Final Environmental Study Report

Schedule C Municipal Class Environmental Assessment

Midtown Creek Flood Ponding Area and Kerr Street Extension - Division Street West to Railway Spur

D.M. Wills Project Number 17-5268

D.M. Wills Associates Limited
Partners in Engineering
Peterborough

November 2018

Prepared for:
Town of Cobourg

Summary of Revisions

Revision No.	Revision Title	Date of Release	Summary of Revisions
1	Draft ESR	05/08/18	Issued for Client Review
2	Final ESR	11/28/18	Issued for Public Review

This report has been formatted considering the requirements of the Accessibility for Ontarians with Disabilities Act.

Executive Summary

D.M Wills Associates Limited was retained by the Town of Cobourg to undertake the Schedule C Municipal Class Environmental Assessment for the Midtown Creek Flood Ponding Area and Kerr Street Extension. The Schedule C Municipal Class EA will follow all five (5) phases of the Municipal Class EA Process.

Historical and recent flooding events along Midtown Creek upstream of the Canadian National Railway (CNR) and Canadian Pacific Railway (CPR) corridor have caused substantial flood damages to private properties in the area of Buchanan Street, George Street and Station Street as well as frequent flooding of the Division Street railway underpass.

The purpose of this project is to assess the available measures for providing flood protection for properties upstream of the CNR and CPR corridor within the Midtown Creek floodplain. This project incorporates the extension of Kerr Street from Division Street west to the railway spur as a means of creating upstream ponding of water during periods of high flows in Midtown Creek.

The identification of alternative solutions was carried out by the Town of Cobourg and the Ganaraska Region Conservation Authority and passed on to Wills for use in this study. The list of alternative solutions includes the following:

- Alternative 1 - Do Nothing
- Alternative 2 - Off-Line Flood Ponding Area Upstream of Kerr Street Right of Way
- Alternative 3 - On-Line Flood Ponding Area Upstream of Kerr Street Right of Way
- Alternative 4 - Increase Capacity of CNR and CPR Railway Culverts
- Alternative 5 - Off-Line Flood Ponding Area Upstream of Division Street
- Alternative 6 - Removal of Flood Prone Structures from Floodplain

Wills completed an evaluation of alternatives and determined that Alternative 3 - On-Line Flood Ponding Area Upstream of the Kerr Street Right of Way was the preferred alternative.

Following the confirmation of the preferred alternative, Wills reviewed eight (8) alternative design concepts which included different combinations of two (2) storage configurations and four (4) different outlet configurations. Following an evaluation of the alternative design concepts, it was determined that the preferred alternative design concept would be: Flood ponding area west of the George Street right of way with an orifice plate (circular or rectangular) control structure.

Wills, the Town of Cobourg and the GRCA undertook three (3) Public Information Centres to consult with the public and sent out notices to agencies requesting feedback. Upon approval of this Class EA, the Town of Cobourg will move forward with the implementation of the preferred alternative design concept.

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1.0 Introduction

1.1 Purpose

The Town of Cobourg has retained D.M. Wills Associates Limited (Wills) to complete the Municipal Class Environmental Assessment (Class EA), Design, Tendering and Contract Administration/Inspection for the Midtown Creek Flood Ponding Area and Kerr Street Extension - Division Street West to Railway Spur.

The purpose of this project is to assess the available measures for providing flood protection for properties upstream of the Canadian National Railway (CNR) and Canadian Pacific Railway (CPR) corridor within the Midtown Creek floodplain. This project incorporates the extension of Kerr Street from Division Street west to the railway spur as a means of creating upstream ponding of water during periods of high flows in Midtown Creek.

This Environmental Study Report (ESR) documents the Municipal Class EA process, including the background environmental inventory, the evaluation of alternatives, selection of the preferred alternative, the identification of potential effects, mitigation measures and monitoring requirements and the public, agency and Indigenous group consultation.

1.2 Background

1.2.1 Midtown Creek

Historical and recent flooding events along Midtown Creek upstream of the CNR and CPR corridor have caused substantial flood damages to private properties in the area of Buchanan Street, George Street and Station Street as well as frequent flooding of the Division Street railway underpass. The Ganaraska Region Conservation Authority (GRCA) has estimated that flood damages will occur for storm events equal to and greater than the 5-year return period peak flow (GRCA, April 2012).

Following the January 25, 2010 flood event, the Town of Cobourg requested that the GRCA investigate opportunities to reduce the risk to life and property damage in the area.

The study completed by the GRCA is documented in the Preliminary Design of a Conceptual Detention Pond on Midtown Creek Report (GRCA, 2011). The Report outlined the existing hydrologic data, identified the target flow rates and documented the preliminary hydraulic analysis of two options, Online Flood Ponding Area and Offline Flood Ponding Area. Based on the analysis presented in the Report, the capacity of the Buchanan Street culvert was selected as the target flow rate for the design of the Flood Ponding Area because its capacity is less than the capacity of the culverts crossing the CPR and CNR corridor. The target flow rate, 4.1 m^3/s, is approximately equal to the 2-

year return period peak flow for Midtown Creek in this area. The GRCA completed a preliminary design for each of the two options proposed in the Report and determined that the Online Flood Ponding Area provided the best attenuation of peak flows for the 5-year to 100-year return periods.

1.2.2 Kerr Street

The Town of Cobourg Transportation Master Plan (TMP) (HDR|iTrans, 2011) suggests that the existing east-west road network in Cobourg will experience capacity or over capacity conditions in the near future. In order to mitigate the expected capacity issues, the TMP recommends that Kerr Street from Westwood Drive to D'Arcy Street be constructed between 2011 and 2021. The proposed section of Kerr Street that is the subject of this report is located within this corridor.

The section of Kerr Street that is the subject of this study consists of a short section of Kerr Street that currently dead-ends approximately 70 m West of Division Street and approximately 300 m of unopened road allowance which was formerly part of the railway corridor.

The Town of Cobourg is currently proceeding with the design, tendering and construction of the extension of Kerr Street from Division Street to D'Arcy Street, which includes a 200 m section of road that was designed by Wills and constructed in 2014. The Municipal Class EA for Kerr Street from Westwood Drive to William Street and Kerr Street from Division Street to D'Arcy Street was completed by AECOM in 2010.

1.3 Study Area

The Study Area generally covers the area north of the CNR and CPR tracks, south of the rear lots of the properties on Ballantine Street, west of Division Street and east of the rear lots of the properties on Sutherland Crescent and Gillett Court. The Study Area includes the light industrial and residential lands fronting on Division Street, Buchanan Street, George Street and Station Street, the Kerr Street Right-of-Way (ROW) and a railway spur that provides access to the rear of the Canada Pallet Company property. Midtown Creek generally flows from north to south through the study area with culvert crossings at Division Street, the railway spur, Buchanan Street, George Street and Station Street and the CNR/CPR tracks. There is currently an open channel through the former railway embankment that is contained within the Kerr Street ROW.

The Study Area for this project is shown in **Figure 1**.

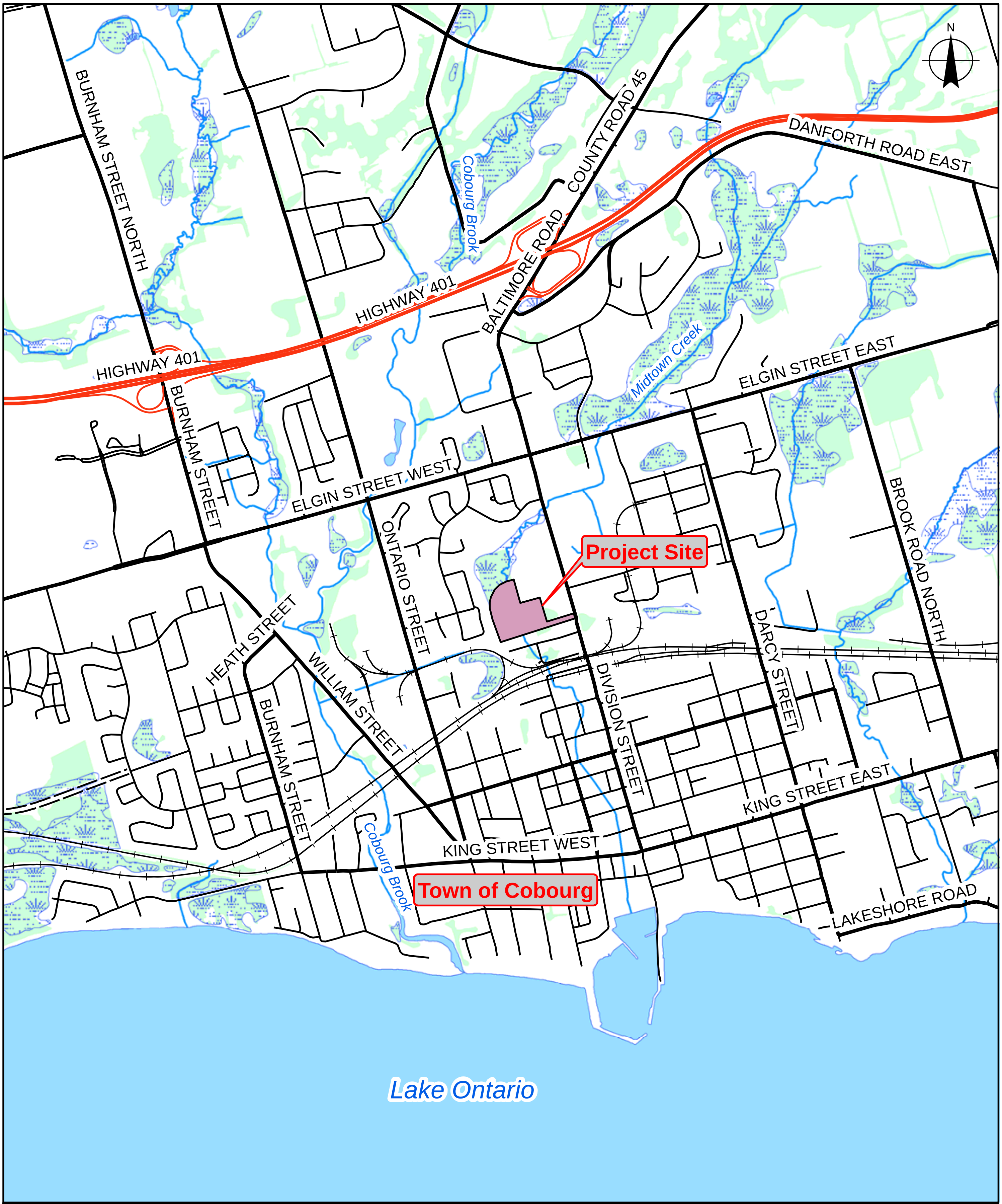

Figure 1: Location Plan

NAD83 UTM Zone 17 North

0 0.15 0.3 0.6 0.9 1.2
Kilometers

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Legend
- ┼ Railway
- ▭ Wetland
- 🟦 Lakes
- — Watercourse
- 🟩 Wooded Area

Drawn by:
DG

Checked by:
DG

Engineer:
DG

Project No.
5268

Scale (Horz.)
1:25,000

Map Date
05/03/18

Map File No.
5268 - LP

1.4 Project Team

The study was carried out under the direction of the Project Team, which was comprised of staff from the Town of Cobourg, Ganaraska Region Conservation Authority and D.M. Wills Associates Limited. Key members of the Project Team include the following individuals:

Barry Thrasher, P.Eng.	Town of Cobourg
Laurie Wills, P.Eng.	Town of Cobourg
David Green, P.Eng.	D.M. Wills Associates Limited
Caitlyn Howe, P.Eng.	D.M. Wills Associates Limited
Diana Keay, MCIP, RPP	D.M. Wills Associates Limited
Mark Spiers	D.M. Wills Associates Limited

Each of the above Project Team members and their respective staff and organizations have contributed to this Environmental Study Report.

1.5 Municipal Class Environmental Assessment Process

The Municipal Class Environmental Assessment (Class EA) was prepared by the Municipal Engineers Association (MEA) on behalf of Ontario Municipalities and approved by the Ministry of the Environment (MOE), now the Ministry of the Environment, Conservation and Parks (MOECP), under the Ontario Environmental Assessment Act (EA Act). The Municipal Class EA focuses on municipal road and municipal water and wastewater projects.

The Class EA process is broken down into the following five (5) phases:

Phase 1: Identification of the problem or opportunity.
Phase 2: Assessment and evaluation of the alternative solutions.
Phase 3: Assessment and evaluation of alternative design concepts for the preferred solution.
Phase 4: Preparation of the Environmental Study Report.
Phase 5: Detailed design, tender, and construction.

These phases are illustrated in **Figure 2**, which is provided as Exhibit A.2 in the Municipal Class EA. The Municipal Class EA designates three (3) project types and the corresponding process requirements for each project type. A list of the project types and general definitions of project requirements, in ascending order of complexity, are described below:

Schedule ‘A’ - Projects are limited in scale, have minimal adverse environmental effects and include the majority of municipal road maintenance, operational, and emergency activities.

- Projects are pre-approved and can proceed without further approval under the EA Act.

Schedule 'A+' - Same as Schedule 'A' except that public notification is required.

Schedule 'B' - Projects that have the potential for some adverse environmental effects.

- Screening process involving mandatory contact with directly affected public and review agencies is required.
- Projects generally include improvements and minor expansions to existing facilities.

Schedule 'C' - Projects that have the potential for significant environmental effects must proceed under the planning and documentation procedures specified in the Class EA document.

- Projects generally include the construction of new facilities and major expansions to existing facilities.

The Municipal Class EA provides guidance on how municipal road and water and wastewater projects are classified. Information related to the Class EA Schedules from the Municipal Class EA relevant to this project includes:

Municipal Road Projects

21. Construction of new roads or other linear paved facilities < 2.4 M (Schedule B)

Municipal Water and Wastewater Projects

17. Works undertaken in a watercourse for the purposes of flood control or erosion control which may include (Schedule B):

- *Bank and slope regrading*
- *Deepening the watercourse*
- *Relocation, realignment or channelization of watercourse*
- *Revetment including soil bio-engineering techniques*
- *Reconstruction of a weir or dam.*

Although the applicable schedules of the Municipal Class EA indicate that the study may be a Schedule 'B', there are special circumstances to be considered, including requiring property, affecting watercourses, removing trees and the community impacts regarding the extension of Kerr Street. Therefore, the Town of Cobourg has decided to proceed with this project as a Schedule 'C' Municipal Class EA.

The filing of the ESR for public review will complete Phases 1 through 4 of the Class EA planning and design process for a Schedule 'C' project. The ESR shall be made available for a minimum thirty (30) calendar day period. A public notice (Notice of Completion) will be published to announce the review period.

The ESR shall be made available for public viewing online at the Town of Cobourg's website (http://www.cobourg.ca) and in person during regular business hours at the Town of Cobourg Public Works Office (740 Division Street, Building 7 Cobourg, ON).

If no outstanding concerns are brought forward during the review period, then the Town of Cobourg may proceed to the Phase 5 implementation stage, i.e. detailed design, tendering, and construction.

If members of the public, agencies, utilities, or stakeholders feel that their concerns have not been addressed through the Class EA process, the Class EA process includes an appeal provision that allows for changing the status of a project from a Schedule 'C' Class EA to an Individual Environmental Assessment. During the thirty (30) day review period, the affected stakeholders may request that the Minister of the Ministry of the Environment, Conservation and Parks make an order for the project to comply with Part II of the EA Act. The Minister shall decide whether to deny the request (either with or without conditions), refer the matter to mediation or require the proponent to comply with Part II of the EA Act.

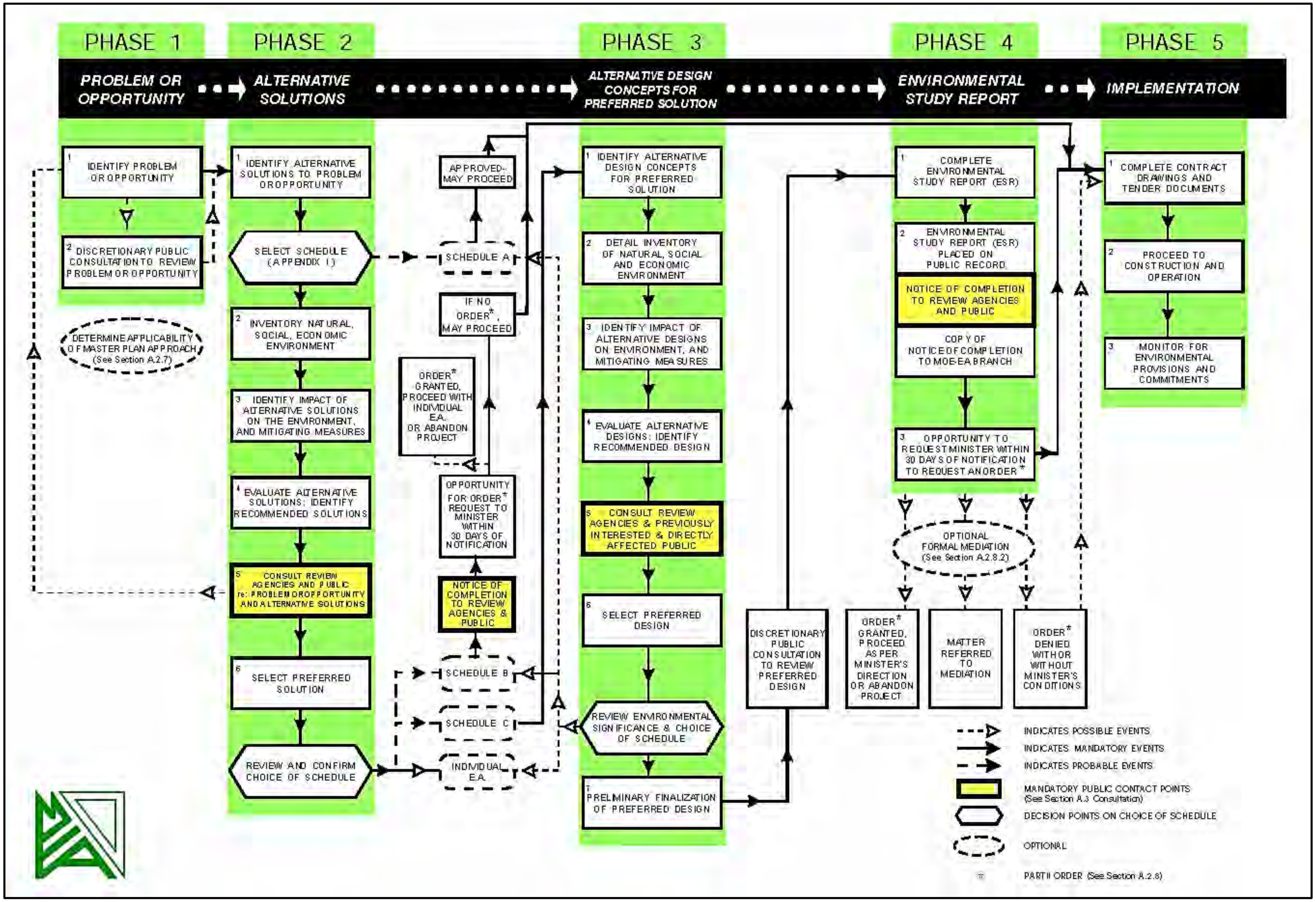
Additional information regarding this appeal process can be found in the Municipal Class EA document. Anyone wishing to request a Part II Order must submit a written request within the thirty (30) calendar day review period, to the Minister of the Ministry of the Environment, Conservation and Parks at the following address, with a copy to the Environmental Assessment and Permissions Branch and proponent of the project, the Town of Cobourg.

Minister
Ministry of the Environment, Conservation and Parks
77 Wellesley Street West
11th Floor, Ferguson Block
Toronto, ON M7A 2T5

Director, Environmental Assessment and Permissions Branch
Ministry of the Environment, Conservation and Parks
135 St. Clair Avenue West, 1st Floor
Toronto, ON M4V 1P5

Laurie Wills, P.Eng.
Director of Public Works
Town of Cobourg
740 Division Street, Building 7
Cobourg, ON K9A 0H6

Figure 2 - Municipal Class EA Planning and Design Process



1.6 Town of Cobourg Official Plan

The Town of Cobourg Official Plan, 2017 (OP) provides the policy framework which guides decisions related to land use and development. In addition, the OP also provides direction on addressing capital works projects for immediate and long-term requirements, which considers the financial resources available to the Town of Cobourg. The following OP policies are applicable to the lands affected by the project.

Section 3.3 of the OP provides that watershed management and flood and erosion control projects carried out or supervised by a public authority are permitted in any land use designation, save and except for the Environmental Constraint Area (ECA) designation. These uses are subject to policies located in Section 3.11 and 4.2 of the OP. The lands affected by this project are designated ECA; therefore, Sections 3.11 and 4.2 apply.

Section 3.11 provides that the ECA designation includes those lands which have inherent environmental hazards, are environmentally sensitive or which have a role in the protection of the environment. Section 3.11.2 indicates uses permitted in this designation shall be in accordance with Section 4.2, particularly Sections 4.2.2 and 4.2.3.

Section 4.2.2(i) provides that uses permitted in the ECA designation include: conservation and preservation of the natural environment; and, recreational uses which have minimal impact on the natural environmental features and ecological functions of the area. Exceptions to this provision are identified in Section 4.2.2 (ii)(f) which permits stormwater control facilities where there will be net environmental benefit as determined by the Town of Cobourg, in consultation with the GRCA.

Section 4.2.3 identifies the uses, buildings and structures which are prohibited in the ECA designation; however, Section 4.2.3 (ii) provides exceptions to this policy which include: buildings or structures related to flood, or erosion control; and. where such works are in accordance with the regulations of the GRCA and are approved by the authority.

The OP policies allow for the development of stormwater management and flood or erosion control measures within the ECA designation in consultation with the Town of Cobourg and the GRCA.

Section 4.2.6 (i) of the OP also provides that development and site alteration shall not be permitted on lands adjacent to the natural heritage features identified in Section 4.2.1 (i) through (ix) unless it has been demonstrated that there will no be negative impact on the natural features or their ecological functions through an Environmental Impact Study (EIS). The features listed in Section 4.2.1 include the following:

- Significant woodlands;
- Wetlands including both provincially and non-provincially significant wetlands and coastal wetlands;

- Significant habitat of endangered and threatened species;
- Significant valleylands;
- Significant wildlife habitat;
- Fish habitat;
- Significant areas of natural and scientific interest;
- Groundwater discharge areas; and,
- Steep slopes which are susceptible to erosion or present a danger to development.

Based on a review of the OP policies, the proposed use of a flood detention pond is permitted provided that natural heritage features are protected. Since the project is located within and adjacent to a wetland, the OP policies require the completion of an EIS to support the implementation of the preferred alternative.

2.0 Problem/Opportunity Statement

The study will identify and evaluate alternatives to maximize flood protection for downstream properties within the Midtown Creek floodplain as a result of the extension of Kerr Street between Division Street and the railway spur.

3.0 Existing Conditions

Wills staff reviewed several engineering studies, environmental background reports and computer models for the study area and Midtown Creek, including the following:

- Stage 1 and 2 Archaeology Report, Amick Consultants Limited, 2017.
- Midtown Creek Hydrology Report, GRCA, 2007.
- Midtown Creek at Rotary Park Baseflow Data 2011 to 2017, GRCA, 2017.
- Midtown Creek Hydraulic Assessment and Flood Plain Mapping, Final Report, Greenland Consulting Engineers, 2008.
- Town of Cobourg Preliminary Design of a Conceptual Flood Detention Pond: Chris Garrett Park – Midtown Creek, Draft Report, GRCA, 2012.
- Town of Cobourg Preliminary Design of a Conceptual Detention Pond on Midtown Creek, GRCA, 2012.
- Preliminary Geotechnical and Environmental Study: Midtown Creek Flood Control Pond, WSP Canada Inc, 2016.
- Geotechnical Investigation Addendum Letter: Midtown Creek Flood Control Pond, WSP Canada Inc., 2016.
- Midtown Creek Terrestrial Ecology Study, GRCA, 2016.
- Midtown Creek Fisheries Assessment, GRCA, 2016.

3.1 Natural Environment

The primary background studies for this project were undertaken by the GRCA and are included in **Appendix D**. An Environmental Impact Study, undertaken by Wills, was also completed and is included in **Appendix F**. A summary of the results of the background studies is provided in the sections below.

3.1.1 Ecological Land Classification

Field visits to the study area were completed by the GRCA on three separate occasions during July and August of 2016. Ecological Land Classification (ELC) mapping was done to determine habitat community types throughout the study area. Soil samples were also taken and it was found that inconsistency of soil types combined with drainage patterns and human disturbance are the determining factor for the vegetation present in the area.

As identified by the GRCA, the area of the proposed flood ponding area contains five community types, as shown in **Figure 3**. Although there is a high diversity of vegetation community types on the site, none are significant with respect to rarity. Most of the relatively natural woodland is early successional and some is highly disturbed. The remainder is cultural woodland dominated by invasive tree species. The open areas are cultural meadow and highly disturbed.

The wetland communities on the site, specifically the meadow marsh and the thicket swamp, are of higher quality, and are dominated by a greater diversity of native plant species. These communities provide the highest wildlife values in that they support the most sensitive and habitat-specialist plant and vertebrate species. Additional information is included in the GRCA Report in **Appendix D** and in Wills' EIS in **Appendix F**.

3.1.2 Species at Risk

A review of the Natural Heritage Information Centre (NHIC) database did not identify any Species at Risk (SAR) within 1 square kilometer of the study area. Field studies completed by the GRCA noted Monarch butterflies as being present in the area. Monarch butterflies are listed as a species of Special Concern by the Ministry of Natural Resources and Forestry Species at Risk database. Only Endangered and Threatened species have protection under the Endangered Species Act (ESA). Although Milkweed, a plant species used by Monarch caterpillars during breeding, was found on site, there was no evidence that breeding was taking place. Fisheries and Oceans Canada (DFO) aquatic species at risk maps shows Northern Brook Lamprey, a species of Special Concern, as being present in the watercourse.

3.1.3 Fisheries and Aquatic Habitat

Midtown Creek is classified as a cold water stream. It includes sensitive fish species such as Brook Trout, Rainbow Trout, Mottled Sculpin, and Lamprey species. Fisheries sampling was completed by the GRCA in 2016 at three locations near the project site. The sampling sites ELT0212 and 2016b are located within the proposed flood ponding area and sampling site 2016a is downstream of the proposed flood ponding area; upstream of Station Street. The sampling sites are identified in **Figure 4**.

ELTO212

This site is characterized by large amounts of silt, low gradient and lack of defined riffles, with moderate amounts of woody material within the channel. Watercress was observed upstream of the site and one Brook Trout was captured at this site. Remaining species captured were tolerant cyprinids including Fathead Minnow, Creek Chub, and Blacknose Dace. Creek Chub had the highest density while White Sucker had the highest biomass. This site is described as showing signs of stress due to degradation of habitat and water quality. Additional stressors may cause the complete loss of coldwater species from these areas, as well as degrade downstream habitats.

2016b

Creek Chub, Blacknose Dace, White Sucker, and Rainbow Trout were captured at this location. Substrates consisted primarily of sand and silt, with significant amount of refuse within the channel (e.g. tires, scrap metal, etc.).

2016a

Creek Chub, Blacknose Dace, White Sucker, and Rainbow Trout were captured at this location. Substrates consisted of a mix of gravel/cobble and sand and silt.

3.1.4 Wildlife

Incidental mammal observations were completed during field investigations by Wills. Gray Squirrel were observed on multiple occasions, as well as an unknown bat species. Previous studies by the GRCA identified Hairy-tailed Mole, Eastern Cottontail, Eastern Chipmunk, Coyote and Common Raccoon in addition to the species identified by Wills' staff.

3.1.5 Breeding Birds

A review of the Ontario Breeding Bird Atlas (OBBA) (accessed May 2018) and Ebirds Canada databases was completed to obtain information regarding known species occurrences within the study area that may utilize existing natural heritage features. 185 species are known to occur within 10 km of the study area. Of the 185 species, breeding records have been confirmed for 72 species, 24 were identified as probable breeders, 30 possible breeders, and the remaining 59 were simply observed.

Breeding bird surveys were completed by Wills on May 30, 2018 and June 21, 2018 following Ontario Breeding Bird Atlas (OBBA) standard procedures and protocols. Three (3) listening stations were determined prior to arriving at site. During the two (2) surveys, a total of 28 species were observed through auditory or visual cues. Only one SAR, Barn Swallow, was heard during the Surveys, on May 30, 2018.

Full details of the database review and breeding bird surveys are included in the EIS.

Figure 3 – GRCA Ecological Land Classification Mapping

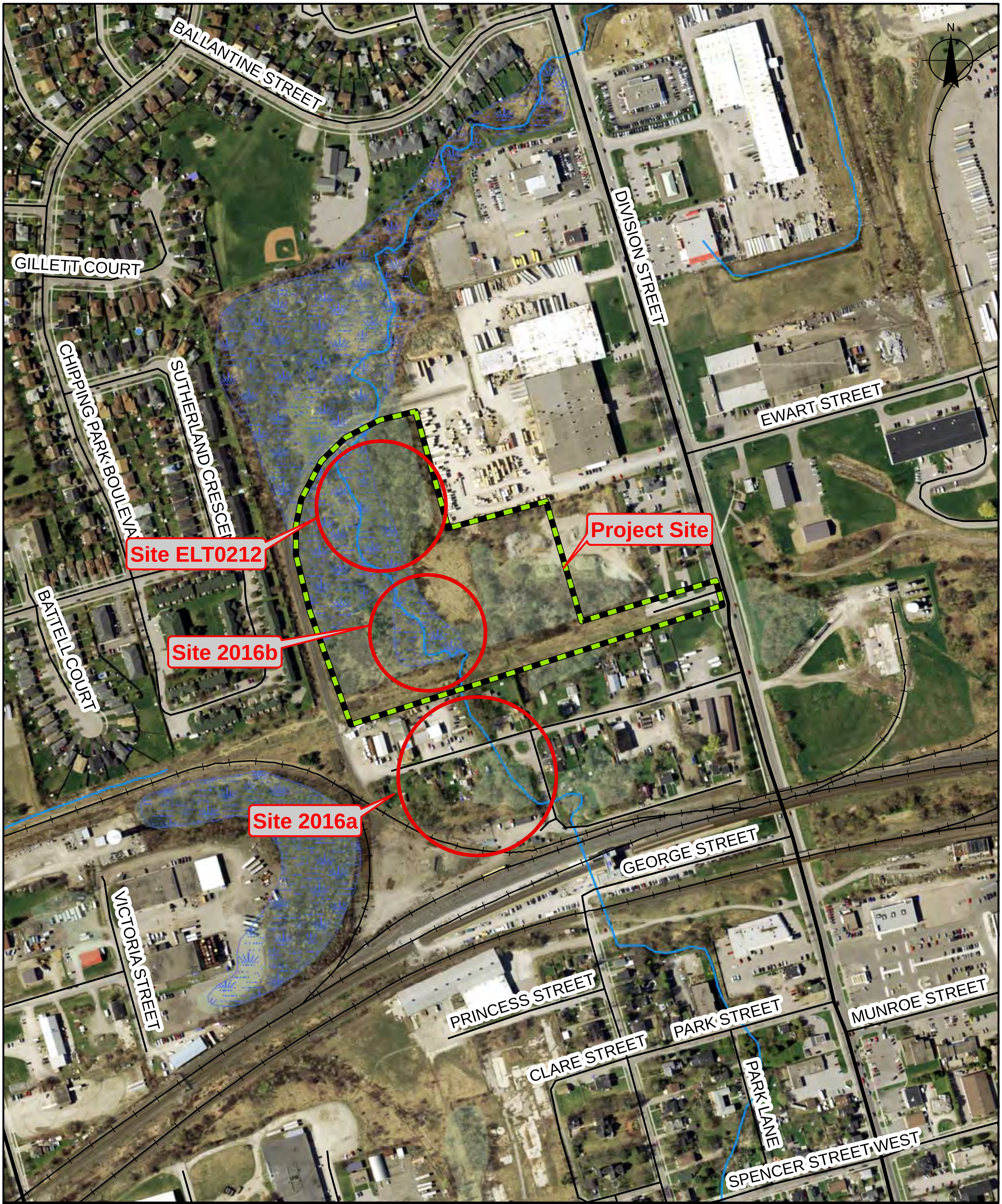


Figure 3
GRCA Fish Sampling Sites

NAD83 UTM Zone 17 North

0 0.03 0.06 0.12 0.18 0.24
Kilometers

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Legend
- ┼ Railway
- ▭ Wetland
- ─ Watercourse
- 🟩 Wooded Area

Drawn by: DG
Checked by: DG
Engineer: DG
Project No. 5268
Scale (Horz.) 1:5,000
Map Date 05/03/18
Map File No. 5268 - Fish

3.1.6 Reptiles and Amphibians

A review of the Ontario Reptile and Amphibians Atlas (ORAA) (accessed July, 2018) identified 15 herpetofauna species within the 10 km^2 grid encompassing the study area. Of the 15 species observed, six (6) species of conservation concern (listed under the SARO and / or SARA acts) were among the list.

Amphibian call surveys were completed on May 22, 2018 and June 19, 2018 following Marsh Monitoring Program (MMP) standard procedures and protocols. The Amphibian Call Surveys took place at three (3) listening stations in the Study Area and commenced after sunset. Listening stations were strategically chosen to optimize coverage while preventing overlap of species. Amphibian call surveys were conducted based on auditory cues for mating purposes, with incidental visual observations noted as well. Three (3) species of amphibians were heard during surveys including American Toad, Gray Treefrog and Spring Peeper. The identified species are not SAR.

Full details of the database review and amphibian call surveys are included in the EIS.

3.2 Archaeology and Cultural/Built Heritage

Stage 1 and 2 Archaeological Assessments were completed by AMICK Consultants Limited in 2017. No archaeological resources were encountered as a result of the Stage 2 Archaeological Assessment. No further archaeological assessment of the study area is warranted as the proposed undertaking is clear of any archaeological concern. The completed archaeological assessment is provided in **Appendix E**.

3.3 Tree Inventory

A Tree Inventory and Mitigation Plan was completed by Treescape in April 2017. Treescape identified a number of tree species including Trembling Aspen, Black Locust, Manitoba Maple, Black Walnut, Eastern Cottonwood, Black Cherry, Red Pine, Sugar Maple, Balsam Poplar, Ash, Norway Maple, American Elm, European Mountain Ash, Black Willow, Crabapple, Norway Maple, Paper Birch, Scots Pine, Grey Birch, Eastern Red Cedar, Eastern White Pine and Eastern White Cedar. A number of invasive species were also identified within the study area including Buckthorn and Grapevine. Treescape provided recommendations for replacing the canopy cover lost as a result of constructing the flood ponding area. A copy of the Tree Inventory and Mitigation Plan is included in **Appendix G**.

3.4 Noise

A Noise Study was completed by RWDI in September 2018. RWDI set up two (2) noise monitoring stations near the residential areas adjacent to the site in order to collect sound level readings. The monitoring found that the sound levels ranged from 47 dBA to 58 dBA. The report concluded that the removal of the trees within the proposed flood ponding area would have a marginal impact on the adjacent residential properties; having a noise level increase of less than 4 dB. Adjacent land owners may notice a change in noise type rather than noise level with the removal of trees. A copy of the Noise Study Memorandum is included in **Appendix H**.

3.5 Socio-Economic

The lands adjacent to the project site are generally within the Employment Area land use designation as defined in the Town of Cobourg Official Plan. The industrial building located to the north of the Kerr Street right of way (Canada Pallet) is considered Employment Area. North of the industrial building, and west of Division Street, is considered Business Park zoning within the Employment Area designation for a car dealership. An area generally between Division Street and Sutherland Crescent, north of the Kerr Street right of way, is Environmental Constraint area. Lands west of this area are within the Residential Area designation.

According to Town of Cobourg Official Plan, May 2017, permitted land uses within Residential areas include low density residential including single detached, semi-detached and duplex dwellings; and, Medium density residential including townhouse dwellings, low rise apartments and stacked townhouses.

Permitted land uses within Employment areas include industrial, office, wholesale, research and development, hotel, motel, conference, convention and banquet facility, institutional, education and training, data processing and building supply use.

3.6 Hydrology and Hydraulics

There is a history of flooding along Midtown Creek upstream of the CNR and CPR corridor that has caused substantial flood damages to private properties in the area of Buchanan Street, George Street, and Station Street, as well as frequent flooding of the Division Street Railway Underpass.

Following the January 2010 flood, the Town of Cobourg and the GRCA undertook a series of studies to investigate the causes of the flooding and assess alternatives to mitigate future flooding in the area. In order to determine the causes of flooding, the GRCA assessed the capacity of the culverts downstream of the Kerr Street right of way. The culvert crossing the CNR/CPR corridor is a concrete and masonry culvert with a steel grate on the upstream end. The culvert is approximately 1200 mm square with a 600 mm (rise) arch at the top. The GRCA estimated the open channel, unpressurized, flow capacity of this culvert as 5.7 m^3/s (GRCA, 2012). Assuming a blockage of 25%, the capacity of this culvert would be 4.3 m^3/s (GRCA, 2012). The Buchannan Street culvert is a 1200 mm diameter corrugated steel pipe culvert. The GRCA estimated the open channel, unpressurized, flow capacity of the culvert as 4.1 m^3/s (GRCA, 2012).

Based on the results of the culvert capacity assessment, the open channel, unpressurized, flow capacity of the Buchanan Street culvert (4.3 m^3/s) was recommended as the target flow rate for any potential mitigation measures. The GRCA authored two technical reports regarding the flooding and potential mitigation measures, including:

- Town of Cobourg Preliminary Design of a Conceptual Detention Pond on Midtown Creek, dated April 2012.
- Town of Cobourg Preliminary Design of a Conceptual Flood Detention Pond: Chris Garrett Park – Midtown Creek, dated October 2012.

The Town of Cobourg Preliminary Design of a Conceptual Detention Pond on Midtown Creek focused on providing a flood ponding area upstream of the Kerr Street right-of-way. Two different solutions were considered, which included an on-line pond and an off-line pond, and it was determined that an on-line flood ponding area would provide the highest level of flood reduction within the study area.

The Town of Cobourg Preliminary Design of a Conceptual Flood Detention Pond: Chris Garrett Park – Midtown Creek focused on providing a flood ponding area upstream of Elgin Street (Chris Garrett Park). It was determined that a ponding area upstream of Elgin Street would reduce flooding of the Elgin Street culvert; however, the flood reduction downstream of Division Street would be negligible.

The Midtown Creek Hydrology Report (GRCA, 2007) included digital hydrology models for Midtown Creek using the Visual OTTHYMO (VO2) hydrologic modelling software to predict existing and future flows in the creek at key locations. The peak flows corresponding to various storm events in the 2007 Report used in this Environmental Assessment are presented in **Table 1.**

Table 1 – Midtown Creek Peak Flows at the Site Location

Return Period	Flow at Chris Garrett Park (m^3/s)	Flow at Kerr Street (m^3/s)
2-year	1.42	4.11
5-year	2.39	5.69
10-year	3.15	6.76
25-year	4.22	8.09
50-year	5.13	9.12
100-year	6.06	10.16
Regional (Hazel)[1]	37.18	44.85

Note: 1. Regional flow reflects future land use conditions, since SWM criteria does not reduce post-development runoff flows to existing levels for Regional storm flows.

The Midtown Creek Hydraulic Assessment and Flood Plain Mapping Final Report (Greenland Consulting Engineers, 2008) included HEC-RAS hydraulic models of Midtown Creek using the flows in the 2007 GRCA Hydrology Report. The floodplain maps that were created were adopted by the Town of Cobourg and the GRCA board in September 2010, subject to approval of the Town of Cobourg Special Policy Area. The floodplain mapping in the area of the Site is included **Appendix D.**

3.7 Hydrogeological and Geotechnical

3.7.1 Field Study

An assessment of the subsurface conditions was carried out by WSP Canada Inc. (WSP). The existing Kerr Street railway berm is to be enhanced to contain periodic flood water and will eventually be upgraded to support a 4-lane roadway. The adjacent properties are municipally serviced and no potable wells are within 250 m of the site.

Eight (8) test pits were carried out and advanced to depths ranging between 2.1 mBGS and 2.5 mBGS within the proposed pond footprint. Six (6) boreholes were advanced to a depth of 5 mBGS. Four of the boreholes were completed as monitoring wells to facilitate groundwater measurements and sampling within the proposed flood control pond footprint. Groundwater levels measured in the monitoring wells on March 8, 2016 existed between 89.4 and 91.1 mASL. Groundwater on the site is anticipated to flow in a southerly to southeasterly direction with regional drainage being toward Lake Ontario, approximately 1.6 km to the south. Bedrock was documented at the site at depths greater than 2 m.

Topsoil was encountered at each test pit and borehole location and ranged in thickness from 200 mm to 460 mm. A sandy silt to silt and sand layer was encountered beneath the topsoil in test pits TP16-4 to TP16-8 on the west side of Midtown Creek. A discrete sand and gravel layer exists in TP16-2 overlying sand. A sand layer was encountered at BH16-3 and test pits TP16-2 to TP16-6. Clayey silt was encountered at all borehole and test pit locations with the exception of TP16-1 to TP16-4. This material was found to underlie topsoil or sandy deposits where it was found.

A layer of fill material was encountered at TP16-1 and TP16-3 in a grassy clearing that may have been used as a dump site. The fill deposit ranges in thickness from greater than 2.1 m at TP-16-1 to 1.3 m at TP16-3, and consists of silty sand fill containing concrete slabs, bricks, plastic and other construction waste debris. The fill is covered by 150 mm thick concrete and topsoil in these areas.

3.7.2 Environmental Site Assessment

Phase 1 and 2 Environmental Site Assessments were carried out by WSP. Although there is a history of industrial activities on and adjacent to the site, the soil and groundwater analytical results indicate that all parameters meet the MOECC requirements.

3.7.3 Slope Stability

WSP completed a slope stability analysis as part of the Geotechnical Investigation. The analysis concluded that the berm structure and internal stability should be adequate for the intended further use, provided the proposed roadway is widened and constructed according to good practices.

3.8 Utilities

There is an existing watermain and overhead hydro line that runs through the Kerr Street right of way from Division Street to Ontario Street. There is also an existing overhead hydro service, watermain and sanitary service within the unopened George Street road allowance that runs perpendicular (north) to the Kerr Street right of way. These utilities are to be maintained during detailed design and construction of the Midtown Creek flood ponding area the and Kerr Street extension.

There is a small storm sewer system on Kerr Street that connects to existing storm sewer on Division Street. The existing sewer will be replaced and resized during detailed design, and in conjunction with the Kerr Street Design east of Division Street. The new storm sewer will outlet west to the Midtown Creek flood ponding area.

Any existing, unused infrastructure and utilities will be abandoned or removed in accordance with the Town of Cobourg and provincial (OPS) standards.

3.9 Transportation

The existing Kerr Street dead-end currently provides primary access to three properties; two residential for 703 and 699 Division Street, and one commercial, a material storage site at 715 George Street. There is also a secondary access for the commercial property at 711 Division Street.

As recommended by the TMP, Kerr Street, a new arterial road, is to be constructed from Westwood Drive to D'Arcy Street. The proposed Kerr Street extension that is the subject of this report will be constructed simultaneously with the Midtown Creek flood ponding area.

Under a separate contract, The Town of Cobourg is currently proceeding with the design, tendering and construction of the extension of Kerr Street from Division Street to D'Arcy Street. The design of both sections of Kerr Street will be coordinated by the Town of Cobourg.

The construction of Kerr Street, as discussed previously, will require upgrading to a signalized intersection at Kerr Street and Division Street.

3.10 Property Ownership

The Kerr Street right of way is owned by the Town of Cobourg and there are three (3) separate private property owners that may be affected by the flood ponding area construction. CNR owns the railway spur on the west side of the flood ponding area. The Town of Cobourg will be required to acquire any land that is needed to facilitate the construction of the flood ponding area.

4.0 Alternative Solutions

4.1 Identification of Alternative Solutions

The identification of alternative solutions to the Problem Statement was carried out by the Town of Cobourg and the Ganaraska Region Conservation Authority and passed on to Wills for use in this study. The list of alternative solutions includes the following:

- Alternative 1 - Do Nothing
- Alternative 2 - Off-Line Flood Ponding Area Upstream of Kerr Street Right of Way
- Alternative 3 - On-Line Flood Ponding Area Upstream of Kerr Street Right of Way
- Alternative 4 - Increase Capacity of CNR and CPR Railway Culverts
- Alternative 5 - Off-Line Flood Ponding Area Upstream of Division Street
- Alternative 6 - Removal of Flood Prone Structures from Floodplain

Detailed descriptions of each alternative are described below.

Alternative 1 - Do Nothing

This alternative would involve maintaining the status quo, with no modifications to Midtown Creek or the culverts and no extension of Kerr Street west of Division Street to the railway spur. While it is not anticipated that this alternative will address the Problem Statement, it is included as a basis of comparison between alternatives and the status quo for the purposes of the evaluation of alternatives.

Alternative 2 - Off-Line Flood Ponding Area Upstream of Kerr Street Right of Way

This alternative would involve the excavation of a two-cell off-line flood ponding area, separated by the Canada Pallet railway spur, west of Midtown Creek. The preliminary analysis indicates that the 100-year flow can be attenuated to 5.77 m^3/s, which is above the recommended target. Midtown Creek would not require reconstruction on Canada Pallet property, and the east side of the creek would remain untouched, somewhat limiting tree cutting and property acquistion requirements.

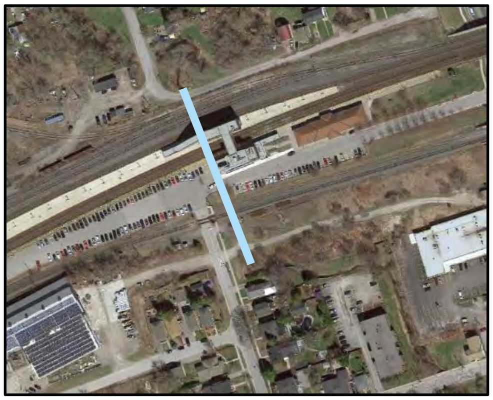
The alternative does not meet flow targets and introduces a wet area north of the spur line. Pond flows must be conveyed between the two cells through the railway spur. An offset from Midtown Creek is required, which limits the area available for storage. The diversion structure is complex to design and the alternative would require upsizing Buchanan and George Street culverts to control the bakwater from these structures. There is also an increased maintenance difficulty. Concerns include flooding the condominiums in subdivisions adjacent to Division Street.

Alternative 3 - On-Line Flood Ponding Area Upstream of Kerr Street Right of Way

This alternative would involve excavating an on-line flood ponding area and reconstructing the Midtown Creek natural channel through the basin. The preliminary analysis indicates that the 100-year flow can be attenuated to the recommended target of 4.1 m^3/s. This alternative does not require flooding the area north of the railway spur. Significant tree cutting would be required and more earthworks are required than in Alternative 2.

This alternative includes the construction of Kerr Street to form the containment berm for the flood ponding area. A large culvert with an inlet control device (orifice, weir, etc.) will be located at the existing Midtown Creek crossing of the former railway.

Alternative 4 - Increase Capacity of CNR and CPR Railway Culvert



This alternative would involve providing additional conveyance capacity across the CNR and CPR corridor. The additional conveyance capacity could be accomplished by replacing and upsizing the existing culvert or by adding additional culverts. The capacity of the existing culvert would need to be doubled (approximately) in order to convey the 100-year storm peak flow of 10.2 m^3/s.

Due to the large amount of train traffic, it is not anticipated that the railway could be shut down to facilitate construction; therefore, it is expected that the culvert works would need to be completed using trenchless technologies. The implementation of this alternative would increase the risk of flooding in the downstream flood prone areas (Midtown Creek between the CNR/CPR corridor and Lake Ontario) because there is not sufficient capacity in the conveyance system.

Alternative 5 - Off-Line Flood Ponding Area Upstream of Division Street

This alternative would require the excavation of a one-cell off-line stormwater detention basin upstream of Division Street at Chris Garrett Park. The flow would need to be reduced to 3.0 m^3/s to match the maximum Elgin Street single culvert and the Division Street culvert capacities. The preliminary analysis indicates that the 100-year flow can be attenuated to 3.7 m^3/s, which corresponds to the existing 10-year peak flow.

Even though the runoff from the upstream 418 ha of rural catchment is attenuated, the runoff from the uncontrolled 29 ha of commercial land downstream negates any flood reduction provided by an off-line flood ponding area in Chris Garrett Park (GRCA, 2012).

Alternative 6 - Removal of Flood Prone Structures

This alternative involves the purchase and demolition of the existing flood prone structures upstream of the CNR and CPR culvert on Buchannan Street, George Street and Station Street. Based on current Regulatory floodplain mapping provided by the GRCA, it would appear as though up to twenty-five (25) residential and light industrial properties may be affected.

4.2 Preliminary Review of Alternative Solutions

Based on a preliminary review of the alternative solutions:

- Alternative 1 will be carried forward as a means of comparison to the "status quo".
- Alternatives 2 and 3 are considered viable solutions to provide flood prevention to the study area and will be carried forward for further study.
- Alternative 4 would mitigate flooding in the study area; however, flooding would be increased for the downstream flood prone areas of downtown Cobourg. In addition, this alternative would be very difficult to construct with a live railway above the tunneling operation. This alternative has been removed from consideration.
- Alternative 5 would provide flood protection upstream of Division Street; however, the impact downstream of Division Street would be negligible. This alternative has been removed from consideration.
- Alternative 6 involves removing established light industrial and residential buildings from the floodplain. This is not considered as a viable solution because of the high cost involved in purchasing the affected properties and the potential socioeconomic impacts caused by displacing people and businesses. This alternative has been removed from consideration.

Based on the above assessment, Alternatives 1, 2 and 3 were carried forward for further analysis and evaluation.

4.3 Evaluation of Alternative Solutions

Alternatives 1, 2 and 3 were evaluated based on the following categories of screening criteria: Natural Environment, Social Environment, Cultural Environment, Engineering/Technical Environment and Economic Environment. The screening criteria were assigned a weighting factor based on their relative significance in this project. The factors were based on a scale of one (1) to ten (10), with ten being very important.

Each alternative was scored by Wills. The scoring was based on a rating of the potential effect of each alternative on the screening criteria. The environmental effects were assessed based on the scale presented in **Table 2.**

Table 2 – Scoring Criteria

Range of Effect	Code	Points Assigned
High Negative Effect	-H	-5
Moderate Negative Effect	-M	-3
Slight Negative Effect	-L	-1
No Effect	Nil	0
Slight Positive Effect	+L	+1
Moderate Positive Effect	+M	+3
Significant Positive Effect	+H	+5

The total score for each rating criterion resulted from the multiplication of the weighting factor and the scoring factor. The scores of each alternative were totaled and ranked from highest to lowest. The highest ranked alternative (a rank of 1) was selected as the preferred alternative.

