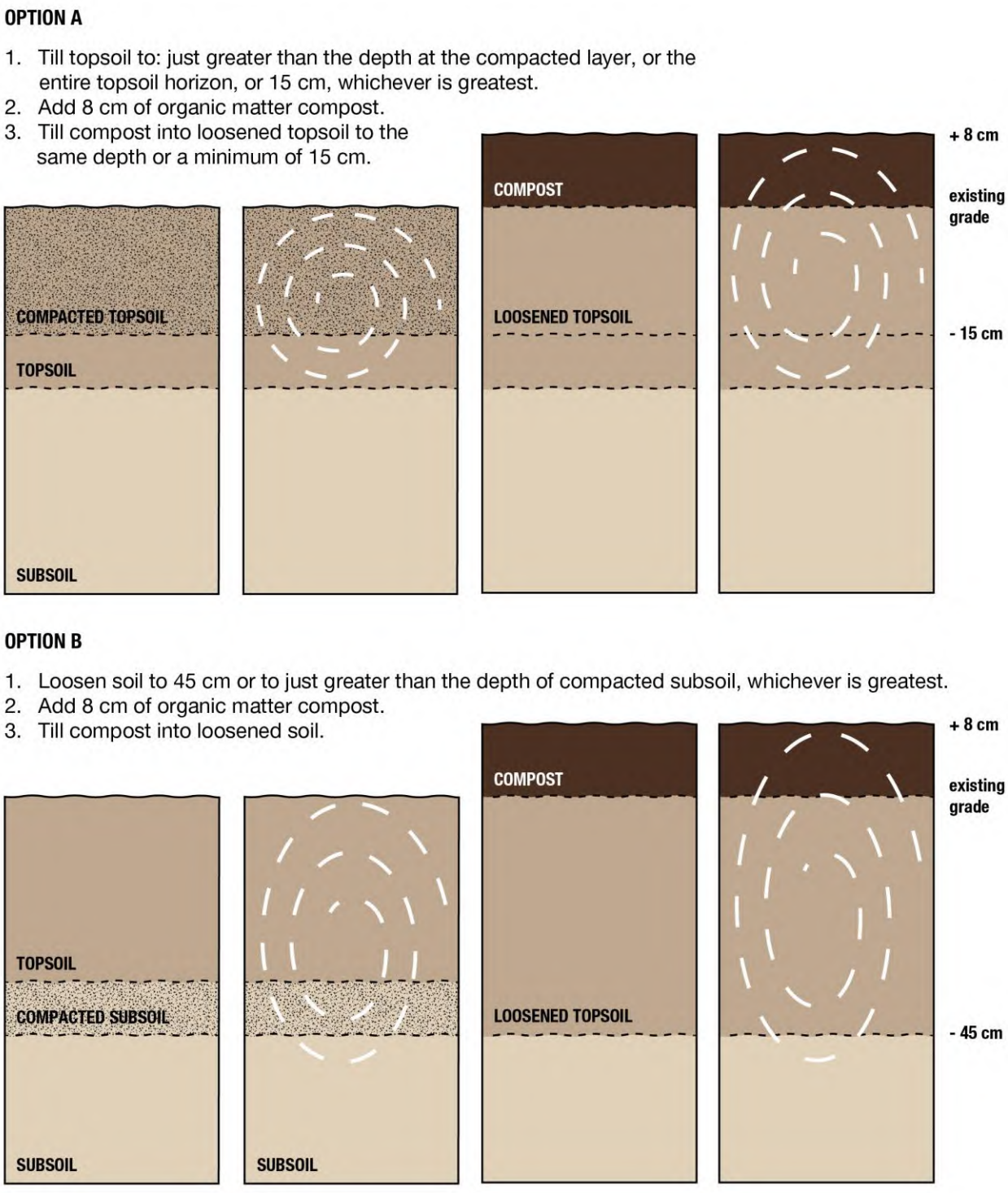
4. **For compaction and organic matter deficiencies**, incorporate compost amendments in <u>one</u> of the following ways (see figure 3):

    a) **Where existing topsoil is compacted or deficient in organic matter**:
    - Amend at a default rate: Till the topsoil to just greater than the depth of the compacted area, or the entire topsoil horizon, or 15 cm, whichever is greatest. Spread 8 cm of organic matter compost on the surface of the tilled soil and till the compost into the loosened soil to the same depth if possible, or a minimum of 15 cm. This option may be pursued if a proponent decides to forgo detailed soil analysis/testing.
    - Alternatively, amend via a custom calculated rate based on the results of soil testing to determine the depth and quantity of organic matter compost amendments needed to make a final topsoil that meets the thresholds for organic matter content and compaction in Table 2 of Appendix A.

    b) **Where topsoil is present (and not being stripped) but deficient in organic matter and subsoil is compacted** (e.g. former agricultural fields):
    - Loosen subsoil by deep tilling/subsoiling/ripping to a depth greater than the compacted subsoil depth indicated by soil sampling, or to a depth of 45 cm, whichever is greatest. Spread 8 cm of organic matter compost on the surface of the tilled soil and till the compost into the loosened soil.
    - Alternatively, amend via a custom calculated rate based on the results of soil testing to determine the depth and quantity of organic matter compost

needed to make a final topsoil that meets the thresholds for organic matter content and compaction in Table 2 of Appendix A.

Figure 3: Amending Existing Soil options a and b



5. **For pH amendments:** If pH amendments are specified in the soils analysis results, the project ecologist should review the existing soil pH against the intended restoration target and the suitability of the proposed plantings to determine if pH amendments are required for the target to be achieved. Results should be discussed with the local municipality and CVC.

6. **Where topsoil is absent or has been stripped**, see section 2.3 *Import Healthy Topsoil*.

General Recommendations:

7. Compost used for organic matter amendments must meet Ontario Compost Quality Standards (MOE, 2012). Use compost that meets category AA for amending site subsoil, or category AA or A for amending site topsoil. Compost should be obtained from a supplier certified by the Compost Council of Canada's Compost Quality Assurance (CQA) program and meet the CQA program requirements for use as a soil amendment (A&L Canada Laboratories, 2004). Consult local municipal by-laws as appropriate.

8. Organic matter used for amendments must not contain or be derived from sphagnum peat or contain uncomposted manure.

9. Soil can be loosened by deep tilling/subsoiling/ripping. This is only effective if done under dry conditions; it must not be done when soil is wet or frozen. Loosening should be timed to ensure subsequent traffic does not re-compact the soil.

10. Improving soil health and planting conditions includes amending the entire planting area, not only the immediate area around the plant material/roots.

11. In some situations tilling/subsoiling/ripping activities to amend the soil are not recommended, such as within tree protection zones or certain natural heritage features and ecological buffers. If plans are required for a project, they must clearly indicate areas where soil loosening activities will and will not occur. Please consult with CVC and the local municipality.

12. Areas that have bare soil after loosening and amendment should be seeded with an appropriate cover crop and/or seed mix for the site and intended restoration target in order to discourage non-native plant establishment, promote ecological function and prevent soil loss. See CVC's Seed Mix Guidelines: http://www.creditvalleyca.ca/wp-content/uploads/2013/05/planning-seedmix-flyer-may-20131.pdf.

2.3 Import Healthy Topsoil

Condition of Soil	Management Option	Applicable to:
Topsoil absent/stripped; subsoil present only	Import healthy topsoil	• Existing buffers to natural heritage features • Proposed restoration areas

Process Recommendations (see figure 4):

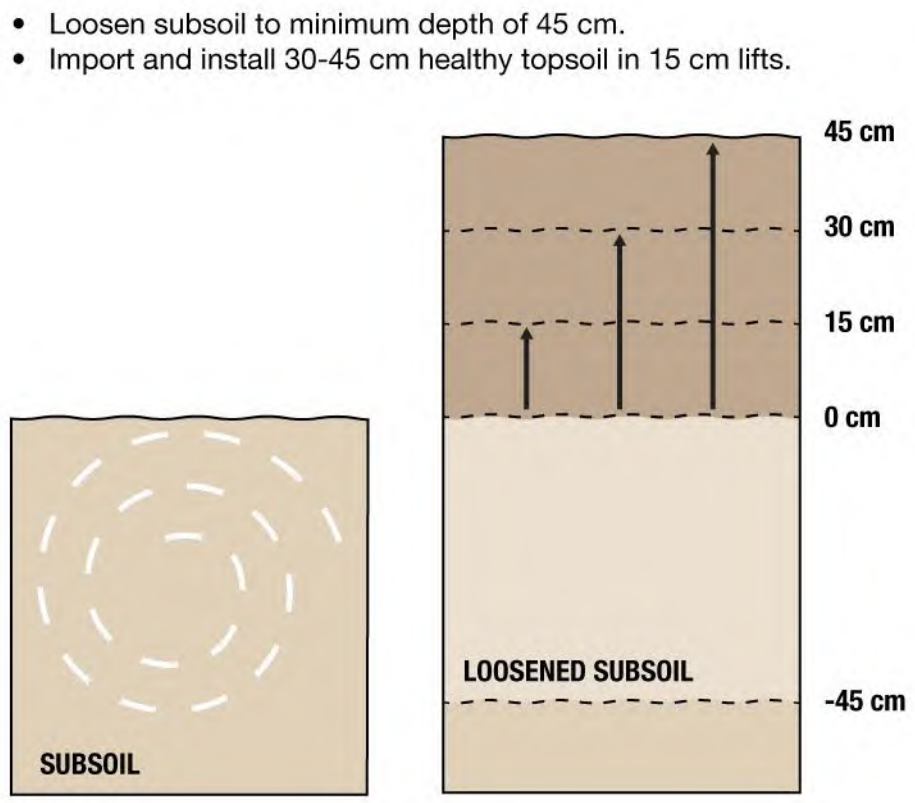
1. Prior to importing new topsoil, till and/or scarify the existing subsoil to address any compaction to a depth of 45cm.

2. Import new topsoil that meets the specifications in Table 2 of Appendix A. Imported topsoil must also meet any requirements/standards set out by the local municipality, where they exist.

3. Spread topsoil over the entire area to a settled depth of 30 – 45 cm for a final uncompacted soil depth of 75 – 90 cm.

4. It is recommended that topsoil be placed in lifts of 15 cm.

Figure 4: Importing Healthy Topsoil



General Recommendations:

5. Use only low ground pressure machinery (e.g. rated to <4 PSI) to re-apply the topsoil or compost amendments in order to avoid additional compaction.

6. Reduce machinery traffic required to re-spread topsoil or compost amendments by defining access areas/pathways.

7. Loosening the soil can be effected by deep tilling/subsoiling/ripping. This is only effective if done under dry conditions; it must not be done when soil is wet or frozen. Loosening should be timed to ensure subsequent traffic does not re-compact the soil.

8. Ensure that topsoil has been wetted after machinery has ceased operation on the site. Topsoil must be allowed to settle for at least one week prior to verification tests.

9. Depth and compaction must be verified in the field at the completion of the works, prior to planting. Post-installation depths are best measured using soil pits. Post-installation soil compaction is best measured on-site using cone-penetrometer tests. A minimum of five sample locations per area should be tested to verify both depth and compaction.

10. In some situations, tilling/subsoiling/ripping activities to amend the soil are not recommended, such as within the dripline of a tree, tree protection zones associated with existing trees or certain natural heritage features and ecological buffers. If plans are required for a project, they must clearly indicate areas where soil loosening activities will and will not occur. Please consult with CVC and the local municipality.

2.4 Preserve Soil Health, Install Healthy Soil

Condition of Soil	Management Option	Applicable to:
Topsoil is or will be stockpiled	Preserve soil health	• Topsoil stockpiles • Areas where stockpiled soil will be re-spread

Table 1 lists the best management practices that apply to soils that have been/will be stockpiled and ultimately will be used for restoration *within the NHS*. Soil that is being stockpiled for other applications is outside the scope of this document.

Table 1: Management recommendations for stockpiled topsoil

Parameter	Recommendations
Selection of soil salvage sites / **Preventing Invasive species spread**	• Avoid salvaging soil for use in the NHS from areas with high concentration of invasive species. • Machinery and equipment used in the salvage and/or re-spreading of soils that have also been previously used in invasive-species infested areas should be cleaned before use to minimize potential spread.

Height of Stockpiles	• Less than 1.3 m for topsoil. • Design to maximize surface area to volume ratio of the stockpile to minimize impacts to soil microorganisms. • Stockpiles material should be dry

Separation of Layers	• Soil horizons should be stripped in shallow layers.
	• Separate stockpiles should be created for:
	  ○ Topsoil vs. subsoil.
	  ○ Uppermost layer of topsoil (typically the most productive).
	  ○ Soils with different textures (i.e.: sandy soils vs. clay soils) (see figure 5a).

Erosion control	• Stockpile areas are to have appropriate erosion and sediment controls (as dictated by local municipal standards and CVC requirements).
Stabilization	• Soils that are stockpiled and not actively used for a period greater than 30 days should be stabilized with an appropriate treatment for the time of year, intended use and site activities. Options include stabilizing with an appropriate cover crop (Refer to CVC Seed Mixes http://www.creditvalleyca.ca/wp-content/uploads/2013/05/planning-seedmix-flyer-may-20131.pdf), or through the use of a mulch blanket or pervious geotextile.
Duration	• Minimize duration of stockpiling to reduce potential for anoxic conditions. Topsoil should be stockpiled for no longer than one year. If longer, further discussion with CVC is required to address the ecological function of soil.
Testing (pre- and post-installation)	• Conduct a test of existing soil conditions to determine the depth and composition of topsoil and subsoil prior to stripping and stockpiling. This will affect how the stockpiling occurs. • Evaluate the quality and quantity of stockpiled soil prior to re-spreading to ensure it meets the values in Table 2 of Appendix A. • Depth and compaction must be re-tested in the field at the completion of works, prior to planting. Post-installation depths are best measured using soil pits. Post-installation soil compaction is best measured on-site using cone-penetrometer tests. A minimum of five sample locations per area should be tested to verify both depth and compaction.
Rebuilding the Soil Profile (amending and installing stockpiled soil)	• Prior to re-spreading stockpiled soil, mix individual stockpiles to inoculate interior layers with soil from the outermost levels. Do not mix soil from different stockpiles (see figure 5b). • When re-spreading soil from multiple stockpiles, always use the same sequence of horizons to avoid burying surface layers with underlying material (see figure 5b). • **If stockpiled topsoil meets the specifications in Table 2 of Appendix A for organic matter:** follow the recommendations in section 2.3 for installation. • **If stockpiled topsoil does not meet the specifications in Table 2 of Appendix A for organic matter content:** Loosen existing subsoil to a depth of 45 cm. Amend stockpiled topsoil with organic

	matter compost at a ratio of 3:1 and apply to the subsoil in lifts. Each lift can be composed of 4 cm compost and 12 cm of topsoil (see figure 5c). Incorporate the compost and topsoil through tilling to a depth of approximately 15 cm prior to adding an additional lift. Continue this process to produce a settled, amended topsoil depth of 30 – 45 cm and a total depth of uncompacted soil of 75 – 90 cm.

Figure 5a: Create separate stockpiles (max. 1.3 m high) for soils of different layers or textures.

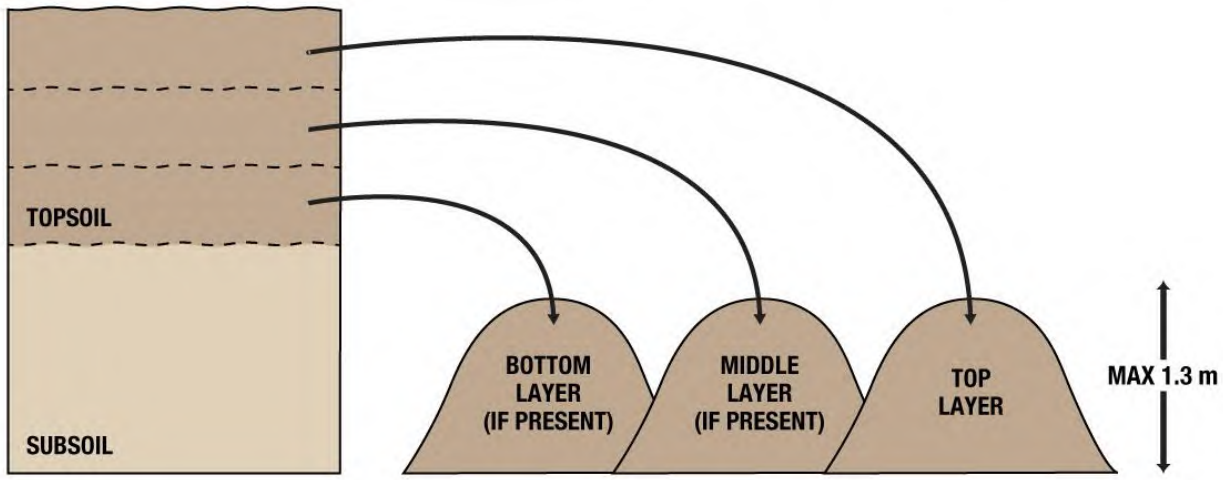


Figure 5b: Rebuild the soil profile (if topsoil is healthy).

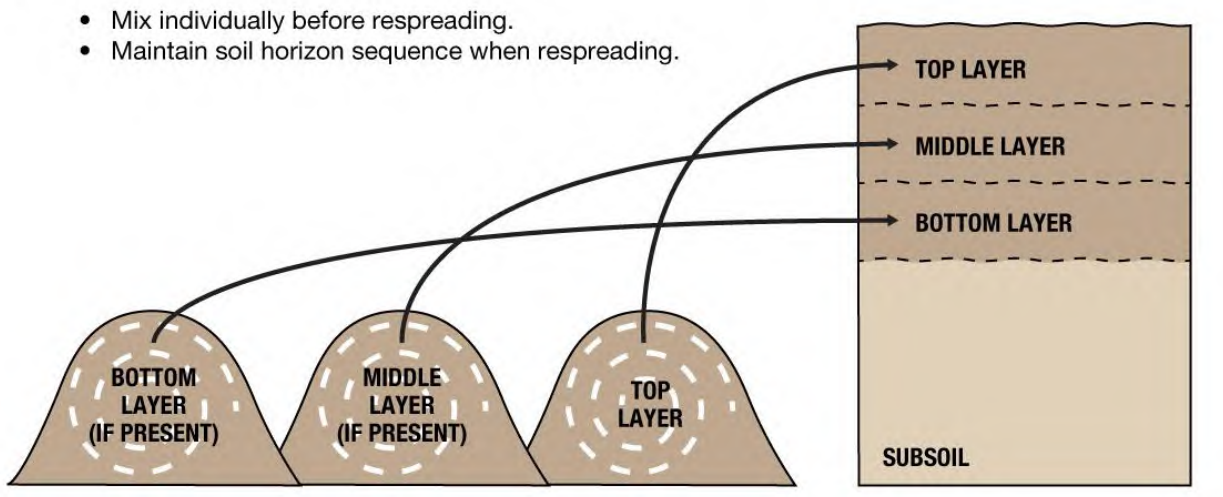
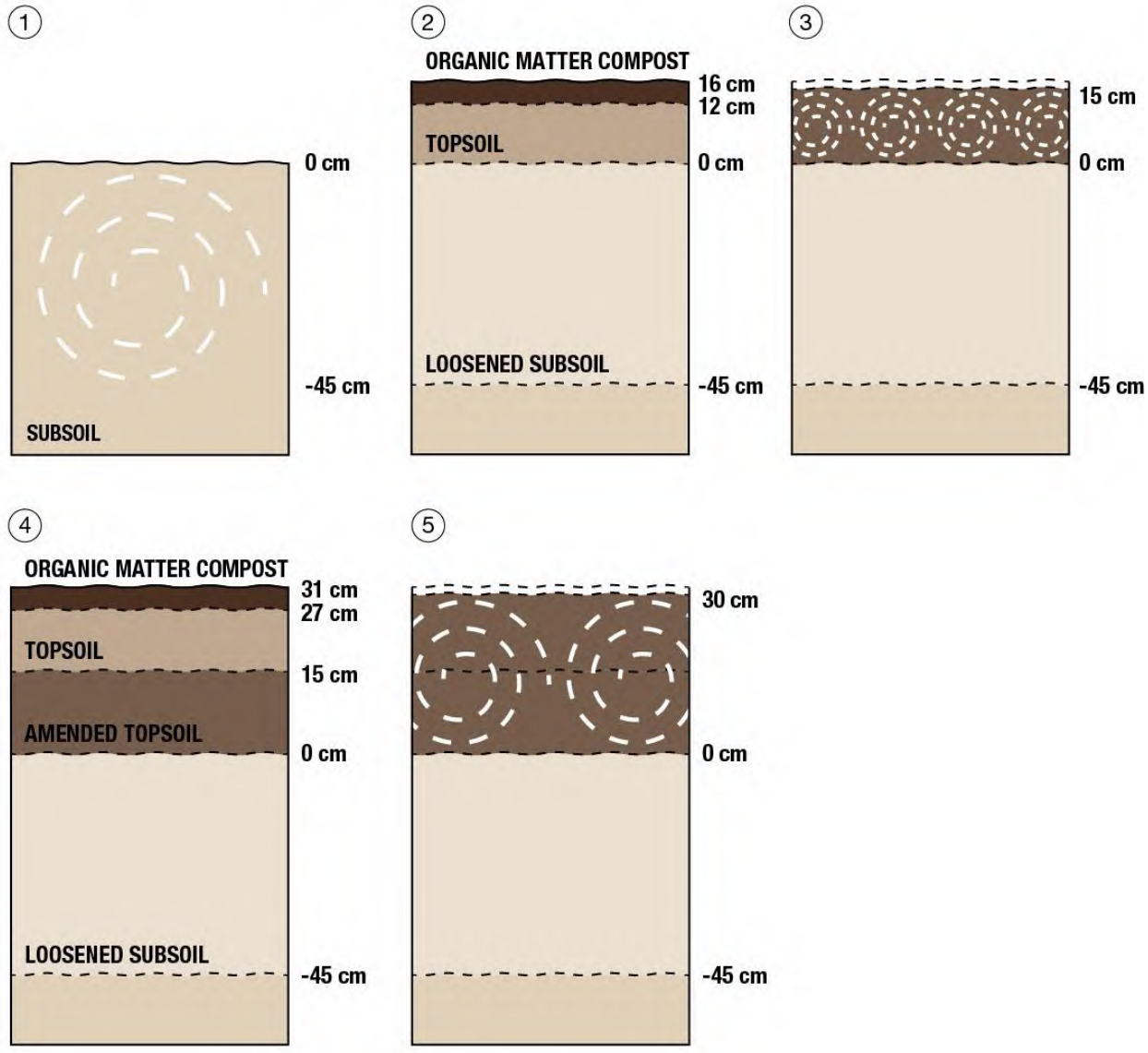


Figure 5c: Rebuild the soil profile when stockpiled soils are deficient in organic matter.

1. Loosen soil to 45 cm.
2. Layer 12 cm of topsoil and 4 cm of organic matter compost.
3. Till compost and topsoil, settled to 15 cm.
4. Layer 12 cm of topsoil and 4 cm of organic matter compost.
5. Till compost and topsoil, settled depth of 30 cm.



3 Glossary

A horizon: Typically the upper-most layer of mineral soil closest to the surface.

Disturbed soils: Soils that do not meet the definitions of ***undisturbed*** or ***stripped***.

Ecological Buffer: A vegetated area surrounding a natural feature in which only those land uses permitted within the feature or area itself are permitted. A buffer protects the feature and its functions from potential impacts and where possible, restores or enhances the feature including its ecological and hydrological functions (adapted from CVC, 2010).

Natural Heritage Feature: A feature or area containing woodlands, wetlands, valleylands, wildlife habitat which are important for environmental and social values (adapted from CVC, 2010).

Natural Feature Reference Site: A site within the same local geographic area and supporting the intended target ecological or vegetation community. In the case of ***ecological buffers***, the reference site is typically the adjacent ***natural heritage feature*** which is associated with the buffer, unless the conservation authority and municipality direct otherwise. A natural feature reference site would provide information on a reference soil, which is a healthy native soil that supports the intended target ecological or vegetation community.

Natural Heritage System (NHS): A system made up of natural heritage features and areas, and linkages intended to provide connectivity (at the regional or site level) and support natural processes which are necessary to maintain biological and geological diversity, natural functions, viable populations of indigenous species and ecosystems. These systems can include natural heritage features and areas, federal and provincial parks and conservation reserves, other natural heritage features, lands that have been restored or have the potential to be restored to a natural state, areas that support hydrologic functions and working landscapes that enable ecological functions to continue. (Provincial Policy Statement, 2014)

On-site soil survey: An investigation of existing soil conditions on a site to confirm soil presence, texture, depth, compaction, signs of contamination and any other parameter of concern.

Restoration Area: An area of land that will receive activities that initiate or accelerate the recovery of an ecosystem with respect to its health, integrity and sustainability (adapted from the Society for Ecological Restoration).

Soil protection area: An area in which the existing soil will be protected in-situ. Development and site alteration in this area is typically restricted in order to preserve soil health and physical properties.

Stockpiled soil: Soil that has been stripped/excavated from the original grade and stored (typically on-site) for later re-use.

Stripped soils: Soil where the ***A horizon*** (or more) has been stripped and relocated.

Subsoil: Soils lacking in organic matter and consequently not desired for growing medium, typically referred to as “B” horizon

Topsoil: Naturally produced and harvested soil from the A horizon or upper layers of a soil (O horizon).

Undisturbed soils: Soils where:

- the original ***A horizon*** is intact and has not been previously stripped, excessively compacted or otherwise contaminated;
- the A horizon is at least 15 cm deep and subsoil horizons with acceptable compaction, if the area has been previously farmed; and,
- existing vegetation growth is supported and in good health as determined by an ecological professional[1]. Soils in existing forested areas are presumed to be undisturbed. If existing soil is functional but does not meet the acceptable range for depth or organic matter in Table 2 of Appendix A, consideration can be made for leaving it in place.

[1] Some ecological communities may not support vegetation but do have functional soils which is why assessment from a professional is recommended i.e.: vernal pools.

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Appendix A

The acceptable parameters for soil health are described in Table 2 for each type of soil condition referred to in this document. Information has been adopted and adapted from multiple sources representing local and international best practices for soil health. The table does not represent a full suite of physical, chemical and biological parameters that affect soil health. Specific circumstances may exist that warrant additional parameters than those in Table 2 to be assessed (e.g. contaminated sites) which is outside of the scope of this document.

If laboratory testing is required, testing is to be performed by an accredited commercial soil laboratory using accredited test methods. See http://www.omafra.gov.on.ca/english/crops/resource/soillabs.htm for a list of current accredited soil testing laboratories in Ontario.

Table 2: Acceptable Soil Health Parameters

Parameter	Undisturbed Soils	Disturbed Soils	Stripped Soils	Stockpiled Soils
Topsoil Depth	Retain existing topsoil depth.	Maintain/restore a topsoil depth comparable to a ***natural feature reference site***.	Re-spread 30 – 45 cm topsoil on top of 45cm scarified subsoil	Re-spread 30 – 45 cm topsoil on top of 45cm scarified subsoil
Organic matter content	As existing	10 – 13% by dry weight	10 – 13% by dry weight	10 – 13% by dry weight
Soil pH	As existing	6.0 – 7.5	6.0 – 7.5	6.0 – 7.5
Soil Texture	As existing	No range exists. Soil treatments to be tailored to existing or expected site conditions for the local area and target ecological community. To be designed by the ecological professional.		
Soil Compaction	Bulk Density or Penetration-Resistance tests are acceptable. **Bulk Density** can be calculated based on a soil core taken in the field and will vary based on soil texture which may not be consistent over a site. This test is most accurate when samples are handled			

Parameter	Undisturbed Soils	Disturbed Soils	Stripped Soils	Stockpiled Soils

with care to avoid agitation during transport.

Soil Texture	Ideal Bulk Densities for plant growth[2] (g/cm^3)
Sands, loamy sands	<1.60
Sandy loams, loams	<1.40
Sandy clay loams, clay loams	<1.40
Silts, silt loams	<1.40
Silt loams, silty clay loams	<1.40
Sandy clays, silty clays, clay loams	<1.10
Clays (>45% clay)	<1.10

Alternatively, compaction can be measured in-situ as a function of **penetration-resistance**.[3] Penetration-resistance is the preferred method of testing for compaction in soils that have been modified by loosening activities, and for verifying post-installation compaction for soils that have been stripped/stockpiled and re-spread.

Soil Texture	Surface Resistance PSI	Surface Resistance kg/cm2	Surface Resistance KPa
Sandy – loamy sand, sandy laom, sandy clay cloam and sandy clay	<=260	<=18.3	<=1793
Silty – loam, silty loam, silty clay loam, and silty clay	<=260	<=18.3	1793
Clay – clay loam	<=225	<=15.8	<=1551

[2] Adapted from USDA-NRCS, 2003. Values of bulk density in existing woodlands is typically between 1 – 1.34Mg/m3 (Forests Ontario, 2015).

[3] Values are as per TRCA, 2012. Penetration Resistance is a more inexpensive and rapid method of testing for compaction but it is not always accurate and the results may be misinterpreted.

Credit Valley Conservation
inspired by nature

Guidelines for Designing Enhancement Plans within Setbacks and Buffers



Prepared by: Credit Valley Conservation

August 2023

Contents

Guidelines for Designing Enhancement Plans within Setbacks and Buffers .. 1
Tables 3
Figures 3
Section 1 - Overview 4
Section 2 - Creating an Enhancement Planting Plan 5
Section 3 - Buffer Strip Planting Design 7
Step 1: Determine the Number of Trees and Shrubs Required: 7
Step 2: Choose Your Planting Form 7
Step 3: Select Plant Species 8
Section 4 - Mass Planting Enhancement Design 9
Step 1: Determine the Number of Mass Planting Groups Required: 9
Step 2: Determine the Number of Trees and Shrubs Required: 9
Step 3: How Moist is Your Soil? 10
Section 5 - Recommendations for Site Preparation and Timing 11
1. Ensure Healthy Soil Prior To Planting 12
2. Preserving Existing Herbaceous Layer 12
3. Establishing a Native Herbaceous Layer 12
4. Protecting Existing Trees and Shrubs 12
5. Choosing of Plant Material 12
6. Planting Windows 13
7. Application of Ground Cover / Seed Mix 14
8. Plant Material Protection 14
9. Structural Barriers 15
10. Maintenance Phase 15
Appendix A: Suggestions for Buffer Strip and Enhancement Node Plant Groupings
Suggested Groupings for Buffer Strips: 16
Screening / Windbreak (shrubs): 16
Living Fence / Encroachment Barrier: 16
Riparian Areas: 16
Erosion Prevention / Top of Slope: 17

Suggested Groupings for Enhancement Nodes..... 18
Dry-fresh Soil 18
Fresh-moist Soil 18
Moist Soil or Floodplain:..... 19
Appendix B: Example Planting Plan 20

Tables

Table 1 Possible project types that the Guideline could be used for and not used for. 4
Table 2 Potentially suitable species grouped to ecological function. 8
Table 3 Suitable tree species for each soil moisture group. Choose three to five tree species including a mast tree. Species listed may include the following notes 1: Mast tree and/or food producing shrub, 2: North of Brampton only, 3: Not in beaver-prone areas..... 10
Table 4 Suitable shrub species for each soil moisture group. Choose a minimum of two shrub species. Species listed may include the following notes 1: Mast tree and/or food producing shrub, 2: North of Brampton only, 3: Not in beaver-prone areas..... 11
Table 5 Plant material type and size in millimetres (mm), centimetres (cm) and hectares (ha)..... 12
Table 6 Optimal planting times for trees, shrubs, and live stakes. 14

Figures

Figure 1 Flow chart to select the appropriate planting design. 6
Figure 2 Example of Buffer Strips within a plantable area that is 4 metres wide and 20 metres long..... 7
Figure 3 Example design and calculation for mass planting nodes within a plantable area; showing 19 trees and up to 19 shrubs, all within a CVC seed mix. 9

Section 1 - Overview

This document is to be used after the decision has been made to plant the setback and/or buffer. These guidelines are a tool to use when the recommendation to provide an Enhancement Plan has been requested through the Development and Permitting Process. In most cases, the Enhancement Plan will focus on naturalizing the area between an existing natural heritage feature and the permitted new land use (e.g., the area between a new factory and a watercourse); this area is typically referred to as either the *development setback* or the *ecological buffer*.

Where the intent of the setback/buffer is to mitigate potential impacts from the permitted land use change on an adjacent natural heritage feature (e.g., watercourse, wetland, woodland, significant wildlife habitat) these guidelines provide a consistent approach in the development of the Enhancement Plan. The setback and/or buffer will typically not already consist of native, self-sustaining vegetation. Therefore, the overall intent of these guidelines is to aid the user in creating an Enhancement Plan that will ideally meet the agreed intent upon first submission.

These guidelines provide the user with the following tools in the preparation of a successful Enhancement Plan.

- Recommended planting designs depending on available area;
- Species assemblages according to general soil moisture type or objective(s);
- Planting and design principles (e.g. when to plant, size of stock, etc.);
- Easy to follow density calculations.

Please note, this document is intended for use when required/recommended as part of a Development Application, however all or some of this resource may also be a helpful tool for other project types (**Table 1**):

Table 1 Possible project types that the Guideline could be used for and not used for.

To be used when:	Should not be used for:
Enhancing a setback/buffer next to any natural heritage feature type	Specialized habitat creation (e.g., prairie)
Stream realignments and/or channel works projects (e.g., restoration)	Stormwater Management Planting Plans or Streetscaping
Enhancement projects in/around existing natural heritage features	Forest Creation / Management that have long term management plans
Afforestation projects that have no long-term management plan	Planting in areas regulated for species at risk (SAR)

Section 2 - Creating an Enhancement Planting Plan

CVC (Credit Valley Conservation) has developed two design types for Enhancement Planting Plans depending on the area available for planting – Buffer Strips and Mass Plantings.

The first step is to determine the size of the plantable area; do either the length or the width of the plantable area measure as less than 10 metres-15 metres, or are each at least 15 metres or greater? Remember to first subtract any trail widths, municipal mown strips, and any existing natural vegetation from the plantable area calculation within the buffer. CVC can help to navigate which planting design would best suit your site.

If the plantable area width is narrow (i.e., a setback/buffer of less than 10 metres-15 metres), you will use the **Buffer Strip Planting Design** (page 7) together with trees and/or shrubs from the appropriate **Buffer Strip Species Assemblage** (Appendix A). Note that if the planting area is very small or is interior to a feature, consult with CVC to create a custom design to suit the purpose.

If the plantable area is wide (i.e., a setback/buffer of greater than or equal to 10 metres to 15 metres), you will use the **Mass Planting Design** (page 9) together with trees and shrubs from the appropriate **Mass Planting Species Assemblage** (Appendix A).

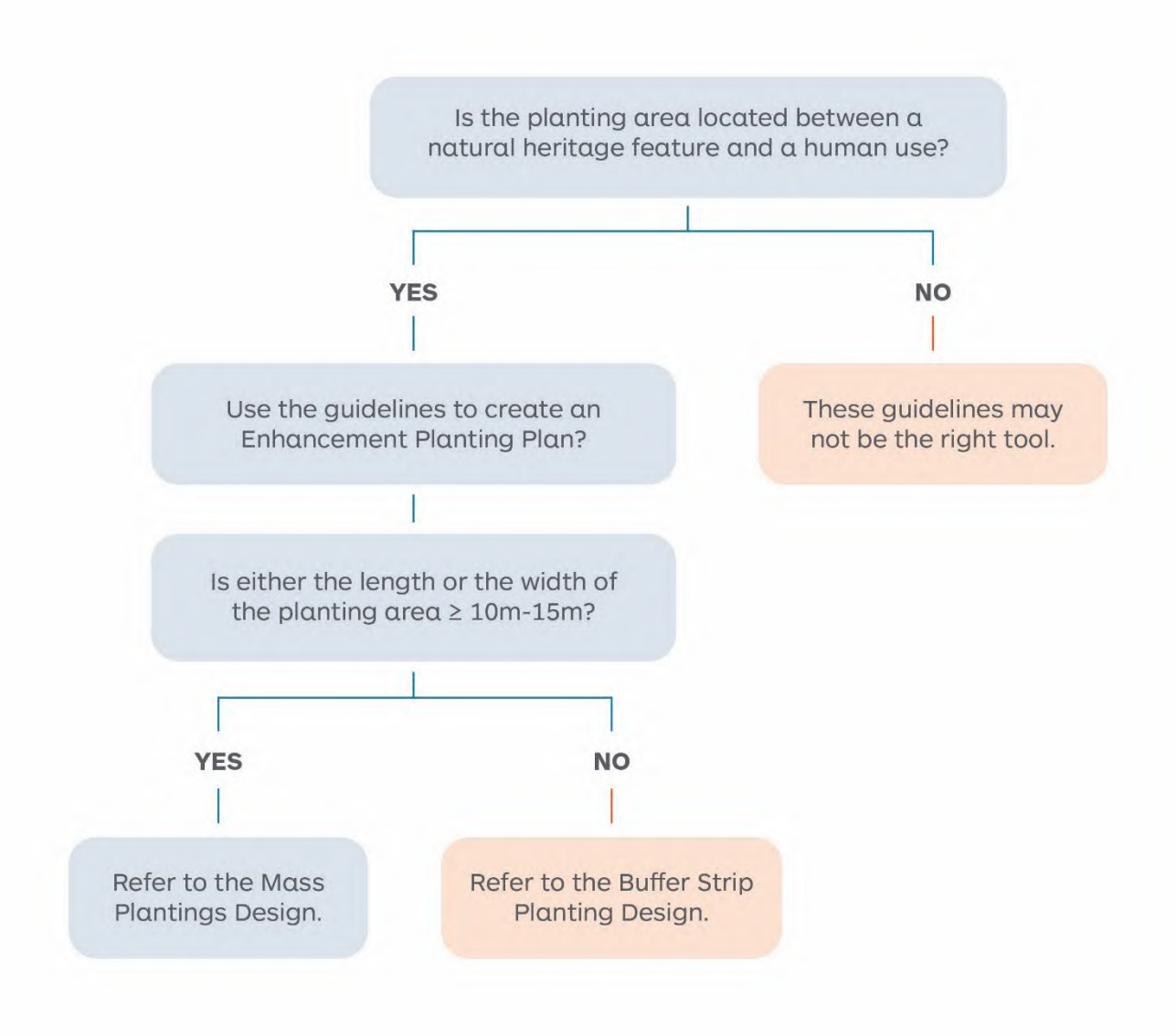


Figure 1 Flow chart to select the appropriate planting design.

When creating an Enhancement Planting Plan, remember to always include native species names, quantities, locations, size and material type, seed mixes, cover crops, planting times, and maintenance efforts. See Appendix B for an example.

Section 3 - Buffer Strip Planting Design

Each buffer strip is two metres wide and 10 metres long and designed to provide a targeted function towards protecting the natural heritage feature (e.g., shading, encroachment barrier, screening, erosion prevention).

Step 1: Determine the Number of Trees and Shrubs Required:

The Buffer Strips can be planted side-to-side and end-to-end to provide gap-free protection through dense plantings; they can be used in conjunction with the Mass Planting Design where space permits or used in narrow buffers.

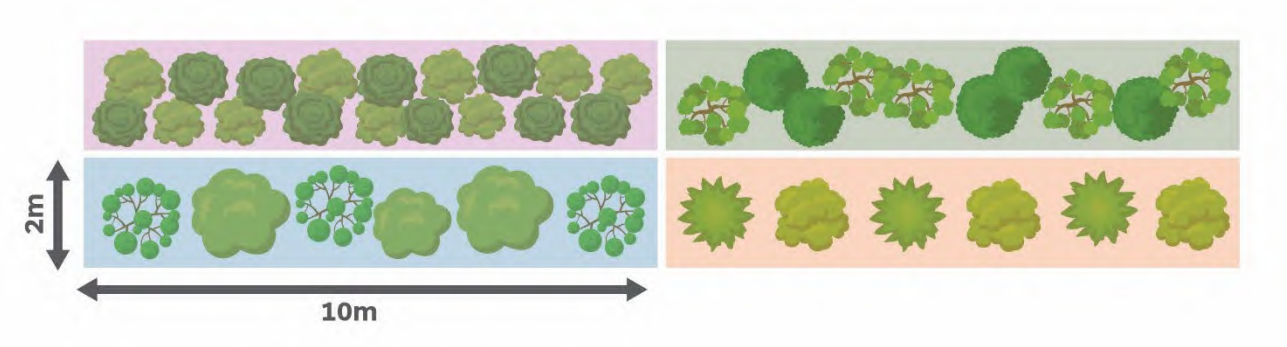


Figure 2 Example of Buffer Strips within a plantable area that is 4 metres wide and 20 metres long.

Step 2: Choose Your Planting Form

Plantings should mimic a natural forest edge with strips that contain small shrubs at the front, while placing trees and larger shrubs along the existing feature edge. Within each Buffer Planting Strip, tree and shrub density recommendations are as follows:

- Small shrubs only (1 metre to 1.45 metres on centre (o.c)): use 10 to 20 shrubs planted in staggered formation.
- Riparian strip: plant at least 20 live stakes nearest to the water's edge; 5 to 10 shrubs behind.
- Deciduous trees/large shrubs (2.2 metres o.c): use 5 trees/large shrubs planted in staggered formation with the smallest on the outer edge.
- Coniferous trees and/or large shrub species (1.45 metres to 2.2 metres o.c): use 5 to 10 trees/large shrubs planted in staggered formation.

Step 3: Select Plant Species

Identify the function(s) you want your buffer strip to achieve from the list below in **Table 2**, then select your tree and/or shrub species from the corresponding column(s) to fill your buffer strips. Your strip can be all one species or a mix of species from a functional group. Alternatively, choose one of the suggested Buffer Strip groupings from Appendix A.

Table 2 Potentially suitable species grouped to ecological function.

Ecological Function	Trees	Shrubs
Screening/ Windbreak	*Betula papyrifera* *Thuja occidentalis* *Picea glauca* *Pinus strobus*	*Cornus rugosa* *Prunus virginiana* *Rosa blanda* *Rhus typhina* *Ribes americanum* *Ribes triste* *Rubus occidentalis* *Rubus odoratus*
Living Fence/ Encroachment Barrier	*Betula papyrifera* *Thuja occidentalis* *Picea glauca* *Pinus strobus*	*Cornus sericea* *Cornus obliqua* *Salix sp.* *Ribes americanum*
Riparian Stabilization/ Shading	*Abies balsamea* *Acer x freemanii* *Acer rubrum* *Acer saccharinum* *Picea glauca* *Populus sp.* *Salix amygdaloides*	Shrubs or live stakes: *Cornus sericea* *Cornus obliqua* *Salix sp.* *Thuja occidentalis* *Ribes americanum*
Erosion Prevention/ Top of Slope	*Acer freemanii* *Acer saccharinum* *Pinus strobus* *Quercus alba* *Q. macrocarpa* *Quercus rubus*	*Cornus alternifolia* *Diervilla lonicera* *Prunus pensylvanica* *Prunus virginiana* *Rhus typhina* *Ribes americanum* *Rubus ideaus strigosus* *Rubus occidentalis* *Rubus odoratus*

Section 4 - Mass Planting Enhancement Design

This design consists of groups of mass plantings. Each group or node is 10 metres wide by 10 metres long (i.e., 100 square metres). The overall intent of the Mass Planting Design is to enhance and/or protect natural areas through the creation of a natural, self-sustaining vegetated buffer or connection (i.e., this will result in just over 1200 trees per hectare by placing 19 trees per group).

Step 1: Determine the Number of Mass Planting Groups Required:

Calculate your planting area to determine the number of Mass Planting groups that can fit within. Remember, a one hectare sized plantable area can accommodate 64 groups of Mass Plantings spaced two metres apart. See **Figure 3** for an example.

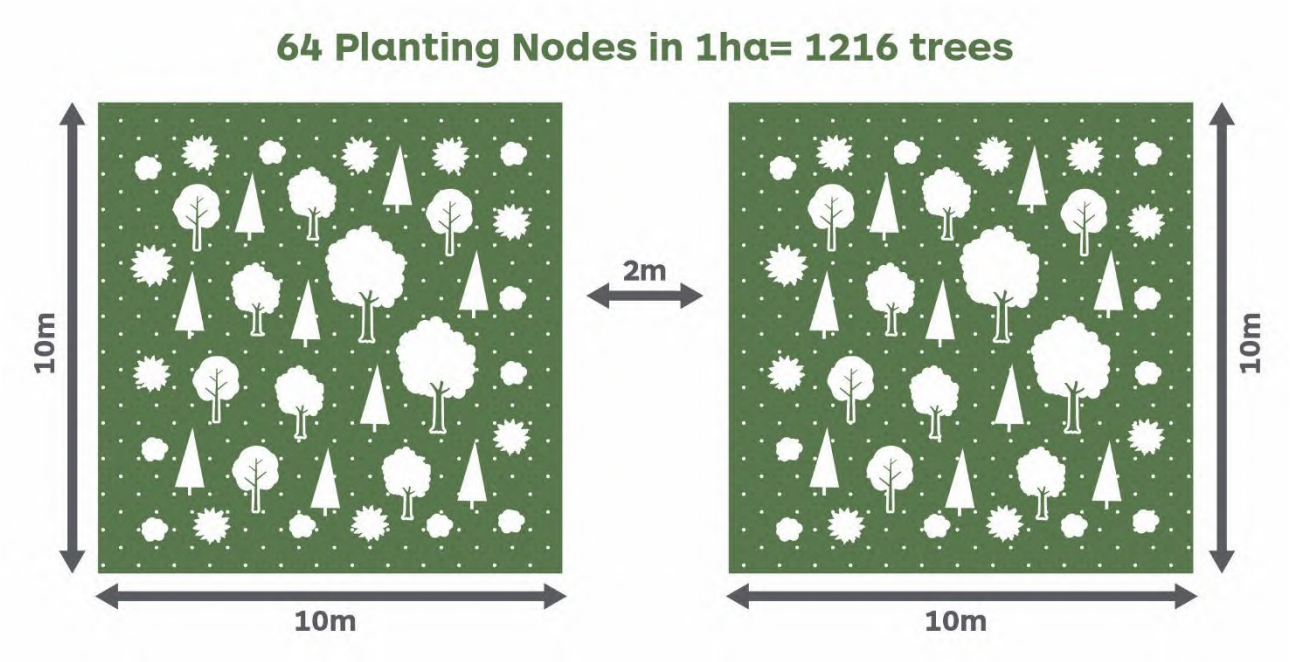


Figure 3 Example design and calculation for mass planting nodes within a plantable area; showing 19 trees and up to 19 shrubs, all within a CVC seed mix.

Step 2: Determine the Number of Trees and Shrubs Required:

Each Mass Planting Group should contain:

- 17 container grown trees (or 22 bareroot trees) and two caliper sized trees; 3 to 5 tree species.
- 15 to 19 shrubs planted along the outer edges of each group/node; minimum of two shrub species.

Groundcover throughout the entire planting area (i.e., inside, and outside of the nodes) is to be established with native, self-sustaining herbaceous cover (refer to CVC Plant

Selection Guidelines for seed mixes). A cover crop may be required prior to planting to secure soil and dissuade invasive species. Wholesale application of mulch is not recommended.

Step 3: How Moist is Your Soil?

Is the topsoil within the planting area generally moist, fresh, dry, or sandy? The answer will help decide which Mass Planting Species column will be most suitable for your planting area (CVC can help). Pick species from one of these soil moisture groups to fill your Mass Planting Plan (or choose from pre-selected nodal plant lists from Appendix A).

Consult with CVC or an ecological consultant for guidance; assemblage should consider the community type of adjacent feature (i.e., deciduous, or coniferous dominant).

Table 3 Suitable tree species for each soil moisture group. Choose three to five tree species including a mast tree. Species listed may include the following notes 1: Mast tree and/or food producing shrub, 2: North of Brampton only, 3: Not in beaver-prone areas.

Dry-Fresh Soil	Fresh-Moist Soil	Moist Soil and Floodplain
Carya ovata[1]	*Abies balsamea*	*Acer x freemanii*
Ostrya virginiana	*Acer nigrum*	*Acer nigrum*
Picea glauca[2]	*Acer x freemanii*	*Acer rubrum*
Pinus strobus	*Thuja occidentalis*	*Acer saccharinum*
Populus deltoides ssp *deltoides*	*Juglans nigra*[1]	*Betula allegheniensis*[3]
Populus grandidentata	*Pinus strobus*	*Betula papyrifer*[3]
Populus tremuloides	*Prunus serotina*[1]	*Juglans nigra*
Prunus serotina[1]	*Quercus macrocarpa*[1]	*Pinus strobus*
Quercus alba[1]	*Quercus rubra*[1]	*Populus balsamifera*[3]
Quercus rubra[1]	*Tilia americana*	*Populus deltoides ssp deltoides*
Thuja occidentalis	*Tsuga canadensis*	*Populus tremuloides*[3]
Tilia americana		*Quercus macrocarpa*[1]
Tsuga canadensis		*Salix amygdaloides*

Table 4 Suitable shrub species for each soil moisture group. Choose a minimum of two shrub species. Species listed may include the following notes 1: Mast tree and/or food producing shrub, 2: North of Brampton only, 3: Not in beaver-prone areas.

Dry-Fresh Soil	Fresh-Moist Soil	Moist Soil and Floodplain
Amelanchier laevis[1]	*Acer spicatum*	*Alnus incana*[Error! Bookmark not defined.,Error! Bookmark not defined.]
Cornus racemosa[1]	*Amelanchier arborea*[1]	*Cornus sericea*[1]
Cornus rugosa	*Cornus alternifolia*[1]	*Ribes americanum*
Diervilla lonicera	*Cornus sericea*[1]	*Ribes triste*
Hamamelis virginiana	*Lonicera canadensis*	*Rubus occidentalis*[1]
Prunus pensylvanica[1]	*Prunus pensylvanica*[1]	*Salix bebbiana*
Prunus virginiana[1]	*Ribes cynosbati*	*Salix discolor*
Rhus typhina	*Rosa blanda*	*Salix eriocephala*
Rubus occidentalis[1]	*Rubus allegheniensis*[1]	*Salix interior*
Rubus idaeus ssp strigosus[1]	*Rubus idaeus* ssp. *strigosus*[1]	*Salix lucida*
Rubus odoratus[1]	*Rubus odoratus*[1]	*Salix petiolaris*
Sambucus canadensis	*Salix discolor*	*Sambucus canadensis*[1]
	Sambucus racemosa	*Spiraea alba*
	Thuja occidentalis	*Thuja occidentalis*
	Viburnum lentago[1]	*Viburnum opulus ssp. trilobum*

Section 5 - Recommendations for Site Preparation and Timing

Prior to planting, ensure that the site is cleared of invasive vegetation. When clearing any vegetation, it is important to avoid contravention with the Migratory Birds Convention Act; vegetation clearing should be avoided between April and August of a given year and a note stating this should be added to site plans.

1. Ensure Healthy Soil Prior To Planting

Ensure that the existing soil is healthy prior to planting and seeding by following the CVC Healthy Soil Guidelines for the Natural Heritage System.

2. Preserving Existing Herbaceous Layer

If a native ground cover layer is present and soil conditions are adequate, it is recommended that topsoil and groundcover be retained and if possible, mown to facilitate planting.

3. Establishing a Native Herbaceous Layer

If the existing community is dominated by non-native or invasive species, an Invasive Species Removal Strategy may be recommended. A list of tools and resources is available on CVC's website. Consultation with CVC is free and recommended.

4. Protecting Existing Trees and Shrubs

To minimize negative impacts from adjacent land uses, root pruning, installation of tree protection fencing/hoarding (as per municipal standards), moisture protection efforts (e.g., mulch), and/or compaction mitigation can be applied. If using tree protection fencing, note that it is to be located along the buffer's outer limit to avoid compacting the soil before installing enhancement plantings within the buffer.

5. Choosing of Plant Material

To achieve the expected ecological function with minimal maintenance and within a reasonable time frame, the trees and shrubs obtained for planting should meet size criteria as shown below in **Table 5**.

Table 5 Plant material type and size in millimetres (mm), centimetres (cm) and hectares (ha)

Plant Material	Type	Size
Trees	Caliper - Wire basket / Ball and burlap	4cm to 6cm diameter at breast height (DBH)
	Container grown[1]	1.5 m to 2.5 m in height;

Plant Material	Type	Size
	Bare root – plant at 1400/ha	30cm+ size; larger preferred
Shrubs	Container grown	0.4 m to 1.0 m in height; over 40mm caliper
	Live stake[1]	0.5 m to 1.0 m in length

Live Stake Detail Notes:

- Live Stakes must be cut from dormant materials.
- Live Stakes shall be planted the same day as harvested or stored for a period no longer than two days.
- The contractor shall protect plant materials from drying and overheating at the time of harvest, during transport and during the construction process.
- Live Stakes must be 2 to 4 centimetres diameter and cut to a length of 1.0 to 1.5 metres.
- Make an angle cut at the basal end, or bottom of the stake.
- Trim all side branches, taking care not to damage the bark.
- DO NOT plant upside down.
- Live Stakes should be installed using a deadblow hammer (large rubber mallet with the head filled with lead pellets).
- 80 per cent of the stake is to be below the surface.
- Gently tamp the Live Stake into the ground at right angles to the slope
- If the soil is compact, a pilot hole made with a steel bar should be used.
- If using a pilot hole, re-pack soil around the stake.
- Density of Live Stakes to be four per square metre (higher densities might be warranted in different situations).

6. Planting Windows

Optimal planting times vary depending on the type of plant material. **Table 6** below provides the recommended planting times for trees, shrubs, seed mixes, and cover crops (refer to CVC's Cover Crop Selection Tool in CVC's Plant Selection Guidelines 2018).

Table 6 Optimal planting times for trees, shrubs, and live stakes.

Material Type	Planting Time							
	Apr	May	June	July	Aug	Sept	Oct	Nov
Caliper trees	yes	yes	yes	no	no	yes	yes	yes
Large container grown	yes	yes	yes	no	no	yes	yes	no
Bare Root (kept moist prior; mulch mats applied after)	yes	yes	no	no	no	no	no	no
Shrubs (container grown)	yes	yes	yes	no	no	yes	yes	no
Live stakes (above bankfull)	yes	yes	no	no	no	no	yes	yes

7. Application of Ground Cover / Seed Mix

Once the soil has been cleared of non-invasive competing groundcover, CVC's recommended seed mix(es) and cover crop(s) can be used to create the appropriate groundcover assemblage (Refer to CVC's Plant Selection Guideline, 2018). CVC can be consulted for information on basic seed establishment practices. Tending of groundcover will be required until trees / shrubs have attained free-to-grow height. Please note that further erosion control measures may be needed on slopes greater than 3:1 (please see CVC/TRCA Erosion Control Guideline, 2020).

8. Plant Material Protection

There are cases where herbaceous vegetation suppressants may be required to facilitate the success of newly planted material; coir mats may be installed around trees and shrubs. Tree shelters and/or repellant is suggested for tree and shrub stems to deter browsing in areas with high concentrations of mice, voles, rabbits, fox, beaver or deer (please note tree guard should be removed as per warranty specifications).

Note that the wholesale application of mulch within the restoration area is not recommended as this would inhibit native groundcover growth. However, the application of mulch or the placement of coir mats around the newly planted trees and shrubs can be beneficial.

If you are interested in keeping people and animals out of your newly planted area, try planting with species that deter them, such as thorny raspberries (*Rubus occidentalis, Rubus idaeus ssp. strigosus*); to deter geese, refrain from mowing.

9. Structural Barriers

Structural barriers such as wooden fences, hedgerows, logs, and brush piles can be added to the restoration site to deter the public from creating informal trails or other intrusions into the natural area. These are to be shown on the planting plan and be in accordance with the management objective(s).

10. Maintenance Phase

The contractor is responsible for using best industry practices to establish a site-specific maintenance plan.

At minimum, a maintenance plan should include the following:

1. Watering schedule (to promote deep root growth, the quantity and frequency needed should be determined prior to each season); learn more about developing a watering program.
2. Removal of non-native and invasive species; refer to CVC's Invasive Species Program for guidance.
3. Timing for removal of tree stakes and/or plastic/non-biodegradable plant protectors.
4. Erosion control as required.

Building a structure near a Natural Heritage Feature? Check out these bird-friendly house design elements that incorporate bird-friendly glass elements into home construction to minimize bird collisions and mortalities from the City of Toronto.