The detailed evaluation matrix is provided in **Appendix B** and the results of the evaluation are presented in **Section 4.4**.

4.4 Selection of the Preferred Alternative Solution

The rankings resulting from the evaluation of alternatives are presented in **Table 3.**

Table 3 – Evaluation Results of Alternative Solutions

Screening Criteria	Alternative #1 Do Nothing	Alternative #2 Off-Line Pond	Alternative #3 On-Line Pond
Natural Environment	3	1	1
Social Environment	3	1	1
Cultural Environment	1	1	1
Engineering / Technical Environment	3	2	1
Economic Environment	3	2	1
Overall Rank	**3**	**2**	**1**

Based on the evaluation results presented in **Table 3** and the detailed evaluation matrix, it is recommended that Alternative 3: On-Line Flood Ponding Area Upstream of Kerr Street be selected as the Preferred Alternative.

5.0 Alternative Designs for Preferred Solution

5.1 Design Criteria and Constraints

A list of design criteria and constraints was developed to assist in the creation of alternative design concepts for the preferred solution. These design criteria are listed below:

1. The facility must control the 100-year peak flow rate to the capacity of the Buchannan Street Culvert (4.1 m^3/s), which is equivalent to the 2-year peak flow rate.
2. The Regional Storm peak flow rate of 44.85 m^3/s must be conveyed across Kerr Street and safe access must be provided (flood depth of 0.30 m or less).
3. The outlet structure must have a span less than 6.0 m.
4. The facility should promote fish passage.
5. The facility should not restrict normal base flows.
6. A freeboard of 1.0 m is desired for the design (50-year) storm (measured from the high water level to the lowest edge of the traveled lane).
7. Berms other than the Kerr Street embankment should not be used to contain the online storage.
8. The maximum ponding elevation is 91.60 m, above which water will spill over the railway spur.
9. The facility must not impact private properties adjacent to Midtown Creek upstream of the railway spur that are not currently within the Regulatory Floodplain.
10. The invert elevation of the outlet structure should be set to match the existing watercourse invert downstream of the proposed Kerr Street right-of-way.

Other parameters were selected to aid in the detailed design of the restored natural channel for Midtown Creek. These parameters can be changed in the detailed design phase, but are used as preliminary sizes and elevations for conservative basin and outlet structure sizing:

1. The reconstructed reach of Midtown Creek should contain the 2-year flow (4.11 m^3/s) within its banks and utilize the surrounding area as floodplain.
2. The reconstructed Midtown Creek channel should have a preliminary longitudinal slope of 1.5%.
3. The control invert elevation for the outlet structure should be set at 87.95 m to maintain a 0.35 m channel depth for the reconstructed reach of Midtown Creek.

5.2 Identification of Alternative Designs for Preferred Solution

With consideration of the noted design criteria and constraints, several alternate design concepts were developed. Each of the design concepts considers two main elements:

1. Storage Configuration.
2. Outlet Configuration.

Details regarding each of the design concept elements and the various design concepts generated from different combinations of those elements are discussed in the sections below.

5.2.1 Alternative Storage Configurations

Two (2) different storage configurations have been considered. The first storage configuration contains all ponding to the west side of the George Street right-of-way so as not to disturb the existing infrastructure (watermain, sewers, overhead hydro) within that area. This storage configuration provides 6.27 ha*m of storage up to a ponding elevation of 91.60 m. The second storage configuration extends east of the George Street right-of-way, impacting the existing infrastructure (watermain, sewers, overhead hydro) and provides 7.17 ha*m of storage up to a ponding elevation of 91.60 m.

Both storage basins have been designed with a top elevation of 91.60 m since any ponding above 91.60 m will spill onto the railway spur at the south west corner of the site. The bottom elevations of both basin configurations are the same and range from 91.10 m at the north end of the site to 88.60 m at the basin outlet at Kerr Street.

Minor surface grading is required on private property at the south east corner of the site to contain the ponding and prevent spills onto private property. Due to this area of minor grading, the area of tree and vegetation clearing required for both basins is the same at 5.11 ha. Vegetation clearing is proposed to be completed in two phases: Phase 1 will include the clearing and removal of trees prior to the breeding bird timing window, and Phase 2 will include removal of all other low level vegetation. A planting plan will be incorporated into the detailed design for the restored natural channel.

5.2.2 Alternative Outlet Configurations

Four (4) outlet configurations have been considered for each of the two (2) storage configurations and are described as follows:

1. Circular orifice plate.
2. Circular orifice tube.
3. Circular concrete culvert.
4. Rectangular orifice plate.

5.2.3 Alternative Design Concepts

The eight (8) alternative design concepts (two (2) storage configurations each with four (4) outlet configurations) were modelled in Visual Otthymo 3 (VO3) using the hydrology model provided by the GRCA. The results of the analyses are discussed below and summarized in **Table 4,** and the Stage-Storage Discharge Tables are included in **Appendix C**.

The interim and ultimate design of Kerr Street will be consistent as part of each design concept. The width of spill weir varies depending on chosen concept. Grading will be designed so that overflows will be contained within the road allowance (wherever possible) and overland drainage will be directed to Midtown Creek to minimize impacts on adjacent properties.

Design Concept 1

Design Concept 1 uses the small basin storage configuration and a 1084 mm diameter circular orifice plate with an invert elevation of 87.95 m. The 50-year storm creates ponding up to an elevation of 90.91 m (4.24 ha*m) and the 100-year storm ponds to an elevation of 91.30 m (5.36 ha*m). A 170 m long spill is required to convey the Regional Storm across Kerr Street with safe access.

Design Concept 2

Design Concept 2 uses the small basin storage configuration and a 917 mm diameter circular orifice tube with an invert elevation of 87.95 m. The 50-year storm creates ponding up to an elevation of 90.95 m (4.35 ha*m) and the 100-year storm ponds to an elevation of 91.35 m (5.50 ha*m). A 200 m long spill is required to convey the Regional Storm across Kerr Street with safe access.

5.2.3.1 Design Concept 3

Design Concept 3 uses the small basin storage configuration and a 1050 mm diameter circular concrete culvert with an inlet invert elevation of 87.95 m. The 50-year storm creates ponding up to an elevation of 91.00 m (4.49 ha*m) and the 100-year storm ponds to an elevation of 91.38 m (5.61 ha*m). A 250 m long spill is required to convey the Storm across Kerr Street with safe access.

5.2.3.2 Design Concept 4

Design Concept 4 uses the small basin storage configuration and a rectangular orifice plate with a rise of 593 mm and a span of 1500 mm, and an invert elevation of 87.95 m. The 50-year storm creates ponding up to an elevation of 90.87 m (4.13 ha*m) and the 100-year storm ponds to an elevation of 91.27 m (5.27 ha*m). A 150 m long spill is required to convey the Regional Storm across Kerr Street with safe access.

5.2.3.3 Design Concept 5

Design Concept 5 uses the large basin storage configuration and a 1107 mm diameter circular orifice plate with an invert elevation of 87.95 m. The 50-year storm creates ponding up to an elevation of 90.71 m (4.28 ha*m) and the 100-year storm ponds to an elevation of 91.07 m (5.40 ha*m). A 150 m long spill is required to convey the Regional Storm across Kerr Street with safe access.

5.2.3.4 Design Concept 6

Design Concept 6 uses the large basin storage configuration and a 900 mm diameter circular orifice tube with an invert elevation of 87.95 m. The 50-year storm creates ponding up to an elevation of 90.85 m (4.70 ha*m) and the 100-year storm ponds to an elevation of 91.22 m (5.90 ha*m). A 150 m long spill is required to convey the Regional Storm across Kerr Street with safe access.

5.2.3.5 Design Concept 7

Design Concept 7 uses the large basin storage configuration and a 1050 mm diameter circular concrete culvert with an inlet invert elevation of 87.95 m. The 50-year storm creates ponding up to an elevation of 90.86 m (4.72 ha*m) and the 100-year storm ponds to an elevation of 91.21 m (5.87 ha*m). A 150 m long spill is required to convey the Regional Storm across Kerr Street with safe access.

5.2.3.6 Design Concept 8

Design Concept 8 uses the small basin storage configuration and a rectangular orifice plate with a rise of 620 mm and a span of 1500 mm, and an invert elevation of 87.95 m. The 50-year storm creates ponding up to an elevation of 90.67 m (4.14 ha*m) and the 100-year storm ponds to an elevation of 91.03 m (5.28 ha*m). A 150 m long spill is required to convey the Regional Storm across Kerr Street with safe access.

5.3 Evaluation of Alternative Designs for Preferred Solution

The design concepts were compared based on their ability to meet and exceed the design constraints described in **Section 5.1**. The hydraulic modelling results and details of the eight design concepts are summarized in **Table 4.**

It should be noted that all design concepts control the 2-year storm (4.11 m^3/s) to a flow between 1.88 m^3/s and 2.20 m^3/s. It is infeasible to allow the 2-year flow pass without being controlled since the 2-year storm flow coincidentally corresponds to the target flow rate set for the 100-year controlled flow (4.11 m^3/s). Expected ponding in either basin during the 2-year storm will occupy approximately 30% to 50% of the basin bottom area.

Table 4 – Alternative Design Concept Details

Design Concept	Basin Area (ha)	Basin Volume (ha-m)	Outlet Configuration		50-year[2]				100-year[2]				Spill over Kerr Street	
			Size[1] (mm)	Type	Ponding Elevation (m)	Freeboard (m)	Volume (ha*m)	Controlled Flow (m^3/s)	Ponding Elevation (m)	Freeboard (m)	Volume (ha*m)	Controlled Flow (m^3/s)	Spill Length (m)	Spill Elevation (m)
1	3.35	6.27	1084	Circular Orifice Plate	90.91	0.41	4.24	3.81	91.30	0.02	5.36	4.11	170.00	91.32
2	3.35	6.27	917	Circular Orifice Tube	90.95	0.40	4.35	3.73	91.35	0.00	5.50	4.01	200.00	91.35
3	3.35	6.27	1050	Circular Concrete Culvert	91.00	0.39	4.49	3.77	91.38	0.01	5.61	4.08	250.00	91.39
4	3.35	6.27	593 x 1500	Rectangular Orifice Plate	90.87	0.43	4.13	3.83	91.27	0.03	5.27	4.11	150.00	91.30
5	3.82	7.17	1107	Circular Orifice Plate	90.71	0.59	4.28	3.80	91.07	0.23	5.40	4.10	150.00	91.30
6	3.82	7.17	900	Circular Orifice Tube	90.85	0.45	4.70	3.53	91.22	0.08	5.90	3.78	150.00	91.30
7	3.82	7.17	1050	Circular Concrete Culvert	90.86	0.44	4.72	3.65	91.21	0.09	5.87	3.95	150.00	91.30
8	3.82	7.17	620 x 1500	Rectangular Orifice Plate	90.67	0.63	4.14	3.83	91.03	0.27	5.28	4.11	150.00	91.30

Note:

1. Orifice sizing details are considered preliminary and are included for the purpose of evaluating the alternative design concepts, and to ensure that the alternative design concepts are feasible. Actual orifice sizing may change during detailed design.
2. Results are provided to demonstrate how each alternative design concept performs. Ponding elevations, storage volumes, and controlled flow rates may change during detailed design.

5.4 Selection of the Preferred Alternative Design for the Preferred Solution

Wills completed a detailed evaluation of each of the alternative design concepts using a modified version of the evaluation matrix developed to complete the evaluation of alternatives in Phase 2 of the Class EA (Section 4.3). Based on the results of the evaluation, Alternative Design Concept 4 (Small Basin, Rectangular Orifice Plate) is ranked first with Alternative Design Concept 1 (Small Basin, Circular Orifice Plate) ranked a close second. The evaluation matrix is included in **Appendix B** and the resulting rankings are summarized in **Table 5**.

Table 5 – Evaluation Results of Alternative Design Concepts

Screening Criteria	Alternative Design Concept 1	Alternative Design Concept 2	Alternative Design Concept 3	Alternative Design Concept 4
Natural Environment	1	1	1	1
Social Environment	1	1	1	1
Cultural Environment	1	1	1	1
Engineering / Technical Environment	2	4	5	1
Economic Environment	1	3	3	1
Overall Rank	**2**	**3**	**4**	**1**

Screening Criteria	Alternative Design Concept 5	Alternative Design Concept 6	Alternative Design Concept 7	Alternative Design Concept 8
Natural Environment	1	1	1	1
Social Environment	1	1	1	1
Cultural Environment	1	1	1	1
Engineering / Technical Environment	6	7	3	8
Economic Environment	5	7	7	5
Overall Rank	**6**	**7**	**5**	**8**

Based on the evaluation results presented in **Table 3** and the detailed evaluation matrix, and in order to retain additional flexibility during detailed design, it is recommended that a combination of Alternative Design Concepts 1 and 4 be selected as the preferred alternative design concept. Therefore, the preferred alternative design concept is: Flood ponding area west of the George Street right of way with an orifice plate (circular or rectangular) control structure.

6.0 Project Description

The construction of the preferred alternative with preferred design concept, On-line flood ponding area west of the George Street right of way with an orifice plate control device, will involve the following:

- Construction of Kerr Street (interim cross section) between Division Street and the CNR railway spur;
- Removal of vegetation within the flood ponding area and other areas where minor grading is required;
- Excavation and removal of soil and grading for the proposed flood ponding area;
- Construction of a restored natural channel between the railway spur and Kerr Street;
- Construction of a control structure that uses an orifice plate (circular or rectangular) to restrict flows (the 100-year storm peak flow will be reduced to the target flow rate of 4.11 m^3/s);
- Construction of a culvert under Kerr Street to convey up to the 100-year storm controlled peak flow, including erosion and scour protection at the outlet to the Midtown Creek main channel;
- Construction of Kerr Street as a weir to convey the Regulatory Storm to ensure safe access (flood depth less than 0.3 m) with no increased flood impacts to both upstream and downstream properties; and
- Implementation of the planting plan for the restored natural channel and surrounding area.

7.0 Potential Effects, Mitigation and Monitoring

7.1 Natural Environment

7.1.1 Potential Effects

The preferred alternative of the flood ponding area will require excavation, the removal of terrestrial habitat and the alteration and destruction of fish habitat within Midtown Creek. The removal and subsequent rehabilitation of fish habitat will result in temporary and permanent changes to the watercourse. These may include altering the abiotic conditions such as flow regimes, as well as water chemistry from rapid erosion/sedimentation events (i.e. temperature, dissolved solids, etc.). In turn, abiotic impacts will affect the biotic conditions (i.e. fish communities, riparian vegetation communities, turtle populations, etc.). In addition to impacts to fish habitat, any clearing of trees also poses potential impacts on nesting birds and roosting bats. Two areas that are proposed to be cleared are wetland habitats and are protected under the Provincial Policy Statement (PPS). Potential impacts to the natural environment need to be planned for with appropriate mitigation measures.

7.1.2 Mitigation

The following section proposes mitigation measures to address the environmental impacts associated with the construction of the flood ponding area.

Turtles

Although no turtles were observed on site, turtle habitat is present both in Midtown Creek and the two (2) wetland communities. To prevent impact on local turtle populations that may utilize this habitat, the following mitigation measures are recommended:

- If work is to be completed during the turtle breeding season (May 1 – July 30), turtle exclusionary fencing should be installed to exclude turtles from the work areas prior to May 1.
- Protection of nesting sites in close proximity to the construction site.

Breeding Birds

Any clearing of trees or vegetation poses potential impacts on nesting birds. These impacts can come directly from construction equipment or through construction activities such as removal, clearing, or grubbing of trees or riparian vegetation communities. The following mitigation measures relating to breeding birds should be applied to any vegetation removal:

- Any tree removal must occur outside of the breeding bird timing window (May 1 to August 31).
- If tree or vegetation removal is necessary during the timing window, a nest sweep must be completed by a trained biologist prior to construction activities.
- If any nests are found subsequent to the nest sweep, construction activities should cease and a 15 m buffer should be applied to the area surrounding the nest. The buffer should remain until all young have fledged.

Fish

To prevent impact on local and migratory fish species that utilize the immediate upstream and downstream aquatic habitat associated with Midtown Creek, the following mitigation measures should be used during construction:

- No in-water work should occur from October 1 to May 31 (Brook Trout) and March 15 to June 15 (Rainbow Trout) unless otherwise defined by MNRF to protect local fish populations during their spawning and nursery periods.
- Minimize duration of in-water work.
- Schedule work that may expose soils to avoid wet, windy and rainy periods that may increase erosion and sedimentation.
- A Sediment and Erosion Control Plan should be developed and implemented prior to construction.
- All equipment and materials used for the purpose of site preparation and project completion should be operated in a way that prevents the release of deleterious substances into the water.

- Develop a response plan that is to be implemented immediately in the event of a sediment release or spill of a deleterious substance and keep an emergency spill kit on site.
- Plan activities near water such that materials such as paint, primers, blasting abrasives, rust solvents, degreasers, grout, poured concrete or other chemicals do not enter the watercourse.
- Ensure that building material used in a watercourse has been handled and treated in a manner to prevent the release or leaching of substances into the water that may be deleterious to fish.
- All work should be completed in the dry through installation of a cofferdam and dewatering of the work area through diversion of flows and/or pumping flows.
- All pumps should be equipped with screens to prevent impingement or entrapment of fish.
- Fish salvage efforts should be conducted to remove fish from the work area prior to dewatering.
- Design and plan activities and works in waterbody such that loss or disturbance to aquatic habitat is minimized and sensitive spawning habitats are avoided.
- Clearing of riparian vegetation should be kept to a minimum.
- Minimize the removal of natural woody debris, rocks, sand or other materials from the banks, the shoreline, or the bed of the waterbody.
- If material is removed from the waterbody, set it aside and return it to the original location once construction activities are completed.
- Immediately stabilize shoreline or banks disturbed by any activity associated with the project to prevent erosion and/or sedimentation.
- If replacement rock reinforcement/armouring is required to stabilize eroding or exposed areas, ensure that appropriately-sized, clean rock is used; and that rock is installed at a similar slope to maintain a uniform bank/shoreline and natural stream/shoreline alignment.
- Remove all construction materials from site upon project completion.

Wetlands

Site development will result in an unavoidable impact to wetland function within approximately 0.34 ha (3,432 m^2) of existing wetland area. The Conservation Authorities Act 168/06 prohibits development in any wetland; however, development can be granted at the discretion of the Conservation Authority, provided that habitat is created (compensated) at a rate of 2:1. A Wetland Compensation Plan (WCP), detailing the proposed plan to compensate for the lost wetland habitat will be required at the detailed design stage. The WCP will outline the design specifications as well as subsequent monitoring required to ensure successful completion of the project.

7.1.3 Monitoring

Due to the disruptive nature of construction activities, the implementation of Monitoring programs may be required to ensure that no impacts to wildlife and fish communities occur and that any habitat, either wetland compensation or stream reconstruction, is functioning as intended.

Wetland Compensation

Monitoring for the wetland compensation should be completed in two stages: Construction Monitoring and Post Construction Monitoring.

Methods for conducting Construction Monitoring will include:

- Erosion and sediment control monitoring on a weekly basis, and immediately following any significant rainfall events.
- Ongoing breeding bird monitoring.
- Ongoing Amphibian monitoring.
- Incidental wildlife monitoring throughout construction.
- Ongoing invasive species monitoring and implementation of a designated action plan.

A Construction Monitoring Report should be submitted to GRCA upon completion of this phase.

A Post Construction Monitoring Program should be developed and implemented for a minimum of five years after construction to ensure the wetland has established and is functioning as intended. It should include quarterly field visits and the submission of Monitoring Reports on an annual basis, submitted to the GRCA for review. Success of the wetland compensation should be based on four performance standards: hydrologic conditions, vegetation success rate, control of invasive species and site stabilization.

Stream Rehabilitation/Reconstruction

A monitoring program should be set up in accordance with Ontario’s Stream Rehabilitation Manual (Ontario Streams / MNR 2002).

Implementation monitoring will occur during and immediately following construction to identify whether the rehabilitation techniques were constructed according to the designs. Any deficiencies will be the responsibility of the contractor to rectify.

Effectiveness monitoring will occur within the following weeks, months and years to determine project success rates, and validate the design based on an understanding of stream ecology.

A monitoring report should be completed at the end of every year for five (5) years, detailing the monitoring performance indicators Performance indicators are summarized in **Table 6.**

It is the intent of the stream rehabilitation/restoration that natural adjustments in the channel can and will occur. These adjustments are part of a natural self-maintenance function, in which the channel adjusts to maintain equilibrium with the current flow and sediment regime.

In addition to the monitoring outlined in **Table 6,** the following should also be included in the yearly monitoring report:

- A photo inventory of banks and bank erosion, corridor vegetation communities, and canopy cover.
- Aquatic insect inventories, if pre-construction aquatic insect diversity inventories are available from the Ganaraska Region Conservation Authority.

The annual monitoring report should be circulated to all relevant stakeholders, including the Town of Cobourg and the GRCA.

Sediment and Erosion Control Monitoring

Sediment and Erosion control monitoring during construction. The plan should include:

- Installation of effective erosion and sediment control measures before starting work to prevent sediment from entering the waterbody.
- Measures for managing water flowing onto the site, as well as water being pumped/diverted from the site such that sediment is filtered out prior to the water entering a waterbody. For example, pumping/diversion of water to a vegetated area, construction of a settling basin or other filtration system.
- Site isolation measures (e.g. silt boom and silt curtain) for containing suspended sediment where in-water work is required.
- Measures for containing and stabilizing waste material.
- Regular inspection and maintenance of erosion and sediment control measures and structures during the course of construction and monitoring of downstream turbidity levels.
- Repairs to erosion and sediment control measures and structures if damage occurs.
- Removal of non-biodegradable erosion and sediment control materials once site is stabilized.

Table 6 – Monitoring Performance Indicators

Indicator	Timeline	Positive	Negative	Mitigation
Fish biomass inventory	Every year for 5 years in the summer or fall	Increase or maintenance of populations, and diversity, specifically of sensitive species	Decrease in populations or elimination of sensitive species	Assess stream for barriers to fish passage
Flow monitoring upstream and downstream of site	Ongoing to include fluctuations in the drier months	Maintenance or increase in flow from the pre-construction flows	Decrease in flow compared to the pre-construction condition	Investigation of flow loss and potential spot lining of constructed channel
Thermal monitoring upstream and downstream of site	Ongoing, or 4 per year between storm events (dry periods)	No change compared to pre-construction, or a change in temperature difference between upstream and downstream, resulting in cooling of the stream	Change in temperature difference between upstream and downstream, resulting in warming of the stream	Plant more riparian vegetation as shade
Channel and bank condition monitoring	Four times per year	Minor to no areas require erosion repair, or major repairs required at under 5 locations	Major repairs required at 5 or more locations	Repair bank erosion and stabilize with vegetation or riffle realignment
Corridor Vegetation community	Four times per year	80% - 100% survival of planted vegetation, by numbers or by area	Less than 80% - 100% survival of planted vegetation, by numbers or by area	Re-plant vegetation, water more frequently to ensure survival. Ensure correct conditions for vegetation type.
Cross Vane Inspection	Once per year for 5 years and after major storms (2-year to 5-year)	Cross Vane continues to function, and cap stones remain ahead of footer stones	Stones in cross-vane have shifted off of footing stone	Move migrated cap stone back into place

7.2 Potential Effects on Social/Economic Environment

Existing and future developments throughout the Town of Cobourg and along Kerr Street will benefit greatly from the provision of an additional east-west arterial link as proposed for Kerr Street. Provision of this link will provide more efficient flow for vehicle traffic moving throughout the Town of Cobourg's road network, by helping to alleviate stress on remaining east-west links, as well as north-south conduits within the local road network. This segment of road will need to connect to other portions to complete the network in the future. In the long-term, there may be development opportunities for properties fronting onto Kerr Street.

The proposed flood ponding area will prevent flooding in areas downstream of Kerr Street and upstream of the CNR/CPR corridor, saving millions of dollars in flooding related costs (i.e. property damages, flood response from Town of Cobourg staff and emergency services, etc.). The proposed flood ponding area will also reduce the risk and frequency of flooding of the Division Street CNR/CPR underpass. The privately owned lands required to construct the flood ponding area will need to be acquired by the Town of Cobourg.

7.3 Potential Effects on the Engineering/Technical Environment

Some existing utilities (i.e. overhead hydro, sanitary sewer, watermain, etc.) may be affected as part of the construction project. Any affected utilities will need to be relocated as part of the construction in order to ensure that there are no impacts to residents and businesses that rely on those utilities.

8.0 Public Consultation

8.1 General

Public consultation is an integral component of the Class EA process because it allows residents, local businesses, stakeholder groups and external agencies to provide comments, identify issues and provide additional information and data. Public consultation included a Notice of Study Commencement and two (2) Public Information Centres (PICs). An additional PIC was hosted by Town of Cobourg and GRCA staff in advance of Wills' engagement in the project.

A project mailing list of stakeholders was developed for the purpose of study notices, meetings and information exchanges. The notices, agency contact list, and correspondence are located in public and agency consultation documentation in **Appendix A**.

8.2 Public Information Centre #1 (June 8, 2017)

The first PIC was held by the Town of Cobourg and GRCA to introduce the public to the project and discuss the purpose, problems/needs and opportunities. The conceptual drawing for the online pond was presented. A list of attendees was not available;

however, only one (1) comment sheet was received. The PIC materials and comments are included in **Appendix A**.

8.3 Public Information Centre #2 (November 29, 2017)

The second PIC was held by Wills in coordination with the Town of Cobourg and GRCA at the Cobourg Community Centre. The purpose of this PIC was to kick-off the Municipal Class EA Process, present the background information and problem statement, identify and evaluate alternative solutions and present the preferred alternative. Twelve (12) individuals signed in at the PIC and one (1) comment sheet was received. The PIC materials and comments are included in **Appendix A**.

8.4 Public Information Centre #3 (January 25, 2018)

The third PIC was held by Wills in coordination with the Town of Cobourg and GRCA at the Cobourg Community Centre. The purpose of this PIC was to present the alternative design concepts for the preferred alternative, show the evaluation of the alternative design concepts and present the details of the preferred alternative design concept. Twelve (12) individuals signed in at the PIC and three (3) comment sheets were received. The PIC materials and comments are included in **Appendix A**.

9.0 Permits and Approvals

9.1 Federal Approvals

The removal of fish habitat and subsequent reconstruction of the stream channel will require the submission of a request for review to the Department of Fisheries and Oceans (DFO). The result of the request for review will either be a letter of advice or a notice that an Authorization under the Fisheries Act is required. The request for review will be submitted to the DFO once the final design details are determined.

9.2 Provincial Approvals

The GRCA confirmed with the MNRF that an approval under the Lakes and Rivers Improvement Act (LRIA) is not required because the proposed water crossing meets the requirements of a water crossing in Section 2 (c) (i) of O.Reg. 454/96 and that the water crossing will be designed in accordance with MNRF guidelines (span less than 6 m, able to convey the 50-year storm). The correspondence between the GRCA and MNRF is included in **Appendix D**.

An Environmental Compliance Approval from the Ministry of the Environment, Conservation and Parks will be required to facilitate operation and maintenance of the proposed Kerr Street storm sewers and the flood ponding area.

A Permit to Take Water (PTTW) from the Ministry of the Environment, Conservation and Parks or submission to the Environmental Activity Sector Registry (EASR) may be required to facilitate dewatering during construction.

9.3 Local/Municipal Approvals

A permit from the GRCA will be required in order to alter the existing watercourse (Midtown Creek) and wetland, remove fill material from the floodplain and construct the on-line flood ponding area.

10.0 Conclusion

The purpose of this project was to assess the available measures for providing flood protection for properties upstream of the CNR and CPR corridor within the Midtown Creek floodplain, while incorporating the extension of Kerr Street from Division Street west to the railway spur as a means of creating upstream ponding of water during periods of high flow in Midtown Creek. Several alternatives were considered, including:

- Alternative 1 - Do Nothing
- Alternative 2 - Off-Line Flood Ponding Area Upstream of Kerr Street Right of Way
- Alternative 3 - On-Line Flood Ponding Area Upstream of Kerr Street Right of Way
- Alternative 4 - Increase Capacity of CNR and CPR Railway Culverts
- Alternative 5 - Off-Line Flood Ponding Area Upstream of Division Street
- Alternative 6 - Removal of Flood Prone Structures from Floodplain

The alternatives were evaluated based on their impact on the Natural Environment, Social Environment, Cultural Environment, Engineering / Technical Environment and Economic Environment. Alternative 3 was selected as the preferred alternative. A Public Information Center was held on November 29, 2017, that outlined the alternative solutions, the evaluation of alternatives and the preferred alternative.

Several alternative design concepts for the on-line flood ponding area were analyzed, including two (2) storage configurations and four (4) outlet structure types (a circular orifice plate, a circular orifice tube, a circular culvert and a rectangular orifice plate). The alternative design concepts were evaluated using the same criteria used to evaluate the alternative solutions. The preferred alternative design concept was selected as a flood ponding area west of the George Street right of way with an orifice plate (circular or rectangular) control structure. A Public Information Center was held on January 25, 2018, which detailed the alternative design concepts, the scoring, and the preferred alternative design concept.

Following the acceptance of this Environmental Study Report and upon receipt of the necessary approvals the preferred design concept will be implemented by the Town of Cobourg.

11.0 References

Environmental Impact Study, Wills, 2018.

Geotechnical Investigation Addendum Letter: Midtown Creek Flood Control Pond, WSP Canada Inc., 2016.

Kerr Street Ambient Monitoring Memorandum, RWDI, 2018.

Midtown Creek Fisheries Assessment, GRCA, 2016.

Midtown Creek Hydraulic Assessment and Flood Plain Mapping, Final Report, Greenland Consulting Engineers, 2008.

Midtown Creek Hydrology Report, GRCA, 2007.

Midtown Creek Terrestrial Ecology Study, GRCA, 2016.

Town of Cobourg Official Plan, 2017.

Town of Cobourg Preliminary Design of a Conceptual Flood Detention Pond: Chris Garrett Park – Midtown Creek, Draft Report, GRCA, 2012.

Town of Cobourg Preliminary Design of a Conceptual Detention Pond on Midtown Creek, GRCA, 2012.

Preliminary Geotechnical and Environmental Study: Midtown Creek Flood Control Pond, WSP Canada Inc., 2016.

Stage 1 and 2 Archaeology Report, Amick Consultants Limited, 2017.

Tree Inventory and Mitigation Plan, Treescape, 2018.

Appendix A

Public and Agency Consultation

Notices

THE CORPORATION OF THE TOWN OF COBOURG

Corporate Communications Department
Telephone (905) 372-4301
Toll Free 1-888-972-4301
Fax (905) 372-7421
Email: communications@cobourg.ca

PUBLIC NOTICE

Public Meeting Set for Midtown Creek Ponding Area and Kerr Street Extension

Cobourg, ON (Issued November 9, 2017 at 4:20 p.m. EST) – The Town of Cobourg would like to advise all residents that a Public Meeting has been scheduled for the Midtown Creek Ponding Area and Kerr Street Extension from Division Street to the Railway Spur.

In accordance with the requirements for Schedule C projects of the Municipal Class Environmental Assessment, the Town is making preliminary study material and plans available for review at the first mandatory public meeting to be held:

Wednesday, November 29, 2017.
5:00pm to 7:00pm
HTM Room at the Cobourg Community Centre (750 D'Arcy Street)

The Town of Cobourg is conducting a Municipal Class Environmental Assessment (Class EA) study to assess the available measures for providing flood protection for structures upstream of the existing railway corridor that crosses Midtown Creek. The Study will incorporate the extension of Kerr Street from Division Street to the railway spur in order to create upstream overbank ponding of water during periods of high Midtown Creek flows.

This notice indicates the commencement of the Class Environmental Assessment, a study which will define the problem, identify and evaluate alternative solutions and designs, and finally determine a preferred design in consultation with regulatory agencies and the public. The Study is being carried out in accordance with the planning and design process for Schedule ‘C’ projects as outlined in the Municipal Class Environmental Assessment (October 2000, as amended in 2007), which is approved under the Ontario Environmental Assessment Act. This Study will satisfy Phases 1 to 5 of the Class EA process and will require two (2) Public Information Centres (PICs).

Upon completion of the Study, an Environmental Study Report (ESR) will be prepared and made available for public review and comment. It is expected this study will be completed during the winter of 2017/2018 and the preferred design alternative will go to construction in the summer of 2018.

During the public meeting, the Town’s consultants as well as Ganaraska Region Conservation Authority and Town staff will be available to discuss issues and concerns with members of the public. Thereafter, input and comment will be accepted by the consultants for a period of two weeks.

-30-

Media Contacts

Ashley Purdy, CMP
Communications Officer
Town of Cobourg
p: 905-372-4301 x 4105
e: apurdy@cobourg.ca

Laurie Wills, P.Eng
Deputy Director of Public Works
Town of Cobourg
p: 905-372-9971
e: lwills@cobourg.ca

About The Town of Cobourg

The Town of Cobourg is a lakeside community (population 19,440) located on the north shore of Lake Ontario halfway between Toronto and Kingston and has been recognized multiple times by MoneySense Magazine as “One of Canada’s Best Places to Live” in populations under 25,000.

Founded in 1798, Cobourg is rich in heritage offering a vibrant downtown, sophisticated small town atmosphere and renowned waterfront that serves as a popular getaway destination. As the largest town in Northumberland County, Cobourg is personified by historic Victoria Hall, hosts a 27.4 million community centre, an educated and skilled labour force, flourishing commercial sector and supportive municipal government. Cobourg has received the Federation of Canadian Municipalities Sustainable Communities Award, accolades from the Accessibility for Ontarians with Disabilities Act Alliance, and multiple heritage, environmental, and event awards.

NorthumberlandNews.com

Cobourg to host public meeting for Midtown Creek pond and Kerr Street extension

News Nov 12, 2017 Northumberland News

COBOURG – The Town of Cobourg will host a public meeting on Nov. 29 for the Midtown Creek ponding area and Kerr Street extension from Division Street to the railway spur. An environmental assessment study is being conducted to assess the available measures for providing flood protection for structures upstream of the existing railway corridor that crosses Midtown Creek. November 10, 2017. - Submitted photo

COBOURG — The Town of Cobourg will be hosting a public meeting for the Midtown Creek ponding area and Kerr Street extension from Division Street to the railway spur on Nov. 29.

A municipal class environmental assessment study is being conducted to assess the available measures for providing flood protection for structures upstream of the existing railway corridor that crosses Midtown Creek.

The study will incorporate the extension of Kerr Street from Division Street to the railway spur in order to create upstream overbank ponding of water during periods of high Midtown Creek flows.

Preliminary study material and plans will be made available for review at the first mandatory public meeting on Wednesday, Nov. 29, to be held from 5 to 7 p.m. in the HTM room at the Cobourg Community Centre.

Two public information centres are required and will be held as part of the process.

Upon completion of the study, an environmental study report will be prepared and made available for public review and comment.

It is expected this study will be completed during the winter of 2017/2018 and the preferred design alternative will go to construction in the summer of 2018.

During the public meeting, the town's consultants as well as Ganaraska Region Conservation Authority and town staff will be available to discuss issues and concerns with members of the public.

Input and comment will be accepted by the consultants for a period of two weeks.

Tags: **Local News (/search/allarticles/?q=&location=northumberlandcounty&ttid=7)**, **Politics (/search/allarticles/?q=&location=northumberlandcounty&ttid=8)**, **Events (/search/allarticles/?q=&location=northumberlandcounty&ttid=24)**, **News (/northumberlandcounty-news/)**

Cobourg Home

Citizens Invited to Attend Midtown Creek Flood Control Public Meeting

Posted on Wednesday January 10, 2018

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(https://www.cobourg.ca/subscribe?newsId=282a074f-d23d-466f-98ad-fad2ab859497)

Cobourg, ON (Issued January 10, 2018 at 9:50 a.m. EST) – The Town of Cobourg would like to invite citizens to attend a public information meeting for the Midtown Creek Flood Control Ponding Area and Kerr Street Extension to Division Street West to the railway spur, Class Environmental Assessment (EA).

The Town of Cobourg is conducting a Municipal Class Environmental Assessment (Class EA) study to assess the available measures for providing

(https://icreate6.esolutionsgroup.ca/2300
3c84-4d9e-acdb-d6567713d8da)

flood protection for structures upstream of the existing railway corridor that crosses Midtown Creek. The Study will incorporate the extension of Kerr Street from Division Street to the railway spur in order to create upstream overbank ponding of water during periods of high Midtown Creek flows.

The Study is being carried out in accordance with the planning and design process for Schedule 'C' projects as outlined in the Municipal Class Environmental Assessment (October 2000, as amended in 2007), which is approved under the Ontario Environmental Assessment Act. The Study that will define the problem, identify and evaluate alternative solutions and designs, and finally determine a preferred design in consultation with regulatory agencies and the public. This Study will satisfy Phases 1 to 5 of the Class EA process and will require two (2) Public Information Centres (PICs).

The 1st mandatory PIC held on November 29, 2017 presented the problem statement, alternative solutions to the problem statement, and identified the preferred solution which completed Phases 1 and 2 of the EA process. Currently, the Study is at the conclusion of Phase 3 of the EA process where the design alternatives have been evaluated and a preferred design concept has been identified for public comment.

Upon the successful completion of Phase 3, an Environmental Study Report (ESR) will be prepared and made available for public review and comment. It is expected this study will be completed during the winter of 2017/2018 and the preferred design alternative will go to construction in the summer of 2018.

In accordance with the requirements for Schedule C projects of the Municipal Class Environmental Assessment, the Town is making preliminary study material and plans available for review at the second mandatory public meeting to be held:

Thursday, January 25, 2018

5 p.m. to 7 p.m.

Cameco 'C' Room at the Cobourg Community Centre (750 D'Arcy Street)

During the public meeting, the Town's consultants as well as Ganaraska Region Conservation Authority and Town staff will be available to discuss issues and concerns with members of the public. Thereafter, input and comment will be accepted by the consultants for a period of two weeks. For further information on the project, or on the planning process being followed please see the contact information provided.

Mr. David Green, P.Eng. Assistant Manager, Water Resources D.M. Wills Associates Limited 150 Jameson Drive Peterborough, ON K9J 0B9 (705) 742-2297 dgreen@dmwills.com (mailto:dgreen@dmwills.com)	Ms. Laurie Wills, P.Eng. Deputy Director of Public Works Town of Cobourg 740 Division Street, Bldg. #7 Cobourg, ON K9A 0H6 (905) 372-9971 lwills@cobourg.ca (mailto:lwills@cobourg.ca)

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NorthumberlandNews.com

Second meeting for Midtown Creek pond and Kerr Street extension coming to Cobourg

News Jan 11, 2018 **Northumberland News**

COBOURG – The Town of Cobourg will be hosting a second public meeting on Jan. 25 for the Midtown Creek pond and Kerr Street extension from Division St. to the railway spur. Currently, the study is at the conclusion of phase 3 of the EA process, where the design alternatives have been evaluated and a preferred design concept has been identified for public comment. January 11, 2018. - Submitted photo

COBOURG -- Citizens are invited to attend a second public meeting for the Midtown Creek flood control and Kerr Street extension.

The Town of Cobourg is conducting a municipal class environmental assessment (Class EA) study to assess the available measures for providing flood protection for structures upstream of the existing railway corridor that crosses Midtown Creek.

The study will incorporate the extension of Kerr Street from Division Street to the railway spur in order to create upstream overbank ponding of water during periods of high Midtown Creek flows.

During the first mandatory meeting held on Nov. 29, the town presented the problem statement, alternative solutions to the problem statement, and identified the preferred solution which completed phases 1 and 2 of the EA process.

Currently, the study is at the conclusion of phase 3 of the EA process, where the design alternatives have been evaluated and a preferred design concept has been identified for public comment.

Upon the successful completion of phase 3, an environmental study report will be prepared and made available for public review and comment.

It is expected this study will be completed during the winter of 2017/2018 and the preferred design alternative will go to construction in the summer of 2018.

The meeting will be held on Thursday, Jan. 25 from 5 to 7 p.m. in Cameco 'C' Room at the Cobourg Community Centre, 750 D'Arcy Street, Cobourg.

During the public meeting, the town's consultants as well as Ganaraska Region Conservation Authority and town staff will be available to discuss issues and concerns with members of the public.

Thereafter, input and comment will be accepted by the consultants for a period of two weeks.

For further information on the project, or on the planning process being followed contact David Green, assistant manager, Water Resources D.M. Wills Associates Limited at 705-742-2297 or dgreen@dmwills.com (mailto:dgreen@dmwills.com).

Tags: **Local News (/search/allarticles/?q=&location=northumberlandcounty&ttid=7)**, **News (/northumberlandcounty-news/)**

Schedule C

Class Environmental Assessment

The Corporation of the Town of Cobourg

Midtown Creek Ponding Area and Kerr Street Extension

Notice of Completion of Environmental Study

The Project

In response to historical and recent flooding events along Midtown Creek upstream of the Canadian National Railway (CNR) and Canadian Pacific Railway (CPR) corridor, the Town of Cobourg is proposing to establish an on-line flood ponding area upstream of the Kerr Street right of way.

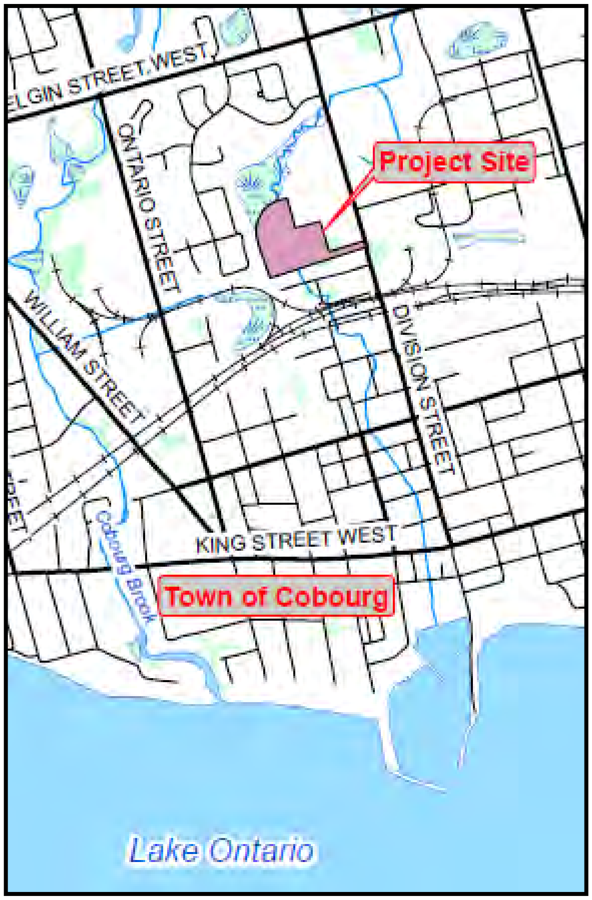
The Process

The Town has planned this project under Schedule C of the Municipal Class Environmental Assessment process. The Environmental Study Report has been completed by way of this Notice and is now being made available for public review and comment.

Public Consultation

Interested persons should provide written comments to the Town on the proposal within 30 calendar days from the date of this Notice. The Environmental Study Report is available for public viewing online on the Town of Cobourg's website (www.cobourg.ca) and in person during regular business hours at the Town of Cobourg Public Works Office (740 Division Street, Building 7 Cobourg, ON).

Key Map



For additional information on the Project and how to submit your comments please go to: www.cobourg.ca

Schedule C

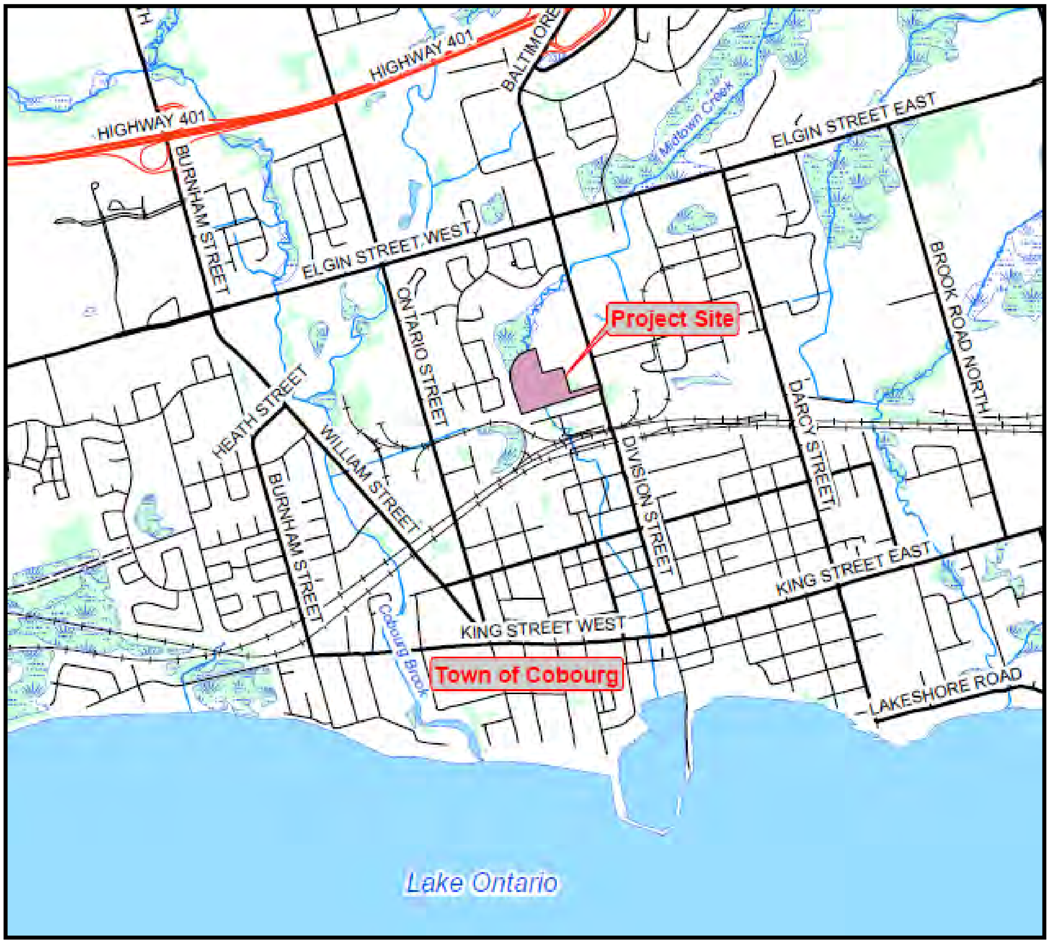
Class Environmental Assessment

The Corporation of the Town of Cobourg

Midtown Creek Ponding Area and Kerr Street Extension

Notice of Completion

In response to historical and recent flooding events along Midtown Creek upstream of the Canadian National Railway (CNR) and Canadian Pacific Railway (CPR) corridor, the Town of Cobourg is proposing to establish an **On-Line Flood Ponding Area Upstream of the Kerr Street Right of Way.** This project incorporates the extension of Kerr Street from Division Street west to the railway spur as a means of creating upstream ponding of water during periods of high flows in Midtown Creek.



The Town has planned this project under **Schedule C** of the **Municipal Class Environmental Assessment** process. The Environmental Study Report has been completed by way of this Notice and is now being made available for public review and comment. Subject to comments received as a result of this Notice and the receipt of necessary approvals, the Town intends to complete the detailed design of the preferred design alternative and proceed to construction in 2019.

The Environmental Study Report is available for review at www.cobourg.ca and at the following location:

Town of Cobourg Public Works Office
740 Division Street, Building 7
Cobourg, ON K9A 0H6
Mon-Fri: 8:30am – 4:30pm

Interested persons should provide written comments to the Town on the proposal within 30 calendar days from the date of this Notice. Comments should be directed to the Director of Public Works.

A person or party may request that the Minister of the Environment, Conservation and Parks order a change in the project status and require a higher level of assessment under an individual Environmental Assessment process (referred to as a Part II Order). Reasons must be provided for the request. Copies of the Request Form must be sent to:

Minister
Ministry of the Environment, Conservation and Parks
77 Wellesley Street West
11th Floor
Toronto, ON M7A 2T5

-and-

Director, Environmental Assessment and Permissions Branch
Ministry of the Environment, Conservation and Parks
135 St. Clair Avenue West
1st Floor
Toronto, ON M4V 1P5

-and-

Director of Public Works
Town of Cobourg
740 Division Street, Building 7
Cobourg, ON K9A 0H6

Please note that ALL personal information included in a Part II Order submission – such as name, address, telephone number and property location – is collected, maintained and disclosed by the Ministry of the Environment, Conservation and Parks for the purpose of transparency and consultation. The information is collected under the authority of the Environmental Assessment Act or is collected and maintained for the purpose of creating a record that is available to the general public as described in s.37 of the Freedom of Information and Protection of Privacy Act. Personal information you submit will become part of a public record that is available to the general public unless you request that your personal information remain confidential. For more information, please contact the Ministry's Freedom of Information and Privacy Coordinator at 416-327-1434.