Appendix A: Suggestions for Buffer Strip and Enhancement Node Plant Groupings

Suggested Groupings for Buffer Strips:

Screening / Windbreak (shrubs):

Select one or two species for each 2 metre x 10 metre strip:

- Round-leaved Dogwood - *Cornus rugosa*
- Red-Osier Dogwood - *Cornus sericea*
- Bush Honeysuckle - *Diervilla lonicera*
- White Spruce – *Picea glauca*
- White Pine – *Pinus strobus*
- Trembling Aspen – *Populus tremuloides*
- Staghorn Sumac – *Rhus typhina*
- Eastern White Cedar – *Thuja occidentalis*

Living Fence / Encroachment Barrier:

Select one or two species for each 2 metre x 10 metre strip:

- Paper Birch – *Betula papyrifera*
- Round-leaved Dogwood - *Cornus rugosa*
- White Spruce – *Picea glauca*
- Eastern White Pine – *Pinus strobus*
- Chokecherry – *Prunus virginiana*
- Staghorn Sumac – *Rhus typhina*
- Wild Black Currant – *Ribes americanum*
- Prickly Gooseberry – *Ribes cynosbati*
- Swamp Red Currant – *Ribes triste*
- Smooth Rose – *Rosa blanda*
- Purple-flowering Raspberry - *Rubus odoratus*
- Common Elderberry – *Sambucus canadensis*
- Eastern White Cedar – *Thuja occidentalis*

Riparian Areas:

Group A: Zone 3, Closest to water's edge

Live stakes – 0.75 metre to 1 metre long by 15-to-50-millimeter diameter:

- Red-Osier Dogwood - *Cornus sericea*
- Bebb's Willow - *Salix bebbiana*
- Pussy Willow - *Salix discolor*
- Heart-leaved Willow - *Salix eriocephala*
- Speckled Alder - *Alnus incana*

Group B: Zone 3, Extended detention water level

- Canada Fly Honeysuckle - *Lonicera canadensis*
- Pussy Willow – *Salix discolor*
- Nannyberry - *Viburnum lentago*
- Heart-leaved Willow - *Salix eriocephala*

Group C: Zone 4, 5-year water level - shrubs

- Allegheny Blackberry - *Rubus allegheniensis*
- Common Elderberry - *Sambucus canadensis*
- Red Elderberry - *Sambucus racemosa*
- Mountain Maple - *Acer spicatum*

Group D: Zone 4, 5-year water level – coniferous trees (furthest from water's edge)

- Balsam Fir – *Abies balsamea*
- Eastern White Cedar – *Thuja occidentalis*

Group E: Zone 4, 5-year water level – deciduous trees (furthest from water's edge)

- Freemans's Maple – *Acer x freemanii*
- Balsam Poplar – *Populus balsamifera*
- Peach-leaved Willow – *Salix amygdaloides*

Erosion Prevention / Top of Slope:

Select one or two species for each 2 metre by 10 metre strip:

- Hybrid Maple – *Acer x freemanii*
- Silver Maple – *Acer saccharinum*
- Downy Serviceberry - *Amelanchier arborea*
- Round-leaved Dogwood - *Cornus rugosa*
- Bush Honeysuckle - *Diervilla lonicera*
- *Eastern White Pine – Pinus strobus*
- Chokecherry - *Prunus virginiana*
- White Oak – *Quercus alba*
- Bur Oak - *Quercus macrocarpa*
- *Red Oak - Quercus rubus*
- Wild Black Currant - *Ribes americanum*
- American Red Raspberry - *Rubus idaeus strigosus*
- Black Raspberry - *Rubus occidentalis*
- Purple-flowering Raspberry - *Rubus odoratus*
- Highbush Cranberry - *Viburnum opulus ssp. trilobum*

Suggested Groupings for Enhancement Nodes

Use three to five trees species from each grouping within each node:

Dry-fresh Soil

Group 1

- Alternate-leaved Dogwood – *Cornus alternifolia*
- Northern Bush-honeysuckle - *Diervilla lonicera*
- Eastern Hophornbeam – *Ostrya virginiana*
- Eastern White Pine – *Pinus strobus*
- White Oak[1] - *Quercus alba*
- Red Oak[1] – *Quercus rubra*
- Wild Red Raspberry – *Rubus idaeus* ssp. *strigosus*
- Purple Flowering Raspberry – *Rubus odoratus*

Group 2

- Red Maple – *Acer rubrum*
- Smooth Serviceberry - *Amelanchier laevis*
- American Witch-hazel – *Hamamelis virginiana*
- Trembling Aspen – *Populus tremuloides*
- Large-toothed Aspen - *Populus grandidentata*
- Black Cherry[1] – *Prunus serotina*
- Choke Cherry[1] – *Prunus virginiana*
- Common Elderberry – *Sambucus canadensis*
- Eastern White Hemlock – *Tsuga canadensis*

Group 3

- Smooth Serviceberry – *Amelanchier laevis*
- Gray Dogwood – *Cornus racemosa*
- Ironwood – *Ostrya virginiana*
- Eastern White Pine - *Pinus strobus*
- Pin Cherry – *Prunus pensylvanica*
- White Oak[1] - *Quercus alba*
- American Basswood – *Tilia americana*

Fresh-moist Soil

Group 4: Forest / wetland edges (fresh moist soils):

- Red Maple – *Acer rubrum*
- White Birch – *Betula papyrifera*
- Shagbark Hickory[1] - *Carya ovata*
- Pussy Willow - *Salix discolor*

[1] Mast tree and/or food producing shrub

- Bebb's Willow – *Salix bebbiana*
- Common Elderberry – *Sambucus canadensis*
- Eastern White Cedar – *Thuja occidentalis*

Group 6: Floodplain:

- Red Maple – *Acer rubrum* or Hybrid maple - *Acer x freemanii*
- Black Walnut[1] – *Juglans nigra*
- Bebb's Willow – *Salix bebbiana*
- Common Elderberry[1] – *Sambucus canadensis*
- Basswood – *Tilia americana*
- Eastern White Cedar – *Thuja occidentalis*

Group 7: Coniferous Fresh-Moist Soil:

- Balsam Fir – *Abies balsamea*
- White Spruce – *Picea glauca*
- Red Oak[1] - *Quercus rubra*
- Eastern White Cedar – *Thuja occidentalis*
- *Viburnum* sp.

Moist Soil or Floodplain:

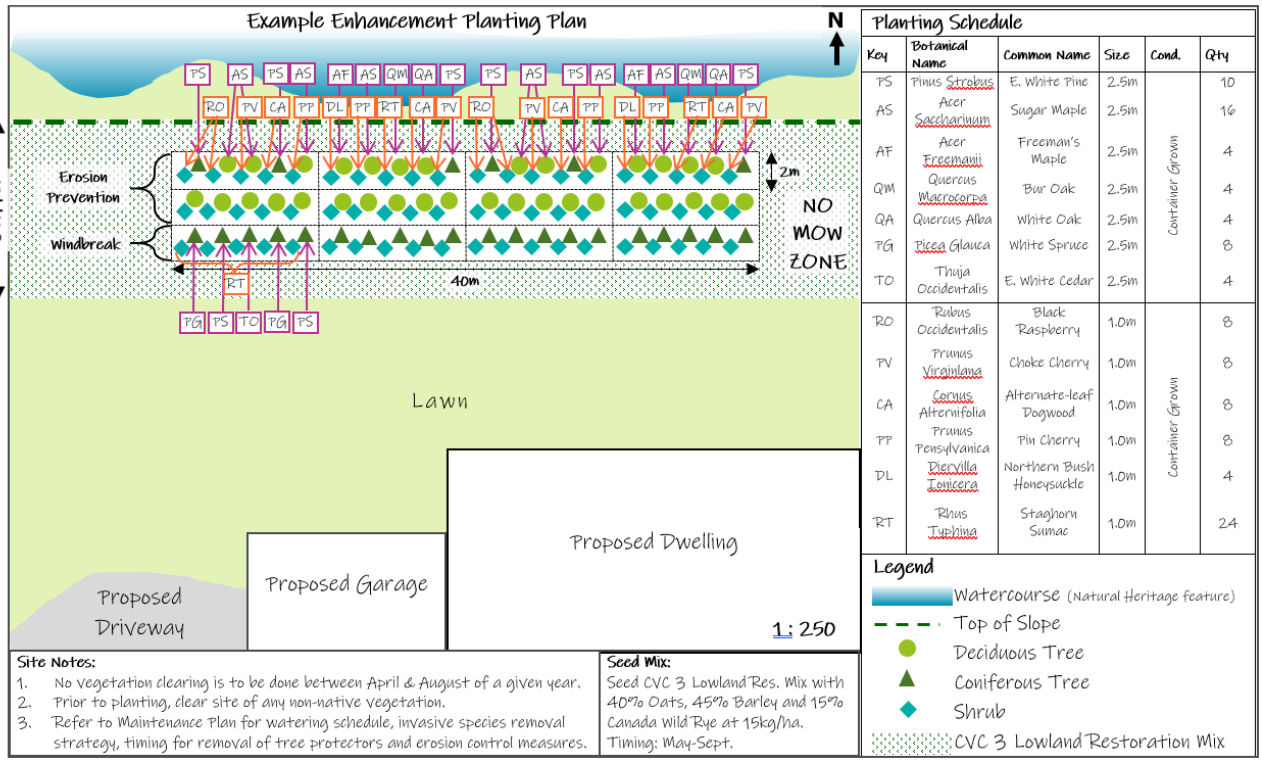
Group 8: Riparian or Floodplain (not for beaver-prone areas):

- Yellow Birch – *Betula alleghaniensis*
- White Birch – *Betula papyrifera*
- Balsam Poplar – *Populus balsamifera*
- Bur Oak[1] – *Quercus macrocarpa*
- Wild Black Currant – *Ribes americanum*
- Peach-leaved Willow – *Salix amygdaloides*
- Nannyberry – *Viburnum lentago*

Group 9: Moist soil

- Silver Maple – *Acer saccharinum*
- White Birch – *Betula papyrifera*
- Red Osier Dogwood - *Cornus sericea*
- Trembling Aspen – *Populus tremuloides*
- Willows - *Salix* sp.
- Eastern White Cedar – *Thuja occidentalis*

Appendix B: Example Planting Plan



Planting Schedule

Key	Botanical Name	Common Name	Size	Cond.	Qty
PS	Pinus Strobus	E. White Pine	2.5m	Container Grown	10
AS	Acer Saccharinuum	Sugar Maple	2.5m		16
AF	Acer Freemanii	Freeman's Maple	2.5m		4
QM	Quercus Macrocarpa	Bur Oak	2.5m		4
QA	Quercus Alba	White Oak	2.5m		4
PG	Picea Glauca	White Spruce	2.5m		8
TO	Thuja Occidentalis	E. White Cedar	2.5m		4
RO	Rubus Occidentalis	Black Raspberry	1.0m	Container Grown	8
PV	Prunus Virginiana	Choke Cherry	1.0m		8
CA	Cornus Alternifolia	Alternate-leaf Dogwood	1.0m		8
PP	Prunus Pensylvanica	Pin Cherry	1.0m		8
DL	Diervilla Lonicera	Northern Bush Honeysuckle	1.0m		4
RT	Rhus Typhina	Staghorn Sumac	1.0m		24

Legend

- Watercourse (Natural Heritage feature)
- Top of Slope
- Deciduous Tree
- Coniferous Tree
- Shrub
- CVC 3 Lowland Restoration Mix

Site Notes:

1. No vegetation clearing is to be done between April & August of a given year.
2. Prior to planting, clear site of any non-native vegetation.
3. Refer to Maintenance Plan for watering schedule, invasive species removal strategy, timing for removal of tree protectors and erosion control measures.

Seed Mix:

Seed CVC 3 Lowland Res. Mix with 40% Oats, 45% Barley and 15% Canada Wild Rye at 15kg/ha. Timing: May-Sept.



MARCH 2017

TECHNICAL GUIDELINES FOR FLOOD HAZARD MAPPING

Central Lake Ontario Conservation

Credit Valley Conservation

Grand River Conservation Authority

Ganaraska Conservation

Toronto and Region Conservation Authority

Nottawasaga Valley Conservation Authority

Environmental Water Resources Group Ltd.

Dr. B. Adams & D. Haley

TECHNICAL GUIDELINES FOR

FLOOD HAZARD MAPPING

MARCH, 2017

prepared for:

Central Lake Ontario Conservation

CVC Credit Valley Conservation

Ganaraska Conservation

Grand River Conservation Authority

Nottawasaga Valley Conservation Authority

Toronto and Region Conservation for The Living City

prepared by:

EWRG Environmental Water Resources Group Ltd.

in association with Dr. B. Adams, and D. Haley

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S. Dhalla, P.Eng. D. Hipple, P.Eng. W. Ho D. Chekol, Ph.D. N. Lorrain	G. Switzer, P.Eng. T. Reeve, P.Eng.	M. Peacock, P.Eng. I. Jeffrey
G. Rungis, P.Eng.	Dr. N. Gupta, P.Eng. R. Ul-Haq, P.Eng.	P. Sisson, P.Eng. A. Langmuir, P.Eng.

The Consultant Team that developed the Technical Guidelines included the following:

C. Doherty, P.Eng.	University of Toronto Dr. B. Adams, P.Eng.	D. Haley, P.Eng.

Limitations of use

The Technical Guidelines for Flood Hazard Mapping is intended for the use of the Steering Committee agencies270 (Toronto and Region Conservation, Nottawasaga Valley Conservation Authority, Ganaraska Conservation, Grand River Conservation Authority, Credit Valley Conservation, and the Central Lake Ontario Conservation).

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Publication Information

Comments on the Technical Guidelines should be directed to the following:

Sameer Dhalla, P.Eng.
Associate Director | Engineering Services | Restoration and Infrastructure
Toronto and Region Conservation Authority
5 Shoreham Drive, Downsview, Ontario, M3N 1S4
e-mail: sdhalla@trca.on.ca

Table of Contents

1.0 Introduction 6
1.1 Background 6
1.2 Document Purpose and Scope 8
1.3 Flood Hazard Mapping Study Components 9
1.4 Public Consultation 10
2.0 Data Requirements 11
2.1 General 11
2.2 Digital Elevation Data - Contours, Cross Section Points and Grids 14
2.2.1 General 14
2.2.2 Digital Elevation Data - Contours and Spot Elevations 17
2.2.3 Digital Elevation Data - Ground Surveys 17
2.2.4 Digital Elevation Data – Datum 18
2.2.5 Digital Elevation Data - Vertical Accuracy 18
2.2.6 Digital Elevation Data - Vertical Accuracy Checking 19
2.3 Feature Data 21
2.3.1 General 21
2.3.2 Feature Data - Datum 21
2.3.3 Feature Data - Accuracy 21
2.3.4 Feature Data - Accuracy Checking 22
2.4 Hydraulic Structure Data 28
2.5 References 30
3.0 Hydrologic Analysis 31
3.1 General 31
3.2 Information Requirements 33
3.3 Watershed Conceptualization and Characterization 33
3.4 Data Availability: Climatic, Precipitation, Streamflow 35
3.5 Selecting A Computational Procedure 37
3.6 Technical Reviews 38
3.7 Frequency Analysis: Streamflow 39
3.7.1 General 39
3.7.2 Single Station Frequency Analysis 40

3.7.3 Regional Frequency Analysis 41
3.7.4 Corroboration 41
3.7.5 Documentation and Deliverables 41
3.8 Computer Modelling 43
3.8.1 General 43
3.8.2 Program/Software Selection 45
3.8.3 Model Building 48
3.8.4 Model Evaluation 58
3.8.5 Model Acceptability 63
3.8.6 Modelling Scenarios and Results 63
3.8.7 Study Report and Deliverables 64
3.9 Hydrologic Standard Parameters 67
3.10 References 80
4.0 Hydraulic Analysis 81
4.1 General 81
4.2 Information Requirements 82
4.3 Watercourse Conceptualization and Characterization 82
4.4 Data Availability: 83
4.5 Technical Reviews 83
4.6 Selecting A Flow Analyses Procedure 86
4.7 Computer Modelling 87
4.7.1 General 87
4.7.2 Program/Software Selection 87
4.7.3 Model Building 87
4.7.4 Model Evaluation 87
4.7.5 Model Acceptability 87
4.7.6 Modelling Scenarios and Results 87
4.7.2 Program/Software Selection 89
4.7.3 Model Building 90
4.7.4 Model Evaluation 105
4.7.5 Model Acceptability 109
4.7.6 Modelling Scenarios and Results 110

4.8 Study Report and Deliverables 116
4.9 Hydraulic Standard Parameters 118
4.10 References 120
5.0 Flood Hazard Maps 121
5.1 General 121
5.2 Map Sheet Layout and Contents 122
5.3 Flood Risk Information 124
5.3.1 Flood Hazard Information 124
5.3.2 Gridded Flood Risk Information 127
5.4 References 130
6.0 Flood Hazard Map Updates 131
6.1 General 131
6.2 Estimated Flood Hazard Mapping 132

1.0 INTRODUCTION

1.1 Background

The need for flood plain management has been emphasized over the last six (6) decades after major floods have taken numerous lives and generated hundreds of millions of dollars in damages. Some of the major Ontario floods that have occurred over the last six decades have been located in Toronto (1954), Cambridge (1974), Dover Township (1979), Field Township (1979), Nipissing French River (1979), Port Hope (1980), Windsor (1981), Chatham, Dover, Dresden, Huntsville, and Fort Albany (1985), Winisk (1986), Harrow (1990), Peterborough (2002-2004), Toronto (2005), Mississauga (2009), Toronto and Mississauga (2013), and Burlington (2014).

The objectives of flood plain management in Ontario are to:

(i) Prevent the loss of life;
(ii) Minimize property damage and social disruption; and
(iii) Encourage a coordinated approach to the use of land and the management of water in reducing flood risk.

The three (3) basic components of flood plain management to achieve a reduction in flood risk include the following:

- PREVENTION through land use planning and regulation of development;
- PROTECTION through structural and land acquisition measures; and
- EMERGENCY PLANNING and RESPONSE through flood warning and disaster relief.

Flood hazard maps are used to support all of the three (3) basic components of flood plain management. Flood hazard maps are used in identifying the following:

- Undeveloped flood prone areas that can be regulated;
- Flood risk in existing developed areas to allow for protection through structural and land acquisition measures; and
- Properties that will be at risk during flood events.

For the Province of Ontario the following applies:

"The flooding hazard limit is the greater of:

i) the flood resulting from a rainfall actually experienced during a major storm such as the Hurricane Hazel storm (1954) or the Timmins storm (1961), transposed over a specific watershed and combined with the local conditions, where evidence suggests that the storm event could have potentially occurred over watersheds in the general area;
ii) the one hundred year flood; or

iii) a flood which is greater than i) or ii) which was actually experienced on a particular watershed or portion thereof, for example as a result of ice jams and which has been approved as the standard for that specific area by the Minister of Natural Resources; and

The exception is where the use of the 100 year flood or actually experienced event as the flood standard for a specific watershed, even though it does not exceed the Hazel or Timmins event, has been approved by the Minister of Natural Resources, (where past history of flooding supports the lowering of the standard)." [1]



Essa, October 20th, 1954

[1] page 11, Technical Guide - River and Stream Systems: Flooding Hazard Limit, 2002, Ontario Ministry of Natural Resources[1]

1.2 Document Purpose and Scope

The Technical Guidelines serve several purposes including the following:

- To provide guidance to staff of the Steering Committee agencies, and to Consultants undertaking flood hazard mapping studies for those agencies;
- To provide a consistent approach in the development of flood hazard maps; and
- To establish "good engineering practice" in the development of flood hazard maps. This will provide a technical framework for evaluating the acceptability and adequacy of flood hazard maps during Regulatory and technical reviews.

The Technical Guidelines are intended for Steering Committee agencies and their consultants. The Technical Guidelines will be considered as "good engineering practice" during review of external consultants' flood hazard maps produced for new land development sites.

Although the Technical Guidelines represent commonly accepted best practices, it remains the users' responsibility to recommend and justify procedures, computation methods, and parameters that best represent conditions in study areas of concern. It is presumed and recommended that users of the Technical Guidelines have a good working knowledge of hydrologic and hydraulic engineering principles.

The Technical Guidelines do not replace a project's Terms of Reference but should be used in-conjunction with a project's Terms of Reference to determine how flood hazard limits are to be developed. The Terms of Reference should document the intended use of the hazard limits, and the requirements of the Conservation Authority. Too little information in a Terms of Reference may result in a product that does not meet the needs of the Conservation Authority.

This document does not replace, but rather complements the Ontario Ministry of Natural Resources (OMNR) River & Stream Systems: Flooding Hazard Limit, Technical Guide, 2002. This document updates the 2002 Guide with respect to hydrologic models, hydraulic models, survey techniques, and GIS procedures. In addition, it clarifies certain hydrologic and hydraulic procedures.

This document covers both the development of new flood hazard maps and the updating of existing maps due to new development at the watershed, reach and site levels.

1.3 Flood Hazard Mapping Study Components

A flood hazard mapping study includes the following components:

- Data Requirements - Section 2;
- Hydrologic Analysis - Section 3;
- Hydraulic Analysis - Section 4;
- Flood Hazard Maps - Section 5; and
- Flood Hazard Map Updates - Section 6.

Not all components are necessarily conducted during the same study.



Rescue mission during the floods on CNR in Tecumseth Township, ON, October 15th, 1954.

1.4 Public Consultation

A public consultation process is recommended for flood hazard mapping studies. For new flood hazard mapping, two public contacts are recommended. One to inform the public a flood hazard mapping study is underway and to collect information from the public. The second contact would present the draft flood hazard maps and request any comments on the maps. For flood hazard map updates, one public contact is recommended to present the draft flood hazard maps.

A public contact can be an information centre, if there are a significant number of properties at risk from inundation or can be a personal contact if there are only a few properties at risk.



Albion Hills Conservation Area, Caledon, ON, 2015.

2.0 DATA REQUIREMENTS

2.1 General

Section 2 outlines the data required to develop flood hazard maps. The required data includes the following:

1.	Digital Elevation Data	Section 2.2;
2.	Feature Data	Section 2.3; and
3.	Hydraulic Structure Data	Section 2.4.

The methodology for a flood hazard mapping project must be specified in the project's Terms of Reference. Methodologies will be based on existing data, required data, the intended future use of digital elevation data, and follow up studies that may be required. An example of a follow up study would be a Two Zone analysis where flood depths, and flood velocities are required. Project costs could differ depending on the methodology used to develop the flood hazard maps. It is important that the project Terms of Reference list the intended use and the methodologies to be used when developing flood hazard maps.

Flood hazard limits can be delineated on (1) line maps with contours and spot elevations; (2) ortho-photo maps with contours and spot elevations; and (3) ortho-photos with an elevation grid. Typically, contours and spot elevations will be used to display the results of 1-D hydraulic models, and an elevation grid will be used to display the results of 2-D hydraulic models.

Figure 2-1 identifies digital elevation data options available for a flood hazard mapping project. There are options for collecting digital elevation data, there are options for input to the hydraulic model, and there are options for displaying the results of the hydraulic model. The collection and processing of digital elevation data will probably be conducted by agencies external to those conducting the hydrologic and hydraulic analyses. These agencies include a Conservation Authority's Geographic Information System (GIS) department or an external mapping firm. Each method used to collect digital elevation data has its associated strengths and weaknesses. A balance must be struck between cost and accuracy when choosing the data collection method.

The digital elevation data for input to the hydraulic analysis will include contours and cross section points for 1-D modelling and gridded elevation data or DEMs for 2-D modelling.

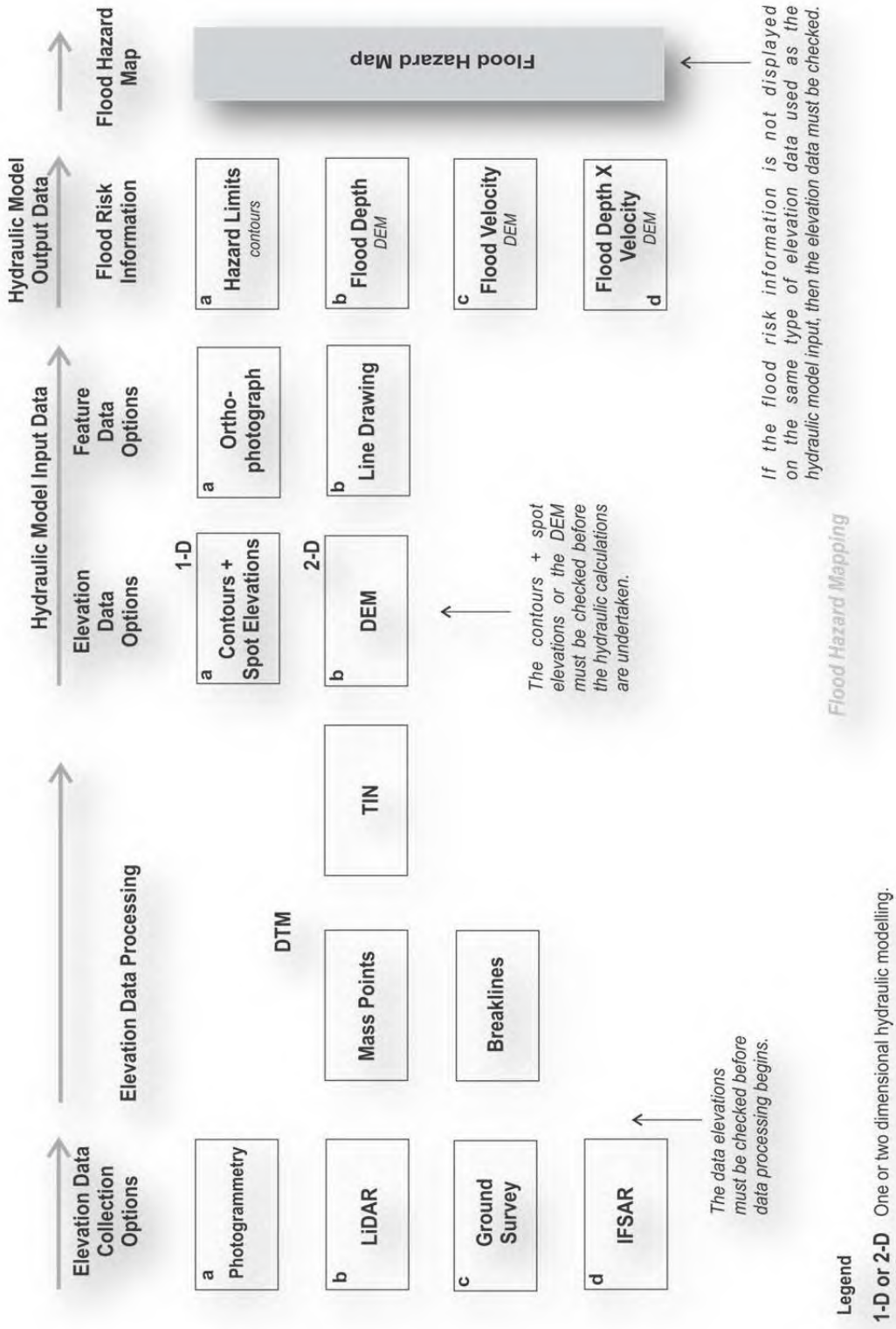
Digital elevation data sources, used for input to the hydraulic model, must be field survey checked prior to use. Also, if the results of the hydraulic analysis are placed on digital elevation data sources different from the input data, then the output digital elevation data sources must also be checked. As an example, water surface elevations may be created from contours and spot elevations while the flood elevations are plotted on a grid such as a DEM. This example would require two checks, one for the contours and spot elevations and one for the DEM. Survey data collected to check contours and spot elevations could be used to check the DEM.

The collection and processing of data must be conducted using established procedures, and must be easily reproducible. Qualified persons are to be able to recognize and understand all methods, approaches, basic data and rationale and any assumptions used in the analysis. Qualified persons are to be able to recreate the entire work without referring to other documents. Documentation must include the following:

- What analysis was done including purpose, alternative methods, and the rationale for the chosen method;
- How the analysis was conducted including input data, data sources, measurements of data, verification, corroboration, uncertainty analysis, calibration, validation, and sensitivity analysis;
- The results of the analysis;
- How the results were checked; and
- What are the limitations of the analyses.

Minimum Upstream Drainage Area For Flood Hazard Mapping - currently there is no Provincial minimum upstream drainage area requirement for the development of flood hazard limits. During the 1970's and 1980's a minimum drainage area of 125 ha was utilized presumably not to conflict with the Ontario Drainage Act. Headwater tributaries can have a significant impact on downstream flooding. The effective management of headwater tributaries may require flood hazard limits. It is currently up to the individual Conservation Authorities to define and implement flood hazard mapping or regulations on headwater tributaries based on their established watershed management needs and not upon any set drainage area.

Figure 2-1 - Flood Hazard Map Options



2.2 Digital Elevation Data - Contours, Cross Section Points and Grids

2.2.1 General

Hydraulic programs that model one-dimensional (1-D) flow usually require cross section points as part of the input. Cross sections are represented by a series of points located along a line or series of line segments that are perpendicular to flow. These points have a location specified by UTM co-ordinates and an elevation referenced to a datum. Cross section points represent the ground in the channel and the flood plain. Contours are required to (1) align cross sections, to abstract cross section points; (2) to identify ineffective flow areas; and (3) to plot hazard limits between cross sections. Contours are imaginary lines with all points on the line having the same elevation.

Hydraulic programs that model two-dimensional (2-D) flow usually required a grid or mesh to model the ground surface. Grids can be irregular in size or can be rectangular of the same size. DEMs (Digital Elevation Model) are one example of a grid.

Contours, cross section points, and grids can be manually or automatically developed from several different types of surface models that include mass points, breaklines, DTMs, TINs, and DEMs.

Mass Points - mass points define the horizontal and vertical location of specific points on the earth. Mass points can be generated using photogrammetry, LiDAR, IFSAR, ground based laser scanning, ground surveys (GNSS, Total Station) as well as other methods that meet the required accuracy.

Photogrammetry **-** can be used to gather digital elevation data for use in mass point data sets. Photogrammetry is the science of making accurate measurements from aerial photographs. Adjustments must be made to account for distortions in the camera system, and the curvature of the Earth. Photogrammetric mapping is accomplished through four processes that include aerial photograph acquisition, ground control acquisition, adjustment of the aerial photographs to the Earth, and feature collection.

LiDAR (Light Detection and Ranging) - Airborne LiDAR systems can gather digital elevation data to be used in mass point data sets, and in DEMs. LiDAR is composed of an airborne GPS with a GPS base station, an Inertial Measurement Unit (IMU), and light-emitting scanning laser. The airborne GPS determines the in-flight three-dimensional position of the sensor, and the IMU determines the attitude of the sensor i.e., the roll, pitch and heading. Automated and manual processing are required to identify vegetation, anthropogenic features and artifacts to produce a bare-earth model. LiDAR generates first return data that represents tree tops, roof tops, etc. Also, LiDAR produces last return data that represents points on bare-earth.

Ground Surveys - are typically conducted using GNSS (Global Navigation Satellite System) surveys or total station surveys. GNSS receivers can gather digital elevation

data to be used in mass point data sets. GNSS receivers capture data from several satellites to determine position coordinates (Northing, Easting, elevation) of a survey station. Total Stations can be used to gather digital elevation data to be used in mass point data sets. A Total Station measures horizontal and vertical angles as well as horizontal and vertical distances. Recorded data is stored in a data collector.

IFSAR (Interferometric Synthetic Aperture Radar) - airborne systems can gather digital elevation data to be used to create bare earth DEMs and associated data products. LiDAR transmits and receives pulses using lasers. IFSAR transmits and receives radar pulses. IFSAR is side looking where LiDAR is centered over the terrain features. IFSAR pulses can penetrate clouds where LiDAR pulses are absorbed by water. IFSAR operates at high altitudes (6,000 to 10,000 m) and speeds approaching 750 km/hr. LiDAR operates at approximately 200 km/hr. and at elevations of 300 m to 1,880 m. Vertical accuracy for LiDAR is about 15 - 50 cm RMSE and IFSAR is approximately 60 cm RMSE. Generally, LiDAR has greater accuracies than IFSAR for small urban and forested areas. IFSAR is more cost efficient for large areas where lower accuracies are required.

Breaklines - are linear features that describe a change in the slope, smoothness, or continuity of a surface. Breaklines should be produced using either stereo photogrammetric procedures or digital ortho-photography, where breakline features are digitized as two-dimensional features. Breaklines are created for stream centerlines, drainage ditches, tops and bottoms of streambanks, ridge lines, road crowns, levees, bulkheads, seawalls, road/highway embankments, and features that constrict the flow of water.

DTMs (Digital Terrain Model) - is the combination of mass points and breaklines that can be used to generate a TIN. See Table 2.5 for more details.

TINs (Triangulated Irregular Networks) - a TIN is a set of adjacent, non-overlapping triangles computed from point, line, and polygon data interpreted from mass points and breaklines. The TIN model stores the topological relationship between triangles and their adjacent neighbors. A TIN allows for the efficient generation of surface models for the analysis and display of terrain surfaces. A TIN model can be used to generate contour lines and DEMs. DEM accuracy is a function of the accuracy of the mass point data and the grid spacing.

DEMs - represent the elevation of bare earth at regularly spaced intervals in eastings and northings. DEMs are usually displayed as uniformly spaced grids. DEMs may neglect breakline information, as the DEM is grid based. DEMs are normally produced from irregularly spaced mass points. DEMs are slightly less accurate than TINs, or mass points from which they are averaged or interpolated. DEMs can be produced by a variety of methods. See Table 2.4 for more detail.

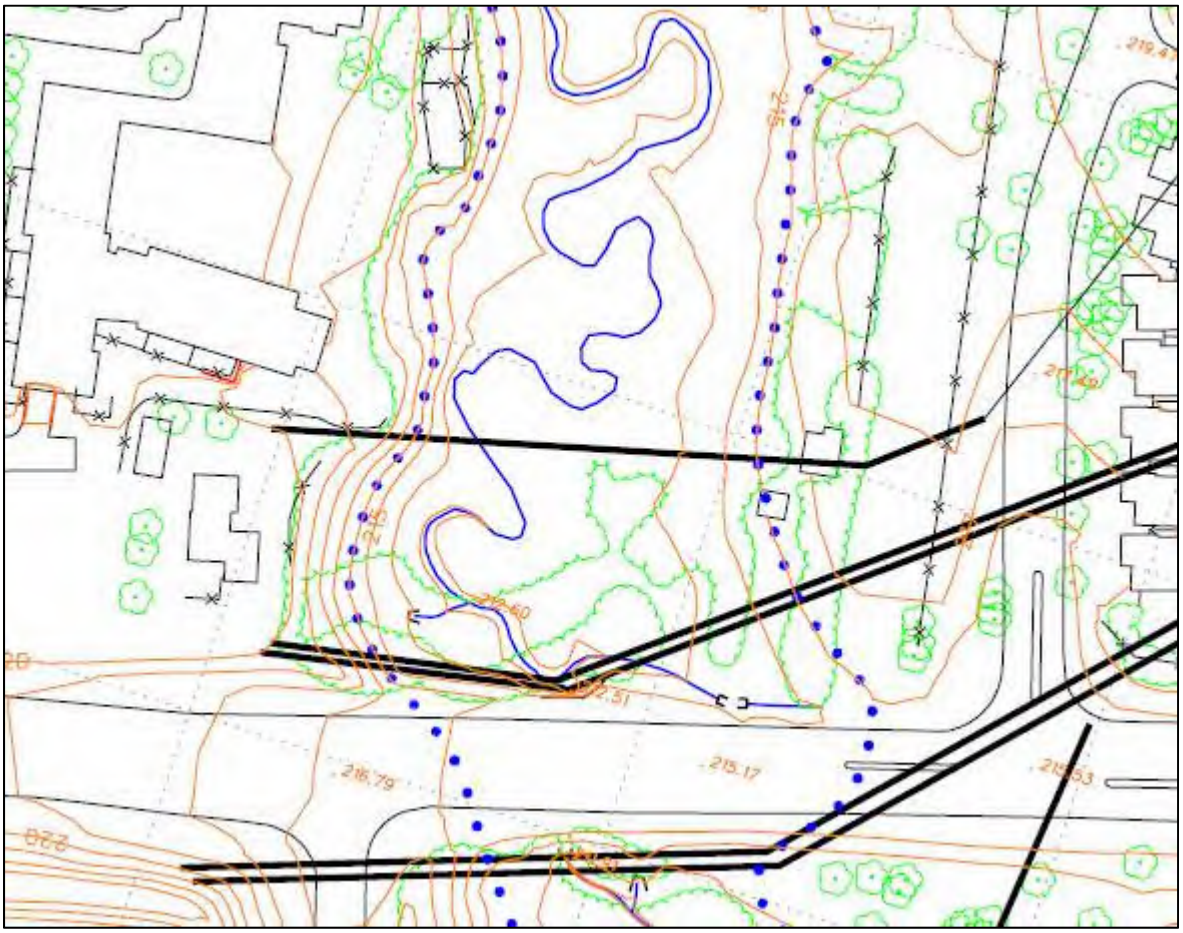
DEM cells may not accurately represent a watercourse (i.e., puddles) due to the averaging or interpolation nature of a grid cell. A hydro-enforced DEM uses breaklines to lower DEM cell

elevations to accurately represent watercourses and water bodies. Breaklines must be manually entered in the DEM. Thus, errors are introduced when the DEM is hydrologically conditioned.

The remainder of Section 2 has been divided into the following sub-sections:

2.2.2 Digital Elevation Data - Contours and Spot Elevations
2.2.3 Digital Elevation Data - Ground Surveys
2.2.4 Digital Elevation Data - Datum
2.2.5 Digital Elevation Data - Vertical Accuracy
2.2.6 Digital Elevation Data - Vertical Accuracy Checking
2.2.7 Digital Elevation Data – Deliverables

Figure 2-2 - Example of Flood Hazard Map



2.2.2 Digital Elevation Data - Contours and Spot Elevations

Contours are used to align cross sections, to abstract cross section points, and to plot floodlines between cross sections. Contours can be created in several different ways including a Triangular Irregular Network (TIN), a Digital Terrain Model (DTM), or a DEM. All methods must, at a minimum, generate contours at the following interval:

Contour Interval

- Maximum contour interval shall be 1 m for line maps and ortho-photo maps with 0.5 m interpolated contours.

  The contour interval for any project will be based on the intended use of the hazard limits, and should not be greater than the maximum contour interval. The project contour interval should be defined in the Flood Hazard Mapping Terms of Reference.

Spot Elevations

Spot elevations will be shown at the following locations:

- Intersections of all roads, railways, trails and foot paths;
- End of runways;
- All bridges, culverts and watercourse crossings;
- Dams, docks, piers, and wharfs; and
- All water bodies.

2.2.3 Digital Elevation Data - Ground Surveys

Low-flow Cross Section Points - A representative low flow section shall be field measured for each reach between crossings and applied to each cross section in the hydraulic model.

Flood plain cross section points can be abstracted from digital elevation products (mass points, contours, TINs, DEMs, etc.) or from ground surveys. All surveyed cross section points must conform to the following:

- All points must be geo-referenced, and shown in ESRI shapefiles;
- All points must be referenced to the datum in Section 2.2.4 and must conform to the accuracies specified in Section 2.2.5;
- Surveyed points must represent significant breaks in ground slope and at changes in the hydraulic characteristics of the floodplain;
- Bank elevations to the channel bed and the deepest part of the stream must be measured;

- Underwater cross section elevations may require measurement (as per study Terms of Reference);
- Surveyed cross sections must include the entire flood plain of the main channel and any tributaries. Surveyed cross sections must be tied in vertically to established benchmarks and horizontally to permanent structures;
- In areas of uniform slope, readings must be taken at a maximum spacing of 15 metres. Supplementary data readings will be taken in areas of major change in relief (e.g. ditch centerline, top of fill slopes, etc.); and
- For irregular features such as watercourses, the survey must include points at significant bends in the feature. The maximum distance between data readings for irregular features is 10 meters.

2.2.4 Digital Elevation Data – Datum

Contours should be based on the following datum and projections:

- The vertical datum will be based upon the most current Geodetic Survey of Canada (Canadian Geodetic Vertical Datum CGVD28 - 1978 Version);
- The horizontal projection and datum for all the imagery and digital elevation data will be 6-degree Universal Transverse Mercator Projection (UTM) grid coordinates on NAD83 - CSRS (Canadian Spatial Reference System);
- The Canadian Gravimetric Geoid 2000 (CGG2000) with HTv2.0 will be used; and
- Imagery and data will be expressed in UTM Easting, UTM Northing, and elevation in metric.

2.2.5 Digital Elevation Data - Vertical Accuracy

The Terms of Reference for a flood hazard mapping project must define the level of accuracy of the digital elevation data to be used for the project. Each flood hazard mapping project is unique. The level of accuracy should not be greater than the level of accuracy required for the intended use. Levels of accuracy greater than what is required will result in increased costs, increased project schedules, and decreases in the number of studies that can be completed. The accuracy of the digital elevation data should be based on data needs related to the project Terms of Reference.

The vertical accuracy of a point is defined as the difference in elevation of a point on a map, and the elevation of the point on Earth. Geodetic or ground surveying is used to determine the location and elevation of a point on Earth. The horizontal accuracy of a point or spot elevation is defined as the difference in location between a point on the terrain data model and a point on Earth.

The following vertical accuracy must at a minimum be used for flood hazard mapping projects:

Vertical Accuracy

All contours, spot elevations, breaklines, TINs, and DEMs that have been used to develop cross section data for the hydraulic model will have an accuracy of 0.30 m at the 95% confidence level. This implies that 38 of 40 checkpoints must be within plus or minus 0.30 m of their true elevation.

2.2.6 Digital Elevation Data - Vertical Accuracy Checking

The accuracy of the digital elevation data will be checked for all flood hazard mapping projects. Checkpoints are defined as points in the digital elevation data that will be field surveyed. The surveyed UTM Northing, UTM Easting, and elevation will be compared with the digital elevation data values to determine the accuracy of the digital elevation data.

Checkpoints will be located within a Check Area or a block of land with an area of approximately 2 km2. More than one Check Area with checkpoints may be required to determine the accuracy of digital elevation data and surface models. Checkpoints should be located on public/government owned land to avoid the need for obtaining private property owner permission for conducting the field survey. Checkpoints should be located in flood plain areas if possible. Checkpoints will be evenly distributed across a Check Area.

Check Areas will be selected by the project manager. The number of Check Areas should not be more than 10% of the total surface model area. At least one Check Area will be selected per project to determine the accuracy of the digital elevation data. If the number of Check Areas is greater than one, then the Check Areas will be evenly spaced within the surface model.

Digital Elevation Data Vertical Accuracy Check - Contours & Spot Elevations

A minimum of 40 checkpoints will be used to check the elevation accuracy of a Check Area. The checkpoints will be distributed as follows:

- A minimum of 15 checkpoints will be located on a contour;
- A minimum of 15 checkpoints will be located on a spot elevation; and
- A minimum of 15 checkpoints will be located within the estimated flood hazard limit.

The contours and spot elevations are acceptable if it meets the required accuracy from Section 2.2.5.

Digital Elevation Data Vertical Accuracy Check - DEMs

A minimum of 40 checkpoints in a Check Area shall be used to determine the acceptability of the DEM. The checkpoints shall be selected in terrain that is flat or uniformly sloped. The uniform slope must not exceed 20 percent.

The checkpoints must never be located near to breaklines, such as bridges or embankments. The checkpoints should be evenly distributed in each of the following categories and evenly spaced across the Check Area:

- A minimum of 10 checkpoints will be located on bare earth and low grass;
- A minimum of 10 checkpoints will be located on impervious surfaces; and
- A minimum of 10 checkpoints will be located in high grass, weeds, and crops.

Areas of heavy vegetation may be less accurate than lightly vegetated areas, bare earth areas and impervious surfaces.

The DEM is acceptable if it meets the required accuracy in Section 2.2.5.

2.2.7 Digital Elevation Data - Deliverables

The following shall be submitted in the Accuracy Check Report:

- All field survey notes including electronic files (ASCII files), and paper copies of the notes and files;
- ESRI shapefiles showing the following:
- Benchmarks, temporary benchmarks, and monument locations;
- Contour locations used in the elevation data model check; and
- All surveyed checkpoints;
- A table comparing the field surveyed contour line elevations with the digital elevation model shown contour line elevations;
- A table comparing the field surveyed spot elevations with the digital elevation model shown spot elevations;
- A table comparing the field surveyed UTM coordinates of the checkpoint locations with the abstracted terrain data model values; and
- A table comparing all checkpoints used to determine the acceptability of the DEM.

2.3 Feature Data

2.3.1 General

Generally, flood hazard limits can be displayed on either ortho-photo maps or line maps. The use of either line maps or ortho-photo maps as a base for floodlines should be specified in the project Terms of Reference. Contour lines, and spot elevations will be added to either the ortho-photo maps or the line maps. Features such as buildings, road outlines, etc. appear in the ortho-photos. For line maps those features must be digitized from aerial photos.

Ortho-photographs and Line Drawings

Ortho-photo maps and line maps should show contours, spot elevations, grids, property lines, political boundaries, geographic names, planimetric features, cultural features, etc. Features (property lines, political boundaries, etc.) must be digitized from aerial photos or images. As a result line maps may be more expensive than orhto-photos.

Ortho-photos are a combination of aerial photographs and a DEM after undergoing process call ortho-rectification. The process includes (i) acquisition of photographs; (ii) scanning of non-digital photographs; (iii) ground control point selection for rectification of the photographs to its geographical position; (iv) acquisition of a DEM; (v) merging of the DEM with the aerial photograph with radiometric correction; and (vi) tiling and formatting of the ortho-photos.

Table 2.1 lists some of the features required for ortho-photo maps and line maps.

Deliverables for ortho-photo maps and line maps are shown in Tables 2.2 and 2.3 respectively.

2.3.2 Feature Data - Datum

The horizontal projection and datum for all the imagery and digital elevation data will be 6-degree Universal Transverse Mercator Projection (UTM) grid coordinates on NAD83 - CSRS (Canadian Spatial Reference System).

2.3.3 Feature Data - Accuracy

Features shown on ortho-photos or line maps for hazard maps should at a minimum have the following horizontal accuracy:

- 95% of the features are within a 1 m radius of their true position. Features will include buildings (building corners), fire hydrants, utility poles, or other single fixed points. This implies that 19 of 20 points must be within a 1 m radius of their true position.

2.3.4 Feature Data - Accuracy Checking

A minimum of 20 points per Check Area will be used to check the horizontal accuracy of features on a line drawing or features on an ortho-photograph. The checkpoints will be located at 20 well-defined, identifiable and accessible features that are evenly distributed throughout the Check Area. The feature data locations are acceptable if it meets the required accuracy shown in Section 2.3.3.



Brooklin, ON, July 2008.

Table 2.1 Feature Collection

Ortho-photo Maps & Line Maps

- Contour lines (Intermediate, Index, Auxiliary, Indefinite, and Depressions)
- Control Points (horizontal and vertical)
- Benchmarks/Monuments
- Watercourse Centre Lines & Flow Direction
- Boundaries - (International, Provincial, District, Municipal, Township, Native Reserve, Lot and Concession, Approximate, Annotation, Parking Lots, and Park Dump)
- Parks (National, Provincial, Amusement, Conservation Areas, Campgrounds, Tennis Courts, etc.)
- Spot Elevations
- Road Names (Highway, County, Township, Access, Runways, etc.)
- Cemetery Names
- Watercourse Names

Line Maps

- Aerial Cableways
- Antennae
- Marshes/Swamps/Wetlands
- Woods, plantations, etc.
- Lakes, Ponds
- Bridges (Foot, Road, and Railroad)
- Buildings (Ruins,)
- Cemeteries
- Chimneys
- Control Points (horizontal and vertical)
- Benchmarks/Monuments
- Shoals
- Conveyors, Ski Lifts,
- Culverts
- Dams, Ditches, and Dykes
- Flooded Lands
- Feature Outliers (buildings under construction)
- Fencing
- Light Standard, Poles,
- Depressions, Pits, Quarries
- Rocks
- Rivers, Streams, and Canals (including direction of flow)
- Piles
- Pipelines
- Rail Lines
- Roads (Highway, County, Township, Access, Runways, etc.)
- Trail/Brush Road
- Swimming Pools
- Tanks, Storage Bins,
- Towers
- Trails
- Transmission Lines (Poles, Pylons, and Tunnels, etc)
- Utility Poles & Lines
- Walls, Fence, Headwalls, & Breakwalls
- Wharfs, Docks, Ferry Slips, Groynes, & Piers
- Wooded Areas
- Reservoirs
- Masts
- Cliffs, Pits, and Piles
- Falls, Rapids,
- Shorelines

Table 2.2 – Ortho-Photo and Images

All ortho-rectified imagery will be delivered in 8-bit/band GeoTIFF; with multi-spectral imagery packaged as either two 3-band files (RGB and CIR) or one 4- band file; with the panchromatic band provided as a separate file.

Breaklines shall be placed on features such as overpasses, bridges, water crossings, dams, cliffs and other features that may cause vertical shifts in the imagery.

Delivery formats: GeoTIFF, JPEG2000, JPEG, ECW (ER Mapper Compress Wavelets), and MrSID (Multi-resolution Seamless Image Database). File extensions. Image files should predefined, format-specific file extensions, listed in the table below.

World files. Each image dataset should be accompanied by a valid world file with format-specific file extension (see table below) or generic extension ".wld". For example, a GeoTIFF image file "sample.tif" should have associated world file "sample.tfw" or "sample.wld.

For GeoTIFF files, it is desirable that files contain the GeoTIFF tag "Coordinate System" which contains the full definition of the spatial reference system in the Well-Known Text (WKT) format.

Image Format	File Extension	World File Extension
GeoTIFF	.tif	.tfw
JPEG	.jpg	.jgw
JPEG2000	.jp2	.j2w
ECW	.ecw	.eww
MrSID	.sid	.sdw

Point and tabular data in X/Y or X/Y/Z format can be delivered in ASCII (comma or tab separated) Excel, MS Access, ESRI geo-database table, dBase formats.

GeoTIFF based raster imagery will have all the projection parameters correctly defined in the GeoTIFF headers.

The rasterized version of a DEM will also be delivered in an uncompressed 32 bit GeoTIFF file at the same post spacing.

Data Tiling - All processed tiles should be uniquely identified and labelled using the lower left (southwest) coordinate values for position and uniqueness.

Notes:
Portions of the text have been abstracted from Flood Inundation Mapping Guidelines by Environmental Water Resources Group Ltd. in association with 4DM for the Ontario Power Generation, March 2009.

Portions of the text have been abstracted from Imagery and Elevation Acquisition Guidelines by Mapcon Mapping Ltd. for the Ministry of Natural Resources, November 2009.

Table 2.3 – Line Maps

Shapefiles should have a clean geometry as indicated by the ArcGIS Check Geometry tool.

Data submission should include the relevant ".shp", ".shx", ".dbf" and ".prj" files; optionally the relevant ".sbn" and ".sbx" files may be included.

Tolerance, resolution and domain: Feature classes and feature datasets in ESRI geodatabases have associated tolerance, resolution and domain settings for the X, Y, Z and M coordinates.

Topology: If geodatabase topologies have been created in a geodatabase, the topological rules and relationships, as well as the reasons for implementing the topologies, should be fully documented in the metadata.

All datasets referenced in the project and layer files must be submitted.

Vector data and other shapefile based data such as LiDAR Point Clouds will be delivered in ESRI shapefile format, along with the appropriate ArcGIS projection file (*.prj) indicating the above projection and datum.

Contours will be delivered as an ESRI LineZ Shapefile. Each contour line will have an attribute to indicate if it is an index or intermediate contour and whether it is a depression contour and if it is in an obscured or low reliability area. Contours shall be developed using a combination of elevation mass points, polygons, and breaklines to generate a TIN.

Spot elevations will be shown at the following locations:

- Intersections of all roads, railways, trails and foot paths;
- End of runways;
- All bridges, culverts and watercourse crossings;
- Dams, docks, piers, and wharfs; and
- All water bodies.

The edited topologically correct breakline and other planimetric features as ESRI LineZ or PolygonZ shapefiles as is appropriate will be submitted.

AutoCAD DWG and DXF or Bentley Microstation V8 DGN will be submitted in addition to the shapefile listed above. Non data element such as drawing borders, title blocks, north arrows, etc. shall be placed on a separate layer.

The original collected mass points and a raster data which may be interpolated from the TIN created by the mass points and breaklines) as ESRI PointZ.

All shapefiles will be full 3D files.

Notes:
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Portions of the text have been abstracted from Imagery and Elevation Acquisition Guidelines by Mapcon Mapping Ltd. for the Ministry of Natural Resources, November 2009

Table 2.4 – Mass Points/DEM

Deliverables:

Mass Point Data X/Y or X/Y/Z Format

- ASCII (comma or tab separated)
- Excel
- MS Access
- ESRI Geo-database table
- dBase

ESRI ASCII Grid

- ESRI Binary Grid.
- ESRI file geodatabase raster, ArcGIS version 9.2 or later.

GeoTIFF

- GeoTIFF files should have an associated valid world file with extension ".tfw" (or ".wld");
- GeoTIFF files should have an associated valid spatial reference system definition file (".prj") in a well-known text (WKT) format;

The GeoTIFF tag "Coordinate System" which contains the full definition of the spatial reference system in the well-known text (WKT) format will be submitted.

Breakline features must be classified and separately attributed for the following features:

- Water Body Features, Shorelines (lakes, reservoirs, etc.)
- Water features (such as wide rivers)
- Linear Hydrographic Features - streams, shorelines, canals, etc. with varying elevations
- Road Features - not including bridges and overpasses
- Overpasses and Bridges
- Ditches and other constructed features
- Obscured Areas - vegetated areas that are considered obscured to the extent that adequate vertical data cannot be clearly determined.

Notes:
Portions of the text have been abstracted from Flood Inundation Mapping Guidelines by Environmental Water Resources Group Ltd. in association with 4DM for the Ontario Power Generation, Draft March 2009.

Portions of the text have been abstracted from Imagery and Elevation Acquisition Guidelines by Mapcon Mapping Ltd. for the Ministry of Natural Resources, November 2009.

Table 2.5 – DTM

Deliverables:

Mass points, breaklines, obscured areas, and optionally contours, shall be referred to herein as the Digital Terrain Model.

Elevation data will include mass point data with a posting not greater than ten times the specified accuracy.

Elevation data will include breakline data for any hydrologically significant features to support the development of a hydrologic terrain surface. A hydrologic terrain surface is defined here as a 3D elevation surface created from elevation points and line and/or polygon breaklines that accounts for any barriers to hydrologic flow.

Breakline features must be classified and separately attributed for the following features:

- Water Body Features, Shorelines (lakes, reservoirs, etc.)
- Water features (such as wide rivers)
- Linear Hydrographic Features - streams, shorelines, canals, etc. with varying elevations
- Road Features - not including bridges and overpasses
- Overpasses and Bridges
- Ditches and other constructed features
- Obscured Areas - vegetated areas that are considered obscured to the extent that adequate vertical data cannot be clearly determined.

Contours shall be developed using a combination of elevation mass points, polygons, and breaklines to generate a TIN.

Notes:
Portions of the text have been abstracted from Flood Inundation Mapping Guidelines by Environmental Water Resources Group Ltd. in association with 4DM for the Ontario Power Generation, Draft March 2009.

Portions of the text have been abstracted from Imagery and Elevation Acquisition Guidelines by Mapcon Mapping Ltd. for the Ministry of Natural Resources, November 2009.

2.4 Hydraulic Structure Data

Hydraulic structure data is required to undertake the hydrologic and hydraulic analyses required for flood hazard maps. Generally, the data is acquired through field surveys, field investigations, and as built drawings. Hydraulic structure data includes the following:

- Photographs;
- Highwater Marks and Debris Lines; and
- Hydraulic Structure Dimensions and Elevations.

Photographs

- Photographs of each hydraulic structure, upstream face, downstream face, looking across the overtopping section from left to right, looking upstream, looking through the structure, and looking downstream; and
- All photographs taken in the field will be geo-referenced and will be located in ESRI shapefiles.

Highwater Marks and Debris Lines

The following should be photographed and surveyed/measured:

- Highwater or flood marks;
- Ice scars, scour marks, etc.;
- Signs of relief flow and any signs of scour of deposition; and
- The location, type, size and amount of debris.

Hydraulic Structure Dimensions and Elevations

Hydraulic structure data sheets should be prepared outlining the physical characteristics of each structure. The data sheets shall be prepared for all hydraulic structures (bridges, dams and embankments, road/rail crossings, etc.).

- Included on the data sheets for bridges/culverts will be the following:
  - Street Name;
  - UTM Co-ordinates;
  - Skew Angle;
  - Crossing Length;
  - Entrance (vertical abutments, headwalls, wingwalls, mitered to slope, projecting);
  - Parapet Type and Dimensions, length and Height;
  - Deck Thickness;
  - Number of Cells;
  - Each Cell Shape;
  - Each Cell Dimensions - Span, Height;
  - Each Cell Material;
  - Pier Width;
  - Top of Road Elevation;
  - Road Sag Elevation;
  - Upstream and Downstream Crossing Invert Elevations;
  - Upstream and Downstream Soffit Elevations;
  - Crossing Material; and
  - Assessment of Scour/Deposition, and Potential for Debris Blockage.

- Included on the data sheets for dams/weirs will be the following:
  - Top-of-dam elevation;
  - Normal pool elevation;
  - Principal spillway type;
  - Inlet and outlet elevations and dimensions; and
  - Emergency spillway type, elevation and dimensions.

- Surveyed profiles across each hydraulic structure. The surveyed profile will be used in the hydraulic model and the points surveyed in the field will be included in the ESRI shapefiles;

- Channel and bridge/culvert drawings used to develop the hydraulic models; and

- All information surveyed and measured in the field will be submitted in ESRI shapefiles. This includes hydraulic structures (road crossings, dams, stormwater ponds, benchmarks, monuments, etc.).

2.5 References

Parts of Section 2 has been abstracted from the following documents:

- Guidelines for Digital Elevation Data v1.0, by National Digital Elevation Program (NDEP), May 2004;
- Photogrammetric Mapping,by U.S. Army Corps of Engineers, July 2002;
- Imagery and Elevation Acquisition Guidelines,by Mapcon Mapping Ltd., November 2009;
- Data Capture Standards, Appendix M, Guidelines and Standards for Flood Risk Analysis and Mapping by FEMA, January 2008;
- Guidance for Aerial Mapping and Surveying, Appendix A, Guidelines and Specifications for Flood Hazard Mapping Partners by FEMA, April 2003;
- Supporting Sustainable Water Management in Ontario through Innovation, by Ganaraska Region Conservation Authority, March 2009;
- Surveying Principles and Applications, 6th Edition, Barry F. Kavanagh, 2003;
- ASPRS Positional Accuracy Standards for Digital Geospatial Data, American Society for Photogrammetry & Remote Sensing, Revision 7 Version 1, Final Draft for Board Approval, November 14, 2014;
- LAS Specification Version 1.4 - R13, American Society for Photogrammetry & Remote Sensing, July 15, 2013;
- LiDAR Base Specification, By Hans Karl Heidemann, Chapter 4 of Section B, U.S. Geological Survey Standards Book 11, Collection and Delineation of Spatial Data, Version 1.2, November 2014;
- LiDAR Specifications for Flood Hazard Mapping, Appendix 4B: Airborne Light Detection and Ranging Systems, Federal Emergency Management Agency; and
- National Floodplain Mapping Assessment, MMM Group Limited in association with JFSA and Matrix Solutions Inc. for Public Safety Canada June 2014.

3.0 HYDROLOGIC ANALYSIS

3.1 General

Hydrologic analyses are undertaken to develop a comprehensive assessment and understanding of precipitation runoff characteristics and to provide input data to hydraulic analysis procedures. Hydrologic analyses must be conducted using established procedures, and must be easily reproducible. Professional engineers are to be able to recognize and understand all methods, approaches, basic data and rationale and any assumptions used in the analysis. Professional engineers are to be able to recreate the entire work without referring to other documents. Documentation must include the following:

- What analysis was done including purpose, alternative methods, and the rationale for the chosen method;
- How the analysis was conducted including input data, data sources, measurements of data, verification, collaboration, uncertainty analysis, calibration, validation, and sensitivity analysis;
- The results of the analysis;
- How the results were checked; and
- What are the limitations of the analyses.

A hydrologic analysis can be undertaken using the following steps (Figure 3-1):

1. Determine the information that is required, and to what level of accuracy;
2. Conceptualize and characterize the watershed including historical meteorological drivers of flooding;
3. Determine what data is available and to what level of accuracy;
4. Select the hydrologic computation procedure;
5. Conduct the hydrologic computations;
6. Determine the acceptability of the results and
7. Document the study process and results.

Standard Hydrologic Parameters (Section 3.9) should be used in all hydrologic computations. If the engineer feels that the Standard Parameters should be modified, the engineer should provide documentation to the Conservation Authority providing justification that can include the results of calibration/validation analyses.

Hydrologic computations for hazard limit delineation are usually conducted through either a frequency analysis of recorded streamflow rates, or by simulating streamflow rates using a computer program or by field measurements of maximum flood elevations.

Section 3 refers to two (2) types of data or series of data. Historical data refers to floods that have occurred. Design data or series of data refers to simulated streamflow using standard input such as design storms. For example, a historical flood frequency curve refers to return

period values developed using recorded streamflow data. A design flood frequency curve refers to return period values developed from computer simulation model data.

Section 3 is divided into the following subsections:

3.2 Information Requirements
3.3 Watershed Conceptualization and Characterization
3.4 Data Availability: Climatic, Precipitation, Streamflow
3.5 Selecting a Computational Procedure
3.6 Technical Reviews
3.7 Frequency Analysis: Streamflow
3.8 Computer Modelling
3.9 Hydrologic Standard Parameters
3.10 References

The hydrologic study report must be sealed, signed, and dated by a professional engineer. All computer program input and output data must be sealed, signed, and dated by the professional engineer who prepared or supervised the preparation of the input data and who checked the output data. The computer model description boxes must include the professional engineers name, PEO number, and the completion date.

3.2 Information Requirements

- The study report must discuss the hydrologic information required for input to the hydraulic model, and the methodology used to obtain that information. Information includes the characteristics of streamflow, and where the information is required. The report must discuss what scenarios are to be calculated, and what level of accuracy is required.

- It is the engineer's responsibility to review the accuracy of the input parameters and the computation methods to ensure the flood hazard maps are produced at a reasonable cost. The accuracy of the hydrologic results is a function of the accuracy of the input values and the computation methods. Generally, the greater the level of accuracy required in the hydrologic results, the greater the level of effort and resources needed to produce the hydrologic results. Each input value and computation method has an associated level of accuracy. Increasing the level of accuracy in one of the inputs does not necessarily increase the level of accuracy to the same extent in the hydrologic results. Increasing the level of accuracy in one of the inputs or selecting a computation method with a higher level of complexity may result in higher costs.

- Specification of the information requirements combined with characterization of the watershed, and determination of available data will allow a computation procedure to be selected.

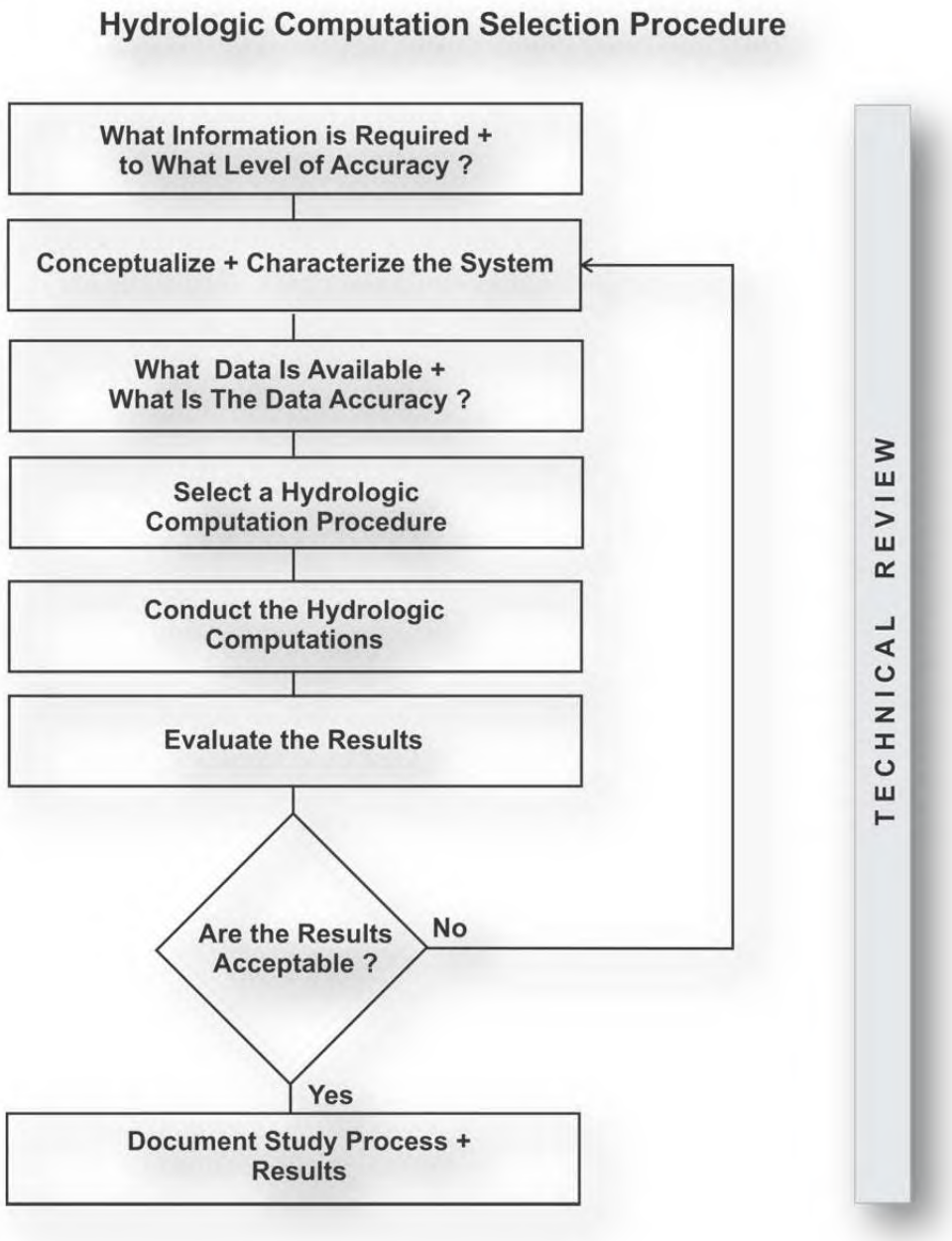
3.3 Watershed Conceptualization and Characterization

- The report must discuss the conceptualization and characterization of the watershed under study. Conceptualization and characterization aids in determining the computation methods to be used in the hydrologic calculations including which computer programs may be applicable.

- Conceptualization will determine the salient components of the watershed, the relationships between the components, the upstream and downstream boundary conditions, and the temporal computation requirements. Also, the size of the time step to be used in the computations must be determined. Conceptualization will determine how lumped or detailed the hydrologic processes will be modelled. Assumptions must be fully discussed and justified.

- Characterization of the watershed will aid in determining which computation methods are selected. It includes the size and location of storage and conveyance elements within the watershed.

Figure 3-1


Hydrologic Computation Selection Procedure
What Information is Required + to What Level of Accuracy ?
Conceptualize + Characterize the System
What Data Is Available + What Is The Data Accuracy ?
Select a Hydrologic Computation Procedure
Conduct the Hydrologic Computations
Evaluate the Results
Are the Results Acceptable ?
No
Yes
Document Study Process + Results
TECHNICAL REVIEW

3.4 Data Availability: Climatic, Precipitation, Streamflow

The study report should contain a discussion on the data used to derive parameters for the model, and the data used to evaluate the model. The accuracy of the model will depend on the accuracy of the data used to develop and calibrate the model. The discussion should include the following:

- Where can the data be sourced;
- How and by whom was the data measured;
- Period of record that was used in the model; and
- What is the level of accuracy of the data.

Error and uncertainty creeps into data through a number of ways. Included are errors due to the procedures used to acquire the data, errors due to natural spatial and temporal variability, transcription errors, data storage errors, and errors due to data manipulation.

An example is streamflow data. Accuracy of streamflow rates can vary from plus or minus 2% to as high as 40%. The process entails observations of flow depth, periodic measurements of streamflow, and development of a rating curve to convert flow depth to flow rate. Error is dependent on the following:

- Accuracy and precision of the instruments used for making the flow depth measurements;
- Methods used to average the depth measurements;
- Skill of the hydrographer measuring streamflow rates;
- Open channel flow conditions such as backwater and non- steady flow conditions;
- Climatic and environmental factors that affect the quality of streamflow measurements; and
- The validity of the method used to develop the rating curve and the stability of the channel section.

Some agencies have considered measurements of daily streamflow to be excellent if measured within 5% of the true value, good if measured within 10% and fair if measured within 15%. For individual storm events, the accuracy of measurements could be greater than 15%.

Data Filling and Modification

- The study report must contain a discussion on data filling and modification of data used in the study. Generally, missing data needs to be filled. Also, suspect data needs to be modified.

- Discussion should include the following:
  - What data was filled or modified; and
  - What techniques were used to fill the data including the statistical characteristics of the modified data. Statistics include data means, standard deviation, skewness, event frequency, and high/low spell lengths.

Data Stationarity

- The study report must contain a discussion regarding data stationarity. Changes to data sets may be gradual, or may be abrupt or may be in a more complex form.

- Data sets may not be stationary for a variety of reasons including the following:
  - Changes in measurement techniques or instrumentation or relocation of the gauge;
  - Changes in land use or land use management;
  - Changes in stream channel geometry;
  - Changes in streamflow regulation and deregulation;
  - Changes in groundwater; and
  - Changes in climate.

3.5 Selecting A Computational Procedure

There are several procedures that may be conducted to calculate the hydrologic requirements for flood hazard mapping projects. Included are single station frequency analysis, regional frequency analysis, and hydrologic modelling. The choice is based on the need for a hydrograph as opposed to peak discharge rate, the size and characteristics of the watershed, the availability of data, input requirements of the hydraulic procedures, previous studies, and future land use change.

Single station frequency analysis that includes the use of recorded data in the vicinity of the study area is the preferred choice for developing the return periods of peak streamflow rates. The use of single station frequency analysis is limited to a significant period of record, stable upstream land use, unchanging future upstream land use, the lack of a need for a full hydrograph in the drainage system analysis, and the lack of a need for the analysis of a historical storm event. Many stations within southern Ontario cannot meet these criteria.

Regional frequency analysis is an extension of single station analysis to a region where data from several gauges is utilized to develop equations for the prediction of peak streamflow rates. Regional frequency analyses have limitations similar to single station frequency analyses.

Precipitation-runoff modelling or hydrologic modelling is the typical method used to develop the input data for the development of flood hazard maps. Data recorded at streamflow gauges and single station frequency analysis should be used in the development of precipitation-runoff models.

The Conservation Authority must approve the computation procedure prior to the analysis.



Brock St, in Stayner, ON

3.6 Technical Reviews

Hydrologic studies should be reviewed to determine the correctness, completeness or appropriateness of procedures used to develop information for the intended purpose and for adherence to these Technical Guidelines. Included are input data, initial conditions, conceptual model, mathematical model and parameters, model limitations, and documentation.

Reviews can be undertaken near the end of a study, or throughout the study. Both approaches have limitations. For example, there may not be sufficient budget to correct any deficiencies found in a review if the review is conducted near the end of a study. Also, a reviewer's independence may become jeopardized if reviews are conducted throughout the study, as the reviewer may act as an advisor rather than a reviewer. The preference is to have the reviewer involved throughout the study.

A formal process should be followed to review hydrologic studies, and each review should be documented. Reviewers may be performed by the client organization soliciting the work, or can be undertaken by third parties.

Reviewers must have sufficient expertise in the area of practice to properly assess the hydrologic analysis. Reviewers must be capable of conducting the study, and reviewers must have a thorough understanding of methodologies and knowledge of accepted hydrologic engineering practice. A reviewer should have access to the computer program being used in the study. A reviewer should be a Professional Engineer licensed in the Province of Ontario.

The reviewers report should identify the following:

- The individual who authorized the review,
- The author;
- The purpose of the review;
- The basis under which the review was conducted;
- A brief description of the study report under review;
- A summary of documentation provided to the reviewer;
- Communications made during the review;
- A description of the reviewer’s methodology for conducting the review; and
- The reviewer’s findings that include information upon which the opinions are base.

3.7 Frequency Analysis: Streamflow

3.7.1 General

Single station frequency analysis or regional frequency analysis may be used to determine peak streamflow rates required for the hydraulic analysis. Frequency analysis does not provide a full streamflow hydrograph and is not applicable to changing land use conditions.

As a result, frequency analysis cannot provide the input required for 2-D hydraulic modelling, or for unsteady flow modelling or for catchments where the existing land use is substantially different than future anticipated conditions.



Yonge/York Mills Channel, Toronto, ON

3.7.2 Single Station Frequency Analysis

- Frequency analysis can be undertaken where suitable streamflow records exist for the study watershed;

- The suitability of the records for frequency analysis will be evaluated through discussion with the Conservation Authority, the operating agency, field inspection and review of the records;

- Single station analysis should be carried out when the length of record is equal to or greater than 20 years;

- For record lengths between 10 years and 19 years, single station analysis shall be substantiated through comparison with regional frequency analysis. If the length of record is less than 10 years, only regional frequency analysis shall be undertaken;

- The 95% confidence limits on peak streamflow estimates and expected probability adjustments must be provided;

- Frequency analysis of streamflow data should only be performed for data that is random, independent, homogeneous and stationary;

- Factors that must be considered in using existing streamflow records are the conversion and reconversion of regulated and natural flows; non-stationary records; the extension of the streamflow records; single site versus regional flood frequency analysis; and transfer of location of record;

- Any modifications to streamflow data or the results of the frequency analysis must be documented in the study report. Documentation must include reasons for the modifications, and any limitations caused by the modifications;

- Frequency analysis may be performed using the Consolidated Frequency Analysis computer program (CFA88), developed by Environment Canada. Programs and spreadsheets may be used when prior approval has been granted by the Conservation Authority; and

- Computer programs, that are used to perform the frequency analysis must be selected by the engineer and approved by the Conservation Authority. Reasons for selecting the program must be documented in the study report.

3.7.3 Regional Frequency Analysis

- All parameter values must fall within the range of basin and climatic characteristics used to derive the equations; and

- Several regional frequency analyses have been prepared for Ontario applications. Included are the following:
  - Index Flood Method, Environment Canada 1985;
  - Multiple Regression Method, Environment Canada, 1986;
  - Regionalization by Multiple Regression Analysis, Ontario Ministry of Natural Resources, 1984; and
  - Modified Flood Index Method, by Ontario Ministry of Transportation, 1986.

3.7.4 Corroboration

- Where results from a single station or a regional frequency analysis are used as input to hydraulic procedures, the results must be corroborated using an independent method.
  Regional frequency analysis results may be used to corroborate the results from a single station frequency analysis.
  Regional frequency analysis results may be used to corroborate the results from a different regional frequency analysis methodology; and

- The results from the corroboration must be documented in the study report. If the results cannot be corroborated then the Conservation Authority must be contacted before hydraulic analyses are initiated.

3.7.5 Documentation and Deliverables

- All model input and output files and geo-referenced spatial files showing hydrologic features used for the analysis must be submitted;

- All data and reports must be submitted in electronic format as specified by the Conservation Authority;

- Discussion on streamflow gauging stations including equipment, site rating curve, vulnerability to backwater, ice influence or flanking with conclusions regarding its reliability shall be prepared as part of the study report;

- Discussion on the criteria used in the flood frequency analysis and reasons for choosing a particular frequency distribution shall be included in the study report;

- Table - results of the regional frequency analysis for 2 through 100 year peak flow rates at various points of interest;
- Table - input parameters used in the regional frequency analysis;
- Table - summary of streamflow gauges, including location, period of record, etc.;
- Table - summary of streamflow data used in the frequency analysis; and
- Graphs of flood frequency curves with 90% confidence limits.

3.8 Computer Modelling

3.8.1 General

Computer models are a simplification of reality. Computer models are simply tools that can be used to better understand how watersheds function. Computer models can range from complex, geographically explicit computer models, to simple lumped models. Modelling to a higher resolution or level of accuracy than is necessary will not always produce superior results and may ultimately waste time and resources.

Figure 3-2 is a methodology or process that may be followed to undertake computer modelling. The process is similar to the hydrologic selection process shown in Figure 3-1.

Section 3.8 is divided into the following sections:

3.8.2 Program/Software Selection

3.8.3 Model Building
- 3.8.3.1 Precipitation
- 3.8.3.2 Discretization
- 3.8.3.3 Land Use
- 3.8.3.4 Time Steps
- 3.8.3.5 Hydrologic Abstractions
- 3.8.3.6 Hydrograph Convolution
- 3.8.3.7 Channel Routing
- 3.8.3.8 Reservoir Routing
- 3.8.3.9 Diversions
- 3.8.3.10 Input Hydrographs

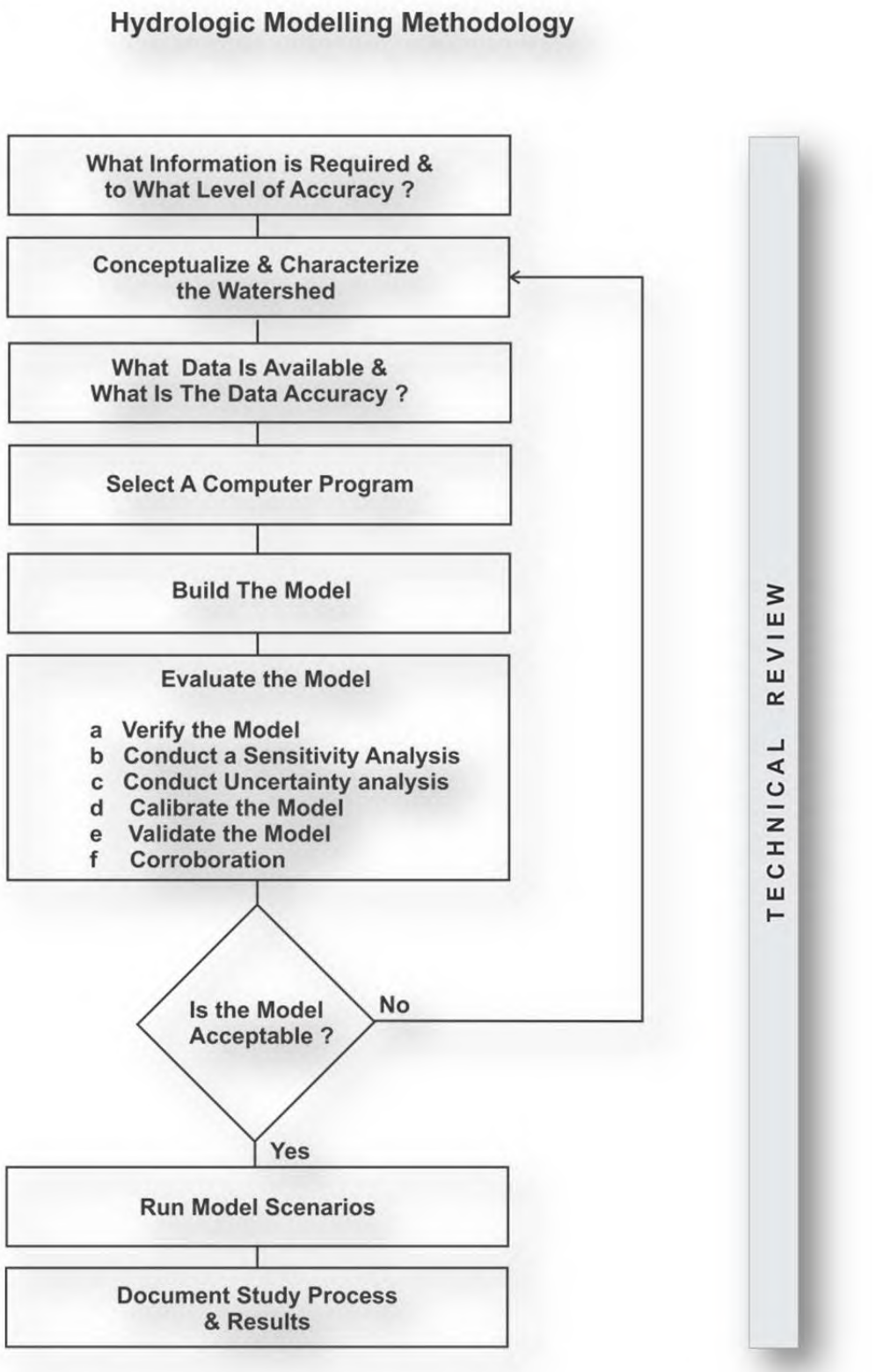
3.8.4 Model Evaluation
- 3.8.4.1 Model Verification
- 3.8.4.2 Sensitivity Analysis
- 3.8.4.3 Uncertainty Analysis
- 3.8.4.4 Calibration/Validation
- 3.8.4.5 Corroboration
- 3.8.4.6 Error and Warning Messages

3.8.5 Model Acceptability

3.8.6 Modelling Scenarios and Results

3.8.7 Study Report and Deliverables

Figure 3-2


Hydrologic Modelling Methodology
What Information is Required & to What Level of Accuracy ?
Conceptualize & Characterize the Watershed
What Data Is Available & What Is The Data Accuracy ?
Select A Computer Program
Build The Model
Evaluate the Model
a Verify the Model
b Conduct a Sensitivity Analysis
c Conduct Uncertainty analysis
d Calibrate the Model
e Validate the Model
f Corroboration
Is the Model Acceptable ?
No
Yes
Run Model Scenarios
Document Study Process & Results
TECHNICAL REVIEW

3.8.2 Program/Software Selection

- An engineer must select the computer program to be used in the hydrologic analysis. Reasons for selecting a computer program must be documented by the engineer and approved by the Conservation Authority. The documentation must include alternate programs, and reasons why the alternate programs were not selected. The documentation for the program selection must be sealed, signed and dated by a professional engineer;

- Computer programs used in the hydrologic analyses must be the most recent version. The engineer should follow the procedures and guidance given in the program User's Manual;

- Computer programs used in the hydrologic analyses should not be modified by anyone except the programs author; and

- If the engineer proposes any modifications to the computer program or proposes to use an existing modified program, the consultant must submit to the Authority input test data, output, and complete listing of the modified computer program, user's manual and an explanation in detail as to the nature of and reasons for modifications for review and approval prior to its use. The Conservation Authority and its agents should be granted a royalty free license to use the program for flood plain modifications.

Program/Software Selection Notes

- A computer program is a system or algorithm with mathematical equations, parameters and data structures. Programs may be developed in-house, may be external open source or may be an external proprietary program where the source code is not shared. Open source programs that are actively managed are recommended;

- There may be more than one suitable program to conduct the computations and more than one computer program may be required;

- The engineer should be familiar with the principles, equations, algorithms, and assumptions used in the program; be aware of the programs limitations; and know when the program is providing the appropriate answers;

- Table 3.1 identifies some of the steps required by the engineer to demonstrate due diligence when selecting and using hydrologic and hydraulic software. The

engineer selecting the software is responsible for conducting due diligence whether it is Conservation Authority staff or a consultant;

- The engineer should select a program (algorithms and equations) with the available data that reflects the dominant and sensitive processes described in the conceptual model; and
- The engineer should select a program that is no more complicated than necessary to compute the required information. Models tend to increase uncertainty in their results as they become too simple or too complex. The complexity of a model should be sufficient to minimize uncertainty, and that any more or less complexity will increase uncertainty.



Old Mill, Hamilton, ON

Table 3.1 - Software Due Diligence

1. The engineer should accept or reject software based on their own assessment of the compatibility and viability of the software to the task at hand.
2. The engineer should be able to justify and document the selection of each software tool.
3. The engineer should keep records of input data, and check output data from newer software versions with that obtained from earlier, verified versions.
4. The engineer should test all problematic situations that arose in the past.
5. Logs should be kept that report software performance and observations of past problems and limitations.
6. The engineer should establish and conduct suitable tests to determine that the software performs as it was intended to do.
7. Software is verified by comparing output data with actual results from real-life situations or thoroughly checked manual calculations.
8. The engineer should check output data after each run to be assured the data is correct and reliable for use in design.

The data can be checked by comparing output from manual calculations with software output. Also, output data can be checked through comparison of output data from past projects of a similar nature.

Notes:
One or more engineers may be required to comply with the above statements.

"Due diligence is the effort expected to be made by an ordinarily prudent or reasonable party to avoid harm to another party."

"Professional engineers are responsible for all aspects of the design or analysis they incorporate into their work, whether it is done by an engineering intern, a technologist or a computer program."

page 4, Professional Engineers Using Software-Based Engineering Tools *April 2011*, by Professional Engineers Ontario.

3.8.3 Model Building

Model building is the development of a mathematical model from a conceptual model. Conceptual models describe how a system behaves, the system components, and the functional relationships between these components. Model building requires both a spatial and temporal discretization of the physical watershed into a mathematical model. The construction of the mathematical model is a function of the computer program. The model building phase determines parameter values that are fixed, and parameter values before calibration. Parameters before calibration or standard parameters can be found in Section 3.9 Hydrologic Standard Parameters.

The development of flood hazard maps specifically refers to models that simulate extreme streamflow rates and streamflow hydrographs. Separate models may have to be developed for low flow events.

3.8.3.1 Precipitation

Historical Storms

- Observed storms can be transposed from their location of occurrence to the basin in question and their orientation changed to maximize the flooding effects on the watershed; and
- For historical storms, the spatial distribution of rainfall must be discussed in the report. It is important to note that historic storms move across a catchment while design storms are assumed to be stationary over the catchment and evenly distributed across the catchment.

IDF Curves

- The model shall be based on rainfall frequency or, where snowmelt floods are significant, a combination of snowmelt and rainfall; and
- Municipal intensity-duration-frequency (IDF) values can be used when undertaking hydrologic simulations for urban watersheds. If municipal IDF values are not available, then the values shown in Section 3.9 Hydrologic Standard Parameters may be used.

Long Duration Climate/Precipitation

- Continuous simulation programs may be used to simulate the runoff response required as input to hydraulic models. The continuous model should be capable of simulating high flow events. Time steps used for computation should be short enough to simulate high flow events. Typically, time steps should be equal to roughly 1/5th of the time to streamflow peak for a catchment. The study report must justify the selection of continuous simulation to develop flood flows and document the area where the flood flows are not appropriate. Continuous simulation programs and input data must be approved by the Conservation Authority before the analysis is initiated.

Design Storms

- The engineer must document the characteristics of the design storm, the methodology used to develop the design storm, and where the data was sourced. Typically, design storms will represent either a snowmelt/rainfall (spring) event or an intense thunderstorm (summer) event. The design storm will be characterized by duration, time step, a temporal pattern, areal reduction factors, and antecedent precipitation.

  The use of a snowmelt/rainfall event or an intense thunderstorm event will be dependent on when the majority of annual maximum peak flow rates occur, spring or summer. Generally, floods on rural basins are generated by spring snowmelt/rainfall events while floods on urban basins are generated by intense summer events. In some instances, both a snowmelt/rainfall event and an intense thunderstorm event will be required.

  The design storm duration must exceed the time of concentration of the catchment upstream of the point of interest. The time of concentration should include the residence time in ponds and reservoirs. The time step of the design storm should be less than the minimum time of concentration of any subcatchment.

  There are several design storm patterns available for intense summer events. Included are the Keifer & Chu or Bandyopadhyay storm, the SCS Type II storm, the AES storm, and the Hydrotek storm. The Keifer & Chu or Bandyopadhyay storm is recommended for use on urban or urbanizing basins. The storm has a variable duration, a variable time step, and all intensities within the storm conform to all durations within the Intensity-Duration-Frequency curve from which it is developed. The Conservation Authority should approve the design storm before the analysis is initiated.

A "critical design storm" approach should not be used for hydrologic modelling. A critical design approach involves simulating runoff from all design storms and then selecting the design storm that yields the highest flow rate. This approach does not preserve risk or return period intensities for all points of interest within a watershed. Intensities may be over estimated for some points of interest and under estimated for other points of interest. Intensity-duration curves can be developed for historical storms and design storms. These intensity-duration curves can be compared to intensity-duration-frequency curves (MSC) developed from recorded rainfall. For a given point of interest or a time of concentration, the intensities from the two curves should be equal or similar. Design storm distributions such as the SCS type II storm, the AES storm, and the Hydrotek storm do not preserve risk or return period intensities for all durations within the storm.

- The engineer must develop a design storm for snowmelt/rainfall events and have it approved by the Conservation Authority before use. There are no accepted design storms for snowmelt/rainfall (spring) events. A frequency analysis of snow-course data and meteorological conditions will have to be conducted to develop a design storm. The analyses will include the amount of snow (water) on the ground, the temperature pattern, and the volume of rainfall to be utilized in the design storm.

- Sensitivity analyses should be conducted when modelling snowmelt-rainfall events. Engineering experience with snowmelt-rainfall modelling is required when data is limited.

Climate Change

It is recommended that an adaptive approach be utilized when accounting for climate change in the development of flood hazard maps. The recommended approach is based on the use of the last 50 years of recorded data when developing intensity-duration-frequency curves (IDF) and the last 50 years of recorded streamflow data when developing return period streamflow rates. This moving window approach should capture climate change that may be occurring and the 50 year period of record should be sufficient to develop 100 year return period values. There are other approaches to reflecting climate change in hazard limits. Maintaining up-to-date IDF curves and flood frequency curves of streamflow data is within the flood plain manager's area of control.

One of the key components of the hydrology that will change will be the local intensity-duration-frequency curve (IDF) that may result in a shift in how design storms are distributed or defined. While this component is often developed outside of the floodplain manager's area of control, utilizing the most recent IDF curve and understanding its vulnerabilities from a climate change perspective should be a component of any mapping update program. Maintaining a working understanding of IDF research related to climate change is recommended.

Climate change may also result in the key drivers of flood risk within the watershed to shift. An example may be a watershed that responds to snowmelt and rainfall as the key flood driver may shift to a thunderstorm driven watershed. Flow and weather data may change and will need to be understood to determine how sensitive the watershed may be to climate change, and therefore the need to reassess flood hazard mapping needs. It is anticipated that climate driven changes will be subtle and may need to be viewed over a longer duration. Understanding the potential changes and creating a component within the watershed management program that allows for their recognition and assessment in terms of defining a need to update mapping should be incorporated, if not already in place.

There may also be an impact to the riverine system and therefore hydraulic component of flood hazard mapping as a result of climate change. Increased erosion and flood events can lead to major changes within the channel. This may or may not be a major trigger for a flood hazard mapping update. Changes to the low flow channel may result in a shift in terms of the frequency of flooding experienced within the floodplain area, and impacts to local servicing infrastructure and transportation features.

Determining the need to update a map or series of maps or even an entire watershed based upon impacts related to climate change alone, while possible is operationally unlikely. Understanding the impacts that the effects of a changing climate can create such as those noted above is important. It is also important to understand and incorporate all stressors that may create changes that result in a need to update flood hazard mapping. A sensitivity analysis can be conducted to gain insight on how changing precipitation patterns impact runoff.

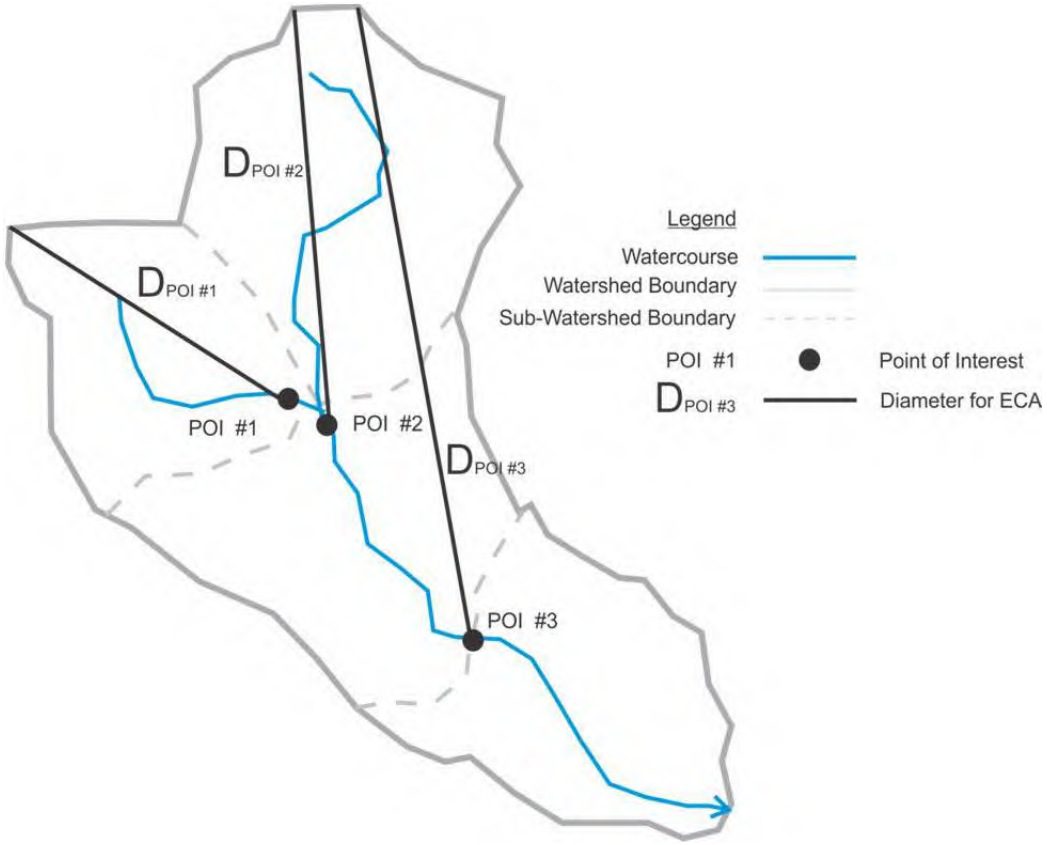
Areal Reduction Factors

- Areal reduction factors should be used for all design storms including 2 through 100 year events. Areal reduction factors (or lack thereof) for return period storms must be documented in the study report and approved by the Conservation Authority. If areal reduction factors are not used, reasons must be documented in the report.

- The areal reduction factors must be calculated using the equivalent circular area method (ECA).

  The equivalent circle area (ECA) will be calculated by using the distance, as the diameter, from the point of interest to the furthest upstream watershed boundary.

  For the Regional Storm, extremely elongated shaped watersheds can use the isohyetal method where the Regional Storm rainfall isohyets are transposed to the upstream watershed.



3.8.3.2 Discretization

- Watershed points of interest will be included in the discretization scheme;
- Future proposals for culvert replacement shall also be considered. For points downstream of such structures, the design flows shall not exhibit the retardation provided by the structures; i.e., only non-routed flows should be used;
- Drainage Boundaries - determine the watershed contributing drainage area through the use of topographic maps, DEMs, shapefiles, air photo interpretation, and field reconnaissance. Ineffective runoff areas, (e.g. pits and quarries) shall be included in the model and the parameters affecting runoff should be adjusted accordingly. Ineffective runoff areas will be discussed in the report and with the Conservation Authority prior to finalizing the hydrologic calculations;
- Sub-catchments used for modelling should have similar times of concentration, have fairly homogeneous land use, fairly homogeneous soils, fairly homogeneous vegetation, and similar geographic characteristics. Sub-catchments should be delineated at confluences of major tributaries;
- Data sources and datum must be provided for all topographic information used in the analysis. Information should include map title, author, publisher, scale, surveyor name, survey date, and date flown. If multiple sources are used then the datum must be modified to be congruent; and
- Generally, the change in flow rate between points of interest should be limited through discretization to 10%. There may be exceptions in headwater areas, and where tributaries confluence with the main branch. An iterative approach in discretization is required to achieve the 10% change in flow rate.

3.8.3.3 Land Use

- All hydrologic analysis for the development of flood hazard maps must be based on anticipated future land use conditions as defined in Official Plans and other municipal land use planning documents. An assessment of the impact of the future land use on the return period flows must be conducted using an existing condition calibrated hydrologic model as the base and fully documented in the study report. Land use at the time of the calibration/validation events maybe different than the when the Study is being undertaken; and
- Existing Land Use Impervious Areas - shall be computed for existing areas from topographic maps, aerial photographs, and shapefiles. For large basins,

impervious areas can be determined by sampling a representative area in each sub-catchment. An accurate estimate of the impervious area is very important, as models are sensitive to this parameter. The method of determining impervious areas must be documented and justified in the study report.

3.8.3.4 Time Steps

- The study report must document the time steps used within the computer model, and the reasons for choosing the time steps. There may be up to several time steps required in a computer model. Included are a time step for precipitation, a time step for hydrograph computation, a time step for sewer routing, a time step for reservoir routing, and a time step for channel routing. Some programs allow only a single time step value.

  If a more accurate hydrograph peak flow rate is required, the hydrograph computation time step must be based on the shortest catchment time of concentration and shortest routing time step. The rainfall time step should be at approximately 1/5 the shortest catchment time of concentration.

  For example, the use of a design storm that uses a 15 minute time step, would dictate the shortest basin time of concentration of approximately 1.25 hours (5 x 0.25 hours). A channel reach of say 200 m would dictate routing time step in the order of a few minutes. The conceptualization and subsequent discretization of the model must ensure that time step criteria are met. If the criteria are not met then simulated peak flow rates for some points of interest may not be accurate.

3.8.3.5 Hydrologic Abstractions

- The study report must include a discussion on the methods used to compute rainfall losses, the reasoning for using those methods, the sources of data and methods used to measure parameters. Also, the report should include a discussion on the antecedent precipitation condition modelled for each frequency; and

- The method used for simulating infiltration should account for all the flows entering, moving within, and leaving soil-water storage. As an example, perched groundwater tables should be included in soil-water storage. The amount of infiltration may be low even though the soil matrix is capable of higher infiltration rates.

3.8.3.6 Hydrograph Convolution

- The study report must document the rationale for using a particular option and the sources and methods used for measuring data and determining the input parameters;

- If a unit hydrograph is input as a table, documentation must include its derivation, including the sources of rainfall and runoff data; and

- There are many methods to calculate hydrograph time to peak or time of concentration for rural areas. Two (2) methods commonly used include the Airport Method, and the Bransby-Williams method. The methods are described in the Hydrologic Standard Parameters Section 3.9 of this report.

3.8.3.7 Channel Routing

- Appropriate channel/sewer routing method should be incorporated into the hydrologic model. Sewer routing may be necessary where runoff from upstream rural areas is piped through a development area;

- Dynamic wave routing shall be undertaken for channel reaches with mild slope where the diffusive wave model criterion cannot be satisfied;

- Cross Section Points - cross section points required for the hydrologic model routing procedure must be obtained from contours, TINs, DTMs or from field surveys. Cross sections shall be extended sufficiently to ensure that the flows shall not exceed the range of the travel timetable.

- Rating curves and travel times used in channel routing shall be determined by preliminary hydraulic calculations of the backwater profile or by procedures available in the approved hydrologic model;

- The study report will contain graphs of all cross sections utilized in the hydrologic model. In addition, the cross section locations will be shown in the shapefiles.

- Manning Roughness Parameters - refer to Section 3.9 Hydrologic Standard Parameters;

- The study report must document the routing methods used, including the values of input parameters, the derivation of those parameters, and the methods of measurements and sources from which those parameters were obtained or measured; and

- Two or more hydrographs will be combined before being routed through channel reaches. It is not acceptable to route the hydrographs separately.



3.8.3.8 Reservoir Routing

- Reservoir routing shall be undertaken for in-stream lakes and swamps, dam and embankments, such as railway embankments and road fills that have significant storage effects. e.g. A minimum volume assessment for road and railway embankments where 10-15% of the flood is available for routing can be used as a trigger to determine if routing should be investigated further. The 10-15% trigger can also be used to investigate whether storage behind embankments should be used in the calibration/validation events;

- Storage upstream of road embankments, dams, and in reservoirs should not be used in the development of peak flow rates unless it can be demonstrated that the structure will not fail under extreme events. A geotechnical analysis may be required to confirm stability. Failure includes the exceedance of design flow rates;

- The Conservation Authority shall be consulted where this storage upstream of road and railway embankments, or alternatively, failure of the dam or embankment, will have a significant effect on downstream flows and upstream flood levels. If failure may occur under flood conditions, consideration will be given to the effect on increasing the downstream peak flows or requesting a dam break analysis;

- Elevation-storage-outflow relations used in the model must be documented in the study report. Documentation must include sources of data regarding reservoir operation, the outlet structure, and the methods, sources, and measurements of data used to define the relation; and

- The study report should discuss the method used and assumptions made in the calculating the effect of storage on flows.

3.8.3.9 Diversions

- All calculations and results used to divert flow in the hydrologic model must be included in the study report. Often hydraulic analysis must be completed before the hydrologic analysis is conducted.

3.8.3.10 Input Hydrographs

- Any inflow hydrographs used in the hydrologic model must be documented in the study report. Details should include synchronization of rainfall and the input hydrographs.

3.8.4 Model Evaluation

- The study report must discuss the results of the model evaluation, and the model evaluation process. Model evaluation is the process used to determine whether a model and its results are sufficient to simulate the inputs required for the hydraulic analysis. Model evaluation includes the following:

  3.8.4.1 Model Verification
  3.8.4.2 Sensitivity Analysis
  3.8.4.3 Uncertainty Analysis
  3.8.4.4 Calibration/Validation
  3.8.4.5 Corroboration
  3.8.4.6 Error and Warning Messages

  The engineer must consider what degree of uncertainty is acceptable within the context of model application. If the engineer does not accept the model for its intended purpose, then the process must be re-started by re-visiting the conceptualization of the study watershed and the drainage system.

3.8.4.1 Model Verification

- The computer model will be verified and documented in the study report. Model verification is the examination of the model to prove that it truly represents the conceptual model.

  Model verification checks the proper implementation of the model on the computer. The model should be computationally stable and provide credible results.

3.8.4.2 Sensitivity Analysis

- Sensitivity analyses should be performed to determine the impact of changing model input parameters and initial conditions on simulated flows. Model input parameters to be varied for the sensitivity analysis may include impervious area, time to peak, recession constants, storage coefficients, overland flow lengths, slopes, Curve Numbers, initial abstraction, and roughness coefficients. Typical ranges would be 75% to 125% of the estimated parameter values; and

- Documentation of the results of the sensitivity analyses shall be provided in the study report. The results will identify the importance of model parameters that will have to be adjusted during calibration.

3.8.4.3 Uncertainty Analysis

- An uncertainty analysis will be conducted and discussed in the study report.

- The uncertainty analysis will investigate the effects of the lack of knowledge and other potential sources of error of model inputs (e.g., the “uncertainty” associated with parameter values, constants, data and beliefs). Models cannot be expected to be more accurate than the errors in the input and observed data. Sources include the science underlying the model, assumptions, and simplifications of what the model is representing. Uncertainty analysis is performed with numerical modelling.

3.8.4.4 Calibration/Validation

- Calibration/validation must be conducted for any hydrologic computer simulation model. Calibration/validation improves the confidence in the hydrologic model results;

- Calibration - consists of a model test with known input and output information that is used to adjust or estimate model coefficients or parameters within physically defensible ranges until the resulting predictions give the best possible fit to the observed data;

- Validation - the model results are compared with an independent set of observations (not used in the calibration) of the real system to verify whether the model describes system behaviour correctly;

- If there are no suitable records within the study watershed, parameters used in the model must be supported by calibration/validation on a similar adjacent watershed. Selection of the appropriate adjacent watersheds or sub-watersheds must be documented and agreed upon by the Conservation Authority;

- Both calibration and validation should be conducted. Validation is as important as calibration. Validation is used to determine the accuracy of the hydrologic model. Validation is used, in part, to determine if the model is good enough to simulate the required information;

- Calibration/validation of the hydrologic model shall be undertaken using all available streamflow records

- Calibrated watershed parameters shall not be adjusted beyond ranges shown in Section 3.9 Hydrologic Standard Parameters. Parameters outside the range must be revised;

- The flows generated by the calibrated model must be substantiated through comparison with other analyses such as regional frequency analysis;

- Documentation must include dates, measurements, and locations of measurements of historical storms; parameters revised and rationale for revising; and input and output data for the calibrated model;

- All hydrologic data must be submitted in electronic format;

- Size of Events - events greater than the capacity of the natural low flow channel or in the case of channelization the events should be greater than the 2 year flow rate. The model has been developed to simulate flood flows. Flood flows are conveyed in the left and right overbanks. Therefore the model should be calibrated and validated with flow rates greater than the capacity of the natural low flow channel. If no such events exist, the model should use Hydrologic Standard Parameters shown in Section 3.9. The selected events for calibration/validation must be approved by the Conservation Authority;

- Duration of Events - should exceed the time of concentration of the watershed upstream of the streamflow gauge;

- Number of Events - At a minimum, two (2) events should be used for each calibrated parameter. One event should be used for calibration and one event for validation. Usually there are more model parameters for calibration than there are observed precipitation/streamflow data sets. Alternatively stated: there are fewer equations than there are unknowns. As a result there is more than one combination of parameter values that can yield good results. A set of parameters that yields good results for one storm event may not yield equally good results for another event. Generally, the number of parameters required for calibration needs to be reduced. Usually, sensitivity analysis is used to reduce the number of parameters to be calibrated. The parameters that have considerable influence on the model results should be used in the calibration process. A sensitivity analysis can be undertaken to determine the parameters that have considerable influence; and

- Antecedent Moisture Conditions - soil moisture conditions should match as closely as possible to actual soil moisture conditions for the historical storm event. Soil moisture conditions have a significant impact on runoff and peak flow rates for rural catchments. The most accurate calibration and validation results will occur when model soil moisture conditions match actual soil moisture conditions. Soil moisture conditions for historic storms must be discussed and approved by the Conservation Authority.

Calibration/Validation Notes

No calibration/validation procedure is perfect.

- There are always deviations due to modelling and measurement errors. There are conceptual errors due to model definition such as the simplification of complex structures, neglect of sub-processes, and errors in the mathematical description or in the numerical method applied. There are errors when measuring field observations such as precipitation and streamflow. There are also errors when selecting model parameters that are not known with certainty.

No model can be truly validated, but can only be invalidated for a specific application. After a sufficient number of successful tests the model is not valid or good but good enough. The model can then be regarded as having been validated.

There are no universally accepted "goodness-of-fit" criteria that will apply in all cases.

- Model performance is evaluated by a series of graphical and statistical tests. Model performance is the ability to reproduce field observations. Graphical tests include the following:
  - Time series plots of observed and simulated values;
  - Observed vs. simulated scatter plots with a 45o linear regression line; and
  - Cumulative frequency distributions of observed and simulated variables.

- Statistical tests include the following:
  - Error statistics; e.g., mean error, absolute mean error, relative error, relative bias, standard error of estimate;
  - Nash-Sutcliffe Efficiency;
  - Correlation tests e.g. linear correlation coefficient, coefficient of model fit efficiency; and
  - Cumulative distribution tests.

Manual vs. Automatic Calibration**:**

- Involves adjusting parameters until a good fit is achieved between measured and simulated values. Manual trial-and-error adjustments can be successful for a simple set of parameters. Manual trial-and-error is usually not reproducible, and the minimum difference between measured and simulated values may not be found. Automatic calibration finds the minimum difference between measured and simulated values using iterations of many parameter values. The engineer is usually limited to the automation procedures found within the program.

- Either manual or automatic calibration will involve (i) selecting the parameters to be calibrated; (ii) determining the range of values for the calibration parameters; (iii) selecting an objective function to determine the goodness of fit; and (iv) determining the criteria to stop the calibration process.

Non-stationarity Data Sets:

- Care must be taken when using data sets that are non-stationary; e.g., streamflow has been measured while the upstream watershed is undergoing urbanization.

Example of the Steps in a Single Event Manual Calibration/Validation Process -

1. Select Cutoff Points for Calibration and Validation
2. Conduct a Sensitivity Analysis
3. Select Recorded Events for Calibration/Validation
4. Conduct Calibration Simulations for Hydrograph Volume of Runoff
5. Conduct Calibration Simulations for Hydrograph Time to Peak
6. Conduct Calibration Simulations for Hydrograph Shape and Peak
7. Accept or Reject the Calibration Results
8. Conduct the Validation Simulations
9. Accept the Validation Simulations
10. Accept the Calibration/Validation Process

3.8.4.5 Corroboration

- Results from computer simulation models must be corroborated using other methods that include previous studies, single station frequency analysis, and regional frequency analysis. The comparison must be documented in the study report. If the results are significantly different reasons must be stated to explain the differences.

3.8.4.6 Error and Warning Messages

- All error and warning messages generated by hydrologic programs must be corrected. Any messages that cannot be corrected must be discussed in the study report.

3.8.5 Model Acceptability

- The study report must include a statement regarding the acceptability of the model to simulate the information required for the hydraulic model. The statement should summarize the results of the model verification, the calibration/validation analysis, the sensitivity analysis, and the uncertainty analysis. Also, the discretization in time and space, and the correctness of the conceptual model will be addressed. The statement will need to answer the question of whether the correct program, and model have been chosen; and

- The Conservation Authority must approve the acceptability of the model in writing before the modelling scenarios are conducted.

3.8.6 Modelling Scenarios and Results

- The study report must contain the results of the scenario runs. Once the model has been accepted or the model is sufficient to conduct the simulations, the scenario runs may be undertaken.

3.8.7 Study Report and Deliverables

Study Report

The Study Report should allow third parties to reproduce the model study including its results. The Study Report must include the following:

- List of technical persons with qualifications that worked on the project;
- The hydrologic study report must be sealed, signed, and dated by a professional engineer. Any computer program input and output data must be sealed, signed, and dated by the professional engineer who prepared or supervised the preparation of the input data and who checked the output data. Where the input data and the output data cannot be sealed, the computer model description box must include the professional engineers name, PEO number, and the completion date;
- A statement on the appropriateness of the model to provide the information required for the hydraulic program;
- A section on model limitations;
- An explanation of differences between observations and model predictions;
- The location of the watershed and study area, study limits, locations where the flood discharges were estimated, associated streamflow gauges, climatic data, hydrologic features;
- The rainfall-runoff model used and all the assumptions and supporting computations associated with the model;
- All data, and assumptions used for rainfall analyses, including the antecedent moisture conditions modeled for each frequency, the methods used to compute the rainfall losses, and areal reduction factors;
- The reasoning for selecting and the methods for determining the hydrograph parameters;
- The routing methods used, including the values of input parameters, the derivation of those parameters, and methods of measurements and sources of data;
- The methods and data used for modelling any diversions;
- The process for model calibration/validation, including dates, measurements, and locations of measurements of historical storms; parameters revised and rationale for revising; and input and output data for the calibrated model; and
- A comparison of modelled flow rates with regional frequency analysis, previous studies, and single station frequency analysis.

Typical Report Figures and Maps

- All Figures and maps to be provided in electronic format acceptable to the Conservation Authority;
- Figure - watershed location plan;
- Figure - watershed modelling schematic that reflects the model input data and the sub-catchment map;
- Figure - precipitation, and observed and simulated hydrographs in the calibration and validation analysis;
- Figure - cross section plot of all routing cross sections with Manning roughness coefficient values, and channel slope;
- Watercourse Profile Graph - through all sub-catchments with the location of the routing cross sections;
- Map - showing sub-catchment location, hydrometric stations, and meteorological stations. Use of an aerial photograph is recommended;
- Map - showing sub-catchments and soil types;
- Map - showing hydrologic model input parameters by catchment.;
- Map - showing sub-catchments and existing and anticipated future land use;
- Map - showing the location of the routing cross sections and the watershed sub-catchments; and
- Map - showing key nodes described in the modelling report.

Typical Report Tables

- Table - model input parameters for existing and anticipated future land use;
- Table - listing the percentage of each soil type in each sub-catchment;
- Table - storage and associated discharge rates used in the reservoir routing;
- Table - discharge storage values, or number of inlets and inlet capacities for diversion structures;
- Table - calibration and validation results;
- Tables - data (observed hydrographs, rainfall amounts, spatial and temporal distributions of rainfall, antecedent moisture conditions, etc.) used in calibration;
- Table - calculated and calibrated watershed parameters for existing and anticipated future conditions;
- Table - comparison of modelled and regional frequency analysis peak flow rates at various points of interest for 2- through 100-year return periods;
- Table - comparison of modelled peak flow rates developed in the present study with values generated in past studies;
- Table - comparison of 100 year peak flow rates generated by varying model input parameters such as impervious area, infiltration rates, and hydrograph shape parameters;

- Table - Regional 100-, 50-, 25-, 10-, 5-, and 2-year peak flow rates for various points of interest within the Study watershed for existing and future land use conditions;
- Table - identifying potential spill areas;
- Table - available hydrometric and meteorological data;
- Table - listing the intensity-duration-frequency values for the 2 through 100 year return periods;
- Table - listing input design storm values; and
- Table - listing the equivalent circular drainage areas and rainfall reduction factors for the various points of interest for the Regional Storm and 2- through 100-year return period events.