Agency Correspondence

Midtown Creek Ponding Area and Kerr Street Extension
Municipal Class Environmental Assessment
Agency/Stakeholder Contact List

Title	First Name	Last Name	Job Title	Company	Address1	Address2	City	Province	Postal Code
Mr.	Trevor	Griffin	District Manager, Peterborough	Ministry of Natural Resources	South Tower, 1st Floor	300 Water Street	Peterborough	Ontario	K9J 8M5
Ms.	Sharon	Rew	Regional Director	Ministry of Natural Resources	South Tower, 4th Floor	300 Water Street	Peterborough	Ontario	K9J 8M5
Dr.	Lynn	Noseworthy	Medical Officer of Health	Haliburton Kawartha Pine Ridge District Health Unit	200 Ross Glen Road		Port Hope	Ontario	L1A 3V6
Mr.	David	Bradley	Manager, Peterborough District	Ministry of the Environment and Climate Change	Robinson Place, South Tower, 2nd Floor	300 Water Street	Peterborough	Ontario	K9J 3C7
Ms.	Annamaria	Cross	Manager of Environmental Assessment Services	Ministry of the Environment and Climate Change	1st Floor	135 St. Clair Ave. West	Toronto	Ontario	M4V 1P5
Ms.	Hollee	Kew	Director, Eastern Region	Ministry of the Environment and Climate Change	P.O.Box 22032		Kingston	Ontario	K7M 8S5
Mr.	Jim	Sherratt	Manager, Archaeology Program Unit	Ministry of Tourism, Culture, and Sport	Suite 1700	401 Bay Street	Toronto	Ontario	M7A 0A7
Mr.	James	Hamilton	Manager, Heritage Program Unit	Ministry of Tourism, Culture, and Sport	401 Bay Street		Toronto	Ontario	M7A 0A7
				Fisheries and Oceans Canada	867 Lakeshore Road		Burlington	Ontario	L7S 1A1
				Environment Canada	4905 Dufferin Street		Toronto	Ontario	M3H 5T4
Mr.	Dereck	Paul	President	Lakefront Utility Services Inc.	207 Division Street	P. O. Box 577	Cobourg	Ontario	K9A 4L3
				Ministry of Indigenous and Northern Affairs Canada	25 St. Clair Avenue East	8th Floor	Toronto	Ontario	M4T 1M2
Mr.	Greg	Wells	Manager Planning and Regulations	Ganaraska Region Conservation Authority (Conservation Ontario)	2216 County Road 28	Box 328	Port Hope	Ontario	L1A 3W4
Ms.	Kelly	Brown	Director, Policy and Planning Branch	Ministry of Infrastructure	Mowat Block 5th Floor	900 Bay Street	Toronto	Ontario	M7A 1C2
				Ministry of Municipal Affairs	College Park 2nd Floor	777 Bay Street	Toronto	Ontario	M5G 2E5
			Programs	Transport Canada	4900 Yonge Street	Government of Canada Building	North York	Ontario	M2N 6A5
Ms.	Kathryn	Moore	Regional Director, Eastern Region	Ministry of Transportation	1355 John Counter Blvd	PO Box 4000	Kingston	Ontario	K7L 5A3
Ms.	Bev	Mollard	Vice President, Operations	Ontario Clean Water Agency	1 Yonge Street	17th Floor	Toronto	Ontario	M5E 1E5
Ms.	Valery	Maidens		Bell Canada	183 Hunter Street	2nd Floor	Peterborough	Ontario	K9J 7B4
Mr.	Ed	Gouweloos	Utility Services/Construction Manager	Union Gas Limited	520 Thompson Road		Cobourg	Ontario	K9A 4M3
Chief	Laurie	Carr		Hiawatha First Nation	123 Paudash Street		Hiawatha	Ontario	K9J 0E6

Midtown Creek Ponding Area and Kerr Street Extension
Municipal Class Environmental Assessment
Agency/Stakeholder Contact List

Title	First Name	Last Name	Job Title	Company	Address1	Address2	City	Province	Postal Code
Chief	R. Donald	Maracle		Mohawks of the Bay of Quinte	24 Meadow Drive		Tyendinaga Mohawk Territory	Ontario	K0K 1X0
Chief	Kelly	LaRocca		Mississaugas of Scugog Island	22521 Island Road	Administration Building	Port Perry	Ontario	L9L 1B6
Chief	Phyllis	Williams		Curve Lake First Nation	22 Winookeedaa Road		Curve Lake	Ontario	K0L 1R0
Chief	Donna	Big Canoe		Chippewas of Georgina Island	RR2	P.O. Box N-13	Sutton West	Ontario	L0E 2X0
Chief	James	Marsden		Alderville First Nation	PO Box 46		Roseneath	Ontario	K0K 2X0
	Patrick	Madahbee	Grand Council Chief	Union of Ontario Indians	P.O. Box 711		North Bay	Ontario	P1B 8J8
Ms.	Jennifer	Leclerc	Director of Education	Kawartha Pine Ridge District School Board	1994 Fisher Drive		Peterborough	Ontario	K9J 7A1
Mr.	Michael	Nasello	Director of Education	Peterborough, Victoria, Northumberland and Clarington Catholic District School Board	1355 Lansdowne Street West		Peterborough		K9J 7M3
Ms.	Sandra	Arthur		Delcom Management	P.O. Box 415		Cobourg	Ontario	K9A 4L1
			Engineering Services	CN Rail	4 Welding Way	P.O. Box 1000	Concord	Ontario	K4K 1B9
Mr.	Kai	Lui	Chief of Police	Cobourg Police Services	107 King Street West		Cobourg	Ontario	K9A 2M4
Mr.	Bill	Detlor	Chief (Director)	Northumberland Paramedics	555 Courthouse Road		Cobourg	Ontario	K9A 5J6
Mr.	Mike	Vilneff	Chief	Cobourg Fire Department	111 Elgin Street East		Cobourg	Ontario	K9A 1A1
Mr.	Wayne	Bird		Cogeco	259 Division Street	Unit F	Cobourg	Ontario	M9A 3P9
Mr.	Dwayne	Campbell	Land Use Planning Manager	Northumberland County	555 Courthouse Road		Cobourg	Ontario	K9A 5J6
				Canadian Pacific Railway	7550 Ogden Dale Road S.E.		Calgary	Alberta	T2C 4X9
Mr.	Richard	Hart			1295 Morningside Ave.	#20	Scarborough	Ontario	M1B 4Z4
Mr.	Tom	Behan		Behan Construction Limited	P.O. Box 596		Cobourg	Ontario	K9A 4L3
Mr.	Dan	Dunkley		Canada Pallet Limited	755 Division Street		Cobourg	Ontario	K9A 3T1

From: Laurie Wills <lwills@cobourg.ca>
Sent: March-02-18 11:04 AM
To: David Green
Cc: Mark Spiers
Subject: Canada Pallet
Attachments: doc04542020180302110925.pdf

Hi,
My meeting with Canada Pallet was good yesterday but a few things came up.

I've had concerns about not having a noise study done and inquired with RWDI a while back, still trying to connect with them as another issue was brought to light yesterday. Once all the trees are down, Canada Pallet is going to seem a lot louder to people around them. I think I need to be hiring a noise consultant to cover the Kerr Street extension and Canada Pallet concerns. Can you ask around about other noise consultants who I could contact to get quotes from?

The 20m setback from the gravel area is not correct. The aerial photo we have been using of the gravel area shows trees right up to the gravel when in fact they have cleared about 100' west of this and that is the limit we should be aiming for. So 20m setback just became 30m. if that doesn't work, it's not a deal breaker but please check.

The other thing he brought up was extending his access platform along the spur line by another 150'. This means a 10m built up platform to the south of the spurline for a distance of 150' past the existing platform.
We are going to need survey to confirm all of this. See attached sketch of google maps. Please check to see if this impacts the pond volume too much. The slopes can be steeper along the spur line and Canada pallet property line since we don't want people accessing those areas anyway.

I have a signed permission to enter for the tree removals at least. I'll have to negotiate the rest of these requests when we do the legal transfer of land.

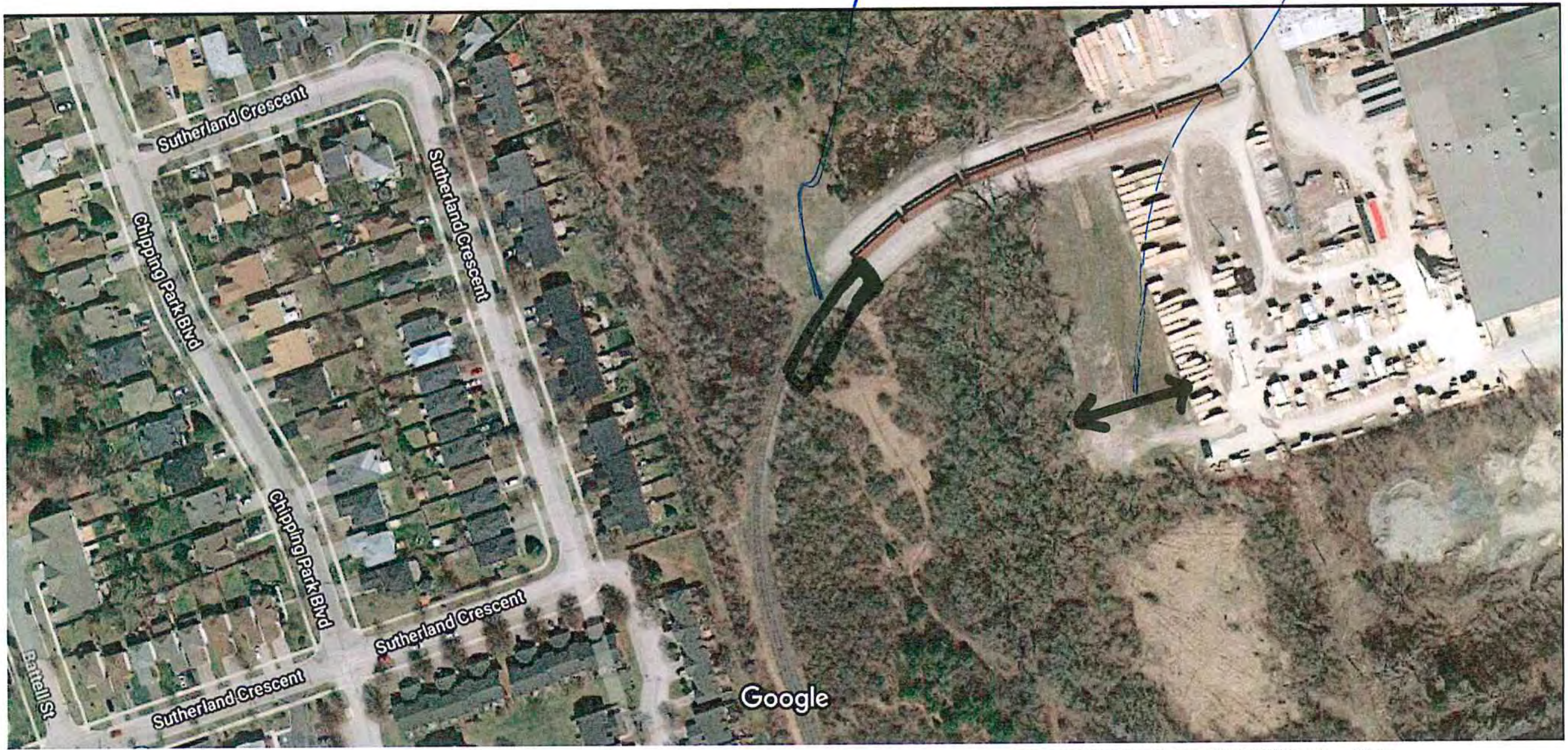
…..Laurie

Laurie Wills, P. Eng.
Deputy Director of Public Works
Town of Cobourg
740 Division Street, Building 7
Cobourg, ON K9A 0H6
www.cobourg.ca
(p) 905.372.9971 Ext. 4350
(f) 905.372.0009

Google Maps

Buchanan St

Canada Pallet



10m wide Platform to accommodate 2 more 75' rail cars.

~100' (30m)

Imagery ©2018 Google, Map data ©2018 Google 50 m

From: Laurie Wills <lwills@cobourg.ca>
Sent: February-06-18 3:21 PM
To: David Green
Cc: Mark Spiers
Subject: CN setbacks

Hi there,

I finally talked to someone at CN regarding setbacks. We have to be setback 10' from the rail tie and from there a 2:1 slope is allowed.

Preferably we're not even working within their property line but if we are, as long as we meet those two conditions, we'll be fine but we'll need permission to enter and construct, etc.

They may want us to put up some orange fencing or signage along the property line just to make the conductors aware that construction is happening adjacent to the site.

Let me know what you're proposing for a limit of grading and I'll relay the message to CN.

.....Laurie

Laurie Wills, P. Eng.
Deputy Director of Public Works
Town of Cobourg
740 Division Street, Building 7
Cobourg, ON K9A 0H6
www.cobourg.ca
(p) 905.372.9971 Ext. 4350
(f) 905.372.0009

From: Laurie Wills <lwills@cobourg.ca>
Sent: December-07-17 3:38 PM
To: deMoissac, Daniel (MTCS); David Green
Subject: RE: Midtown Creek Ponding Area and Kerr Street Extension - Request for PIC slides

Thank you for your comments and please note that it was in error for us to use terminology implying that the archaeological aspect of this project has been addressed. We understand that the report has to be reviewed and cleared by the Ministry before the EA can be completed.

We have completed a Stage 1 and 2 assessment however the consultant has just been authorized today to submit the final report to the Ministry.

Could you please advise when we could expect the report to be reviewed given that the report is currently being submitted to the Ministry? I would like to understand if we should be requesting an expedited review.

Thank you,

…..Laurie

Laurie Wills, P. Eng.
Deputy Director of Public Works
Town of Cobourg
740 Division Street, Building 7
Cobourg, ON K9A 0H6
www.cobourg.ca
(p) 905.372.9971 Ext. 4350
(f) 905.372.0009

From: deMoissac, Daniel (MTCS) [mailto:Daniel.deMoissac@ontario.ca]
Sent: Thursday, December 7, 2017 3:29 PM
To: dgreen@dmwills.com
Cc: Laurie Wills <lwills@cobourg.ca>
Subject: RE: Midtown Creek Ponding Area and Kerr Street Extension - Request for PIC slides

Dear David Green,

Thank you for providing the link to the PIC materials that were presented on November 29th. After review, and further to our comments sent on December 5th, MTCS has the following additional comments:

Regarding archaeology, your PIC materials state that a “Stage 1-2 Archaeological Assessment has been completed” and that “the provincial interest in archaeology has been addressed”. Please note that this is not consistent with MTCS records. MTCS records indicate that a Stage 1-2 Archaeological Assessment PIF (P058-1557-2017) number has been issued; however, the licensed archaeologist has not yet filed the report with MTCS.

Below is some information regarding the archaeology review process:

The ministry has a role to regulate archaeology by licensing archaeologists under the *Ontario Heritage Act (OHA)*. The ministry reviews archaeological assessment reports as a condition of licensing in accordance with Part VI of the OHA. This review is to ensure that the licensed professional consultant archaeologist has met the terms and conditions of their archaeological licence, that archaeological sites have been identified and documented according to the standards set by the Ministry, and that the archaeological fieldwork and report recommendations ensure the conservation, protection and preservation of the cultural heritage of Ontario.

Once reviewed, ministry staff provides the consultant archaeologist with a letter that comments on the archaeological assessment report. If the report complies with the *Standards and Guidelines for Consultant Archaeologists (2011)*, the letter informs the licensee that the report has been accepted. The letter is copied to the development proponent and the approval authority (e.g. municipality and/or MOECC). Approval authorities often use the letter to address legislative requirements, and more broadly, to address concerns for due diligence.

Therefore, your Stage 1-2 Archeological Assessment report must be submitted to MTCS and accepted into the register in advance of EA completion and prior to any ground disturbance. The licensed archaeologist may request on behalf of the proponent that the review be expedited.

I hope that the above information is helpful. Feel free to contact me should you have any questions.

Regards,

Daniel de Moissac

Daniel de Moissac
Heritage Planner (Acting)
Heritage Program Unit | Programs and Services Branch | Ministry of Tourism, Culture and Sport
401 Bay Street Suite 1700 Toronto ON M7A 0A7
daniel.demoissac@ontario.ca

From: Laurie Wills [mailto:lwills@cobourg.ca]
Sent: December-06-17 8:33 AM
To: deMoissac, Daniel (MTCS)
Subject: RE: Midtown Creek Ponding Area and Kerr Street Extension - Request for PIC slides

Good morning,

Please follow this link to see the PIC information slides.

https://www.cobourg.ca/en/have-your-say.aspx

…..Laurie

Laurie Wills, P. Eng.
Deputy Director of Public Works
Town of Cobourg
740 Division Street, Building 7
Cobourg, ON K9A 0H6
www.cobourg.ca
(p) 905.372.9971 Ext. 4350
(f) 905.372.0009

From: deMoissac, Daniel (MTCS) [mailto:Daniel.deMoissac@ontario.ca]
Sent: Monday, December 4, 2017 2:15 PM
To: Laurie Wills <lwills@cobourg.ca>
Subject: Midtown Creek Ponding Area and Kerr Street Extension - Request for PIC slides

Dear Laurie Wills,

I am reaching you on behalf of the Ministry of Tourism, Culture and Sport (MTCS) in order to provide comments on the ‘Midtown Creek Ponding Area and Kerr Street Extension’ project, as a part of the Municipal Class Environmental Assessment process.

Would you be able to forward me the PIC slides material from the November 29th public meeting regarding this project?

Thanks in advance,

Daniel de Moissac

Daniel de Moissac
Heritage Planner (Acting)
Heritage Program Unit | Programs and Services Branch | Ministry of Tourism, Culture and Sport
401 Bay Street Suite 1700 Toronto ON M7A 0A7
Tel. 416.314.5424 | email: daniel.demoissac@ontario.ca

Ministry of Tourism, Culture and Sport

Archaeology Programs Unit
Programs and Services Branch
Culture Division
401 Bay Street, Suite 1700
Toronto ON M7A 0A7
Archaeology@ontario.ca

Ministère du Tourisme, de la Culture et du Sport

Unité des programmes d'archéologie
Direction des programmes et des services
Division de culture
401, rue Bay, bureau 1700
Toronto ON M7A 0A7
Archaeology@ontario.ca

Dec 19, 2017

Michael Henry (P058)
AMICK Consultants Limited
553 Dufferin London ON N6B 2A5

RE: Entry into the Ontario Public Register of Archaeological Reports: Archaeological Assessment Report Entitled, "Stage 1-2 Archaeological Assessment of Part of Lot 17, Concession A (Geographic Township of Hamilton, County of Northumberland) Town of Cobourg, County of Northumberland", Dated Dec 7, 2017, Filed with MTCS Toronto Office on Dec 18, 2017, MTCS Project Information Form Number P058-1557-2017, MTCS File Number 0008043

Dear Mr. Henry:

The above-mentioned report, which has been submitted to this ministry as a condition of licensing in accordance with Part VI of the Ontario Heritage Act, R.S.O. 1990, c 0.18, has been entered into the Ontario Public Register of Archaeological Reports without technical review.[1]

Please note that the ministry makes no representation or warranty as to the completeness, accuracy or quality of reports in the register.

Should you require further information, please do not hesitate to send your inquiry to Archaeology@Ontario.ca

cc. Archaeology Licensing Officer
Mark Peacock,Ganaraska Region Conservation Authority
n/a n/a,Cobourg

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[1] In no way will the ministry be liable for any harm, damages, costs, expenses, losses, claims or actions that may result: (a) if the Report(s) or its recommendations are discovered to be inaccurate, incomplete, misleading or fraudulent; or (b) from the issuance of this letter. Further measures may need to be taken in the event that additional artifacts or archaeological sites are identified or the Report(s) is otherwise found to be inaccurate, incomplete, misleading or fraudulent.

Public Information Centre #1

Welcome to….

A public information session on the:

Midtown Creek Flood Control Ponding Area and Kerr Street Extension – Division Street West to Railway Spur Class Environmental Assessment

June 8, 2017

Cobourg
Ontario, Canada

Ganaraska
CONSERVATION

Description of Work from Appendix I of Class EA - Project Schedules

General Operation and Maintenance of Linear Paved Facilities and Related Facilities (Schedule B)

21. Construction of new Roads or other linear paved facilities <2.4m

Wastewater Management Project (Schedule B)

17. Works undertaken in a watercourse for the purposes of flood control or erosion control which may include:

- Bank and slope regrading
- Deepening the watercourse
- Relocation, realignment of channelization of watercourse
- Revetment including soil bi-engineering techniques
- Reconstruction of weir or dam

Project Problem Statement:

To identify and evaluate alternatives to maximize flood protection of downstream structures as a result of the extension of Kerr Street between Division Street and the railway spur.

Purpose of the Project:

To assess the available measures for providing flood protection for structures upstream of the existing railway corridor that crosses Midtown Creek. The study will incorporate the extension of Kerr Street from Division Street to the railway spur in order to create upstream overbank ponding of water during periods of high Midtown Creek flows.

Problems/Needs:

- Flooding during extreme events along Midtown Creek occurs from Elgin Street to the CNR and CPR Railway corridor. If a number of improvements are not made this flooding will continue.
- Without specific improvements, the most significant flood damage area (between Kerr Street and the Railways) will continue to be flooded by Midtown Creek during high flow events.
- The Transportation Master Plan suggests that the existing east-west road network in Cobourg will experience capacity or over capacity conditions without the construction of Kerr Street.

Opportunities:

- Construction of the extension of Kerr Street will allow upstream ponding of Midtown Creek to be maximized during periods of high flow and increase protection of downstream structures.
- Kerr Street from Westwood Drive to D’Arcy Street has been recommended for construction between 2011 and 2021 in the Transportation Master Plan. The subject road is located within this recommended section of Kerr Street.

Midtown Creek Flooding January 25, 2010 versus Typical Flow, June 2, 2017

Midtown Pond Concept April 2015 Revisions

1:2,500

🟥 Future Pond Area
🟥 Future Kerr Street Extenstion Area

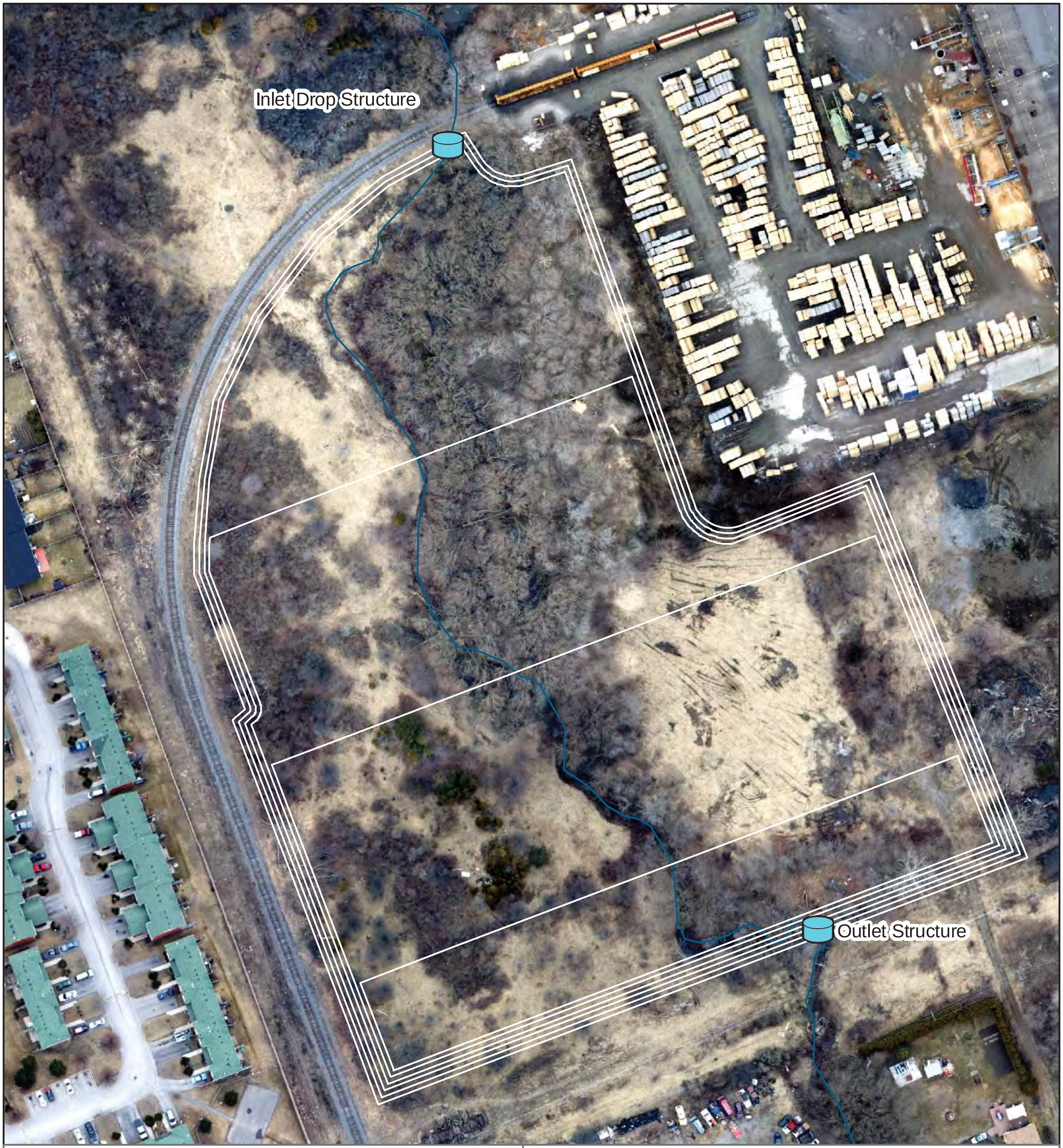


Figure # 3
Conceptual Online Pond

● Inlet Outlet Structure

— Detail_S4_Pond_Contours

— Creek

Cobourg
Ontario, Canada

N

0 12.5 25 50 75 100
Meters
1:1,500

This map is for information purposes only and the Ganaraska Region Conservation Authority takes no responsibility for, nor guarantees, the accuracy of the information contained within the map.

Prepared by Ganaraska Region Conservation Authority: June 2010.

Produced using information provided by the Ministry of Natural Resources, GRCA and other municipal sources

Ganaraska
CONSERVATION

Ganaraska Region
Conservation Authority
2216 County Road 28
Port Hope, ON
L1A 3W8
Phone: 905-885-8173
Fax: 905-885-9824
www.grca.on.ca

Midtown Creek Flood Control Ponding Area, Kerr Street Extension – Division Street West to Railway Spur

We'd like your comments.....

Name:
Address:

Postal Code:
Telephone Number:
Email:

What comments about the project do you have?

My Proposal is while Putting Kurr Street in Expand George Street or carry Buckanannan Street up to turn around and connect to End of Kerr Street Extension.

Reason For connecting and opening the George Street area to it could be better trafic control.

It is sometimes impossible to get onto division Street in mid time periods of the day.

Since the roadway narrowing there has already been accidents on that stretch of Road (Division & Buchannan.) Move to Kurr Street and Put a set of lights in For better Flow control.

Public Information Centre #2

Welcome

Town of Cobourg
Midtown Creek Flood Ponding Area and Kerr Street Extension from Division Street to the Railway Spur

Schedule C Municipal Class Environmental Assessment

Public Information Centre
- Open House -

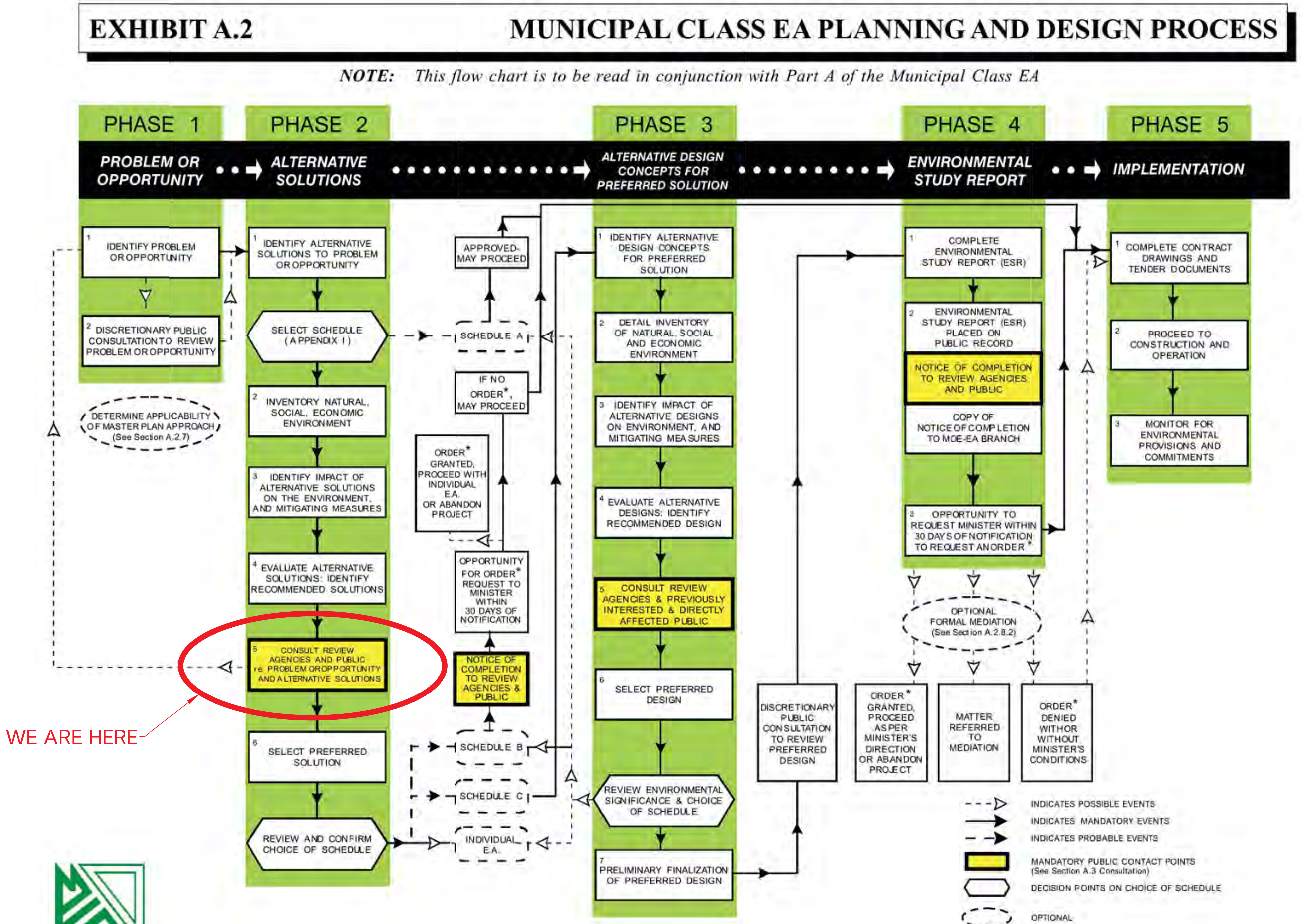
November 29, 2017

Please sign in and take an information package and comment sheet.

Feel free to provide written input or comment using the comment sheets provided or by contacting the identified representatives of the Town of Cobourg or its consultant for this project (D.M. Wills Associates Limited).

Representatives of the Town of Cobourg and D.M. Wills Associates Limited are available to discuss questions or concerns you may have regarding this project.

Municipal Class Environmental Assessment Process



WE ARE HERE

Town of Cobourg
Midtown Creek and Kerr Street - Municipal Class EA
Public Information Centre #2

Phase 1 - Problem or Opportunity

Phase 1: Identification of Problem or Opportunity

General Location Plan

Problem / Opportunity Statement

- **The study will identify and evaluate alternatives to maximize flood protection for downstream properties within the Midtown Creek floodplain as a result of the extension of Kerr Street between Division Street and the railway spur.**

Study Area

- The Study Area generally covers the area north of the Canadian National Railway (CNR) and Canadian Pacific Railway (CPR) tracks, south of the rear lots of the properties on Ballantine Street, west of Division Street and east of the rear lots of the properties on Sutherland Crescent and Gillett Court.

- The Study Area includes the light industrial and residential lands fronting on Division Street, Buchanan Street, George Street and Station Street, the Kerr Street Right-of-Way (ROW) and a railway spur that provides access to the rear of the Canada Pallet Company property.

- Midtown Creek generally flows from north to south through the study area with culvert crossings at Division Street, the railway spur, Buchanan Street, George Street and Station Street and the CNR/CPR tracks. There is currently an open channel through the former railway embankment that is contained within the Kerr Street ROW.

Purpose of Study

- The provision of Kerr Street as additional east-west capacity will enhance distribution throughout the Town of Cobourg and increase the capacity life of the existing road network. Vehicular traffic volumes on existing east-west, as well as north-south routes within the Town of Cobourg will continue to increase steadily with the growth of the Town through area developments and infilling of lands.

- Construction of this portion of the Kerr Street extension will create overbank ponding along Midtown Creek, upstream of the roadway that will protect existing structures in the floodplain between the proposed Kerr Street extension and the existing railway corridor to the south. Excavation of soil from lands to the north of the proposed Kerr Street extension will increase the ponding of water and thereby further increase flood protection.

Public and Review Agency Consultation

- A "Notice of Study Commencement" was previously published in local newspaper(s), posted on the Town of Cobourg website and sent to review agencies and identified stakeholders.

- This Public Information Centre (PIC) is intended to provide an opportunity for members of the public to review and discuss the project with the Town of Cobourg and its representatives, provide input for consideration during the planning of this project, express any concerns with respect to proposed alternatives and discuss potential impacts associated with construction related to the project.

Cobourg "Ontario's Feel Good Town" Ontario, Canada

Town of Cobourg
Midtown Creek and Kerr Street - Municipal Class EA
Public Information Centre #2

WILLS

Phase 1 - Existing Conditions

Water Resources

- There is a history of flooding along Midtown Creek upstream of the CNR and CPR corridor that has caused substantial flood damages to private properties in the area of Buchanan Street, George Street and Station Street as well as frequent flooding of the Division Street Railway Underpass.

January 2010 Flooding at George Street and Buchanan Street

- Following the January 2010 flood, the Town of Cobourg and Ganaraska Region Conservation Authority undertook studies to investigate the causes of the flooding and assess alternatives to mitigate future flooding in the area.

- Based on the analysis completed by the Ganaraska Region Conservation Authority, it was determined that the Buchanan Street culvert has less capacity than the culverts crossing the railway corridor.

- The Ganaraska Region Conservation Authority authored two technical reports regarding the flooding and potential mitigation measures.

  The first report focused on providing a flood ponding area upstream of Elgin Street (Chris Garrett Park). It was determined that a ponding area upstream of Elgin Street would reduce flooding of the Elgin Street culvert, however the flood reduction downstream of Division Street would be negligible.

  The second report focused on providing a flood ponding area upstream of the Kerr Street right of way. Two different solutions were considered (on-line pond and off-line pond) and it was determined that an on-line flood ponding area would provide the highest level of flood reduction within the study area.

Utilities and Services

- There are existing utilities (electrical, gas, sanitary sewer, storm sewer, watermain) located within the vicinity of the Midtown Creek flood ponding area and the Kerr Street right of way. As required, utility relocations will be incorporated into the detailed design.

Property Ownership

- The construction of the flood ponding area may require the Town of Cobourg to acquire parts of the existing properties upstream of the Kerr Street right of way.

Natural Environment

- Terrestrial ecology and fisheries studies were completed by the Ganaraska Region Conservation Authority.

- Fisheries Assessment Report - Midtown Creek is a coldwater fishery with species captured by the GRCA within the study area including Brook Trout, Rainbow Trout and Mottled Sculpin. The site is characterized by large amounts of silt, has a low gradient and lacks defined riffles and has been described as showing signs of stress due to degradation of habitat and water quality. The area serves as a migratory corridor for lake run Rainbow Trout that utilize upstream habitats for spawning and rearing.

- Terrestrial Ecology Report - There is a high diversity of vegetation community types on the site; however, none of these is significant with respect to rarity. Most of the relatively natural woodland is early successional and some is highly disturbed. The remainder is cultural woodland and is dominated by invasive tree species. The open areas are cultural meadow and are highly disturbed.

Cultural Heritage and Archaeology

- Stage 1 and Stage 2 Archaeological Assessments were completed by AMICK Consultants Limited. No archaeological resources were encountered as a result of the Stage 2 Archaeological Assessment.

- The Provincial interest in archaeological resources with respect to the proposed undertaking has been addressed and no further archaeological assessment is warranted as the proposed project is clear of any archaeological concern.

Soils and Groundwater

- Phase 1 and 2 Environmental Site Assessments and a Geotechnical Investigation was completed by WSP Canada Inc. to support the planning and design process for the flood ponding area.

- Although there is a history of industrial activity on and adjacent to this site, the soil and groundwater analytical results indicate that all parameters meet the MOECC requirements.

- The slope stability analysis completed as part of the Geotechnial Investigation concluded that the berm structure and internal stability should therefore be adequate for the intended future use, provided the proposed roadway is widened and constructed according to good practices .

Transportation

- The Town of Cobourg Transportation Master Plan (TMP) suggests that the existing east-west road network in Cobourg will experience capacity or over-capacity conditions in the near future. In order to mitigate the expected capacity issues, the TMP recommends that Kerr Street from Westwood Drive to D'Arcy Street be constructed between 2011 and 2021. The proposed section of Kerr Street is located wtihin this corridor.

Phase 2 - Alternative Solutions

Phase 2: Identification and Evaluation of Alternative Solutions

Identification of Alternative Solutions

#1 Do Nothing

#2 Off-Line Flood Ponding Area Upstream of Kerr Street Right of Way

#3 On-Line Flood Ponding Area Upstream of Kerr Street Right of Way

#4 Increase Capacity of CNR and CPR Railway Culverts

#5 Off-Line Flood Ponding Area Upstream of Division Street

#6 Removal of Flood Prone Structures from Floodplain

Preliminary Review of Alternative Solutions

- Alternative #4 would mitigate flooding in the study area; however, flooding would be increased for the downstream flood prone areas of downtown Cobourg. This alternative has been removed from consideration.
- Alternative #5 would provide flood protection upstream of Division Street; however, the impact downstream of Division Street would be negligible. This alternative has been removed from consideration.
- Alternative #6 involves removing established light industrial and residential buildings from the floodplain. This is not considered as a viable solution because of the high cost involved in purchasing the affected properties and the potential socioeconomic impacts caused by displacing people and businesses. This alternative has been removed from consideration.
- **Alternatives #2 and #3 are considered viable solutions to provide flood prevention to the study area and will be carried forward for further study. Alternative #1 will be carried forward as a means of comparison to the "status quo".**

Class EA Schedule

The Municipal Class EA provides guidance on how municipal road and water and wastewater projects are classified. Information related to the Class EA Schedules from the Municipal Class EA relevant to this project includes:

Municipal Road Projects (Schedule B)

21. Construction of new roads or other linear paved facilities < 2.4 M.

Municipal Water and Wastewater Projects (Schedule B)

17. Works Undertaken in a watercourse for the purposes of flood control or erosion control which may include:
    - Bank and slope regrading.
    - Deepening the watercourse.
    - Relocation, realignment or channelization of watercourse.
    - Revetment including soil bio-engineering techniques.
    - Reconstruction of a weir or dam.

Although the applicable schedules of the Municipal Class EA indicate that the study may be a Schedule B project, there are special circumstances to be considered, including requiring property, affecting watercourses, removing trees and the community impacts regarding the extension of Kerr Street. Therefore, the Town of Cobourg has decided to proceed with this project as a Schedule C Municipal Class EA.

Phase 2 - Alternative Solutions

Flood Ponding Alternatives

- Two options (as outlined below) were considered to provide flood storage upstream of Kerr Street.
- A flow target of 4.1 m³/s was set, which corresponds to the flow capacity of the Buchanan Street culvert.

Alternative #2 - Off-Line Flood Ponding Area Upstream of Kerr Street Right of Way

- A 2-cell pond, one north and one south of the railway spur, west of Midtown Creek. The preliminary analysis indicates that the 100-year flow can be attenuated to the 25-year flow of 5.77 m^3/s.
- The benefits include not having to rebuild Midtown Creek on Canada Pallet Property and not using the east side of the creek, thereby somewhat limiting tree removal and property requirements.
- The alternative does not meet flow targets and introduces a wet area above the spur line. Pond flows must be conveyed between the cells through the railway spur. An offset from the creek is required, limiting the available area. Flooding condos in subdivisions adjacent to Division street is a concern. The diversion structure is complex to design. The alternative would require upsizing Buchanan and George Street culverts to control the backwater from these structures and flooding. There is an increased maintenance difficulty.

Alternative #3 - On-Line Flood Ponding Area Upstream of Kerr Street Right of Way

- One online pond can attenuate the 100-year flow to the recommended target of 4.1 m^3/s.
- The alternative meets flow targets and does not include use of the flooded area north of the railway spur.
- The scenario would require natural channel design of Midtown Creek, significant tree removal, and more earthworks than Alternative #2.

Town of Cobourg
Midtown Creek and Kerr Street - Municipal Class EA
Public Information Centre #2

Phase 2 - Evaluation of Alternative Solutions and Preferred Alternative

Evaluation Process

- The screening criteria were adapted from the MEA MCEA document. Items deemed not related to this project were eliminated to simplify the screening process. The screening criteria are divided in to five (5) categories:

  1. Natural Environment
  2. Social Environment
  3. Cultural Environment
  4. Engineering / Technical Environment
  5. Economic Environment

- The screening criteria were each assessed a weighting factor based on their relative significance in this situation. The factors were assigned on a scale of one (1) to ten (10), with ten (10) being very important and one (1) being not important.

- Each alternative was scored by Wills with input from the Town of Cobourg and Ganaraska Region Conservation Authority. The scoring was based on a rating of the potential effect of each alternative on the screening criteria. The environmental effects were assessed based on the following scale:

Range of Effect	Code	Points Assigned
Highly Negative Effect	-H	-5
Moderate Negative Effect	-M	-3
Slight Negative Effect	-L	-1
No Effect	Nil	0
Slight Positive Effect	+L	+1
Moderate Positive Effect	+M	+3
Significant Positive Effect	+H	+5

- The total score for each rating criteria was the multiplication of the weighting factor and the scoring factor. The scores for each alternative were totaled and ranked from highest to lowest. The highest ranked alternative was selected as the preferred alternative.

Evaluation Results

- The rankings resulting from the evaluation of alternatives are as follows:

Screening Criteria	Alternatvie 1 Do Nothing	Alternative 2 Off-Line Pond	Alternative 3 On-Line Pond
Natural Environment	3	1	1
Social Environment	3	1	1
Cultural Environment	1	1	1
Engineering / Technical Environment	3	2	1
Economic Environment	3	2	1
Overall Rank	3	2	1

1 - Highest Ranked (Most Preferred)
3 - Lowest Ranked (Least Preferred)
Same Rank - Evaluation resulted in a tie

Selection of the Preferred Alternative

- Based on the evaluation results presented above, it is recommended that **Alternative 3 - On-line Flood Ponding Area Upstream of Kerr Street** be selected as the Preferred Alternative.

Town of Cobourg
Midtown Creek and Kerr Street - Municipal Class EA
Public Information Centre #2

Preferred Alternative Details (Alternative #3)

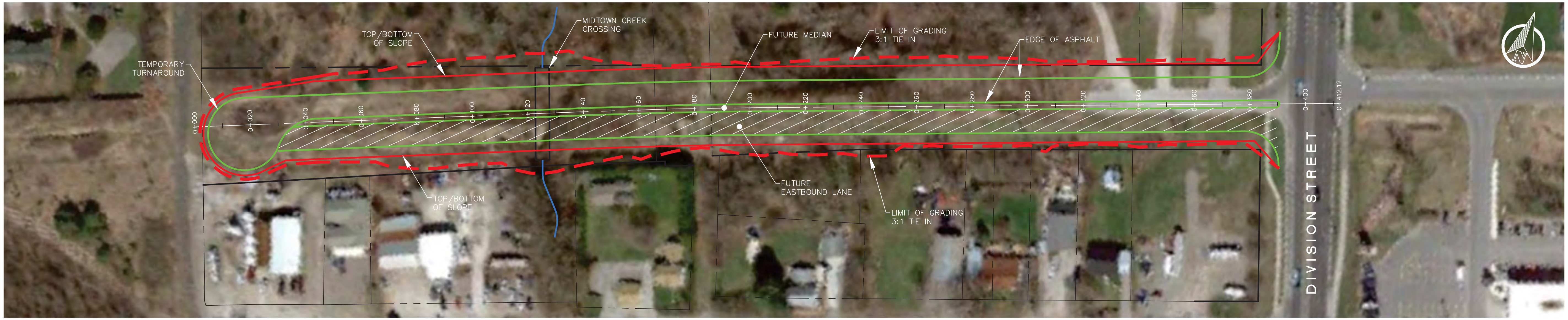
Alternative #3 Details

The construction of this alternative will involve the following:

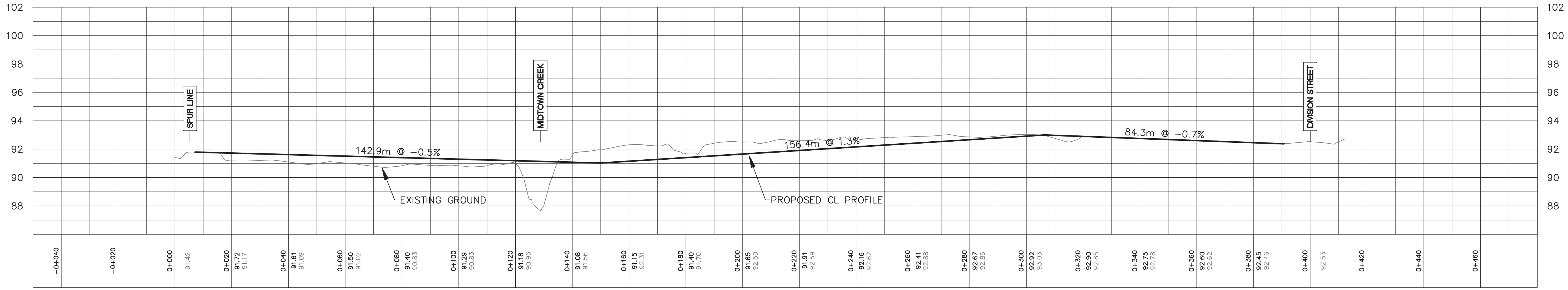
- Construction of Kerr Street between Division Street and the railway spur.
- Removal of trees within the flood ponding area.
- Excavation/removal of soil and grading for the proposed flood ponding area.
- Construction of a restored natural channel between the railway spur and Kerr Street.
- Construction of a control structure/culvert that:
    1. Conveys base flows (up to the 2-year peak flow) without restriction.
    2. Restricts/reduces peak flows for the 5-year to 50-year (or 100-year) storm events to the target flow rate.
    3. Conveys the Regional/Regulatory Storm (Hurricane Hazel) with no flooding impacts upstream or downstream of the study area.
    4. Ensures safe access (flood depth of less than 0.30 m) across Kerr Street.

Alternative design concepts (configuration of storage and outlet structure) will be reviewed as part of Phase 3 of the Municipal Class EA process.

Kerr Street Conceptual Design



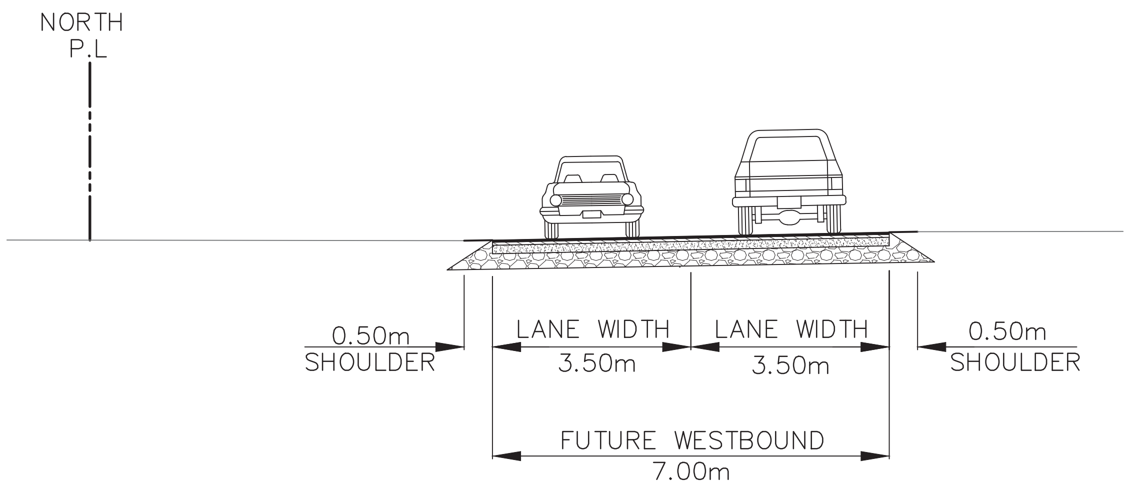
KERR STREET EXTENSION



Town of Cobourg
Midtown Creek and Kerr Street - Municipal Class EA
Public Information Centre #2

Kerr Street Conceptual Design

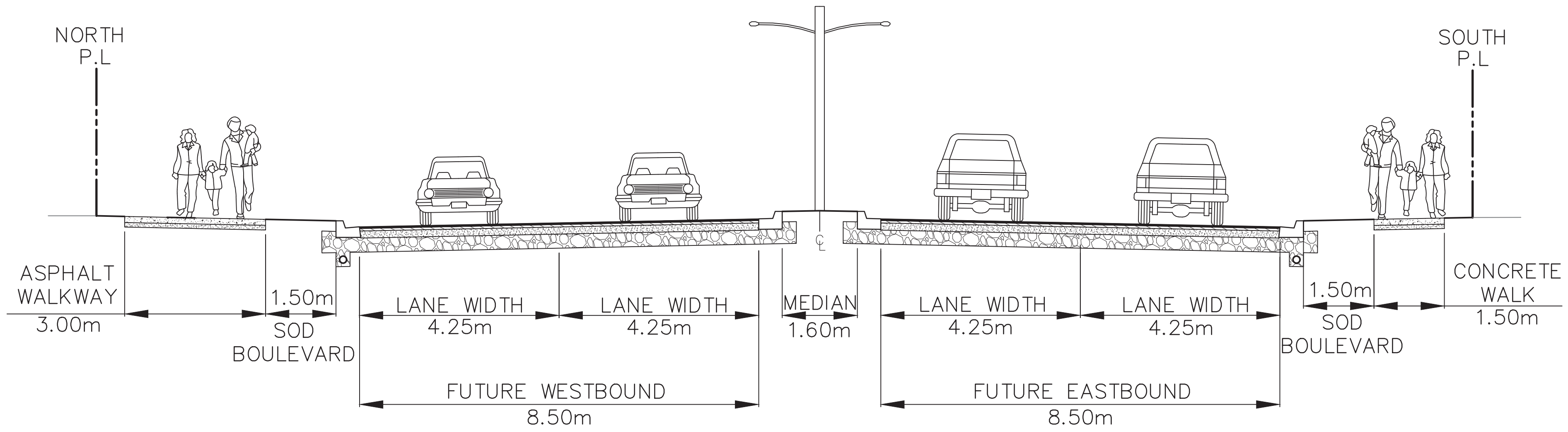
KEER STREET
INTERIM CROSS SECTION



Cross Sections

- The ultimate cross section will match the cross section west of Ewing Street.
- The ultimate cross section includes four lanes of divided traffic, a multi-use trail and a sidewalk.
- A future storm sewer will be included to collect and convey runoff.
- The interim cross section will be constructed with two traffic lanes until the ultimate section is warranted.

KERR STREET
ULTIMATE CROSS SECTION



Town of Cobourg
Midtown Creek and Kerr Street - Municipal Class EA
Public Information Centre #2

Next Steps and Project Contacts

Next Steps

- Review Public and Review Agency Input from the PIC.
- Confirm Preferred Alternative.
- Identify Alternative Design Concepts for Preferred Solution.
- Detailed Inventory of Natural, Social and Economic Environment.
- Identify Impact of Alternative Designs on Environment and Mitigating Measures.
- Evaluate Alternative Designs: Identify Recommended Design.
- Prepare Draft Environmental Study Report
- Consult Review Agencies and Previously Interested and Directly Affected Public at PIC #3.
- Publish "Notice of Study Completion" and place Draft Environmental Study Report on Public Record.
- Review Public and Review Agency comments on Environmental Study Report.
- Detailed Design and Approvals.
- Construction.