Deliverables

- Electronic copies of model input data and output files used in the sensitivity analysis;
- Electronic copies of input and output files used in the computer modelling including Regional, and 2- through 100-year return period events for existing and future land uses;
- Electronic copies of the model input data and output of the calibration and validation analysis;
- Electronic copies of the Study Report that contains at the minimum the Submission Requirements;
- Deliverables - geo-referenced shapefiles showing the sub-basins, locations of estimated flood discharges, flood control structures, such as reservoirs, soil types, creek centreline, road network, and diversions within the reach system that affect flood flow; and
- Electronic copies of all model input and output files and geo-referenced spatial files showing hydrologic features used in the modelling must be submitted.

3.9 Hydrologic Standard Parameters

Standard parameters are shown in Table 3.2. The parameters should be used for un-calibrated models. If the engineer feels that the Standard Parameters should be modified, the engineer should provide documentation to the Conservation Authority providing justification. Area weighted calculations based on land use and soil types are required for Curve Numbers, initial abstraction and runoff coefficients.

An analysis should be conducted for each computer program to determine the sensitive input parameters.



Burlington, ON, on August 5, 2014.

Table 3.2 - Hydrologic Standard Parameters

Table 3.2.1 - Rainfall

Summer Rainfall or Intense Rainfall Storms

- Pattern - Keifer & Chu (Chicago)
- Duration - 24 hours, 5 min time step
- Time of Peak - 0.4 of Storm Duration
- IDF Curves - as below

MSC Toronto Gauge 6158350
1940 - 2003 55 years

Rainfall Intensity Duration Frequency Values

Duration min	2 year mm/hr	5 year mm/hr	10 year mm/hr	25 year mm/hr	50 year mm/hr	100 year mm/hr
5	111	154	183	220	247	274
10	76.8	103	120	142	158	174
15	61.8	85.5	101	121	136	150
30	39.1	54.6	64.9	77.8	87.5	97.0
60	23.8	32.0	38.5	45.9	51.4	56.9
120	14.1	18.8	21.9	25.9	28.8	31.7
360	5.8	7.7	9.0	10.6	11.8	12.9
720	3.4	4.5	5.1	6.0	6.6	7.3
1440	1.9	2.5	2.8	3.3	3.6	4.0

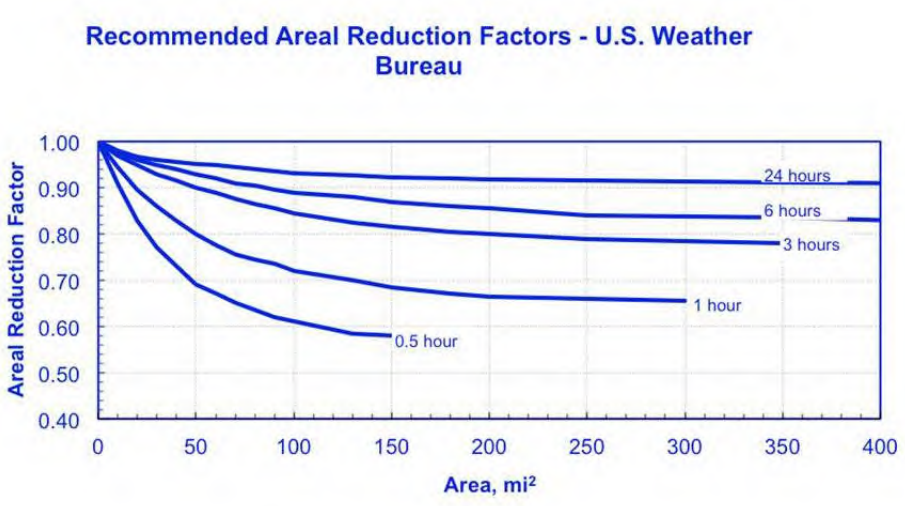


Table 3.2 - Hydrologic Standard Parameters…continued

Table 3.2.2 - Depression Storage Parameters

Depression Storage	d_s Standard mm	Calibration Range	
		Minimum mm	Maximum mm
Impervious	2.0	1.0	3.0
Lawns	5.0	3.0	10.0
Cultivated	7.0	3.0	10.0
Meadows	8.0	3.0	10.0
Woods	10.0	5.0	15.0
Wetland	15.0	15.0	45.0

Table 3.2.3 - Subcatchment Width

Overland Flow Length - SWMM/PCSWMM			
Width = Area/OFL, m^2/m	OFL Should not include channelized flow.		
Overland Flow Length	**OFL Standard m**	**Calibration Range**	
		Minimum m	**Maximum m**
Rural	100	20	150
Urban	40	20	50

Note: The sub-catchment width represents overland sheet flow and not rill or channel flow.

Table 3.2 - Hydrologic Standard Parameters…continued

Table 3.2.4 - Horton Infiltration Parameters

Horton Equation - Minimum Infiltration Rate

SCS Hydrologic Soil Group	f_c Standard mm/hr.	Calibration Range Minimum mm/hr.	Calibration Range Maximum mm/hr.
A	10.0	8.0	12.0
B	6.0	4.0	8.0
C	3.0	2.0	4.0
D	1.0	0.0	2.0

Horton Equation - Maximum Infiltration Rate

SCS Hydrologic Soil Group	f_o Standard mm/hr.	Calibration Range Minimum mm/hr.	Calibration Range Maximum mm/hr.
A	250.0	150.0	300.0
B	80.0	60.0	150.0
C	50.0	35.0	60.0
D	25.0	15.0	35.0

Horton Equation - Decay Parameter

	k Standard hr^{-1}	Calibration Range Minimum hr^{-1}	Calibration Range Maximum hr^{-1}
Decay Parameter	4	1	**5**

Note: Table is not applicable to frozen soils or to a period where snowmelt contributes to runoff.

Table 3.2 - Hydrologic Standard Parameters…continued

Approval is required from the Conservation Authority to modify any of the following Green-Ampt parameters:

Table 3.2.5 – Green – Ampt Method Parameters

Soil Texture Class	Hydrologic Soil Group	Porosity	Wetting Front Soil Suction Head cm	Saturated Hydraulic Conductivity cm/h
Sand	A	0.435	4.95	23.56
Loamy Sand	A	0.440	6.13	5.98
Sandy Loam	A	0.450	11.01	2.18
Loam	B	0.465	8.89	1.32
Silt Loam	B	0.500	16.68	0.68
Sandy	C	0.400	21.85	0.30
Clay Loam	D	0.465	20.88	0.20
Silty Clay	D	0.470	27.3	0.20
Sandy Clay	D	0.430	23.90	0.12
Silty Clay	D	0.480	29.22	0.10
Clay	D	0.475	31.63	0.06

Table 3.2.6 - SCS Curve Numbers

Curve Numbers - AMC II							
Cover	Hydrologic Soil Group						
	A	AB	B	BC	C	CD	D
Woods	32	46	60	67	73	76	79
Meadows	38	51	65	71	76	79	81
Cultivated	62	68	74	78	82	84	86
Lawns	49	59	69	74	79	82	84
Impervious Areas	100	100	100	100	100	100	100

Note: AMC II conditions are used where the Timmins Storm is applicable and AMC III conditions are used for the Hurricane Hazel Storm. Converting from an AMC II Curve Number can be accomplished using Table 3.2.7.

Hydrologic classification of soils types can be found in the MTO Drainage Manual, Design Flood Estimations, Chapter H, Chart H2-5, Hydrologic Soil Groups for Soil Associations in Southern Ontario.

Table 3.2 - Hydrologic Standard Parameters…continued

Table 3.2.7 - Variation In Curve Number Based On Antecedent Condition

Condition			Condition			Condition		
I	**II**	**III**	**I**	**II**	**III**	**I**	**II**	**III**
100	100	100	48	68	84	19	36	56
97	99	100	47	67	83	18	35	55
94	98	99	46	66	82	18	34	54
91	97	99	45	65	82	17	33	53
89	96	99	44	64	81	16	32	52
87	95	98	43	63	80	16	31	51
85	94	98	42	62	79	15	30	50
83	93	98	41	61	78	12	25	43
81	92	97	40	60	78	9	20	37
80	91	97	39	59	77	6	15	30
78	90	96	38	58	76	4	10	22
76	89	96	37	57	75	2	5	13
75	88	95	36	56	75	0	0	0
73	87	95	35	55	74			
72	86	94	34	54	73			
70	85	94	33	53	72			
68	84	93	32	52	71			
67	83	93	31	51	70			
66	82	92	31	50	70			
64	81	92	30	49	69			
63	80	91	29	48	68			
62	79	91	28	47	67			
60	78	90	27	46	66			
59	77	89	26	45	65			
58	76	89	25	44	64			
57	75	88	25	43	63			
55	74	88	24	42	62			
54	73	87	23	41	61			
53	72	86	22	40	60			
52	71	86	21	39	59			
51	70	85	21	38	58			
51	69	85	20	37	57			

I	dry antecedent precipitation conditions
II	average antecedent precipitation conditions
III	wet antecedent precipitation conditions

Table 3.2 - Hydrologic Standard Parameters…continued

Table 3.2.8 - Entrance/Exit, and Transition Loss Coefficients

Weir Flow Coefficients	'C' Standard	Calibration Range	
		Minimum	Maximum
Broad Crested i.e. Road Embankment	1.5	1.40	1.70
Sharp Crested	1.6	1.40	1.80

A sharp crested weir coefficient should be used when there is air underneath the nappe. Such conditions would exist for a stormwater management pond weir outlet. A broad crested weir assumes the nappe is supported. An example of a broad crested weir would be a road crossing. Generally, when the ratio of flow depth divided by the weir thickness is greater than 0.5 a sharp crested weir coefficient should be used. When the ratio is less than 0.5 the broad crested weir coefficient should be used.

Orifice Coefficient	'C' Standard	Calibration Range	
		Minimum	Maximum
Orifice Coefficient	0.66	0.62	0.78

Expansion/Contraction Coefficients	Contraction	Expansion
Gradual Transitions	0.1	0.3
Bridges	0.3	0.5
Culverts	0.5	0.8
Abrupt Transitions	0.6	0.8

Table 3.2 - Hydrologic Standard Parameters…continued

Table 3.2.9 - Manning Roughness Coefficients

Conduit	'n' Standard	Calibration Range	
		Minimum	Maximum
Concrete	0.013	0.011	0.015
Brick	0.015	0.013	0.017
Plastic	0.013	0.011	0.015
Iron	0.013	0.011	0.015
Corrugated Steel Pipe - 3"x1"	0.024	0.021	0.027
Structural Plate Corrugated Steel Pipe - 6"x2"	0.032	0.026	0.036

Open Channel	'n' Standard	Calibration Range	
		Minimum	Maximum
Overbank			
Woods	0.080	0.040	0.120
Meadows	0.055	0.035	0.070
Lawns	0.045	0.030	0.055
Channel			
Natural	0.035	0.025	0.045
Grass	0.030	0.025	0.035
Natural Rock	0.035	0.025	0.045
Armour Stone	0.025	0.017	0.030
Concrete	0.015	0.011	0.017
Articulated Block	0.020	0.019	0.032
Gabions	0.025	0.020	0.030
Wood	0.012	0.011	0.013

Overland	'n' Standard	Calibration Range	
		Minimum	Maximum
Impervious	0.013	0.011	0.015
Lawns	0.250	0.150	0.410
Cultivated	0.300	0.060	0.170
Meadows	0.350	0.025	0.400
Woods	0.600	0.400	0.800

Table 3.2 - Hydrologic Standard Parameters…continued

Table 3.2.10 - Computation Time Steps

Hydrograph Computation Time Step

Time step should be equal to 1/5 of smallest basin time to peak.

Routing Computation Time Step

DT = Length / Celerity

= Length * (g * Avg. Depth) 0.5 / Q

DT = time step, s
Length = routing length, m
g = gravitational constant, 9.8... m2/s
Depth = flow depth, m
Q = flow rate, m3/s

Table 3.2 - Hydrologic Standard Parameters…continued

Table 3.2.11 - Time of Concentration

Bransby-Williams Formula [2]

If runoff coefficient "C" value is greater than 0.4

$$t_c = 0.057 * L * S_w^{-0.2} * A^{-0.1}$$

Airport Equation [2]

If "C" value is less than 0.4

$$t_c = 3.26 * (1.1 - C) * L^{0.5} * S_w^{-0.33}$$

t_c = time of concentration, minutes
C = runoff coefficient
L = watershed length, m
Sw = watershed slope, %
A = watershed area, ha

Rational Method Runoff Coefficients

Rational Method 'C' Values	'C' Standard	Calibration Range	
		Minimum	Maximum
Impervious	0.95	0.95	0.95
Lawns	0.15	0.05	0.35
Cultivated	0.45	0.22	0.70
Meadows	0.35	0.10	0.55
Woods	0.30	0.08	0.52
Wetlands	0.05	0.00	0.10
Business	0.70	0.50	0.95
Residential	0.50	0.25	0.75
Industrial	0.80	0.50	0.90
Parks	0.15	0.10	0.25
Apartments	0.60	0.50	0.70

Table 3.2 - Hydrologic Standard Parameters…continued

Table 3.2.12 - Hurricane Hazel Storm

In the first 36 hours the total rainfall recorded was 73 mm. The following 12 hour rainfall represents the Ontario Ministry of Natural Resources Storm:

Timing	Depth (mm)	Percent of Total
37th hour	6	3
38th hour	4	2
39th hour	6	3
40th hour	13	6
41st hour	17	8
42nd hour	13	6
43rd hour	23	11
44th hour	13	6
45th hour	13	6
46th hour	53	25
47th hour	38	18
48th hour	13	6
Total	212 mm	100

Table 3.2.13 - Hurricane Hazel Areal Reduction Factors

Circular Drainage Area (km^2)	Total Percentage of Rainfall
0 to 25	100
26 to 45	99.2
46 to 65	98.2
66 to 90	97.1
91 to 115	96.3
116 to 140	95.4
141 to 165	94.8
166 to 195	94.2
196 to 220	93.5
221 to 245	92.7
246 to 270	92.0
271 to 450	89.4
451 to 575	86.7
576 to 700	84.0
701 to 850	82.4
851 to 1000	80.8
1001 to 1200	79.3
1201 to 1500	76.6

Table 3.2 - Hydrologic Standard Parameters…continued

Table 3.2.14 - Timmins Storm

The following 12 hour rainfall represents the Ontario Ministry of Natural Resources Storm:

Timing	Depth (mm)	Percent of Total
1st hour	15	8
2nd hour	20	10
3rd hour	10	6
4th hour	3	1
5th hour	5	3
6th hour	20	10
7th hour	43	23
8th hour	20	10
9h hour	23	12
10th hour	13	6
11th hour	13	7
12th hour	8	4
Total	193 mm	100

Table 3.2.15 – Timmins Storm Areal Reduction Factors

Circular Drainage Area (km^2)	Total Percentage of Rainfall
0 to 25	100
26 to 50	97
51 to 75	94
76 to 100	90
101 to 150	87
151 to 200	84
201 to 250	82
251 to 375	79
376 to 500	76
501 to 750	74
751 to 1000	70
1001 to 1250	68
1251 to 1500	66
1501 to 1800	65
1801 to 2100	64
2101 to 2300	63
2301 to 2600	62
2601 to 3900	58
3901 to 5200	56
5201 to 6500	53
6501 to 8000	50

Figure 3-3 Flood Hazard Criteria Zones

Abstracted from Technical Guide, River & Stream Systems: Flooding Hazard Limit, page 12, Ontario Ministry of Natural Resources, 2002

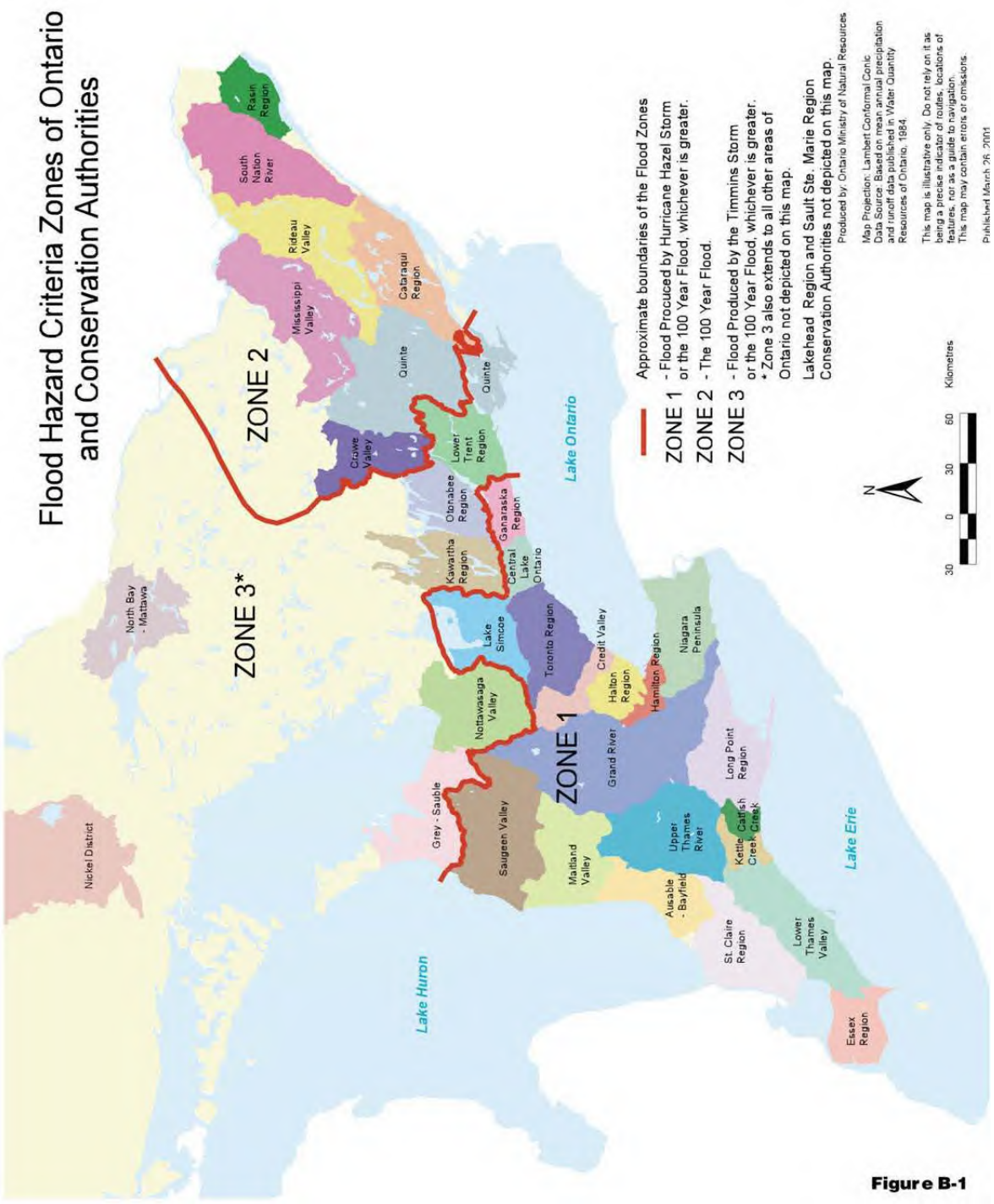


Figure B-1

3.10 References

Information used in Section 3 has been abstracted from the following documents:

- Guidelines for Water Management Modelling
  eWater CRC, Australia 2011
- Guidance on the Development, Evaluation, and Application of Environmental Models
  US EPA CREM (Council for Regulatory Environmental Modeling) March 2009
- Good Modelling Practice Handbook
  STOWA Report 99-05
- Appendix 2 Modelling
  Assessment Report: Draft Guidance Modules, Ontario Ministry of the Environment October 2006
- Flooding Hazard Limit, Technical Guide River & Stream Systems
  Ontario Ministry of Natural Resources 2002
- Appendix C: Guidance for Riverine Flooding Analyses and Mapping
  Guidelines and Specifications for Flood Hazard Mapping Partners US FEMA November 2009
- Selection, Calibration, and Testing of Hydrologic Models.
  D.L. James and S.J. Burges. In Hydrologic Modeling of Small Watersheds, Mono. No. 5, American Society of Agricultural Engineers. 1982

4.0 HYDRAULIC ANALYSIS

4.1 General

Hydraulic analyses are performed to determine water surface elevations at various locations along a watercourse for various streamflow return periods. The water surface elevations are used to delineate flood hazard limits and floodplains.

- The technical reports for hydraulic analyses are to be prepared in such a manner that the entire work can be recreated by professional engineers without the need to refer to any other material. Further, professional engineers are to be able to recognize and understand all methods, approaches, basic data, and rationale used for these methods;

- Hydraulic Standard Parameters (Section 4.9) should be used in all hydraulic computations. If the engineer feels that the standard parameters should be modified, the engineer should provide documentation to the Conservation Authority providing justification that can include the results of calibration/validation analyses;

- Hydraulic calculations must be approved by the Conservation Authority before the flood hazard limits are delineated. Hydraulic calculations to determine water surface elevations are usually conducted using a computer program;

- The study report documentation must include the following:
  - What analysis was done including purpose, alternative methods, and the rationale for the chosen method;
  - How the analysis was conducted including input data, data sources, measurements of data, verification, collaboration, uncertainty analysis, calibration, validation, and sensitivity analysis;
  - The results of the analysis;
  - How were the results checked; and
  - What are the limitations of the analyses.

The hydraulic analysis report must be sealed, signed, and dated by a professional engineer. Any computer program input and output data must be sealed, signed, and dated by the professional engineer who prepared or supervised the preparation of the input data and who checked the output data. The computer model description box must include the professional engineer's name, PEO registration number, and the completion date.

Section 4 is divided into the following subsections:

4.2 Information Requirements
4.3 Watercourse Conceptualization and Characterization
4.4 Data Availability
4.5 Technical Reviews
4.6 Selecting a Flow Analyses Procedure
4.7 Computer Modelling
4.8 Study Report and Deliverables
4.9 Hydraulic Standard Parameters
4.10 References

4.2 Information Requirements

- The study report must discuss the objectives of the analysis, the information required for input to the hydraulic model, and the methodology used to obtain that information. The report must discuss the scenarios to be analyzed, and the level of accuracy required.

  Specification of the information requirements combined with characterization of the watercourse, and determination of available data, will allow a computation flow analyses procedure to be selected.

4.3 Watercourse Conceptualization and Characterization

- The report must discuss the conceptualization and characterization of the watercourse under study. Conceptualization and characterization aids in determining the computation methods to be used in the hydraulic analysis including which computer programs may be applicable.

  Conceptualization will determine the salient components of the watercourse, the relationships between the components, the upstream and downstream boundary conditions, and the temporal computation requirements. Conceptualization will determine if computations should be undertaken at a 1-D or 2-D level. Conceptualization will also include the size of the time step if unsteady flow computations are conducted. Conceptualization will determine how lumped or detailed the hydraulic processes will be modelled. Assumptions must be fully discussed and justified in the study report.

4.4 Data Availability:

- The study report should contain a discussion on the data used to derive parameters for the model, and the data used to evaluate the model. The accuracy of the model will depend on the accuracy of the data used to develop and calibrate the model. The discussion should include the following:
  - Where the data can be sourced;
  - How and by whom was the data measured;
  - Period of record that was used in the model; and
  - What is the level of accuracy of the data.

  Error creeps into data through a number of ways. Included are errors due to the procedures used to acquire the data, errors due to natural spatial and temporal variability, transcription errors, data storage errors, and errors due to data manipulation.

Data Filling and Modification

- The study report must contain a discussion on any data filling and modification of data used in the study. Generally, missing data needs to be filled. Also, suspect data needs to be modified. Discussion should include the following:
  - What data was filled or modified, why; and
  - What techniques were used to fill the data.

Data Stationarity

- The study report must contain a discussion regarding data stationarity. Changes to data sets may be gradual, or may be abrupt or may be in a more complex form. Data sets may not be stationary for a variety of reasons. Included are the following:
  - Changes in measurement techniques or instrumentation or relocation of the gauge; and
  - Changes to stream channel geometry.

4.5 Technical Reviews

Hydraulic studies should be reviewed to determine the correctness, completeness and appropriateness of procedures used to develop information for the intended purpose and for adherence to these Technical Guidelines. Included are input data, boundary conditions, conceptual model, mathematical model and parameters, model limitations, and model documentation.

Reviews can be undertaken near the end of a study, or throughout the study. Both approaches have limitations. Both approaches have limitations. For example, there may not be sufficient budget to correct any deficiencies found in a review if the review is conducted near the end of a study. Also, a reviewer's independence may become jeopardized if reviews are conducted throughout the study, as the reviewer may act as an advisor rather than a reviewer. It is recommended that the technical review be undertaken throughout the study to minimize the potential for wasted efforts.

A formal process should be followed to review hydraulic studies, and each review should be documented. Reviewers can be from the Conservation Authority undertaking the work, or can be undertaken by third parties.

Reviewers must have sufficient expertise in the area of practice to properly assess the hydraulic analysis. Reviewers must be capable of conducting the study, and reviewers must have a thorough understanding of methodologies and knowledge of accepted hydraulic engineering practice. A reviewer must have access to the computer program being used in the study. A reviewer must be a Professional Engineer licensed in the Province of Ontario.

The reviewer's report should identify the following:

- The individual who authorized the review,
- The author;
- The purpose of the review;
- The basis under which the review was conducted;
- A brief description of the study report under review;
- A summary of documentation provided to the reviewer;
- Communications made during the review;
- A description of the methodology for conducting the review; and
- The reviewer’s findings that include information upon which the reviewer's opinions are based.

The reviewer shall check the following:

- Results of the hydraulic model should match the maps, including the distances between cross sections, water-surface elevations, flood widths;
- All hydraulic structures in the model are reflected on the maps and vice versa;
- Water-surface and energy grade line profiles of different flood frequencies do not cross one another;
- Water-surface profiles do not show water-surface elevations at an upstream cross section lower than a water-surface elevation at a downstream cross section;
- Flood discharges used as inputs correlate with the hydrologic analysis;
- Cross section location and alignment;

- Ineffective flow areas;
- Absence of buildings from cross sections;
- Floodline map accuracy and appearance;
- Starting water-surface elevations are correct;
- Distribution of flood flows or changes to the distribution between left overbank, channel, and right overbank;
- Cross sections, Manning's roughness coefficients, transition loss coefficients, and loss coefficients at structures are modeled in accordance with the Technical Guidelines;
- Water-surface elevations at bridges or culvert sections are correct;
- Hydraulic models are calibrated with high-water marks or measured flow rates and water surface elevations where available;
- Hydraulic model results that are compared with aerial photographs of historic flooding where flood elevations can be determined;
- Appropriateness of the program used in the analysis; and
- Water surface elevations on the main branch must equal the water surface elevations of tributaries that confluence with the main branch for those tributaries not being studied.

Figure 4-1 – Sample Flood Plain Mapping Product for Public Discussion.



4.6 Selecting A Flow Analyses Procedure

- Generally, the type of flow analysis will be requested in a study's Terms of Reference. The engineer should confirm and discuss in the study report the type of flow analyses that is appropriate for the development of floodlines in the study area.

  Four (4) types of flow analyses can be analyzed for the development of floodlines. The types of flow analysis include the following:

  - One-dimensional steady flow;
  - One-dimensional unsteady flow;
  - Two-dimensional steady flow; and
  - Two-dimensional unsteady flow.

  One-dimensional (1-D) steady flow models are applicable where flow peaks are not significantly affected by storage, where the channel storage-discharge relationship is represented by a single-valued rating curve, and where water-surface profiles are not affected by reverse flow conditions. Typical reaches are well-defined open channels with gradually varied flow.

  One-dimensional (1-D) unsteady flow models are applicable to reaches with significant storage, reverse flow, or are subject to rapidly varied flow and waves.

  Two-dimensional (2-D) steady and unsteady flow models are most applicable to streams on flat terrain with broad floodplains where flow is moving in two or more directions, or flow is hydraulically disconnected between the main channel and the floodplain (spills and split flow). Two-dimensional (2-D) modellng may be appropriate for Special Policy Areas, Two-Zone mapping, risk assessment, emergency response and flood remediation measures.

4.7 Computer Modelling

4.7.1 General

Computer models, despite their complexity, are a simplification of reality. Computer models are simply tools that can be used to better understand how watercourses function. Modelling to a higher resolution or level of accuracy than is necessary may not guarantee better results and may ultimately waste time and resources.

The hydraulic modelling methodology is shown in Figure 4-2.

Section 4.7 is divided into the following subsections:

4.7.2 Program/Software Selection

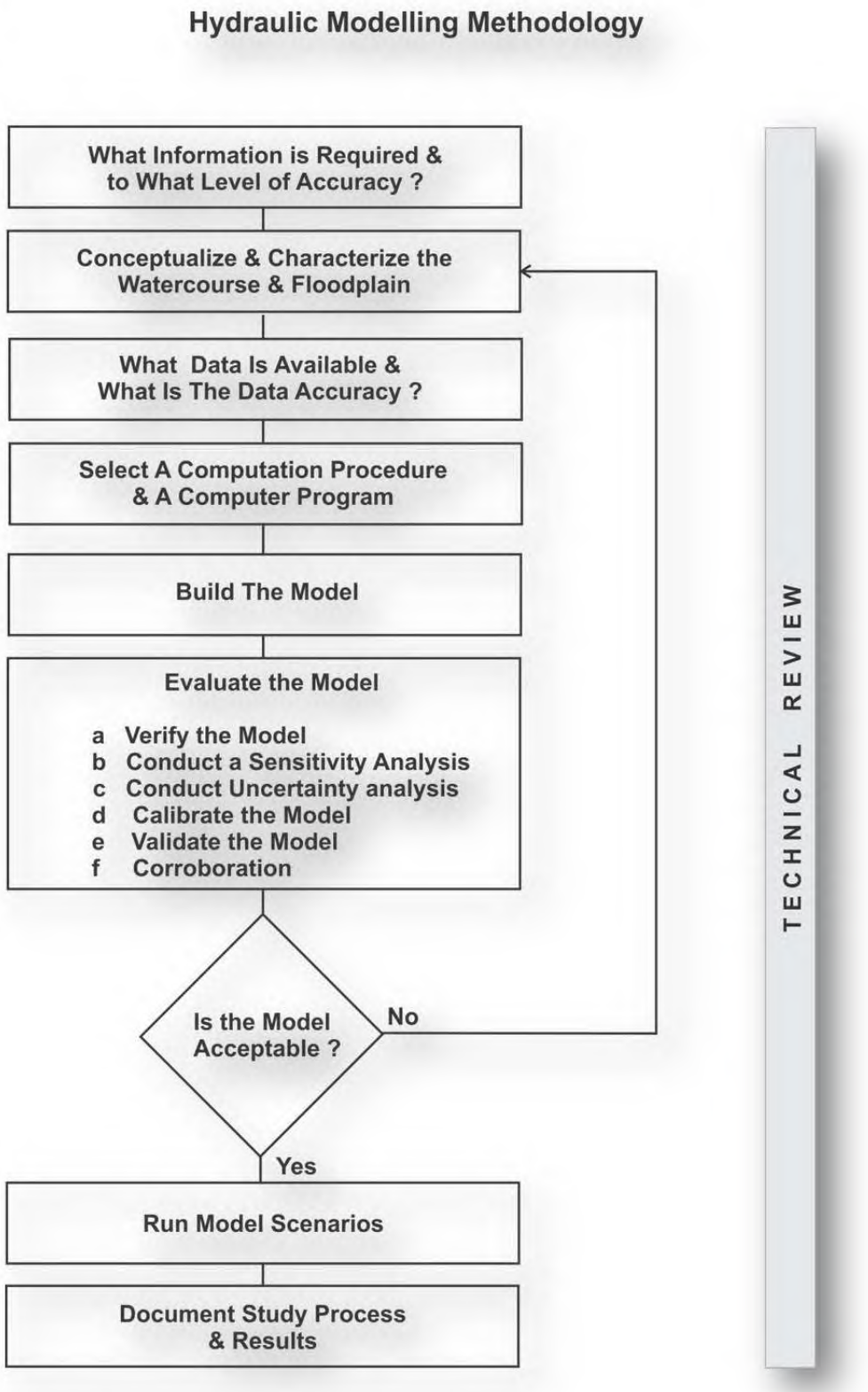
4.7.3 Model Building
- 4.7.3.1 One Dimensional - Steady Flow Models
- 4.7.3.2 One Dimensional - Unsteady Flow Models
- 4.7.3.3 Two Dimensional - Steady and Unsteady Flow Models

4.7.4 Model Evaluation
- 4.7.4.1 Model Verification
- 4.7.4.2 Sensitivity Analysis
- 4.7.4.3 Uncertainty Analysis
- 4.7.4.4 Calibration/Validation
- 4.7.4.5 Corroboration
- 4.7.4.6 Error/Warning Messages

4.7.5 Model Acceptability

4.7.6 Modelling Scenarios and Results

Figure 4-2


Hydraulic Modelling Methodology
What Information is Required & to What Level of Accuracy ?
Conceptualize & Characterize the Watercourse & Floodplain
What Data Is Available & What Is The Data Accuracy ?
Select A Computation Procedure & A Computer Program
Build The Model
Evaluate the Model
a Verify the Model
b Conduct a Sensitivity Analysis
c Conduct Uncertainty analysis
d Calibrate the Model
e Validate the Model
f Corroboration
Is the Model Acceptable ?
No
Yes
Run Model Scenarios
Document Study Process & Results
TECHNICAL REVIEW

4.7.2 Program/Software Selection

- The engineer must select the computer program to be used in the hydraulic analysis. Reasons for selecting a computer program or a suite of programs must be documented in the study report and must be approved by the Conservation Authority prior to model building;

- The documentation must include an assessment of alternate programs, and reasons why the alternate programs were not selected;

- The most recent version of the computer programs must be used. The engineer should follow the procedures and guidance given in the program's User Manual and Technical Reference;

- Computer programs used in the hydraulic analyses should not be modified by anyone except the program author; and

- If the engineer proposes any modifications to a computer program or proposes to use an existing modified program, the engineer must submit to the Authority input test data, output, and complete listing of the modified computer program, user's manual and an explanation in detail as to the nature of and reasons for modifications for review and approval prior to its use. The Conservation Authority and its agents should be granted a royalty free license to use the program for floodline modifications.

Program/Software Selection Notes

- A computer program is a system or algorithm with mathematical equations, parameters and data structures. Programs may be developed in-house, may be external open-source or may be an external proprietary program where the source code is not shared. Open source programs are preferred;

- There may be more than one suitable program to conduct the computations and more than one computer program may be required;

- The engineer should be familiar with the principles, equations, algorithms, and assumptions used in the program; be aware of the programs limitations; and know when the program is providing the appropriate answers;

- Table 3.1 identifies some of the steps required by the engineer to show demonstrate due diligence when selecting and using hydrologic and hydraulic software. The engineer who selects the software is responsible for conducting due diligence whether it is Conservation Authority staff or a consultant;

- The engineer should select a program (algorithms and equations) with the available data that reflects the dominant and sensitive processes described in the conceptual model; and

- The engineer should select a program that is no more complicated than necessary to compute the required information. Models tend to increase uncertainty as they become too simple or too complex. The complexity of a model should be sufficient to minimize uncertainty, and that more or less complexity will increase uncertainty.

4.7.3 Model Building

Model building is the development of a mathematical model based on a conceptual model. Model building requires both a spatial and temporal discretization of the physical watercourse into a mathematical model. The construction of the mathematical model is a function of the computer program used. The model building phase determines parameter values that are fixed, and initial estimates of calibration parameters are made. Hydraulic standard parameters are shown in Section 4.9.

Section 4.7.3.1 should be read first as it contains information common to Section 4.7.3.2 and Section 4.7.3.3.

Some general notes include the following:

- The hydraulic model should be continuous from the upstream study limit to the downstream study limit. Only one hydraulic model should be used; and

- The study report must include a discussion of the assumptions made and methods used, with respect to parameter estimation, and effective flow areas of the cross section at various stages of the hydraulic analysis.

  Effective flow areas are portions of cross sections through which floodwaters are conveyed. Ineffective flow areas are portions of the flood plain where water ponds.

4.7.3.1 One-Dimensional Steady Flow Models

- One-dimensional (1-D) steady flow backwater models must be applied to channels with mild to moderate slopes without significant storage and with gradually varied flow. One dimensional steady flow models should not be applied to channels with reverse flow conditions;

- Documentation of one-dimensional models must include shapefiles showing the location and alignment of each cross section, location of each hydraulic structure, river centreline, and show water surface elevations; and

- One-dimensional models usually require the following information:
  - Cross Sections;
  - Hydraulic Structures;
  - Ineffective Flow Areas;
  - Expansion and Contraction Coefficients;
  - Weir Coefficients;
  - Manning 'n' Values;
  - Starting Water-Surface Elevations;
  - Flow Interpolation Between Points of Interest;
  - Spills and Split Flows; and
  - Mixed Flow Calculations.

<u>Cross Sections</u>

- Documentation must include the sources of cross-section data points and methods of measurement; and

- Each cross section must have a unique identifier that is used on the maps, in the hydraulic model, in the field survey notes, and on the cross section plots.

<u>Cross Sections - Location</u>

- Cross sections should be located in accordance with a program's user manual;

- Maximum spacing between successive cross sections shall be dictated by the analytical requirements of the program. The length between cross sections should be based on river geometry and the assumption that gradually varied flow within a reach is valid;

- Cross sections should be representative of the reaches adjacent to them, and located close enough together to ensure accurate computation of the energy losses;

- Cross sections should be located such that the energy gradient, water-surface slope, and bed slope are all as parallel to each other between cross sections as is pragmatic. If any channel feature causes one of these three profiles to curve, break, or not be parallel to the others, the reach should be further subdivided with more sections;

  Discussion shall be contained within the report on the criteria used in locating and defining the cross-sections;

- Cross sections shall be located where changes occur in longitudinal slope, cross-sectional area, channel roughness, bridges and other channel constrictions. Several cross sections at short intervals maybe required to model abrupt changes where the conveyance changes greatly as a result of changes in width, depth, or roughness, and where the lateral distribution of conveyance changes radically with distance. Abrupt changes occur at bridges, culverts, weirs, dams, ponds, levees, bends, and expanding and contracting reaches;

- Tributaries - cross sections should be located immediately upstream and downstream from the confluence on the main stream and immediately upstream on the tributary to account for changes in flow rates in the hydraulic model;

- Locate cross-sections immediately upstream and downstream of any culvert or bridge. The cross sections should be just outside the toe of the fill and the side ditch; and

- Locate cross-sections at the same cross sections used in previous floodplain studies, where high water marks are available, at county, city, and town and other corporate boundaries, and at future development sites.

Cross Sections - Alignment

- Cross sections must be placed perpendicular to flood flow. Cross section alignment should be a straight line if possible. Cross sections with more than two or more segments are likely to occur;

- Cross sections should never cross or intersect each other. Care must be taken at river bends and tributary junctions to avoid overlap of sections;

- Cross sections shall be extended across the entire anticipated floodplain, should be perpendicular to the anticipated flow lines (approximately perpendicular to contour lines) and only positive distances are to be utilized. Computer generated vertically extended and interpolated cross-sections are not acceptable; and

- Buildings shall be included (coded or obstructions) in the flood plain portion of cross sections.

Cross Sections - Points

- All cross sections should be coded left to right looking downstream. Existing models and detail design drawings for crossings may contain cross sections looking upstream. Updates to existing models should be coded consistently looking upstream or downstream;

- Cross sections should include points at changes in grade across the cross section;

- Cross section data points can be abstracted from mass points, DEMs, TINS, contours, geodetic field surveys, and measured low flow sections. Cross section data points must have the accuracy specified in Section 2. Typical low flow sections shall be field measured for each reach between hydraulic structures;

- Left and right bank channel stations shall be representative of actual channel low flow banks;

- Ineffective flow areas shall be noted and excluded from the conveyance portion of the cross section;

- The maximum elevation of each end of a cross section should be higher than the anticipated maximum water surface elevation. The maximum water surface elevation must be contained within the input cross section. Some computer programs will modify input cross sections to contain the flow; and

- Local irregularities in the ground surface such as depressions or rises that are not typical of the reach or do not allow conveyance of flow should not be included in the cross sectional data.

Hydraulic Structures

- For each stream crossing modeled, the engineer must document the dimensions of the crossing, values of energy loss coefficients, and the justification of those values;

- The sources of data and means of measurement must be fully documented. Documentation must include an explanation for any structures that were not surveyed;

- Discussion of the method used and assumptions made in the calculation of water surface elevations at watercourse crossings;

- Dimensions of hydraulic structures may be taken from as-built drawings where access to the structure cannot be obtained and the as-built drawings can be visually verified in the field;

- Survey information of dimensions and elevations must be referenced to geodetic datum;

- The top of road profile should be obtained by field survey and extend across the entire width of the flood plain;

- A dam break analysis shall be considered to determine flood levels downstream of high (greater than 5 m) embankments that are associated with large upstream storage volumes and where failure under flood conditions may occur. The Conservation Authority should be contacted to confirm dam break modelling. Inundation lines may be plotted on maps for information purposes.

- Hydraulic model coding should reflect the bridge data sheets;

- Equivalent culverts may be required where culverts are composed of two or more segments with different shapes, sizes, and constructed of different materials. Also, equivalent culverts may be required where there are bends in the culvert alignment. The upstream culvert should be modified to equate to the combined head losses of the two or more segments;

- Horizontal stationing at a bridge or culvert section must be consistent with the downstream and upstream channel-floodplain cross-sections. The centerline station of a culvert should be provided and be consistent with the upstream and downstream cross-section stationing;

- Bridge/culvert cross sections will include parapets and railings;

- Bridge/culvert losses should be checked by a method other than the hydraulic program used to develop water surface profiles. In addition the results of the bridge/culvert loss check should be documented in the study report;

- The study report must document for each profile the amount of flow through bridges/culverts and the amount of weir flow. For the HEC-RAS program an option under the profile output table report lists the amount of pressure and weir flow; and

- Skewed cross sections must be corrected for the hydraulic calculations. The corrections can be made using program parameters or corrected manually.

Ineffective Flow Areas

- Ineffective flow elevations at a bridge/culvert represent weir flow over the bridge/culvert. For the upstream cross section the elevations are set equal to the elevation (minimum top of road) at which weir flow occurs in the left and right overbanks. For the downstream cross section the elevation at which weir flow occurs is not known for the initial run. An initial estimate is the half way between the low chord and the minimum top of road. The final downstream ineffective flow elevation must be determined through trial runs with different flow rates to determine the flow at which weir flow occurs and then setting the ineffective elevation equal to the downstream water level; and

- The study report must fully document the location and the technique used to exclude ineffective flow areas from the conveyance portion of the watercourse.

Contraction and Expansion Coefficients

- Expansion and contraction coefficients - refer to Hydraulic Standard Parameters Section 4.9. Typical values are 0.1 and 0.3 for gradual contractions and expansions respectively and 0.3 and 0.5 at abrupt contractions and expansions such as bridges and culverts.

  The engineer may use other values when approved by the Conservation Authority. The engineer must document the reasons for using other values and provide documentation to support those reasons.

Weir Coefficients

- Weir coefficients - refer to Hydraulic Standard Parameters Section 4.9. The engineer may use other values when approved by the Conservation Authority. The engineer must document the reasons for using other values and provide documentation to support those reasons.

Manning 'n' Values

- Manning's roughness coefficients - refer to Hydraulic Standard Parameters Section 4.9;

  The engineer may use other values when approved by the Conservation Authority. The engineer must document the reasons for using other values and provide documentation to support those reasons. Other values may be suggested after a site visit. Documentation of on-site observations must include photographs; and
- If “n” values are adjusted based on calibration, the documentation must include a summary of the values before and after the adjustments.

Starting Water-Surface Elevations

- Where a control starting elevation, such as a weir that creates a critical depth, is not possible, the starting section shall be located sufficiently downstream that the reach under consideration is not significantly affected by starting water surface elevations. A sensitivity analysis can be used to demonstrate that the starting water surface elevation is located sufficiently downstream not to affect the study reach.

  A control is a cross section at which the computed water-surface elevation is unaffected by changes in the downstream flood elevation, and the upstream reach is hydraulically independent;

- Starting water surface elevations for tributaries will assume coincident peaks with the main branch unless it can be justified otherwise;

- Where a lake is the control point, the starting water surface elevation shall be based on the long-term mean lake level;

- Discussion on the methods used and assumptions made in the determination of the starting water surface elevations for backwater computations shall be included in the study report; and

- 100-year lake levels are to be superimposed on the resultant water surface profile to establish the Regulatory level.

Flow Interpolation Between Points of Interest

- The study report must contain a discussion on how flow rates were interpolated for locations between points of interest in the hydrologic model. Generally, flow rates should not change more than 10% between points of interest and less between cross sections.

  Two methods are acceptable. The first method uses the flow rate from a downstream point of interest in all cross sections to the upstream point of interest. The flow rate does not vary.

  The second method interpolates the flow rate between two points of interest based on drainage area. A linear interpolation of drainage area is used in the calculations.

Spills and Split Flows

- The study report must document the location of a spill, the estimated maximum depth of the spill, the estimated maximum flow rate of the spill, the estimated volume of the spill, and the receiving watercourse of the spill. The lack of mapping is not considered a spill location.

  Spills are floodwaters that leave a defined watercourse and spill overland. Spills can re-enter the watercourse at a downstream point or flow overland to another watercourse;

- The study report must discuss whether a spill is natural or as a result of artificial structures. In case of a significant natural spill, downstream flood levels may be based upon reduced peak flow rates. The Conservation Authority should be contacted for approval prior to the use of reduced peak flow rates.

  The hydrologic model may need to be modified to include the natural spill;

- The study report must discuss the methods used and assumptions made in the determination of the estimated spill flows, effects on downstream flows and flood plains, and areas affected due to the spill shall be included in the study report.

At crossings, spill characteristics may be estimated using the lateral weir option in HEC-RAS or by using a top of road or weir cross section that accounts for flow moving over the crossing and moving along the path of the diverted flow. Both these methods provide estimates only, as the methods assume that flow passes through critical depth.

A more accurate estimate may be made using split flow analysis or a 2-D model. Split flow analysis refers to flow that is separated from the main channel for some distance and then merges back with the main channel. Spilt flow analysis requires at a minimum a common upstream headwater level. HEC-RAS contains an option to conduct a split flow analysis. Split flow analysis can be conducted manually as described in Open Channel Hydraulics by Ven Te Chow.

Mixed Flow Calculations

- Subcritical flow calculations shall be assumed for natural reaches. Mixed flow (subcritical and supercritical) calculations will be considered for artificial watercourses such as concrete lined channels. The Conservation Authority should be contacted for approval prior to the use of mixed flow calculations;

- The study report must document the reaches where subcritical and mixed flow calculations were used to delineate the Regulatory Floodlines. The study report should document where there are large differences in water surface elevations between subcritical and mixed flow calculations; and

- The engineer must investigate and report on natural reaches where the computer program indicated that flow was critical at a cross section. Some hydraulic programs use critical depth as a default water surface elevation. If critical depth is calculated, then the engineer should check the number of iterations used to calculate critical depth. If the number is equal to the maximum allowed number of iterations, then more cross sections may be required. Where there are numerous or continuous critical depth values, mixed flow calculations may be required. The Conservation Authority should be contacted for approval prior to the use of mixed flow calculations.

4.7.3.2 One-Dimensional Unsteady Flow Models

- Generally, 1-D unsteady flow models are not used to develop Regulatory Floodlines. 1-D unsteady flow modelling maybe used to delineate Two Zone areas and may be used to develop inundation areas for dam break analysis;

- The Conservation Authority should be consulted and must approve the use of 1-D unsteady flow modelling to delineate Regulatory Floodlines;

- The study report must document data sources used to develop the hydraulic model, including inflow hydrographs, geometry data for channel cross sections or other conduits, junctions and/or other storage areas, energy loss coefficients, and downstream boundary conditions. Some one-dimensional unsteady state models describe the drainage system as a nodal network, consisting of nodes (junctions) and links (conduits). Other programs use channel network features described by cross sections. All data and sources must be described in the study report; and

- Steady flow models may not be easily converted into unsteady flow models.

Cross Sections for 1-D Unsteady Flow

- Cross section end points should have the same elevations. Uneven end points may cause numerical instabilities during simulation;

- Interpolated cross sections should not be used;

- Hydraulic properties such as top width, hydraulic radius, etc. of a cross section should not change abruptly; and

- In-line weirs should be used for severe drops in bed profile.

Boundary Conditions for Unsteady Flow Computations

- The study report must document the upstream boundary conditions (hydrographs), downstream boundary conditions (stage-discharge relationship), tributary hydrographs, and lateral inflows. The documentation should include the source of the data, and the reasoning used to assign frequencies to the hydrographs.

Non-Conveyance Areas for Unsteady Flow Computations

- The study report must document any non-conveyance or storage portions of cross sections used in the unsteady flow computations. Many 1-D unsteady flow programs can model off-channel storage area connected to the channel. Documentation must include elevation-storage relationships, used in the

analysis, including the methods, sources, and measurements of data used to define the relationships; and

- These storage areas are usually defined by elevation-volume or elevation-surface area relations or modeled by user-defined flow allocation ratios. Such areas should be clearly labeled with a unique identifier corresponding to the storage area used in the model.

4.7.3.3 Two-Dimensional Steady and Unsteady Flow Models

- Generally, 2-D steady or unsteady flow models are not used to develop flood hazard limits. 2-D modelling may be required in areas where flow is moving in two different directions at the same time or where flow paths may not be well defined or difficult to visualize. 2-D models provide a better estimation of local variations of velocity and water depths. 2-D models will only be required for reaches where 1-D modelling is inappropriate;

- 2-D models are applicable to bi-furcated flow patterns, rigid boundaries, overland flow, and complex hydrodynamics. For flood hazard maps, 2-D models should only be used when flow depths are greater than 0.3 m;

- It is expected that full 2-D models will be rarely required to develop flood hazard maps. Rather a 1-D model coupled with a 2-D model will be used after consultation with and approved by the Conservation Authority; and

- The study report must document the reasons for utilizing a 1-D/2-D steady or unsteady state model for delineating hazard limits.

  1-D analysis may be appropriate to represent the channel flow for wide floodplains with defined channels where conveyances, velocities, and associated physical forces are only significant in the downstream direction. Hydraulic parameters can be computed using cross sections placed perpendicular to the flow direction. 1-D modelling is well suited to hydraulic structures and has short computation times when compared to 2-D modelling.

  The 2-D analysis has the ability to accurately model steady or unsteady, unconfined flows caused by flat terrain. Flow in this scenario is moving in two or more directions. The 1-D flow analysis may not accurately model water surface elevations. For 2-D modelling grid elevations are presumed to vary gradually. For 2-D analysis a grid is required instead of cross sections and rating curves maybe used to model crossing losses. The 2-D model accounts for lateral variations in

water surface elevations. The 2-D analysis has significant computation times and may not accurately account for head losses at structures.

A coupled 1-D/2-D model is often the most efficient model given the advantages and disadvantages of 1-D models and 2-D models. A coupled 1-D/2-D model has short computation times, accounts for bifuracted flow, and accurately accounts for head losses at hydraulic structures.

Model Domain

- The model domain defined by bathymetry should cover the river network and its floodplain. In urbanized areas the slope of the road network may carry the shallow flooding well beyond the area of interest. A boundary should be chosen sufficiently far from the area of interest and located where the surface is sloping down away from the model domain;

- In places where the 2-D model domain crosses the 1-D channel model the location of the 2-D model boundary should be chosen such that flow is expected to be generally confined to the 1-D channel;

- The model domain must be sufficiently extended laterally from the channel to ensure that overland flow moving away from the channel does not encounter the boundaries of the 2-D domain and become artificially constrained within the domain; and

- The model domain should be adjusted in such a way that the 1-D model network should ideally extend upstream and downstream such that the start point and end point are outside of the 2-D model area of interest.

Boundary Conditions for 1-D/2-D Models

- The study report must document the upstream boundary conditions (hydrographs), downstream boundary conditions (stage-discharge relationship), tributary hydrographs, and lateral inflows. The documentation should include the sources of the data, and the reasoning used to assign frequencies to the hydrographs;

- Downstream boundary conditions for the 2-D model will be extracted from the 1-D model at the domain limits;

- The 2-D domain must be of sufficient lateral extent to ensure that flow moving away from the channel does not encounter the boundaries of the 2-D domain and

become artificially constrained within the domain. The lateral flow should be allowed to reach a shallow depth of flow under hydraulic influence only 0.05 m; and

- The 2-D model must provide for lateral inflows or changes in flow over the 2-D domain, where the domain is large enough that there is a distinct hydrologic transition to higher flows (e.g. domain encompasses an area where upstream catchments are connected via downstream reaches to additional catchments providing inflows into the river network).

Cross Section in coupled 1-D/2-D model

- Cross sections should be spaced to adequately represent the bank elevations along the lateral link for smooth transfer of flows from 1-D to 2-D and vice versa.

Links in coupled 1-D/2-D model

- The study report must document linkages (lateral and standard/structure link) types, locations and lengths of the 1-D and 2-D model components and why the linkages were selected.

Initial Conditions in Coupled 1-D/2-D Models

- The study report must justify the initial conditions used for 2-D analysis. The documentation should include the source of inflow hydrographs and downstream water surface elevations; and

- If inflow hydrographs are modified, for example to reduce computation time, then justification should be provided in the study report.

Computational Grids in Coupled 1-D/2-D Models

- The study deliverables must include a geo-referenced spatial data file (i.e. DEM, DTM) showing the locations of the stream under study, major flow paths emanating from and adjacent to the study stream, hydraulic structures adjacent to and crossing the stream, and the grid of cells. The location of each cell must be readily ascertained from the spatial data file. The grid cells should cover the entire project area and consider buildings.

- The study report should document the grid cell size, and the reasoning for the selection of the cell size. The cell size will be dependent on the accuracy of the

topographic data, the computational efficiency of the program, and the mapping and floodplain management requirements. The engineer must ensure gradual changes in elevation from one cell to adjacent cells.

The grid spacing should be sufficiently resolved such that it can capture the topographic features (e.g. curbs, berms, ditches, etc.) that will act as hydraulic controls to influence the direction and depth of overland flow. In order to capture appropriately the flood waters in the floodplain, review of noticeable land features should be conducted to determine if there will be any high or low ground topography that required a finer resolution in the grid spacing. Some sensitivity analysis may be required to develop reasonable grid spacing.

Hydraulic Structures in Coupled 1-D/2-D Models

- The study report must document the modeling of each hydraulic structure. The documentation must include a list of each cell associated with the structure and a description of the rating table including its derivation and its sources of data. Typically, hydraulic structures are input as rating tables at specific grid cells;

- A long crossing with significant overtopping that does not flow back to the stream should be coded in the 2-D model. In a coupled 1-D/2-D model, the majority of crossings should be coded as part of the 1-D model;

- Q-h relations should be calculated for all weirs and culverts to verify the model hydraulics are representative of the defined geometries.

Non-Conveyance Areas (Buildings) in Coupled 1-D/2-D Models

- The study report must document the reasoning for, location of, and technique used to model non-conveyance areas through input data and include a discussion where artificial data have been used.

  The engineer must ensure that non-conveyance areas be modelled to reflect natural conditions (topography and roughness) as closely as practical. Removing cells from computation should not be used when performing hydraulic computations.

Energy Loss Coefficients in Coupled 1-D/2-D Models

- The study report must document roughness coefficients or Manning's 'n' values for each of the grid cells. Roughness coefficients are one of the parameters to be considered in model calibration.

- Bed roughness within the 2-D domain should provide equivalent representation of the frictional characteristics of the 2-D domain as the Manning 'n' roughness coefficients for the corresponding 1-D model.

Coupled 1-D/2-D Models Modelling Notes

- Deliverables must include geo-referenced shapefiles showing the locations of the stream, major flow paths, hydraulic structures crossing the stream, and the grid of cells. For models using a grid of cells, the location of each cell must be readily ascertained from the geo-referenced shapefiles;

- The study report must include a list of each grid or element associated with the crossings, and a description of the rating table including the derivation, sources of data;

- The study report must document initial conditions and why the initial conditions were selected;

- The study report must document a discussion of the sensitivity analysis and the results;

- The study report should summarize mathematical formulations integrated in the proposed 2-D model to simulate the physical processes, numerical method to solve the mathematical formulation, numerical grid type to discretize the study area in order to apply the numerical method, representation of boundary condition to the model domain and method of linking with other models; and

- The study report should show separate flood profiles for significant flow paths including the main channel that can be identified by velocity, flow rate, flow depth, and flow volume.

4.7.4 Model Evaluation

- The study report must discuss the results of the model evaluation, and the model evaluation process. Model evaluation is the process used to determine whether a model and its results are sufficient to simulate the inputs required for the hydraulic analysis. Model evaluation includes the following:

  4.7.4.1 Model Verification
  4.7.4.2 Sensitivity Analysis
  4.7.4.3 Uncertainty Analysis
  4.7.4.4 Calibration/Validation
  4.7.4.5 Corroboration
  4.7.4.6 Error/Warning Messages

  The engineer must consider what degree of uncertainty is acceptable within the context of model application. If the engineer does not accept the model for its intended purpose, then the process must be re-started by re-visiting the conceptualization of the study watershed and the drainage system.

4.7.4.1 Model Verification

- The computer model will be verified and documented in the study report. Model verification is the examination of the model to prove that it truly represents the conceptual model.

  Model verification checks the proper implementation of the model on the computer. The model should be computationally stable over the entire range of flow rates being analyzed and provide credible results; and

- FEMA's Check-RAS program can be utilized to check HEC-RAS models for errors and reasonableness. The Check-RAS program offers comments on Manning's roughness coefficients and transition loss coefficients, cross-sections, bridges and culverts, floodways, and computed profiles. Engineering judgement must be utilized to interpret the Check-RAS results.

4.7.4.2 Sensitivity Analysis

- Sensitivity analyses shall be performed to determine the impact of changing model input parameters and initial conditions on calculated flows;

- Sensitivity analysis will involve varying Manning roughness coefficients by plus/minus 20%, expansion/contraction parameters by plus/minus 100%, bridge area by plus/minus 20%;

- An assessment of the sensitivity of culvert blockages on upstream flood levels must also be carried out for high embankments that have a history of debris blockages. The Conservation Authority should be contacted before undertaking sensitivity analyses; and

- Documentation of the results of the sensitivity analyses shall be provided in the study report. The results will identify the importance of model parameters that will have to be adjusted during calibration.

4.7.4.3 Uncertainty Analysis

- An uncertainty analysis will be conducted and discussed in the study report.

  The uncertainty analysis will investigate the effects of the lack of knowledge and other potential sources of error. Sources include data collection, model inputs, constants, and recorded data, numerical simulation, post processing, and theoretical assumptions.

4.7.4.4 Calibration/Validation

- The model should be calibrated where sufficient data exists. The study report must document the process, including dates, measurements, and locations of measurements of historic floods; parameters revised and rationale for revising; and the calibration model input and output data.

  Generally, calibration of hydraulic model parameters is performed by adjusting energy loss coefficients and comparing model results with values from historic floods.

  Data for calibration/validation includes the following:
  - Highwater marks;
  - Rating curves at streamflow gauges;

  - Measured water surface elevations and flow rates along a reach;
  - Photographs showing flood plains with measured flow rates and water surface elevations;

- Calibrated parameters shall not be adjusted beyond the ranges shown in Section 4.9. Model parameters must be within the range of engineering practice. Parameters outside the range must be revised;

- All hydraulic data must be submitted in electronic format; and

- Discussion of the data used in calibration work including the reasons for the choice of data used in the work shall be included in the study report.

Calibration/Validation Notes

Calibration

- Consists of a model test with known input and output information that is used to adjust or estimate model coefficients or parameters within physically defensible ranges until the resulting predictions give the best possible fit to the observed data.

Validation

- The model results are compared with an independent set of observations (not used in the calibration) to verify whether the model describes system behaviour correctly.

No calibration/validation procedure is perfect

- There are always deviations due to modelling and measurement errors. There are conceptual errors due to model definition such as the simplification of complex structures, neglect of sub-processes, and errors in the mathematical description or in the numerical method applied. There are errors when measuring field observations such as high water marks, precipitation and streamflow. There are also errors when selecting model parameters that are not known with certainty.

No model can be truly validated

- But can only be invalidated for a specific application. After a sufficient number of successful tests the model is not valid or good but good enough. The model can then be regarded as having been validated.

There are no universally accepted "goodness-of-fit" criteria that will apply in all cases

- Model performance is evaluated by a series of graphical tests. Model performance is the ability to reproduce field observations. Graphical tests include the following:
  - Observed vs. simulated profile plots of water surface elevations; and
  - Observed vs. simulated plots stage vs. water surface elevations at a specific location (e.g., streamflow gauge).

Manual vs. Automatic Calibration

- Calibration for hydraulic simulation models typically involves energy loss coefficients. Examples include expansion/contraction coefficients and Manning 'n' roughness coefficients. Manual trial-and-error adjustments can be very successful for a few parameters. The engineer must determine whether automatic calibration is required.

Data Set Trends

- Care must be taken when using data sets where changes in measurement locations, changes in equipment, and changes in personnel can negatively impact measurements.

Number of Parameters To Be Calibrated

- Generally, there are fewer parameters to be calibrated in hydraulic models than in hydrologic models. Calibration usually entails the matching water surface elevations to measured streamflow rates at gauges.

4.7.4.5 Corroboration

- Results from computer simulation models must be corroborated using other methods. For hydraulic programs these methods include hand calculations, MTO inlet and outlet charts, and results from previous studies. The comparison must be documented in the study report. If the results are significantly different, then reasons must be stated in the study report to explain the differences.

4.7.4.6 Error/Warning Messages

- All error and warning messages generated by hydraulic programs should be corrected. Any messages that cannot be corrected must be discussed and explained in the study report; and

- Critical depth locations in the HEC-RAS model output must be carefully reviewed. HEC-RAS defaults to critical depth when the flow changes from

subcritical to supercritical flow and when the program cannot reach a solution in a specified number of iterations.

Engineering judgement is required to ensure that the location of critical depth is correct when the flow is changing from sub- to super-critical. When the program cannot reach a solution this is an indication of errors in the modelling procedure. The engineer should review whether additional cross sections are required or cross sections have to be modified.

4.7.5 Model Acceptability

- The study report must include a statement regarding the acceptability of the model to simulate the information required from the hydraulic analysis. The statement should summarize the results of the model verification, the calibration/validation analysis, the sensitivity analysis, and the uncertainty analysis. Also, the discretization in time and space, and the correctness of the conceptual model will be addressed. The statement is required to answer the question of whether the correct program, and model have been chosen; and

- The Conservation Authority must approve the acceptability of the model before the modelling scenarios are conducted.

4.7.6 Modelling Scenarios and Results

4.7.6.1 General

- The study report must discuss the methods used and assumptions made in the determination of spill flows; effects on downstream flows and flood plains, and areas affected due to the spill shall be included in the Hydraulic Report; and

- The study report must contain the results of the scenario runs. Once the model has been accepted or the model is sufficient to conduct the simulations, the scenario runs may be undertaken.

4.7.6.2 Ice Jams

The study report must document instances or lack of instances of ice jam flooding through the study reach. Ice jams can reduce watercourse flow area and increase upstream water surface elevations that result in flooding. Flood hazard limits must consider ice jams whenever ice jams have historically been indicated within the study reach. There are several methods to predict ice jam water levels. Most have not been widely tested in Ontario.

Ice Jam Characteristics

- Ice jams have been categorized as freeze-up jams or break-up jams;
- Several freeze-up and break-up jams may occur each year;
- Freeze-up and break-up jams do not necessarily denote fall and spring events;
- Ice accumulation may remain until the next thaw;
- Ice jams may occur in some reaches but not in others;
- Ice jam data in one reach may not be transposed to other reaches;
- Ice jams cannot be predicted with certainty in any given year;
- Ice jams often re-occur at the same locations;
- Ice jams may not be sustainable beyond a given flow rate;
- Ice jams occur over small areas (e.g., a few kilometres), and for short durations (e.g., a few hours to a few days);
- Ice jams often occur when flow rates are low and increasing;
- Ice usually flows downstream and accumulates at an obstruction or a sudden change in channel flow direction, slope, alignment, or cross sectional shape or depth;
- Ice jam growth depends on the river discharge, the quantity of ice delivered from upstream, and meteorological conditions; and
- Ice jams can only be removed by either thermal melt or a sudden dynamic collapse created by an increase in upstream hydraulic head or from internal ice

erosion caused by flows moving through the ice jam. Ice jams may re-form downstream.

The maximum stage-frequency distribution through a reach is the combination of a stage-frequency distribution for ice jam conditions with the stage-frequency distribution for open water conditions. Stage-frequency distributions are developed rather than discharge-frequency distributions, as ice jams tend to occur at periods other than very high flow rates.

The stage-frequency distribution analysis will consist of ranking stages, assigning plotting positions, plotting the ranked stages on probability paper, and curve fitting the stages. The stage-frequency analysis can use historical stages or can use synthetic (computer simulated) stages.

Figure 4-3 presents the procedure for undertaking an ice jam analysis. It is based upon information presented in the Technical Guide - River and Stream System: Flooding Hazard Limit, Ontario Ministry of Natural Resources, 2002. The following text gives a short description of that procedure:

Are High Water Levels the Result of Ice Jams ?

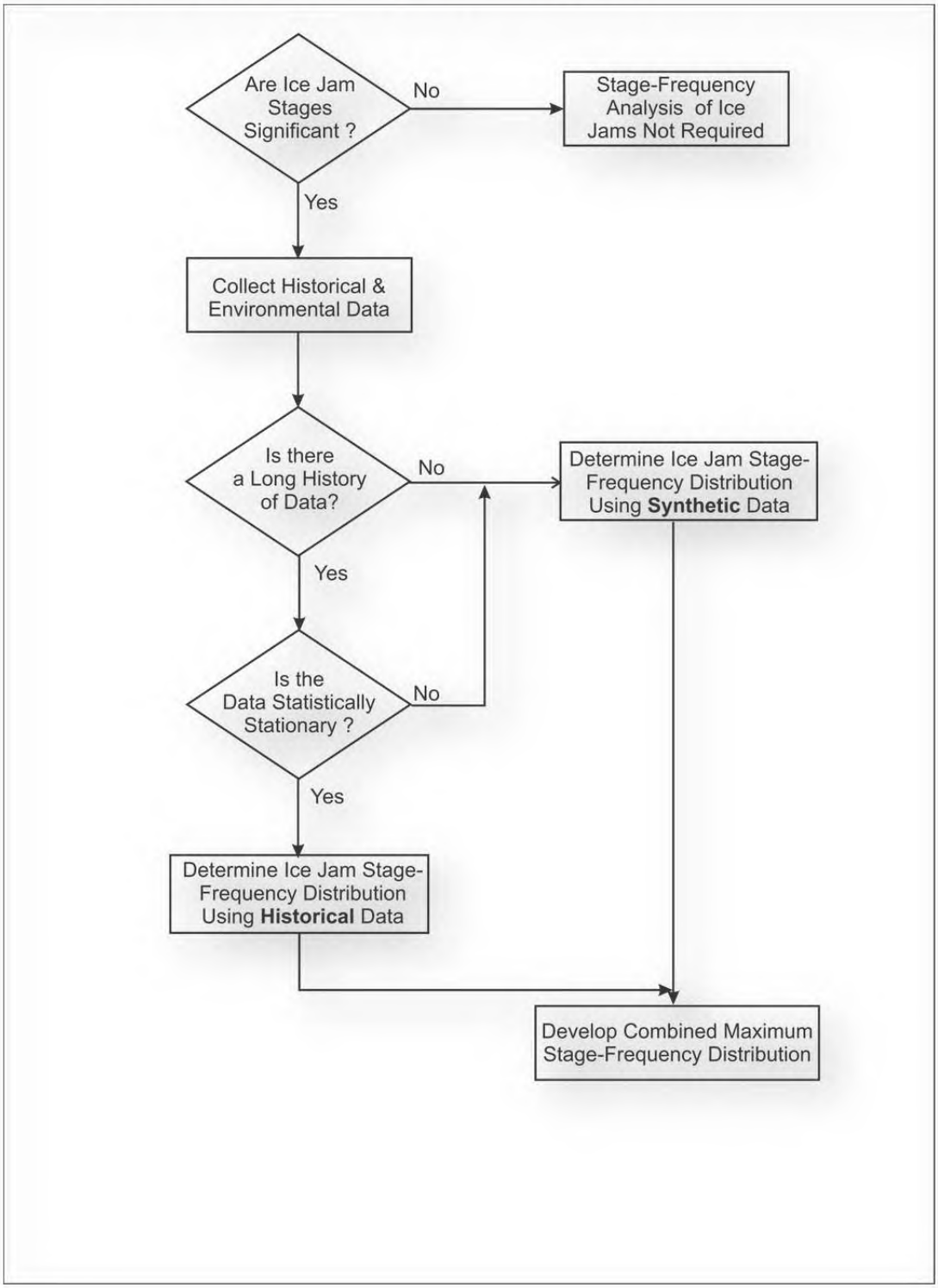
The study report must document whether high water levels or stages within the study reach are the result of ice jams. Conservation Authorities, municipalities, and local residents should be contacted to determine if high water levels are the result of ice jams. Also, the study report should document who was contacted and when.

If high water levels are not the result of ice jams, then the frequency analysis of ice jam stages does not have to be performed.

If high water levels are the result of ice jams, then historical and environmental data relating to ice jams must be collected.

A detailed review of the ice jam documents listed in Section 4.10 should be conducted before ice jam calculations are conducted.

Figure 4-3 - Ice Jam Stage-Frequency Analysis Procedure



Collection of Historical and Environmental Data

The study report must document all of the historical and environmental data relating to ice jams and the source of that data collected during the study. Data is collected during on-site investigations, surveys, and through discussions with local authorities and residents. Data include the following:

- Tree damage and scars;
- Vegetation trim lines;
- Disturbed bank material;
- Gravel pavement;
- Ridges of bank material;
- Societal - resident recollections, archives, newspapers, books, photographs, hydrometric gauges;
- Location of ice jams;
- Dimensions of ice jams;
- Volume of ice jams;
- Causes of ice jams;
- Associated river stages and discharges;
- Frequency of occurrence;
- Detailed river geometry;
- Lateral and upstream extent of flooding;
- Historical flood level data;
- Discharge measurement data;
- Duration of ice jam event;
- Season of occurrence; and
- Damage to structures.

Is There A Long History of Data? and Is the Data Statistically Stationary?

The study report must document whether there is a long history of data and if that data is statistically stationary.

If there is a long history of data and the data is statistically stationary, then a frequency analysis of historical stages may be undertaken. A long history is considered to be three or more events in a 25 year period of record. Data may not be statistically stationary if there have been modifications to the watercourse or streamflow. Modifications may include channelization, reservoirs, dyking, etc.

If there isn't a long history of data or the data is not statistically stationary then a frequency analysis of synthetic (computer simulated) and historical data is required.

The results from the use of historical information or synthetic information should always be checked using an alternate method.

Determining a Stage-Frequency Distribution Using Historic Ice Jam Stages

The study report should document the stage-frequency distribution analysis and the historical data used in the analysis. Separate stage-frequency distribution curves will be developed for ice jam events and for open water events. The peak ice jam stage can occur at a different time than the maximum discharge rate. Graphical frequency analysis may be used to develop the stage-frequency distribution.

A frequency analysis of historical data requires the following:

- Many years of observed levels at an ice jam site;
- An ice regime that has been statistically stationary;
- An examination of ice jam flood stages and the flood prone area; and
- On-site investigations and interviews.

A methodology is presented in the paper entitled "Probability Analysis of Historical Flood Data" by Gerard and Karpuk to determine a stage-frequency distribution using historical ice jam stages. The Gerard and Karpuk methodology is presented in the MNR Flooding Hazard Limit document (2002).

Determining a Stage-Frequency Distribution Using Synthetic Ice Jam Stages

The study report should document the stage-frequency distribution analysis and the synthetic data used in the analysis. A stage-frequency distribution for ice jams must be developed using synthetic data when there is insufficient historical data or the historical data is not statistically stationary. A methodology presented in "Ice Related Flood Frequency Analysis: Application of Analytical Estimates" by Gerard and Calkins may be used for determining a stage-frequency distribution for ice jams.

The study report will document the development of a stage-frequency distribution for open water, for a solid ice cover, and for an ice jam cover in equilibrium. The stage-frequency distribution curve would represent a minimum ice-affected stage while the stage-frequency curve for an ice jam in equilibrium would represent the maximum stage possible for a given discharge.

Discharge data used in the analysis may have to be transposed from gauge data elsewhere along the river course or from computer simulation models. Ice jam stages may have to be developed using computer simulation modeling (HEC-RAS, RIVJAM, etc.) and confirmed with observed ice jam stages. Considerable judgement is required when estimating stages for ice

cover conditions and for ice jam conditions. Information required includes estimates of ice thickness, ice cover or ice jam roughness, position of the jam's toe and head, and the upstream length contributing ice to a jam.

The final ice jam stage-frequency distribution is the highest stage resulting from a combination of the solid cover distribution curve and the ice jam distribution curve. The final distribution is largely a matter of engineering judgement.

Develop A Maximum Stage-Frequency Distribution

Once the ice jam stage-frequency distribution has been determined, it must be combined with the open water stage-frequency distribution. The combined maximum stage-frequency distribution will allow the abstraction of flood stages for various return periods.

4.8 Study Report and Deliverables

Study Report

- The study report should allow third parties to reproduce the model study including its results; and
- The study report must document the program utilized to conduct the computations, the source and method of measuring cross-section data; the source and method of measuring hydraulic structures; and the method of estimating loss parameters and starting water-surface elevations.

The study report must include the following:

- List of technical persons with qualifications that worked on the project;
- PEO seal, signature, and date of the professional engineers who prepared or supervised the preparation of the input data and checked the output data;
- A statement on the appropriateness of the model to provide the information required for the hydraulic program; and
- A section on model limitations.

Tables

- Table - Design flows and water surface elevations for the Regional, 100, 50, 25, 10, 5 and 2-year return period floods. Design flows and water surface elevations must be determined for existing and future land use conditions;
- Table - starting water surface elevations;
- Table - results of calibration;
- Table - of initial hydraulic parameters and calibrated hydraulic parameters;
- Table - observed flow hydrographs and water level profiles used in the calibration;
- Table summarizing spill locations and associated details;
- Table - results of the sensitivity analysis; and
- Table - comparing the immediate previous study water surface elevations with the current study water surface elevations.

Figures

- Figure - a topographic map showing the watershed and sub-watershed boundaries, flood plain mapping study limits and flood plain map sheet location;
- Figure - water surface profiles of all design floods;
- Plots of field measured representative low flow sections of each reach;

- Plots of all cross-sections and road profiles with crossings;
- Photographs of channel and floodplain at several representative locations;
- Plots of surveyed profiles across each hydraulic structure (road/rail crossing, dam, etc.);
- Copies of all bridge/culvert drawings used to develop the hydraulic model;
- Photographs of all hydraulic structures including bridges, dams, weirs, etc.; and
- Schematic plot with names of the main branch and tributaries in the HEC-RAS model.

Deliverables

- Electronic copies of model input and output data;
- Electronic copies of all calibration input and output data;
- Electronic copies of all sensitivity input and output data; and
- Electronic copies of all Check-RAS output files.

4.9 Hydraulic Standard Parameters

Standard parameters are shown in Table 4.1. The parameters should be used for un-calibrated models. If the engineer feels that the Standard Parameters should be modified, the engineer should provide documentation to the Conservation Authority providing justification. For calibrated models, the parameters must be within the range shown in each of the tables.

A sensitivity analysis should be conducted for each computer program to determine the sensitive input parameters.

Table 4.1 - Hydraulic Standard Parameters

Table 4.1.1 – Loss Coefficients

Weir Flow Coefficients	'C' Standard	Calibration Range	
		Minimum	Maximum
Broad Crested i.e. Road Embankment	1.5	1.4	1.7
Sharp Crested	1.6	1.4	1.8

A sharp crested weir coefficient should be used when there is air underneath the nappe. Such conditions would exist for a stormwater management pond weir outlet. A broad crested weir assumes the nappe is supported. An example of a broad crested weir would be a road crossing. Generally, when the ratio of flow depth divided by the weir thickness is greater than 0.5 a sharp crested weir coefficient should be used. When the ratio is less than 0.5 the broad crested weir coefficient should be used.

Orifice Coefficient	'C' Standard	Calibration Range	
		Minimum	Maximum
Orifice Coefficient	0.66	0.62	0.78

Expansion/Contraction Coefficients	Standard Parameters	
	Contraction	Expansion
Gradual Transitions	0.1	0.3
Bridges/Culverts	0.3	0.5
Abrupt Transitions	0.6	0.8

Table 4.1 - Hydraulic Standard Parameters…continued

Table 4.1.2 - Manning Roughness Coefficients

Conduit	'n' Standard	Calibration Range Minimum	Maximum
Concrete	0.013	0.011	0.015
Brick	0.015	0.013	0.017
Plastic	0.013	0.011	0.015
Iron	0.013	0.011	0.015
Corrugated Steel Pipe - 3"x1"	0.024	0.021	0.027
Structural Plate Corrugated Steel Pipe - 6"x2"	0.032	0.026	0.036
Open Channel	**'n' Standard**	**Calibration Range Minimum**	**Maximum**
Overbank			
Woods	0.080	0.040	0.120
Meadows	0.055	0.035	0.070
Lawns	0.045	0.030	0.055
Channel			
Natural	0.035	0.025	0.045
Grass	0.030	0.025	0.035
Natural Rock	0.035	0.025	0.045
Armour Stone	0.025	0.017	0.030
Concrete	0.015	0.011	0.017
Articulated Block	0.020	0.019	0.032
Gabions	0.025	0.020	0.030
Wood	0.012	0.011	0.013

4.10 References

Information used in Section 4 has been abstracted from the following documents:

- Appendix C: Guidance for Riverine Flooding Analyses and Mapping,
  Guidelines and Specifications for Flood Hazard Mapping Partners, US FEMA, November 2009

- Open Channel Hydraulics
  by Ven Te Chow, McGraw-Hill Book Company, 1959

- Chapter 10 Ice Jam Floods
  Hydrology of Floods in Canada, A Guide to Planning and Design, W.E. Watt, et. al. National Research Council of Canada, 1989

- Technical Guide, River & Stream Systems: Flooding Hazard Limit
  Ontario Ministry of Natural Resources,
  2002

- Guidance for Ice-Jam Flooding Analyses and Mapping
  Guidelines and Specifications for Flood Hazard Mapping Partners, Federal Emergency Management Agency (FEMA)
  April 2003

- Probability Analysis of Historical Flood Data
  R. Gerard and E.W. Karpuk, Journal of the Hydraulics Division, A.S.C.E., pp. 1153-1165.
  1979

- Ice Related Flood Frequency Analysis: Application of Analytical Estimates
  R. Gerard and D.J. Calkins
  Proceedings Cold Regions Engineering Specialty Conference, CSCE, Montreal.
  1984

- River Ice Jams: Theory, Case Studies, and Applications
  S. Beltaos, Journal of Hydraulic Engineering, American Society of Civil Engineers,
  Vol. 109, No. 10, pp. 1338-1359.
  1983

5.0 FLOOD HAZARD MAPS

5.1 General

Section 5 provides guidance for displaying and communicating flood risk information including flood hazard limits, water surface elevations, flood depths, flood velocities, and the product of flood depth times flood velocity.

Flood hazard maps identify cultural information, topographic information, and flood risk information. Traditionally, flood hazard maps show cultural information that can be shown on ortho-photographs or line drawings. Topographic information is added to the cultural information along with the flood risk information.

Flood hazard maps can be composed of ortho-photographs combined with a grid of cells representing flood characteristics. Gridded information can be categorized with colours to more easily communicate flood risk information.

Section 5 is comprised of the following sections:

Map Sheet Layout and Contents	Section 5.2
Flood Risk Information	Section 5.3
References	Section 5.4

5.2 Map Sheet Layout and Contents

A sample map sheet layout is shown on Figure 5-1. For this sample, the trimmed map sheet size is 1067 mm x 762 mm (42 inches by 30 inches) although other sizes are acceptable. The map border size is 1025 mm X 710 mm. The map sheet is composed of a series of information blocks. The map sheet includes the following blocks:

- Base Map/Photo & Flood Risk Information Block
- Base Map Author & Stamp Block
- Flood Risk Author & Stamp Block
- Legend Block
- North Arrow & Datum Block
- Scale & Contour Interval Block
- Map Sheet Index Block
- Client Logo Block
- Title Block
- Sheet Number Block

The following describes each of the information blocks:

Base Map/Photo & Flood Risk Information Block - will contain an ortho-photograph or a line drawing showing cultural information, flood risk information, and topographic information. If gridded information is presented, topographic information may be omitted. The base map block (Figure 5-1) will show the location of the following:

- Location of all benchmarks and monuments;
- Location of all streamflow gauges and climate stations;
- Street names, park names, cultural information, etc.;
- Political boundaries; i.e., cities, municipalities, townships, counties, etc.;
- Watercourse name and flow arrow;
- Name of major water control structures;
- Cross section and cross section labels;
- Water surface elevation at each cross section;
- Gridded flood characteristic name and colour ramp categories;
- Upstream and downstream study limits and mapping limits;
- Match lines for overlapping map sheets; and
- Topographic information.

Base Map Author & Stamp Block - will identify the author or organization that developed the base map showing the cultural and topographic information. If appropriate the block will contain an author's stamp. The block will contain the date of the data used to derive the mapping.

Flood Risk Author & Stamp Block - will identify the author or organization conducting the flood risk map study and the PEO seal, signature, and date of the professional engineers who prepared or supervised the preparation of the flood risk map.

Legend Block - will contain all annotations used on the base map.

North Arrow & Datum Block - will contain a north arrow and the horizontal and vertical datum used to develop the base map and the flood risk information.

Scale & Contour Interval Block - will contain a scale for metric units. In addition, the block will contain the contour interval used for the topographic information along with the interpolated contour interval. A 1:2000 scale is commonly used.

Map Sheet Index Block - will identify the location and number of all map sheets for the study area, and will show the location of the current sheet. In addition, the index will identify the major transportation features to aid in identifying the location of the current sheet.

Client Logo Block - the clients name, address information, and logo will be contained within this block.

Title Block - The title block will contain the watercourse name and a brief description of the study limits or the limit of the hydraulic profiles.

Sheet Number Block - will contain the sheet number and the total number of sheets for the Study area.

5.3 Flood Risk Information

5.3.1 Flood Hazard Information

The following information will be added to each flood hazard map:

- Flood hazard limit (Hurricane Hazel or Timmins);
- 100-year floodline;
- Cross sections used in the hydraulic model;
- Water surface elevations (Hurricane Hazel or Timmins and 100 year Storms) at each cross section; and
- Notes on annotating flood hazard limits, cross sections, and text are shown on Figure 5-2 and on the following pages.

Floodlines should be used to define flood hazard limits. Gridded flood risk maps can be used to present flood risk information (water surface elevations, flood depths, flood velocities, etc.) to the general public.

If hydraulic characteristics of a flood plain require a 2-D model, then the results of the 2-D model should be used to develop floodlines for the flood hazard limit. A gridded map can be used to convey flood risk information to the public.

In some situations the results of the hydraulic modelling may not be appropriate to define flood hazard areas. For instance, most hydraulic programs do not model rapidly varied flow. In those situations, flood elevations should not be shown on the flood risk maps and floodlines should be shown as dashed lines. A note should be added to the maps indicating more detailed analysis is required to define the flood hazard areas. Other situations are where the results of the hydraulic modelling may not be appropriate is where the watercourse is under active and significant erosion.

Floodline Notes

- All cross sections in the hydraulic model must be shown on the Flood Hazard Maps. Two types of cross sections can be shown: major and minor;
- Major cross sections are shown with a large circle with water surface elevations, and a cross section label;
- Minor cross sections are shown with a small circle;
- The flood hazard limit (Hurricane Hazel or Timmins Storm or the 100 year floodlines) must be plotted on all maps and ;
- The flood hazard limits or floodlines that intersect a building must be drawn to include the entire building and not drawn along the side of the building facing the watercourse;
- Two floodlines must not intersect;
- Flood hazard limits or floodlines must join at the edge of sheets and match on adjacent sheets. Do not overlap information on different sheets;
- Flood hazard limits or floodlines must be continuous across the sheet;
- Flood hazard limits or floodlines must only cross a contour line once. Flood hazard limits or floodlines must parallel contour lines in all other locations;
- Flood hazard limits or floodlines at the cross section must have the same label as in the hydraulic model;
- Flood hazard limits or floodlines at the cross section must have the same elevation as the label; and
- Flood hazard limits or floodlines, cross section labels, water surface elevations must be identical to the legend.

Cross Section Notes

- Crossings are represented by two small circles with a line over the road profile;
- All channel drops must be shown with two circles. A small circle for the cross section at the bottom of the drop (no water surface elevations), and a standard cross section label for the crest of the drop. Crest of the drop is a major cross section, and bottom of drop is a minor cross section;
- All cross section endpoints must be outside the flood plain. All cross section map lengths must match the lengths in the hydraulic model;
- A white background must be used on cross section labels to improve readability;
- The flood hazard limits or floodlines or cross sections must not be shown beyond mapping sheet match lines or study limits;
- Cross sections that overlap two sheets must have a label on both sheets;
- Hurricane Hazel or Timmins Storm and the 100 year flood elevation must be shown in circles at the end of the cross section labels;
- Each cross section will be labelled with the cross section number in the hydraulic model;

- Labels must be placed on one side of the map in an ascending order; and
- Tic marks must be located at both ends of the cross section to denote the start and end of each cross section.

Text Notes

- Study Limits at upstream and downstream boundaries of the flood profiles;
- Mark minor watercourses with a Study Limit;
- Starting and ending chainage should be located where the watercourse enters and leaves the mapping sheet;
- Notes where topographic mapping does not match surveyed data;
- Street names adjacent to watercourse; and
- Spills - open floodline with a large arrow and marked SPILL. Spill locations must be approved by the Conservation Authority.

5.3.2 Gridded Flood Risk Information

Floodlines should be used to define flood hazard limits. A grid of cells can be used to communicate flood risk information to the public. Each cell can represent a magnitude of a flooding characteristic. Only one characteristic would be shown on a single map sheet. Each cell can have geographic coordinates. The grid would define geographic space with an array of square cells arranged in rows and columns. A grid of cells can more easily communicate flood risk information to the public than traditional floodline maps.

Typical flood characteristics for a gridded map include the following:

- Water Surface Elevation;
- Flood Depth;
- Velocity and Direction; and
- Flood Severity - the product of depth and velocity.

Cell Size - each flood characteristic cell size should be based on the cell size of the ground elevation data.

Grid Origin - all flood characteristic grids should have the same origin, extent, and coordinate system. This allows for comparison and manipulation of cell values for characteristics of flood depth and flood velocity.

Results from both 1-D and 2-D hydraulic models can be displayed as gridded values. 2-D models are developed using DEMs or gridded elevation data. Results from 1-D models, such as HEC-RAS, can be displayed in a grid using a GIS program, a TIN (Triangulated Irregular Network) and water surface elevations at each cross section.

Figure 5-1 Sample Flood Hazard Map Sheet Layout

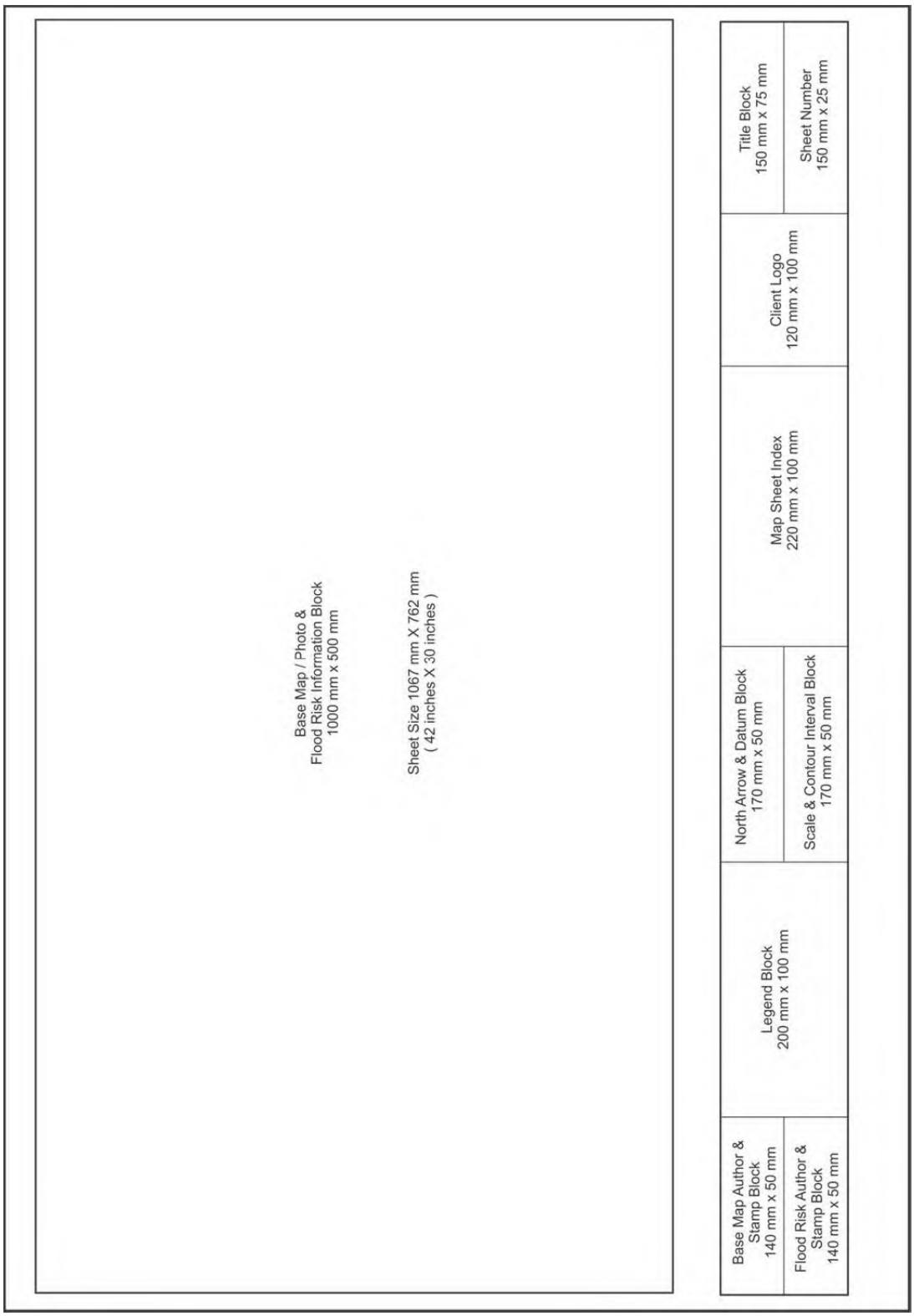
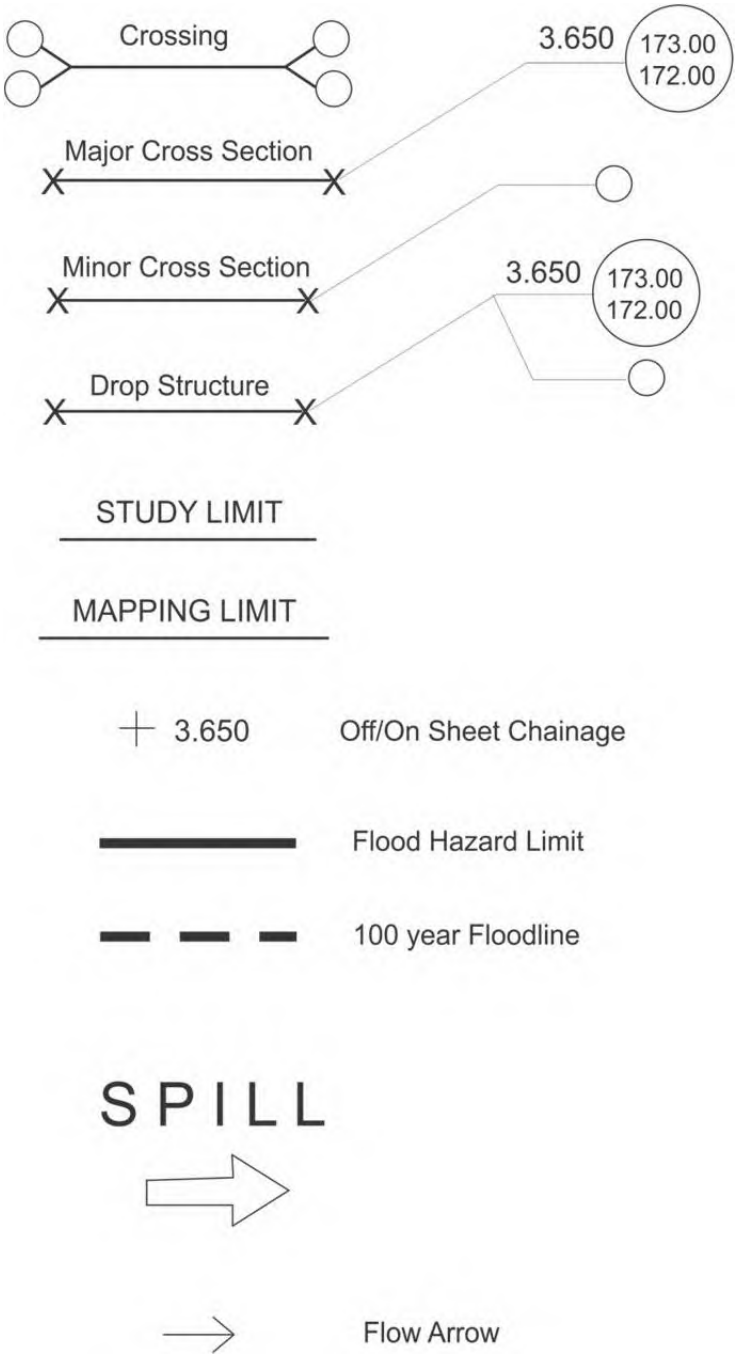


Figure 5-2 Typical Flood Hazard Map Sheet Annotations



Note: Spills are floodwaters that leave a defined watercourse and spill overland. Spills can re-enter the watercourse at a downstream point or flow overland to another watercourse.

5.4 References

Information used in Section 5 has been abstracted from the following documents:

- Appendix K: Format and Specifications for Flood Insurance Rates Maps,
  Guidelines and Specifications for Flood Hazard Mapping Partners
  FEMA (Federal Emergency Management Agency)
  April 2003

- Flood Depth and Analysis Grids,
  Guidance for Flood Risk Analysis and Mapping
  FEMA (Federal Emergency Management Agency)
  May 2014

6.0 FLOOD HAZARD MAP UPDATES

6.1 General

Flood hazard maps may need to be updated for many reasons including the following:

- More accurate terrain information is available;
- If a frequency analysis was used to determine flow rates, then the frequency analysis may need to be updated when there are additional streamflow data;
- If a hydrologic model is used to determine flow rates, then the model may need to be updated when there are more flow events for the calibration/validation process;
- If there has been a significant change to the hydrologic and hydraulic flow regimes. Examples include encroachment, new dams, removal of flood control structures, stormwater ponds, new crossings, land use changes, stream re-habilitation, revised operating procedures, etc. Existing data files should be run with the model updates, and if necessary the flood risk maps should be updated;
- To correct errors in previous modelling; and
- Hydrologic and hydraulic computer programs used in the original flood hazard map study have been upgraded.

An investigation must be conducted in-conjunction with Official Plan reviews to determine if flood hazard maps need to be updated. Currently Official Plan reviews are conducted every five years. Flood hazard map updates should be conducted to inform the land use planning process rather than in reaction to the land use planning process.

For some Authorities there may be a need to replace a few maps, but not all maps in a series. In these cases, replacement flood hazard maps must be edge matched with existing flood hazard maps not being replaced.

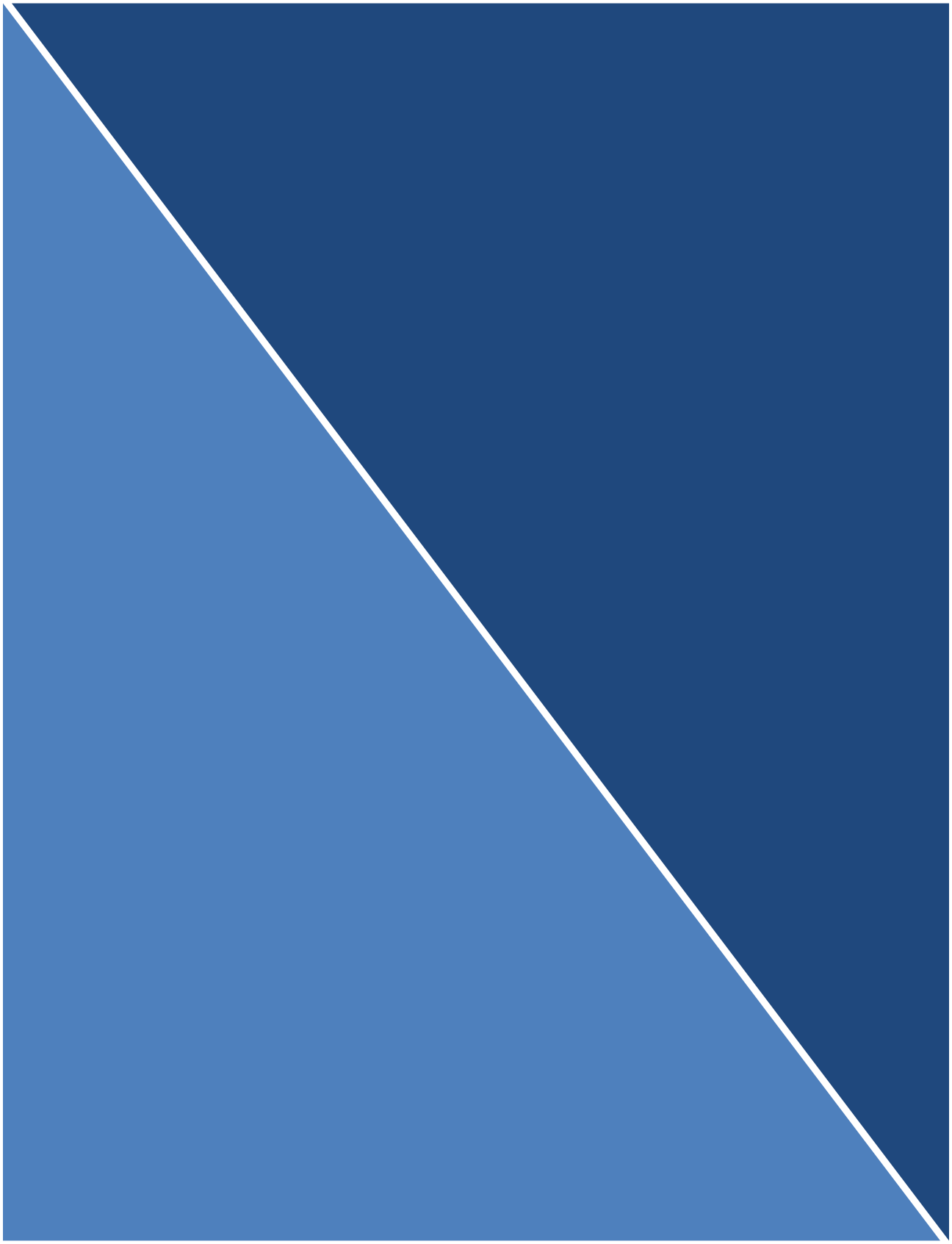
A new study should be commissioned to update floodlines within a flood hazard map. The new flood hazard map sheet should incorporate the PEO seal, signature, and date of the professional engineers who prepared or supervised the preparation of the input data and checked the output data for the flood hazard map. It is not recommended to update the original flood hazard map unless the original authoring engineer is conducting the update.

Hydrologic and hydraulic analyses required to update flood hazard maps must, when feasible, be conducted with the methodology that was used to develop the original flood hazard maps. If the methodology is not available or it's use is inappropriate, the reasons why the methodology cannot be used must be documented along with the reasons why the proposed methodology is appropriate.

6.2 Estimated Flood Hazard Mapping

Estimated flood hazard mapping must be updated to engineered flood hazard mapping to support a development application that is within or near estimated flood hazard limits. Estimated flood hazard mapping has been developed by Conservation Authorities where engineered flood hazard mapping does not exist. Estimated flood hazard maps are not prepared to the same level of detail as engineered flood hazard maps that are described in this Technical Guideline document. The level of detail pertains to topographic information, hydrology, and hydraulics.

The Conservation Authority should be contacted before updating estimated flood hazard mapping.



Credit Valley Conservation
inspired by nature



Plant Selection Guideline

Species List for Planting Plans within the Credit River Watershed

Document Contents:

Section 1: CVC Species List for Planting Plans within the Credit River Watershed
Section 2: CVC Seed Mixes
Section 3: CVC Cover Crop Selection Guideline

Prepared by: Credit Valley Conservation
April 2018

Section 1: CVC Species List for Planting Plans within the Credit River Watershed

Version 2.0 – April 2017

Credit Valley Conservation (CVC) promotes native plant biodiversity. CVC mandates the use of native species that are common within CVC's jurisdiction in regulated areas and recommends them in non-regulated areas.

The following guideline is used to select species for planting plans for natural restoration projects, mitigation plans and stormwater management pond blocks. This list ensures that restoration plantings, required by the planning and development process, enhance the ecological function of the natural heritage system of the Credit River Watershed. The Plant Selection Guideline also includes a coefficient of wetness to provide guidance on the soil moisture preferences of each species. Please refer to Table 1 for further details on species coefficient of wetness codes.

Table 1: Coefficient of Wetness and Related Soil Moisture Regime Preferences

Coefficient of Wetness	Soil Moisture Regime Preference
5	Almost always occur on uplands
4 3 2	Usually occur on uplands
1 0 -1	Found on uplands and in wetlands
-2 -3 -4	Usually occur in wetlands
-5	Almost always in wetlands

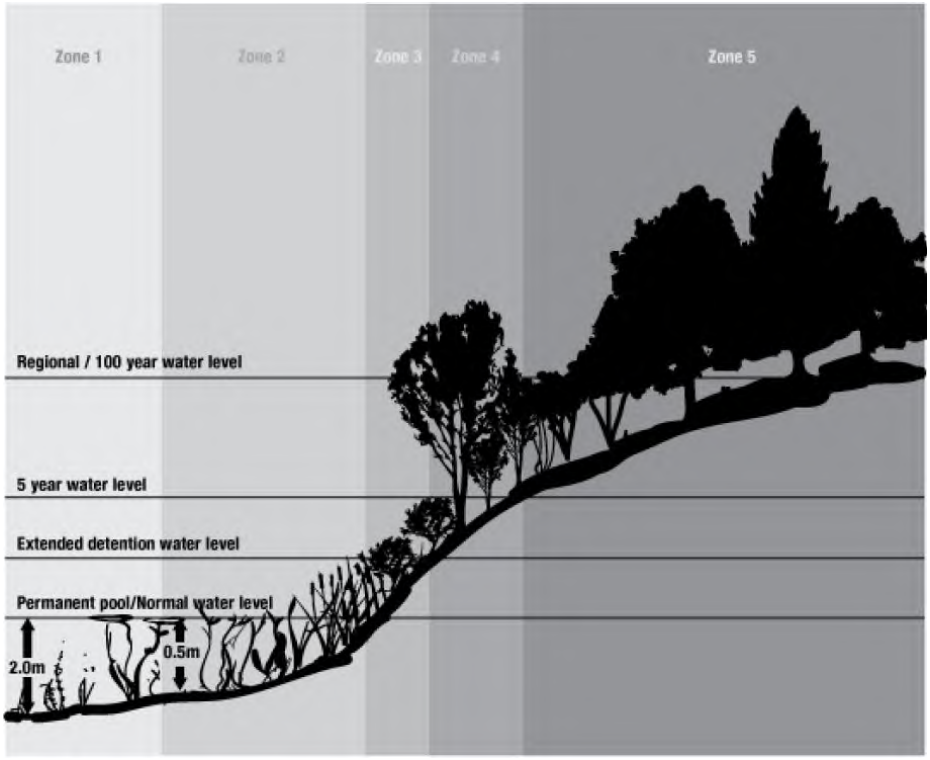
Note: Coefficient of Wetness taken from the Floristic Assessment System for Southern Ontario (Oldham et al, 1995).

There are two ecoregions within the Credit River Watershed: 6E - Lake Simcoe-Rideau Ecoregion and 7E – Lake Erie-Lake Ontario Ecoregion. Each ecoregion is characterized by a distinct biological response (i.e. species and communities) to environmental conditions (i.e. climate and geology) associated with that region. This list provides guidance on which species are appropriate for planting in each of these ecoregions. To simplify implementation and ensure consistency within individual municipalities, the watershed has been divided into two zones (upper and lower watershed) that roughly correspond to the boundaries of the ecoregions. Within this document, species identified with "**YES**" are suitable for planting in both the upper and lower watershed, "**U**" is suitable for **upper watershed only** and "**L**" is suitable for **lower watershed only**. The lower watershed includes the City of Mississauga, City of Brampton, Town of Oakville and Town of Milton. The upper watershed includes the Town of Halton Hills, Town of Caledon, Town of Orangeville, Town of Erin, Township of East Garafraxa, Township of Amaranth, and Town of Mono.

CVC staff have identified a selection of herbaceous, sedges, rushes, emergent and aquatic plants that appear to be successful in Stormwater Management (SWM) ponds, based on a review of SWM ponds within our watershed and the following reports: Performance Assessment of a Highway Stormwater Quality Detention Pond (SWAMP 2003) and Town of Aurora Stormwater Ponds Vegetation & Wildlife Study (Aurora Environmental Advisory Committee 2007). These species are **highlighted in green** in the Plant Selection Guideline List provided below. The column titled "SWM Pond Planting Zone" should be used in conjunction with Figure 1 to determine in which area of a SWM pond the species may be suitable. Species marked "NR" within this column are not recommended for planting in SWM ponds as a result of characteristics which deem them unsuitable (i.e. potential confusion with non-native species, site specific needs for growth). Please note that woody vines are not included in the calculation of shrub material to meet CVCs SWM Planting Guidelines but can be included to add diversity.

For information on how Wildlife Use, Characteristic and LID Codes were determined please refer to the definitions at the end of this document. A list of acceptable cover crops is included at the end of the plant list. To obtain a workable version of this document in excel format please contact a CVC Planning Ecologist.

Figure 1: SWM Pond Planting Zones



This document and the recommendations provided herein were developed based on the most recent scientific research available to CVC as well as professional opinion and experience. Please note that this list is not exhaustive and other species may be suitable. As a result, CVC will review any proposed species and rationale for use provided by the proponent or their consultants in support of their specific project. If you have any questions regarding the guidelines, contact a CVC Planning Ecologist.