Public Input and Comment

- Feel free to provide written input or comment, for consideration by the project team, using the comment sheets provided or by contacting the identified representatives of the Town of Cobourg or D.M. Wills Associates Limited.
- Information and comments received are collected under the authority of the Municipal Act and will be subject to the requirements of the Freedom of Information and Protection of Privacy Act.
- Should you have any questions or concerns at any time during the project, or would like additional information please contact the identified representatives of the Town of Cobourg or D.M. Wills Associates Limited.

THANK YOU FOR ATTENDING

Town of Cobourg
Laurie Wills, P.Eng.
Deputy Director of Public Works
740 Division Street, Bldg. #7, Coburg, ON K9A 0H6
Phone: 905-372-9971
Email: lwills@cobourg.ca

D.M. Wills Associates Limited
David Green, P.Eng.
Assistant Manager, Water Resources
150 Jameson Drive, Peterborough, ON K9J 0B9
Phone: 705-742-2297 Ext. 268
Email: dgreen@dmwills.com

Sign-in Sheet

Town of Cobourg

Midtown Creek Flood Ponding Area and Kerr Street Extension from Division Street to the Railway Spur Schedule C Municipal Class Environmental Assessment

Public Information Centre #2 - November 29, 2017

Name	Address	Phone	Email
Leslie Benson	[redacted]	[redacted]	[redacted]
Denise Marshall	[redacted]	[redacted]	[redacted]
Dan McBride	[redacted]	[redacted]	[redacted]
Aaron Burdett	[redacted]	[redacted]	[redacted]
Tom Bolan	[redacted]	[redacted]	[redacted]
Wayne Simpson	[redacted]	[redacted]	[redacted]
JIM HARTFORD	[redacted]	[redacted]	[redacted]
Ashley Corneli	[redacted]	[redacted]	[redacted]
Brian Darling	[redacted]	[redacted]	[redacted]
Suzanne Seguin			
John Henderson			
Glenn McGlashon			

Comment Sheet

Town of Cobourg

Midtown Creek Flood Ponding Area and Kerr Street Extension from Division Street to the Railway Spur Schedule C Municipal Class Environmental Assessment

Public Information Centre #2 - November 29, 2017

We would like your comments....

No.	Design Item	Comment(s)
1	Please describe any impacts to your property as a result of flooding on Midtown Creek. Please be specific and provide an address / location and date as well as an estimate of the total flood damages.	
2	Six (6) alternative solutions have been considered as part of the Midtown Creek Flood Ponding Area Study. Are there any other flood reduction alternatives for Midtown Creek that you feel should be considered?	Alternative 5 - addressing upstream of Elgin → This would address flooding issue along entire length of creek and @ Elgin + Division intersect
3	Alternative 3 has been selected as the preferred alternative for flood reduction on Midtown Creek. Please provide your feedback on this alternative.	

General Comments

Is it possible to please share all the information for this study with Northumberland County. We would be interested in working with the Town + GRCA to address flooding issues related to midtown Creek at Elgin and Division Street.

The boards indicate a study was completed to review mitigation measures north of Elgin and the County would be interested in reviewing this study for information.

Information can be sent to Denise Marshall, Manager of Project Engineering at the County. Contact info below.

*Your comments on this form are collected under the authority of the Municipal Act and will be used to assist Town staff in making decisions on this project. All names, addresses and comments will be included in material available to the public. Questions regarding this collection should be forwarded to Ms. Laurie Wills, P.Eng., Deputy Director of Public Works at the Town of Cobourg.

Name:

Telephone:

Address:

E-mail: ma

Please add me to the study contact list: YES / NO (Circle One)

Your feedback is important to us. Please let us know how we did and provide any questions, comments, concerns or suggestions that you believe will improve our design. Please forward your written comments by December 15, 2017

D.M. Wills Associates Limited
150 Jameson Drive
Peterborough, ON · K9J 0B9
Tel: (705) 742-2297
Fax: (705) 748-9944
Email: wills@dmwills.com

Public Information Centre #3

Welcome

Town of Cobourg
Midtown Creek Flood Ponding Area and Kerr Street Extension from Division Street to the Railway Spur

Schedule C Municipal Class Environmental Assessment

Public Information Centre No. 3
- Open House -

January 25, 2018

Please sign in and take an information package and comment sheet.

Feel free to provide written input or comment using the comment sheets provided or by contacting the identified representatives of the Town of Cobourg or its consultant for this project (D.M. Wills Associates Limited).

Representatives of the Town of Cobourg and D.M. Wills Associates Limited are available to discuss questions or concerns you may have regarding this project.

Municipal Class Environmental Assessment Process

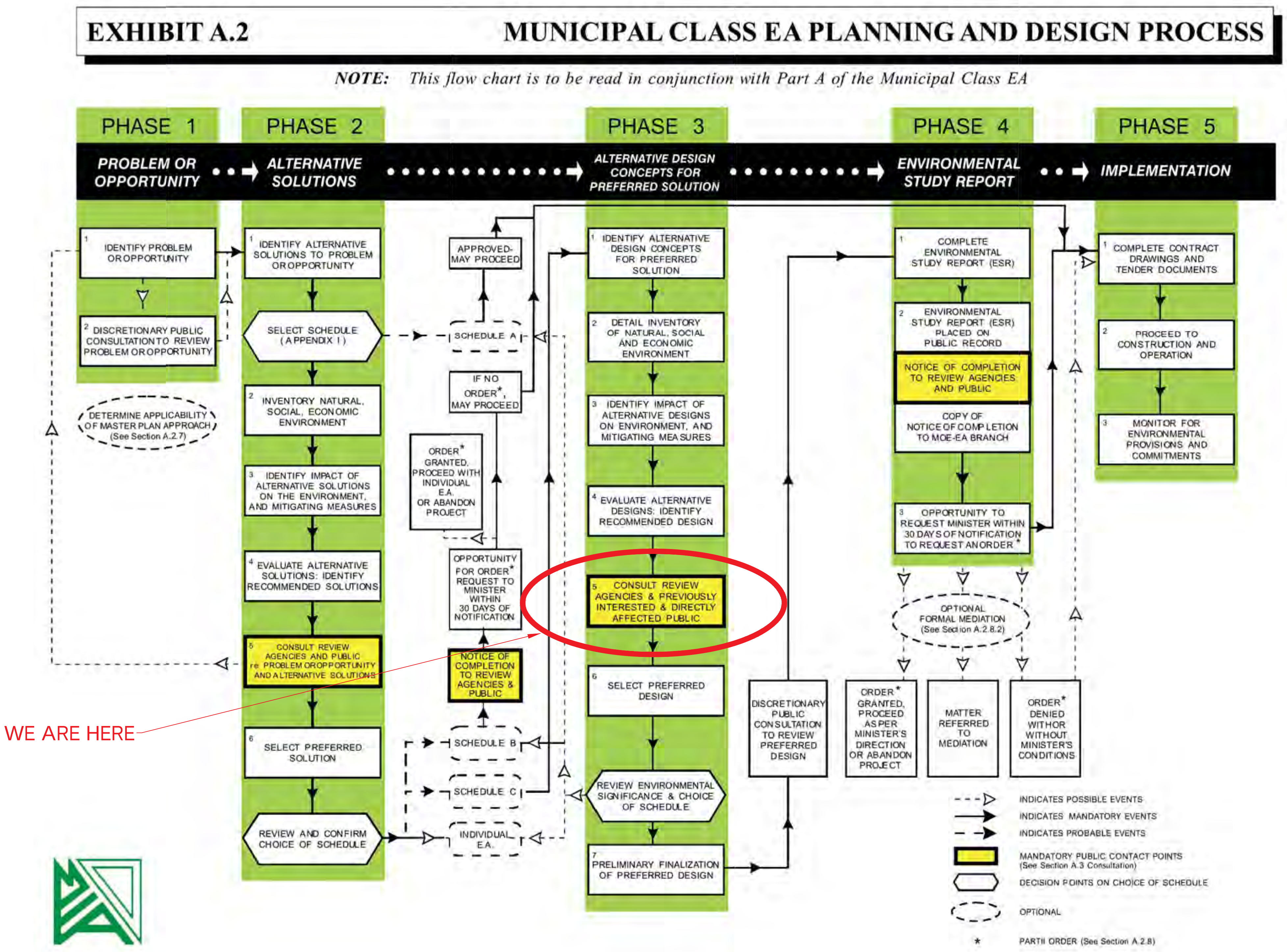


EXHIBIT A.2

MUNICIPAL CLASS EA PLANNING AND DESIGN PROCESS

NOTE: *This flow chart is to be read in conjunction with Part A of the Municipal Class EA*

PHASE 1 — PROBLEM OR OPPORTUNITY

1 IDENTIFY PROBLEM OR OPPORTUNITY

2 DISCRETIONARY PUBLIC CONSULTATION TO REVIEW PROBLEM OR OPPORTUNITY

DETERMINE APPLICABILITY OF MASTER PLAN APPROACH (See Section A.2.7)

PHASE 2 — ALTERNATIVE SOLUTIONS

1 IDENTIFY ALTERNATIVE SOLUTIONS TO PROBLEM OR OPPORTUNITY

SELECT SCHEDULE (APPENDIX 1)

2 INVENTORY NATURAL, SOCIAL, ECONOMIC ENVIRONMENT

3 IDENTIFY IMPACT OF ALTERNATIVE SOLUTIONS ON THE ENVIRONMENT, AND MITIGATING MEASURES

4 EVALUATE ALTERNATIVE SOLUTIONS: IDENTIFY RECOMMENDED SOLUTIONS

5 CONSULT REVIEW AGENCIES AND PUBLIC re PROBLEM OR OPPORTUNITY AND ALTERNATIVE SOLUTIONS

6 SELECT PREFERRED SOLUTION

REVIEW AND CONFIRM CHOICE OF SCHEDULE

APPROVED- MAY PROCEED

SCHEDULE A

IF NO ORDER*, MAY PROCEED

ORDER* GRANTED, PROCEED WITH INDIVIDUAL E.A. OR ABANDON PROJECT

OPPORTUNITY FOR ORDER* REQUEST TO MINISTER WITHIN 30 DAYS OF NOTIFICATION

NOTICE OF COMPLETION TO REVIEW AGENCIES & PUBLIC

SCHEDULE B

SCHEDULE C

INDIVIDUAL E.A.

PHASE 3 — ALTERNATIVE DESIGN CONCEPTS FOR PREFERRED SOLUTION

1 IDENTIFY ALTERNATIVE DESIGN CONCEPTS FOR PREFERRED SOLUTION

2 DETAIL INVENTORY OF NATURAL, SOCIAL AND ECONOMIC ENVIRONMENT

3 IDENTIFY IMPACT OF ALTERNATIVE DESIGNS ON ENVIRONMENT, AND MITIGATING MEASURES

4 EVALUATE ALTERNATIVE DESIGNS: IDENTIFY RECOMMENDED DESIGN

5 CONSULT REVIEW AGENCIES & PREVIOUSLY INTERESTED & DIRECTLY AFFECTED PUBLIC

6 SELECT PREFERRED DESIGN

REVIEW ENVIRONMENTAL SIGNIFICANCE & CHOICE OF SCHEDULE

7 PRELIMINARY FINALIZATION OF PREFERRED DESIGN

WE ARE HERE

PHASE 4 — ENVIRONMENTAL STUDY REPORT

1 COMPLETE ENVIRONMENTAL STUDY REPORT (ESR)

2 ENVIRONMENTAL STUDY REPORT (ESR) PLACED ON PUBLIC RECORD

NOTICE OF COMPLETION TO REVIEW AGENCIES AND PUBLIC

COPY OF NOTICE OF COMPLETION TO MOE-EA BRANCH

3 OPPORTUNITY TO REQUEST MINISTER WITHIN 30 DAYS OF NOTIFICATION TO REQUEST AN ORDER*

OPTIONAL FORMAL MEDIATION (See Section A.2.8.2)

DISCRETIONARY PUBLIC CONSULTATION TO REVIEW PREFERRED DESIGN

ORDER* GRANTED, PROCEED AS PER MINISTER'S DIRECTION OR ABANDON PROJECT

MATTER REFERRED TO MEDIATION

ORDER* DENIED WITH OR WITHOUT MINISTER'S CONDITIONS

PHASE 5 — IMPLEMENTATION

1 COMPLETE CONTRACT DRAWINGS AND TENDER DOCUMENTS

2 PROCEED TO CONSTRUCTION AND OPERATION

3 MONITOR FOR ENVIRONMENTAL PROVISIONS AND COMMITMENTS

- - -▷ INDICATES POSSIBLE EVENTS

→ INDICATES MANDATORY EVENTS

– –► INDICATES PROBABLE EVENTS

🟨 MANDATORY PUBLIC CONTACT POINTS (See Section A.3 Consultation)

⬡ DECISION POINTS ON CHOICE OF SCHEDULE

◯ OPTIONAL

* PARTII ORDER (See Section A.2.8)

Town of Cobourg

Midtown Creek and Kerr Street - Municipal Class EA

Public Information Centre #3

Problem or Opportunity

Identification of Problem or Opportunity

General Location Plan

Problem / Opportunity Statement

- **The study will identify and evaluate alternatives to maximize flood protection for downstream properties within the Midtown Creek floodplain as a result of the extension of Kerr Street between Division Street and the railway spur.**

Study Area

- The Study Area generally covers the area north of the Canadian National Railway (CNR) and Canadian Pacific Railway (CPR) tracks, south of the rear lots of the properties on Ballantine Street, west of Division Street and east of the rear lots of the properties on Sutherland Crescent and Gillett Court.
- The Study Area includes the light industrial and residential lands fronting on Division Street, Buchanan Street, George Street and Station Street, the Kerr Street right of way and a railway spur that provides access to the rear of the Canada Pallet Company property.
- Midtown Creek generally flows from north to south through the study area with culvert crossings at Division Street, the railway spur, Buchanan Street, George Street and Station Street and the CNR/CPR tracks. There is currently an open channel through the former railway embankment that is contained within the Kerr Street ROW.

Purpose of Study

- The provision of Kerr Street as additional east-west capacity will enhance distribution throughout the Town of Cobourg and increase the capacity life of the existing road network. Vehicular traffic volumes on existing east-west, as well as north-south routes within the Town of Cobourg will continue to increase steadily with the growth of the Town through area developments and infilling of lands.
- Construction of this portion of the Kerr Street extension will create overbank ponding along Midtown Creek, upstream of the roadway that will protect existing structures in the floodplain between the proposed Kerr Street extension and the existing railway corridor to the south. Excavation of soil from lands to the north of the proposed Kerr Street extension will increase the ponding of water and thereby further increase flood protection.

Public and Review Agency Consultation

- PIC #2 was conducted on November 29, 2017 where alternative solutions were presented and the preferred alternative solution was identified as Alternative #3, an on-line pond upstream of the proposed Kerr Street.
- A "Notice of Public Information Centre" was previously published in local newspaper(s), posted on the Town of Cobourg website and sent to review agencies and identified stakeholders.
- This Public Information Centre (PIC) is intended to present alternative design concepts and to select a preferred alternative design concept and provide an opportunity for members of the public to review and discuss the project with the Town of Cobourg and its representatives, provide input for consideration during the planning of this project, express any concerns with respect to proposed alternatives and discuss potential impacts associated with construction related to the project.

Town of Cobourg
Midtown Creek and Kerr Street - Municipal Class EA
Public Information Centre #3

Inventory of Natural, Social and Economic Environment

Water Resources

- There is a history of flooding along Midtown Creek upstream of the CNR and CPR corridor that has caused substantial flood damages to private properties in the area of Buchanan Street, George Street and Station Street as well as frequent flooding of the Division Street Railway Underpass.

January 2010 Flooding at George Street and Buchanan Street

- Following the January 2010 flood, the Town of Cobourg and Ganaraska Region Conservation Authority undertook studies to investigate the causes of the flooding and assess alternatives to mitigate future flooding in the area.

- Based on the analysis completed by the Ganaraska Region Conservation Authority, it was determined that the Buchanan Street culvert has less capacity than the culverts crossing the railway corridor.

- The Ganaraska Region Conservation Authority authored two technical reports regarding the flooding and potential mitigation measures.

  The first report focused on providing a flood ponding area upstream of Elgin Street (Chris Garrett Park). It was determined that a ponding area upstream of Elgin Street would reduce flooding of the Elgin Street culvert, however the flood reduction downstream of Division Street would be negligible.

  The second report focused on providing a flood ponding area upstream of the Kerr Street right of way. Two different solutions were considered (on-line pond and off-line pond) and it was determined that an on-line flood ponding area would provide the highest level of flood reduction within the study area.

Utilities and Services

- There are existing utilities (electrical, gas, sanitary sewer, storm sewer, watermain) located within the vicinity of the Midtown Creek flood ponding area and the Kerr Street right of way. As required, utility relocations will be incorporated into the detailed design.

Property Ownership

- The construction of the flood ponding area will require the Town of Cobourg to acquire parts of the existing properties upstream of the Kerr Street right of way.

Natural Environment

- Terrestrial ecology and fisheries studies were completed by the Ganaraska Region Conservation Authority.

- Fisheries Assessment Report - Midtown Creek is a coldwater fishery with species captured by the GRCA within the study area including Brook Trout, Rainbow Trout and Mottled Sculpin. The site is characterized by large amounts of silt, has a low gradient and lacks defined riffles and has been described as showing signs of stress due to degradation of habitat and water quality. The area serves as a migratory corridor for lake run Rainbow Trout that utilize upstream habitats for spawning and rearing.

- Terrestrial Ecology Report - There is a high diversity of vegetation community types on the site; however, none of these is significant with respect to rarity. Most of the relatively natural woodland is early successional and some is highly disturbed. The remainder is cultural woodland and is dominated by invasive tree species. The open areas are cultural meadow and are highly disturbed.

Cultural Heritage and Archaeology

- Stage 1 and Stage 2 Archaeological Assessments were completed by AMICK Consultants Limited. No archaeological resources were encountered as a result of the Stage 2 Archaeological Assessment.

- No further archaeological assessment is warranted as the proposed project is clear of any archaeological concern.

Soils and Groundwater

- Phase 1 and 2 Environmental Site Assessments and a Geotechnical Investigation was completed by WSP Canada Inc. to support the planning and design process for the flood ponding area.

- Although there is a history of industrial activity on and adjacent to this site, the soil and groundwater analytical results indicate that all parameters meet the MOECC requirements.

- The slope stability analysis completed as part of the Geotechnical Investigation concluded that the berm structure and internal stability should be adequate for the intended future use, provided the proposed roadway is widened and constructed according to good practices.

Transportation

- The Town of Cobourg Transportation Master Plan (TMP) suggests that the existing east-west road network in Cobourg will experience capacity or over-capacity conditions in the near future. In order to mitigate the expected capacity issues, the TMP recommends that Kerr Street from Westwood Drive to D'Arcy Street be constructed between 2011 and 2021. The proposed section of Kerr Street is located wtihin this corridor.

Phase 3 - Alternative Design Concepts

Phase 3: Alternative Design Concepts for the Preferred Solution

Design Goals and Constraints

1. The facility must control the 100-year peak flow rate to the capacity of the Buchannan Street Culvert (4.11 m^3/s), which is equivalent to the 2-year peak flow rate.
2. The Regional Storm peak flow rate of 44.85 m^3/s must be conveyed across Kerr Street and safe access must be provided (flood depth of 0.30 m or less).
3. The outlet structure must have a span less than 6.0 m.
4. The facility should promote fish passage.
5. The facility should not restrict normal base flows.
6. A freeboard of 1.0 m is desired for the design (50-year) storm (measured from the high water level to the edge of the traveled lane).
7. Berms other than the Kerr Street embankment should not be used to contain the online storage.
8. The maximum ponding elevation is 91.60 m, above which water will spill over the railway spur.
9. The facility must not impact private properties adjacent to Midtown Creek upstream of the railway spur that are not currently within the Regulatory Floodplain.
10. The invert elevation of the outlet structure should be set to match the existing watercourse invert downstream of the proposed Kerr Street right of way.

Preferred Alternative

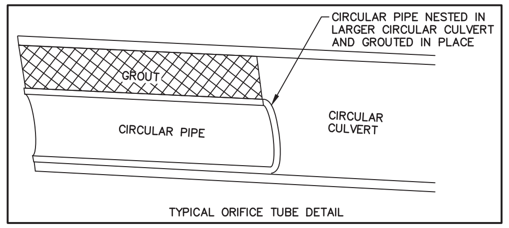
The preferred alternative from Phase 2 of the Municipal Class EA was Alternative 3 - On-Line Flood Ponding Area Upstream of Kerr Street right of way.

Alternative Storage Configurations

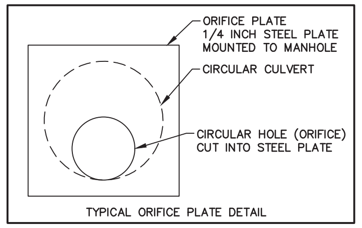
1. Flood Ponding Area contained on West side of George Street right of way (6.27 ha*m at 91.60 m).
2. Flood Ponding Area extending to East side of George Street right of way (7.17 ha*m at 91.60 m).

Alternative Outlet Configurations

1. Circular Orifice Plate.
2. Circular Orifice Tube.
3. Circular Concrete Culvert.
4. Rectangular Orifice Plate.



TYPICAL ORIFICE TUBE DETAIL



TYPICAL ORIFICE PLATE DETAIL

Alternative Design Concepts

#1 Storage Configuration 1 with Outlet Configuration 1.

#2 Storage Configuration 1 with Outlet Configuration 2.

#3 Storage Configuration 1 with Outlet Configuration 3.

#4 Storage Configuration 1 with Outlet Configuration 4.

#5 Storage Configuration 2 with Outlet Configuration 1.

#6 Storage Configuration 2 with Outlet Configuration 2.

#7 Storage Configuration 2 with Outlet Configuration 3.

#8 Storage Configuration 2 with Outlet Configuration 4.

Phase 3 - Alternative Design Concepts

Alternative Design Concepts #1 to #4

Storage Configuration

- Storage Configuration #1 - Flood ponding area contained on west side of George Street right of way.
- Storage volume of 6.27 ha*m at 91.60 m. Ponded area of 3.35 ha.
- Minor grading (fill) up to an elevation of 92.00 m is required on the east side of the George Street right of way to ensure the flood ponding does not spill onto adjacent lands and that those lands continue to drain to the Flood Ponding Area.
- Maintains the existing infrastructure (watermain, sewer, hydro) in the George Street right of way.

Outlet Configurations

- Considered four (4) outlet configurations. Each outlet configuration includes a 45 m long, 2000 mm diameter smooth walled HDPE culvert under Kerr Street to convey flows up to the 100-year storm and a weir spill over top of Kerr Street to ensure safe passage of the Regional Storm.

Design Concept	Control Type	Size (m)
1	Circular Orifice Plate	1084
2	Circular Orifice Tube	917
3	Circular Concrete Culvert	1050
4	Rectangular Orifice Plate	593 x 1500

Results of Analyses

Design Concept	50-Year Design Storm			100-Year Design Storm			Spill over Kerr Street	
	Ponding Elevation (m)	Storage Volume (ha-m)	Controlled Flow (m^3/s)	Ponding Elevation (m)	Storage Volume (ha-m)	Controlled Flow (m^3/s)	Spill Length (m)	Spill Elevation (m)
1	90.91	4.24	3.81	91.30	5.36	4.11	170	91.32
2	90.95	4.35	3.73	91.35	5.50	4.01	200	91.35
3	91.00	4.49	3.77	91.38	5.61	4.08	250	91.39
4	90.87	4.13	3.83	91.27	5.27	4.11	150	91.30

Notes

1. Orifice/pipe sizing details are considered preliminary and are included for the purpose of evaluating the alternative design concepts and to ensure that the alternative design concepts are feasible. Actual orifice/pipe sizing may change during detailed design.
2. Results are provided to demonstrate how each alternative design concept performs. Ponding Elevations, Storage Volumes and Controlled Flow Rates may change during detailed design.

Town of Cobourg
Midtown Creek and Kerr Street - Municipal Class EA
Public Information Centre #3

Phase 3 - Alternative Design Concepts

Alternative Design Concepts #5 to #8

Storage Configuration

- Storage Configuration #2 - Flood ponding area extending to east side of George Street right of way.
- Storage volume of 7.17 ha*m at 91.60 m. Ponded area of 3.82 ha.
- Minor grading (fill) up to an elevation of 92.00 m is required on the east side of the George Street right of way to ensure the flood ponding does not spill onto adjacent lands and that those lands continue to drain to the Flood Ponding Area.
- Existing infrastructure (watermain, sewer, hydro) in the George Street right of way would be affected.

Outlet Configurations

- Considered four (4) outlet configurations. Each outlet configuration includes a 45 m long, 2000 mm diameter smooth walled HDPE culvert under Kerr Street to convey flows up to the 100-year storm and a weir spill over top of Kerr Street to ensure safe passage of the Regional Storm.

Design Concept	Control Type	Size (m)
5	Circular Orifice Plate	1107
6	Circular Orifice Tube	900
7	Circular Concrete Culvert	1050
8	Rectangular Orifice Plate	620 x 1500

Results of Analyses

Design Concept	50-Year Design Storm			100-Year Design Storm			Spill over Kerr Street	
	Ponding Elevation (m)	Storage Volume (ha-m)	Controlled Flow (m^3/s)	Ponding Elevation (m)	Storage Volume (ha-m)	Controlled Flow (m^3/s)	Spill Length (m)	Spill Elevation (m)
5	90.71	4.28	3.80	91.07	5.40	4.10	150	91.30
6	90.85	4.70	3.53	91.22	5.90	3.78	150	91.30
7	90.86	4.72	3.65	91.21	5.87	3.95	150	91.30
8	90.67	4.14	3.83	91.03	5.28	4.11	150	91.30

Notes

1. Orifice/pipe sizing details are considered preliminary and are included for the purpose of evaluating the alternative design concepts and to ensure that the alternative design concepts are feasible. Actual orifice/pipe sizing may change during detailed design.

2. Results are provided to demonstrate how each alternative design concept performs. Ponding Elevations, Storage Volumes and Controlled Flow Rates may change during detailed design.

Town of Cobourg
Midtown Creek and Kerr Street - Municipal Class EA
Public Information Centre #3

Vegetation Clearing Requirements

Design Concepts #1 to #4

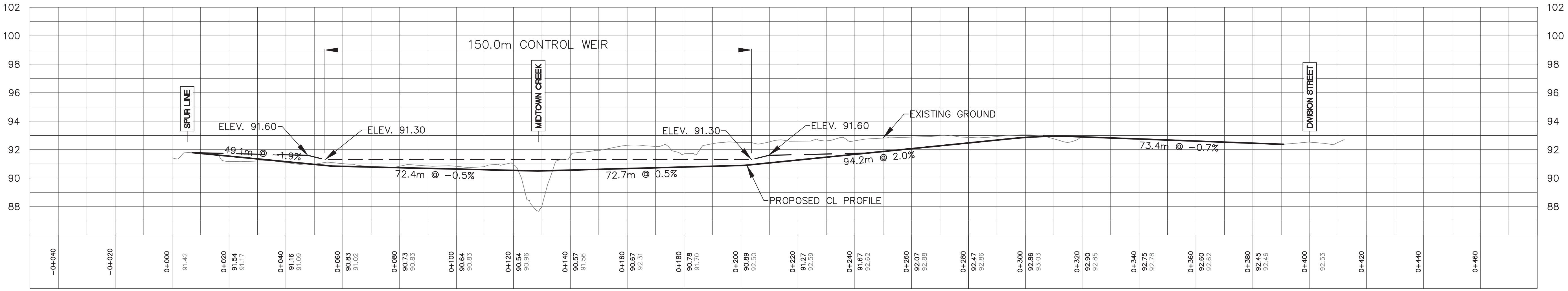
- Vegetation clearing is required in order to facilitate construction and grading of the flood ponding area.
- These design concepts would require approximately 5.11 ha of land to be cleared.
- Vegetation clearing is proposed to be completed in two (2) phases. Phase 1 will include the clearing and removal of trees prior to the Migratory Birds Convention Act timing window and Phase 2 will include removal of all other low level vegetation.
- A planting plan will be incorporated into the detailed design for the restored natural channel.

Design Concepts #5 to #8

- Vegetation clearing is required in order to facilitate construction and grading of the flood ponding area.
- These design concepts would require approximately 5.11 ha of land to be cleared.
- Vegetation clearing is proposed to be completed in two (2) phases. Phase 1 will include the clearing and removal of trees prior to the Migratory Birds Convention Act timing window and Phase 2 will include removal of all other low level vegetation.
- A planting plan will be incorporated into the detailed design for the restored natural channel.

Kerr Street Conceptual Design

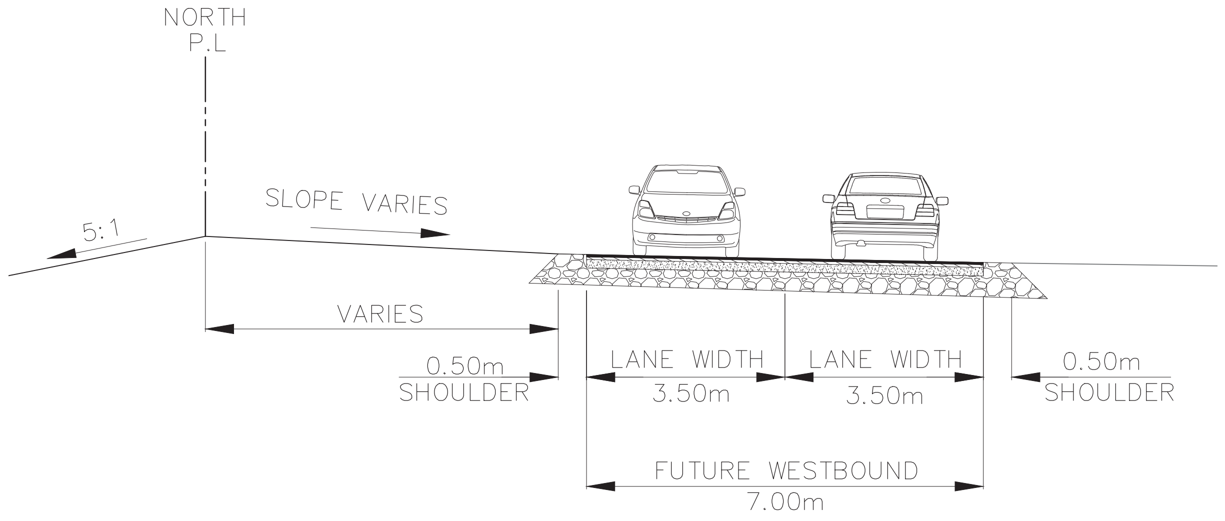
KERR STREET EXTENSION



Town of Cobourg
Midtown Creek and Kerr Street - Municipal Class EA
Public Information Centre #3

Kerr Street Conceptual Design

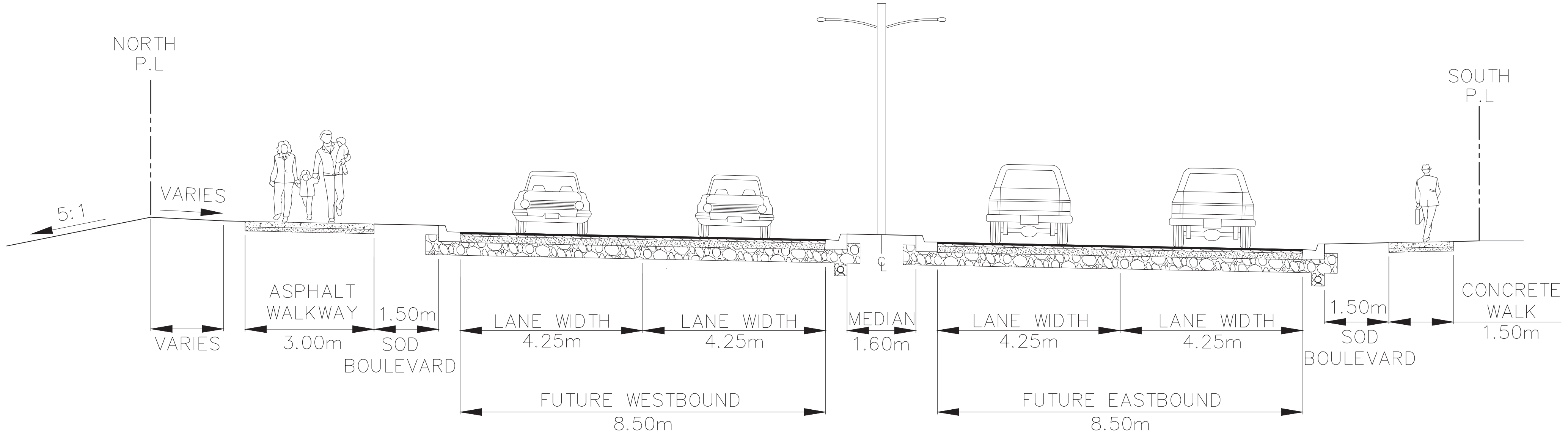
KEER STREET
INTERIM CROSS SECTION



Cross Sections

- The ultimate cross section includes four lanes of divided traffic, a multi-use trail and a sidewalk.
- A future storm sewer will be included to collect and convey runoff.
- The interim cross section will be constructed with two traffic lanes until the ultimate section is warranted.

KERR STREET
ULTIMATE CROSS SECTION



Town of Cobourg
Midtown Creek and Kerr Street - Municipal Class EA
Public Information Centre #3

Phase 3 - Evaluation of Alternative Design Concepts

Evaluation Process

- The screening criteria were adapted from the MEA MCEA document. Items deemed not related to this project were eliminated to simplify the screening process. The screening criteria are divided in to five (5) categories:

  1. Natural Environment
  2. Social Environment
  3. Cultural Environment
  4. Engineering / Technical Environment
  5. Economic Environment

- The screening criteria were each assigned a weighting factor based on their relative significance in this situation. The factors were assigned on a scale of one (1) to ten (10), with ten (10) being very important and one (1) being not important.

- Each alternative was scored by Wills with input from the Town of Cobourg and Ganaraska Region Conservation Authority. The scoring was based on a rating of the potential effect of each alternative on the screening criteria. The environmental effects were assessed based on the following scale:

Range of Effect	Code	Points Assigned
Highly Negative Effect	-H	-5
Moderate Negative Effect	-M	-3
Slight Negative Effect	-L	-1
No Effect	Nil	0
Slight Positive Effect	+L	+1
Moderate Positive Effect	+M	+3
Significant Positive Effect	+H	+5

- The total score for each rating criteria was the multiplication of the weighting factor and the scoring factor. The scores for each alternative were totaled and ranked from highest to lowest.

Evaluation Results

- The rankings resulting from the evaluation of alternatives are as follows:

Alternative Design Concepts 1 to 4 - Flood Ponding Area West of George Street right of way

Screening Criteria	**Alternative Design Concept 1 Circular Orifice Plate**	**Alternative Design Concept 2 Circular Orifice Tube**	**Alternative Design Concept 3 Circular Concrete Culvert**	**Alternative Design Concept 4 Rectangular Orifice Plate**
Natural Environment	1	1	1	1
Social Environment	1	1	1	1
Cultural Environment	1	1	1	1
Engineering / Technical Environment	2	4	5	1
Economic Environment	1	3	3	1
Overall Rank	**2**	**3**	**4**	**1**

Alternative Design Concepts 5 to 8 - Flood Ponding Area East of George Street right of way

Screening Criteria	**Alternative Design Concept 5 Circular Orifice Plate**	**Alternative Design Concept 6 Circular Orifice Tube**	**Alternative Design Concept 7 Circular Concrete Culvert**	**Alternative Design Concept 8 Rectangular Orifice Plate**
Natural Environment	1	1	1	1
Social Environment	1	1	1	1
Cultural Environment	1	1	1	1
Engineering / Technical Environment	6	7	3	8
Economic Environment	5	7	7	5
Overall Rank	**6**	**7**	**5**	**8**

1 - Highest Ranked (Most Preferred)
8 - Lowest Ranked (Least Preferred)
Same Rank - Evaluation resulted in a tie

Selection of the Preferred Alternative Design Concept

- Alternative Design Concepts 1 and 4, ranked numbers 2 and 1 respectively, were the highest scoring alternative design concepts. The detailed evaluation scoring resulted in a difference of only four (4) points between the two concepts.

- Based on the evaluation results and to give additional flexibility during detailed design, it is recommended that a combination of Alternative Design Concepts 1 and 4 be selected as the preferred alternative design concept.

- The preferred alternative design concept is: **Flood ponding area west of the George Street right of way with a control structure that uses an orifice plate (any shape and dimension).**

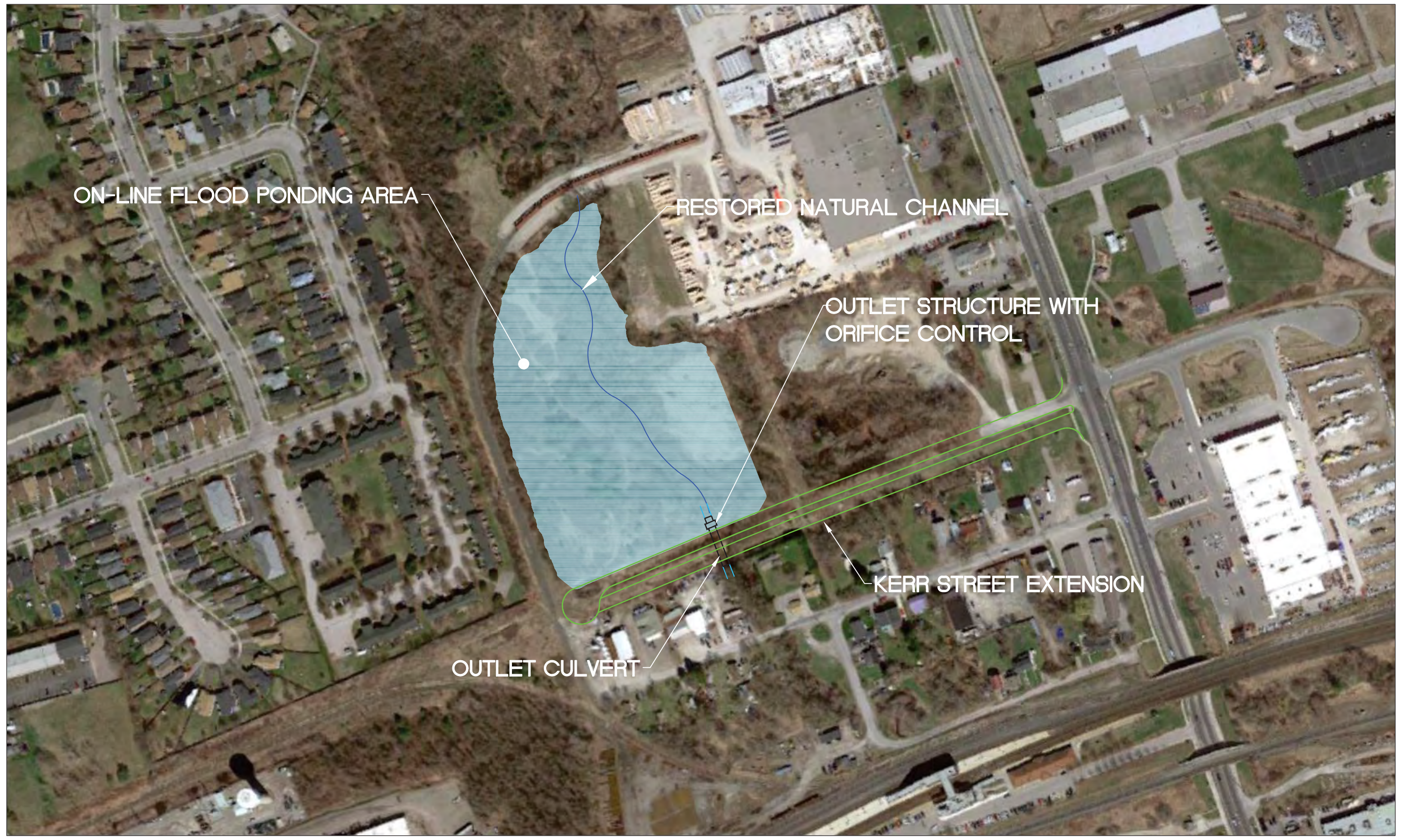
Town of Cobourg
Midtown Creek and Kerr Street - Municipal Class EA
Public Information Centre #3

Preferred Alternative Design Concept

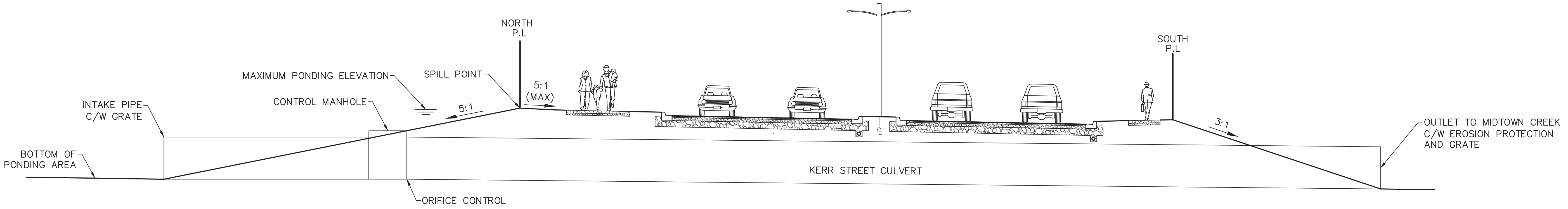
Details of Preferred Alternative Design Concept

The construction of this alternative design concept will involve the following:

- Construction of Kerr Street between Division Street and the railway spur.
- Removal of vegetation within the flood ponding area and other areas where minor grading is required.
- Excavation/removal of soil and grading for the proposed flood ponding area.
- Revegetation and stabilization of the proposed flood ponding area.
- Construction of a restored natural channel between the railway spur and Kerr Street, including a step pool drop structure at the north end of the railway spur.
- Construction of a control structure that uses an orifice pate (any shape or dimension) to restrict flows (the 100-year storm peak flow will be reduced to the target flow rate of 4.11 m^3/s).
- Construction of a culvert under Kerr Street to convey up to the 100-year storm controlled peak flow, including erosion/scour protection at the outlet to the Midtown Creek main channel.
- Construction of Kerr Street as a weir to convey the Regulatory Storm to ensure safe access (flood depth less than 0.30 m) with no increased flood impacts to both upstream and downstream properties.
- Erosion protection on the downstream side of the Kerr Street embankment.



KERR STREET PRELIMINARY CULVERT CROSS-SECTION



Town of Cobourg
Midtown Creek and Kerr Street - Municipal Class EA
Public Information Centre #3

Next Steps and Project Contacts

Next Steps

- Prepare Draft Environmental Study Report.
- Publish "Notice of Study Completion" and place Draft Environmental Study Report on Public Record.
- Review Public and Review Agency comments on Environmental Study Report, if any.
- Detailed Design and Approvals.
- Construction.

Public Input and Comment

- Feel free to provide written input or comment, for consideration by the project team, using the comment sheets provided or by contacting the identified representatives of the Town of Cobourg or D.M. Wills Associates Limited.
- Information and comments received are collected under the authority of the Municipal Act and will be subject to the requirements of the Freedom of Information and Protection of Privacy Act.
- Should you have any questions or concerns at any time during the project, or would like additional information please contact the identified representatives of the Town of Cobourg or D.M. Wills Associates Limited.

THANK YOU FOR ATTENDING

Town of Cobourg
Laurie Wills, P.Eng.
Deputy Director of Public Works
740 Division Street, Bldg. #7, Cobourg, ON K9A 0H6
Phone: 905-372-9971
Email: lwills@cobourg.ca

D.M. Wills Associates Limited
David Green, P.Eng.
Assistant Manager, Water Resources
150 Jameson Drive, Peterborough, ON K9J 0B9
Phone: 705-742-2297 Ext. 268
Email: dgreen@dmwills.com

Sign-in Sheet

Town of Cobourg

Midtown Creek Flood Ponding Area and Kerr Street Extension from Division Street to the Railway Spur Schedule C Municipal Class Environmental Assessment

Public Information Centre #3 - January 25, 2018

Name	Address	Phone	Email
FRANK GODFREY			
David Targon			
JOHN DRAPER			
Don Mac			
Janet Rowe			
JOHN VICKERS			
STEVE MAI			
Laurie & Kim Latchford			
Miriam Mutton			
Sheila McCoy			
IAN Macdonald			

Comment Sheet

Town of Cobourg

Midtown Creek Flood Ponding Area and Kerr Street Extension from Division Street to the Railway Spur Schedule C Municipal Class Environmental Assessment

Public Information Centre #3 - January 25, 2018

We would like your comments....

- Consider salvage of site plant material where possible - staged construction may facilitate this approach.
- Where does excavated material go?
- In proposed Kerr St section add street trees as part of essential green infrastructure - right from design stage. Need to be planned now.
- Plan looks good. Keep it natural, with walking/jogging trails; connect with other parks, streetpaths, etc.

*Your comments on this form are collected under the authority of the Municipal Act and will be used to assist Town staff in making decisions on this project. All names, addresses and comments will be included in material available to the public. Questions regarding this collection should be forwarded to Ms. Laurie Wills, P.Eng., Deputy Director of Public Works at the Town of Cobourg.

Name: ______ **Telephone:** ______

Address: ______ **E-mail:** ______

Please add me to the study contact list: YES / NO (Circle One)

Your feedback is important to us. Please let us know how we did and provide any questions, comments, concerns or suggestions that you believe will improve our design. Please forward your written comments by February 16, 2018.

D.M. Wills Associates Limited
150 Jameson Drive
Peterborough, ON · K9J 0B9
Tel: (705) 742-2297
Fax: (705) 748-9944
Email: wills@dmwills.com

Comment Sheet

Town of Cobourg

Midtown Creek Flood Ponding Area and Kerr Street Extension from Division Street to the Railway Spur Schedule C Municipal Class Environmental Assessment

Public Information Centre #3 - January 25, 2018

We would like your comments....

AT THIS STAGE OF PLANNING FOR THE WATER RETENTION BASIN I WOULD LIKE TO SEE PARKS & REC. INPUT SO AS TO ENSURE THAT FUTURE PLANTINGS RE NATIVE PLANTS & SHRUBS, BE OPTIMELY CONSIDERED. THIS SMART VEGETATIVE REHABILITATION WILL CREATE EDUCATIONAL BENEFITS AS WELL AS PASSIVE RECREATION FOR THE CITIZENS OF COBOURG, REHABILITATION OF HABITAT ALONG THE NATURALIZED STREAM COURSE AIDS IN FLOOD CONTROL & BANK STABILIZATION, REDUCING SEDIMENT BUILDING UP. I NOTICED THAT SPECKLED TROUT ARE PRESENT WHICH IS A REAL PLUS.

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Name: ___ **Telephone:** ___

Address: ___ **E-mail:** ___

Please add me to the study contact list: [✓ YES] / NO (Circle One)

Your feedback is important to us. Please let us know how we did and provide any questions, comments, concerns or suggestions that you believe will improve our design. Please forward your written comments by February 16, 2018.

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Comment Sheet

Town of Cobourg

Midtown Creek Flood Ponding Area and Kerr Street Extension from Division Street to the Railway Spur Schedule C Municipal Class Environmental Assessment

Public Information Centre #3 - January 25, 2018

"Ontario's Feel Good Town"
Cobourg
Ontario, Canada

WILLS

We would like your comments....

1. WATCH FOR (TRAPPED) FISH, FRogs etc.
2. REPLACE GOOD VEGETATION.
3. POST "NO SWIMMING/BOATING" SIGNS.
4. SUPPLY LIFE BOUYS JUST IN CASE SOMEONE DOES FALL IN (OR BREAK THROUGH ICE)
5. CHECK THE FOUNDATION LAYOUT OF THE NEW (CN/CP) BRIDGE — IS IT SUBJECT TO WITHSTANDING EXCESS WATER PRESSURE.
6. MONITOR FOR MOSQUITO CONTROL IN WARMER MONTHS.
7. POST "NO DUMPING" SIGNS.

*Your comments on this form are collected under the authority of the Municipal Act and will be used to assist Town staff in making decisions on this project. All names, addresses and comments will be included in material available to the public. Questions regarding this collection should be forwarded to Ms. Laurie Wills, P.Eng., Deputy Director of Public Works at the Town of Cobourg.

Name: ____ **Telephone:** ____

Address: ____ **E-mail:** ____

Please add me to the study contact list: YES / NO (Circle One)

Your feedback is important to us. Please let us know how we did and provide any questions, comments, concerns or suggestions that you believe will improve our design. Please forward your written comments by February 16, 2018.