Plant Selection Guideline List - Version 2.0

Species Use Codes:

- Breeding and migratory birds
- Pollinators
- Mast species providing wildlife foraging opportunities

LID Codes:

BR Bioretention
DS Dry swale
ES Enhanced grass swale
F Filter strips

Characteristics Codes:

- Not recommended for planting due to recent population decline or confusion/ hybridization with non-native sources
- Prefers full sun
- Prefers shade
- Salt tolerant
- Drought tolerant
- Suitable for bioengineering
- Susceptible to wind throw damage; plant away from lot lines, infrastructure and trails

Scientific Name	Common Name	Coefficient of Wetness	Upper/Lower Watershed	SWM Pond Planting Zone	Wildlife Use Codes	Characteristic Codes	LID Codes
Trees							
Abies balsamea	Balsam Fir	-3	U	3, 4			
Acer nigrum	Black Maple	3	Yes	5			
Acer rubrum	Red Maple	0	Yes	3, 4			BR, DS, F
Acer saccharinum	Silver Maple	-3	Yes	3, 4			F
Acer saccharum	Sugar Maple	3	Yes	5			BR, F
Acer x freemanii	Hybrid Maple	N/A	Yes	3, 4			BR, DS, F
Betula alleghaniensis	Yellow Birch	0	Yes	4			
Betula papyrifera	Paper Birch	2	Yes	4, 5			BR, DS
Carya cordiformis	Bitternut Hickory	0	Yes	4			F
Carya ovata	Shagbark Hickory	3	L	5			F
Fagus grandifolia	American Beech	3	Yes	NR			

Scientific Name	Common Name	Coefficient of Wetness	Upper/Lower Watershed	SWM Pond Planting Zone	Wildlife Use Codes	Characteristic Codes	LID Codes
Fraxinus americana	White Ash	3	Yes	NR		⊘	BR, DS
Fraxinus nigra	Black Ash	-4	Yes	NR		⊘	BR, DS, F
Fraxinus pennsylvanica	Green Ash	-3	Yes	NR		⊘	F
Juglans nigra	Black Walnut	3	**L**	5			BR, DS, F
Larix laricina	American Larch	-3	**U**	3, 4			BR, DS, F
Ostrya virginiana	Eastern Hop-hornbeam	4	Yes	5			
Picea glauca	White Spruce	3	**U**	5			BR, F
Pinus strobus	Eastern White Pine	3	Yes	5			F
Populus balsamifera	Balsam Poplar	-3	Yes	3, 4			BR, DS
Populus deltoides ssp. *deltoides*	Eastern Cottonwood	-1	Yes	4			BR, DS, F
Populus grandidentata	Large-toothed Aspen	3	Yes	5			BR, DS, F
Populus tremuloides	Trembling Aspen	0	Yes	4			BR,DS
Prunus serotina	Black Cherry	3	Yes	5			BR, DS, F
Quercus alba	White Oak	3	Yes	5			BR, DS, F
Quercus macrocarpa	Bur Oak	1	Yes	4, 5			BR, DS
Quercus rubra	Northern Red Oak	3	Yes	5			BR, DS, F
Salix amygdaloides	Peach-leaved Willow	-3	Yes	3,4			BR, DS,

Scientific Name	Common Name	Coefficient of Wetness	Upper/Lower Watershed	SWM Pond Planting Zone	Wildlife Use Codes	Characteristic Codes	LID Codes
Salix nigra	Black Willow	-5	**L**	NR		⊘	
Thuja occidentalis	Eastern White Cedar	-3	Yes	3, 4			BR, F
Tilia americana	American Basswood	3	Yes	5			F
Tsuga canadensis	Eastern Hemlock	3	Yes	NR			
Ulmus americana	American Elm	-2	Yes	NR		⊘	
Ulmus rubra	Slippery Elm	0	Yes	NR		⊘	
Shrubs							
Acer spicatum	Mountain Maple	3	Yes	NR			
Alnus incana	Speckled Alder	-5	**U**	NR			
Amelanchier arborea	Downy Serviceberry	3	Yes	5			
Amelanchier laevis	Smooth Serviceberry	5	Yes	5			BR, DS
Aronia melanocarpa	Black Chokeberry	-3	**U**	NR		⊘	
Carpinus caroliniana	Blue-beech	0	Yes	4			
Cornus alternifolia	Alternate-leaved Dogwood	5	Yes	5			DS
Cornus canadensis	Bunchberry	0	**U**	NR			
Cornus obliqua	Pale Dogwood	-4	**U**	3,4			
Cornus racemosa	Gray Dogwood	-2	Yes	4			BR, DS, F
Cornus rugosa	Round-leaved Dogwood	5	Yes	5			
Cornus sericea	Red-osier Dogwood	-3	Yes	3,4			
Corylus cornuta	Beaked Hazelnut	5	Yes	5			F

Scientific Name	Common Name	Coefficient of Wetness	Upper/Lower Watershed	SWM Pond Planting Zone	Wildlife Use Codes	Characteristic Codes	LID Codes
Crataegus punctata	Dotted Hawthorn	5	Yes	NR			
Diervilla lonicera	Northern Bush-honeysuckle	5	Yes	5			DS,F
Euonymus obovatus	Running Strawberry Bush	5	**L**	NR			
Gaultheria procumbens	Eastern Teaberry	3	Yes	NR			
Hamamelis virginiana	American Witch-hazel	3	**L**	5			DS,F
Ilex verticillata	Black Holly	-4	**U**	3			
Lonicera canadensis	Canada Fly Honeysuckle	3	Yes	5			
Mitchella repens	Partridge-berry	2	**U**	NR			
Prunus pensylvanica	Pin Cherry	4	Yes	5			BR,DS
Prunus virginiana	Choke Cherry	1	Yes	4, 5			BR,DS, F
Rhus typhina	Staghorn Sumac	5	Yes	5			BR, DS, F
Ribes americanum	Wild Black Currant	-3	Yes	3,4			
Ribes cynosbati	Prickly Gooseberry	5	Yes	5			DS, F
Ribes triste	Swamp Red Currant	-5	**U**	3			F
Rosa blanda	Smooth Rose	3	Yes	5			F
Rubus allegheniensis	Allegheny Blackberry	2	Yes	4, 5			DS, F
Rubus idaeus ssp. *strigosus*	Wild Red Raspberry	-2	Yes	4			BR, DS, F
Rubus occidentalis	Black Raspberry	5	Yes	5			
Rubus odoratus	Purple-flowering Raspberry	5	Yes	5			BR, DS

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Rubus pubescens	Dewberry	-4	Yes	NR			F
Salix bebbiana	Bebb's Willow	-4	Yes	3			DS
Salix discolor	Pussy Willow	-3	Yes	3,4			BR,DS, F
Salix eriocephala	Heart-leaved Willow	-3	Yes	3,4			BR, DS
Salix interior	Sandbar Willow	-5	Yes	3,4			BR, F
Salix lucida	Shining Willow	-4	**U**	3,4			F
Salix petiolaris	Meadow Willow	-4	**U**	3			BR, DS, F
Sambucus canadensis	Common Elderberry	-2	Yes	4			DS, F
Sambucus racemosa	Red Elderberry	2	Yes	4, 5			BR, DS, F
Spiraea alba	White Meadowsweet	-4	**U**	3			
Symphoricarpos albus ssp.. *albus*	Common Snowberry	4	Yes	5			
Taxus canadensis	Canadian Yew	3	Yes	NR			
Viburnum acerifolium	Maple-leaved Viburnum	5	Yes	5			
Viburnum lentago	Nannyberry	-1	Yes	4			BR, DS, F
Viburnum opulus ssp. *trilobum*	Highbush Cranberry	-3	Yes	NR			
Woody Vines							
Celastrus scandens	Climbing Bittersweet	3	Yes	NR			
Clematis Virginiana	Virginia Virgin's-bower	0	Yes	4			BR
Lonicera dioica	Limber Honeysuckle	3	Yes	5			

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Parthenocissus quinquefolia	Virginia Creeper	3	Yes	5			
Parthenocissus viacea	Thicket Creeper	3	Yes	5			
Smilax tamnoides	Hispid Greenbrier	0	Yes	4			
Vitis riparia	Riverbank Grape	-2	Yes	4			
Ferns							
Adiantum pedatum	Northern Maidenhair Fern	1	**U**	NR			
Athyrium filix-femina ssp.. *angustum*	Northeastern Lady Fern	0	Yes	NR			
Botrypus virginianus	Rattlesnake Fern	3	**U**	NR			
Cystopteris bulbifera	Bulblet Fern	-2	Yes	NR			
Cystopteris tenuis	Mackay's Bladder Fern	5	**U**	NR			
Dendrolycopodium dendroideum	Round-branched Tree-clubmoss	0	**U**	NR			
Diphasiastrum digitatum	Southern Ground-cedar	5	**U**	NR			
Dryopteris carthusiana	Spinulose Wood Fern	-2	Yes	NR			
Dryopteris cristata	Crested Wood Fern	-5	**U**	NR			
Dryopteris intermedia	Evergreen Wood Fern	0	Yes	NR			
Dryopteris marginalis	Marginal Wood Fern	3	Yes	NR			
Equisetum arvense	Field Horsetail	0	Yes	NR			
Equisetum hyemale	Common Scouring-rush	-2	Yes	NR			
Gymnocarpium dryopteris	Common Oak Fern	0	**U**	NR			

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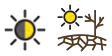
Huperzia lucidula	Shining Firmoss	-1	**U**	NR			
Matteuccia struthiopteris	Ostrich Fern	-3	Yes	3,4			F
Onoclea sensibilis	Sensitive Fern	-3	Yes	NR			F
Osmundastrum cinnamomeum	Cinnamon Fern	-3	Yes	NR			
Polystichum acrostichoides	Christmas Fern	5	Yes	NR			
Pteridium aquilinum	Bracken Fern	3	Yes	5			
Thelypteris palustris	Marsh Fern	-4	Yes	NR			F
Herbaceous							
Acalypha rhomboidea	Common Three-seeded Mercury	3	Yes	5			
Actaea pachypoda	White Baneberry	NR	Yes				
Actaea rubra	Red Baneberry	NR	Yes				
Ageratina altissima	White Snakeroot	3	Yes	5			
Agrimonia gryposepala	Hooked Agrimony	2	Yes	4, 5			
Allium tricoccum ssp.. *tricoccum*	Wild Leek	2	Yes	NR			
Ambrosia artemisiifolia	Annual Ragweed	3	Yes	NR			
Ambrosia trifida	Great Ragweed	-1	Yes	NR			
Anaphalis margaritacea	Pearly Everlasting	5	**U**	5			
Anemone acutiloba	Sharp-lobed Hepatica	5	Yes	NR			
Anemone canadensis	Canada Anemone	-3	Yes	3,4			BR, DS, F
Anemone quinquefolia	Wood Anemone	0	**L**	NR			
Anemone virginiana ssp.. *virginiana*	Tall Anemone	5	Yes	5			

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Antennaria neglecta	Field Pussytoes	5	Yes	Yes			
Apocynum androsaemifolium	Spreading Dogbane	5	Yes	4			
Apocynum cannabinum ssp.. *cannabinum*	Hemp Dogbane	0	Yes	4			
Aquilegia canadensis	Wild Columbine	1	Yes	NR			DS, F
Aralia nudicaulis	Wild Sarsaparilla	3	Yes	NR			
Arisaema triphyllum	Jack-in-the-pulpit	-2	Yes	NR			
Asarum canadense	Canada Wild-ginger	5	Yes	NR			
Asclepias incarnata	Swamp Milkweed	-5	Yes	3			BR, DS
Asclepias syriaca	Common Milkweed	5	Yes	5			
Bidens cernua	Nodding Beggarticks	-5	Yes	3			BR
Bidens frondosa	Devils Beggarticks	-3	Yes	3,4			BR
Boehmeria cylindrica	False Nettle	-5	Yes	3			
Calystegia sepium ssp. *americana*	American False Bindweed	0	Yes	4			
Cardamine concatenata	Cut-leaved Toothwort	3	Yes	NR			
Cardamine diphylla	Two-leaved Toothwort	5	Yes	NR			
Cardamine pensylvanica	Pennsylvania Bittercress	-4	**U**	NR			
Caulophyllum giganteum	Giant Blue Cohosh	5	Yes	NR			
Chelone glabra	White Turtlehead	-5	Yes	3			
Chenopodiastrum simplex	Maple-leaved Goosefoot	5	Yes	5			
Circaea alpina	Small Enchanters Nightshade	-3	**U**	NR			

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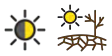
Circaea canadensis	Broad-leaved Enchanters Nightshade	3	Yes	5			
Claytonia virginica	Narrow-leaved Spring Beauty	3	**L**	NR			
Clinopodium vulgare	Field Basil	5	Yes	5			
Clintonia borealis	Blue Bead-lily	-1	**U**	NR			
Coptis trifolia	Goldthread	-3	**U**	NR			
Cryptotaenia canadensis	Canada Honewort	0	Yes	4			
Dicentra canadensis	Squirrel-corn	5	**U**	NR			
Epifagus virginiana	Beechdrops	5	Yes	NR			
Epilobium ciliatum ssp. *ciliatum*	Northern Willowherb	3	Yes	5			
Erigeron annuus	Annual Fleabane	1	Yes	4, 5			
Erigeron canadensis	Canada Horseweed	1	Yes	4, 5			
Erigeron philadelphicus	Philadelphia Fleabane	-3	Yes	3,4			
Erigeron strigosus	Rough Fleabane	1	Yes	4, 5			
Erythronium americanum	Yellow Trout-lily	5	Yes	NR			
Eupatorium perfoliatum	Common Boneset	-4	Yes	3			F
Eurybia macrophylla	Large-leaved Aster	5	Yes	NR			
Euthamia graminifolia	Grass-leaved Goldenrod	-2	Yes	4			BR, DS, F
Eutrochium maculatum ssp.. *maculatum*	Spotted Joe Pye Weed	-5	Yes	3			
Fragaria vesca ssp. *americana*	American Woodland Strawberry	4	Yes	NR			

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Fragaria virginiana	Wild Strawberry	1	Yes	4, 5			BR, DS
Galium asprellum	Rough Bedstraw	-5	Yes	NR			
Galium palustre	Marsh Bedstraw	-5	Yes	NR			
Galium triflorum	Three-flowered Bedstraw	2	Yes	NR			
Geranium maculatum	Spotted Geranium	3	**L**	NR			ES
Geum aleppicum	Yellow Avens	-1	Yes	4			
Geum canadense	White Avens	0	Yes	4			
Geum fragarioides	Barren Strawberry	5	Yes	NR			
Geum laciniatum	Rough Avens	-3	**L**	3,4			
Hackelia virginiana	Virginia Stickseed	1	Yes	4, 5			
Hydrocotyle americana	American Water-pennywort	-5	**U**	NR			
Hydrophyllum virginianum	Virginia Waterleaf	-2	Yes	NR			F
Impatiens capensis	Spotted Jewelweed	-3	Yes	3,4			
Lactuca canadensis	Canada Lettuce	2	Yes	NR			
Laportea canadensis	Wood Nettle	-3	Yes	NR			
Lilium michiganense	Michigan Lily	-1	**L**	4			
Lobelia inflata	Indian-tobacco	4	Yes	5			
Lobelia siphilitica	Great Blue Lobelia	-4	Yes	3			F
Lycopus americanus	American Water-horehound	-5	Yes	3			
Lycopus uniflorus	Northern Water-horehound	-5	Yes	3			
Lysimachia borealis	Northern Starflower	-1	Yes	NR			
Lysimachia ciliata	Fringed Loosestrife	-3	Yes	3,4			F

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Maianthemum canadense	Wild Lily-of-the-valley	0	Yes	NR			
Maianthemum racemosum	False Solomons-seal	3	Yes	NR			
Maianthemum stellatum	Star-flowered False Solomons-seal	1	Yes	NR			
Mentha canadensis	Canada Mint	-3	Yes	3,4			
Mimulus ringens	Square-stemmed Monkeyflower	-5	Yes	3			
Mitella diphylla	Two-leaved Mitrewort	2	Yes	NR			
Mitella nuda	Naked Mitrewort	-3	Yes	NR			
Monarda fistulosa ssp.. *fistulosa*	Wild Bergamot	3	Yes	5			BR, F
Monotropa uniflora	Indian-pipe	3	Yes	NR			
Myosotis laxa	Small Forget-me-not	-5	Yes	NR			
Nabalus albus	White Rattlesnake-root	3	Yes	NR			
Nabalus altissimus	Tall Rattlesnake-root	3	Yes	NR			
Oenothera biennis	Common Evening Primrose	3	Yes	5			
Oenothera parviflora	Small-flowered Evening Primrose	3	Yes	5			
Osmorhiza claytonii	Hairy Sweet Cicely	4	Yes	NR			
Penthorum sedoides	Ditch-stonecrop	-5	Yes	3			
Persicaria lapathifolia	Pale Smartweed	-4	Yes	3			
Phryma leptostachya	Lopseed	5	Yes	5			
Pilea pumila	Canada Clearweed	-3	Yes	NR			
Plantago rugelii	Rugels Plantain	0	Yes	NR			

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Platanthera aquilonis	Tall Northern Green Orchid	-4	**U**	NR			
Podophyllum peltatum	May-apple	3	Yes	NR			F
Polygaloides paucifolia	Gay-wing Milkwort	3	**U**	NR			
Polygonatum pubescens	Hairy Solomons Seal	5	Yes	NR			
Potentilla norvegica	Norwegian Cinquefoil	0	Yes	4			
Prunella vulgaris ssp. *lanceolata*	Lance-leaved Self-heal	5	Yes	NR			
Pyrola asarifolia	Pink Pyrola	-3	**U**	NR			
Pyrola elliptica	Shinleaf	5	Yes	NR			
Ranunculus abortivus	Kidney-leaved Buttercup	-2	Yes	NR			
Ranunculus hispidus ssp.. *caricetorum*	Northern Swamp Buttercup	-5	Yes	3			
Ranunculus recurvatus	Hooked Buttercup	-3	Yes	3,4			
Rorippa palustris ssp. *hispida*	Hispid Marsh Yellowcress	-5	Yes	3			
Rudbeckia hirta	Black-eyed Susan	3	Yes	5			BR, DS
Rudbeckia laciniata	Cut-leaved Coneflower	-4	**L**	3			BR, DS,F
Sanguinaria canadensis	Bloodroot	4	Yes	NR			
Sanicula marilandica	Maryland Sanicle	3	Yes	5			
Scutellaria galericulata	Hooded Skullcap	-5	Yes	3			
Scutellaria lateriflora	Mad Dog Skullcap	-5	Yes	3			
Solanum ptychanthum	Black Nightshade	5	Yes	NR			
Solidago altissima ssp.. *altissima*	Eastern Tall Goldenrod	3	Yes	5			BR, DS, F

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Solidago caesia	Blue-stemmed Goldenrod	3	Yes	NR			
Solidago canadensis ssp.. *canadensis*	Canada Goldenrod	3	Yes	5			BR, DS,F
Solidago flexicaulis	Zigzag Goldenrod	3	Yes	NR			BR, DS
Solidago gigantea	Giant Goldenrod	-3	Yes	3,4			
Solidago juncea	Early Goldenrod	5	Yes	5			
Solidago nemoralis ssp. *nemoralis*	Gray-stemmed Goldenrod	5	Yes	5			BR, DS
Solidago rugosa ssp. *rugosa*	Northern Rough-stemmed Goldenrod	-1	**U**	4			BR, DS,F
Streptopus lanceolatus ssp.. *lanceolatus*	Eastern Rose Twisted-stalk	0	**U**	NR			
Symphyotrichum cordifolium	Heart-leaved Aster	5	Yes	NR			BR, DS
Symphyotrichum ericoides ssp.. *ericoides*	White Heath Aster	4	Yes	5			BR
Symphyotrichum lanceolatum ssp. *lanceolatum*	Panicled Aster	-3	Yes	3,4			BR, DS
Symphyotrichum lateriflorum	Calico Aster	-2	Yes	4			
Symphyotrichum novae-angliae	New England Aster	-3	Yes	3,4			BR, DS,F
Symphyotrichum puniceum	Swamp Aster	-5	Yes	3			BR, DS, F
Thalictrum dioicum	Early Meadow-rue	2	Yes	NR			
Thalictrum pubescens	Tall Meadow-rue	-2	Yes	4			BR, DS, F
Tiarella cordifolia	Heart-leaved Foam-flower	1	Yes	NR			

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Trientalis borealis	Northern Starflower	-1	Yes	NR			
Trillium erectum	Red Trillium	1	Yes	NR			
Trillium grandiflorum	White Trillium	5	Yes	NR			
Urtica dioica ssp. *gracilis*	Slender Stinging Nettle	-1	Yes	4			
Uvularia grandiflora	Large-flowered Bellwort	5	Yes	NR			
Verbena hastata	Blue Vervain	-4	Yes	3			BR, DS
Verbena urticifolia	White Vervain	-1	Yes	4			BR, DS, F
Veronica americana	American Speedwell	-5	**U**	NR			
Viola affinis	Le Conte's Violet	-3	Yes	NR			
Viola blanda	Sweet White Violet	-2	**U**	NR			
Viola canadensis ssp.. *canadensis*	Canada Violet	5	Yes	NR			
Viola labradorica	Labrador Violet	-2	Yes	NR			
Viola pubescens	Yellow Violet	4	Yes	5			
Viola rostrata	Long-spurred Violet	3	**U**	NR			
Viola sororia	Woolly Blue Violet	1	Yes	4, 5			
Xanthium strumarium	Rough Cocklebur	0	Yes	4			
Grasses							
Bromus ciliatus	Fringed Brome	-3	**U**	3,4			
Bromus latiglumis	Broad-glumed Brome	-2	**L**	4			BR, DS, F
Calamagrostis canadensis ssp.. *canadensis*	Bluejoint Reedgrass	-5	Yes	3			BR, DS, F
Danthonia spicata	Poverty Oatgrass	5	Yes	5			BR, ES, DS

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Dichanthelium acuminatum	Hairy Panicgrass	N/A	Yes	4			
Elymus hystrix	Bottlebrush Grass	5	Yes	5			
Elymus riparius	Eastern Riverbank Wildrye	-3	**U**	3,4			BR, ES, DS, F
Elymus virginicus ssp.. *virginicus*	Virginia Wildrye	-2	Yes	4			BR, DS
Festuca subverticillata	Nodding Fescue	2	Yes	NR			
Glyceria striata	Fowl Mannagrass	-5	Yes	3			
Leersia oryzoides	Rice Cutgrass	-5	Yes	3			
Muhlenbergia mexicana ssp.. *mexicana*	Mexican Muhly	-3	Yes	3,4			BR, DS
Oryzopsis asperifolia	White-grained Mountain-ricegrass	5	Yes	NR			
Panicum acuminatum ssp.. *acuminatum*	Tapered Rosette Grass	0	Yes	4			
Panicum capillare	Common Panicgrass	5	Yes	5			
Phalaris arundinacea ssp.. *arundinacea*	Reed Canary Grass	-4	Yes	NR			
Poa palustris	Fowl Bluegrass	-4	Yes	3			
Schizachne purpurascens	Purple False Melic	2		NR			
Sphenopholis intermedia	Slender Wedge Grass	0	Yes	4			
Sedges							
Carex arctata	Drooping Woodland Sedge	5	Yes	5			
Carex aurea	Golden Sedge	-4	Yes	3			

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Carex bebbii	Bebbs Sedge	-5	Yes	3			BR, DS, F
Carex blanda	Woodland Sedge	0	Yes	NR			
Carex communis	Fibrous-root Sedge	5	Yes	5			
Carex crinita	Fringed Sedge	-4	**U**	3			ES
Carex cristatella	Crested Sedge	-4	Yes	3			
Carex deweyana	Deweys Sedge	4	Yes	5			
Carex disperma	Two-seeded Sedge	-5	**U**	3			
Carex gracillima	Graceful Sedge	3	Yes	5			
Carex granularis	Limestone Meadow Sedge	-4	Yes	3			
Carex hystericina	Porcupine Sedge	-5	Yes	3			BR,ES, DS
Carex interior	Inland Sedge	-5	**U**	3			
Carex intumescens	Bladder Sedge	-4	Yes	3			F
Carex leptalea	Bristle-stalked Sedge	-5	**U**	3			
Carex lupulina	Hop Sedge	-5	Yes	3			F
Carex peckii	Pecks Sedge	5	Yes	NR			
Carex pedunculata	Long-stalked Sedge	5	Yes	NR			
Carex pensylvanica	Pennsylvania Sedge	5	Yes	NR			BR, ES, DS
Carex plantaginea	Plantain-leaved Sedge	5	Yes	NR			
Carex platyphylla	Broad-leaved Sedge	5	Yes	NR			
Carex pseudocyperus	Cyperus-like Sedge	-5	Yes	3			
Carex radiata	Eastern Star Sedge	5	Yes	5			

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Carex retrorsa	Retrorse Sedge	-5	Yes	3			
Carex rosea	Rosy Sedge	5	Yes	NR			
Carex sparganioides	Burreed Sedge	0	Yes	4			
Carex stipata	Awl-fruited Sedge	-5	Yes	3			BR, ES
Carex vulpinoidea	Fox Sedge	-5	Yes	3			DS
Eleocharis erythropoda	Red-stemmed Spikerush	-5	Yes	3			
Eleocharis obtusa	Blunt Spikerush	-5	**U**	3			
Scirpus atrovirens	Dark-green Bulrush	-5	Yes	3			BR
Scirpus microcarpus	Red-tinged Bulrush	-5	Yes	3			
Rushes							
Juncus articulatus	Jointed Rush	-5	Yes	3			
Juncus dudleyi	Dudleys Rush	0	Yes	4			
Juncus effusus	Soft Rush	-5	Yes	3			BR, F
Juncus nodosus	Knotted Rush	-5	Yes	3			
Juncus tenuis	Path Rush	0	Yes	4			BR, DS, F
Juncus torreyi	Torreys Rush	-3	Yes	3,4			
Emergents							
Alisma triviale/subcordatum (A. plantago-aquatica)	Water-plantain species	-5	Yes	2, 3			BR, F
Calla palustris	Wild Calla	-5	**U**	NR			
Caltha palustris	Yellow Marsh Marigold	-5	Yes	NR			F
Carex lacustris	Lake Sedge	-5	Yes	2, 3			
Carex stricta	Tussock Sedge	-5	**U**	2, 3			

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Cicuta bulbifera	Bulb-bearing Water-hemlock	-5	**U**	NR			
Cicuta maculata ssp.. *maculata*	Spotted Water-hemlock	-5	Yes	NR			
Glyceria grandis	Tall Mannagrass	-5	Yes	2, 3			
Iris versicolor	Harlequin Blue Flag	-5	Yes	2, 3			
Sagittaria latifolia	Broad-leaved Arrowhead	-5	Yes	2, 3			
Schoenoplectus tabernaemontani	Soft-stemmed Bulrush	-5	Yes	2, 3			BR, DS, F
Scirpus cyperinus	Cottongrass Bulrush	-5	Yes	2, 3			BR, DS, F
Sium suave	Hemlock Water-parsnip	-5	Yes	2, 3			
Sparganium emersum	Green-fruited Burreed	-5	**U**	2, 3			
Sparganium eurycarpum	Broad-fruited Burreed	-5	Yes	2, 3			BR, DS
Typha latifolia	Broad-leaved Cattail	-5	Yes	FB*			BR
Submergent Aquatics							
Ceratophyllum demersum	Common Hornwort	-5	Yes	1			
Elodea canadensis	Broad Waterweed	-5	Yes	1			
Myriophyllum sibiricum	Siberian Water-milfoil	-5	Yes	1			
Najas flexilis	Slender Naiad	-5	Yes	1			
Potamogeton foliosus	Leafy Pondweed	-5	Yes	1			
Potamogeton pusillus ssp. *pusillus*	Small Pondweed	-5	Yes	1			
Potamogeton pusillus ssp. *tenuissimus*	Narrow-leaved Small Pondweed	-5	Yes	1			

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Potamogeton richardsonii	Richardsons Pondweed	-5	Yes	1			
Ranunculus aquatilis	White Water Buttercup	-5	Yes	1			
Stuckenia pectinata	Sago Pondweed	-5	Yes	1			
Floating Aquatics							
Lemna minor	Lesser Duckweed	-5	Yes	1			
Nuphar ssp.iegata	Ssp.iegated Pond-lily	-5	Yes	1			
Nymphaea odorata ssp. *odorata*	Fragrant Water-lily	-5	Yes	1			
Persicaria amphibia	Water Smartweed	-5	**U**	1			
Potamogeton natans	Floating Pondweed	-5	Yes	1			
Spirodela polyrhiza	Great Duckweed	-5	**U**	1			

*Please note *Typha latifolia* (broad-leaved cattail) is only recommended within the forebay of SWM ponds only.

Species use and characteristic codes were developed using current research and expert knowledge. This list is not intended to be exhaustive and is subject to change as a result of evolving information. A general description of the criteria that went into the assessment of each species use or characteristic code is as follows:

1. **Breeding and Migratory Birds**: Adapted from *CVC Native Plant List for Breeding and Migratory Birds*. These reflect ideal species for native bird breeding, nesting and foraging. Please note that other species of trees and shrubs may also provide nesting opportunities and utilization. If vegetation removals are required for a project, the absence of species identified on the above list does not negate the need for proper nesting surveys and assessments.

2. **Pollinators:** Includes species that attract or are utilized by various types of insect pollinators (bees, butterflies, moths etc.) during various life stages. This may include food and/ or habitat for larvae or adults.

3. **Mast Species:** Mast is considered the edible reproductive part (i.e. nuts and berries) produced by woody species of plants which are consumed by wildlife. Species on the list were identified to provide mast and foraging opportunities to native wildlife.

4. **Salt Tolerance**: Identifies species that can withstand some salinity in the soil around their root system. Please note that no species within the list is considered a halophyte (ability thrive in high salinity). All species listed are susceptible to decline or mortality in highly saline conditions. As a result, urban and roadside plantings may require additional mitigation measures to limit potential impacts of salt exposure.

5. **Drought Tolerance**: Identifies species that can tolerate dry to average-dry soil conditions. This may include mid to upper slopes, exposed flat sites, roadside edges and sites with shallow or highly modified soils (e.g. mixed with non-native material such as gravel). Please note that some species identified can tolerate dry periods, but do not prefer dry soils as a long-term growing condition.

6. **Light Tolerance:** Identifies species that prefer full sun (SU) or fully shaded sites (SH). The list does not presently indicate species which are tolerant to both sun and shade or part shade conditions.

7. **LID Codes**: Species identified for various LID features were adapted directly from the CVC *Low Impact Development Stormwater Management Planning and Design Guide, Appendix B: Landscape Design Guide for LID.*

Section 2: CVC Seed Mixes

Version 2 – April 2018

In partnership with Ontario Seed Company (OSC), CVC has developed a selection of seed mixes that are appropriate for use within the Credit River watershed. These seed mixes are suitable for restoration and naturalization projects, as well as for planting plans for stormwater management facilities. For complex sites a qualified professional should review the site conditions to determine an appropriate seed mix.

These mixes have been designed to be used in a variety of soil and moisture conditions. Proponents can select any supplier to purchase their seed mixes but CVC recommends proponents select suppliers who obtain/ source seeds locally.

If specific habitat or ecological community targets are being pursued for a project (e.g. grasslands, prairie, pollinator habitat or a specific wetland community type), contact a CVC Planning Ecologist for additional input.

Application Rate
These seed mixes should be applied at a rate of 22 - 25 kg/ha (21-23 lbs/acre) or at a rate of 250g/90m2 (1/2lb/1000 sq. ft) for smaller areas. Seed mixes should be used in conjunction with an appropriate cover crop (refer to Section 3 below)

CVC 1 – Upland Mix

Generally moist to dry upper slope and tableland sites and soils or SWM pond zones 3 to 5.

Scientific Name	Common Name	%
Anemone canadensis	Canada Anemone	1
Asclepias syriaca	Common Milkweed	2
Carex granularis	Limestone Meadow Sedge	15
Elymus virginicus var. virginicus	Virginia Wildrye	40
Euthamia graminifolia	Grass-leaved Goldenrod	1
Monarda fistulosa var. fistulosa	Wild Bergamot	1
Oenothera biennis	Common Evening Primrose	25
Rudbeckia hirta	Black Eyed Susan	10
Solidago canadensis var. canadensis	Canada Goldenrod	1
Solidago juncea	Early Goldenrod	1
Solidago nemoralis ssp. nemoralis	Gray-stemmed Goldenrod	1
Symphyotrichum novae-angliae	New England Aster	1
Verbena urticifolia	White Vervain	1

CVC 2 – Lowland Mix

Generally wet to moist sites and soils including floodplain/ riparian areas or SWM pond zones 2-3.

Scientific Name	Common Name	%
Carex vulpinoidea	Fox Sedge	25
Elymus virginicus var. virginicus	Virginia Wildrye	35
Juncus tenuis	Path Rush	5
Poa palustris	Fowl Bluegrass	25
Scirpus atrovirens	Dark-green Bulrush	5
Verbena hastata	Blue Vervain	5

CVC 3 – Lowland Restoration Mix

Wet to moist sites and soils including riparian areas where restoration or enhancement of an existing natural community is required. Typically not required for SWM ponds.

Scientific Name	Common Name	%
Anemone canadensis	Canada Anemone	1
Bidens cernua	Nodding Beggarticks	1
Carex vulpinoidea	Fox Sedge	25
Elymus virginicus var. virginicus	Virginia Wildrye	25
Eutrochium maculatum var. maculatum	Spotted Joe Pye Weed	1
Juncus effusus ssp. solutus	Soft Rush	5
Juncus tenuis	Path Rush	5
Poa palustris	Fowl Bluegrass	25
Scirpus atrovirens	Dark-green Bulrush	5
Symphyotrichum novae-angliae	New England Aster	1
Symphyotrichum puniceum	Swamp Aster	1
Verbena hastata	Blue Vervain	5

*% of seed mix refers to % by weight

Section 3: CVC Cover Crop Selection Guideline

Version 1.0 – April 2018

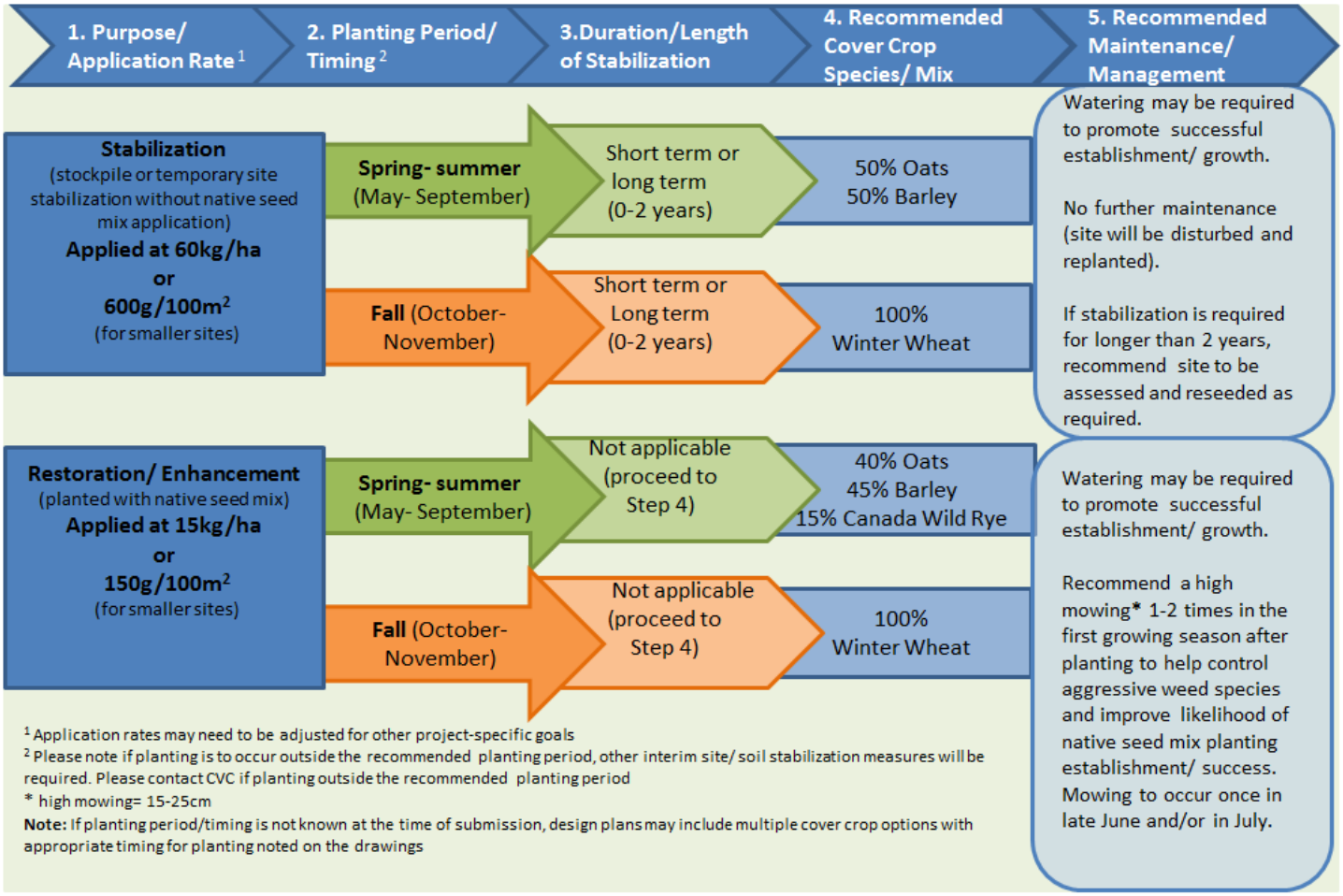
The following cover crop species recommendations were developed in consultation with Ontario Seed Company (OSC), review of relevant scientific information and expert knowledge. The purpose of this guideline is to provide direction on the selection of cover crop species for use in development and restoration projects within the Credit River watershed. Cover crop application is an important aspect of development and restoration projects, providing multiple ecological functions including soil stabilization and erosion prevention as well as soil compaction reduction. When applied with an appropriate native seed mix, the recommended cover crops may also act as a nurse crop; suppressing weed species and providing nutrient supply to the soil for improved native seed mix establishment and growth. Alternative non-invasive cover crop species that are not in the guideline may be suitable to meet project specific goals. Further consultation with CVC, prior to submission of restoration plans, is recommended in such cases.

Exposed sites should be stabilized as soon after completion of land disturbance as possible. Please refer to applicable municipal guidelines for stabilization requirements of exposed sites. Please note that cover crop and native seed mix application is not recommended in mid-summer (July-August) unless appropriate maintenance (i.e. regular watering in dry conditions) can be provided. Interim erosion protection may be required for some projects.

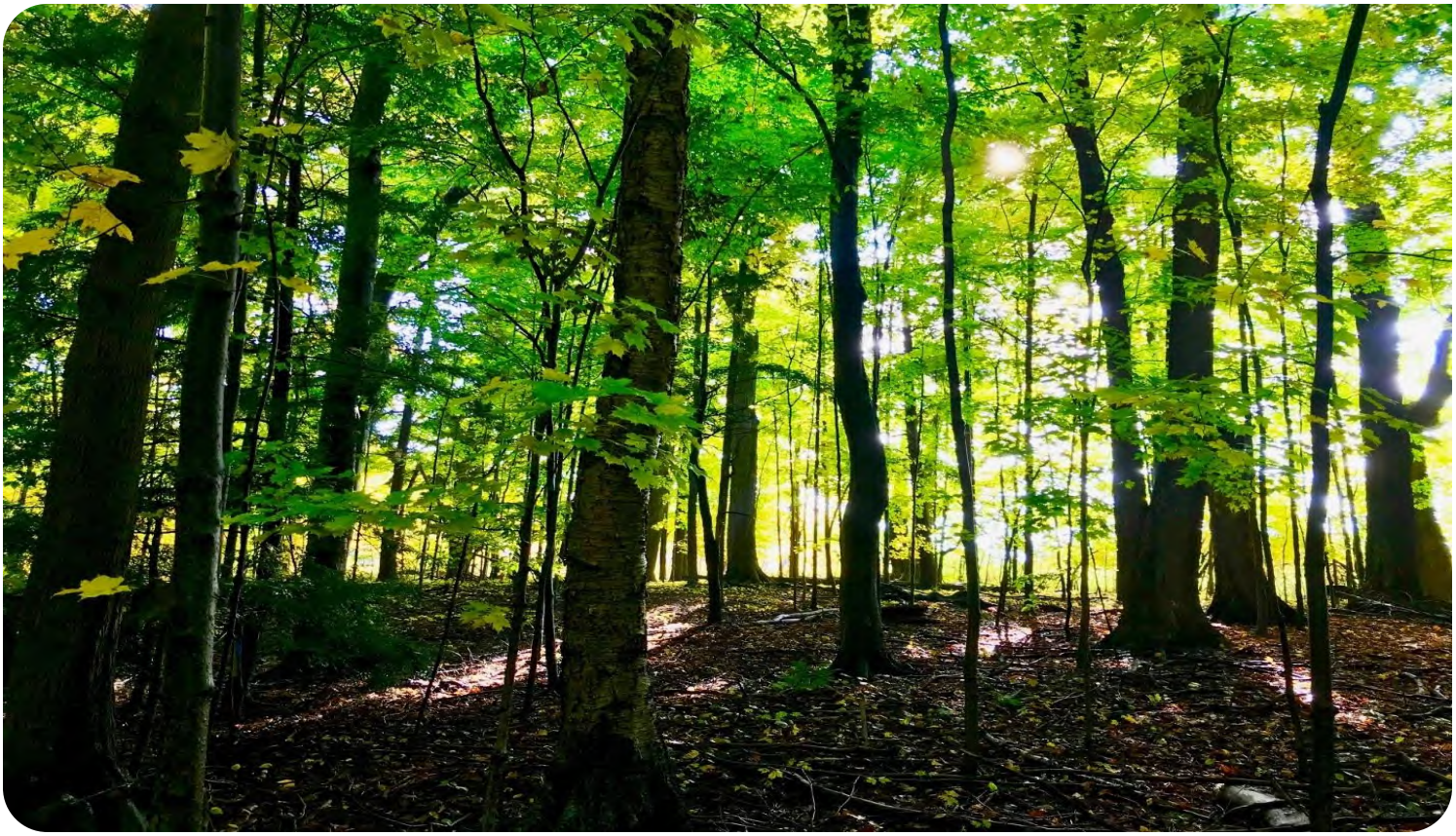
Site preparation and assessment is also recommended prior to application. Ensuring that soils are of sufficient quality and depth (i.e. a healthy topsoil layer is present, top and sub soils are not heavily compacted) to receive cover crop and seed mix application is imperative for supporting growth and establishment. Management of cover crop plantings is also integral to the success of naturalization, restoration and compensation efforts. Improper management can result in increased mortality of planted shrub, herbaceous and tree species which may increase project costs as a result of stock replacement or reseeding efforts. Management recommendations are provided in the cover crop selection tool below. Please refer to the Cover Crop Selection Tool below to determine which cover crop species or species mix is suitable for project specific requirements and goals. The list below is provided to ensure accurate sourcing of cover crop species based on scientific and common names:

Common Name	Scientific Name
Oats	*Avena sativa*
Barley	*Hordeum vulgare*
Canada Wild Rye	*Elymus canadensis*
Winter Wheat	*Triticum aestivum*

CVC Cover Crop Selection Tool



Credit Valley Conservation
inspired by nature



Ecosystem Offsetting Guidelines

Prepared by: Credit Valley Conservation

March 13, 2020

1255 Old Derry Road, Mississauga, Ontario L5N 6R4 | cvc.ca | T 905-670-1615 | TF 800-668-5557 | F 905-670-2210

Document prepared by Scott Sampson, Manager, Natural Heritage Management and Joshua Campbell, Director, Planning and Development Services.

For additional information regarding this document, please contact:

Joshua Campbell, Director
Planning and Development Services
Credit Valley Conservation (www.cvc.ca)
Email: Joshua.campbell@cvc.ca , Phone: 905-670-1615 ext. 289

This document contains material directly from Toronto and Region Conservation Authority's *Guideline for Determining Ecosystem Compensation* (June 2018). CVC would like to thank TRCA staff for all their hard work on the development of their guideline. This document is as consistent as possible with TRCA's guideline; however, there are changes to speak to CVC specific policies and programs. In addition, there are a couple of new requirements or methods intended to provide more clarity and consistency between projects.

The authors would also like to thank the following CVC staff for the input, contributions, and review of this document: Gary Murphy, Aviva Patel, Bob Morris, Liam Marray, Jakub Kilis, Kate Hayes, Rod Krick, Aaron Day, Brian Boyd, Sherwin Watson-Leung, Christine Wilson, Charlotte Cox, and Laura Timms.

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- Leslie Matich and Holly Anderson from Conservation Halton.

This document should be referenced as:

Credit Valley Conservation. 2020. Ecosystem Offsetting Guidelines, Credit Valley Conservation. March 2020.

This guideline was approved by Credit Valley Conservation's Board of Directors under Resolution 29/20 on 13 March 2020.

RESOLUTION:

WHEREAS *natural systems continue to often be adversely impacted by development and infrastructure projects throughout the Credit River watershed (and area) despite Credit Valley Conservation's (CVC) and partner municipalities' commitment to natural heritage protection and adherence to a strong provincial policy and regulatory regime; and*

WHEREAS *past approaches to ecosystem compensation have only been partially successful at replacing lost ecosystem features and functions; and*

WHEREAS *the land use planning, environmental assessment and permitting process determines when impacts from development on ecosystems are appropriate; and*

WHEREAS *CVC Watershed Planning and Regulation Policies (April 2010) recommend that "CVC will encourage all planning and permit applications to achieve an ecological gain. Where it has been demonstrated an ecological gain is not feasible, CVC will promote the principle of no net loss of ecological functions and hydrologic functions"; and*

WHEREAS *there is a lack of transparent, consistent and replicable technical guidance on determining what is required to effectively replace ecosystem losses; and*

WHEREAS *based on their expertise and experience, staff have developed a technical guideline that outlines a best practice to compensate for losses to natural features - after the decision to compensate has been made by the approval authority; and*

WHEREAS *in some instances, CVC may accept funds from development proponents to undertake compensation works on their behalf, recognizing they may not have the resources and CVC may be better positioned;*

THEREFORE BE IT RESOLVED THAT *the report entitled "Ecosystem Offsetting Guideline" be received and appended to the minutes of this meeting as Schedule "F"; and further*

THAT *the Board of Directors endorses the CVC Ecosystem Offsetting Guidelines and its implementation/distribution through CVC's Planning and Development Services processes, where appropriate*

THAT *the Board of Directors directs staff to establish a reserve to accept, track and manage cash-in-lieu payments associated with offsetting projects to support CVC's commitment to transparency and accountability;*

THAT *the Board of Directors directs staff to develop a database to track and manage offsetting projects and their associated losses; and*

THAT *the Board of Directors directs staff to provide a report annually on the application of Ecosystem Offsetting in the Credit River Watershed.*

CONTENTS

1 INTRODUCTION 1

1.1 Ecosystem Offsetting and Ecological (Net) Gain 2

1.1.1 Ecosystem Offsetting 2

1.1.2 Ecological (Net) Gain 3

1.2 Setting Principles and Standards 4

1.3 Municipal and Other Public Agency Adaptation 5

1.4 Plan Review and Approval Processes 5

1.5 Purpose and Scope of the Guideline 7

1.5.1 What the Guideline Is Not 7

1.6 Role of Municipalities, CVC and Proponents in Ecosystem Offsetting 8

1.6.1 Municipalities 8

1.6.2 Credit Valley Conservation 8

1.6.3 Private Proponents 9

1.7 Guideline Applicability 9

1.7.1 Exceptions 9

1.7.2 Green Infrastructure 10

1.7.3 Other Compensation or Offsetting Programs 10

1.8 CVC's Principles of Ecosystem Offsetting 11

2 COMPONENTS OF AN OFFSETTING PROJECT 12

2.1 Inventory and Assessment Requirements for Ecosystem Offsetting 13

2.2 Maintaining the Land Base & Natural Heritage System Form 16

2.2.1 Land Base Offsets for Development Projects 16

2.2.2 Land Base Offsets for Public Infrastructure Projects (Authorized under an Environmental Assessment) 17

2.2.3 Land Base for Private Infrastructure Projects 18

2.3 Replicating Ecosystem Structure and NHS Function 18

2.3.1 Offsetting for Trees in Forests, Woodlands and Swamp Communities (with Greater than 35% Tree Cover) 19

2.3.2 Offsetting for Woodland Understory Vegetation, and Vegetation in Communities with Less than 35% Tree Cover 21

2.3.3 Habitat Features and Structures 23

2.3.4 Considerations for Offset Adjustments for Invasive Species 23
3 OFFSET DESIGN AND PLANNING 26
3.1 Developing an Offsetting Plan 27
3.1.1 Offset Design and Planning Considerations 28
3.1.2 Natural Heritage System Function 29
3.1.3 Ecosystem Configuration 31
3.1.4 Ecosystem Connectivity 32
3.1.5 Location of Offset 32
3.1.6 Proximity to Loss 32
3.1.7 Land Availability 32
3.1.8 Land Ownership and Designation 33
3.1.9 Ecosystem Type 33
3.1.10 Project-Specific Requirements 33
3.1.11 Planting trees in communities with less than 35 per cent tree cover ... 34
3.1.12 Use of Understory Vegetation 34
3.1.13 Ecological (Net) Gain 34
3.1.14 Ecosystem Restoration Guidelines and Tools 35
3.1.15 Restoration Services 35
3.1.16 Offset Implementer 36
3.1.17 Considerations for Monitoring and Maintenance 36
3.1.18 Contingency 37
4 OFFSET DESIGN REVIEW AND APPROVAL 38
5 AGREEMENTS 39
5.1 Agreements and Public Agencies as Proponents 40
5.2 Cash-in-Lieu 40
5.3 Transparency and Accountability 41
6 CONCLUSIONS AND RECOMMENDATIONS 42
7 GLOSSARY 43
8 REFERENCES 47

APPENDICES

Appendix A: Considerations for Offset Adjustments for Invasive Species 52
Appendix B: Offsetting Tool Box 55
Appendix C: Calculating Basal Area 58
Appendix D: Individual Tree Replacement Table 61
Appendix E: Area Percentage Charts 62
Appendix F: Offsetting Examples 63
Appendix G: Method for Calculating the Volume of Downed Wood in Vegetation Communities 66
Appendix H: Assessing Wildlife Habitat Features and Structures 70

FIGURES

Figure 1: Mitigation hierarchy 3
Figure 2: Offset and review and approval processes 6
Figure 3: Ecosystem Offsetting Process 12
Figure 4: Progress in the Ecosystem Offsetting Process 26

TABLES

Table 1: Definitions and Descriptions of Vegetation Layers 15
Table 2: Offset ratios based on the basal area of the impacted site..... 20
Table 3: Form for calculating offset for replacing larger trees in sparsely treed vegetation communities based on diameter at breast height (dbh)..... 22
Table 4: Form for calculating offset requirements for woodland understory and vegetation in non-woodland communities (except trees > 5cm dbh) 23
Table 5: Offsetting Discount for Percentage of High Threat Invasive Species by Vegetation Layer..... 25
Table 6: Example of Offsetting Adjustment for Percentage of High Threat Invasive Species by Vegetation Layer 25
Table 7: Natural Heritage System Metrics and their use in Ecosystem Offsetting .. 30

1 INTRODUCTION

Ecosystem offsetting is an approach to offset the adverse impacts of land use change on the natural heritage system through the creation or restoration of natural features.

Increased stress is placed on natural heritage systems and on their ability to provide the same benefits to the population as the Greater Golden Horseshoe region continues to grow. Conservation in an urban context is challenging because of the finite space available to fit all basic needs of communities, including homes, workplaces, amenities, infrastructure and natural features and areas. Issues at a larger scale, such as global climate change, add to the complexity of addressing the local challenges. These pressures should result in increased support for conservation; however, despite a strong protective policy and regulatory regime, natural features and the functions and services they provide continue to decline in some areas within the Credit River watershed and the Greater Golden Horseshoe region.

Within this context, ecosystem offsetting becomes an important tool to help ensure that the critical ecosystem functions and services lost through development and site alteration related activities are restored on the landscape for the betterment of our watershed and its communities. Credit Valley Conservation (CVC) and our municipal partners are dedicated to the protection, restoration and enhancement of the natural heritage system, its features and functions, and the valuable ecosystem services that the system provides to residents. Our agencies' ecological restoration programs and the strong environmental objectives and policies contained in municipal official plans, and in CVC's Watershed Planning and Regulation Policies, clearly demonstrate this commitment.

Compensation for the loss of natural features has been occurring in Ontario for a long time. This compensation has lacked standards or guidance. This lack of guidance has produced long negotiations, inconsistent results, and inadequate compensation for the loss of ecological features and functions. CVC has developed ecosystem offsetting guidelines to improve and streamline the approval process, clarify expectations, and achieve better ecological outcomes for the health of the Credit River Watershed. The guideline provides a consistent, fair and transparent process informed by science and best practices.

This guideline applies only after the decision to offset has been made by the approval authority. Offsetting is often applied to planning and development activities or infrastructure projects that produce losses or impacts on the natural heritage system. The application of offsetting shall be consistent with relevant provincial, municipal and other approval authority natural heritage system planning policies, legislation and regulations. Offsetting may not be appropriate or permitted

in all cases. Proponents are encouraged to consult the appropriate approval authority to discuss the applicability of ecosystem offsetting to your project. These guidelines are intended to ensure offsetting activities remain a last resort and that all efforts for protection on site have been considered before contemplating removals.

1.1 Ecosystem Offsetting and Ecological (Net) Gain

In accordance with the Provincial Policy Statement and Provincial Plans, municipal official plans contain policies for the protection of natural heritage systems, natural features and areas, lands containing natural hazards and water resources. Through the development process, there may be a need to modify, move or remove natural areas on the landscape to achieve overall planning objectives.

Where avoidance and mitigation measures are not possible or financially feasible, offsetting may be considered where the approval authority deems it possible and the plan continues to conform with federal, provincial, municipal and conservation authority requirements. In addition, natural heritage features and areas may be impacted through the construction or expansion of infrastructure through the environmental assessment process – including other development-related activities requiring permitting pursuant to Section 28 of the Conservation Authorities Act.

1.1.1 Ecosystem Offsetting

Municipalities and CVC have used compensation in the past to address unavoidable losses to the natural heritage system. Compensation frequently occurred with little or no guidance to ensure full compensation for the loss. In many cases, the goal of the compensation was to only mitigate impacts to an acceptable level. As a result, these compensation projects typically only partially replaced the lost ecosystem services they remove.

Compensation activities have also been applied inconsistently across the watershed and typically do not address risks and uncertainties associated with impacting complex ecosystems or consider cumulative impacts, climate change, time lag and other unanticipated or unmeasurable impacts.

Alternatively, ecosystem offsetting is a methodical, consistent approach in which adverse impacts on natural features are offset by the intentional restoration or creation of new features - providing positive environmental outcomes of an equivalent or greater magnitude and kind. Offsetting policies and programs have been developed in Canada (Alberta, and British Columbia), the United States and Australia, and have been generating interest in the business community through the development of the Business and Biodiversity Offset Programme (BBOP). Governments and agencies in Ontario are currently exploring, developing, or adopting offsetting approaches (City of Pickering, Toronto and Region Conservation

Authority, Lake Simcoe Region Conservation Authority, and the Province's *Considerations for the Development of a Wetland Offsetting Policy for Ontario*).

Offsetting activities are typically embedded within the mitigation hierarchy (Figure 1) where the offsetting phase of the sequence is considered only after a thorough assessment of impact avoidance, minimization and mitigation alternatives have been considered and where policy permits.

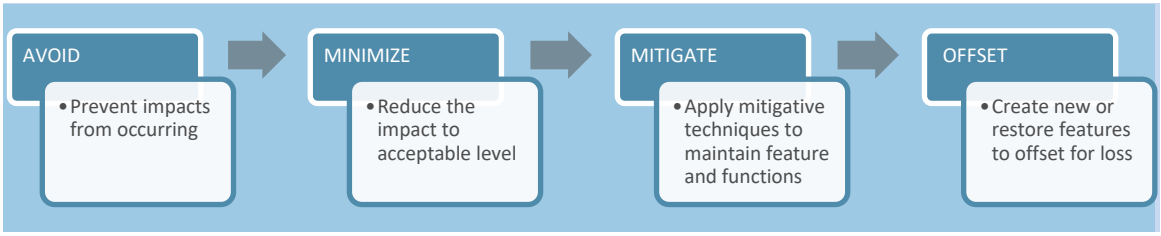


Figure 1: Mitigation hierarchy

In updating official plans and other environmental policies, some municipalities and agencies have included provisions that address limited instances where impacts to natural heritage features and areas may be permitted on condition that appropriate mitigation or offsetting be provided. Credit Valley Conservation recognizes that impacts on natural heritage features and areas, in specific circumstances, may be permitted through the planning and development processes – consistent with federal, provincial, municipal and CVC policy.

1.1.2 Ecological (Net) Gain

Credit Valley Conservation continues to use a "protection first" approach to natural heritage protection and management. The development of this guideline does in no way diminish CVC's commitment, or the commitment of its member municipalities, to the protection of the natural features, functions and services of natural heritage systems.

As planning and development activities occur throughout CVC's watersheds, we strive to ensure positive environmental outcomes by implementing the concept of ecological (net) gain:

> *"CVC will encourage all planning and permit applications to achieve an ecological gain. Where it has been demonstrated an ecological gain is not feasible, CVC will promote the principle of no net loss of ecological functions and hydrologic functions." (CVC Watershed Planning and Regulation Policies April 2010)*

Each natural area provides a specific set of ecological functions and services related to the natural area's ecological composition and structure. Offsetting programs as a principle recommend that offsetting should strive to achieve some equivalency

between the ecological conditions and functions at the development and offset site to achieve no net loss in ecological form and function, and preferably an ecological (net) gain. It is recognized that this is challenging due to the unique conditions at each site, so characteristics and functions will need to be identified and prioritized. Two priority considerations for offsetting in the Credit River watershed are to create an ecological community similar to what was lost (like-for-like) and to provide the equivalent land base. CVC also acknowledges there are some circumstances (limited) when greater ecological outcomes can be achieved by creating ecosystem components or functions different from those lost to development. The decision to deviate from "like-for-like" offsetting should be guided by large scale environmental reports and a thorough technical analysis.

Land Base Offsetting

The overall size of a natural heritage system and its features determines what ecosystem functions and services the system and the features can provide. Offsetting strives to achieve a net gain in both ecosystem form and function to offset the adverse impacts of development on the natural heritage system. A **land base offset** replaces the land removed from the natural heritage system by a development project. The land base offset is also important to provide a place for the planting of vegetation associated with the offset.

Best practice for deviating from "like-for-like" offsetting is to document the ecological justification, identify objectives, set clear measurable targets, and monitor to inform future offsets.

1.2 Setting Principles and Standards

To date, the application of compensation has resulted in some success at replacing lost natural features and the ecosystem functions they provide. However, there are several challenges, such as the limited availability of land for restoration, the risks and complexities associated with restoration, lengthy negotiations, lack of transparency, inconsistent results and, in many instances, an inability to fully replace the complex ecosystem functions of many natural heritage features and areas.

Some of these challenges are difficult, if not impossible to fully address. However, it is intended that establishing a guideline outlining principles and standards for offsetting will assist in addressing many of them. The principles and standards established in this guideline are intended to ensure offsetting activities remain a last resort and that all efforts for protection on site have been considered before

contemplating removals. Standards of practice can also help ensure that offset projects are adequately financed and successfully implemented for the long term.