WILLS

D.M. Wills Associates Limited
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Appendix B

Evaluation of Alternatives

Evaluation of Alternative Solutions

Town of Cobourg Midtown Creek Flood Ponding Area
Alternative Evaluation Matrix
D.M. Wills Project No. 17-5268
November 2017

		Alternative 1 Do Nothing							Alternative 2 Off-Line Pond							Alternative 3 On-Line Pond						
Weighting Factor	**Screening Criteria**	**Rating of Potential Effect**							**Rating of Potential Effect**							**Rating of Potential Effect**						
		-5	**-3**	**-1**	**0**	**1**	**2**	**3**	**-5**	**-3**	**-1**	**0**	**1**	**2**	**3**	**-5**	**-3**	**-1**	**0**	**1**	**2**	**3**
		-H	**-M**	**-L**	**Nil**	**+L**	**+M**	**+H**	**-H**	**-M**	**-L**	**Nil**	**+L**	**+M**	**+H**	**-H**	**-M**	**-L**	**Nil**	**+L**	**+M**	**+H**
	Natural Environment																					
5	Species at Risk				0							0							0			
5	Fish and Fish Habitat			-5									5							5		
5	Water Quality			-5									5							5		
5	Shoreline Impacts			-5									5							5		
5	Significant Vegetation Communities				0							0							0			
5	Erosion			-5									5							5		
	Subtotal Score	**-20**							**20**							**20**						
	Category Rank	**3**							**1**							**1**						
	Social Environment																					
5	Impacts to Public During Construction				0						-5							-5				
8	Long Term Impacts to Private Property	-40										0						-8				
8	Public Health and Safety	-40												16								24
	Subtotal Score	**-80**							**11**							**11**						
	Category Rank	**3**							**1**							**1**						
	Cultural Environment																					
5	Archaeological				0							0							0			
5	Heritage				0							0							0			
5	First Nations				0							0							0			
	Subtotal Score	**0**							**0**							**0**						
	Category Rank	**1**							**1**							**1**						
	Engineering / Technical Environment																					
5	Utilities				0							0							0			
5	Infrastructure				0							0							0			
6	Constructability				0							0							0			
8	Durability / Life Cycle Impacts				0						-8							-8				
8	Flow Conveyance			-8										16							16	
8	Slope Stability				0						-8							-8				
10	Flood Reduction	-50											10									30
	Subtotal Score	**-58**							**10**							**30**						
	Category Rank	**3**							**2**							**1**						
	Economic Environment																					
8	Easements / Land Acquisition				0						-8							-8				
7	Capital Costs				0						-7							-7				
8	Maintenace Costs and Access										-8							-8				
8	Risk / Liability	-40											8								16	
	Subtotal Score	**-40**							**-15**							**-7**						
	Category Rank	**3**							**2**							**1**						
	TOTAL SCORE	**-198**							**26**							**54**						
	OVERAL RANK	**3**							**2**							**1**						

Evaluation of Alternative Design Concepts

Town of Cobourg Midtown Creek Flood Ponding Area
Alternative Design Concept Evaluation Matrix
D.M. Wills Project No. 17-5268
January 2018

Weighting Factor	Screening Criteria	Alternative Design Concept 1							Alternative Design Concept 2							Alternative Design Concept 3							Alternative Design Concept 4							Alternative Design Concept 5							Alternative Design Concept 6							Alternative Design Concept 7							Alternative Design Concept 8						
		Small Basin, Circular Orifice Plate							Small Basin, Circlar Orifice Tube							Small Basin, Circular Culvert							Small Basin, Rect. Orifice Plate							Large Basin, Circular Orifice Plate							Large Basin, Circlar Orifice Tube							Large Basin, Circular Culvert							Large Basin, Rect. Orifice Plate						
		Rating of Potential Effect							Rating of Potential Effect							Rating of Potential Effect							Rating of Potential Effect							Rating of Potential Effect							Rating of Potential Effect							Rating of Potential Effect							Rating of Potential Effect						
		-5	-3	-1	0	1	2	3	-5	-3	-1	0	1	2	3	-5	-3	-1	0	1	2	3	-5	-3	-1	0	1	2	3	-5	-3	-1	0	1	2	3	-5	-3	-1	0	1	2	3	-5	-3	-1	0	1	2	3	-5	-3	-1	0	1	2	3
		-H	-M	-L	Nil	+L	+M	+H	-H	-M	-L	Nil	+L	+M	+H	-H	-M	-L	Nil	+L	+M	+H	-H	-M	-L	Nil	+L	+M	+H	-H	-M	-L	Nil	+L	+M	+H	-H	-M	-L	Nil	+L	+M	+H	-H	-M	-L	Nil	+L	+M	+H	-H	-M	-L	Nil	+L	+M	+H
	Natural Environment																																																								
5	Species at Risk				0							0							0							0							0							0							0							0			
5	Fish and Fish Habitat					5							5							5							5							5							5							5							5		
5	Water Quality					5							5							5							5							5							5							5							5		
5	Shoreline Impacts					5							5							5							5							5							5							5							5		
5	Significant Vegetation Communities				0							0							0							0							0							0							0							0			
5	Erosion					5							5							5							5							5							5							5							5		
	Subtotal Score	**20**							**20**							**20**							**20**							**20**							**20**							**20**							**20**						
	Category Rank	**1**							**1**							**1**							**1**							**1**							**1**							**1**							**1**						
	Social Environment																																																							
5	Impacts to Public During Construction			-5							-5							-5							-5							-5							-5							-5							-5				
8	Long Term Impacts to Private Property					8							8							8							8							8							8							8							8		
8	Public Health and Safety							24							24							24							24							24							24							24							24
	Subtotal Score	**27**							**27**							**27**							**27**							**27**							**27**							**27**							**27**						
	Category Rank	**1**							**1**							**1**							**1**							**1**							**1**							**1**							**1**						
	Cultural Environment																																																							
5	Archaeological				0							0							0							0							0							0							0							0			
5	Heritage				0							0							0							0							0							0							0							0			
5	First Nations				0							0							0							0							0							0							0							0			
	Subtotal Score	**0**							**0**							**0**							**0**							**0**							**0**							**0**							**0**						
	Category Rank	**1**							**1**							**1**							**1**							**1**							**1**							**1**							**1**						
	Engineering / Technical Environment																																																							
8	Utilities				0							0							0							0					-24							-24							-24							-24					
5	Infrastructure				0							0							0							0							0							0							0							0			
6	Constructability			-6						-18								-6						-18								-6						-18								-6						-18					
5	Durability / Life Cycle Impacts			-5							-5							-5							-5							-5							-5							-5							-5				
8	Flow Conveyance						16						8					-8											24							24							24							24							24
8	Slope Stability				0							0							0								8						0							0							0							0			
10	Flood Reduction					10								20							20						10							10								20							20						10		
	Subtotal Score	**15**							**5**							**1**							**19**							**-1**							**-3**							**9**							**-13**						
	Category Rank	**2**							**4**							**5**							**1**							**6**							**7**							**3**							**8**						
	Economic Environment																																																							
8	Easements / Land Acquisition			-8							-8							-8							-8					-40							-40							-40							-40						
7	Capital Costs		-21								-7							-7						-21						-35								-21							-21						-35						
8	Maintenace Costs and Access		-24							-24							-24							-24							-24							-24							-24							-24					
8	Risk / Liability			-8						-24							-24								-8							-8						-24							-24								-8				
	Subtotal Score	**-61**							**-63**							**-63**							**-61**							**-107**							**-109**							**-109**							**-107**						
	Category Rank	**1**							**3**							**3**							**1**							**5**							**7**							**7**							**5**						
	TOTAL SCORE	**1**							**-11**							**-15**							**5**							**-61**							**-65**							**-53**							**-73**						
	OVERAL RANK	**2**							**3**							**4**							**1**							**6**							**7**							**5**							**8**						

Appendix C

Analysis of Alternative Design Concepts

WILLS

PARTNERS IN ENGINEERING

January 16, 2018

Town of Cobourg
Public Works Department
740 Division Street, Building #7
Cobourg, ON
K9A 0H6

Attention: **Ms. Laurie Wills, P.Eng, Deputy Director of Public Works**

Dear Ms. Wills:

Re: Midtown Creek Flood Ponding Area and Kerr Street Extension
Municipal Class EA, Detailed Design and Contract Administration
Online Pond - Alternative Design Concepts
D.M. Wills Associates Project No. 17-5268

As part of Phase 3 of the Class EA, D.M. Wills Associates Limited (Wills) has prepared a number of alternative design concepts for the preferred alternative; which was identified as part of Phase 2 of the Class EA. These alternative design concepts include two (2) different storage configurations, each with four (4) different outlet structure configurations, for a total of eight (8) alternative design concepts.

Design Criteria and Constraints

The design criteria and constraints that were considered in the development of the alternative design concepts are listed below:

1. The facility must control the 100-year peak flow rate to the capacity of the Buchannan Street Culvert (4.1 m^3/s), which is equivalent to the 2-year peak flow rate.
2. The Regional Storm peak flow rate of 44.85 m^3/s must be conveyed across Kerr Street and safe access must be provided (flood depth of 0.30 m or less).
3. The outlet structure must have a span less than 6.0 m.
4. The facility should promote fish passage.
5. The facility should not restrict normal base flows.
6. A freeboard of 1.0 m is desired for the design (50-year) storm (measured from the high water level to the edge of the traveled lane).
7. Berms other than the Kerr Street embankment should not be used to contain the online storage.

D.M. Wills Associates Limited
150 Jameson Drive, Peterborough, Ontario, Canada K9J 0B9
P. 705.742.2297 **F**. 705.748.9944 **E**. wills@dmwills.com

8. The maximum ponding elevation is 91.60 m, above which water will spill over the railway spur.
9. The facility must not impact private properties adjacent to Midtown Creek upstream of the railway spur that are not currently within the Regulatory Floodplain.
10. The invert elevation of the outlet structure should be set to match the existing watercourse invert downstream of the proposed Kerr Street right-of-way.

Other parameters were selected to aid in the detailed design of the restored natural channel for Midtown Creek. These parameters can be changed in the detailed design phase, but are used as preliminary sizes and elevations for conservative basin and outlet structure sizing:

1. The reconstructed reach of Midtown Creek should contain the 2-year flow (4.11 m^3/s) within its banks and utilize the surrounding area as floodplain.
2. The reconstructed Midtown Creek channel should have a preliminary longitudinal slope of 1.5%.
3. The control invert elevation for the outlet structure should be set at 87.95 m to maintain a 0.35 m channel depth for the reconstructed reach of Midtown Creek.

Storage Configurations

As described above, two (2) different storage configurations have been considered.

The first storage configuration contains all ponding to the west side of the George Street right-of-way so as not to disturb the existing infrastructure (watermain, sewers, hydro) within that area. This storage configuration provides 6.27 ha*m of storage up to a ponding elevation of 91.60 m.

The second storage configuration extends west of the George Street right-of-way and provides 7.17 ha*m of storage up to a ponding elevation of 91.60 m. Both storage basins have been designed with a top elevation of 91.60 m since any ponding above 91.60 m will spill onto the railway spur at the south west corner of the site.

Minor surface grading is required on private property at the south east corner of the site to contain the ponding and prevent spills onto private property.

Outlet Configurations

Four (4) outlet configurations have been considered for each of the two (2) storage configurations and are described as follows:

1. Circular orifice plate.
2. Circular orifice tube.
3. Circular concrete culvert.
4. Rectangular orifice plate.

Alternative Design Concepts

The eight (8) alternative design concepts, two (2) storage configurations each with four (4) outlet configurations, were modelled in Visual Otthymo 3 (VO3) using the model provided by the GRCA. The results of the analyses are discussed below and summarized in **Table 1** and the Stage-Storage Discharge Tables are attached.

Design Concept 1

Design Concept 1 uses the small basin storage configuration and a 1084 mm diameter circular orifice plate with an invert elevation of 87.95 m. The 50-year storm creates ponding up to an elevation of 90.91 m (4.24 ha*m) and the 100-year storm ponds to an elevation of 91.30 m (5.36 ha*m). A 170 m long spill is required to convey the Regional Storm across Kerr Street and provide safe access.

Design Concept 2

Design Concept 2 uses the small basin storage configuration and a 917 mm diameter circular orifice tube with an invert elevation of 87.95 m. The 50-year storm creates ponding up to an elevation of 90.95 m (4.35 ha*m) and the 100-year storm ponds to an elevation of 91.35 m (5.50 ha*m). A 200 m long spill is required to convey the Regional Storm across Kerr Street and provide safe access.

Design Concept 3

Design Concept 3 uses the small basin storage configuration and a 1050 mm diameter circular concrete culvert with an inlet invert elevation of 87.95 m. The 50-year storm creates ponding up to an elevation of 91.00 m (4.49 ha*m) and the 100-year storm ponds to an elevation of 91.38 m (5.61 ha*m). A 250 m long spill is required to convey the Storm across Kerr Street and provide safe access.

Design Concept 4

Design Concept 4 uses the small basin storage configuration and a rectangular orifice plate with a rise of 593 mm and a span of 1500 mm, and an invert elevation of 87.95 m. The 50-year storm creates ponding up to an elevation of 90.87 m (4.13 ha*m) and the 100-year storm ponds to an elevation of 91.27 m (5.27 ha*m). A 150 m long spill is required to convey the Regional Storm across Kerr Street and provide safe access.

Design Concept 5

Design Concept 5 uses the large basin storage configuration and a 1107 mm diameter circular orifice plate with an invert elevation of 87.95 m. The 50-year storm creates ponding up to an elevation of 90.71 m (4.28 ha*m) and the 100-year storm ponds to an elevation of 91.07 m (5.40 ha*m). A 150 m long spill is required to convey the Regional Storm across Kerr Street and provide safe access.

Design Concept 6

Design Concept 6 uses the large basin storage configuration and a 900 mm diameter circular orifice tube with an invert elevation of 87.95 m. The 50-year storm creates ponding up to an elevation of 90.85 m (4.70 ha*m) and the 100-year storm ponds to an elevation of 91.22 m (5.90 ha*m). A 150 m long spill is required to convey the Regional Storm across Kerr Street and provide safe access.

Design Concept 7

Design Concept 7 uses the large basin storage configuration and a 1050 mm diameter circular concrete culvert with an inlet invert elevation of 87.95 m. The 50-year storm creates ponding up to an elevation of 90.86 m (4.72 ha*m) and the 100-year storm ponds to an elevation of 91.21 m (5.87 ha*m). A 150 m long spill is required to convey the Regional Storm across Kerr Street and provide safe access.

Design Concept 8

Design Concept 8 uses the small basin storage configuration and a rectangular orifice plate with a rise of 620 mm and a span of 1500 mm, and an invert elevation of 87.95 m. The 50-year storm creates ponding up to an elevation of 90.67 m (4.14 ha*m) and the 100-year storm ponds to an elevation of 91.03 m (5.28 ha*m). A 150 m long spill is required to convey the Regional Storm across Kerr Street and provide safe access.

Comparison

The design concepts were compared based on their ability to meet and exceed the design constraints described above. The results and details of the eight options are summarized in **Table 1.**

It should be noted that all design concepts control the 2-year storm (4.11 m^3/s) to a flow between 1.88 m^3/s and 2.20 m^3/s. It is infeasible to allow the 2-year flow pass without being controlled since the 2-year storm flow coincidentally corresponds to the target flow rate set for the 100-year controlled flow (4.11 m^3/s). Expected ponding in either basin during the 2-year storm will occupy approximately 30% to 50% of the basin bottom.

Evaluation of Alternative Design Concepts

Wills completed a detailed evaluation of each of the alternative design concepts using a modified version of the evaluation matrix developed to complete the evaluation of alternatives in Phase 2 of the Class EA. Based on the results of the evaluation, Alternative Design Concept 4 (Small Basin, Rectangular Orifice Plate) is ranked first with Alternative Design Concept 1 (Small Basin, Circular Orifice Plate) ranked a close second. The evaluation matrix is attached for your review.

Closing

Please review the contents of this letter, including the technical details and evaluation of alternative design concepts, so that we can discuss the preferred alternative design concept to be presented at PIC #3. Our recommendation is to present the Small Basin with an Orifice Plate (circular or rectangular) as the preferred alternative in order to leave us some flexibility during detailed design.

Respectfully submitted,

David Green.

David Green, P.Eng.
Assistant Manager,
Water Resources Engineering

Caitlyn Howe

Caitlyn Howe, P.Eng.
Water Resources Engineer

CH/DG/kc

cc: Leslie Benson, Ganaraska Region Conservation Authority

Table 1 – Alternative Design Concept Comparison

Design Concept	Basin Area (ha)	Basin Volume (ha-m)	Outlet Configuration		50-year				100-year				Spill over Kerr Street	
			Size (mm)	Type	Ponding Elevation (m)	Freeboard (m)	Volume (ha*m)	Controlled Flow (m^3/s)	Ponding Elevation (m)	Freeboard (m)	Volume (ha*m)	Controlled Flow (m^3/s)	Spill Length (m)	Spill Elevation (m)
1	3.35	6.27	1084	Circular Orifice Plate	90.91	0.41	4.24	3.81	91.30	0.02	5.36	4.11	170.00	91.32
2	3.35	6.27	917	Circular Orifice Tube	90.95	0.40	4.35	3.73	91.35	0.00	5.50	4.01	200.00	91.35
3	3.35	6.27	1050	Circular Concrete Culvert	91.00	0.39	4.49	3.77	91.38	0.01	5.61	4.08	250.00	91.39
4	3.35	6.27	593 x 1500	Rectangular Orifice Plate	90.87	0.43	4.13	3.83	91.27	0.03	5.27	4.11	150.00	91.30
5	3.82	7.17	1107	Circular Orifice Plate	90.71	0.59	4.28	3.80	91.07	0.23	5.40	4.10	150.00	91.30
6	3.82	7.17	900	Circular Orifice Tube	90.85	0.45	4.70	3.53	91.22	0.08	5.90	3.78	150.00	91.30
7	3.82	7.17	1050	Circular Concrete Culvert	90.86	0.44	4.72	3.65	91.21	0.09	5.87	3.95	150.00	91.30
8	3.82	7.17	620 x 1500	Rectangular Orifice Plate	90.67	0.63	4.14	3.83	91.03	0.27	5.28	4.11	150.00	91.30

Stage - Storage - Discharge

WILLS

Project No: Design Concept 1
Project Name: 5268 Midtown Creek
Designed/Checked By: CH / DG
Date: January 10, 2018

Storage Summary		
Top of Permanent Pool:	87.95	m
Permanent Pool Volume:	0.0	m^3
Active Storage Volume:	62708.5	m^3

Outlet Capacity Summary

Type	Diameter	Slope	Peak Flow	% Full

Discharge Summary

Stage	Type	Invert Elev (m)	Diameter / Width (mm) (m)
1	Orifice Plate: Vertical	87.95	1084
2	Custom Discharge 2	91.32	

Stage-Storage-Discharge Summary Table

Elevation	**Stage**	**Stage 1 Orifice Plate**	**Stage 2 Custom**					**Active Storage**	**Total Discharge**	**Notes**
m	**m**	**m^3/s**						**ha*m**	**m^3/s**	
87.95	0.00	0.000	0.000					**0.0000**	**0.000**	
87.99	0.04	**0.347**	0.000					**0.0000**	**0.347**	
88.03	0.08	**0.491**	0.000					**0.0000**	**0.491**	
88.07	0.12	**0.601**	0.000					**0.0000**	**0.601**	
88.11	0.16	**0.694**	0.000					**0.0000**	**0.694**	
88.15	0.20	**0.776**	0.000					**0.0000**	**0.776**	
88.19	0.24	**0.850**	0.000					**0.0000**	**0.850**	
88.23	0.28	**0.918**	0.000					**0.0000**	**0.918**	
88.27	0.32	**0.981**	0.000					**0.0000**	**0.981**	
88.31	0.36	**1.041**	0.000					**0.0012**	**1.041**	
88.35	0.40	**1.097**	0.000					**0.0061**	**1.097**	
88.39	0.44	**1.150**	0.000					**0.0111**	**1.150**	
88.43	0.48	**1.202**	0.000					**0.0195**	**1.202**	
88.47	0.52	**1.251**	0.000					**0.0294**	**1.251**	
88.51	0.56	**1.298**	0.000					**0.0405**	**1.298**	
88.55	0.60	**1.343**	0.000					**0.0553**	**1.343**	
88.59	0.64	**1.387**	0.000					**0.0702**	**1.387**	
88.63	0.68	**1.430**	0.000					**0.0888**	**1.430**	
88.67	0.72	**1.472**	0.000					**0.1087**	**1.472**	
88.71	0.76	**1.512**	0.000					**0.1298**	**1.512**	
88.75	0.80	**1.551**	0.000					**0.1548**	**1.551**	
88.79	0.84	**1.590**	0.000					**0.1798**	**1.590**	
88.83	0.88	**1.627**	0.000					**0.2086**	**1.627**	
88.87	0.92	**1.664**	0.000					**0.2388**	**1.664**	
88.91	0.96	**1.699**	0.000					**0.2704**	**1.699**	
88.95	1.00	**1.734**	0.000					**0.3054**	**1.734**	
88.99	1.04	**1.769**	0.000					**0.3408**	**1.769**	
89.03	1.08	**1.802**	0.000					**0.3799**	**1.802**	
89.07	1.12	**1.865**	0.000					**0.4205**	**1.865**	
89.11	1.16	**1.928**	0.000					**0.4628**	**1.928**	
89.15	1.20	**1.990**	0.000					**0.5082**	**1.990**	
89.19	1.24	**2.049**	0.000					**0.5545**	**2.049**	<= 2 Yr: 5115 m3 (89.15m)
89.23	1.28	**2.107**	0.000					**0.6040**	**2.107**	
89.27	1.32	**2.163**	0.000					**0.6553**	**2.163**	
89.31	1.36	**2.218**	0.000					**0.7084**	**2.218**	
89.35	1.40	**2.272**	0.000					**0.7647**	**2.272**	
89.39	1.44	**2.324**	0.000					**0.8218**	**2.324**	
89.43	1.48	**2.375**	0.000					**0.8822**	**2.375**	
89.47	1.52	**2.426**	0.000					**0.9443**	**2.426**	
89.51	1.56	**2.475**	0.000					**1.0079**	**2.475**	
89.55	1.60	**2.523**	0.000					**1.0749**	**2.523**	
89.59	1.64	**2.570**	0.000					**1.1423**	**2.570**	
89.63	1.68	**2.616**	0.000					**1.2125**	**2.616**	
89.67	1.72	**2.662**	0.000					**1.2840**	**2.662**	
89.71	1.76	**2.707**	0.000					**1.3565**	**2.707**	<= 5 Yr: 12926 m3 (89.67m)
89.75	1.80	**2.751**	0.000					**1.4320**	**2.751**	
89.79	1.84	**2.794**	0.000					**1.5075**	**2.794**	
89.83	1.88	**2.837**	0.000					**1.5858**	**2.837**	
89.87	1.92	**2.879**	0.000					**1.6653**	**2.879**	

Stage-Storage-Discharge Summary Table

Elevation	Stage	Stage 1 Orifice Plate	Stage 2 Custom					Active Storage	Total Discharge	Notes
m	m	m^3/s						ha*m	m^3/s	
89.91	1.96	**2.921**	0.000					**1.7457**	**2.921**	
89.95	2.00	**2.962**	0.000					**1.8290**	**2.962**	
89.99	2.04	**3.002**	0.000					**1.9125**	**3.002**	
90.03	2.08	**3.042**	0.000					**1.9988**	**3.042**	
90.07	2.12	**3.081**	0.000					**2.0862**	**3.081**	<= 10 Yr: 20629 m3 (90.06m)
90.11	2.16	**3.120**	0.000					**2.1746**	**3.120**	
90.15	2.20	**3.158**	0.000					**2.2657**	**3.158**	
90.19	2.24	**3.196**	0.000					**2.3568**	**3.196**	
90.23	2.28	**3.234**	0.000					**2.4507**	**3.234**	
90.27	2.32	**3.271**	0.000					**2.5456**	**3.271**	
90.31	2.36	**3.307**	0.000					**2.6415**	**3.307**	
90.35	2.40	**3.343**	0.000					**2.7396**	**3.343**	
90.39	2.44	**3.379**	0.000					**2.8381**	**3.379**	
90.43	2.48	**3.414**	0.000					**2.9388**	**3.414**	
90.47	2.52	**3.450**	0.000					**3.0405**	**3.450**	
90.51	2.56	**3.484**	0.000					**3.1432**	**3.484**	
90.55	2.60	**3.519**	0.000					**3.2479**	**3.519**	<= 25 Yr: 32100 m3 (90.54m)
90.59	2.64	**3.553**	0.000					**3.3531**	**3.553**	
90.63	2.68	**3.586**	0.000					**3.4600**	**3.586**	
90.67	2.72	**3.620**	0.000					**3.5679**	**3.620**	
90.71	2.76	**3.653**	0.000					**3.6765**	**3.653**	
90.75	2.80	**3.686**	0.000					**3.7867**	**3.686**	
90.79	2.84	**3.718**	0.000					**3.8972**	**3.718**	
90.83	2.88	**3.750**	0.000					**4.0089**	**3.750**	
90.87	2.92	**3.782**	0.000					**4.1211**	**3.782**	
90.91	2.96	**3.814**	0.000					**4.2337**	**3.814**	
90.95	3.00	**3.845**	0.000					**4.3473**	**3.845**	<= 50 Yr: 42402 m3 (90.91m)
90.99	3.04	**3.877**	0.000					**4.4611**	**3.877**	
91.03	3.08	**3.907**	0.000					**4.5758**	**3.907**	
91.07	3.12	**3.938**	0.000					**4.6909**	**3.938**	
91.11	3.16	**3.969**	0.000					**4.8064**	**3.969**	
91.15	3.20	**3.999**	0.000					**4.9230**	**3.999**	
91.19	3.24	**4.029**	0.000					**5.0395**	**4.029**	
91.23	3.28	**4.059**	0.000					**5.1572**	**4.059**	
91.27	3.32	**4.088**	0.000					**5.2752**	**4.088**	
91.31	3.36	**4.117**	0.000					**5.3936**	**4.117**	<= 100 Yr: 53626 m3 (91.3m)
91.35	3.40	**4.146**	**1.506**					**5.5131**	**5.652**	170 m Kerr Street Spill
91.39	3.44	**4.175**	**5.368**					**5.6326**	**9.543**	
91.43	3.48	**4.204**	**10.574**					**5.7532**	**14.778**	
91.47	3.52	**4.233**	**16.838**					**5.8741**	**21.070**	
91.51	3.56	**4.261**	**24.004**					**5.9955**	**28.265**	
91.55	3.60	**4.289**	**31.970**					**6.1178**	**36.259**	
91.59	3.64	**4.317**	**40.662**					**6.2402**	**44.979**	
91.60	3.65	**4.324**	**42.942**					**6.2708**	**47.266**	

Stage - Storage - Discharge

WILLS

Project No: Design Concept 2
Project Name: 5268 Midtown Creek
Designed/Checked By: CH / DG
Date: January 10, 2018

Storage Summary		
Top of Permanent Pool:	87.95	m
Permanent Pool Volume:	0.0	m^3
Active Storage Volume:	62708.5	m^3

Outlet Capacity Summary

Type	Diameter	Slope	Peak Flow	% Full

Discharge Summary

Stage	Type	Invert Elev (m)	Diameter / Width (mm)	(m)
1	Orifice Tube: Vertical	87.95	917	
2	Custom Discharge	91.35		

Stage-Storage-Discharge Summary Table

Elevation	Stage	Stage 1 Orifice Tube	Stage 2 Custom					Active Storage	Total Discharge	Notes
m	m	m^3/s						ha*m	m^3/s	
87.95	0.00	0.000	0.000					0.0000	0.000	
87.99	0.04	0.331	0.000					0.0000	0.331	
88.03	0.08	0.468	0.000					0.0000	0.468	
88.07	0.12	0.573	0.000					0.0000	0.573	
88.11	0.16	0.662	0.000					0.0000	0.662	
88.15	0.20	0.740	0.000					0.0000	0.740	
88.19	0.24	0.811	0.000					0.0000	0.811	
88.23	0.28	0.876	0.000					0.0000	0.876	
88.27	0.32	0.936	0.000					0.0000	0.936	
88.31	0.36	0.993	0.000					0.0012	0.993	
88.35	0.40	1.047	0.000					0.0061	1.047	
88.39	0.44	1.098	0.000					0.0111	1.098	
88.43	0.48	1.146	0.000					0.0195	1.146	
88.47	0.52	1.193	0.000					0.0294	1.193	
88.51	0.56	1.238	0.000					0.0405	1.238	
88.55	0.60	1.282	0.000					0.0553	1.282	
88.59	0.64	1.324	0.000					0.0702	1.324	
88.63	0.68	1.365	0.000					0.0888	1.365	
88.67	0.72	1.404	0.000					0.1087	1.404	
88.71	0.76	1.443	0.000					0.1298	1.443	
88.75	0.80	1.480	0.000					0.1548	1.480	
88.79	0.84	1.517	0.000					0.1798	1.517	
88.83	0.88	1.552	0.000					0.2086	1.552	
88.87	0.92	1.590	0.000					0.2388	1.590	
88.91	0.96	1.657	0.000					0.2704	1.657	
88.95	1.00	1.722	0.000					0.3054	1.722	
88.99	1.04	1.785	0.000					0.3408	1.785	
89.03	1.08	1.845	0.000					0.3799	1.845	
89.07	1.12	1.903	0.000					0.4205	1.903	
89.11	1.16	1.960	0.000					0.4628	1.960	
89.15	1.20	2.015	0.000					0.5082	2.015	<= 2 Yr: 4938 m3 (89.14m)
89.19	1.24	2.069	0.000					0.5545	2.069	
89.23	1.28	2.121	0.000					0.6040	2.121	
89.27	1.32	2.172	0.000					0.6553	2.172	
89.31	1.36	2.222	0.000					0.7084	2.222	
89.35	1.40	2.271	0.000					0.7647	2.271	
89.39	1.44	2.319	0.000					0.8218	2.319	
89.43	1.48	2.365	0.000					0.8822	2.365	
89.47	1.52	2.411	0.000					0.9443	2.411	
89.51	1.56	2.456	0.000					1.0079	2.456	
89.55	1.60	2.500	0.000					1.0749	2.500	
89.59	1.64	2.544	0.000					1.1423	2.544	
89.63	1.68	2.587	0.000					1.2125	2.587	
89.67	1.72	2.629	0.000					1.2840	2.629	
89.71	1.76	2.670	0.000					1.3565	2.670	<= 5 Yr: 13097 m3 (89.68m)
89.75	1.80	2.711	0.000					1.4320	2.711	
89.79	1.84	2.751	0.000					1.5075	2.751	
89.83	1.88	2.790	0.000					1.5858	2.790	
89.87	1.92	2.829	0.000					1.6653	2.829	

Stage-Storage-Discharge Summary Table

Elevation	Stage	Stage 1 Orifice Tube	Stage 2 Custom					Active Storage	Total Discharge	Notes
m	m	m^3/s						ha*m	m^3/s	
89.91	1.96	**2.868**	0.000					**1.7457**	**2.868**	
89.95	2.00	**2.906**	0.000					**1.8290**	**2.906**	
89.99	2.04	**2.943**	0.000					**1.9125**	**2.943**	
90.03	2.08	**2.980**	0.000					**1.9988**	**2.980**	
90.07	2.12	**3.017**	0.000					**2.0862**	**3.017**	
90.11	2.16	**3.053**	0.000					**2.1746**	**3.053**	<= 10 Yr: 21063 m3 (90.08m)
90.15	2.20	**3.088**	0.000					**2.2657**	**3.088**	
90.19	2.24	**3.124**	0.000					**2.3568**	**3.124**	
90.23	2.28	**3.159**	0.000					**2.4507**	**3.159**	
90.27	2.32	**3.193**	0.000					**2.5456**	**3.193**	
90.31	2.36	**3.227**	0.000					**2.6415**	**3.227**	
90.35	2.40	**3.261**	0.000					**2.7396**	**3.261**	
90.39	2.44	**3.294**	0.000					**2.8381**	**3.294**	
90.43	2.48	**3.327**	0.000					**2.9388**	**3.327**	
90.47	2.52	**3.360**	0.000					**3.0405**	**3.360**	
90.51	2.56	**3.393**	0.000					**3.1432**	**3.393**	
90.55	2.60	**3.425**	0.000					**3.2479**	**3.425**	
90.59	2.64	**3.457**	0.000					**3.3531**	**3.457**	<= 25 Yr: 32918 m3 (90.57m)
90.63	2.68	**3.488**	0.000					**3.4600**	**3.488**	
90.67	2.72	**3.519**	0.000					**3.5679**	**3.519**	
90.71	2.76	**3.550**	0.000					**3.6765**	**3.550**	
90.75	2.80	**3.581**	0.000					**3.7867**	**3.581**	
90.79	2.84	**3.612**	0.000					**3.8972**	**3.612**	
90.83	2.88	**3.642**	0.000					**4.0089**	**3.642**	
90.87	2.92	**3.672**	0.000					**4.1211**	**3.672**	
90.91	2.96	**3.701**	0.000					**4.2337**	**3.701**	
90.95	3.00	**3.731**	0.000					**4.3473**	**3.731**	
90.99	3.04	**3.760**	0.000					**4.4611**	**3.760**	<= 50 Yr: 43498 m3 (90.95m)
91.03	3.08	**3.789**	0.000					**4.5758**	**3.789**	
91.07	3.12	**3.818**	0.000					**4.6909**	**3.818**	
91.11	3.16	**3.847**	0.000					**4.8064**	**3.847**	
91.15	3.20	**3.875**	0.000					**4.9230**	**3.875**	
91.19	3.24	**3.903**	0.000					**5.0395**	**3.903**	
91.23	3.28	**3.931**	0.000					**5.1572**	**3.931**	
91.27	3.32	**3.959**	0.000					**5.2752**	**3.959**	
91.31	3.36	**3.986**	0.000					**5.3936**	**3.986**	
91.35	3.40	**4.014**	**0.000**					**5.5131**	**4.014**	<= 100 Yr: 55008 m3 (91.35m)
91.39	3.44	**4.041**	**2.728**					**5.6326**	**6.769**	200 m Kerr Street Spill
91.43	3.48	**4.068**	**7.715**					**5.7532**	**11.783**	
91.47	3.52	**4.095**	**14.174**					**5.8741**	**18.269**	
91.51	3.56	**4.121**	**21.823**					**5.9955**	**25.944**	
91.55	3.60	**4.148**	**30.498**					**6.1178**	**34.646**	
91.59	3.64	**4.174**	**40.091**					**6.2402**	**44.265**	
91.60	3.65	**4.181**	**42.622**					**6.2708**	**46.803**	

Stage - Storage - Discharge

Project No: Design Concept 3
Project Name: 5268 Midtown Creek
Designed/Checked By: CH / DG
Date: January 10, 2018

Storage Summary		
Top of Permanent Pool:	87.95	m
Permanent Pool Volume:	0.0	m^3
Active Storage Volume:	62708.5	m^3

Outlet Capacity Summary				
Type	Diameter	Slope	Peak Flow	% Full

Discharge Summary				
Stage	Type	Invert Elev (m)	Diameter / Width (mm)	(m)
1	Custom Discharge 2	87.95		
2	Custom Discharge	91.39		

Stage-Storage-Discharge Summary Table

Elevation	Stage	Stage 1 Custom	Stage 2 Custom					Active Storage	Total Discharge	Notes
m	m	m^3/s						ha*m	m^3/s	
87.95	0.00	0.000	0.000					**0.0000**	**0.000**	1050 mm Concrete Culvert
87.99	0.04	**0.041**	0.000					**0.0000**	**0.041**	
88.03	0.08	**0.081**	0.000					**0.0000**	**0.081**	
88.07	0.12	**0.122**	0.000					**0.0000**	**0.122**	
88.11	0.16	**0.162**	0.000					**0.0000**	**0.162**	
88.15	0.20	**0.203**	0.000					**0.0000**	**0.203**	
88.19	0.24	**0.243**	0.000					**0.0000**	**0.243**	
88.23	0.28	**0.284**	0.000					**0.0000**	**0.284**	
88.27	0.32	**0.324**	0.000					**0.0000**	**0.324**	
88.31	0.36	**0.365**	0.000					**0.0012**	**0.365**	
88.35	0.40	**0.405**	0.000					**0.0061**	**0.405**	
88.39	0.44	**0.446**	0.000					**0.0111**	**0.446**	
88.43	0.48	**0.486**	0.000					**0.0195**	**0.486**	
88.47	0.52	**0.527**	0.000					**0.0294**	**0.527**	
88.51	0.56	**0.567**	0.000					**0.0405**	**0.567**	
88.55	0.60	**0.608**	0.000					**0.0553**	**0.608**	
88.59	0.64	**0.648**	0.000					**0.0702**	**0.648**	
88.63	0.68	**0.689**	0.000					**0.0888**	**0.689**	
88.67	0.72	**0.729**	0.000					**0.1087**	**0.729**	
88.71	0.76	**0.770**	0.000					**0.1298**	**0.770**	
88.75	0.80	**0.820**	0.000					**0.1548**	**0.820**	
88.79	0.84	**0.898**	0.000					**0.1798**	**0.898**	
88.83	0.88	**0.976**	0.000					**0.2086**	**0.976**	
88.87	0.92	**1.054**	0.000					**0.2388**	**1.054**	
88.91	0.96	**1.132**	0.000					**0.2704**	**1.132**	
88.95	1.00	**1.210**	0.000					**0.3054**	**1.210**	
88.99	1.04	**1.288**	0.000					**0.3408**	**1.288**	
89.03	1.08	**1.366**	0.000					**0.3799**	**1.366**	
89.07	1.12	**1.444**	0.000					**0.4205**	**1.444**	
89.11	1.16	**1.522**	0.000					**0.4628**	**1.522**	
89.15	1.20	**1.600**	0.000					**0.5082**	**1.600**	
89.19	1.24	**1.671**	0.000					**0.5545**	**1.671**	
89.23	1.28	**1.742**	0.000					**0.6040**	**1.742**	
89.27	1.32	**1.813**	0.000					**0.6553**	**1.813**	
89.31	1.36	**1.884**	0.000					**0.7084**	**1.884**	
89.35	1.40	**1.956**	0.000					**0.7647**	**1.956**	<= 2 Yr: 7380 m3 (89.33m)
89.39	1.44	**2.027**	0.000					**0.8218**	**2.027**	
89.43	1.48	**2.098**	0.000					**0.8822**	**2.098**	
89.47	1.52	**2.169**	0.000					**0.9443**	**2.169**	
89.51	1.56	**2.240**	0.000					**1.0079**	**2.240**	
89.55	1.60	**2.311**	0.000					**1.0749**	**2.311**	
89.59	1.64	**2.382**	0.000					**1.1423**	**2.382**	
89.63	1.68	**2.433**	0.000					**1.2125**	**2.433**	
89.67	1.72	**2.477**	0.000					**1.2840**	**2.477**	
89.71	1.76	**2.521**	0.000					**1.3565**	**2.521**	
89.75	1.80	**2.564**	0.000					**1.4320**	**2.564**	
89.79	1.84	**2.608**	0.000					**1.5075**	**2.608**	
89.83	1.88	**2.652**	0.000					**1.5858**	**2.652**	<= 5 Yr: 15200 m3 (89.8m)
89.87	1.92	**2.696**	0.000					**1.6653**	**2.696**	

Stage-Storage-Discharge Summary Table

Elevation	Stage	Stage 1 Custom	Stage 2 Custom					Active Storage	Total Discharge	Notes
m	m	m^3/s						ha*m	m^3/s	
89.91	1.96	2.740	0.000					1.7457	2.740	
89.95	2.00	2.784	0.000					1.8290	2.784	
89.99	2.04	2.827	0.000					1.9125	2.827	
90.03	2.08	2.871	0.000					1.9988	2.871	
90.07	2.12	2.915	0.000					2.0862	2.915	
90.11	2.16	2.959	0.000					2.1746	2.959	
90.15	2.20	3.003	0.000					2.2657	3.003	
90.19	2.24	3.047	0.000					2.3568	3.047	<= 10 Yr: 22963 m3 (90.16m)
90.23	2.28	3.090	0.000					2.4507	3.090	
90.27	2.32	3.134	0.000					2.5456	3.134	
90.31	2.36	3.178	0.000					2.6415	3.178	
90.35	2.40	3.217	0.000					2.7396	3.217	
90.39	2.44	3.251	0.000					2.8381	3.251	
90.43	2.48	3.285	0.000					2.9388	3.285	
90.47	2.52	3.319	0.000					3.0405	3.319	
90.51	2.56	3.353	0.000					3.1432	3.353	
90.55	2.60	3.387	0.000					3.2479	3.387	
90.59	2.64	3.421	0.000					3.3531	3.421	
90.63	2.68	3.455	0.000					3.4600	3.455	<= 25 Yr: 34554 m3 (90.63m)
90.67	2.72	3.489	0.000					3.5679	3.489	
90.71	2.76	3.523	0.000					3.6765	3.523	
90.75	2.80	3.557	0.000					3.7867	3.557	
90.79	2.84	3.591	0.000					3.8972	3.591	
90.83	2.88	3.626	0.000					4.0089	3.626	
90.87	2.92	3.660	0.000					4.1211	3.660	
90.91	2.96	3.694	0.000					4.2337	3.694	
90.95	3.00	3.728	0.000					4.3473	3.728	
90.99	3.04	3.762	0.000					4.4611	3.762	
91.03	3.08	3.796	0.000					4.5758	3.796	<= 50 Yr: 44900 m3 (91m)
91.07	3.12	3.830	0.000					4.6909	3.830	
91.11	3.16	3.864	0.000					4.8064	3.864	
91.15	3.20	3.898	0.000					4.9230	3.898	
91.19	3.24	3.932	0.000					5.0395	3.932	
91.23	3.28	3.966	0.000					5.1572	3.966	
91.27	3.32	4.000	0.000					5.2752	4.000	
91.31	3.36	4.028	0.000					5.3936	4.028	
91.35	3.40	4.056	0.000					5.5131	4.056	
91.39	3.44	4.083	0.000					5.6326	4.083	<= 100 Yr: 56114 m3 (91.38m)
91.43	3.48	4.111	3.410					5.7532	7.521	250 m Kerr Street Spill
91.47	3.52	4.139	9.644					5.8741	13.783	
91.51	3.56	4.167	17.718					5.9955	21.885	
91.55	3.60	4.195	27.278					6.1178	31.473	
91.59	3.64	4.223	38.123					6.2402	42.345	
91.60	3.65	4.230	41.017					6.2708	45.247	

Stage - Storage - Discharge

WILLS

Project No: Design Concept 4
Project Name: 5268 Midtown Creek
Designed/Checked By: CH / DG
Date: January 10, 2018

Storage Summary		
Top of Permanent Pool:	87.95	m
Permanent Pool Volume:	0.0	m^3
Active Storage Volume:	62708.5	m^3

Outlet Capacity Summary

Type	Diameter	Slope	Peak Flow	% Full

Discharge Summary

Stage	Type	Invert Elev (m)	Diameter / Width (mm)	(m)
1	Orifice Plate: Vertical	87.95	593	
2	Custom Discharge 2	91.30		

Stage-Storage-Discharge Summary Table

Elevation	Stage	Stage 1 Orifice Plate	Stage 2 Custom					Active Storage	Total Discharge	Notes
m	m	m^3/s						ha*m	m^3/s	
87.95	0.00	0.000	0.000					0.0000	0.000	1500x593 Rectangular Orifice
87.99	0.04	0.334	0.000					0.0000	0.334	
88.03	0.08	0.473	0.000					0.0000	0.473	
88.07	0.12	0.579	0.000					0.0000	0.579	
88.11	0.16	0.669	0.000					0.0000	0.669	
88.15	0.20	0.748	0.000					0.0000	0.748	
88.19	0.24	0.819	0.000					0.0000	0.819	
88.23	0.28	0.885	0.000					0.0000	0.885	
88.27	0.32	0.946	0.000					0.0000	0.946	
88.31	0.36	1.003	0.000					0.0012	1.003	
88.35	0.40	1.057	0.000					0.0061	1.057	
88.39	0.44	1.109	0.000					0.0111	1.109	
88.43	0.48	1.158	0.000					0.0195	1.158	
88.47	0.52	1.205	0.000					0.0294	1.205	
88.51	0.56	1.251	0.000					0.0405	1.251	
88.55	0.60	1.302	0.000					0.0553	1.302	
88.59	0.64	1.386	0.000					0.0702	1.386	
88.63	0.68	1.464	0.000					0.0888	1.464	
88.67	0.72	1.538	0.000					0.1087	1.538	
88.71	0.76	1.609	0.000					0.1298	1.609	
88.75	0.80	1.677	0.000					0.1548	1.677	
88.79	0.84	1.743	0.000					0.1798	1.743	
88.83	0.88	1.806	0.000					0.2086	1.806	
88.87	0.92	1.867	0.000					0.2388	1.867	
88.91	0.96	1.926	0.000					0.2704	1.926	
88.95	1.00	1.983	0.000					0.3054	1.983	
88.99	1.04	2.038	0.000					0.3408	2.038	
89.03	1.08	2.093	0.000					0.3799	2.093	
89.07	1.12	2.145	0.000					0.4205	2.145	
89.11	1.16	2.197	0.000					0.4628	2.197	<= 2 Yr: 4242 m3 (89.07m)
89.15	1.20	2.247	0.000					0.5082	2.247	
89.19	1.24	2.296	0.000					0.5545	2.296	
89.23	1.28	2.344	0.000					0.6040	2.344	
89.27	1.32	2.392	0.000					0.6553	2.392	
89.31	1.36	2.438	0.000					0.7084	2.438	
89.35	1.40	2.483	0.000					0.7647	2.483	
89.39	1.44	2.528	0.000					0.8218	2.528	
89.43	1.48	2.572	0.000					0.8822	2.572	
89.47	1.52	2.615	0.000					0.9443	2.615	
89.51	1.56	2.657	0.000					1.0079	2.657	
89.55	1.60	2.699	0.000					1.0749	2.699	
89.59	1.64	2.740	0.000					1.1423	2.740	<= 5 Yr: 11389 m3 (89.59m)
89.63	1.68	2.781	0.000					1.2125	2.781	
89.67	1.72	2.820	0.000					1.2840	2.820	
89.71	1.76	2.860	0.000					1.3565	2.860	
89.75	1.80	2.899	0.000					1.4320	2.899	
89.79	1.84	2.937	0.000					1.5075	2.937	
89.83	1.88	2.975	0.000					1.5858	2.975	
89.87	1.92	3.012	0.000					1.6653	3.012	

Stage-Storage-Discharge Summary Table

Elevation	Stage	Stage 1 Orifice Plate	Stage 2 Custom					Active Storage	Total Discharge	Notes
m	m	m^3/s						ha*m	m^3/s	
89.91	1.96	**3.049**	0.000					**1.7457**	**3.049**	
89.95	2.00	**3.085**	0.000					**1.8290**	**3.085**	
89.99	2.04	**3.121**	0.000					**1.9125**	**3.121**	
90.03	2.08	**3.157**	0.000					**1.9988**	**3.157**	<= 10 Yr: 19169 m3 (89.99m)
90.07	2.12	**3.192**	0.000					**2.0862**	**3.192**	
90.11	2.16	**3.227**	0.000					**2.1746**	**3.227**	
90.15	2.20	**3.262**	0.000					**2.2657**	**3.262**	
90.19	2.24	**3.296**	0.000					**2.3568**	**3.296**	
90.23	2.28	**3.329**	0.000					**2.4507**	**3.329**	
90.27	2.32	**3.363**	0.000					**2.5456**	**3.363**	
90.31	2.36	**3.396**	0.000					**2.6415**	**3.396**	
90.35	2.40	**3.429**	0.000					**2.7396**	**3.429**	
90.39	2.44	**3.461**	0.000					**2.8381**	**3.461**	
90.43	2.48	**3.493**	0.000					**2.9388**	**3.493**	
90.47	2.52	**3.525**	0.000					**3.0405**	**3.525**	
90.51	2.56	**3.557**	0.000					**3.1432**	**3.557**	<= 25 Yr: 30797 m3 (90.49m)
90.55	2.60	**3.588**	0.000					**3.2479**	**3.588**	
90.59	2.64	**3.619**	0.000					**3.3531**	**3.619**	
90.63	2.68	**3.650**	0.000					**3.4600**	**3.650**	
90.67	2.72	**3.680**	0.000					**3.5679**	**3.680**	
90.71	2.76	**3.710**	0.000					**3.6765**	**3.710**	
90.75	2.80	**3.740**	0.000					**3.7867**	**3.740**	
90.79	2.84	**3.770**	0.000					**3.8972**	**3.770**	
90.83	2.88	**3.800**	0.000					**4.0089**	**3.800**	
90.87	2.92	**3.829**	0.000					**4.1211**	**3.829**	
90.91	2.96	**3.858**	0.000					**4.2337**	**3.858**	<= 50 Yr: 41276 m3 (90.87m)
90.95	3.00	**3.887**	0.000					**4.3473**	**3.887**	
90.99	3.04	**3.916**	0.000					**4.4611**	**3.916**	
91.03	3.08	**3.944**	0.000					**4.5758**	**3.944**	
91.07	3.12	**3.972**	0.000					**4.6909**	**3.972**	
91.11	3.16	**4.000**	0.000					**4.8064**	**4.000**	
91.15	3.20	**4.028**	0.000					**4.9230**	**4.028**	
91.19	3.24	**4.056**	0.000					**5.0395**	**4.056**	
91.23	3.28	**4.083**	0.000					**5.1572**	**4.083**	
91.27	3.32	**4.111**	0.000					**5.2752**	**4.111**	<= 100 Yr: 52691 m3 (91.27m)
91.31	3.36	**4.138**	**0.256**					**5.3936**	**4.393**	150 m long Kerr Street Spill
91.35	3.40	**4.165**	**2.859**					**5.5131**	**7.024**	
91.39	3.44	**4.191**	**6.905**					**5.6326**	**11.096**	
91.43	3.48	**4.218**	**11.987**					**5.7532**	**16.205**	
91.47	3.52	**4.244**	**17.925**					**5.8741**	**22.169**	
91.51	3.56	**4.271**	**24.610**					**5.9955**	**28.881**	
91.55	3.60	**4.297**	**31.967**					**6.1178**	**36.263**	
91.59	3.64	**4.323**	**39.938**					**6.2402**	**44.261**	
91.60	3.65	**4.329**	**42.021**					**6.2708**	**46.351**	

Stage - Storage - Discharge

WILLS

Project No: Design Concept 5
Project Name: 5268 Midtown Creek
Designed/Checked By: CH / DG
Date: January 10, 2018

Storage Summary		
Top of Permanent Pool:	87.95	m
Permanent Pool Volume:	0.0	m^3
Active Storage Volume:	71739.1	m^3

Outlet Capacity Summary				
Type	Diameter	Slope	Peak Flow	% Full

Discharge Summary				
Stage	Type	Invert Elev (m)	Diameter / Width (mm)	Diameter / Width (m)
1	Orifice Plate: Vertical	87.95	1107	
2	Custom Discharge 2	91.30		

Stage-Storage-Discharge Summary Table

Elevation	Stage	Stage 1 Orifice Plate	Stage 2 Custom					Active Storage	Total Discharge	Notes
m	m	m^3/s						ha*m	m^3/s	
87.95	0.00	0.000	0.000					**0.0000**	**0.000**	
87.99	0.04	**0.362**	0.000					**0.0000**	**0.362**	
88.03	0.08	**0.512**	0.000					**0.0000**	**0.512**	
88.07	0.12	**0.627**	0.000					**0.0000**	**0.627**	
88.11	0.16	**0.723**	0.000					**0.0000**	**0.723**	
88.15	0.20	**0.809**	0.000					**0.0000**	**0.809**	
88.19	0.24	**0.886**	0.000					**0.0000**	**0.886**	
88.23	0.28	**0.957**	0.000					**0.0000**	**0.957**	
88.27	0.32	**1.023**	0.000					**0.0000**	**1.023**	
88.31	0.36	**1.085**	0.000					**0.0014**	**1.085**	
88.35	0.40	**1.144**	0.000					**0.0070**	**1.144**	
88.39	0.44	**1.200**	0.000					**0.0128**	**1.200**	
88.43	0.48	**1.253**	0.000					**0.0227**	**1.253**	
88.47	0.52	**1.304**	0.000					**0.0344**	**1.304**	
88.51	0.56	**1.354**	0.000					**0.0476**	**1.354**	
88.55	0.60	**1.401**	0.000					**0.0654**	**1.401**	
88.59	0.64	**1.447**	0.000					**0.0832**	**1.447**	
88.63	0.68	**1.492**	0.000					**0.1056**	**1.492**	
88.67	0.72	**1.535**	0.000					**0.1295**	**1.535**	
88.71	0.76	**1.577**	0.000					**0.1550**	**1.577**	
88.75	0.80	**1.618**	0.000					**0.1852**	**1.618**	
88.79	0.84	**1.658**	0.000					**0.2153**	**1.658**	
88.83	0.88	**1.697**	0.000					**0.2502**	**1.697**	
88.87	0.92	**1.735**	0.000					**0.2866**	**1.735**	
88.91	0.96	**1.772**	0.000					**0.3250**	**1.772**	
88.95	1.00	**1.809**	0.000					**0.3674**	**1.809**	
88.99	1.04	**1.845**	0.000					**0.4102**	**1.845**	
89.03	1.08	**1.880**	0.000					**0.4577**	**1.880**	
89.07	1.12	**1.925**	0.000					**0.5068**	**1.925**	
89.11	1.16	**1.992**	0.000					**0.5580**	**1.992**	<= 2 Yr: 5185 m3 (89.08m)
89.15	1.20	**2.057**	0.000					**0.6131**	**2.057**	
89.19	1.24	**2.119**	0.000					**0.6690**	**2.119**	
89.23	1.28	**2.180**	0.000					**0.7290**	**2.180**	
89.27	1.32	**2.239**	0.000					**0.7910**	**2.239**	
89.31	1.36	**2.297**	0.000					**0.8550**	**2.297**	
89.35	1.40	**2.353**	0.000					**0.9230**	**2.353**	
89.39	1.44	**2.408**	0.000					**0.9918**	**2.408**	
89.43	1.48	**2.462**	0.000					**1.0643**	**2.462**	
89.47	1.52	**2.515**	0.000					**1.1387**	**2.515**	
89.51	1.56	**2.566**	0.000					**1.2146**	**2.566**	
89.55	1.60	**2.617**	0.000					**1.2940**	**2.617**	
89.59	1.64	**2.666**	0.000					**1.3739**	**2.666**	<= 5 Yr: 13335 m3 (89.57m)
89.63	1.68	**2.715**	0.000					**1.4566**	**2.715**	
89.67	1.72	**2.763**	0.000					**1.5406**	**2.763**	
89.71	1.76	**2.810**	0.000					**1.6256**	**2.810**	
89.75	1.80	**2.856**	0.000					**1.7137**	**2.856**	
89.79	1.84	**2.901**	0.000					**1.8019**	**2.901**	
89.83	1.88	**2.946**	0.000					**1.8928**	**2.946**	
89.87	1.92	**2.990**	0.000					**1.9849**	**2.990**	

Stage-Storage-Discharge Summary Table										
Elevation	Stage	Stage 1 Orifice Plate	Stage 2 Custom					Active Storage	Total Discharge	Notes
m	m	m^3/s						ha*m	m^3/s	
89.91	1.96	**3.034**	0.000					**2.0781**	**3.034**	
89.95	2.00	**3.076**	0.000					**2.1742**	**3.076**	<= 10 Yr: 21084 m3 (89.92m)
89.99	2.04	**3.119**	0.000					**2.2704**	**3.119**	
90.03	2.08	**3.160**	0.000					**2.3696**	**3.160**	
90.07	2.12	**3.201**	0.000					**2.4698**	**3.201**	
90.11	2.16	**3.242**	0.000					**2.5712**	**3.242**	
90.15	2.20	**3.282**	0.000					**2.6752**	**3.282**	
90.19	2.24	**3.322**	0.000					**2.7793**	**3.322**	
90.23	2.28	**3.361**	0.000					**2.8863**	**3.361**	
90.27	2.32	**3.400**	0.000					**2.9942**	**3.400**	
90.31	2.36	**3.438**	0.000					**3.1032**	**3.438**	
90.35	2.40	**3.476**	0.000					**3.2144**	**3.476**	
90.39	2.44	**3.513**	0.000					**3.3260**	**3.513**	<= 25 Yr: 32564 m3 (90.37m)
90.43	2.48	**3.550**	0.000					**3.4400**	**3.550**	
90.47	2.52	**3.587**	0.000					**3.5549**	**3.587**	
90.51	2.56	**3.623**	0.000					**3.6709**	**3.623**	
90.55	2.60	**3.659**	0.000					**3.7889**	**3.659**	
90.59	2.64	**3.695**	0.000					**3.9073**	**3.695**	
90.63	2.68	**3.730**	0.000					**4.0277**	**3.730**	
90.67	2.72	**3.765**	0.000					**4.1490**	**3.765**	
90.71	2.76	**3.800**	0.000					**4.2711**	**3.800**	
90.75	2.80	**3.834**	0.000					**4.3948**	**3.834**	<= 50 Yr: 42828 m3 (90.71m)
90.79	2.84	**3.868**	0.000					**4.5188**	**3.868**	
90.83	2.88	**3.902**	0.000					**4.6440**	**3.902**	
90.87	2.92	**3.935**	0.000					**4.7698**	**3.935**	
90.91	2.96	**3.968**	0.000					**4.8960**	**3.968**	
90.95	3.00	**4.001**	0.000					**5.0233**	**4.001**	
90.99	3.04	**4.033**	0.000					**5.1508**	**4.033**	
91.03	3.08	**4.066**	0.000					**5.2792**	**4.066**	
91.07	3.12	**4.098**	0.000					**5.4081**	**4.098**	<= 100 Yr: 54029 m3 (91.07m)
91.11	3.16	**4.130**	0.000					**5.5374**	**4.130**	
91.15	3.20	**4.161**	0.000					**5.6678**	**4.161**	
91.19	3.24	**4.193**	0.000					**5.7982**	**4.193**	
91.23	3.28	**4.224**	0.000					**5.9298**	**4.224**	
91.27	3.32	**4.255**	0.000					**6.0618**	**4.255**	
91.31	3.36	**4.285**	**0.256**					**6.1941**	**4.541**	150 m long Kerr Street Spill
91.35	3.40	**4.316**	**2.859**					**6.3276**	**7.175**	
91.39	3.44	**4.346**	**6.905**					**6.4612**	**11.251**	
91.43	3.48	**4.376**	**11.987**					**6.5959**	**16.363**	
91.47	3.52	**4.406**	**17.925**					**6.7309**	**22.331**	
91.51	3.56	**4.435**	**24.610**					**6.8665**	**29.046**	
91.55	3.60	**4.465**	**31.967**					**7.0031**	**36.431**	
91.59	3.64	**4.494**	**39.938**					**7.1397**	**44.432**	
91.60	3.65	**4.501**	**42.021**					**7.1739**	**46.523**	

Stage - Storage - Discharge

Project No: Design Concept 6
Project Name: 5268 Midtown Creek
Designed/Checked By: CH / DG
Date: January 10, 2018

Storage Summary		
Top of Permanent Pool:	87.95	m
Permanent Pool Volume:	0.0	m^3
Active Storage Volume:	71739.1	m^3

Outlet Capacity Summary

Type	Diameter	Slope	Peak Flow	% Full

Discharge Summary

Stage	Type	Invert Elev (m)	Diameter / Width (mm)	Diameter / Width (m)
1	Orifice Tube: Vertical	87.95	900	
2	Custom Discharge 2	91.30		

Stage-Storage-Discharge Summary Table

Elevation	Stage	Stage 1 Orifice Tube	Stage 2 Custom					Active Storage	Total Discharge	Notes
m	m	m^3/s						ha*m	m^3/s	
87.95	0.00	0.000	0.000					**0.0000**	**0.000**	
87.99	0.04	**0.319**	0.000					**0.0000**	**0.319**	
88.03	0.08	**0.451**	0.000					**0.0000**	**0.451**	
88.07	0.12	**0.552**	0.000					**0.0000**	**0.552**	
88.11	0.16	**0.638**	0.000					**0.0000**	**0.638**	
88.15	0.20	**0.713**	0.000					**0.0000**	**0.713**	
88.19	0.24	**0.781**	0.000					**0.0000**	**0.781**	
88.23	0.28	**0.843**	0.000					**0.0000**	**0.843**	
88.27	0.32	**0.902**	0.000					**0.0000**	**0.902**	
88.31	0.36	**0.956**	0.000					**0.0014**	**0.956**	
88.35	0.40	**1.008**	0.000					**0.0070**	**1.008**	
88.39	0.44	**1.057**	0.000					**0.0128**	**1.057**	
88.43	0.48	**1.104**	0.000					**0.0227**	**1.104**	
88.47	0.52	**1.149**	0.000					**0.0344**	**1.149**	
88.51	0.56	**1.193**	0.000					**0.0476**	**1.193**	
88.55	0.60	**1.235**	0.000					**0.0654**	**1.235**	
88.59	0.64	**1.275**	0.000					**0.0832**	**1.275**	
88.63	0.68	**1.314**	0.000					**0.1056**	**1.314**	
88.67	0.72	**1.353**	0.000					**0.1295**	**1.353**	
88.71	0.76	**1.390**	0.000					**0.1550**	**1.390**	
88.75	0.80	**1.426**	0.000					**0.1852**	**1.426**	
88.79	0.84	**1.461**	0.000					**0.2153**	**1.461**	
88.83	0.88	**1.495**	0.000					**0.2502**	**1.495**	
88.87	0.92	**1.545**	0.000					**0.2866**	**1.545**	
88.91	0.96	**1.610**	0.000					**0.3250**	**1.610**	
88.95	1.00	**1.672**	0.000					**0.3674**	**1.672**	
88.99	1.04	**1.732**	0.000					**0.4102**	**1.732**	
89.03	1.08	**1.789**	0.000					**0.4577**	**1.789**	
89.07	1.12	**1.845**	0.000					**0.5068**	**1.845**	
89.11	1.16	**1.900**	0.000					**0.5580**	**1.900**	
89.15	1.20	**1.952**	0.000					**0.6131**	**1.952**	<= 2 Yr: 5913 m3 (89.13m)
89.19	1.24	**2.004**	0.000					**0.6690**	**2.004**	
89.23	1.28	**2.054**	0.000					**0.7290**	**2.054**	
89.27	1.32	**2.103**	0.000					**0.7910**	**2.103**	
89.31	1.36	**2.150**	0.000					**0.8550**	**2.150**	
89.35	1.40	**2.197**	0.000					**0.9230**	**2.197**	
89.39	1.44	**2.243**	0.000					**0.9918**	**2.243**	
89.43	1.48	**2.288**	0.000					**1.0643**	**2.288**	
89.47	1.52	**2.332**	0.000					**1.1387**	**2.332**	
89.51	1.56	**2.375**	0.000					**1.2146**	**2.375**	
89.55	1.60	**2.417**	0.000					**1.2940**	**2.417**	
89.59	1.64	**2.459**	0.000					**1.3739**	**2.459**	
89.63	1.68	**2.500**	0.000					**1.4566**	**2.500**	
89.67	1.72	**2.540**	0.000					**1.5406**	**2.540**	<= 5 Yr: 14924 m3 (89.65m)
89.71	1.76	**2.580**	0.000					**1.6256**	**2.580**	
89.75	1.80	**2.619**	0.000					**1.7137**	**2.619**	
89.79	1.84	**2.658**	0.000					**1.8019**	**2.658**	
89.83	1.88	**2.696**	0.000					**1.8928**	**2.696**	
89.87	1.92	**2.733**	0.000					**1.9849**	**2.733**	

Stage-Storage-Discharge Summary Table											
Elevation	**Stage**	**Stage 1 Orifice Tube**	**Stage 2 Custom**					**Active Storage**	**Total Discharge**	**Notes**
m	**m**	**m^3/s**						**ha*m**	**m^3/s**	
89.91	1.96	**2.770**	0.000					**2.0781**	**2.770**	
89.95	2.00	**2.807**	0.000					**2.1742**	**2.807**	
89.99	2.04	**2.843**	0.000					**2.2704**	**2.843**	
90.03	2.08	**2.878**	0.000					**2.3696**	**2.878**	<= 10 Yr: 23468 m3 (90.02m)
90.07	2.12	**2.913**	0.000					**2.4698**	**2.913**	
90.11	2.16	**2.948**	0.000					**2.5712**	**2.948**	
90.15	2.20	**2.982**	0.000					**2.6752**	**2.982**	
90.19	2.24	**3.016**	0.000					**2.7793**	**3.016**	
90.23	2.28	**3.050**	0.000					**2.8863**	**3.050**	
90.27	2.32	**3.083**	0.000					**2.9942**	**3.083**	
90.31	2.36	**3.116**	0.000					**3.1032**	**3.116**	
90.35	2.40	**3.148**	0.000					**3.2144**	**3.148**	
90.39	2.44	**3.180**	0.000					**3.3260**	**3.180**	
90.43	2.48	**3.212**	0.000					**3.4400**	**3.212**	
90.47	2.52	**3.243**	0.000					**3.5549**	**3.243**	
90.51	2.56	**3.275**	0.000					**3.6709**	**3.275**	<= 25 Yr: 35952 m3 (90.48m)
90.55	2.60	**3.305**	0.000					**3.7889**	**3.305**	
90.59	2.64	**3.336**	0.000					**3.9073**	**3.336**	
90.63	2.68	**3.366**	0.000					**4.0277**	**3.366**	
90.67	2.72	**3.396**	0.000					**4.1490**	**3.396**	
90.71	2.76	**3.426**	0.000					**4.2711**	**3.426**	
90.75	2.80	**3.456**	0.000					**4.3948**	**3.456**	
90.79	2.84	**3.485**	0.000					**4.5188**	**3.485**	
90.83	2.88	**3.514**	0.000					**4.6440**	**3.514**	
90.87	2.92	**3.543**	0.000					**4.7698**	**3.543**	<= 50 Yr: 47005 m3 (90.85m)
90.91	2.96	**3.572**	0.000					**4.8960**	**3.572**	
90.95	3.00	**3.600**	0.000					**5.0233**	**3.600**	
90.99	3.04	**3.628**	0.000					**5.1508**	**3.628**	
91.03	3.08	**3.656**	0.000					**5.2792**	**3.656**	
91.07	3.12	**3.684**	0.000					**5.4081**	**3.684**	
91.11	3.16	**3.711**	0.000					**5.5374**	**3.711**	
91.15	3.20	**3.738**	0.000					**5.6678**	**3.738**	
91.19	3.24	**3.765**	0.000					**5.7982**	**3.765**	
91.23	3.28	**3.792**	0.000					**5.9298**	**3.792**	<= 100 Yr: 58999 m3 (91.22m)
91.27	3.32	**3.819**	0.000					**6.0618**	**3.819**	
91.31	3.36	**3.846**	**0.256**					**6.1941**	**4.101**	150 m long Kerr Street Spill
91.35	3.40	**3.872**	**2.859**					**6.3276**	**6.731**	
91.39	3.44	**3.898**	**6.905**					**6.4612**	**10.803**	
91.43	3.48	**3.924**	**11.987**					**6.5959**	**15.911**	
91.47	3.52	**3.950**	**17.925**					**6.7309**	**21.875**	
91.51	3.56	**3.976**	**24.610**					**6.8665**	**28.586**	
91.55	3.60	**4.001**	**31.967**					**7.0031**	**35.968**	
91.59	3.64	**4.026**	**39.938**					**7.1397**	**43.964**	
91.60	3.65	**4.033**	**42.021**					**7.1739**	**46.054**	

Stage - Storage - Discharge

WILLS

Project No: Design Concept 7
Project Name: 5268 Midtown Creek
Designed/Checked By: CH / DG
Date: January 10, 2018

Storage Summary		
Top of Permanent Pool:	87.95	m
Permanent Pool Volume:	0.0	m^3
Active Storage Volume:	71739.1	m^3

Outlet Capacity Summary

Type	Diameter	Slope	Peak Flow	% Full

Discharge Summary

Stage	Type	Invert Elev (m)	Diameter / Width (mm)	Diameter / Width (m)
1	Custom Discharge 2	87.95		
2	Custom Discharge	91.30		

Stage-Storage-Discharge Summary Table

Elevation	Stage	Stage 1 Custom	Stage 2 Custom					Active Storage	Total Discharge	Notes
m	m	m^3/s						ha*m	m^3/s	
87.95	0.00	0.000	0.000					**0.0000**	**0.000**	1050 mm Concrete Culvert
87.99	0.04	**0.041**	0.000					**0.0000**	**0.041**	
88.03	0.08	**0.081**	0.000					**0.0000**	**0.081**	
88.07	0.12	**0.122**	0.000					**0.0000**	**0.122**	
88.11	0.16	**0.162**	0.000					**0.0000**	**0.162**	
88.15	0.20	**0.203**	0.000					**0.0000**	**0.203**	
88.19	0.24	**0.243**	0.000					**0.0000**	**0.243**	
88.23	0.28	**0.284**	0.000					**0.0000**	**0.284**	
88.27	0.32	**0.324**	0.000					**0.0000**	**0.324**	
88.31	0.36	**0.365**	0.000					**0.0014**	**0.365**	
88.35	0.40	**0.405**	0.000					**0.0070**	**0.405**	
88.39	0.44	**0.446**	0.000					**0.0128**	**0.446**	
88.43	0.48	**0.486**	0.000					**0.0227**	**0.486**	
88.47	0.52	**0.527**	0.000					**0.0344**	**0.527**	
88.51	0.56	**0.567**	0.000					**0.0476**	**0.567**	
88.55	0.60	**0.608**	0.000					**0.0654**	**0.608**	
88.59	0.64	**0.648**	0.000					**0.0832**	**0.648**	
88.63	0.68	**0.689**	0.000					**0.1056**	**0.689**	
88.67	0.72	**0.729**	0.000					**0.1295**	**0.729**	
88.71	0.76	**0.770**	0.000					**0.1550**	**0.770**	
88.75	0.80	**0.820**	0.000					**0.1852**	**0.820**	
88.79	0.84	**0.898**	0.000					**0.2153**	**0.898**	
88.83	0.88	**0.976**	0.000					**0.2502**	**0.976**	
88.87	0.92	**1.054**	0.000					**0.2866**	**1.054**	
88.91	0.96	**1.132**	0.000					**0.3250**	**1.132**	
88.95	1.00	**1.210**	0.000					**0.3674**	**1.210**	
88.99	1.04	**1.288**	0.000					**0.4102**	**1.288**	
89.03	1.08	**1.366**	0.000					**0.4577**	**1.366**	
89.07	1.12	**1.444**	0.000					**0.5068**	**1.444**	
89.11	1.16	**1.522**	0.000					**0.5580**	**1.522**	
89.15	1.20	**1.600**	0.000					**0.6131**	**1.600**	
89.19	1.24	**1.671**	0.000					**0.6690**	**1.671**	
89.23	1.28	**1.742**	0.000					**0.7290**	**1.742**	
89.27	1.32	**1.813**	0.000					**0.7910**	**1.813**	
89.31	1.36	**1.884**	0.000					**0.8550**	**1.884**	<= 2 Yr: 8416 m3 (89.3m)
89.35	1.40	**1.956**	0.000					**0.9230**	**1.956**	
89.39	1.44	**2.027**	0.000					**0.9918**	**2.027**	
89.43	1.48	**2.098**	0.000					**1.0643**	**2.098**	
89.47	1.52	**2.169**	0.000					**1.1387**	**2.169**	
89.51	1.56	**2.240**	0.000					**1.2146**	**2.240**	
89.55	1.60	**2.311**	0.000					**1.2940**	**2.311**	
89.59	1.64	**2.382**	0.000					**1.3739**	**2.382**	
89.63	1.68	**2.433**	0.000					**1.4566**	**2.433**	
89.67	1.72	**2.477**	0.000					**1.5406**	**2.477**	
89.71	1.76	**2.521**	0.000					**1.6256**	**2.521**	
89.75	1.80	**2.564**	0.000					**1.7137**	**2.564**	<= 5 Yr: 16692 m3 (89.73m)
89.79	1.84	**2.608**	0.000					**1.8019**	**2.608**	
89.83	1.88	**2.652**	0.000					**1.8928**	**2.652**	
89.87	1.92	**2.696**	0.000					**1.9849**	**2.696**	

Stage-Storage-Discharge Summary Table

Elevation	Stage	Stage 1 Custom	Stage 2 Custom					Active Storage	Total Discharge	Notes
m	m	m^3/s						ha*m	m^3/s	
89.91	1.96	2.740	0.000					2.0781	2.740	
89.95	2.00	2.784	0.000					2.1742	2.784	
89.99	2.04	2.827	0.000					2.2704	2.827	
90.03	2.08	2.871	0.000					2.3696	2.871	
90.07	2.12	2.915	0.000					2.4698	2.915	
90.11	2.16	2.959	0.000					2.5712	2.959	<= 10 Yr: 24739 m3 (90.07m)
90.15	2.20	3.003	0.000					2.6752	3.003	
90.19	2.24	3.047	0.000					2.7793	3.047	
90.23	2.28	3.090	0.000					2.8863	3.090	
90.27	2.32	3.134	0.000					2.9942	3.134	
90.31	2.36	3.178	0.000					3.1032	3.178	
90.35	2.40	3.217	0.000					3.2144	3.217	
90.39	2.44	3.251	0.000					3.3260	3.251	
90.43	2.48	3.285	0.000					3.4400	3.285	
90.47	2.52	3.319	0.000					3.5549	3.319	
90.51	2.56	3.353	0.000					3.6709	3.353	<= 25 Yr: 36602 m3 (90.51m)
90.55	2.60	3.387	0.000					3.7889	3.387	
90.59	2.64	3.421	0.000					3.9073	3.421	
90.63	2.68	3.455	0.000					4.0277	3.455	
90.67	2.72	3.489	0.000					4.1490	3.489	
90.71	2.76	3.523	0.000					4.2711	3.523	
90.75	2.80	3.557	0.000					4.3948	3.557	
90.79	2.84	3.591	0.000					4.5188	3.591	
90.83	2.88	3.626	0.000					4.6440	3.626	
90.87	2.92	3.660	0.000					4.7698	3.660	<= 50 Yr: 47249 m3 (90.86m)
90.91	2.96	3.694	0.000					4.8960	3.694	
90.95	3.00	3.728	0.000					5.0233	3.728	
90.99	3.04	3.762	0.000					5.1508	3.762	
91.03	3.08	3.796	0.000					5.2792	3.796	
91.07	3.12	3.830	0.000					5.4081	3.830	
91.11	3.16	3.864	0.000					5.5374	3.864	
91.15	3.20	3.898	0.000					5.6678	3.898	
91.19	3.24	3.932	0.000					5.7982	3.932	
91.23	3.28	3.966	0.000					5.9298	3.966	<= 100 Yr: 58697 m3 (91.21m)
91.27	3.32	4.000	0.000					6.0618	4.000	
91.31	3.36	4.028	0.256					6.1941	4.284	150 m long Kerr Street Spill
91.35	3.40	4.056	2.859					6.3276	6.915	
91.39	3.44	4.083	6.905					6.4612	10.988	
91.43	3.48	4.111	11.987					6.5959	16.098	
91.47	3.52	4.139	17.925					6.7309	22.064	
91.51	3.56	4.167	24.610					6.8665	28.777	
91.55	3.60	4.195	31.967					7.0031	36.162	
91.59	3.64	4.223	39.938					7.1397	44.161	
91.60	3.65	4.230	42.021					7.1739	46.251	

Stage - Storage - Discharge

Project No: Design Concept 8
Project Name: 5268 Midtown Creek
Designed/Checked By: CH / DG
Date: January 10, 2018

Storage Summary		
Top of Permanent Pool:	87.95	m
Permanent Pool Volume:	0.0	m^3
Active Storage Volume:	71739.1	m^3

Outlet Capacity Summary

Type	Diameter	Slope	Peak Flow	% Full

Discharge Summary

Stage	Type	Invert Elev (m)	Diameter / Width (mm)	(m)
1	Orifice Plate: Vertical	87.95	620	
2	Custom Discharge 2	91.30		

Stage-Storage-Discharge Summary Table

Elevation	Stage	Stage 1 Orifice Plate	Stage 2 Custom					Active Storage	Total Discharge	Notes
m	m	m^3/s						ha*m	m^3/s	
87.95	0.00	0.000	0.000					**0.0000**	**0.000**	620x1500 Rectangular Orifice
87.99	0.04	**0.350**	0.000					**0.0000**	**0.350**	
88.03	0.08	**0.494**	0.000					**0.0000**	**0.494**	
88.07	0.12	**0.605**	0.000					**0.0000**	**0.605**	
88.11	0.16	**0.699**	0.000					**0.0000**	**0.699**	
88.15	0.20	**0.782**	0.000					**0.0000**	**0.782**	
88.19	0.24	**0.856**	0.000					**0.0000**	**0.856**	
88.23	0.28	**0.925**	0.000					**0.0000**	**0.925**	
88.27	0.32	**0.989**	0.000					**0.0000**	**0.989**	
88.31	0.36	**1.049**	0.000					**0.0014**	**1.049**	
88.35	0.40	**1.105**	0.000					**0.0070**	**1.105**	
88.39	0.44	**1.159**	0.000					**0.0128**	**1.159**	
88.43	0.48	**1.211**	0.000					**0.0227**	**1.211**	
88.47	0.52	**1.260**	0.000					**0.0344**	**1.260**	
88.51	0.56	**1.308**	0.000					**0.0476**	**1.308**	
88.55	0.60	**1.354**	0.000					**0.0654**	**1.354**	
88.59	0.64	**1.420**	0.000					**0.0832**	**1.420**	
88.63	0.68	**1.503**	0.000					**0.1056**	**1.503**	
88.67	0.72	**1.583**	0.000					**0.1295**	**1.583**	
88.71	0.76	**1.658**	0.000					**0.1550**	**1.658**	
88.75	0.80	**1.730**	0.000					**0.1852**	**1.730**	
88.79	0.84	**1.799**	0.000					**0.2153**	**1.799**	
88.83	0.88	**1.866**	0.000					**0.2502**	**1.866**	
88.87	0.92	**1.930**	0.000					**0.2866**	**1.930**	
88.91	0.96	**1.993**	0.000					**0.3250**	**1.993**	
88.95	1.00	**2.053**	0.000					**0.3674**	**2.053**	
88.99	1.04	**2.112**	0.000					**0.4102**	**2.112**	
89.03	1.08	**2.169**	0.000					**0.4577**	**2.169**	<= 2 Yr: 4321 m3 (89.01m)
89.07	1.12	**2.224**	0.000					**0.5068**	**2.224**	
89.11	1.16	**2.279**	0.000					**0.5580**	**2.279**	
89.15	1.20	**2.332**	0.000					**0.6131**	**2.332**	
89.19	1.24	**2.384**	0.000					**0.6690**	**2.384**	
89.23	1.28	**2.434**	0.000					**0.7290**	**2.434**	
89.27	1.32	**2.484**	0.000					**0.7910**	**2.484**	
89.31	1.36	**2.533**	0.000					**0.8550**	**2.533**	
89.35	1.40	**2.580**	0.000					**0.9230**	**2.580**	
89.39	1.44	**2.627**	0.000					**0.9918**	**2.627**	
89.43	1.48	**2.673**	0.000					**1.0643**	**2.673**	
89.47	1.52	**2.719**	0.000					**1.1387**	**2.719**	
89.51	1.56	**2.763**	0.000					**1.2146**	**2.763**	<= 5 Yr: 11554 m3 (89.48m)
89.55	1.60	**2.807**	0.000					**1.2940**	**2.807**	
89.59	1.64	**2.850**	0.000					**1.3739**	**2.850**	
89.63	1.68	**2.893**	0.000					**1.4566**	**2.893**	
89.67	1.72	**2.935**	0.000					**1.5406**	**2.935**	
89.71	1.76	**2.976**	0.000					**1.6256**	**2.976**	
89.75	1.80	**3.017**	0.000					**1.7137**	**3.017**	
89.79	1.84	**3.057**	0.000					**1.8019**	**3.057**	
89.83	1.88	**3.097**	0.000					**1.8928**	**3.097**	
89.87	1.92	**3.136**	0.000					**1.9849**	**3.136**	<= 10 Yr: 19341 m3 (89.85m)

Stage-Storage-Discharge Summary Table

Elevation	Stage	Stage 1 Orifice Plate	Stage 2 Custom					Active Storage	Total Discharge	Notes
m	m	m^3/s						ha*m	m^3/s	
89.91	1.96	**3.175**	0.000					**2.0781**	**3.175**	
89.95	2.00	**3.213**	0.000					**2.1742**	**3.213**	
89.99	2.04	**3.251**	0.000					**2.2704**	**3.251**	
90.03	2.08	**3.288**	0.000					**2.3696**	**3.288**	
90.07	2.12	**3.325**	0.000					**2.4698**	**3.325**	
90.11	2.16	**3.362**	0.000					**2.5712**	**3.362**	
90.15	2.20	**3.398**	0.000					**2.6752**	**3.398**	
90.19	2.24	**3.434**	0.000					**2.7793**	**3.434**	
90.23	2.28	**3.469**	0.000					**2.8863**	**3.469**	
90.27	2.32	**3.504**	0.000					**2.9942**	**3.504**	
90.31	2.36	**3.539**	0.000					**3.1032**	**3.539**	<= 25 Yr: 30957 m3 (90.31m)
90.35	2.40	**3.573**	0.000					**3.2144**	**3.573**	
90.39	2.44	**3.607**	0.000					**3.3260**	**3.607**	
90.43	2.48	**3.641**	0.000					**3.4400**	**3.641**	
90.47	2.52	**3.674**	0.000					**3.5549**	**3.674**	
90.51	2.56	**3.707**	0.000					**3.6709**	**3.707**	
90.55	2.60	**3.740**	0.000					**3.7889**	**3.740**	
90.59	2.64	**3.773**	0.000					**3.9073**	**3.773**	
90.63	2.68	**3.805**	0.000					**4.0277**	**3.805**	
90.67	2.72	**3.837**	0.000					**4.1490**	**3.837**	<= 50 Yr: 41385 m3 (90.67m)
90.71	2.76	**3.869**	0.000					**4.2711**	**3.869**	
90.75	2.80	**3.900**	0.000					**4.3948**	**3.900**	
90.79	2.84	**3.931**	0.000					**4.5188**	**3.931**	
90.83	2.88	**3.962**	0.000					**4.6440**	**3.962**	
90.87	2.92	**3.993**	0.000					**4.7698**	**3.993**	
90.91	2.96	**4.024**	0.000					**4.8960**	**4.024**	
90.95	3.00	**4.054**	0.000					**5.0233**	**4.054**	
90.99	3.04	**4.084**	0.000					**5.1508**	**4.084**	
91.03	3.08	**4.114**	0.000					**5.2792**	**4.114**	<= 100 Yr: 52774 m3 (91.03m)
91.07	3.12	**4.143**	0.000					**5.4081**	**4.143**	
91.11	3.16	**4.173**	0.000					**5.5374**	**4.173**	
91.15	3.20	**4.202**	0.000					**5.6678**	**4.202**	
91.19	3.24	**4.231**	0.000					**5.7982**	**4.231**	
91.23	3.28	**4.260**	0.000					**5.9298**	**4.260**	
91.27	3.32	**4.288**	0.000					**6.0618**	**4.288**	
91.31	3.36	**4.317**	**0.256**					**6.1941**	**4.572**	150 m long Kerr Street Spill
91.35	3.40	**4.345**	**2.859**					**6.3276**	**7.204**	
91.39	3.44	**4.373**	**6.905**					**6.4612**	**11.278**	
91.43	3.48	**4.401**	**11.987**					**6.5959**	**16.387**	
91.47	3.52	**4.428**	**17.925**					**6.7309**	**22.353**	
91.51	3.56	**4.456**	**24.610**					**6.8665**	**29.066**	
91.55	3.60	**4.483**	**31.967**					**7.0031**	**36.450**	
91.59	3.64	**4.510**	**39.938**					**7.1397**	**44.448**	
91.60	3.65	**4.517**	**42.021**					**7.1739**	**46.538**	

Rating Table Report
1050 mm Circular

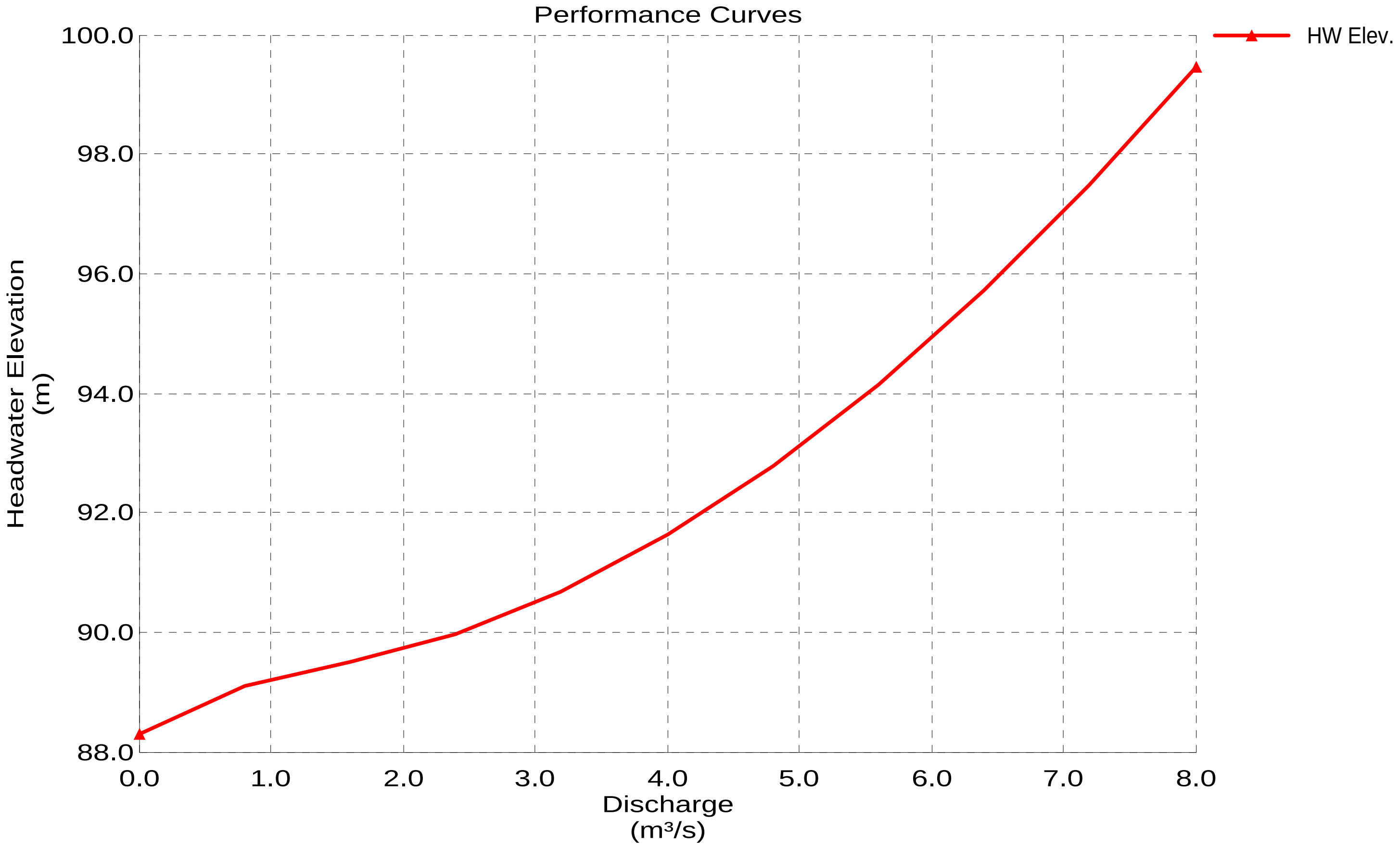
Range Data:	Minimum	Maximum	Increment	
Discharge	0.0000	8.0000	0.8000	m³/s

Discharge (m³/s)	HW Elev. (m)
0.0000	88.30
0.8000	89.09
1.6000	89.50
2.4000	89.95
3.2000	90.68
4.0000	91.62
4.8000	92.77
5.6000	94.13
6.4000	95.70
7.2000	97.48
8.0000	99.47

Performance Curves Report
1050 mm Circular

Range Data:

	Minimum	Maximum	Increment	
Discharge	0.0000	8.0000	0.8000	m³/s



Town of Cobourg Midtown Creek Flood Ponding Area
Alternative Design Concept Evaluation Matrix
D.M. Wills Project No. 17-5268
January 2018

		Alternative Design Concept 1							Alternative Design Concept 2							Alternative Design Concept 3							Alternative Design Concept 4							Alternative Design Concept 5							Alternative Design Concept 6							Alternative Design Concept 7							Alternative Design Concept 8						
		Small Basin, Circular Orifice Plate							Small Basin, Circlar Orifice Tube							Small Basin, Circular Culvert							Small Basin, Rect. Orifice Plate							Large Basin, Circular Orifice Plate							Large Basin, Circlar Orifice Tube							Large Basin, Circular Culvert							Large Basin, Rect. Orifice Plate						
		Rating of Potential Effect							Rating of Potential Effect							Rating of Potential Effect							Rating of Potential Effect							Rating of Potential Effect							Rating of Potential Effect							Rating of Potential Effect							Rating of Potential Effect						
Weighting Factor	Screening Criteria	-5	-3	-1	0	1	2	3	-5	-3	-1	0	1	2	3	-5	-3	-1	0	1	2	3	-5	-3	-1	0	1	2	3	-5	-3	-1	0	1	2	3	-5	-3	-1	0	1	2	3	-5	-3	-1	0	1	2	3	-5	-3	-1	0	1	2	3
		-H	-M	-L	Nil	+L	+M	+H	-H	-M	-L	Nil	+L	+M	+H	-H	-M	-L	Nil	+L	+M	+H	-H	-M	-L	Nil	+L	+M	+H	-H	-M	-L	Nil	+L	+M	+H	-H	-M	-L	Nil	+L	+M	+H	-H	-M	-L	Nil	+L	+M	+H	-H	-M	-L	Nil	+L	+M	+H
	Natural Environment																																																								
5	Species at Risk			0							0							0							0							0							0							0							0			
5	Fish and Fish Habitat				5							5							5							5							5							5							5							5		
5	Water Quality				5							5							5							5							5							5							5							5		
5	Shoreline Impacts				5							5							5							5							5							5							5							5		
5	Significant Vegetation Communities			0							0							0							0							0							0							0							0			
5	Erosion				5							5							5							5							5							5							5							5		
	Subtotal Score	20							20							20							20							20							20							20							20						
	Category Rank	1							1							1							1							1							1							1							1						
	Social Environment																																																								
5	Impacts to Public During Construction		-5							-5							-5							-5							-5							-5							-5							-5				
8	Long Term Impacts to Private Property				8							8							8							8							8							8							8							8		
8	Public Health and Safety						24							24							24							24							24							24							24							24
	Subtotal Score	27							27							27							27							27							27							27							27						
	Category Rank	1							1							1							1							1							1							1							1						
	Cultural Environment																																																								
5	Archaeological			0							0							0							0							0							0							0							0			
5	Heritage			0							0							0							0							0							0							0							0			
5	First Nations			0							0							0							0							0							0							0							0			
	Subtotal Score	0							0							0							0							0							0							0							0						
	Category Rank	1							1							1							1							1							1							1							1						
	Engineering / Technical Environment																																																								
8	Utilities			0							0							0							0					-24						-24						-24						-24					
5	Infrastructure			0							0							0							0							0							0							0							0			
6	Constructability		-6						-18								-6						-18								-6						-18								-6						-18					
5	Durability / Life Cycle Impacts		-5							-5							-5							-5							-5							-5							-5							-5				
8	Flow Conveyance					16						8					-8											24							24							24							24							24
8	Slope Stability			0							0							0								8							0							0							0							0			
10	Flood Reduction				10								20								20						10								10								20								20						10		
	Subtotal Score	15							5							1							19							-1							-3							9							-13						
	Category Rank	2							4							5							1							6							7							3							8						
	Economic Environment																																																								
8	Easements / Land Acquisition		-8							-8							-8							-8					-40							-40							-40							-40						
7	Capital Costs	-21								-7							-7						-21						-35							-21								-21						-35						
8	Maintenance Costs and Access	-24						-24						-24						-24						-24						-24						-24						-24					
8	Risk / Liability		-8						-24						-24							-8							-8						-24						-24							-8				
	Subtotal Score	-61							-63							-63							-61							-107							-109							-109							-107						
	Category Rank	1							3							3							1							5							7							7							5						
	TOTAL SCORE	1							-11							-15							5							-61							-65							-53							-73						
	OVERAL RANK	2							3							4							1							6							7							5							8						

Appendix D

GRCA Background Information and Reports

Ganaraska CONSERVATION

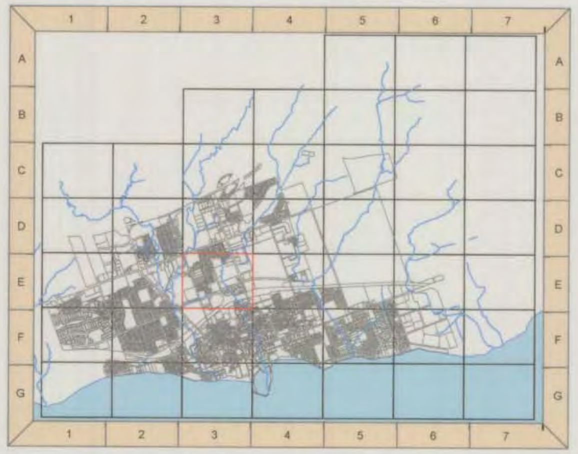
Cobourg Ontario, Canada

Flood Plain Map Town of Cobourg

Cobourg, Midtown, Brook and Massey Creeks

Legend

Regulatory Floodline	Contours (0.5m)
Cross Sections	Contours (1.0m)
River	Railway
	Parcel



Notes:

1) LiDAR (Light Detection and Ranging) survey data by Terrapoint, flown December 8th and 9th 2005 and March 26, 2006. LiDAR product dated March 14th, 2006 bare earth contours by GRCA produced using data provided by Terrapoint 2006.

2) Airphoto from 1:8000 aerial photo flown with LiDAR, 10 cm colour digital orthos by Terrapoint 2006.

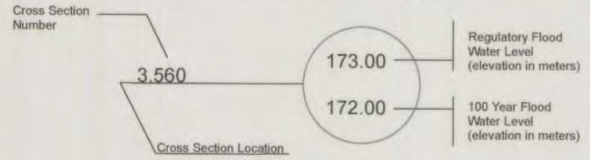
3) Field Survey of structures by GRCA, using LiDAR developed control points GRCA 2006.

4) The flood inudation areas were delineated using the information developed from the sources listed above in notes 1 through 3. The creeks are representational only and are not derived from the LiDAR data.

5) Produced using information provided by the Ministry of Natural Resources, GRCA and other municipal sources Copyright (c) Queen's Printer, 2007.

REVISIONS			
No.	Description	By	Date
0			Oct. 08

Cross Section Numbering



DONALD A. MOSS
10/24/2008

E3

GREENLAND consulting engineers

Greenland International Consulting Ltd
15955 Airport Rd, Suite 304
Caledon East, ON L7C 1H9

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0 25 50 100
Meters

Ganaraska CONSERVATION

Ganaraska Region
Conservation Authority

2216 County Road 28
Port Hope, ON L1A 3V8

Phone: 905-885-8173
Fax: 905-885-9824
www.grca.on.ca

MEMBER OF
CONSERVATION ONTARIO

July 14, 2016

Mr. Mark Stephen, P. Eng.
Engineering Supervisor,
Regional Engineering Services,
Ministry of Natural Resources and Forestry,
300 Water St.,
Peterborough, Ontario
K9J 8M5

Dear Mr. Stephen, P. Eng.:

Re: Kerr Street Extension/Upstream Ponding Construction
Town of Cobourg

Over the past number of months the Ganaraska Region Conservation Authority (GRCA) on behalf of the Town of Cobourg has been in correspondence with Mr. Doug Ryan of your office. This correspondence has been regarding the potential construction of a road crossing for the new Kerr Street arterial being built as a major east/west roadway within the town.

The location of the new arterial on an old rail bed allows for the ponding of water upstream of the new roadway during extreme events in order to protect an existing flood damage center immediately downstream. This damage center is composed of a number of houses just upstream of the CPR/CNR railway bed that act as a dam under events with flows greater than $4m^3$/sec. The railway culverts which are old, deep, and under the joint jurisdiction of the two railway companies, protect the downtown core from high flows. However, when backwater is present, floodwaters inundate the Division St. railway underpass with the consequence of creating an extreme hazard on the main access road for the central historic built portion of the town.

Please see the following figure illustrating the conceptual design of the works.

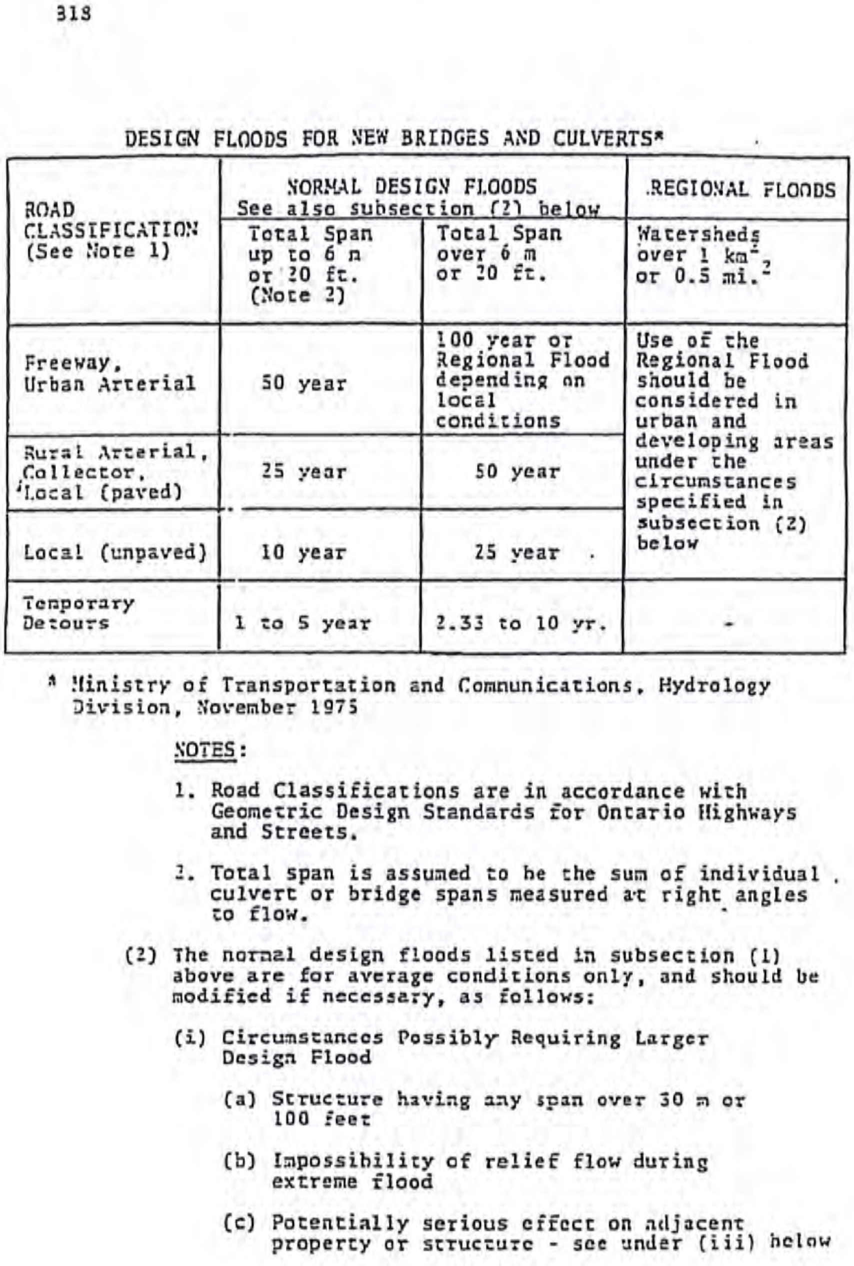
Figure 1: Conceptual Kerr St. Placement and Ponding Area

The Town has asked that the GRCA evaluate if the placement of the roadway and the ponding of undeveloped lands upstream of the Kerr St. arterial could address this issue. Preliminary conceptual design has shown that ponding could address this issue. The area of potential ponding is adjacent an historic chemical plant (GE plastics), so significant geotechnical and hydrogeological investigations were commissioned and have just been completed showing that contamination is not present in these potential ponding lands. With that preliminary work complete, the creation of a ponding area upstream of the proposed road crossing has been deemed financially practical. The project team is now in the process of developing tender documents for the class environmental assessment and design of the roadway and pond.

The project team wishes to determine if the Ministry of Natural Resources and Forestry will require a Work Permit under the Lakes and Rivers Improvement Act. To that end the GRCA has been in communications with Mr. Ryan as noted above.

The GRCA understands that at present the 'required design flow' for water crossings remains in the 1977 LRIA Guidelines, since new technical guidance for water crossings under the LRIA has yet to be produced. Based on the table below, the design flow for this structure would be the 1:50 year event of approximately 9.1m^3/sec (Midtown Creek

Watershed Hydrology Study, GRCA, 2002). The objective behind increasing the floodplain storage upstream of the Kerr Street water crossing was to address downstream constraints in the Midtown Creek system and floodplain (i.e. limited flow capacity under railway). As noted above the 1:50 year flow would be reduced to approximately 4m^3/sec in order to protect the flood damage center located downstream of the proposed roadway. Capacity in the outlet structure (above the ponding level) would be provided to a minimum of the required 9.1m^3/sec discharge.



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DESIGN FLOODS FOR NEW BRIDGES AND CULVERTS*

ROAD CLASSIFICATION (See Note 1)	NORMAL DESIGN FLOODS See also subsection (2) below		REGIONAL FLOODS
	Total Span up to 6 m or 20 ft. (Note 2)	Total Span over 6 m or 20 ft.	Watersheds over 1 km^2 or 0.5 mi.^{2}
Freeway, Urban Arterial	50 year	100 year or Regional Flood depending on local conditions	Use of the Regional Flood should be considered in urban and developing areas under the circumstances specified in subsection (2) below
Rural Arterial, Collector, Local (paved)	25 year	50 year	
Local (unpaved)	10 year	25 year	
Temporary Detours	1 to 5 year	2.33 to 10 yr.	-

* Ministry of Transportation and Communications, Hydrology Division, November 1975

NOTES:

1. Road Classifications are in accordance with Geometric Design Standards for Ontario Highways and Streets.
2. Total span is assumed to be the sum of individual culvert or bridge spans measured at right angles to flow.

(2) The normal design floods listed in subsection (1) above are for average conditions only, and should be modified if necessary, as follows:

(i) Circumstances Possibly Requiring Larger Design Flood

(a) Structure having any span over 30 m or 100 feet

(b) Impossibility of relief flow during extreme flood

(c) Potentially serious effect on adjacent property or structure - see under (iii) below

Specifically, the proposal consists of:

1. The future construction of the Kerr Street arterial roadway, including a water crossing for the existing Midtown Creek. Kerr Street would be constructed by the Municipality, on Municipal lands, and is within the jurisdiction of the GRCA
2. The Kerr Street water crossing will have a span less than 6m and would have hydraulic capacity > then the 1:50 year design flood. The intent is to have a structure that can pass the 50 to 100year event (great than 10m^3/sec) but restrictions would be also in place to restrict the flow to approx. 4m^3/sec which is the capacity of the CP/CN railway culvert.
3. The floodplain upstream of the Kerr Street water crossing would be excavated such that it would result in increased storage when the Kerr Street water crossing was under the design water level (and/or floods of greater magnitude)
4. Under normal conditions the Kerr Street water crossing would not be holding back any water. That is the water levels upstream of the water crossing would be similar to the water levels downstream, considering the normal stream profile.
5. Under normal seasonal flows, not exceeding 4m^3/sec, there will not be ponding of water upstream of the roadway and the water surface elevation difference from downstream of the water crossing to upstream of the water crossing will be parallel to the stream gradient.