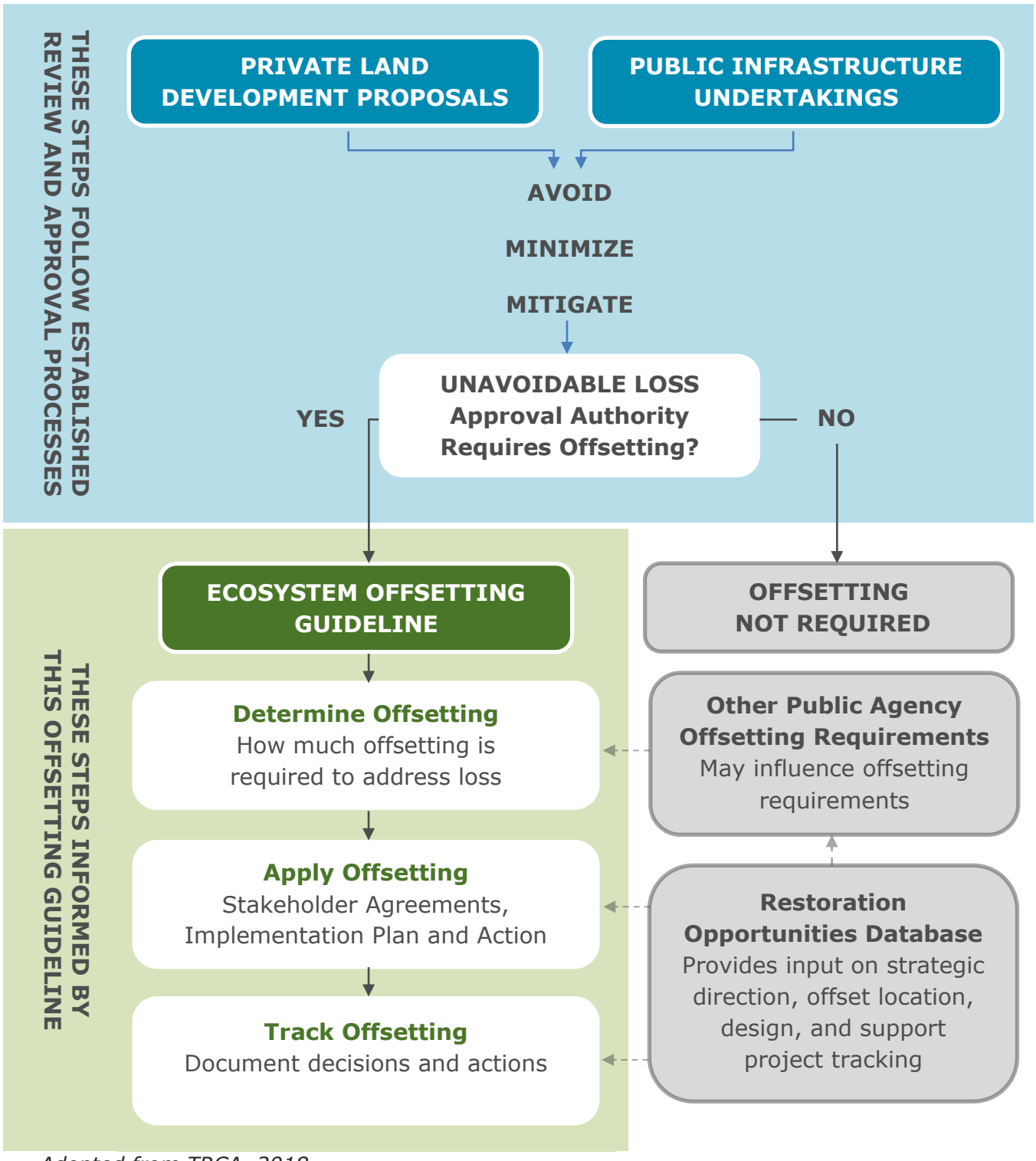
1.3 Municipal and Other Public Agency Adaptation

It is recognized that each municipality has its own unique goals, objectives and policy approaches to ecosystem offsetting. This guideline outlines the key principles and methods needed for improved ecosystem offsetting outcomes, while recognizing municipalities or other public agencies may wish to adapt them to their own needs and/or circumstances.

1.4 Plan Review and Approval Processes

Figure 2 illustrates where ecosystem offsetting fits within the existing plan review and approval processes. In addition, the figure illustrates how this guideline may be a tool for use only after the decision to permit impacts to natural heritage systems, features and areas has been made. It should be noted that CVC's Watershed Planning and Regulation Policies recommends that works within, or modifications to the natural heritage system, features and areas take place at the appropriate stage of the planning and development processes and is supported by an approved environmental assessment, comprehensive environmental study or technical report, as appropriate.

As indicated by the box on the lower left in Figure 2, this guideline has been organized to address each technical aspect of the offsetting approach, from determining what is required to replace the impacted ecosystem, to strategic application of offsetting, to monitoring and tracking outcomes.



Adopted from TRCA, 2018.

Figure 2: Offset and review and approval processes

1.5 Purpose and Scope of the Guideline

The purpose of this Guideline is to guide how to determine the total amount of offsetting required to replace lost or altered ecosystems in a repeatable and transparent manner after it has been decided that offsetting is required through the land use planning or environmental assessment process. As previously stated, offsetting may not be appropriate or permitted under specific policies, legislation and regulations. The Guideline is written to assist planners, ecologists, landscape architects, landowners, other practitioners and interested parties in understanding how CVC recommends approaching offsetting for ecosystem losses. Promoting strategic and effective implementation of offsetting, the Guideline attempts to provide a standard and consistent approach, informed by science and decades of experience in the application of natural heritage planning and ecological restoration.

Ecosystem Structure, Functions and Services

This Guideline determines requirements for replacing the structure and the land base of a natural feature lost to development or infrastructure. Once established and over time, the restored ecosystem structure provides renewed ecosystem functions, which provides the foundation for the provision of ecosystem services. There are a number of risks and uncertainties associated with attempting to replace complex ecosystems. The re-establishment of similar ecosystem functions and associated services is far from certain and can take a significant amount of time. Adhering to the standards in this Guideline (along with long term protection, management, and the passage of time) can lead to the replacement of similar ecosystem functions and services.

1.5.1 What the Guideline Is Not

The Guideline does not provide guidance on when removals are appropriate with associated offsetting. Rather, this determination is made through the planning, environmental assessment or permit processes, and guided by policy addressing offsetting, where such policy exists.

This Guideline does not replace, or in any way negate the requirements of other legislation applicable to impacts to species or ecosystems at the municipal, provincial or federal levels. Protection, and ideally enhancement of the existing natural system remains a primary goal of natural heritage systems planning. The intent of this Guideline is not to weaken this goal or diminish the ability to protect ecosystems in situ.

The Guideline is not suggesting any modifications to the existing planning, environmental assessment or permitting processes leading up to the decision to allow ecological impacts with offsetting. However, the decision will be better informed by the information in the Guideline given that it articulates what is warranted when the decision is made.

This Guideline does not directly address offsetting for aquatic ecosystems, nor does it determine offsetting requirements for stormwater management. Indirectly, this guideline will help offset natural features that contribute to the health and function of aquatic ecosystems. CVC does have other guidelines that are related to hydrologic offsetting and the mitigation hierarchy, including the *Water Balance Guidelines for the Protection of Natural Features* in CVC's Stormwater Management Criteria (2012), and CVC's *Evaluation, Classification and Management of Headwater Drainage Features Guidelines* (2014). The Department of Fisheries and Oceans' *Policy for Applying Measures to Offset Adverse Effects on Fish and Fish Habitat Under the Fisheries Act* (2019) also guides measures to offset impacts to fisheries. In the coming years, CVC will work with other conservation authorities and stakeholders to determine the need for aquatic ecosystem offsetting guidelines.

1.6 Role of Municipalities, CVC and Proponents in Ecosystem Offsetting

1.6.1 Municipalities

Municipalities are the approval authorities under the Planning Act and may or may not have official plan policies, by-laws, or other mechanisms for requiring offsetting or other forms of ecosystem replacements. As approval authorities, municipalities can refuse or approve impacts to natural features as part of a Planning Act application. Once that decision has been made, municipalities share with CVC the assessment of offsetting projects proposed by private development proponents.

As proponents of their municipal infrastructure projects, municipalities may put forward their offsetting projects to replace lost ecosystem structure as described in Section 2.3. Section 2.2.2 of this Guideline speaks to municipal infrastructure projects and special considerations for the lost land base. For all municipal projects affecting CVC Regulated Areas and/or CVC owned or managed lands, municipalities and CVC routinely work together to achieve provincial, municipal and CVC shared objectives for natural heritage systems planning and sustainable communities.

1.6.2 Credit Valley Conservation

As a conservation authority, CVC is a public commenting body under the planning and environmental assessment (EA) processes (delegated by the Province to represent the provincial interest in managing natural hazards) - acting as a resource management agency and service provider to approval authorities through service agreements and/or memorandums of understanding. In its regulatory role,

CVC is the decision-maker for permits issued under section 28 of the Conservation Authorities Act, as well as a landowner and proponent when undertaking works requiring planning and development approvals.

In participating in the review of development applications under the Planning Act and reports under the Environmental Assessment Act, CVC ensures that applicants and approval authorities are aware of any regulatory requirements, where applicable. Further, CVC assists in the coordination of these applications to avoid conflict and unnecessary delay or duplication in the planning and permitting processes. As a proponent of its own projects, CVC may put forward its own offsetting projects to replace lost ecosystem structure and land base.

1.6.3 Private Proponents

As a proponent of private development directed to offset for an impact through the above-noted processes, landowners must be willing to provide and implement an offset project that will adequately address the loss of the impacted ecosystem. The implementation plan must be designed, installed, monitored and maintained in accordance with any conditions or agreements established between the proponent and the public agencies.

1.7 Guideline Applicability

This guideline may be applied to natural heritage features (e.g., forests, woodlands, wetlands, thickets and meadows) and areas within the natural heritage system, or other features that have been determined by the approval authority to require ecosystem offsetting through the review of applications for planning, infrastructure or CVC permitting processes. Restoration or enhancement areas that fall within the natural heritage system, that may not already contain natural heritage features or areas, can also have the land base portion of the guideline applied if determined to require offsetting.

1.7.1 Exceptions

The application of offsetting is determined by the appropriate approval authority and shall be consistent with all applicable policies and exemptions. This guideline is not intended to be applied to small, isolated and/or low functioning natural features or areas where it has been determined their protection can be mitigated and/or is not necessary to meet environmental protection goals and objectives.

Ecosystem offsetting will not be applied to applications that facilitate permitted agricultural uses or the construction of accessory structures (e.g. garages) or a single-family dwelling on an existing lot of record.

1.7.2 Green Infrastructure

Offsetting requirements determined through the use of this Guideline should be applied to the re-establishment of natural ecosystems and not used to install or otherwise improve engineered green infrastructure or community amenities. The Guideline does not apply to individual trees located in parks or along roadsides not associated with natural features.

1.7.3 Other Compensation or Offsetting Programs

For impacts to individual park, yard or street trees, municipalities may have by-laws containing provisions for tree replacements. CVC will continue to support the application of these municipal mechanisms by providing technical guidance in their application, coordinating with municipal staff to avoid duplication, and assist in the development of new or updated by-laws as needed. In this way, the two separate processes of the guideline and individual tree replacement programs work together for a comprehensive approach to restoring losses.

Another mechanism for restoring lost habitat is the Ministry of Environment, Conservation and Parks' (MECP) Overall Benefit Permit (OBP) process under the *Endangered Species Act*. Where an OBP is required, CVC defers to MECP for their requirements under their species-specific permit process. However, there may be cases where a portion of the impact on habitat is offset through one mechanism while the remaining impact is offset through a different mechanism. For example, off-setting required through the *Endangered Species Act* may address impacts to one particular species but may not offset for all of the lost structure and function provided by the impacted ecosystem. In these cases, determining what is required to offset for the remaining impact can be accomplished through the Guideline.

This Guideline does not contain provisions for determining offsetting requirements for the loss of fish habitat and defers to provincial and federal ministries (e.g., Fisheries and Oceans Canada) that direct compensation for impacts to aquatic species and their habitat. For direction on addressing any type of alteration, restoration or removal of a headwater drainage feature, the Evaluation, Classification and Management of Headwater Drainage Features Guideline (TRCA and CVC, 2014) should be used.

1.8 CVC's Principles of Ecosystem Offsetting

The following principles represent the framework and express the intent of this guideline:

1. Consideration for offsetting may only be applicable where it is consistent with the appropriate legislation, regulations and supporting policies and guidelines.

2. Offsetting must follow the mitigation hierarchy of Avoid, Minimize, Mitigate, then Offset. Offsetting should only be applied after a detailed analysis has determined that avoidance, minimization and mitigation of loss is not possible or feasible.

3. The offsetting process should be transparent ensuring accountability of all parties involved.

4. The offsetting process should be consistent and replicable.

5. Offsetting activities should target an ecological (net) gain. Where determined to not be feasible, they should ensure no-net-loss and fully replace the same level of lost ecosystem structure and function in proximity to where the loss occurs.

6. Offsetting should be directed to on-the-ground ecosystem restoration and be informed by strategic watershed and restoration planning.

7. Implementation of offsetting activities should be completed promptly so ecosystem functions are re-established as soon as possible after (or even before) losses occur.

8. The offsetting process should use an adaptive management approach incorporating monitoring, tracking and evaluation to gauge success and inform improvements.

This guide does recognize that there are limits to offsetting and recommends that decision-makers avoid using offsetting to justify the removal of features that are difficult or impossible to replicate due to their complexity, vulnerability, and sensitivity (e.g. bogs and fens). Offsetting for these features is unlikely to replace the functions lost, nor demonstrate a no net loss. Decision-makers should consider this during the planning process and avoid impacts to or losses of these features whenever possible.

2 COMPONENTS OF AN OFFSETTING PROJECT

The offsetting process and the application of this guideline begins with the decision by the approval authority to require offsetting as a condition for the removal of natural features or impacts to the natural heritage system. Figure 3 illustrates the Ecosystem Offsetting Process and directs the user through the various steps in the process and to its location in the guideline.

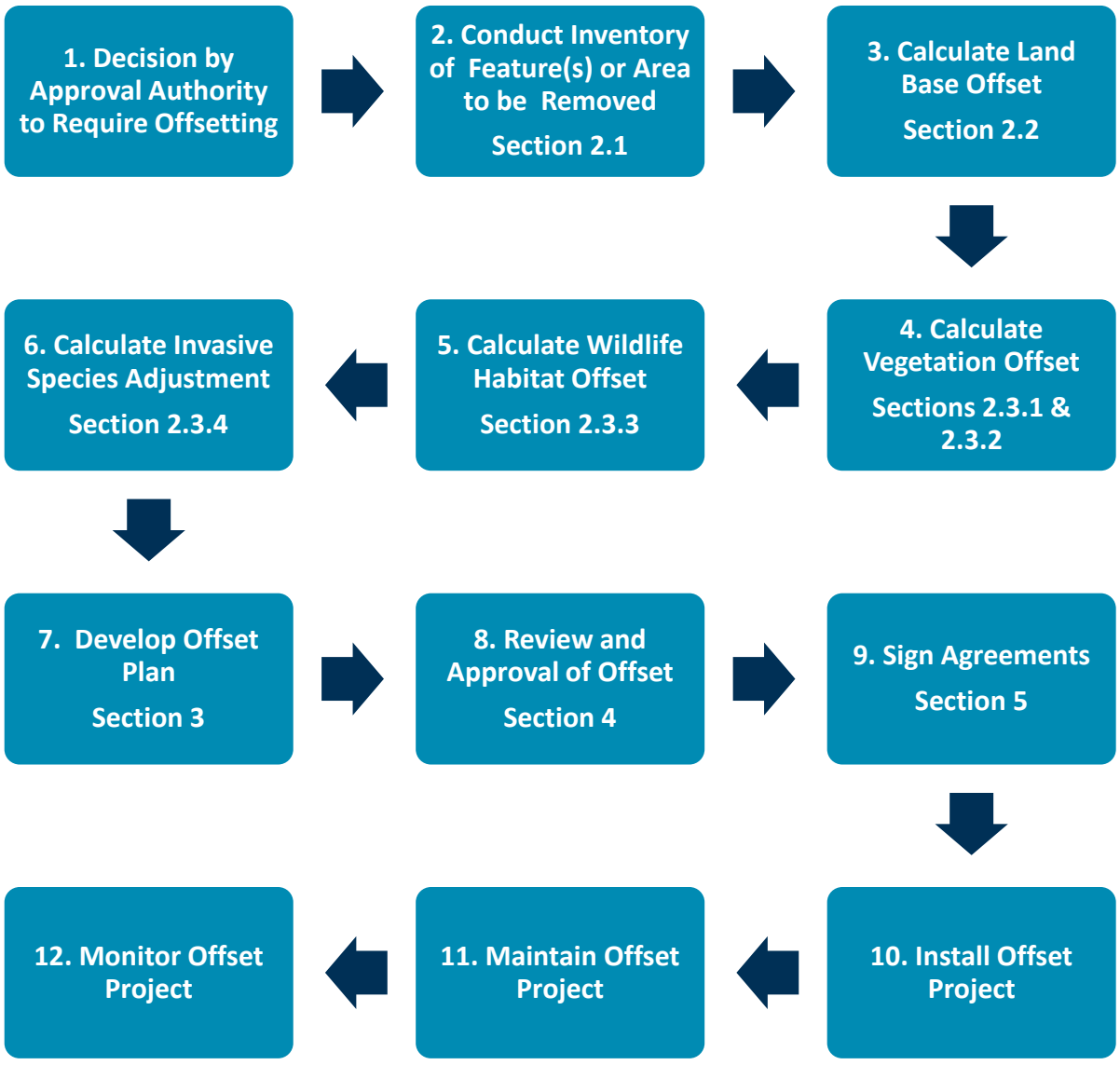


Figure 3: Ecosystem Offsetting Process

Section 2 of the guideline provides direction for the inventory and documentation of the ecological structure, composition and function of the natural feature/area(s) being removed and calculating the amount of land and vegetation that is required to offset that loss.

2.1 Inventory and Assessment Requirements for Ecosystem Offsetting

As ecosystem offsetting strives to achieve a no net loss and preferably an ecological (net) gain, it is essential to have a qualified expert (e.g. ecologist, biologist or forester) conduct a detailed inventory of the natural features and areas to be removed, and their associated functions. The information collected under this section will be used to calculate the amount of offsetting required, guide the design of the offset, and compare the offset to the lost to ensure that there is an ecological (net) gain in ecosystem composition, structure and functions.

In the interest of saving time, the percent cover of the vegetation layers (i.e. canopy trees, sub-canopy trees, tall shrubs, low shrubs, forb and graminoid, floating–leaved aquatic, free-floating aquatic plants, submergent plants, and open water can be estimated based on field observations. Aerial photography can be used to assist with estimations where appropriate, but field surveys are still necessary. These estimations of vegetation cover shall be verified by qualified municipal or conservation authority staff (i.e. ecologist, biologist, or forester).

If cover estimates are disputed, a more quantitative approach, such as the Ontario Ministry of Natural Resources' Vegetation Sampling Protocol (VSP) (Puric-Mladenovic et al., 2010), can be used to resolve the disagreement. The VSP uses a fixed-area method for sampling vegetation types that is practical, easy, and replicable while being scientifically rigorous.

Information required for <u>each</u> vegetation type/community within the feature that is proposed to be removed or impacted:

a. Mapping of the vegetation type's boundaries;
b. Mapping of the proposed area of removal;
c. Classification of community to vegetation type (or Ecosite);
d. Estimation of percent cover (refer to Appendix C of Ecological Land Classification for Southern Ontario (Lee *et al.* 1997) for guidance) and height for each vegetation layer present. Vegetation layers (Table 1) include *canopy trees, sub-canopy trees, tall shrubs, low shrubs, forb, graminoid, floating–leaved aquatic, free-floating aquatic plants, submergent plants, and open water*;
e. List of four most abundant species in each vegetation layer;
f. Complete plant species list with abundance codes for each species in each vegetation layer;

g. Percent cover of each vegetation layer occupied by invasive species, and the percent cover (i.e. None, ≤ 50%, or > 50%) of that vegetation that is high-threat' invasive species
h. Soil classification (texture, moisture, depth of organics);
i. For each treed vegetation type with greater than 35% canopy cover that is going to be removed or impacted, conduct wedge prism sweeps according to the ELC (refer to Appendix D of ELC for guidance), including
    - Basal area of living trees by species;
    - Basal area of dead trees;
j. For each treed vegetation type with less than 35% canopy cover, linear feature or edge, provide a tree inventory plan illustrating the location and diameter of the trees [greater than 5 cm diameter at breast height (dbh)] to be removed;
k. The abundance of downed wood using transects (Appendix G) or plots;
l. Evidence of wildlife habitat structures (cavities trees, dens, nests, hibernacula, roosts, vernal pools, etc.) (Appendix H);
m. Bathymetry/topography for wetlands;
n. Hydrologic characterization for wetlands;
o. Identification of associated watercourses;
p. Identification of hydrologically connected wetlands and watercourses; and
q. An assessment of the natural area's relationship to the natural heritage system. Suggested natural area metrics – size, shape, contribution to interior habitat, proximity or connectedness, matrix quality, patch habitat/species diversity.

Table 1: Definitions and Descriptions of Vegetation Layers

Vegetation Layer	Definition/Description
Canopy Trees	Trees greater than six meters in height whose leaves and branches receive direct sunlight.
Sub-Canopy Trees	Trees greater than six meters in height whose leaves and branches do not receive direct sunlight due to the canopy trees.
Saplings and Tall Shrubs	Trees and shrubs between one and six meters in height
Seedling and Low Shrubs	Trees and shrubs less than one meter in height
Forbs and Graminoids	Forbs are non-woody, broad-leaved plants that are not a graminoid. Graminoids are grass-like, narrow-leaved monocot plants including grasses and sedges
Emergent Plants	Plants that have a photosynthetic surface extending above the normal water level (Lee et al. 1997). Includes cattails, rushes, pickerelweed, bur-reeds, sweet flag, water plantain.
Floating–Leaved Aquatic Plants	Rooted wetland plants with leaves that float on the surface of the water, includes water-lilies, pondweeds, water-shield, etc.
Free-Floating Aquatic Plants	Non-rooted wetland plants that float on the surface of the water, includes duckweeds, watermeals, aquatic liverworts.
Submergent Plants	Wetland plants that normally lie entirely beneath the water, includes coontails, water-milfoils, bladderworts, stonewort.
Open Water	Aquatic communities in permanent water that is generally greater than two meters deep and total vegetation cover is less than 25 per cent (Lee et al. 1997).
Tree	A woody plant usually with a single main stem and capable, under the right conditions, of reaching heights of several meters or more (Lee et al. 1997), examples include Sugar Maple, Eastern White Cedar, ashes, oaks, American Beech, poplars, and birches.
Shrub	A perennial plant often with a multiple woody stem base, examples include Red-osier Dogwood, raspberries, Chokecherry, shrub willows, viburnums, sumacs

Additionally, some information may be extracted from existing comprehensive environmental studies (e.g. EIS, EIR, EIA, etc.); however, additional surveys may be required to gather information specific to the feature or area being removed as determined by the approval authority. Proponents shall consult with the approval authority to determine the scope of the study before study commencement.

2.2 Maintaining the Land Base & Natural Heritage System Form

The overall size of a natural heritage system and its features determines what ecosystem functions and services the system and the features can provide. Larger natural heritage systems are generally more biologically diverse, provide greater levels of ecosystem functions and are better able to withstand the stresses of urbanization and climate change. It is therefore critical to ensure that any losses to the land area of the natural heritage system due to removals be addressed by adding new lands back into the natural heritage system such that the overall physical extent of the natural heritage system is not reduced.

Lands added back into the natural heritage system must be configured in such a way as to improve the overall ecological function of the natural heritage system. Additional direction on land base configuration is provided in Section 3.0.

When replicating the land base for off-site projects, there are two important considerations:

- The offset lands should be located as close as possible to the location of the loss to help ensure the restored ecosystem functions and services remain accessible to the local community. For more guidance see Section 3.1.1. Methods of calculating the land value must consider the cost of securing or acquiring land within the same municipality and sub-watershed as the land removed.
- Secondly, lands secured for offsetting should be located outside of (but connected to) the identified natural heritage system of the municipality so that they can ultimately be added to the system to make up the loss. Securing or purchasing land for offsetting that is already identified as part of the natural heritage system would result in a net loss to the overall area of the natural heritage system.

2.2.1 Land Base Offsets for Development Projects

Approval authorities may require development projects to offset the loss of area of the natural heritage system. Development projects are activities resulting in the creation of a new lot, a change in land use, or the construction of buildings and structures requiring approval under the Planning Act (MMAH, 2014). In addition, development projects may also include activities requiring approvals under other pieces of legislation including, but not limited to, the Conservation Authorities Act

and the Aggregate Resources Act. These projects should, at a minimum, replace the land base removed at a one to one ratio.

Land Base Offsetting

Land removed from the natural heritage system should be offset at a 1:1 ratio.

In other words, one hectare of land removed should be offset by adding one hectare back into the natural heritage system, either on the same site or on another site.

For the purposes of this guideline, development projects do not include activities undertaken by public authorities that create or maintain infrastructure as authorized under an environmental assessment process. For this guideline, there are two approaches to addressing the land base of an offset associated with infrastructure projects. One for public infrastructure projects (2.2.2), and the other for private infrastructure (2.2.3).

2.2.2 Land Base Offsets for Public Infrastructure Projects (Authorized under an Environmental Assessment)

Infrastructure projects are completed by several different public agencies/proponents making a standard approach to land base offsetting difficult. CVC will work with municipal and other public agency partners undertaking infrastructure works to help ensure the land base component of offsetting is appropriately considered. Where municipalities or other agencies have established conservation land acquisition programs, the land base component of offsetting will be addressed comprehensively and not on a project by project basis. Where no conservation land acquisition program is established or the number of projects in the area is limited (e.g. Metrolinx, MTO etc.), land base offsetting should be considered on a project by project basis.

Both investments in infrastructure and the protection of natural heritage systems contribute to the public good. The environmental assessment process for public projects helps to ensure investments in infrastructure minimize impacts to natural features and the functions they provide. However, when impacts cannot be eliminated, offsetting action should be taken to ensure the public benefits provided by the natural heritage system are not diminished.

The requirements for an offsetting project as outlined in the guideline represent the best available practice for the restoration of lost features and for "adding back" to the natural heritage system. In its roles as a public commenting body under the planning and environmental processes, as a regulator, and at times as a landowner,

CVC routinely works with infrastructure providers to seek offsetting to the extent feasible for lost features due to infrastructure projects (new or upgrades) that cannot avoid natural areas, or are already located within them.

The guideline provides guidance to further aid in these review and approval processes by providing a rationale as to why the land base of the natural heritage system is critical to its continued function. The full land base requirements determined by the guideline for a feature lost to infrastructure may not be achievable given that municipalities typically own right-of-way lands sized only to accommodate the infrastructure itself with little surplus land remaining, (see Municipal Infrastructure diagrammatic example in Appendix). In these cases, the land area removed from the natural heritage system from all municipal infrastructure projects can be tracked by CVC and the municipality and compiled together so that cumulative losses to the land base of the natural heritage system can be quantified. Municipalities and CVC can work together to understand how these cumulative losses are impacting the function of the natural heritage system and explore avenues to offset these losses through existing municipal land acquisition and ecological restoration programs or other means.

2.2.3 Land Base for Private Infrastructure Projects

Since private utility companies do not have public conservation land securement programs to offset the losses associated with their activities, this Guideline encourages environmental assessments for private infrastructure projects (e.g. projects carried out by private utility, pipeline and telecommunication companies, etc.) to consider following the same offsetting approach as other types of private development.

Single infrastructure projects that involve the removal of large portions (multiple hectares) of the natural heritage system, or when CVC-owned lands are impacted, may warrant discussions regarding compensating land base on a case-by-case basis.

2.3 Replicating Ecosystem Structure and NHS Function

Ecosystems are complex and dynamic systems. Regardless of the approach to determining the level of offsetting required, attempts to replace lost ecosystem structure and functions will fall short in many instances, at least in the short term. Understanding this limitation, the Guideline establishes an approach that attempts to replicate, to the extent possible and without significant delay or lag time, the same ecosystem structure and associated level of ecosystem functions that are to be lost.

The ability to re-establish generally the same structure in a reasonable time frame is in part dependent on the type of ecosystem being restored. Some functions of

some ecosystem types such as cultural meadows and some marshes can be established relatively quickly since their rate of vegetation growth does not have a significant lag time. This is not to suggest that these ecosystem types are less complex or less important than others, or that restoration of these ecosystems is without risk and uncertainty. It simply recognizes that the vegetation in non-treed ecosystems can be established relatively quickly.

It takes much longer to re-establish treed ecosystems due to their long developmental periods and the limited potential to plant fully grown trees. This Guideline attempts to partially address this issue by prescribing that the loss of a mature forest requires replacement with a larger, young forest.

2.3.1 Offsetting for Trees in Forests, Woodlands and Swamp Communities (with Greater than 35% Tree Cover)

This Guideline uses basal area to establish ecosystem restoration replacement ratios (in hectares) for forests, woodlands, and swamps with greater than 35% tree cover. Basal area is a standard forestry measurement, included in the Ecological Land Classification for Southern Ontario and is a widely used standard practice easily determined using simple equipment (See

Appendix : Calculating Basal Area).

A wedge prism will not be an effective approach in sparsely treed communities (i.e. tree cover less than 35%). This Guideline uses a different approach to assess tree cover in sparsely treed communities (e.g. savannahs, meadows, thickets, some swamps, etc.), go to Section 2.3.2.

For linear infrastructure projects (e.g. roads, pipelines, etc.) where access to the entire vegetation community may not be possible, go to Section 2.3.2.

Basal area is the common term used to describe the cross-sectional area occupied by tree stems. Stand basal area is defined as the total cross-sectional area of all stems in an ecosystem measured at breast height (1.3 m) and expressed as a unit of land area (m^2/ha). In general terms, older and higher functioning treed ecosystems will have a greater basal area. Basal area also loosely equates to and can be used as a surrogate for, biomass of the canopy and sub-canopy trees within a treed ecosystem. Biomass, in turn, correlates to some of the ecosystem functions and services (e.g. carbon sequestration, water management) that a treed ecosystem can provide. Therefore, attempting to re-establish the same basal area in the newly restored treed ecosystem as was lost, helps, in part, to ensure that the same level of some ecosystem functions is maintained.

The objective for treed ecosystems is to re-establish the same level of basal area within 10 years of implementing the offset project. Toronto and Region Conservation Authority has advised that based on the survival and growth rates of their previous restoration projects, it is typical to achieve a basal area of 5 m^2/ha at the 10-year mark. Therefore, as an example, to achieve basal area equivalency at the 10-year mark (5m^2/ha) for an impacted site with an average basal area of 25 m^2/ha, a 5:1 restoration ratio must be used. In other words, 5 hectares of new habitat must be restored for every one hectare removed. For this guideline, the trees to be planted are branched whips at a minimum height of 1.5 – 2.5m. Table 2 (below) is used to determine the offsetting ratios for various basal area categories.

Steps 1 to 5 that follow outline the procedure for calculating replacement ratios.

Table 2: Offset ratios based on the basal area of the impacted site

	Basal area range (m^2/ha)	Average basal area (m^2/ha)	Lag time factor – Basal area of 10-year-old restoration site (m^2/ha)	Offset Ratio
1	0 – 10	5	5	1:1
2	10.1 – 20	15	5	3:1
3	20.1 – 30	25	5	5:1
4	30.1 -50+	40	5	8:1

Procedure for Determining Replacement Ratios with Basal Area

1. Determine the vegetation type(s) for the area being impacted using the Ecological Land Classification for Southern Ontario (ELC) system. If more than one ecosystem type is being impacted, then the vegetation type must be determined for each.
2. Determine the amount (in hectares) of each vegetation type being removed.
3. Determine the basal area for each woodland vegetation type being impacted. (See: Calculating Basal Area). In narrow linear features (less than 30 m wide) or edges of features, a tree inventory plan illustrating the location and diameter of the trees [greater than 5 cm diameter at breast height (dbh)] to be removed is required.
4. Using Table 2, determine the offset ratio for each forest or woodland vegetation type being removed
5. Based on the amount of each vegetation type being removed and the offset ratio for each, determine the total size of the restoration required for each vegetation type.
6. Go to Section 2.3.2 to calculate the offset for the woodland's understory.

In some instances, there may be particular ecosystem functions (e.g. wildlife habitat, topographic, or hydrologic features and functions) provided by the impacted ecosystem that are identified and required through the planning or infrastructure review process to be addressed as part of the restoration implementation. These conditions may influence the ecosystem restoration requirements. Additional information is provided in Section 3 regarding project-specific requirements.

Dead and Dying Trees

For the purposes of the Offsetting Guideline, dead trees are included in the basal area calculations. Dead trees contribute to the function of forested ecosystems in important ways and therefore should be considered in assessing the feature that is being lost. This in turn informs the restoration requirements to replace the lost feature. This is particularly relevant at this time, given that a number of ash trees are dying due to the Emerald Ash Borer.

2.3.2 Offsetting for Woodland Understory Vegetation, and Vegetation in Communities with Less than 35% Tree Cover

The understory of a woodland (forests, cultural woodlands and treed swamps) contains tree saplings, shrubs, seedlings herbaceous vegetation, logs, and fine

woody material that contribute to the ecological and hydrological functions and services provided by our woodlands. The understory represents the future of our woodlands and contributes to the maintenance of biodiversity, soil development, hydrologic functions, and the air quality and climate regulation values associated with woodlands. To achieve a no net loss and preferably an ecological (net) gain, offsetting should account for these components, structures, and functions of a woodland.

Communities with less than 35% tree cover include sparsely treed swamps, shrub swamps, marshes, shrublands (thickets), prairies (including tallgrass savannah and woodlands), meadows, rocklands, bluffs, and beaches. Their functions are defined by the dominance of shrubs, grasses, herbaceous vegetation with some sparse tree cover.

Most of the vegetation associated with communities can be restored without significant issues associated with a time lag (i.e. how long it takes to grow mature trees and the conditions capable of sustaining the flora and fauna associated with mature treed communities). However, a compensation ratio is still used to offset the loss of the larger trees and their services in these communities.

The approach for inventorying trees in communities with less than 35 per cent tree cover is different because, as previously stated, the wedge prism is not an effective method where tree cover is scattered or sparse. For these sparsely treed communities, a tree inventory plan illustrating the location and diameter of the trees greater than 5 cm diameter at breast height (dbh) to be removed is required. A tree inventory plan illustrating the location and diameter of the trees [greater than 5 cm diameter at breast height (dbh)] to be removed should be used in narrow linear features (less than 30 m wide), or edges of features. This plan will provide a count of trees that can be organized into different size classes and placed into Table 3 to calculate the required offset for the loss of those trees. These offsetting ratios were developed based on the i-Tree-Eco analysis model developed by the USDA Forestry Service to help provide relevant, empirical values for some ecosystem services based on tree diameter; these include carbon sequestration and pollution removal.

Table 3: Form for calculating offset for replacing larger trees in sparsely treed vegetation communities based on diameter at breast height (dbh)

DBH Range (cm)	Count	Offsetting Ratio	Offset Required
>5 – 10		1:1	
10.1 – 20		1:3	
20.1 – 30		1:10	
30.1 – 40		1:15	
40.1 – 50		1:20	
50.1 – 60		1:30	
60.1 – 70		1:40	

70.1 +		1:50	
		Total	

Calculating the amount of offsetting required for the woodland understory and non-forest community vegetation relies on the information collected under the Section 2.1 Inventory and Assessment section of this guideline. Section 3.1.1.10 guides the planting of trees to offset for vegetation communities with less than 35% tree canopy cover.

The approach for calculating the amount of vegetation offsetting required for the loss of a forest's understory, or the non-tree component of non-forested communities is based on the following calculation:

Per cent cover of layer at the impact site (e.g. tall shrubs)	X	Area Removed (ha)	X	Recommended Planting Density (#/ha)

Appendix provides area percentage charts to assist in estimating the per cent cover for each vegetation layer.

The recommended planting densities are based on advice from CVC's Ecosystem Restoration Program and through discussions with Foresters from the Ontario Ministry of Natural Resources and Forestry. Table 4 provides a form for calculating the offset requirements for woodland understory and vegetation in non-woodland communities.

Table 4: Form for calculating offset requirements for woodland understory and vegetation in non-woodland communities (except trees > 5cm dbh)

Layer	Cover %	Recommended Planting Density (units per hectare)	Total Area Removed (ha)	Required Offset
	A	B	C	(A x B) x C
Trees (<5cm dbh)		1200		
White Cedar (<5cm dbh)		4350 [a]		
Tall shrubs		2750		
Low shrubs		11000		
Graminoids and Forbs		25 kg		
Emergent		110,000		
Floating–leaved aquatic		110,000		
Free-floating		N/A		
Submergent		110,000		
Open water		N/A		

[a] *Based-on planting density of 1.5 metres on centre.*

2.3.3 Habitat Features and Structures

Natural features and areas provide habitat for our local plants, animals and other organisms and contribute to the health and function of our watershed and ecosystem. These habitats are where they find adequate amounts of food, water, shelter, and space needed to sustain their populations. It is recommended that the impact site be assessed for wildlife habitat features and attempt to replicate these habitat features based on their abundance and distribution at the impact site.

Habitat features of the impact site should have been identified in Section 2.1 Inventory and Assessment, including:

- Cavity trees
- Rock piles
- Basking logs
- Vernal Pools
- Standing water
- Seepage or high water table
- Dead standing trees
- Mast trees (nut-producing)

Appendix H provides a list of references for documents that can assist with the identification of wildlife habitat features and structures.

2.3.4 Considerations for Offset Adjustments for Invasive Species

Invasive species are generally non-native plant, animal or pest species that outcompete native species for resources and dominate space. They may directly kill other species, introduce disease or hybridize with native species. Threats posed by invasive species are now considered one of the most serious threats to global biodiversity, as recognized by the UN Convention on Biological Diversity, the International Union for Conservation of Nature, the Invasive Alien Species Strategy for Canada, and the Ontario Biodiversity Strategy. (CVC, 2018a)

While invasive species pose a significant threat to biodiversity and the health of our environment, they can also provide some important ecological functions and services (e.g. habitat for native species, natural hazard regulation, water cycling, carbon, and nutrient sequestration) particularly in urban areas where there is little remaining natural vegetation.

To recognize the positive functions and the adverse impacts of invasive species, this guideline is adopting a portion of the Habitat-Hectare Approach used in Australia as an offsetting tool (Parkes *et al.* 2003). Offset projects will receive a deduction based on the per cent cover of invasive species at the impact site, and the per cent of that amount that are identified as high threat invasive species. High threat invasive species are those species identified by Donna Havinga and the Ontario Invasive Plants Working Group's Sustaining Biodiversity: A Strategic Plan for

Managing Invasive Plants in Southern Ontario. (2000) as Category 1 or 2 invasive species (Appendix)

To calculate the offset adjustment for invasive species. Based on the data collection record:

1. For each vegetation layer identify the percentage of the area to be removed that is covered by invasive species based on the data collection record (Section 2.1);
2. For each vegetation layer identify the percentage of those invasive species (Step 1) that are high-threat' invasive species (Appendix A);
3. Identify the discount (Table 5) for that vegetation layer based attributes of Step 1 and 2;
4. Subtract the discount from the required offset for the associated strata. An example application is provided in Table 6.

Table 5: Offsetting Discount for Percentage of High Threat Invasive Species by Vegetation Layer

Per cent cover of invasive species of the area to be removed	Per cent of invasive species cover that is 'high-threat' invasive species		
	None	≤ 50%	> 50%
	Discount on Only Vegetation Offset		
> 50%	-11 %	-13 %	-15 %
25–50%	-7 %	-9 %	-11 %
5–25%	-4 %	-6 %	-7 %
< 5%	0 %	-2 %	-4 %

Modified from Parkes *et al.* 2003

Table 6: Example of Offsetting Adjustment for Percentage of High Threat Invasive Species by Vegetation Layer

Layer	Invasive Species Cover (%)	High Threat Invasive Species (%)	Offset Discount by Strata	Before Discount Offset	Final Offset
Canopy trees	0	None	0	0	0
Sub-canopy	15	≤ 50%	-6 %	641	603
Tall shrubs	50	> 50%	-11 %	4450	3961
Low shrubs	0	None	0	0	0
Graminoids and Forbs	45	> 50%	-11 %	40 kg	36
Emergent	0	None	0	0	0
Floating–leaved aquatic	0	None	0	0	0
Free-floating	0	None	0	0	0
Submergent	0	None	0	0	0
Open water	0	None	0	0	0

CVC has developed other tools to suggest approaches to addressing common issues associated with the calculation and implementation of an offset. These tools can be found in Appendix B: The Offset Tool Box. The application of these tools is considered **optional**.

3 OFFSET DESIGN AND PLANNING

Section 2 guided the documentation of the ecological structure, composition and function of the natural feature/area(s) being removed, and the calculation of the amount of land and vegetation that is required to offset that loss. Offset designers and planners should use that information to design an ecosystem creation or restoration project that replicates the ecological structure, composition and function of the natural feature/area(s) removed by the development project. Figure 4 illustrates the progress through the Ecosystem Offsetting Process thus far.

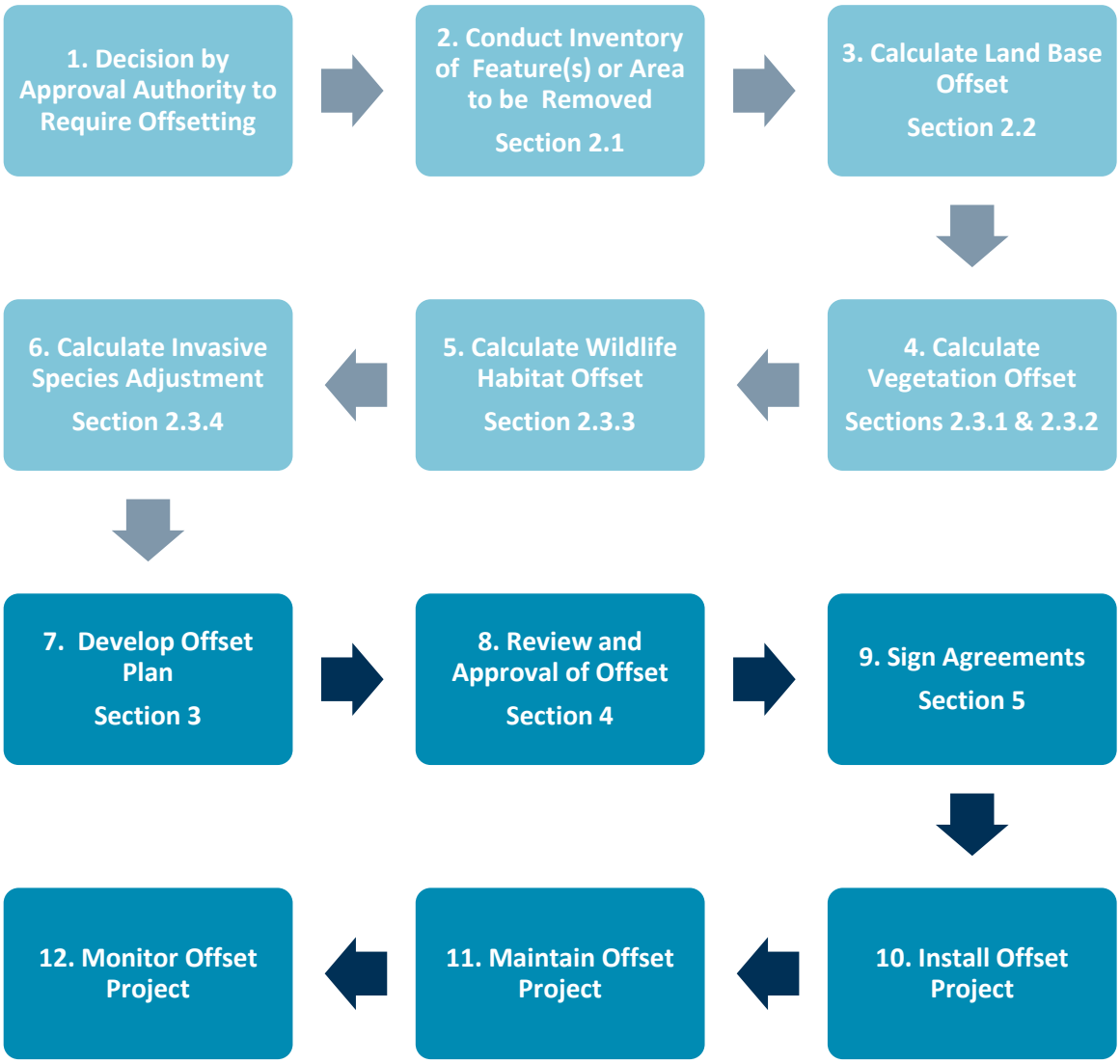


Figure 4: Progress in the Ecosystem Offsetting Process

Section 3 provides suggestions and considerations to help offset designers and planners ensure that the design of an offset adequately replaces the form and function of the lost feature and adheres to the ecosystem offsetting principles.

The guideline provides two approaches to the offset design and implementation process, including:

- a proponent led design and implementation approach, and
- a cash-in-lieu approach for CVC to lead the offset design and implementation.

This cash-in-lieu option helps proponents that may not have the resources to implement offsetting without support.

3.1 Developing an Offsetting Plan

Documentation is essential to successfully designing and implementing an ecological offset project, demonstrating no net loss and an ecological (net) gain, and providing transparency. As such, an offset plan report is required for each offset project. The report shall document the losses to the natural heritage system associated with the development, include calculations of offset requirements, clearly define goals, measurable ecological objectives and targets, and provide an implementation plan including maintenance and monitoring timelines and methods. This report will enable decision-makers to use adaptive environmental management approaches to ensure that we learn from our experiences (i.e. what works and does not work). This approach will provide transparency, improve project outcomes, and produce efficiencies in offset implementation and management.

It is recommended that approval agencies update their Environmental Impact Study (EIS) Guidelines to outline the data required to support the design, implementation and monitoring for implementation of the mitigation hierarchy, in particular, ecosystem offsetting as appropriate.

For each offsetting project, the specific actions proposed to address the required offset must be documented in a report by those implementing the work (or an agent acting on their behalf). The report must document how the offset:

- Adheres to Ecosystem Offsetting Principles (Section 1.8);
- Provides a record and characterization of the features being removed (Section 2.1)
- Replaces the land base (Section 2.2);
- Replaces the lost vegetation communities/type(s) (Section 2.1);
- Adequately compensates for mature trees (Section 2.3.1);
- Replaces understory and shrubs and herbaceous vegetation (Section 2.3.2);

- Replaces the habitat features and functions (2.3.3);
- Provides equal natural heritage system function (2.1.1 and 3.1.1)

In addition, the report must document the following:

- A description of the impacted ecosystem based on the information collected under the guidance of Section 2.1;
- Rationale for the removal of the natural features or area;
- A brief description of the proposed offset location(s) and a rationale for their selection;
- A proposed work plan;
- Detailed design drawings;
- Material costs;
- Equipment and labour costs;
- Construction phasing plan;
- Maintenance and monitoring plan and costs; and
- Any other relevant details as required through agreements between the proponent and the approval authority based on site-specific/file-specific circumstances.

Ultimately, the documentation must show that projects are designed to take advantage of existing site conditions and will provide the agreed to deliverables.

3.1.1 Offset Design and Planning Considerations

Once the appropriate amount of offsetting has been determined and agreed to by the parties involved, the next step is the development and execution of a land securement (if applicable) and ecosystem restoration implementation plan. The execution of the plan will be dependent on the location of the offset and who will complete the works. However, regardless of these, some fundamental considerations apply, including project-specific information, ecosystem restoration principles, and broader CVC or municipal program direction. In addition to the guidelines outlined herein (Section 3.1), CVC has developed several tools to help identify potential restoration sites (e.g. CVC's Restoration Opportunities Database) and guide ecosystem restoration decision making, as referenced in Section 3.1.1.14 of the Guideline.

Offsetting activities should result in a reinvestment into local ecosystem restoration and the lands required for those works and should be guided by strategic watershed and/or natural heritage system management and restoration planning documents and priorities. Offset actions should be directed to new projects (or extensions of existing projects) that require investment and resources.

The following provides considerations to help offset designers and planners improve their design, implementation and outcomes of their ecosystem offsetting project.

3.1.2 Natural Heritage System Function

A natural heritage system (NHS) is a system of connected or to be connected green and natural areas that provide ecological functions over the longer term and to enable the movement of species across the landscape (Ontario Ministry of Natural Resources, 2010). The primary objectives of the natural heritage system are to protect, restore, or enhance the ecological and hydrological health and function of the Credit River watershed.

The natural heritage system assessment and metrics produced under Section 2.1 will help planners and designers understand the relationship of the feature to the system. That assessment should have identified the function of the natural area within the context of the NHS (e.g. core, corridor, steppingstone, buffer) and its metrics (Table 8). Offset designers and planners should use these metrics to ensure that the offset provides equal or greater quality function within the natural heritage system.

Offsetting should strive to provide at least an equivalent quality and quantity in both form and function. The size of the offset should not be compromised for improved function, as the size of the natural heritage system is critical to the function of the system. Ecosystem form and function are both important, and both need to be addressed adequately in the design of the offset.

Table 7: Natural Heritage System Metrics and their use in Ecosystem Offsetting

Metric	Impact of Removal	Suggested Remedies for Consideration
Size	Reduces the size of remaining natural area Or Reduces the amount of natural vegetation cover in the catchment or subwatershed	• Add offset back to the remaining natural area in a different location, • Add to another higher functioning natural area within the same catchment or subwatershed, or • Consider increasing compensation ratio
Shape	Negatively affects the shape of the remaining natural area	• Use the offset to improve the shape of the remaining natural area in a different location, or • Improve the shape of another higher functioning natural area, • Consider increasing compensation ratio
Interior habitat Habitat that is 100 meters from the edge	Reduces the amount of interior habitat	• Use the offset in a different location to restore the interior habitat of the same natural area • Use the offset to increase the interior habitat of another higher functioning natural area, or • Consider increasing compensation ratio
Proximity to other natural areas	Increases the distance between the natural area to other natural areas	• Reduce the distance between these natural areas in a different location • Improve the proximity or connectivity of another higher functioning natural area, or • Consider increasing compensation ratio
Corridor	Negatively affects a corridor or linkage within the provincial, regional or local natural heritage system	• Improve the quality of the same corridor in a different location • Improve the quality of a different but similar corridor

Metric	Impact of Removal	Suggested Remedies for Consideration
		• Improve the quality of a higher priority corridor • Construct an eco-passage, or • Consider increasing compensation ratio
Proximity and relationship to hydrologic features or areas	Negatively affects associated wetland, watercourse, recharge area, discharge area, or floodplain	• Use the offset to restore or enhance the same hydrologic feature or area • Use the offset to restore or enhance a different, but similar hydrologic feature or area in the same catchment or subwatershed, or • Consider increasing compensation ratio
Matrix quality	Negatively affects the matrix quality for the remaining or adjacent natural areas	• Locate the offset within 2 km of the loss, preferably towards the NHS • Improve the proximity or connectivity of the remaining or adjacent natural areas, or • Consider increasing compensation ratio
Habitat and species diversity	Reduces the diversity of the habitats or species of the remaining or adjacent natural areas	• Use the offset in a different location to restore the habitat and/or species diversity of the same natural area, • Use the offset to restore the habitat and/or species diversity of a different higher functioning natural area, or • Consider increasing compensation ratio

3.1.3 Ecosystem Configuration

Ecosystem restoration should be configured in such a way as to improve the size and shape of the natural heritage system, improving both the local ecosystem function and the larger natural heritage system as a whole. Newly restored ecosystems must also be situated to help ensure they are protected from the effects of adjacent land use

3.1.4 Ecosystem Connectivity

When determining the location of restoration areas and land securement, ecosystem connectivity must be considered and maximized to the extent possible; for example, where east-west connectivity could enhance cross-watershed functions.

3.1.5 Location of Offset

Offset projects may be located on-site, off-site, or a combination of both.

On-site	Offset occurs on the same site that the ecosystem impact is taking place;
Off-site	Offset occurs in a different location from where the impact is taking place.

On-site offsetting is preferred as it is in proximity to where the loss occurs; it also removes the complexity of finding new lands in proximity to the loss. Some options to consider allowing on-site offsetting are to adjust alignment (straightening) of rear lot lines, filling in gaps and edges of natural areas, and naturalizing corridors and buffers.

3.1.6 Proximity to Loss

The location of the offset project (both land securement and ecosystem restoration) should be within the same geographic area as the ecosystem that was removed (same neighbourhood, subwatershed, or municipality). This helps to ensure that the restored ecosystem functions and services contribute to the same area. For those circumstances where land acquisition is part of the required offset, the lands to be acquired and the land to be restored do not need to be on the same site. There may be instances where previously identified and secured lands can be restored to address the ecosystem restoration component of the offset and separate lands acquired to address the land base offset component. However, they should both be located within the same geographic area (ideally in the same neighbourhood or subwatershed) as the impacted site. The appropriateness of the location for ecosystem restoration may also be influenced by the requirement to restore a particular ecosystem type or to achieve a specific natural heritage objective.

3.1.7 Land Availability

In highly urbanized watersheds adding lands to the natural heritage system may not always be feasible due to the limited availability of land. In these cases, the municipality, CVC, and the proponent may consider working together to find lands that are perhaps within the natural heritage system but need restoration to compensate for permitted losses. However, this should be the exception to the rule,

given that this scenario would result in a net loss in the amount of land within the natural heritage system. Alternatively, lands can be secured outside of the impacted municipality but within the upper portion of the same watershed, helping to ensure that the downstream municipality will benefit from many of the ecosystem services in the long term.

3.1.8 Land Ownership and Designation

Lands secured for offsetting should be placed in public ownership and designated and zoned in an environmental protection category. They should also be in proximity and preferably contiguous to currently held public lands and be accessible, enabling their effective long-term protection and management.

3.1.9 Ecosystem Type

In most instances, it will be appropriate to restore the same ecosystem type as was lost, e.g., restoring a forest for losing a forest. However, there may be other cases where this is not achievable due to the specific site conditions of the restoration location, or not desirable based on strategic restoration priorities. Site conditions including soil type, drainage, exposure and aspect will dictate which ecosystem types are suitable for a particular location. Additional guidance to help refine the restoration goals and ecosystem type to be restored can be based on the type of restoration that best achieves the natural heritage system strategies and municipal objectives. There may also be site-specific/file-specific circumstances that dictate special technical direction that deviates from a typical "like for like" approach. Nevertheless, in all cases, the type of feature to be restored will be guided by CVC, provincial and municipal natural heritage objectives, restoration programs and strategic ecosystem management priorities.

3.1.10 Project-Specific Requirements

Some offset projects may have specific requirements and deliverables associated with them as part of the offset agreement. These could include restoration of a particular ecosystem type or the need to re-use soil or woody material or perform a plant rescue from the lost ecosystem. In addition, the impacted ecosystem may have been providing a particular function that warrants consideration in the design and implementation of the restoration works. For example, habitat for a particular species or group of species may need to be incorporated into restoration projects to help address the loss of this habitat as a result of the ecosystem removal. These requirements must be adhered to, planned for, and documented through implementation.

3.1.11 Planting trees in communities with less than 35 per cent tree cover

The approach used in Section 2.3.1 (for determining the appropriate offset for larger trees in communities with less than 35 per cent tree cover) uses compensation ratios based on the diameter at breast height of the trees removed. This offset requirement will likely produce more trees than what should be planted at the offsetting site to replicate the feature that was lost (e.g. savannah to replace a savannah). This Guideline recommends planting the approximately the same number of trees (1:1 or 1.5:1) at the offset site as were removed from the impact site to replicate the composition and structure of the lost feature. Over planting the offset site could produce a different community type than what was intended or desired. If there is residual plant material not used at the offset site, then it should be redirected to be incorporated into other natural area restoration projects (see illustrative examples of on-site and off-site offsetting in Appendix) to make up for the functions and services lost to the development.

Frequently, sparsely treed or successional vegetation communities are treated as poor quality woodlands. However, these communities have their unique values and support a unique group of plants, animals and functions. A healthy, functioning natural heritage system should have a diversity of vegetation types and ages. In addition, the successional process helps to build soils and modify site conditions that sustain healthier forests in the long-term. As such, this guideline encourages offset designers to consider replacing what was lost as opposed to converting the offset into forests.

3.1.12 Use of Understory Vegetation

When creating new natural features as part of an offset, the environmental conditions at the offset site are likely going to be hostile (e.g. too much sun, wind, frost, etc.) to the plants typically associated with a forest understory.

As such, this Guideline recommends using the understory vegetation required for an offset to restore older reforestation projects by underplanting plantations, or to help repair damage from invasive species, Emerald Ash Borer, and poor land-use practices or encroachments.

There are other instances and restoration techniques that would allow the understory vegetation to be planted at the same location and time as the trees and shrubs (e.g. planting herbaceous vegetation in sparsely treed swamp).

3.1.13 Ecological (Net) Gain

The principles of offsetting state the offset projects should target an ecological (net) gain. This section offers some suggestions for planners and designers to consider in the design of their project to help achieve an ecological (net) gain.

- Increasing the size of the offset;
- Improving the quality habitat of the offset beyond what is required;
- Improving ecological connectivity or linkages to other natural areas and the natural heritage system;
- Securing other lands beyond those required;
- Connecting the offset to other (different) habitat types to improve habitat and biological diversity;
- Addressing ecosystem stressors outside of those produced by the development;
- Supporting long-term management of the offset beyond what is required under a condition of approval;
- Combining the offset with other restoration projects;
- Implementing measures to protect the function and condition of the offset (e.g. invasive species management, vegetated buffers, hydrologic restoration, fencing, boardwalks).