We draw your attention to the LRIA Administrative guide:

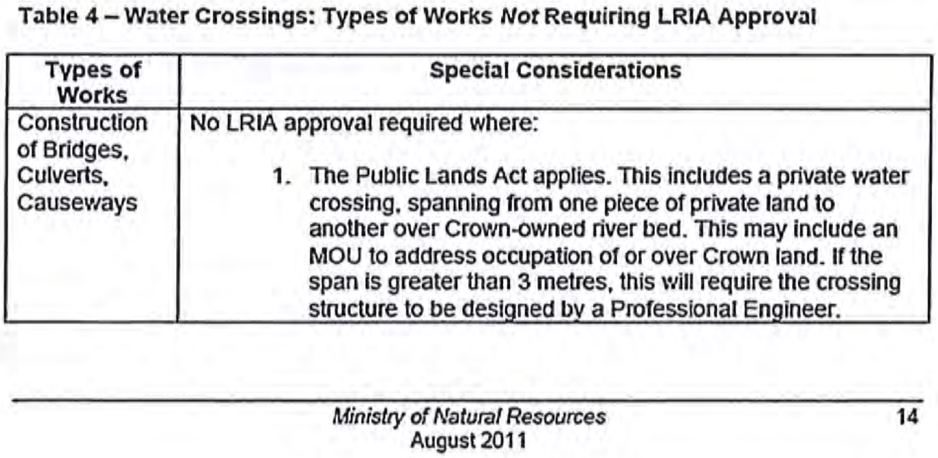

Table 4 – Water Crossings: Types of Works *Not* Requiring LRIA Approval

Types of Works	Special Considerations
Construction of Bridges, Culverts, Causeways	No LRIA approval required where: 1. The Public Lands Act applies. This includes a private water crossing, spanning from one piece of private land to another over Crown-owned river bed. This may include an MOU to address occupation of or over Crown land. If the span is greater than 3 metres, this will require the crossing structure to be designed by a Professional Engineer.

Ministry of Natural Resources 14
August 2011

Types of Works	Special Considerations
	2. Construction is part of a forest operation to which the Forest Operation and Silviculture Manual under the Crown Forest Sustainability Act applies. 3. The water crossing is draining an area greater than 5 sq km and where construction is being undertaken by a Ministry or municipality, or a contractor employed by a Ministry or municipality, on lands owned by the Crown or the municipality. 4. Clear span bridges that meet the required design flow capacity, as determined by MNR. 5. Works done under the Public Transportation and Highway Improvement Act

Based on the above descriptions, we believe that the work represents a water crossing and therefore it does not appear that the proposed work would represent the construction of a 'Dam' under the LRIA that would require an approval from the MNRF.

Although we believe the water crossing may not technically be considered a 'Dam', because the storage upstream is considered important in mitigating downstream flooding impacts, due diligence will be followed in construction of the Kerr St. road crossing. Even though we do not believe LRIA approval is required, the GRCA will require 'best practice' to ensure the Kerr Street roadway and water crossing is hydraulically and structurally adequate to withstand the forces that can reasonably be expected to be imposed upon it. As a minimum this will include the evaluating the Regulatory Flood event per the CA's Regulations, and qualified geotechnical 'best practice' design regarding roadway treatments and crossing, including assessing its Hazard Potential, Inflow Design Flood, and hydraulic and structural design. It is also noted that as per the MNRF's Natural Hazard Policies and Technical Guides, flood lines will not be reduced downstream of the roadway crossing based on the attenuation provided by this project.

We respectfully request that the MNRF confirm that our understanding that no Lakes and Rivers Improvement Act approval will be required for this project is correct.

Thank-you for your attention to this matter. Should there be any questions regarding these comments, please feel free to contact the undersigned. (mpeacock@grca.on.ca or (905) 885-8173)

Sincerely,

Mark Peacock, P. Eng.
Director, Watershed Services

Cc: Mr. Barry Thrasher, P. Eng. , Director Public Works, Town of Cobourg
file

From:	Stephen, Mark (MNRF) <mark.stephen@ontario.ca>
Sent:	July-29-16 1:43 PM
To:	mpeacock@grca.on.ca
Cc:	Ryan, Doug (MNRF)
Subject:	RE: kerr St. roadway construction

Mark

Further to our phone conversation regarding the attached file:

It is understood that the Kerr Street roadway construction is being designed as an urban arterial, and that the water crossing of the Midtown Creek will be designed in accordance with MNRF guidelines (span less than 6 m and able to pass the 50 yr stm). The water crossing meets the requirements of a water crossing in section 2. (c) (i) of O. Reg 454/96 and no approval is required under the LRIA.

Mark Stephen
Regional Engineering Supervisor
Southern Region

From: Mark Peacock [mailto:mpeacock@grca.on.ca]
Sent: July-15-16 1:40 PM
To: Stephen, Mark (MNRF)
Cc: Ryan, Doug (MNRF)
Subject: kerr St. roadway construction

Mark, Doug:
Please find the final version of the letter I sent in an email earlier today. I inadvertently sent an early version of the letter in my first email. Please disregard that earlier attachment.
Thanks
Mark

Mark Peacock, P. Eng.
Director, Watershed Services

Ganaraska Region Conservation Authority
2216 County Road 28
Port Hope, ON
L1A 3V8

Phone: 905-885-8173 x 226
Fax: 905-885-9824
mpeacock@grca.on.ca

www.grca.on.ca

Town of Cobourg
Preliminary Design of A Conceptual Detention Pond on Midtown Creek

Prepared By:
Ganaraska Region Conservation Authority

Prepared In Support of:
Town of Cobourg
Flood Damage Reduction Program

April 2012

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Appendix

1.0 BACKGROUND

The following report provides a review of the analysis and flood frequencies of Midtown Creek between the train tracks and Division Street. The creek, which drains 644 hectares, courses through the Town of Cobourg to Lake Ontario.

The major impetus for this study was the winter rainstorm on January 25, 2010 that flooded a number of houses upstream of the CN/CP tracks. The Town wishes to pursue the possibility of building a pond for storing excess floodwaters to protect downstream property. One possible site is approximately 350-650m upstream of the CN/CP tracks, near the west property line of the Canada Pallet land at 755 Division St. The study area is shown on **Figure 1**, and encompasses the land around the creek, between the train tracks and Division St. The purpose of this study is to carry out a preliminary design to see if the pond is technically and economically feasible. The work was initiated in 2010 and completed in 2011.

2.0 REPORT STRUCTURE

The structure followed in this report includes the following steps:

- Review of Background Material – all available background reports, plans and mapping are reviewed;
- Methodologies for undertaking the detailed analysis are described
- Hydraulic analyses of key culverts is carried out to derive a rating curve for each culvert, and assess potential restrictions in creek flow;
- The 2007 approved hydrology VO_2 model was altered to include proposed pond scenarios;
- The 2008 approved hydraulic HEC-RAS model was modified to reflect the reduced flows due to alternative detention pond designs , and resulting flood elevations were calculated;
- Performance of alternatives was evaluated to determine best flood reduction solution
- Recommendations were prepared based on findings of the above analysis.

Figure # 1
Study Area

3.0 BACKGROUND MATERIAL

3.1 Background Data Review

GRCA staff reviewed and summarized engineering reports and computer models for Midtown Creek in the study area. Key information from each report can be found in Appendix A.

The following reports provided background data:

- March 2007 GRCA *"Midtown Creek Hydrology Report"* . The report created digital hydrology models for Midtown Creek using the Visual Ott-HYMO (VO_2) program to predict existing and future flows in the creek at key nodes. Relevant excerpts from this report are found in Appendix A.
- March 2008 Greenland Consulting Engineers' "Midtown Creek Hydraulic Assessment and Flood Plain Mapping Final Report". The report created digital HEC-RAS hydraulic models for Midtown Creek, using the flows from the above noted hydrology report. The floodplain maps that were created were adopted by the Town and GRCA board in September 2010 subject to approval of the Town of Cobourg Special Policy Area. Culvert information such as dimensions, material type, invert elevations, and road centerline elevations were extracted from the model. Relevant excerpts from this report are found in Appendix B.

3.2 Background Topographic Mapping

The existing mapping available for the preliminary design is the 1:2000 Ortho Imagery rectified to the recent detailed area LIDAR survey of the Town of Cobourg. It is available in an ESRI grid from the GRCA ArcGIS 9.x data. The resolution of the DEM is 0.1m. For this preliminary design, this DEM has been used as it is cost-effective and technically sound for this relatively flat location.

Although the DEM provides high-resolution data, it cannot provide ground elevations under water.

4.0 REVIEW OF BACKGROUND MATERIAL

The above noted reports and models were reviewed and information relevant to the culverts and section of creek was summarized. The main findings are as follows:

4.1 Field Verification

Additional field survey has been undertaken to confirm creek invert elevations found in the background reports and models (at key points). This survey work has been carried out by GRCA and Town of Cobourg staff using RTK GPS and total station survey equipment.

4.2 Hydrologic Model Review

The hydrologic model developed as a component of this project is based upon the existing Visual Ott-HYMO (VO_2) model and LIDAR surveys. A quality check of the available VO_2 model has been completed to ensure resolution and accuracy of the model. No major changes have been made to the existing Ott-hymo model (GRCA, 2007) for this analysis.

4.3 Design Flows

As noted previously, the 2- through 100-year (existing) and Regional flow (future) rates to be used for evaluations have been taken from the GRCA's recent 2007 hydrology study. **Table 1** provides the flows used for this section of Midtown Creek in the analysis of potential detention pond alternatives.

Table 1: Midtown Creek Flows at Potential Pond Site

Return Period	2yr	5yr	10yr	25yr	50yr	100yr	Regional
Flow (m^3/sec)	4.11	5.69	6.76	8.09	9.12	10.16	44.85*

**<u>Note:</u> Regional flow reflects future land use conditions, since SWM criteria does not reduce post-development runoff flows to existing levels for Regional storm flows.*

4.4 Hydraulic Model Review

The hydraulic model developed as a component of this project is based upon the existing digital HEC-RAS hydraulic models for Midtown Creek (Greenland, 2007) ,and LIDAR surveys. A quality check of the available HEC-RAS model has been completed to ensure resolution and accuracy of the model. A number of changes have been made to the existing HEC-RAS for this analysis. These changes are as follows:

- Sections added and improved in potential pond location
- Structure hydraulic properties revised and updated based on field investigations
- Creek conveyance capacity verified at critical locations

5.0 RESULTS OF ANALYSIS

Storage ponds can be either on-line (where a device such as a weir is placed in the creek bed to restrict the flow of water and cause upstream ponding of water), or a pond can be off-line. In the latter case, a flow diversion structure in the main creek redirects water away from the creek into the pond when the creek is in flood flow; base flow is maintained in the creek. This study will assess the feasibility of both an on-line and off-line ponds at the subject location to determine which option is best-suited for the site.

For an off-line pond: Revisions have been made to the existing VO_2 model to determine the optimum dimensions and location of the proposed pond(s). Verification of the capacity of the downstream CN/CP culvert and creek has been carried out. The pond(s) must be able to store excess floodwaters up to an acceptable storm return period, with an allowance for 0.3m freeboard. The requirements for Probable Maximum Flood (PMF) will be incorporated into criteria developed for the berm design at a later date. The critical storm at which flow will divert from the creek to the pond will be calculated. It is expected that, as a minimum, the existing creek channel should be used for baseflow, up to the 2-year flow

For an on-line pond: Revisions have been made to the existing VO_2 model to determine the dimensions and location of the proposed pond. The pond must be able to store excess floodwaters up to an acceptable storm return period, with an allowance for 0.3m freeboard. The requirements for Probable Maximum Flood (PMF) will be incorporated into criteria developed for the berm design at a future date. A preliminary design of a naturalized low flow channel through the proposed pond has not been carried out for this preliminary design project.

Since the site has been used historically for industrial purposes, there is a possibility that the underlying soil cannot be used for pond berm construction. It is beyond the scope of this study to perform a detailed soils investigation of the site. Cut/fill analysis has been performed solely to assess the financial savings of being able to re-use excavated soil as possible berm material.

The following sections describe the results of the engineering analysis completed to prepare a preliminary conceptual design of a detention pond on Midtown Creek. The information gathered through the background review has been included in the discussion of the analysis of elements of the flow system in Midtown Creek.

5.1 Flow Targets

The first question to answer regarding the design of flood control works is “what target flows should flood reduction structures discharge?” This target will define the size of the structure needed and the level of protection afforded to residents downstream of the structure. The target discharge was defined by analyzing the capacity of existing elements of the hydraulic system downstream of Division Street.

5.1.1 Flow Target - Capacity of CN/CP culverts

A series of culverts carry the Midtown Creek through the railway embankment to the channel below the Canadian National and Canadian Pacific Railways. The culverts vary in size and construction. Review of these culverts show that the upstream culvert is the one that controls the peak discharge of water entering the larger culvert system. Analysis of culvert capacity of the first culvert was determined by creating a rating curve for the culvert using the HEC-RAS routing of Midtown Creek. The analysis of the culvert determined that the open channel, unpressurized flow capacity is approximately 5.7m^3/sec (see **Figure 2** – Rating Curve of Railway Culverts).

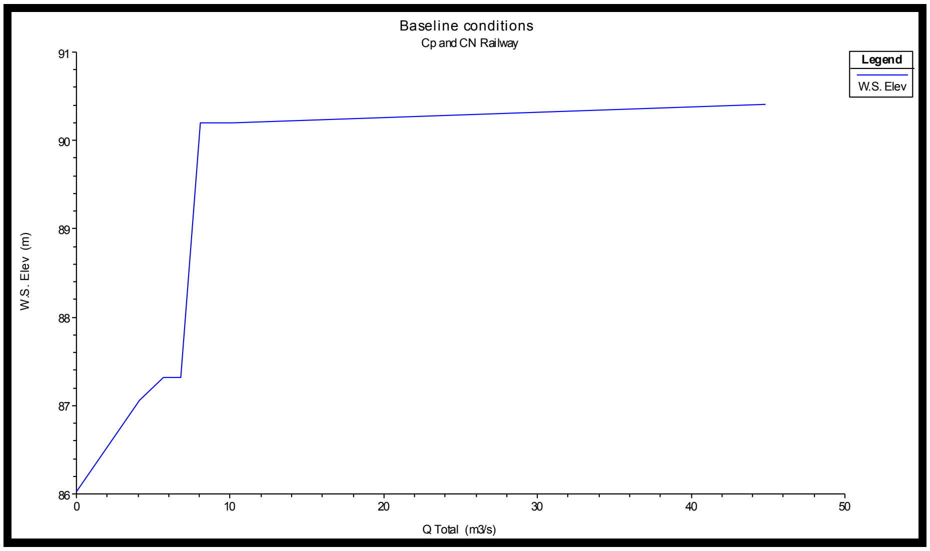


Figure 2: Rating Curve of Railway Culverts

If the discharge of the upstream watercourse was restricted to this value, limited backwater would be created from the railway structure. Control of discharge to this target would ensure houses upstream of the railway were not flooded due to backup from the railway culverts.

However, when large events are occurring, a certain amount of the culvert may be blocked by debris. Review of literature on culvert blockage shows that a wide variety of blockage scenarios are possible given the design of the inlet grating. The grating of the railway culvert is of an older style and could possibly be enhanced with an improved design. If it is assumed that 25% of the railway culvert capacity was removed by debris blockage, the flow target defined by this structure would be 4.3m^3/sec.

Upon review of the January 25, 2010 flood and its impact on the lands downstream of the railway culverts, it has been determined that the peak of 5.7m^3/sec did not get downstream of the railway. Evidence is not available to clearly define the peak that did make it to the area below the railway. However a discharge of 4.3m^3/sec, (which is close to the 2 year return period discharge) appears to be a close approximation of the flow experienced below the railway culverts. This flow did not create damage below the railway.

5.1.2 Flow Target – Capacity of the Buchanan Street Culvert

A culvert analysis has been conducted for the Buchannan Street culvert by creating a rating curve for the culvert using the HEC-RAS routing of Midtown Creek. The analysis determined that the open channel, unpressurized flow capacity is approximately 4.1m^3/sec (see **Figure 3** – Rating Curve of Buchanan Street Culvert).

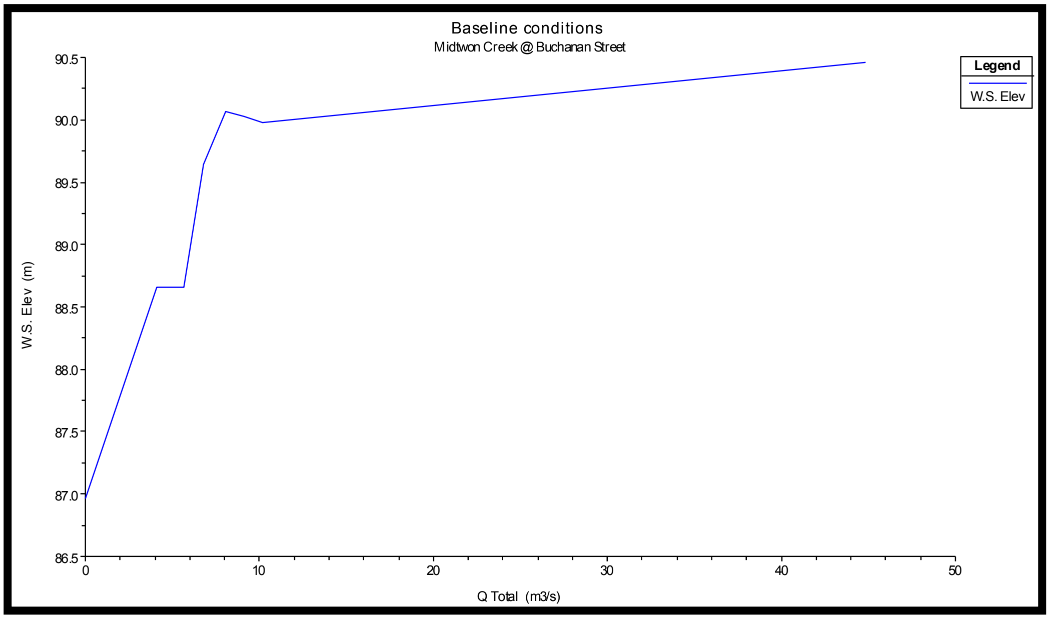


Figure 3: Rating Curve of Buchanan Street Culvert

5.1.3 Recommended Flow Target

Generally, when designing flow control structures, flows of up to the 2 year return period are allowed to move through the system in an uncontrolled manner. This is because in most streams the main channel is defined by the 2 year event. Above the 2 year event, flows naturally exit the channel and move into the flood plain.

In the preliminary design of the Midtown Creek pond the Buchannan Street Culvert Capacity of 4.1m^3/sec has been used as the target. This flow is very close to the 2 year event discharge. It is estimated that the 2 year discharge for the Midtown Creek in the Study Area is 4.1m^3/sec (2008 GRCA).

5.1.4 Impact on downstream lands given use of Flow Target

It must be noted that some structures may flood below the Railway tracks with the use of the 4.1 m^3/sec target. An analysis of extent of flooding downstream of the railway culverts during the 2, 5, 10, 25, 50, and 100 year events show that a small amount of flooding may occur in this area during the 2 year event. The placement of a flood control pond designed to the recommended flow target above the railway will remove the flooding that is shown in this analysis during the 5, 10, 25, 50, and 100 year Events.

During the flood that occurred in January 2010, a number of buildings in the area of Buchanan St. and Station Street were flooded. If the flows to this area were restricted to 4.1m^3/sec and the railway culvert is not blocked more than 25%, the structures in this area would not be flooded.

It must be noted that the flow target cannot be met during the Regional Event. The volume of runoff generated during that event makes it impractical to design the flood control ponds to this standard. If a Regional Event were to occur, major flooding would still be present in much of the Midtown Creek watershed.

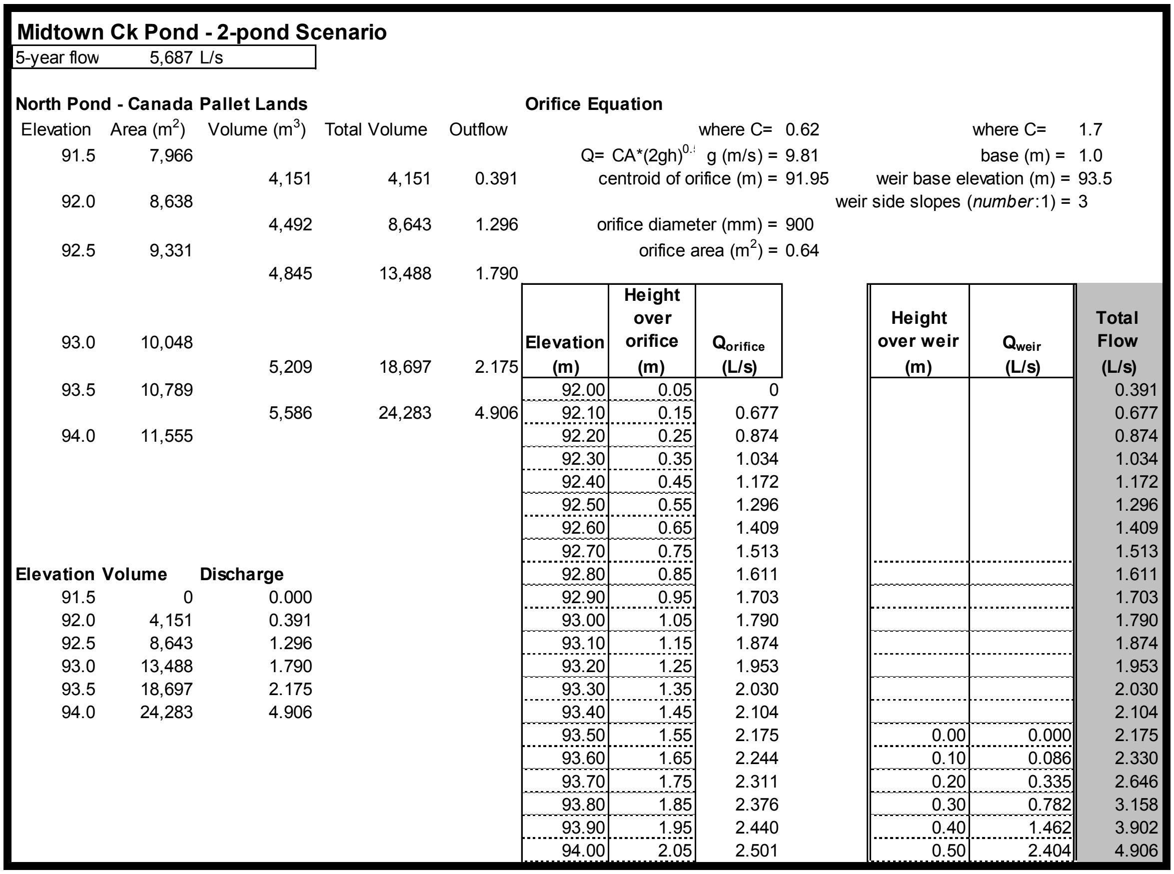
5.2 Off line Pond Preliminary Design

A series of alternatives were assessed looking at the configuration, the best performance was defined by:

Best Off-Line Pond design Scenario: 2 cell pond, 1 north and 1 south of spur line west of creek – flow target from 8.09m^3/sec attenuated to 5.7 m^3/sec. The pond's performance is shown in the following tables:

Table 2: Two Pond Design Rating Curve – North Pond
Table 3: Two Pond Design Rating Curve – South Pond
Table 4: Two Pond Performance – Outflow and Volumes
Table 5: Two Pond Performance - Changes in Flood line Elevations

Further details regarding this design can be found in **Appendix D**.



Midtown Ck Pond - 2-pond Scenario

5-year flow 5,687 L/s

North Pond - Canada Pallet Lands

Elevation	Area (m^2)	Volume (m^3)	Total Volume	Outflow
91.5	7,966			
		4,151	4,151	0.391
92.0	8,638			
		4,492	8,643	1.296
92.5	9,331			
		4,845	13,488	1.790
93.0	10,048			
		5,209	18,697	2.175
93.5	10,789			
		5,586	24,283	4.906
94.0	11,555			

Orifice Equation

where C= 0.62
Q= CA*(2gh)$^{0.}$ g (m/s) = 9.81
centroid of orifice (m) = 91.95
orifice diameter (mm) = 900
orifice area (m^2) = 0.64

where C= 1.7
base (m) = 1.0
weir base elevation (m) = 93.5
weir side slopes (*number*:1) = 3

Elevation (m)	**Height over orifice (m)**	**$Q_{orifice}$ (L/s)**	**Height over weir (m)**	**Q_{weir} (L/s)**	**Total Flow (L/s)**
92.00	0.05	0			0.391
92.10	0.15	0.677			0.677
92.20	0.25	0.874			0.874
92.30	0.35	1.034			1.034
92.40	0.45	1.172			1.172
92.50	0.55	1.296			1.296
92.60	0.65	1.409			1.409
92.70	0.75	1.513			1.513
92.80	0.85	1.611			1.611
92.90	0.95	1.703			1.703
93.00	1.05	1.790			1.790
93.10	1.15	1.874			1.874
93.20	1.25	1.953			1.953
93.30	1.35	2.030			2.030
93.40	1.45	2.104			2.104
93.50	1.55	2.175	0.00	0.000	2.175
93.60	1.65	2.244	0.10	0.086	2.330
93.70	1.75	2.311	0.20	0.335	2.646
93.80	1.85	2.376	0.30	0.782	3.158
93.90	1.95	2.440	0.40	1.462	3.902
94.00	2.05	2.501	0.50	2.404	4.906

Elevation	**Volume**	**Discharge**
91.5	0	0.000
92.0	4,151	0.391
92.5	8,643	1.296
93.0	13,488	1.790
93.5	18,697	2.175
94.0	24,283	4.906

Table 2: Two Pond Design Rating Curve – North Pond

South Pond - Behan Lands

Elevation	Area (m^2)	Volume (m^3)	Total V	Outflow
90.0	2,152			
		1,205	1,205	0.183
90.5	2,667			
		1,477	2,682	0.359
91.0	3,240			
		1,769	4,451	0.473
91.5	3,837			
		2,074	6,524	0.678
92.0	4,457			
		2,389	8,913	4.674
92.5	5,097			

Orifice Equation

where C= 0.62
Q= CA*(2gh)$^{0.}$ g (m/s) = 9.81
centroid of orifice (m) = 90.33
orifice diameter (mm) = 450
orifice area (m^2) = 0.16

where C= 1.7
base (m) = 1.5
weir base elevation (m) = 91.9
weir side slopes (*number*:1) = 3

Elevation (m)	Height over orifice (m)	$Q_{orifice}$ (L/s)	Height over weir (m)	Q_{weir} (L/s)	Total Flow (L/s)
90.40	0.08	0.120			0.120
90.50	0.18	0.183			0.183
90.60	0.28	0.229			0.229
90.70	0.38	0.267			0.267
90.80	0.47	0.301			0.301
90.90	0.57	0.331			0.331
91.00	0.67	0.359			0.359
91.10	0.77	0.385			0.385
91.20	0.87	0.409			0.409
91.30	0.97	0.431			0.431
91.40	1.07	0.453			0.453
91.50	1.17	0.473			0.473
91.60	1.27	0.493			0.493
91.70	1.37	0.512			0.512
91.80	1.47	0.530			0.530
91.90	1.57	0.548			0.548
92.00	1.67	0.565	0.10	0.113	0.678
92.10	1.77	0.582	0.20	0.411	0.992
92.20	1.87	0.598	0.30	0.922	1.520
92.30	1.97	0.614	0.40	1.677	2.291
92.40	2.07	0.629	0.50	2.705	3.334
92.50	2.17	0.644	0.60	4.029	4.674

Elevation	Volume	Discharge
90.0	0	0.000
90.5	1,205	0.183
91.0	2,682	0.359
91.5	4,451	0.473
92.0	6,524	0.678
92.5	8,913	4.674

Table 3: Two Pond Design Rating Curve – South Pond

Two Off-Line Pond Flows and Volumes

Return Period	Flows (m3/s) at diversion	in channel	into North Pond	from South Pond	at CN/CP	% Flow Reduction @ CN/CP	Volume Stored (m3)
2-year	4.63	4.10	0.53	0.01	3.70	20%	400
5-year	6.43	4.10	2.30	0.12	4.00	38%	3,380
10-year	7.60	4.10	3.50	0.23	4.30	43%	6,390
25-year	9.04	4.10	4.90	0.66	4.80	47%	14,360
50-year	10.19	4.10	6.10	1.70	5.80	43%	19,600
100-year	11.34	4.10	7.30	2.40	6.50	43%	26,800

Table 4: Two Pond Performance – Outflow and Volumes

Comparing 100-year Flood Elevations

	Greenland		Two West Ponds				Baseline		
River Sta	Q (m3/s)	W.S. Elev (m)	Q (m3/s)	W.S. Elev (m)	*2West-Greenland*	*2West-Baseline*	Q (m3/s)	W.S. Elev (m)	*Baseline - Grn*
4724.8	7.2	102.31	7.2	102.31	0.00	0.00	7.16	102.31	0.00
4631.1	7.2	102.08	7.2	102.08	0.00	0.00	7.16	102.08	0.00
4447.9	7.2	101.14	7.2	101.14	0.00	0.00	7.16	101.14	0.00
4265.5	7.2	100.08	7.2	100.08	0.00	0.00	7.16	100.08	0.00
4082.0	7.2	99.62	7.2	99.62	0.00	0.00	7.16	99.62	0.00
3986.1	7.2	99.13	7.2	99.13	0.00	0.00	7.16	99.13	0.00
3817.5	7.2	98.69	7.2	98.69	0.00	0.00	7.16	98.69	0.00
3757.1	7.0	98.66	7.0	98.66	0.00	0.00	7	98.66	0.00
3725.0	Elgin St Culvert								
3699.5	7.0	98.09	7.0	98.09	0.00	0.00	7	98.09	0.00
3620.7	7.0	98.05	7.0	98.05	0.00	0.00	7	98.05	0.00
3524.5	7.0	97.69	7.0	97.69	0.00	0.00	7	97.69	0.00
3287.9	7.0	97.6	7.0	97.68	0.08	0.00	7	97.68	0.08
3228.3	7.0	97.59	7.0	97.68	0.09	0.00	7	97.68	0.09
3168.2	8.1	97.55	10.2	97.65	0.10	0.00	10.16	97.65	0.10
3150.0	Division St Culvert								
3131.5	8.1	96.61	10.2	97.24	0.63	0.00	10.16	97.24	0.63
3013.4	8.1	95.19	10.2	95.22	0.03	-0.04	10.16	95.26	0.07
2658.9	8.1	93.04	4.1	92.98	-0.06	-0.09	10.16	93.07	0.03
2368.4	8.1	90.05	4.1	89.8	-0.25	-0.36	10.16	90.16	0.11
2249.5	8.1	90.09	6.5	89.46	-0.63	-0.55	10.16	90.01	-0.08
2225.0	8.1	90.06	6.5	89.39	-0.67	-0.56	10.16	89.95	-0.11
2204.4	8.1	90.08	6.5	89.42	-0.66	-0.56	10.16	89.98	-0.10
2178.5	8.1	90.08	6.5	89.41	-0.67	-0.57	10.16	89.98	-0.10
2156.3	8.1	90.08	6.5	89.41	-0.67	-0.57	10.16	89.98	-0.10
2150.0	Buchanan St Culvert								
2141.4	8.1	90.26	6.5	89.41	-0.85	-0.87	10.16	90.28	0.02
2109.4	8.1	90.25	6.5	89.41	-0.84	-0.87	10.16	90.28	0.03
2016.3	8.1	90.25	6.5	89.41	-0.84	-0.87	10.16	90.28	0.03
1977.1	10.2	90.14	6.5	89.34	-0.80	-0.83	10.16	90.17	0.03
1925.0	CN/CP Culvert								
1892.2	10.2	86.84	6.5	86.73	-0.11	-0.11	10.16	86.84	0.00
1826.6	10.2	86.31	6.5	86.16	-0.15	-0.15	10.16	86.31	0.00
1744.5	10.2	86.22	6.5	86.08	-0.14	-0.14	10.16	86.22	0.00
1711.8	10.2	86.2	6.5	86.07	-0.13	-0.13	10.16	86.2	0.00
1700.0	Park St Culvert								
1695.4	10.2	86.01	6.5	85.79	-0.22	-0.22	10.16	86.01	0.00
1677.8	10.2	85.71	6.5	85.45	-0.26	-0.26	10.16	85.71	0.00
1660.7	10.2	85.81	6.5	85.57	-0.24	-0.24	10.16	85.81	0.00
1621.0	10.2	85.81	6.5	85.56	-0.25	-0.25	10.16	85.81	0.00
1600.0	10.2	85.81	6.5	85.56	-0.25	-0.25	10.16	85.81	0.00
1590.0	Park Lane Culvert								
1585.5	10.2	85.22	6.5	84.92	-0.30	-0.30	10.16	85.22	0.00
1569.2	10.2	84.48	6.5	83.95	-0.53	-0.53	10.16	84.48	0.00
1513.3	10.2	84.51	6.5	84.01	-0.50	-0.50	10.16	84.51	0.00
1504.0	10.2	84.24	6.5	83.81	-0.43	-0.43	10.16	84.24	0.00
1495.0	Spencer St Culvert								
1487.7	10.2	83.55	6.5	83.58	0.03	0.03	10.16	83.55	0.00
1458.8	10.2	83.75	6.5	83.65	-0.10	-0.10	10.16	83.75	0.00
1399.8	10.2	83.7	6.5	83.62	-0.08	-0.08	10.16	83.7	0.00
1382.3	10.2	83.69	6.5	83.61	-0.08	-0.08	10.16	83.69	0.00
1362.3	10.2	83.58	6.5	83.52	-0.06	-0.06	10.16	83.58	0.00
1321.8	10.2	82.8	6.5	82.73	-0.07	-0.07	10.16	82.8	0.00
1207.2	10.2	81.84	6.5	81.74	-0.10	-0.10	10.16	81.84	0.00
1132.3	10.2	80.72	6.5	80.67	-0.05	-0.05	10.16	80.72	0.00
1002.9	10.2	79.78	6.5	79.5	-0.28	-0.28	10.16	79.78	0.00
980.2	10.2	79.77	6.5	79.5	-0.27	-0.27	10.16	79.77	0.00
980.0	Buck St Culvert								
967.3	10.2	79.22	6.5	79.14	-0.08	-0.08	10.16	79.22	0.00
921.5	10.2	79.31	6.5	79.26	-0.05	-0.05	10.16	79.31	0.00
855.7	10.2	79.25	6.5	79.2	-0.05	-0.05	10.16	79.25	0.00
783.5	10.2	77.51	6.5	77.42	-0.09	-0.09	10.16	77.51	0.00
731.1	10.2	76.98	6.5	76.94	-0.04	-0.04	10.16	76.98	0.00
657.6	10.2	76.74	6.5	76.71	-0.03	-0.03	10.16	76.74	0.00
561.4	24.6	76.28	24.6	76.27	-0.01	-0.01	24.55	76.28	0.00

Table 5: Two Pond Performance Changes in Flood line Elevations

With the maximum pond size employed, the best performance achieved was attenuation of the 100year flow to the 25 year discharge of 5.77m^3/sec. **Figure 4** shows the general layout of the two pond scenario.

The scenario therefore has the following issues:

- Doesn’t meet flow target
- Wet area above the spur line
- Requirements to convey pond flows between cells
- Inability to use areas east of the creek
- Offset from creek required
- Flooding of condos in subdivisions adjacent Division Street an concern
- Complexity of the diversion structure
- Would require upsizing of Buchanan and George Street culverts to control backwater from these structures and flooding
- Increased difficulty in maintenance

The scenario’s benefits are as follows:

- Does not have to rebuild Midtown Creek on Pallet Property
- Does not have to use east side of creek thereby somewhat limiting tree cutting requirements

Figure # 4
Offline Ponds Location
2 Pond Scenario

5.3 On Line Pond Preliminary Design

A series of scenarios were run to access the functionality of a single online pond design in the subject area.

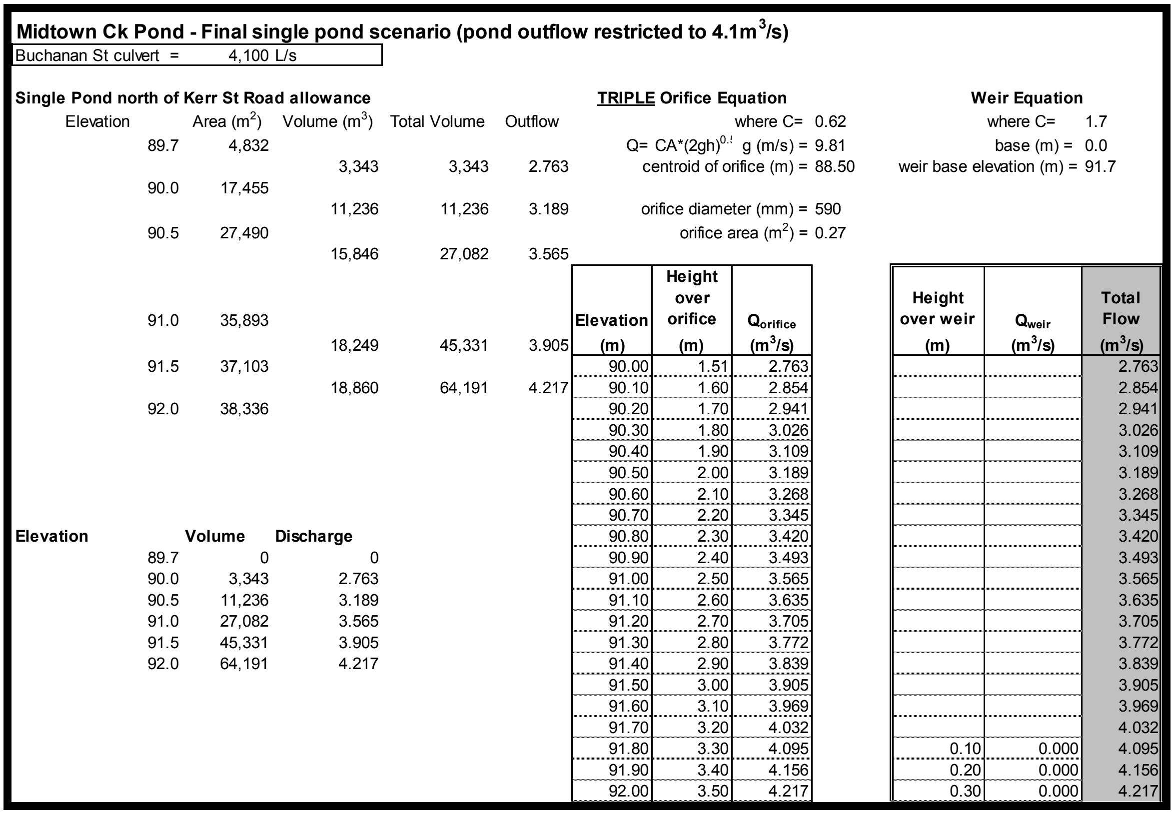
Preliminary scenarios included upsizing Buchanan and George Street culverts to 5.7m^3/sec capacity and using this flow to design the pond. Routing of this scenario showed that volume was available in the pond to easily attenuate the inflow. Additional capacity meant that lower pond discharges could be obtained.

A series of scenarios were run reducing the outflow of the pond. A final scenario achieved the target discharge of 4.1m^3/sec.

The final pond's performance is shown in the following tables:

Table 6: On-line Pond Design Rating Curve
Table 7: On-line Pond Performance – Outflow and Volumes
Table 8: On-line Pond Performance - Changes in Flood line Elevations

Further details regarding this design can be found in **Appendix E**.



Midtown Ck Pond - Final single pond scenario (pond outflow restricted to 4.1m^3/s)

Buchanan St culvert = 4,100 L/s

Single Pond north of Kerr St Road allowance

Elevation	Area (m^2)	Volume (m^3)	Total Volume	Outflow
89.7	4,832			
		3,343	3,343	2.763
90.0	17,455			
		11,236	11,236	3.189
90.5	27,490			
		15,846	27,082	3.565
91.0	35,893			
		18,249	45,331	3.905
91.5	37,103			
		18,860	64,191	4.217
92.0	38,336			

<u>TRIPLE</u> Orifice Equation

where C= 0.62
Q= CA*(2gh)$^{0.!}$ g (m/s) = 9.81
centroid of orifice (m) = 88.50
orifice diameter (mm) = 590
orifice area (m^2) = 0.27

Weir Equation

where C= 1.7
base (m) = 0.0
weir base elevation (m) = 91.7

Elevation (m)	**Height over orifice (m)**	**$Q_{orifice}$ (m^3/s)**	**Height over weir (m)**	**Q_{weir} (m^3/s)**	**Total Flow (m^3/s)**
90.00	1.51	2.763			2.763
90.10	1.60	2.854			2.854
90.20	1.70	2.941			2.941
90.30	1.80	3.026			3.026
90.40	1.90	3.109			3.109
90.50	2.00	3.189			3.189
90.60	2.10	3.268			3.268
90.70	2.20	3.345			3.345
90.80	2.30	3.420			3.420
90.90	2.40	3.493			3.493
91.00	2.50	3.565			3.565
91.10	2.60	3.635			3.635
91.20	2.70	3.705			3.705
91.30	2.80	3.772			3.772
91.40	2.90	3.839			3.839
91.50	3.00	3.905			3.905
91.60	3.10	3.969			3.969
91.70	3.20	4.032			4.032
91.80	3.30	4.095	0.10	0.000	4.095
91.90	3.40	4.156	0.20	0.000	4.156
92.00	3.50	4.217	0.30	0.000	4.217

Elevation	**Volume**	**Discharge**
89.7	0	0
90.0	3,343	2.763
90.5	11,236	3.189
91.0	27,082	3.565
91.5	45,331	3.905
92.0	64,191	4.217

Table 6: On-line Pond Design Rating Curve

Single On-Line Pond Flows and Volumes

Return Period	Flows (m3/s)		% Flow Reduction	Volume Stored (m3)
	Into Pond	From Pond		
2-year	4.63	2.82	39%	4,360
5-year	6.43	3.04	53%	8,664
10-year	7.60	3.32	56%	16,641
25-year	9.04	3.61	60%	29,445
50-year	10.19	3.82	63%	40,999
100-year	11.34	4.04	64%	53,460

Table 7: On-line Pond Performance – Outflow and Volumes

HEC-RAS Plan: Plan 01 River: Midtown1 Reach: 300

Note: Greenland's model used future flows for the 2 to 50-year events (F01) and

	Revised Baseline			Single (4.1)		
River Sta	Q (m3/s)	W.S. Elev (m)	*Rev. Baseline-Grn*	Q (m3/s)	W.S. Elev (m)	*Single Kerr 4.1-Grn*
3150	Division St culvert					
3131.504	4.1	96.22	-0.02	4.6	96.28	0.06
3131.504	5.7	96.38	-0.06	6.4	96.46	0.08
3131.504	6.8	96.49	-0.09	7.6	96.56	0.07
3131.504	8.1	96.61	-0.13	9.0	96.69	0.08
3131.504	9.1	96.7	-0.55	10.2	97.24	0.54
3131.504	10.2	97.24	0.63	10.2	97.24	0.00
3131.504	44.9	97.5	0.02	46.7	97.51	0.01
3013.369	4.1	95.01	0.00	4.6	95.05	0.04
3013.369	5.7	95.09	-0.03	6.4	95.14	0.05
3013.369	6.8	95.13	-0.05	7.6	95.19	0.06
3013.369	8.1	95.17	-0.07	9.0	95.23	0.06
3013.369	9.1	95.22	-0.06	10.2	95.27	0.05
3013.369	10.2	95.24	0.05	10.2	95.31	0.07
3013.369	44.9	95.78	-0.02	46.7	96.02	0.24
2658.945	4.1	92.94	-0.02	4.6	92.95	0.01
2658.945	5.7	92.99	-0.01	6.4	92.99	0.00
2658.945	6.8	93.02	-0.01	7.6	93.02	0.00
2658.945	8.1	93.05	-0.01	9.0	93.05	0.00
2658.945	9.1	93.06	-0.02	10.2	93.06	0.00
2658.945	10.2	93.08	0.04	10.2	93.03	-0.05
2658.945	44.9	93.48	0.19	46.7	93.29	-0.19
2368.388	4.1	89.8	-0.02	1.9	89.56	-0.24
2368.388	5.7	89.93	-0.03	2.4	89.62	-0.31
2368.388	6.8	89.99	-0.05	2.9	89.67	-0.32
2368.388	8.1	90.05	-0.07	3.7	89.74	-0.31
2368.388	9.1	90.09	-0.11	4.4	89.8	-0.29
2368.388	10.2	90.16	0.11	5.2	89.98	-0.18
2368.388	44.9	91.79	0.78	31.6	91.31	-0.48
2249.472	4.1	88.97	-0.02	3.8	88.92	-0.05
2249.472	5.7	89.15	-0.05	4.0	88.95	-0.20
2249.472	6.8	89.67	0.36	4.1	88.96	-0.71
2249.472	8.1	90.08	0.10	4.4	88.98	-1.10
2249.472	9.1	90.05	0.12	4.9	89.03	-1.02
2249.472	10.2	90.01	-0.08	5.2	89.05	-0.96
2249.472	44.9	91.81	0.67	37.7	91.3	-0.51
2225.015	4.1	88.81	-0.02	3.8	88.76	-0.05
2225.015	5.7	88.99	-0.06	4.0	88.8	-0.19
2225.015	6.8	89.62	0.51	4.1	88.81	-0.81
2225.015	8.1	90.05	0.12	4.4	88.84	-1.21
2225.015	9.1	90.01	0.16	4.9	88.89	-1.12
2225.015	10.2	89.95	-0.11	5.2	88.9	-1.05
2225.015	44.9	91.63	0.70	37.7	91.1	-0.53
2204.368	4.1	88.85	-0.02	3.8	88.81	-0.04
2204.368	5.7	89.04	-0.05	4.0	88.84	-0.20
2204.368	6.8	89.64	0.46	4.1	88.85	-0.79
2204.368	8.1	90.06	0.11	4.4	88.88	-1.18
2204.368	9.1	90.03	0.15	4.9	88.93	-1.10
2204.368	10.2	89.98	-0.10	5.2	88.95	-1.03
2204.368	44.9	91.74	0.69	37.7	91.22	-0.52
2178.475	4.1	88.85	-0.02	3.8	88.8	-0.05
2178.475	5.7	89.03	-0.06	4.0	88.84	-0.19
2178.475	6.8	89.64	0.47	4.1	88.85	-0.79
2178.475	8.1	90.06	0.11	4.4	88.88	-1.18
2178.475	9.1	90.03	0.15	4.9	88.93	-1.10
2178.475	10.2	89.98	-0.10	5.2	88.95	-1.03
2178.475	44.9	91.74	0.69	37.7	91.22	-0.52

Table 8: On-line Pond Performance Changes in Flood line Elevations

The final on line pond scenario controls outlet discharge to the recommended target 4.1m^3/sec – which is the capacity of the Buchanan St Structure. This provides control of all storms including the 5 year to 100 year storm flows. **Figure 5** shows the general layout of the on line pond design.

Issues with this scenario:
- Requires natural channel design of channel
- Requires significant tree cutting
- Requires more earthworks than Scenario 1a

Benefits of this scenario:
- Meets flow targets
- Access off of Kerr Street
- Does not include use of flooded area north of spur line (north pond area)

Figure # 5
Online Pond Location

5.4 Preliminary Pond Plan

A conceptual plan has been created showing the tentative location of the proposed pond. The base for the map is the scanned 1:2000 Ortho imagery rectified to the detailed LIDAR survey of the Town of Cobourg.

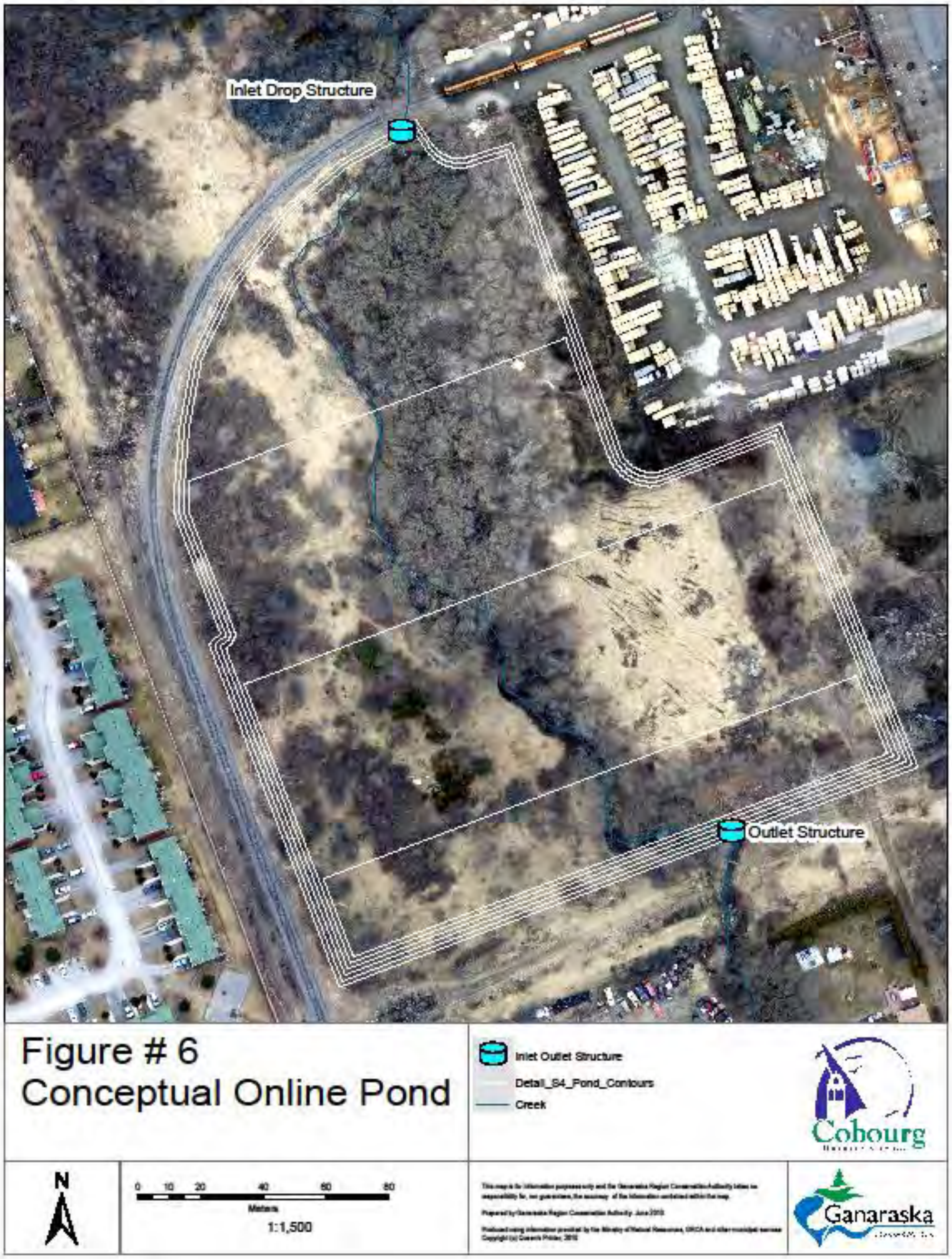


Figure # 6
Conceptual Online Pond

5.5 Inundation Reduction Calculations

Calculations will be provided to compare the pond size vs. the level of inundation protection (i.e. pond size vs. 5-year flood protection, up to the 100-year flood protection vs. pond size). Rating curves for each pond size will be provided, but it is beyond the scope of this study to carry out detailed design of pond outlet structure(s). Comparative costs of each pond size will be provided and compared to the reduction of the number of inundated structures, in order to allow the Town to determine if the pond is feasible.