3.1.14 Ecosystem Restoration Guidelines and Tools

CVC has developed guidelines and tools that can help with the design and implementation of ecosystem offsetting projects, including:

- Healthy Soil Guidelines for Natural Heritage Systems;
- Credit River Watershed Natural Heritage System;
- CVC Fish and Wildlife Crossing Guidelines;
- Plant Selection Guideline – Species List for Planting Plants within the Credit River Watershed;
- Ecological Restoration Strategy and Guidelines [Draft];
- Restoration Cost Calculation Tool [Draft]; and
- Restoration Opportunities Database [Draft].

These draft guidelines and tools will be finalized available shortly.

3.1.15 Restoration Services

CVC has expertise and programs that can help advise, design or implement offset projects, including:

- Reforestation and Naturalization Services;
- Wetland and Stream Management Services;
- Invasive Species Management Services;
- Native Grassland and Habitat Restoration Services;
- Ecological Monitoring Program;
- Land Securement Services; and
- Restoration Performance Monitoring Services.

3.1.16 Offset Implementer

The offset may be installed by:

- The proponent and contractors;
- CVC's Restoration and Management Services;
- Other public agencies (municipalities, provincial or federal); or,
- Non-government organizations (e.g. Ducks Unlimited Canada, Trout Unlimited Canada)

The implementer of the project is responsible for ensuring that the offset project is planned, designed, implemented, monitored and maintained according to approved restoration guidelines and offset requirements stated in the applicable agreements. Roles, responsibilities and timelines should be clearly defined through agreements (see Section 5) between the agency requiring the offset, the proponent, and the implementer.

3.1.17 Considerations for Monitoring and Maintenance

Monitoring outcomes are a critical component of the offsetting process. Regardless of who is implementing the work, it is the responsibility of the implementer to undertake the monitoring and any required remedial actions. The key to achieving the goals of the agreed-upon offsetting plan is ensuring the success of the individual project, which in turn will help guide the improvement of the overall offsetting program over time.

Monitoring should be undertaken at the 1, 3, and 5-year points after construction and or planting is complete, to allow for early detection and correction of any planting or construction failures. Documentation should be uploaded into the CVC Restoration Opportunities Database if implemented by CVC, or provided to the public agency overseeing proponent-led implementation for review.

Monitoring and maintenance of forest offset projects will take longer – the proponent should pay for long term monitoring and maintenance (e.g. thinning if applicable).

Monitoring and maintenance will typically be the responsibility of those undertaking the restoration work. This responsibility will be confirmed and documented as part of the agreements outlined in Section 5. Monitoring reports will be written to document project results. Where projects are not functioning as designed and approved, investigations will be undertaken to understand why. Further, modifications may be required to ensure that the project is successful; the need for these can be stipulated in an agreement and assured through securities held by the public agencies (see Section 5 Agreements). Monitoring and maintenance often

constitutes a learning process that can inform future offsetting decisions and implementation plans.

As a standard best management practice, a 25% planting replacement cost should be built into all project budgets regardless of who is implementing the work. This planting replacement is informed by the experience of the conservation authority and reflects typical restoration replanting rates.

3.1.18 Contingency

The plan shall include a fund to address unforeseen issues that may develop during the implementation of the offset project. Contingency is typically 10 percent of the project's value (excluding the land base costs).

4 OFFSET DESIGN REVIEW AND APPROVAL

CVC Planning and Development Services, with input from the affected municipality(ies) and other relevant agencies, will use the following guidelines to inform and review the design of the proposed offset:

- Ecological Offset Report and Plan;
- Healthy Soil Guidelines for Natural Heritage Systems;
- Credit River Watershed Natural Heritage System;
- CVC Fish and Wildlife Crossing Guidelines;
- Plant Selection Guideline – Species List for Planting Plants within the Credit River Watershed;
- Ecological Restoration Strategy and Guidelines [Draft];
- Restoration Cost Calculation Tool [Draft]; and
- Restoration Opportunities Database [Draft].

As per the usual plan review process, all comments from the CVC technical review team will be conveyed to the proponent by the CVC Planner on the file.

In the instances that the proponent or another public agency will be undertaking the offset project, the approval authority will review the proposed offset project to ensure the intent of the guideline is being adhered to and the quality of the restoration plan is acceptable.

5 AGREEMENTS

Agreements are required after the approval authority has approved the offsetting plan. Agreements will differ from situation to situation, dependent on the offsetting approach applied and on which party will undertake the implementation. Examples of agreements may be within:

- the conditions of draft plan approval for a subdivision,
- a site plan agreement, or
- the commitments of an Environmental Assessment.

Alternatively, there may be a stand-alone agreement for the offset plan signed by all the parties (proponent, municipality and conservation authority). The parties involved in offsetting decisions will ultimately determine the terms and conditions of any subsequent legal agreements. The following are factors to be considered when contemplating agreements:

- Agreements of conditional approval should cite that current costs to restore and current land values (at the time of receipt of the funds) should be used in calculating the offset funds.
- Offsetting funds transferred to a public agency must be applied to the installation of the agreed-upon ecosystem type, including land acquisition (when applicable), helping to ensure the funds are directed to the replacement of lost ecosystem functions and services.
- Funds (when being transferred to a public agency) should be received before the removal of features.
- A timeline for implementation may be determined to ensure the ecosystem is replaced as soon as possible and ideally before the impact occurs.
- If the proponent implements offset actions, a security should be held until the warranty's expiration. Warranty periods will vary but should be consistent with the determined monitoring period. Security amounts and holding periods will also vary depending on perceived risks and the complexity of restoration actions. Phased release of securities may be negotiated depending on the nature of the project to ensure development applicants undertake the required offset work.
- If upon review by the senior leadership of the agency issuing the approval it is found that an agreement is not being followed, the proponent will be provided with written notice to bring the project into compliance by a specified date.
- If the project is not brought into compliance by the specified date, the proponent will be advised in writing and the agency staff may cash the security and use the funds to undertake the necessary work. This ensures

that the appropriate funding is available should the applicant fail to undertake or complete the agreed-upon offset.

In addition to the considerations listed above, there may be circumstances that warrant additional measures to help reduce risk to an acceptable level. The following provides some possible actions:

- Requiring greater financial securities to support possible mitigation measures and contingencies;
- Requiring financial securities to be held for longer periods to ensure the establishment of newly restored ecosystems;
- Increasing the size of the ecosystem required to be restored; and
- Using CVC to undertake ecosystem restoration, land securement, monitoring and any remedial works required.

5.1 Agreements and Public Agencies as Proponents

Securities/letters of credit are generally not applied where the proponent is another public agency such as a municipality. As per current practice, CVC and the public proponent will work together, transparently and consistently, to agree on the best approach to implementing offsetting that meets the principles of the Guideline. Nonetheless, if implementation is being undertaken by a public agency, that agency (municipality, CVC or other) accepts responsibility for the effective implementation and monitoring of the offset works, unless otherwise arranged between agencies. For example, in the case of public-private partnerships, securities may be required.

5.2 Cash-in-Lieu

When an impacted feature cannot be offset on-site and another parcel of land is not readily available off-site, to compensate for the lost land base associated with the impact, the proponent should provide cash-in-lieu that accounts for acquiring land elsewhere to add back to the natural heritage system. The value of purchasing a comparable parcel of land to add to the natural heritage system elsewhere can be determined either through recent comparable sales data (i.e., similarly designated and zoned development parcels with no pre-existing encumbrances, located within 2km of the subject site) by an appraisal or as negotiated where parcels of similar characteristics may already be targeted for acquisition.

Other methods of calculating land costs could be supported, subject to the satisfaction of CVC and/or the appropriate approval authority. In any case, the fair market value of the development site should be determined using generally accepted appraisal principles. Appraisal costs and other fees associated with determining land base replacement costs will be the responsibility of the proponent.

In the instances that CVC or another public agency implements an offset project, private proponents provide funds to CVC or the public agency instead of undertaking the offset project themselves. The amount of the cash-in-lieu is based on the cost to restore the impacted ecosystem's structure (Section 2.3), replace the land base (Section 2.2), and to monitor and maintain the project according to the conditions of the permit and/or agreement.

5.3 Transparency and Accountability

As part of our commitment to transparency and accountability, CVC will establish a financial reserve to manage and track funds associated with offset projects and a database to track the location and status of those projects. Staff will provide a report to the Board of Directors every three years on the application of offsetting in the Credit River watershed.

6 CONCLUSIONS AND RECOMMENDATIONS

This Ecosystem Offsetting Guideline presents a consistent approach for replacing natural features lost to development, site alteration, or infrastructure projects after the decision to offset has been made by the appropriate approval authority.

The Guideline provides an approach to natural heritage system planning and management that provides flexibility while meeting provincial and municipal planning policy requirements. This approach can produce better development and ecological outcomes if all of the guidelines are followed.

The successful implementation of these guidelines will require a collaboration between the proponent and an integrated team of planners, ecologists, restoration specialists and other technical experts depending on the nature of the offset project. These Guidelines should be updated as CVC, municipalities and proponents gain more experience from the design, implementation and monitoring of offset projects. Other tools and products will be produced to improve the efficiency and effectiveness of offsetting projects in the future.

7 GLOSSARY

Conservation Banking	A conservation bank is a parcel of land managed for its conservation values. In exchange for permanently protecting the land, the bank owner is allowed to sell credits to parties who need them to satisfy legal requirements for compensating for the environmental impacts of development projects. (Carroll et al. 2008)
Ecological (Net) Gain	a working principle by which CVC strives to build upon natural features and areas requiring protection under CVC, municipal or provincial policy, and enhances or restores the ecological functions and hydrologic functions of the natural heritage system in both the short term and long term as a result of the approval of an application. Enhancements or restoration may include, but are not limited to, on-site and off-site works that will result in one or more of the following: a) increases in the spatial extent of the natural heritage system; b) increases in biological and habitat diversity; c) enhancement or restoration of ecological functions and hydrological functions; d) enhancement or restoration of wildlife habitat; e) enhancement of natural succession; f) creation of wetlands, water systems or woodlands; g) enhancement or restoration of riparian corridors; h) enhancement or restoration of groundwater features; and i) establishment, enhancement or restoration of linkages between natural features and areas. (Credit Valley Conservation, 2010)
Ecological Land Classification System for Southern Ontario	The Ministry of Natural Resources and Forestry's Southern Ontario system of classification of lands from an ecological perspective; an approach that attempts to identify and classify ecologically similar areas; published in 1998, and as may be updated from time to time.
Ecological Restoration	The process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. - Society for Ecological Restoration

Ecosystem Function	The natural processes, products or services that living and non-living environments provide or perform within or between species, ecosystems, and landscapes. These may include biological, physical, and socio-economic interactions.
Ecosystem goods and services	The benefits to humans and other species, provided by nature.
Ecosystem structure	The biotic (living) and abiotic (non-living) form and composition (e.g. dominant plant species, size of vegetation, soil type and topography) of ecosystems that give each ecosystem its definition and function.
Green infrastructure	Natural vegetation, vegetative technologies, soil in volumes and qualities adequate to sustain vegetation and absorb water, and supportive green technologies that replicate ecosystem functions and that collectively provide society with a multitude of environmental, social and economic benefits.
Headwater Drainage Features	Ill-defined, non-permanently flowing drainage features that may not have defined bed or banks; they are zero-order intermittent and ephemeral channels, swales and rivulets, but do not include rills or furrows. Headwater drainage features that have been assessed through CVC's Evaluation, Classification and Management of Headwater Drainage Features Guideline, as "protection" and "conservation" are subject to CVC's Regulation; those assessed as "mitigation" may be subject to CVC's Regulation.
Invasive plants	Non-native floral species which displace native species, dominate ecosystems and impact ecological integrity and ecosystem services for humans.
Lag Time	In the context of this Guideline, lag time refers to the time required for a newly restored ecosystem to reach a similar level of function as the impacted ecosystem it is attempting to replace.
Land Base Offset	Land that is provided by a development proponent as an offset to replace the land removed from the natural heritage system by a development project. The land can be provided on the same site or a different site as where the development is to occur. Land is replaced at a one to one ratio; in other words, the replacement

	area is equal to the area removed by the development.
Low shrubs	*Rubus sp*. (Raspberry), *Spiraea alba* (Narrow-leaved Meadowsweet), *Clematis virginiana* (Virgins Bower), *Cornus canadensis* (Bunchberry), *Euonymous obovatus* (Running Strawberry Bush), *Menispermum canadense* (Canada Moonseed Vine), *Rhamnus alnifolia* (Alder-leaved Buckthorn), *Ribes americanum* (Wild Black Currant), *Ribes cynosbati* (Prickly Gooseberry), *Ribes triste* (Swamp Red Currant), *Rubus pubescens* (Dwarf Raspberry), *Vitis riparia* (Riverbank Grape/Frost Grape). All other shrubs are considered tall shrubs for this document.
Market Value	The most probable price, as of a specified date, in cash, or in terms equivalent to cash, or in other precisely revealed terms, for which the specified property rights should sell after reasonable exposure in a competitive market under all conditions requisite to a fair sale, with the buyer and seller each acting prudently, knowledgeably, and for self-interest, and assuming that neither is under undue duress. (Appraisal Institute of Canada)
Mitigate	The prevention, modification or alleviation of negative effects on the environment. It also includes any action with the intent to enhance beneficial effects.
Mitigation Hierarchy	Avoid, minimize, mitigate, compensate (offset).
Natural Cover	The land occupied by naturally and culturally occurring native or non-native vegetation that is not characterized as agricultural or urban land uses.
Natural Heritage System	Natural heritage system means "a system made up of natural heritage features and areas, and linkages intended to provide connectivity (at the regional or site level) and support natural processes which are necessary to maintain biological and geological diversity, natural functions, viable populations of indigenous species, and ecosystems. These systems can include natural heritage features and areas, federal and provincial parks and conservation reserves, other natural heritage features, lands that have been restored or have the potential to be restored to a natural state, areas that support

	hydrologic functions, and working landscapes that enable ecological functions to continue." (OMMAH, 2014)
No-Net-Loss	A working principle by which CVC strives to balance unavoidable negative impacts on the natural heritage system with replacement of those ecological functions and hydrologic functions on a project-by-project basis so that further reductions to the natural heritage system may be avoided. (Credit Valley Conservation, 2010)
Vegetation Type/ Vegetation Community	An ecosystem as described by its vegetation composition and form. For example, an oak-maple forest. The level of mapping detail for the "Vegetation Type" is defined by the Ecological Land Classification System for Southern Ontario.

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Appendices

Appendix A: Considerations for Offset Adjustments for Invasive Species

Section 2.3.4 provided an approach to recognize both the positive functions and the adverse impacts of invasive species on the ecosystem. This approach provides offset deductions based on the per cent cover of invasive species at the impact site, and the per cent of that amount that are identified as high threat invasive species. High threat invasive species are those species identified by Donna Havinga and the Ontario Invasive Plants Working Group's Sustaining Biodiversity: A Strategic Plan for Managing Invasive Plants in Southern Ontario (2000) as Category 1 or 2 invasive species (below).

High Threat Invasive Species for Adjusting Offset Calculations

Category 1 — Species that exclude all other species and dominate sites indefinitely. They are the top priority for control, but control may be difficult. Plants in this category are a threat to natural areas wherever they occur because they tend to disperse widely (for example, through transport by birds or water).

Scientific Name	Common Name	Effect on Natural Area
*Acer negundo**	Manitoba maple	invades all habitat types
Aegopodium podagraria	Goutweed	dominates forest understorey
Alliaria petiolate	Garlic mustard	dominates forest herb layer
Alnus glutinosa	Black alder	dominates wetlands
Butomus umbellatus	Flowering rush	dominates open marshes
Cirsium arvense	Canada thistle	dominates meadows/prairies and forest edges
Coronilla varia	Crown vetch	dominates meadows
Cynanchum nigrum	Black swallow-wort	dominates meadows and forest edges
Cynanchum rossicum	Pale swallow-wort	dominates meadows and forest edges
Elaeagnus umbellate	Autumn olive	dominates forest edges
Glyceria maxima	Rough manna grass	dominates wet meadows
Hesperis matronalis	Dames rocket	dominates open forest understorey and meadows
Hydrocharis morsus-ranae	European frog-bit	dominates open water habitats
Impatiens glandulifera	Himalayan balsam	dominates forests and wet meadows
Lonicera japonica	Japanese honeysuckle	dominates forest understorey
Lonicera maackii	Amur honeysuckle	invades meadows and forest edges
Lonicera morrow	Morrow's honeysuckle	invades meadows and forest edges

Lonicera tatarica	Tartarian honeysuckle	invades meadows and forest edges
Lonicera xylosteum	Euro. fly honeysuckle	invades meadows and forest edges
Lythrum salicaria	Purple loosestrife	dominates wetlands
Morus alba	White mulberry	hybridizes with rare *M. rubra*
Myriophyllum spicatum	Eurasian watermilfoil	dominates open water habitats
Nymphoides peltatum	Floating heart	dominates open water habitats
*Phragmites australis**	Common reed	dominates wetlands and wet meadows
Potamogeton crispus	Curly pondweed	dominates open water habitats in SW Ontario
Rhamnus cathartica	Common buckthorn	dominates forest understorey/ meadows and prairies
Rhamnus frangula	Glossy buckthorn	dominates wetlands
Rosa multiflora	Multiflora rose	dominates forest edges

** hardy native species that can become invasive given certain conditions*

Category 2 — Species that are highly invasive but tend to dominate only certain niches or do not spread rapidly from major concentrations. Many spreads by vegetative means or seeds that drop close to the parent plant. Most persist in dense populations for long periods. Control where necessary and limit their spread into other areas.

Scientific Name	Common Name	Effect on Natural Area
Acer platanoides	Norway maple	dominates forest canopy
Acer pseudoplatanus	Sycamore maple	dominates forest canopy
Ailanthus altissima	Tree of Heaven	dominates early successional forest
Betula pendula	European birch	dominates open wetlands
Celastrus orbiculatus	Oriental bittersweet	now more common than native C. scandens
Galium mollugo	White bedstraw	invades meadows
Lotus corniculatus	Bird-foot trefoil	dominates meadows and prairies
Lysimachia nummularia	Moneywort	dominates wet forest understorey
Melilotus alba	White sweet clover	dominates meadows and prairies
Melilotus officinalis	Yellow sweet clover	dominates meadows and prairies
Pinus sylvestris	Scots pine	invades meadows
Poa pratensis	Kentucky bluegrass	dominates prairies
Polygonum cuspidatum	Japanese knotweed	dominates wet meadows and moist forests
Populus alba	White poplar	invades meadows

Robinia pseudo-acacia	Black locust	invades meadows
Scilla siberica	Scilla	dominates forest understorey
Syringa vulgaris	Lilac	dominates shallow limestone areas
Ulmus pumila	Siberian elm	invades prairies
Vicia cracca	Cow vetch	dominates meadows and prairies
Vinca minor	Periwinkle	dominates forest understorey

Havinga, D. and the Ontario Invasive Plants Working Group. 2000. Sustaining Biodiversity: A Strategic Plan for Managing Invasive Plants in Southern Ontario. Society for Ecological Restoration – Ontario Chapter. http://chapter.ser.org/ontario/files/2012/08/Sustaining-Biodiversity.pdf Accessed 12 October 2018.

Appendix B: Offsetting Tool Box

The following tools are not a formal part of this Ecosystem Offsetting Guideline. These tools have been developed to offer suggested approaches to address soil conditions, ecological net gain, and ecological services issues that may relate to an offset project. The application of these tools is optional and can be adjusted to meet the needs of an offset project.

1. Soil and Microtopography Recommendation

Offsetting projects are most likely to be implemented on lands previously used for other land-use practices that can produce problems with soil compaction, loss of organic matter, loss of microtopography, and alteration of site hydrology and soil moisture. These impacts on the soil can significantly affect the eventual species richness, diversity and evenness of the restored site.

As a result, this guideline recommends that decision-makers consider incorporating topsoil, leaf litter, and coarse woody debris from the impact site to the offset site to help to address limiting factors associated with the soils. Adding this organic material will also inoculate the site with mycorrhiza fungi, mould, bacteria and invertebrates that are critical to supporting nutrient cycling and soil development and maintenance processes. This approach will also create habitat structure and microtopography to assist in the restoration and maintenance of biodiversity and hydrologic characteristics associated with restoring the ecosystem.

Other practices to help improve soil health can and should be considered when reviewing offsetting plans or determining the required costs.

2. Suggested approach to achieving an Ecological (Net) Gain

The objective of a net gain is that the development leaves the natural environment in a better condition than before the development started (Figure A-1). A net gain should be pursued to address adverse residual and cumulative impacts, inherent risks and uncertainties, and our incomplete understanding of ecosystem functions and services.

The activities to achieve a net gain must produce a measurable and quantifiable ecological net gain in terms of their improvement to the ecological composition, structure and function of the natural heritage system.

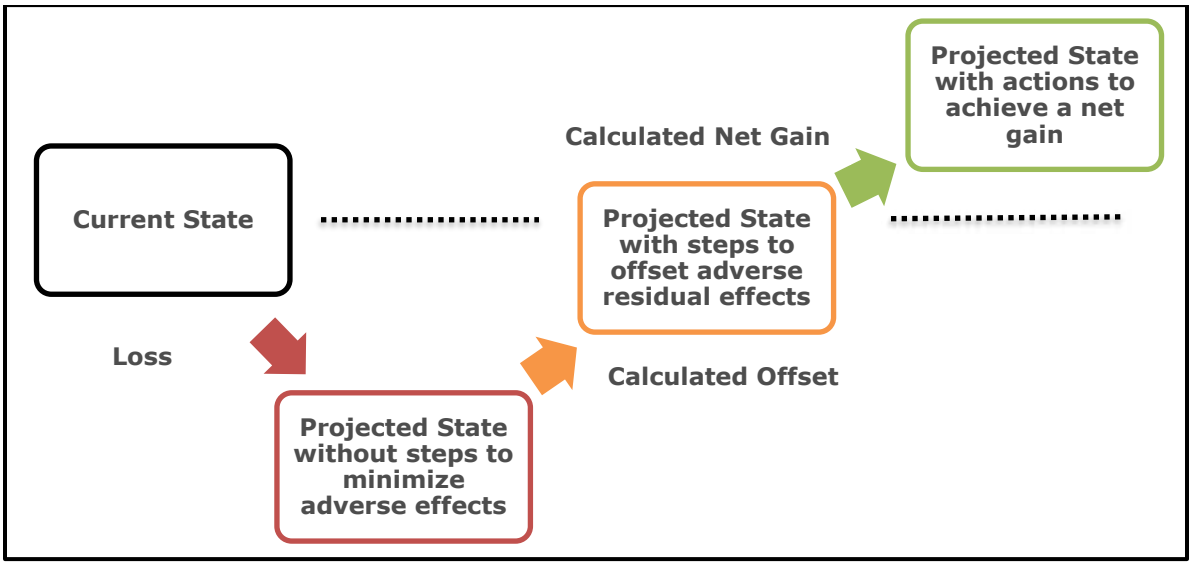
This tool recommends an approach that calculates the required vegetation, labour and materials (i.e. soil, wood chips, stakes, tree guards, etc.) offset for the loss of produced by the development and simply adds 10 percent to the total offset. Ten

percent was selected simply because it is large enough to produce a measurable effect, and not too large as to be unreasonable.

There is no additional offsetting required for the land-based offset (i.e. land base is still 1:1).

Surplus offset vegetation and materials that cannot be applied to the development site will be used in other restoration projects in the municipality or watershed. CVC or municipal restoration or land management programs may be able to assist in the implementation of these surplus offsets.

Figure A-1. Net Ecological Gain Concept



Other approaches that can demonstrate a measurable and quantifiable long-term ecological net gain are appropriate if approved by the agency requiring the offset as a condition of their plan approval or permit.

3. Off-site Offsets and the Loss of Ecological Services

This tool is an optional approach intended to address losses that cannot be offset near the site where the loss occurred, and where it has been determined by the permitting agency that the proposed offsetting plan produces unacceptable residual impacts on the local community or subwatershed.

In most cases, on-site offsetting is the preferred option as it is in proximity to where the loss occurs; it also removes the complexity of finding new lands in proximity to the loss. On-site offsetting should be explored as a priority option before contemplating off-site options. Ideally, the implementation guidance in

Section 3 should be adhered to when determining the appropriateness of on-site offset.

If on-site restoration is not possible, offsetting should be pursued within the same neighbourhood and subwatershed. As last resort, offsets shall occur within the same municipality and watershed (i.e. Credit River watershed). When the offset is located off-site, the municipality may require an Ecological Services Surcharge to mitigate the social impact of the loss on the community.

The Ecological Services Surcharge is calculated based on a percentage of the vegetation component of the offset (Table A-). This surcharge (or its monetary equivalent) will remain with the impacted community and should be used to mitigate the loss of ecological services and quality of life impacts on the local community. Some ideas for applying this surcharge include planting natural vegetation in parks, community centres or near schools, street tree replacement, invasive species management, low impact development projects and or repairing damage to other natural features and areas in the community.

Land base replacement value is not used in calculating the Ecological Service Surcharge.

Table A-1. Ecological Services Surcharge.

Offset Location relative to Loss Location	Ecological Service Surcharge Additional Percent of Required Vegetation Offset
Off-Site - Same Neighbourhood[1] and Catchment[2]	10%
Off-Site - Different Neighbourhood[1] and Catchment[2]	20%
Off-Site - Different Municipality or Subwatershed[3]	50%

[1] Neighbourhood boundaries determined by the impacted municipality

[2] Catchment determined by the Conservation Authority

[3] Subwatershed determined by the Conservation Authority

The values of Ecological Services Surcharge in Table A- are suggested to encourage proponents to address the losses on their properties or locally to avoid or minimize impacts to the community being impacted by the loss. These values can be negotiated between the proponent and the approval agency requiring the offset.

Appendix C: Calculating Basal Area

General guidance on how to perform the basal area calculation can be sought from the Ecological Land Classification for Southern Ontario Field Guide or the Ontario Tree Marking Guide. The following recommendations are provided to standardize the collection and submission of basal area calculations related to CVC's Ecosystem Offsetting.

Please consult with CVC staff before deviating from the ideal data collection recommendations.

- Basal area should be collected from the contiguous ecosystem type (Ecological Land Classification polygon) from which the unavoidable loss or impact to natural feature has been identified.
- Use a BAF 2 metric prism.
- Use fixed area plots in circumstances where the prism provides less accuracy (such as in young plantations or dense hardwood stands where it is not possible to distinguish individual stems).
    - In these circumstances circular plots are recommended; for a 200 m^2 plot the plot radius is 7.99 m.
- A minimum of 3 plots (either prism sweeps or fixed area plots) should be taken within the ecosystem type impacted, with a minimum sample size of 10% coverage.
- Ideally, plots are to be located 40 meters from an edge of the polygon to avoid edge bias. At minimum plots should be located so that they do not solely include the edge of the ecosystem type.
- Ideally, there should be a minimum of 80 meters between sweeps/plots.
- Where appropriate a grid pattern should be used and marked in the office before field data collection.
- The centre of each sweep/plot should be marked on the ground and recorded with GPS, for staff verification, if necessary. This information should be mapped and provided with the data collection sheets to CVC staff.
- Basal area to be recorded by tree species. All dead trees are to be included in the basal area calculation.
- Diameter measurements are to be recorded for all borderline trees. A plot radius table can be used to determine whether the tree is in a plot. A Plot Radius Factor Table can be found in Appendix D of the Ontario Tree Marking Guide.

References:

Lee, H.T., W.D. Bakawsky, J.Reily, J. Bowles, M. Puddister, P. Uhlig and S. McMurray. 1998. Ecological Land Classification for Southern Ontario: First Approximation and Its Application. Ontario Ministry of Natural Resources, Southcentral science Section, Science Development and Transfer Branch. SCSS Field Guide FG-02.

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Basal Area Collection Form

ECOSYSTEM TYPE CHARACTERISTICS	SITE:
	Ecosystem Type:
	DATE:
	SURVEYOR(S):

TREE TALLY BY SPECIES:

PRISM FACTOR

SPECIES	TALLY 1	TALLY 2	TALLY 3	TALLY 4	TALLY 5	TOTAL	REL. AVG

DEAD							
TOTAL							100
BASAL AREA (BA)							

STAND COMPOSITION:

COMMUNITY PROFILE DIAGRAM



Adapted from the Ecological Land Classification for Southern Ontario (Lee et al, 1998)

Appendix D: Individual Tree Replacement Table

When the basal area approach is not suitable for determining offsetting, as may be the case with individual trees where no municipal tree by-laws apply, tree replacement ratios can be a helpful tool. The following provides information on tree replacement ratios as well as typical costing when planting individual trees.

The data collected as part of municipal Urban Forest Studies conducted by TRCA and the i-Tree-Eco analysis model developed by the U.S.D.A. Forestry Service help to provide CVC-relevant, empirical values for some ecosystem services based on tree diameter; these include carbon sequestration and pollution removal. The i-Tree-Eco data, the basal area information used for natural feature offset as well as current municipal tree by-law requirements were all used to inform the suggested tree replacement ratios outlined in Table D-1 below. In general, older or more significant trees are replaced at higher ratios than smaller ones.

Table D-1: Replication Tree (Planting) Ratio by Diameter at Breast Height (DBH)

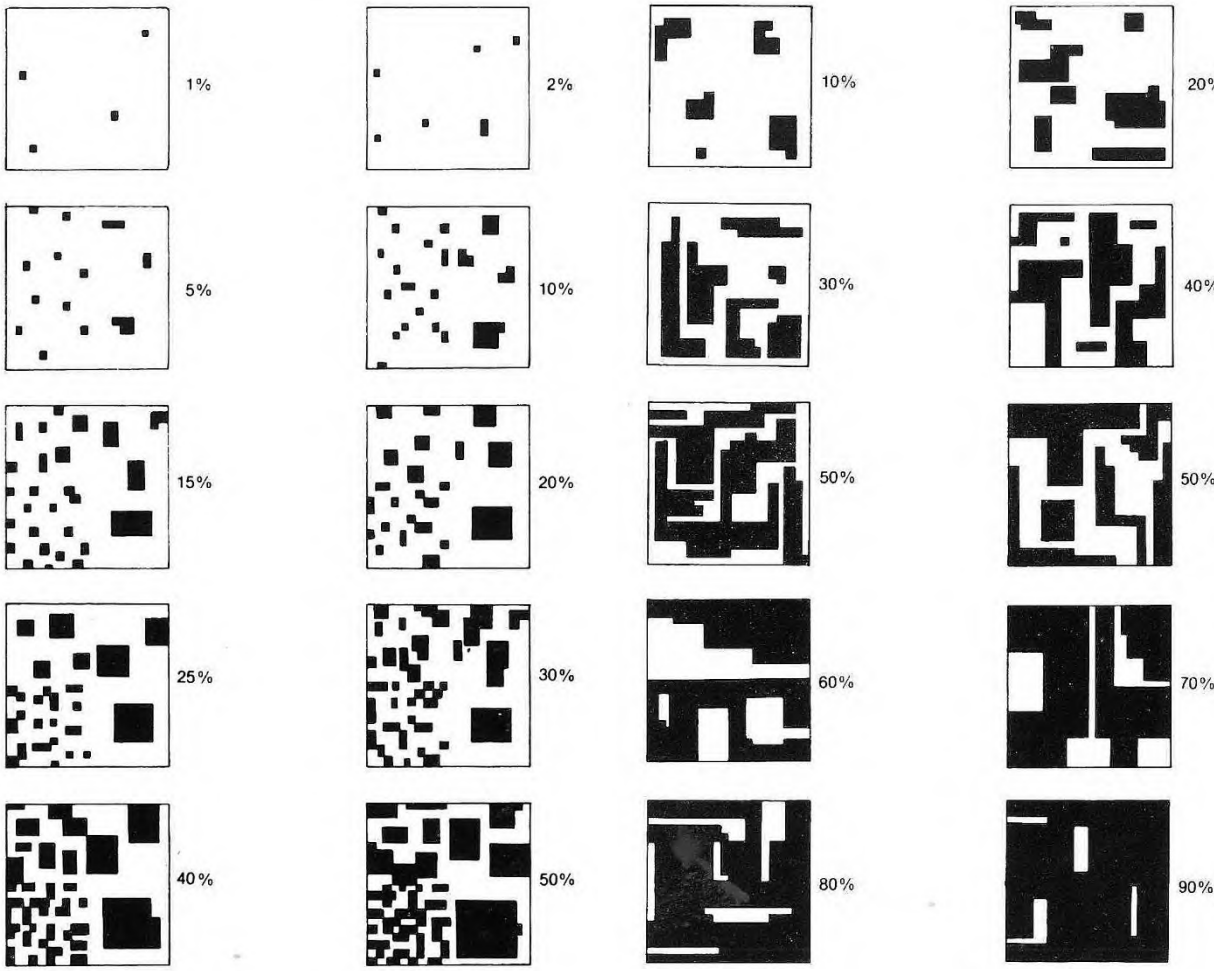
	DBH Range (cm)	Replication Ratio
1	0 – 10	1:1
2	10.1 – 20	1:3
3	20.1 – 30	1:10
4	30.1 – 40	1:15
5	40.1 – 50	1:20
6	50.1 – 60	1:30
7	60.1 – 70	1:40
8	70.1 +	1:50

Improved efficiency would be achieved if a large number of trees would be implemented under one contract. For this Guideline, the following assumptions were made:

1. Replacement of individual trees will have a replacement requirement of minimum 60 mm wire basket calliper tree;
2. Costing will include maintenance and monitoring with a minimum 2-year warranty; and
3. Costing is based on typical industry standards and planting within parkland settings.

Costs associated with these plantings are subject to market changes for fuel, materials, etc., and are therefore not listed. For the most current costs, please contact CVC staff.

Appendix E: Area Percentage Charts

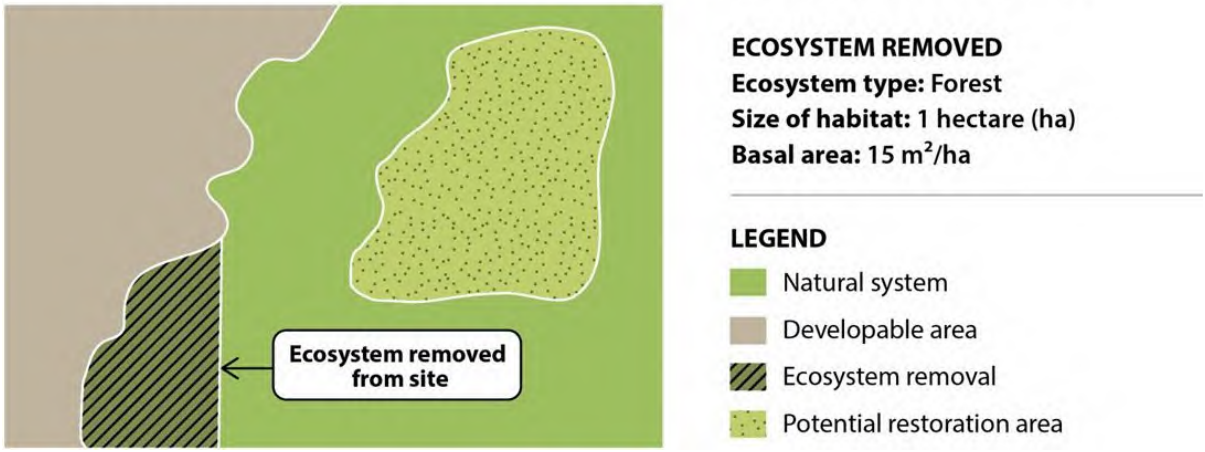


Adopted from Denholm, K. A., L. W. Schut, and D. E. Irvine. 1993. Field manual for describing soils in Ontario, 4th ed. Ontario Centre for Soil Resource Evaluation. Guelph: Land Resource Science, University of Guelph.

Appendix F: Offsetting Examples

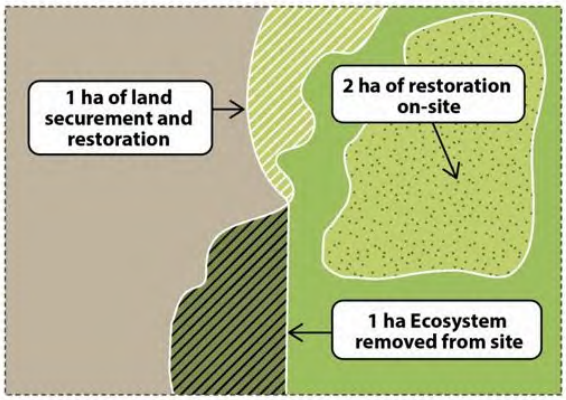
Simple examples are provided in this appendix that helps to illustrate the application of the offsetting approaches described within the Guideline. The examples are not meant to exclude other options of offsetting but to demonstrate some of the more common scenarios.

DESCRIPTION OF THE IMPACTED SITE AND ECOSYSTEM PROPOSED TO BE REMOVED





OPTION 1 - ON-SITE COMPENSATION



ECOSYSTEM STRUCTURE

Basal area of 15 m^2/ha equates to a replacement ratio of 1:3. Total size of ecosystem restoration required = 1 ha x 3 = 3 ha

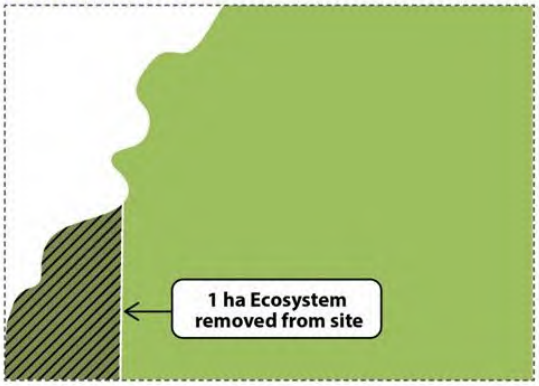
One hectare of restoration can occur on site within the area required to compensate for the lost land base. The remaining two hectares of restoration can occur within the potential restoration area on site.

LAND BASE

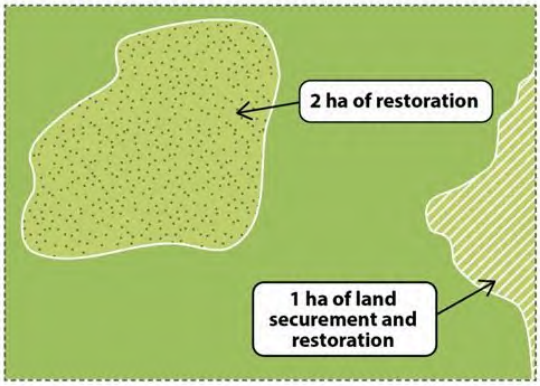
Ratio = 1:1 = one ha removed from the natural system = one hectare added back on the same site
(as illustrated in light green hatching)

OPTION 2 - OFF-SITE COMPENSATION WITH AGENCY-LED IMPLEMENTATION

DEVELOPMENT SITE



OFF-SITE LOCATION



ECOSYSTEM STRUCTURE

Basal area of 15 m^2/ha equates to a replacement ratio of 1:3. Total size of ecosystem restoration required = 1 ha x 3 = 3 ha. If cash-in-lieu option is being used, funds transferred to implementation agency depends on the cost to restore 3 ha of habitat. Cost to restore can be obtained on request.

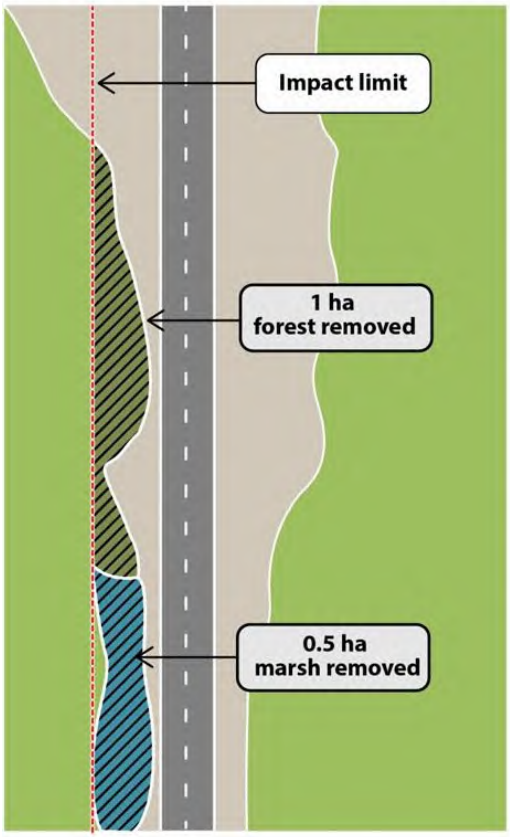
LAND BASE

Ratio = 1:1 = one ha removed from the natural system = one hectare added back off-site. If cash-in-lieu option is being used, land value of one ha determined using guidance from Section 2.2.

TOTAL COST UNDER CASH-IN-LIEU

The total funds to be transferred is the sum of the cost to restore three hectares of habitat and land value for one hectare of land.

MUNICIPAL INFRASTRUCTURE EXAMPLE



ECOSYSTEM REMOVED

Ecosystem type: Forest
Size of habitat: 1 hectare (ha)
Basal area: 15 m^2/hectare

Ecosystem type: Marsh
Size of habitat: 0.5 ha

ECOSYSTEM STRUCTURE

Forest
Assuming a forest basal area of 15 m2/ha, a 3ha:1ha replacement ratio is required. One ha of forest removed requires restoration of three ha.

Marsh
Marsh habitat is restored at a 1ha:1ha ratio. Therefore, 0.5 ha of marsh habitat must be restored to address the removal.

Restoration can occur on site to the extent possible with the remaining restoration being implemented elsewhere in proximity to the impact

LAND BASE

Land base compensation does not need to be addressed on an individual project basis. TRCA and the Municipality can track the land area removed from the natural system from all infrastructure projects and work together to explore avenues to off-set these losses through existing municipal land acquisition and ecological restoration programs or other means.

Appendix G: Method for Calculating the Volume of Downed Wood in Vegetation Communities

The purpose of this document is to provide a standardized approach to collecting Downed Woody Debris (DWD) data to support Ecosystem Offsetting.

Ecosystem offsetting is an approach to offset the adverse impacts of development on the natural heritage system through the creation or restoration of natural features. Offsetting should achieve a net gain in ecosystem function - or at least no net loss where a net gain is not feasible. As ecosystem offsetting strives to achieve an ecological (net) gain or no net loss, it is essential to have a detailed inventory of the natural area to be removed, including its features and associated functions.

Downed Woody Debris provides important ecosystem functions including water retention, nutrient cycling, soil development, carbon sequestration, erosion protection, nurse logs for young trees and important wildlife habitat for a wide range of flora and fauna (Bellhouse and Naylor 1996). Offsetting should account for the functions provided by DWD. For this method downed woody debris includes branches, portions of trees, and entire trees with a diameter greater than 7.5 centimetres (Bellhouse and Naylor 1996).

The protocols within this methodology are based on those established by Credit Valley Conservation's Integrated Watershed Monitoring Program (2018), the Ecological Monitoring and Assessment Network (Robert-Pichette and Gillespie, 1999; Sajan, 2000), those adapted from the USGS (Woodward et. al, 2009).

Equipment

Geographic Positioning System (GPS)
Compass
50-meter measuring tape
Tree callipers or diameter tape
Pigtails with flagging tape

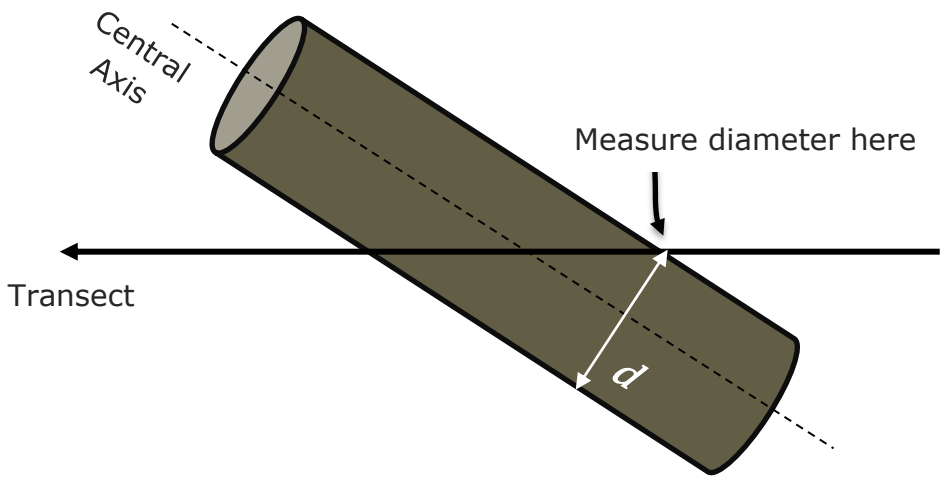
Method

This method should be applied separately to each vegetation community that is being proposed for removal and that is subject to offsetting requirements.

1. Select a representative point in the vegetation community and record the location using a GPS.
2. At that representative point, temporarily anchor the 50 m tape measure using a pigtail.
3. The surveyor runs the entire tape out in the direction of North, ensuring that the tape remains as straight as possible.

4. With the tape left laid out over the entire Downed Woody Debris transect, the surveyor begins walking along the length of the tape until the first piece of applicable downed wood is encountered. Table G-1 reviews the characteristics used to determine if a piece of downed wood is included in surveys.
5. Measure and record the diameter of the piece at the tape interaction point using callipers.

Figure G-1. Measuring the diameter of DWD along a transect.



6. If the transect crosses the end of a piece, tally only if the central axis of the log is crossed.
7. If the transect passes exactly through the end of a piece's central axis, tally every second such piece.
8. Continue along the length of the tape and repeat steps 5-7 for each additional piece encountered along the transect until the surveyor reaches the end of the transect at the 50-meter mark.
9. Repeat steps 2 through 8 along a transect that runs East from the established representative point. This method requires multiple transects to work per community being removed.

Table G-1: Characteristics used to determine if a piece of downed wood is included in surveys (Woodward et. al, 2009).

Characteristic or Situation	Include	Do Not Include
Diameter	7.5 cm or greater	< 7.5 cm
Living material	No	Yes
Roots	No	Yes
Detached bark	No	Yes
Dead stump	Fully uprooted	Fully or partially rooted
Leaning uprooted dead stem	Lean > 45 degrees from vertical	Lean ≤ 45 degrees from vertical
Supported on ground but elevated at tape intersection	The elevation height still allows for other downed wood measurements to be made accurately and safely	The elevation height does not allow for other downed wood measurements to be made accurately and safely
Submerged	Piece is not rooted and downed wood measurements can be made accurately and safely	Cannot determine if piece is rooted and/or downed wood measurements cannot be made accurately and safely

If a single piece of downed wood intersects a transect at more than one distance, treat each applicable stem or branch that crosses the tape as a separate piece of downed wood, regardless of whether or not an attached portion crosses the tape at another distance.

Calculating Volume

The volume (m^3) per hectare of DWD is based on the methods of Van Wagner (1968).

$$V = \frac{\pi^2 \Sigma d^2}{8L}$$

V is the volume of wood m^3/ha

d is piece diameter in centimetres

L is the length of the transect in meters

The results of this assessment provide a measurement of the volume of downed woody debris within a vegetation community. This volume measurement can be used to replicate the DWD functions for an offset project. Designers should incorporate an equal or greater amount of DWD into their offset design.

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Woodward, Andrea, K.M. Hutten, J.R. Boetsch, S.A. Acker, R.M. Rochefort, M.M. Bivin, and L.L. Kurth. 2009. Forest vegetation monitoring protocol for national parks in the North Coast and Cascades Network: U.S. Geological Survey Techniques and Methods 2-A8, 228 p.

Appendix H: Assessing Wildlife Habitat Features and Structures

Section 2.1 of the guideline requires the inventory and documentation of the ecological structure, composition and function of the natural feature/area being removed. Wildlife habitat features and structures are included in that requirement. Inventories of the natural features and areas being removed should document the types of wildlife habitat features and structures present and provide a characterization of each type of feature/structure. The characterization should note the feature/structure type, size, abundance, percent cover, and distribution pattern (e.g. localized or widespread). This information will be used to help design the offset project.

The following documents provide methods on identifying, inventorying and monitoring different types of wildlife habitat features and structures. These documents also offer information to be considered in the design of projects to offset the removal of wildlife habitat features and functions. In addition, these documents provide additional lists of references that may be applicable and useful.

Bird Studies Canada. 2009. Marsh Monitoring Program Participant's Handbook for Surveying Amphibians. 2009 Edition. 13 pp.

Commission for Environmental Cooperation (CEC). 2009. Monarch butterfly monitoring in North America: Overview of initiatives and protocols. Available online: http://www.mlmp.org/Resources/pdf/Monarch-Monitoring_en.pdf Accessed 25 February 2020

Environment Canada. 2013. How Much Habitat is Enough? Third Edition. Environment Canada, Toronto, Ontario.

Konze, Karl and M. McLaren. 1997. Wildlife Monitoring Programs and Inventory Techniques for Ontario. Ontario Ministry of Natural Resources. Northeast Science and Technology. Technical Manual TM-009. 139 pp.

North-South Environmental Inc., Dougan & Associates, and Sorensen Gravely Lowes. 2009. Peel-Caledon significant woodlands and significant wildlife habitat study. Report prepared for the Region of Peel and the Town of Caledon, Ontario, xi + 187 pp + app. Available online at: http://www.peelregion.ca/planning/officialplan/pdfs/Peel-CaledonSW-SWH-Study-Consultation-Summary.pdf Accessed 25 February 2020.

Ontario Breeding Bird Atlas (OBBA). 2001. Guide for Participants. Atlas Management Board, Federation of Ontario Naturalists, Federation of Ontario Naturalists, Don Mills. Available online:

https://www.birdsontario.org/atlas/download/obba_guide_en.pdf Accessed 25 February 2020

Ontario Ministry of Natural Resources. 2000. Significant Wildlife Habitat Technical Guide. 151p

Ontario Ministry of Natural Resources. 2010. Forest Management Guide for Conserving Biodiversity at the Stand and Site Scales. Toronto: Queen's Printer for Ontario. 211 pp.

Ontario Ministry of Natural Resources. 2011. Birds and Bird Habitats: Guidelines for Wind Power Projects - First Edition. Toronto: Queen's Printer for Ontario. 32 pp.

Maine Association of Wetland Scientists Vernal Pool Technical Committee. 2014. Vernal Pool Survey Protocol.

Ministry of Natural Resources. 2011. Bats and bat habitats: guidelines for wind power projects - Second Edition. Toronto: Queen's Printer for Ontario. 24 pp. Available online: https://tethys.pnnl.gov/sites/default/files/publications/Ontario_Ministry_of_Natural_Resources_2011.pdf Accessed 25 February 2020

Ontario Ministry of Natural Resources and Forestry. 2014. Significant Wildlife Habitat Mitigation Support Tool. Peterborough, Ontario. 533 pp.

Ontario Ministry of Natural Resources and Forestry. 2015. Significant Wildlife Habitat Criteria Schedules for Ecoregion 6E. Regional Operations Division, Southern Region Resources Section. Peterborough, Ontario, Canada

Ontario Ministry of Natural Resources and Forestry. 2015. Significant Wildlife Habitat Criteria Schedules for Ecoregion 7E. Regional Operations Division, Southern Region Resources Section. Peterborough, Ontario, Canada

Ontario Ministry of Natural Resources and Forestry. 2015. Significant Wildlife Habitat References. Regional Operations Division, Southern Region Resources Section. Peterborough, Ontario, Canada.

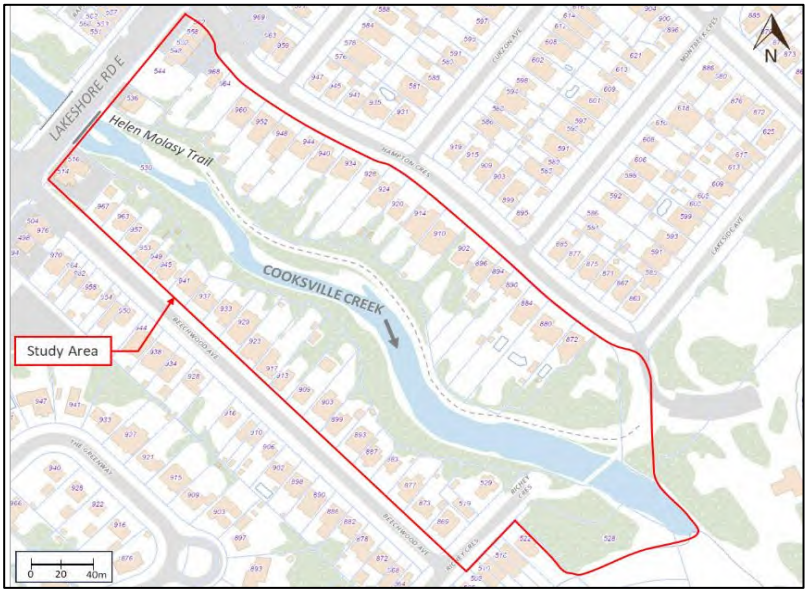
City of Mississauga
Notice of Completion

Municipal Class Environmental Assessment Study:
Cooksville Creek Erosion Control Project – South of Lakeshore Road

Project Background

The City of Mississauga (the City) has completed a Schedule B Municipal Class Environmental Assessment Study for erosion control and restoration of Cooksville Creek south of Lakeshore Road.

The City recognizes that this section of Cooksville Creek has been impacted by recent storm events and high lake levels and is in need of rehabilitation. Plans also considered the deteriorated condition of the adjacent city trail through Helen Molasy Memorial Park that sits above the east bank of the creek, as well as the neighbouring properties which experience ongoing drainage issues.



Study Completion

The Study has examined this section of Cooksville Creek and Helen Molasy Trail along with the associated natural resources to identify existing problems, potential risks, and opportunities for watercourse restoration and drainage improvements.

Through the Class EA process, various alternative solutions were developed and evaluated by the Study Team with input through public and agency consultation. The preferred watercourse erosion control strategy includes extended channel restoration works through the use of vegetated buttress bank protection treatment with embedded armourstone retaining walls. The preferred drainage restoration strategy includes the hybrid drainage solution involving the replacement and enhancement of the drainage infrastructure associated with the Helen Molasy Trail.

A Project File Report (PFR) documenting the planning process has been prepared and will be available for a comment period between **February 24th 2025** and **March 28th 2025** on the City's project webpage:

https://www.mississauga.ca/projects-and-strategies/environmental-assessments/cooksville-creek-erosion-control-south-of-lakeshore-road/

Should a member of the public request a hard copy of the report, the City will make arrangements for delivery of the PFR. If you have any questions or comments regarding the study, please contact the Project Managers listed below by March 28th 2025:

Greg Frew, P.Eng.
City Project Manager
City of Mississauga
300 City Centre Drive
Mississauga, ON L5B 3C1
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Limited
2600 Skymark Avenue
Mississauga, ON L4W 5B2
(416) 705-2367
Amos.R@aquaforbeech.com

City of Mississauga
Notice of Completion

Municipal Class Environmental Assessment Study:
Cooksville Creek Erosion Control Project – South of Lakeshore Road

In addition, a Section 16 Order request may be made to the Ministry of the Environment, Conservation and Parks (MECP or Ministry) for an order requiring a higher level of study (i.e., requiring an individual/comprehensive Environmental Assessment approval before being able to proceed), or that conditions be imposed (e.g., require further studies), only on the grounds that the requested order may prevent, mitigate or remedy adverse impacts on constitutionally protected Aboriginal and treaty rights. Requests on other grounds will not be considered. Requests are to include the requester contact information and full name.

The Section 16 Order request should be sent in writing or by email by March 28th 2025 to both contacts below with a copy to Greg Frew at the City.

Minister of the Environment, Conservation and Parks
Ministry of Environment, Conservation and Parks
777 Bay Street, 5th Floor
Toronto, Ontario M7A 2J3
minister.mecp@ontario.ca

Director, Environmental Assessment Branch
Ministry of Environment, Conservation and Parks
135 St. Clair Avenue West, 1st Floor
Toronto, Ontario M4V 1P5
EABDirector@ontario.ca

This notice signals the Notice of Completion for this Municipal Class Environmental Assessment, a study which defines the problem, identifies/evaluates alternative solutions, and recommends a preferred design in consultation with regulatory agencies and the public. The study has been undertaken in accordance with the planning and design process for Schedule 'B' projects, as outlined in the "Municipal Class Environmental Assessment" document (as amended in 2023), which is approved under the Ontario Environmental Assessment Act.

Personal information is collected under the authority of the Environmental Assessment Act and will be used in the assessment process. With exception of personal information, all comments shall become part of the public records.

This notice issued on **February 24th, 2025**.