A post-development inundation analysis of strategy given number of structures flooded during events shows that:

2 year -	no structures flooded between train tracks and Canada Pallet Property
5 year -	1 structure flooded
10 year -	6 structures flooded
25 year -	20 structures flooded

6.0 COSTING OF ALTERNATIVES

The costing is based on the level of protection that is to be provided by the project. The higher the level of protection, the larger is the cost. In assessing the cost of protecting properties one alternative is to purchase the flood susceptible houses. Cost of purchasing houses that are flood susceptible vs. protection them by construction of a flood control pond must be addressed. A general conservative costing is provided.

Return Period	Number of Structures	Cost of Structure	Total Cost
2year	0	0	0
5year	1	$200,000	$200,000
10 year	6	$200,000	$1,200,000
25 year	20	$200,000	$4,000,000

Table 9: Cost of Purchasing Flood Susceptible Properties

Costing of the recommended pond design includes purchasing the pond site, clearing and grading, construction of a natural channel and building of a control structure at the Kerr Street Road Allowance. Very preliminary costs have been included and should be used as a general comparison to provision of flood protection by other methods. Detailed costing will be required at the preliminary design phase of this project.

	Units	# of Units	Cost / unit	Total Cost
Land Cost	Hectares	5	$50,000	$250,000
Clearing, earthworks/reveg	Cubic meters	25,000	$30	$725,000
Natural Channel	Linear meter	250	$1,000	$250,000
Structures	Ls	1	$300,000	$300,000
Subtotal				***$1,550,000***
Design, EA, Admin	% of cost	10		$155,000
Total				***$1,705,000***

Table 10: Preliminary Costing for Construction of Recommended Pond

7.0 RECOMMENDATIONS:

It is recommended that the Town of Cobourg move forward with further investigations in the development of an on line pond in the site immediately upstream of the Kerr Street Right of Way on the Midtown Creek.

Additionally, it is recommended that the Town of Cobourg install an improved inlet on the railway culvert entrance to ensure 4.1m^3/sec is conveyed by railway culvert thereby preventing blockage during major events.

Finally, it is recommended that the Town of Cobourg investigate other potential sites for construction of facilities to limit flooding upstream of the CNR/CPR railway crossings of Midtown Creek

8.0 CONCLUSIONS AND NEXT STEPS

The proceeding report shows that it is feasible to construct a flood control structure that will reduce the flooding of structures on Midtown Creek for the 5 year to 100 year return period storms. The report further recommends that should the site behind Canada Pallet be considered, an on line facility would be perform in the most efficient manner. It has also been determined that this facility would not be capable of attenuating the Regional Storm to levels that would limit flooding of residents and businesses.

The following next steps are recommended
:

- Access other locations for siting of the flood control pond.
- Complete conceptual design analysis of other candidate sites
- Completion of EA process for final site
- Completion of Design and Drawings for final site

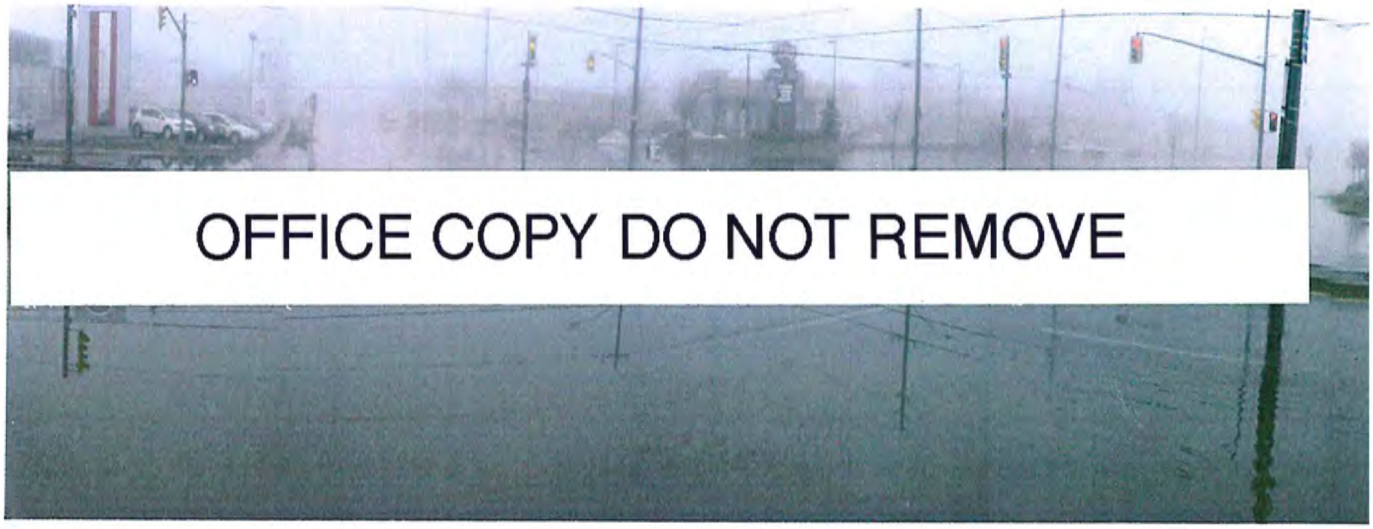
9.0 References

1. Midtown Creek Hydraulic Assessment and Flood Plain Mapping Final Report, Greenland Consulting Engineers, March 2008
2. Midtown Creek Hydrology Update Report, Ganaraska Region Conservation Authority, March 2007

Ganaraska
CONSERVATION

Cobourg
Ontario, Canada

Town of Cobourg
DRAFT – Preliminary Design of A Conceptual Flood Detention Pond Chris Garrett Park – Midtown Creek



Prepared By:
Ganaraska Region Conservation Authority

Prepared In Support of:
Town of Cobourg
Flood Damage Reduction Program
October 2012

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LIST OF APPENDICES

1.0 BACKGROUND

The following report provides a review of a possible a flood control pond within the Midtown Creek catchment in the Town of Cobourg. The upper portion of the creek's catchment is mainly rural in a neighbouring municipality. The lower section of Midtown Creek passes through heavily developed land to Lake Ontario. Refer to **Figure 1**.

The major impetus for this study was the winter rainstorm on January 25, 2010 that flooded a number of houses upstream of the CN/CP tracks. The Town wishes to pursue the possibility of building one or more ponds for storing excess floodwaters to protect downstream property. One possible site is within Chris Garrett Park, located northeast of the intersection of Birchwood Trail and Elgin Street. The study area is shown on **Figure 2**. The purpose of this study is to carry out a preliminary design to see if the pond is technically feasible. The work was initiated in 2012.

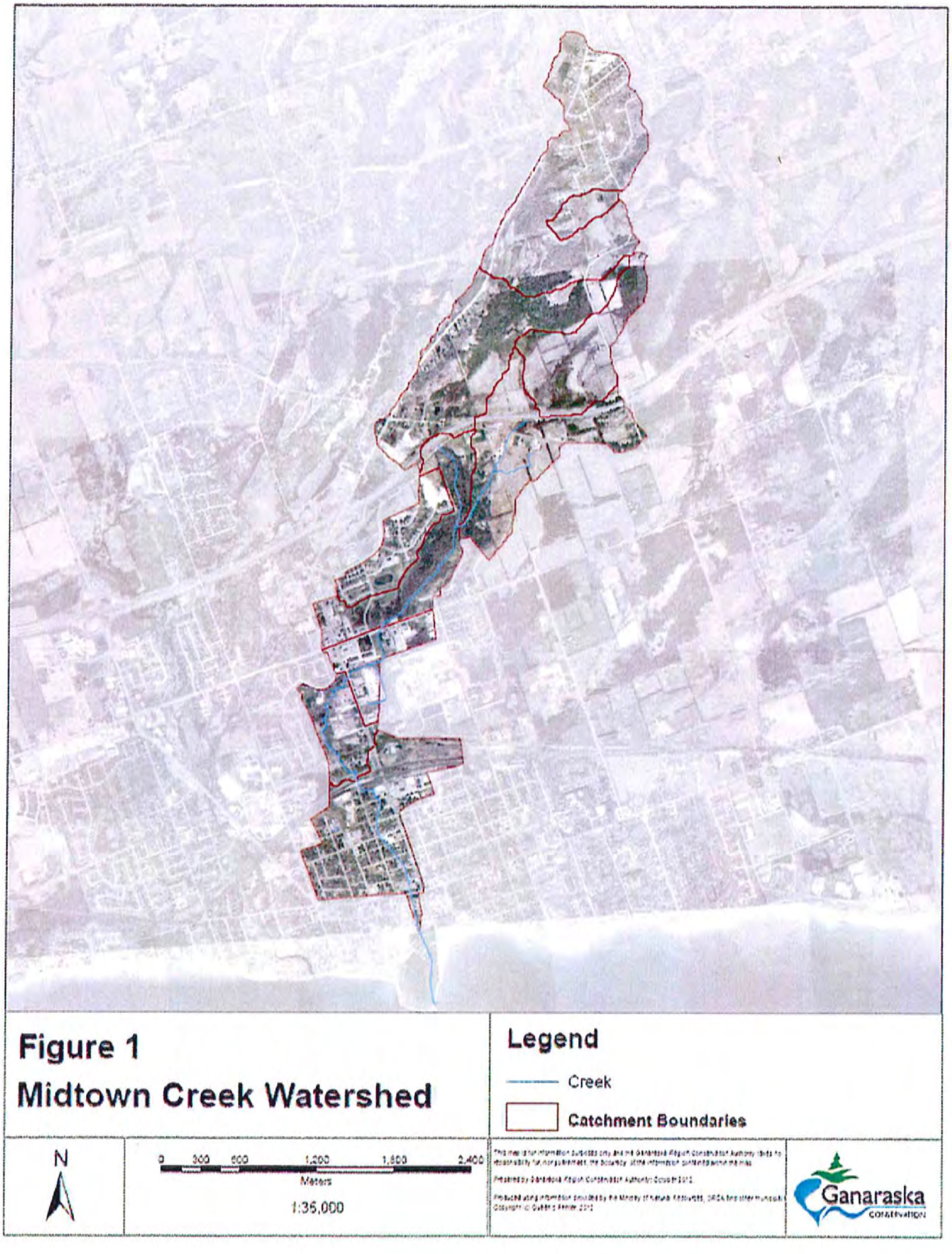


Figure 1

Midtown Creek Watershed

Town of Cobourg

Draft – Preliminary Design of

A Conceptual Flood Detention Pond Chris Garrett Park - Midtown Creek

Figure 2
Study Area

Legend

— Creek

▭ Study Area

Town of Cobourg

Draft – Preliminary Design of

A Conceptual Flood Detention Pond Chris Garrett Park - Midtown Creek

2.0 BACKGROUND MATERIAL

2.1 Background Engineering Report and Model Review

GRCA staff reviewed and summarized engineering reports and computer models for Midtown Creek in the study area. Key information from each report can be found in Appendix A.

The following reports provided background data:

- March 2007 GRCA *"Midtown Creek Hydrology Report"*. The report created digital hydrology models for Midtown Creek using the Visual Ott-HYMO (VO_2) program to predict existing and future flows in the creek at key nodes. Relevant excerpts from this report are found in Appendix A.
- March 2008 Greenland Consulting Engineers' "Midtown Creek Hydraulic Assessment and Flood Plain Mapping Final Report". The report created digital HEC-RAS hydraulic models for Midtown Creek, using the flows from the above noted hydrology report. The floodplain maps that were created were adopted by the Town and GRCA board in September 2010 subject to approval of the Town of Cobourg Special Policy Area. Culvert information such as dimensions, material type, invert elevations, and road centerline elevations were extracted from the model.

2.2 Background Topographic Mapping

Existing mapping available for the preliminary design is the 1:2000 Ortho Imagery rectified to the recent detailed area LIDAR survey of the Town of Cobourg, available in an ESRI grid from the GRCA ArcGIS 9.x data. The resolution of the DEM is 0.1m. For this preliminary design, this DEM has been used as it is cost-effective and technically sound for this relatively flat location.

It must be noted that although the DEM provides high-resolution data, it cannot provide ground elevations under water.

3.0 REPORT STRUCTURE

The structure followed in this report includes the following steps:

- Hydraulic analyses of key culverts is carried out to derive a rating curve for each culvert, and assess potential restrictions in creek flow;
- The 2007 approved hydrology VO_2 model was altered to include proposed pond scenarios;
- The 2008 approved hydraulic HEC-RAS model was modified to reflect the reduced flows due to alternative detention pond designs , and resulting flood elevations were calculated;
- Performance of alternatives was evaluated to determine best flood reduction solution

Recommendations were prepared based on findings of the above analysis.

4.0 REVIEW OF BACKGROUND MATERIAL

The above noted reports and models were reviewed and information relevant to the culverts and section of creek was summarized. The main findings are as follows:

4.1 Hydrologic Model Review

The hydrologic model developed for this project is based upon the existing Visual Ott-HYMO (VO_2) model and LIDAR surveys. A quality check of the available VO_2 model has been completed to ensure resolution and accuracy of the model.

4.2 Design Flows

As noted previously, the 2- through 100-year (existing) and Regional flow (future) rates to be used for evaluations have been taken from the GRCA's recent 2007 hydrology study. **Table 1** provides the flows used for this section of Midtown Creek in the analysis of potential detention pond alternatives.

Table 1: Midtown Creek Flows within Chris Garrett Park (Existing land use)

Return Period	2yr	5yr	10yr	25yr	50yr	100yr	Regional
Flow (m^3/sec)	1.42	2.39	3.15	4.22	5.13	6.06	37.18

**Note: Regional flow reflects future land use conditions, since SWM criteria does not reduce post-development runoff flows to existing levels for Regional storm flows.*

4.3 Hydraulic Model Review

The hydraulic model developed as a component of this project is based upon the existing digital HEC-RAS hydraulic models for Midtown Creek (Greenland, 2008), and LIDAR surveys. A quality check of the available HEC-RAS model has been completed to ensure resolution and accuracy of the model.

The model was used to calculate creek conveyance capacity verified at critical locations. This is explained further in section 5.

5.0 RESULTS OF ANALYSIS

Storage ponds can be either on-line (where a device such as a weir is placed in the creek bed to restrict the flow of water and cause upstream ponding of water), or a pond can be off-line. In the latter case, a flow diversion structure in the main creek redirects water away from the creek into the pond when the creek is in flood flow; base flow is maintained in the creek. This study will assess the feasibility of an off-line pond at the subject location, due to the environmental sensitivity of the creek which is located in an environmentally protected area.

Revisions were made to the existing VO_2 model to determine the optimum dimensions and location of the proposed pond. Verification of the capacity of the downstream roadway creek crossings have been carried out. The pond must be able to store excess floodwaters up to an acceptable storm return period, with an allowance for 0.3m freeboard in the pond. The requirements for Probable Maximum Flood (PMF) have not been assessed; this will be incorporated into criteria for the berm design at a later date. It is expected that the existing creek channel should be used for baseflow, up to the 2-year flow.

Since a portion of the site has saturated soils, there is a possibility that the underlying soil cannot be used for pond berm construction. It is beyond the scope of this study to perform a detailed soils investigation of the site.

The following sections describe the results of the engineering analysis completed to prepare a preliminary conceptual design of a detention pond on Midtown Creek. The information gathered through the background review has been included in the discussion of the analysis of elements of the flow system in Midtown Creek.

5.1 Flow Targets

The first question to answer regarding the design of flood control works is "what target flows should flood reduction structures discharge?" This target will define the size of the structure needed and the level of protection afforded to residents downstream of the structure. The target discharge was defined by analyzing the capacity of existing roadway crossings downstream at Elgin and Division Streets.

5.1.1 Flow Target - Capacity of Elgin St Crossing

Elgin Street acts as a barrier to creek flow; when over-topped, water flows over a low point east of the creek, to rejoin the creek downstream. Currently, there are two culverts in place at the creek crossing. Only the lower, west culvert is available for use; the higher, east culvert is blocked. Analysis of the single culvert capacity was derived from the HEC-RAS rating curve. The open channel, unpressurized flow capacity is 1.7m^3/sec (as seen in the **Figure 3** below); this corresponds roughly to the 2-year peak flow. If the discharge of the upstream watercourse were restricted to this value, no backwater would be created from the Elgin Street roadway. The capacity of the culvert immediately before road submergence is 3.0m^3/s.

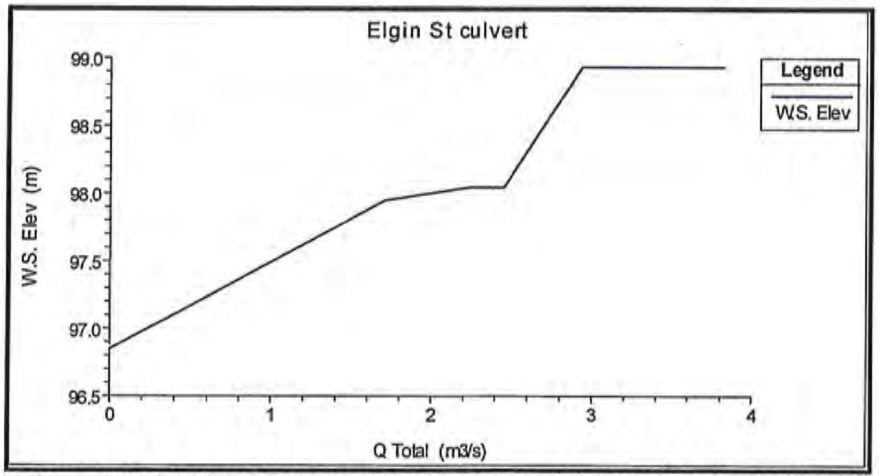


Figure 3: Rating Curve of Elgin Street (with single culvert)

If the second culvert were opened, the HEC_RAS model has determined that the open channel, unpressurized flow capacity for the twin culverts would be 3.7m^3/sec, which is approximately the existing 10-year peak flow. If the discharge of the upstream watercourse was restricted to this value, no backwater would be created from the Elgin Street roadway. The capacity of the culverts immediately before road submergence is 6.0m^3/s. Refer to **Figure 4**.

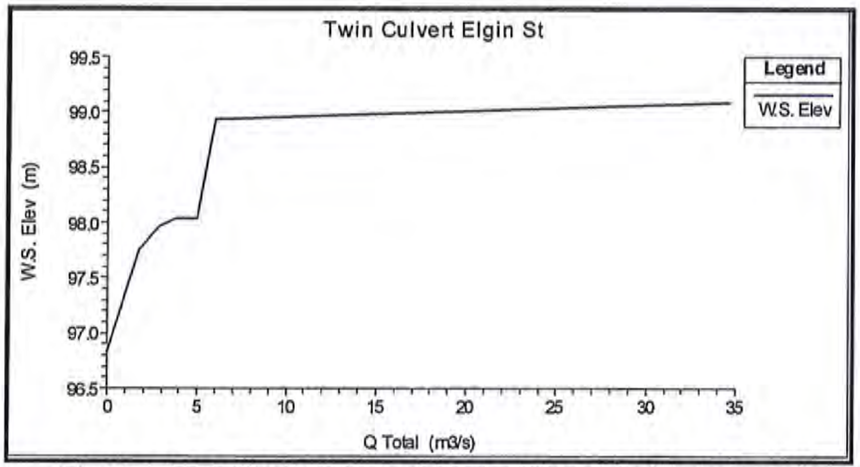


Figure 4: Rating Curve of Elgin Street (with twin culverts)

5.1.2 Flow Target – Capacity of the Division Street crossing

The HEC-RAS rating curve for the Division Street determined that the open channel, unpressurized flow capacity is 3.0m^3/sec, as shown in **Figure 5**. This also corresponds to the 2-year peak flow for existing conditions. Coincidentally, it roughly matches the Elgin Street maximum culvert capacity. The capacity of the culvert immediately before road submergence is 5.1m^3/s.

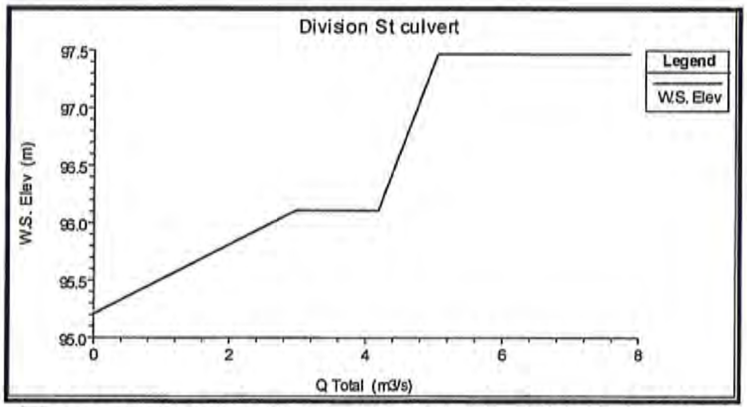


Figure 5: Rating Curve of Division Street Culvert

5.1.3 Recommended Flow Target

Generally, when designing flow control structures, flows of up to the 2 year return period are allowed to move through the system in an uncontrolled manner. This is because in most streams the main channel is defined by the 2 year event. Above the 2 year event, flows naturally exit the channel and move into the flood plain.

In the preliminary design of the Chris Garrett Park pond, the downstream capacities of 3.0m^3/sec, matching both the maximum Elgin Street single culvert and the Division Street culvert capacities, has been set as an initial target. A secondary flow target could be the capacity of Elgin St crossing with the second culvert in operation (3.7m^3/s).

5.2 Off line Pond Preliminary Design

The off-line pond design consists of a stepped bottom ranging from 99.5m to 102m, an ultimate berm height of 102.5m, with 3:1 side slopes. The preliminary design mimicked existing topography by uniformly excavating 0.5m. The peak inflow of 4.6m^3/sec is attenuated to 0.8m^3/sec.

Figure 6 shows the general location of the off-line pond option, while **Figure 7** shows the preliminary grading for the pond. The base for the map is the scanned 1:2000 Ortho imagery rectified to the detailed LIDAR survey of the Town of Cobourg.

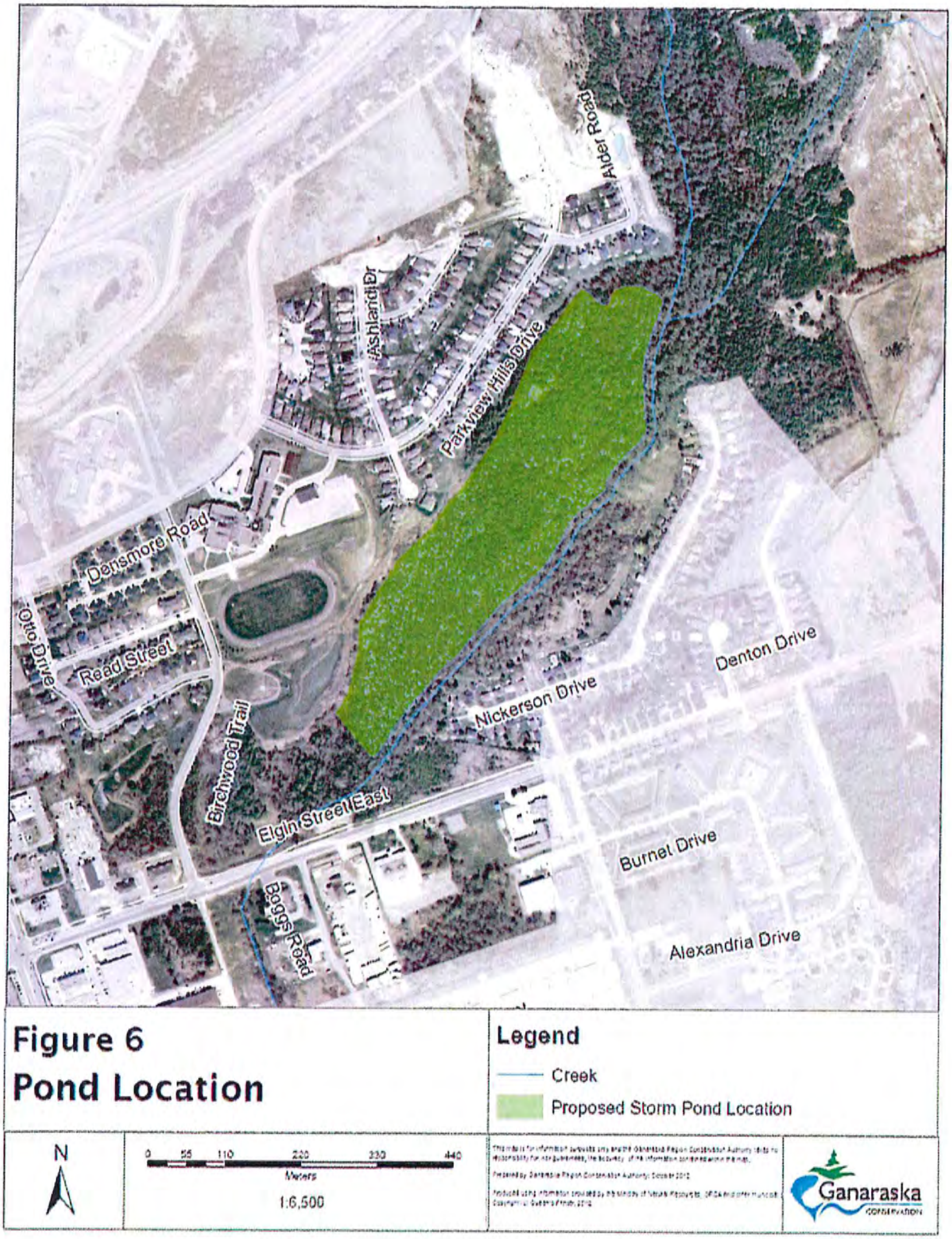


Figure 6
Pond Location

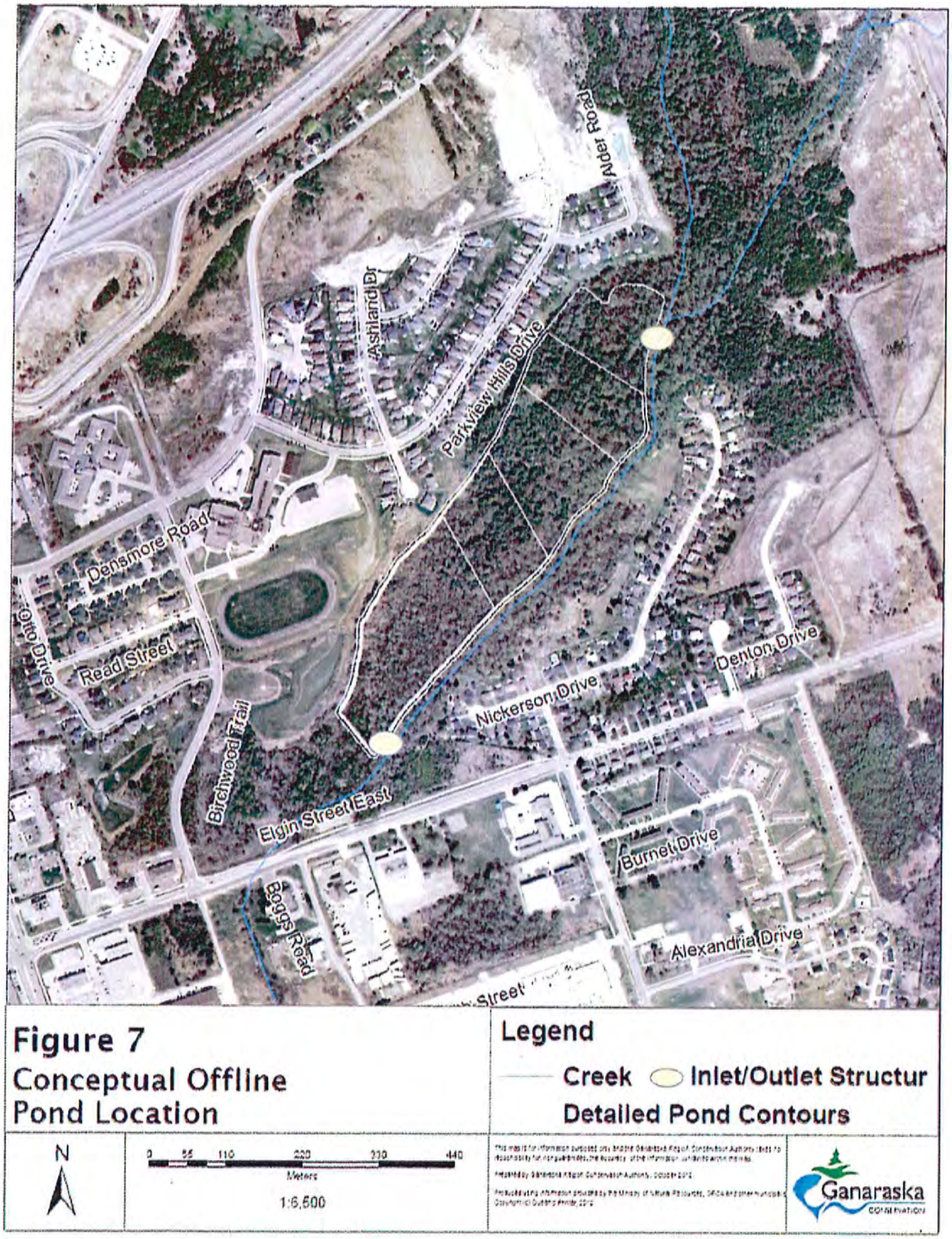


Figure 7
Conceptual Offline Pond Location

The pond's performance is shown in the following tables.

Depth (m)	Volume (Ha-m)	Discharge (m^3/s)
0.0	0.00	0.00
0.5	50,450	0.35
1.0	102,185	0.60
1.5	155,230	0.78
2.0	209,600	0.92
2.5	265,250	1.04
3.0	322,250	1.15

Table 2: Pond Design Rating Curve

Off-Line Pond Flows and Volumes				
Return Period	Flows (m3/s)		% Flow Reduction	Volume Stored (m^3)
	Into Pond	From Pond		
2-year	N/A	N/A	N/A	N/A
5-year	0.98	0.14	86%	5,342
10-year	1.74	0.29	83%	11,216
25-year	2.81	0.54	81%	19,704
50-year	3.72	0.70	81%	27,323
100-year	4.64	0.83	82%	35,828

Table 3: Pond Performance – Outflow and Volumes

With the maximum pond size employed, the best performance achieved was attenuation of the 100-year flow to the existing 10-year peak flow of 3.7m^3/sec at Elgin Street. With the current single culvert configuration under Elgin Street, the road will still experience overtopping. If the second culvert were opened up, the pond would eliminate road overtopping at Elgin Street.

No flow attenuation was realized at the Division Street culvert, even though it is only 600m downstream of the Elgin Street crossing. The highly-impervious commercial area centered on the intersection of Division and Elgin Streets drains to the Division Street culvert with no stormwater controls. As can be seen in **Figure 8**, under existing conditions its runoff has the highest peak flow. **Figure 9** demonstrates that even though the pond in Chris Garrett Park is controlling runoff from the upstream 418Ha rural catchment, the immediate response from the 29Ha commercial catchment negates any flood controls in Chris Garrett Park.

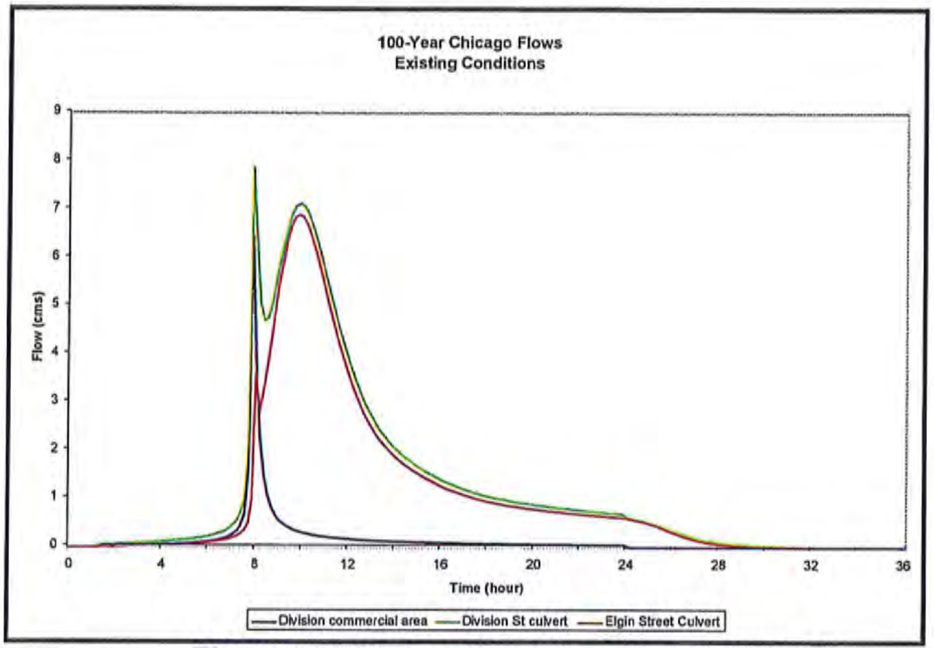


Figure 8: 100-year Flows (existing land use)

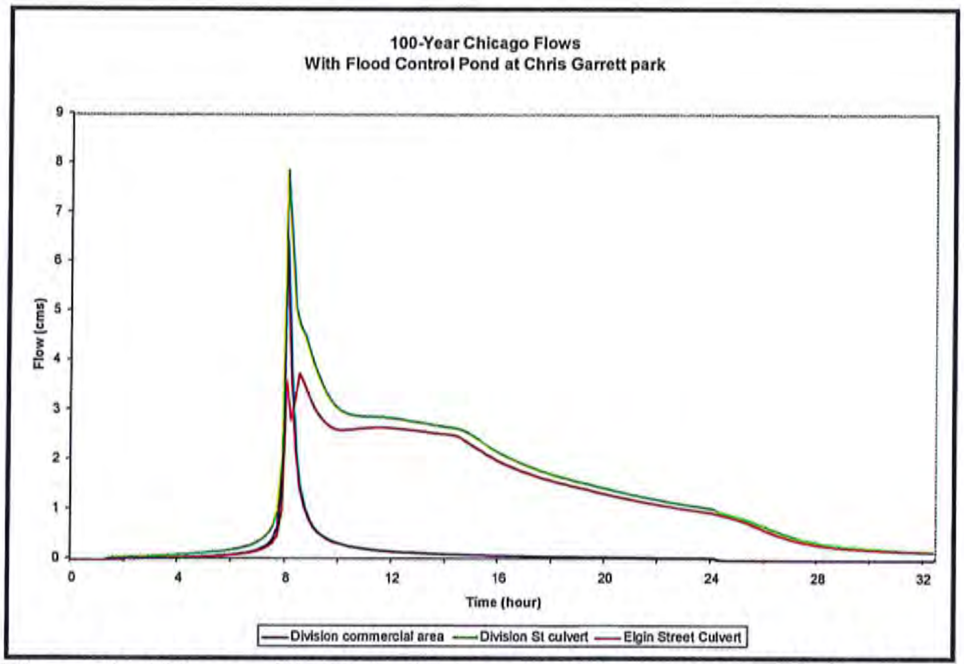


Figure 9: 100-year Flows (with Flood control pond in Chris Garrett Park)

The option of placing a flood control pond in the Chris Garrett Park therefore has limited potential because:

- Doesn't meet flow target at the Division St culvert
- Large excavation required (up to 36,000 m^3)
- Excavation in saturated soil conditions
- Complexity of the diversion structure

The option's benefits are as follows:

- The Elgin St crossing would experience less flooding with the single culvert

The Elgin St crossing would experience no flooding with the twin culverts

6.0 RECOMMENDATIONS:

Further analysis is recommended to determine whether culvert inlet modifications could improve flow capacities and prevent blockage during major events.

It is also recommended that further investigation be carried out for other potential sites for construction of facilities to limit flooding upstream of the Division Street crossing of Midtown Creek.

7.0 CONCLUSIONS AND NEXT STEPS

The proceeding report shows that a flood control structure in Chris Garrett Park will reduce the flooding of the Elgin Street crossing for the 10 year to 100 year return period storms. Downstream of this, at Division Street, the impact is negligible.

The following next steps are recommended:

- Determine from the Town of Cobourg the importance of protecting Elgin Street, as an aid to conclude whether a Chris Garrett park pond is feasible
- Access other locations for siting of a flood control pond. This may involve evaluating other locations upstream to work in concert with a Chris Garrett Park pond or as a stand-alone facility
- Investigate Low Impact Development (LID) options for the commercial/industrial sites within the Elgin-Division intersection, as a possibility of reducing peak flows
- Complete conceptual design analysis of other candidate sites
- Completion of EA process for final site
- Completion of Design and Drawings for final site(s)

8.0 References

1. Midtown Creek Hydraulic Assessment and Flood Plain Mapping Final Report, Greenland Consulting Engineers, March 2008
2. Midtown Creek Hydrology Update Report, Ganaraska Region Conservation Authority, March 2007

Ganaraska Region Conservation Authority
Midtown Creek Fisheries Assessment

Prepared By:
Brian Morrison, B.Sc., Fisheries Biologist
Ganaraska Region Conservation Authority

December 20, 2016

Ganaraska
CONSERVATION

Cobourg
Ontario, Canada

1.0 Fisheries Assessment Background

Midtown Creek is classified as 'coldwater' under the Ontario Ministry of Natural Resources – Peterborough District's Coldwater Streams Strategy, and contain sensitive species such as Brook Trout (*Salvelinus fontinalis*), Rainbow Trout (*Oncorhynchus mykiss*), Mottled Sculpin (*Cottus Bairdii*), and lamprey species (*Lampetra* sp.).

Sampling was conducted by a minimum of two staff from the Ganaraska Region Conservation Authority (GRCA) using the Ontario Stream Assessment Protocol (OSAP) single pass electrofishing module, or spot sampling to determine presence/absence of different fish species. All fish were identified to species, counted, and a total weight per species was collected and used to calculate density (number per m^2) and biomass (weight per m^2) of each species for each sampling location for OSAP sites, or just presence/absence noted. General field conditions were also noted, including dominant stream substrate, and indicators of groundwater inputs into the active channel (e.g., watercress). Fisheries data utilized within this assessment were assimilated from 2003, 2006, 2012, and 2016 with all existing information (2003, 2006, 2012) relative to the assessment undertaken (Figure 1).

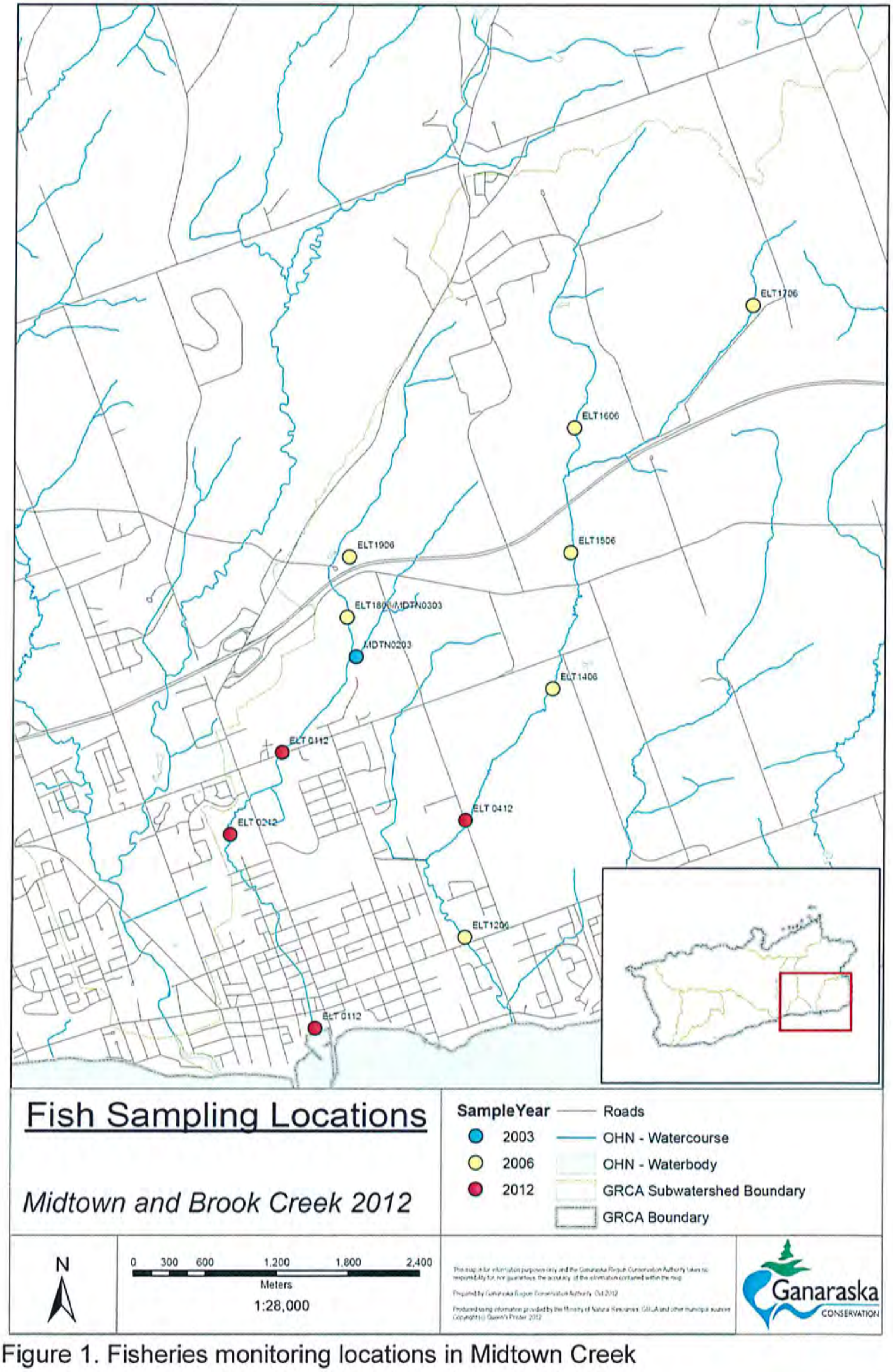


Figure 1. Fisheries monitoring locations in Midtown Creek

1.1 Midtown Creek

Midtown Creek is a small 6.4 km^2 coldwater watercourse. The GRCA had three existing sampling sites on Midtown Creek from 2006, with all three capturing coldwater species. Three additional sites were sampled during the 2012 summer period on Midtown Creek and two additional sites in the fall of 2016 (Figure 1). Brook Trout were captured at five of the eight sites, with Brook Trout being absent at the site at the downstream section of Midtown Creek, below the buried section flowing under downtown Cobourg. Rainbow Trout were captured at six sites, with juveniles captures upstream of the buried section of creek. This indicates that adult Rainbow Trout are capable of migrating upstream through the buried section of Midtown Creek to approximately Highway 401.

ELT 0112

This site is at the downstream extent of Midtown Creek. The site is downstream of a buried section of Midtown Creek, which may preclude upstream passage of certain groups of fish (e.g. cyprinids, centrarchids). The site is characterized as a riffle/pool morphology, with gravel, cobble substrate. Watercress was also present at this site. Coldwater species were captured at this site, including Rainbow Trout, Mottled Sculpin, and Atlantic Salmon (*Salmo salar*). All of the Rainbow Trout captured were young-of-the-year, indicating that there may be poor habitat for age 1+ fish. Two juvenile Atlantic Salmon were captured at the lowest site on Midtown Creek. At this time, it is unknown if these were strays from nearby Cobourg Creek, a stocking location for Atlantic Salmon, or if they were naturally produced within Midtown Creek. In addition to coldwater species, sensitive warmwater species were also present. These include juvenile Smallmouth Bass (*Micropterus dolomieu*) and adult Pumpkinseed (*Lepomis gibbosus*). In addition to the noted fish species, crayfish and tadpoles were also observed at this site. Creek Chub had the highest density (Figure 2), while Creek Chub (*Semotilus atromaculatus*) and Blacknose Dace (*Rhinichthys atratulus*) had the highest biomass (Figure 3) at this site.

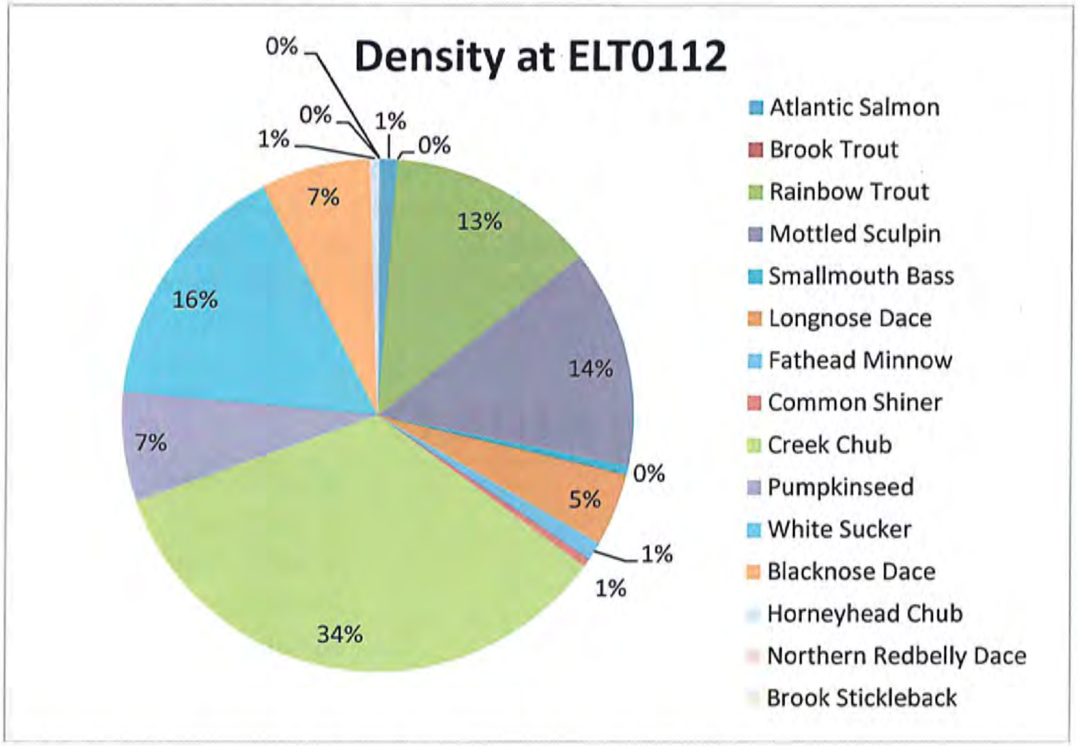


Figure 2. Fish species density (number/m^2) at site ELT 0112

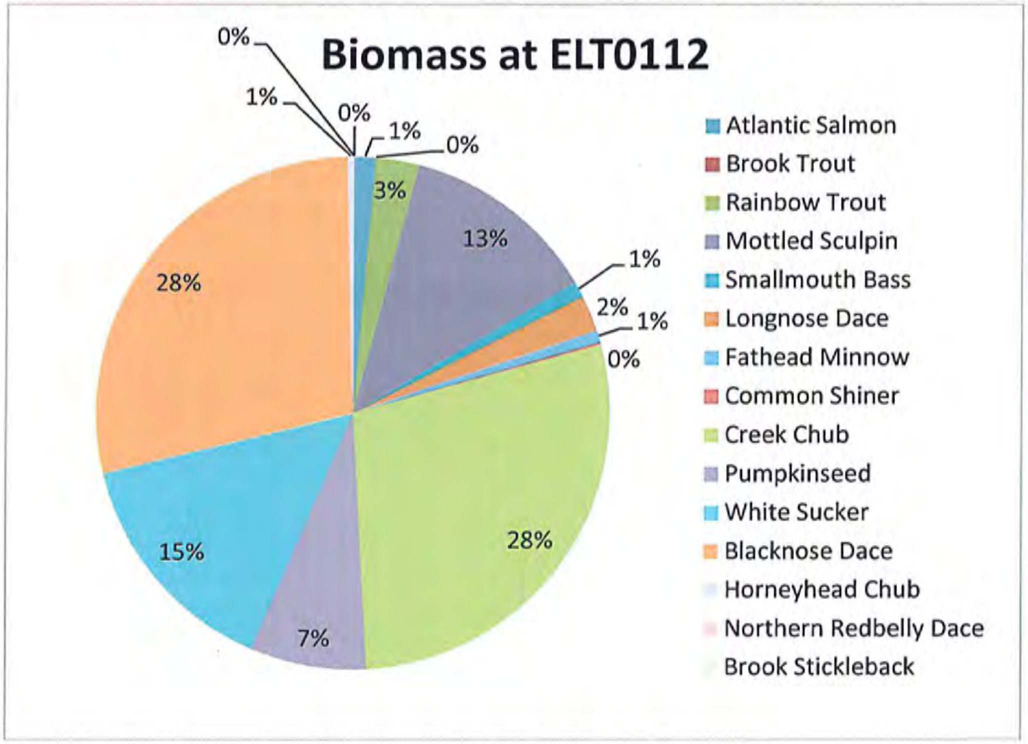


Figure 3. Fish biomass (g/m^2) density at site ELT 0112

ELT 0212

This site is located behind the Canadian Pallet Factory, immediately downstream from a railway line spur. This site is characterized by large amounts of silt, low gradient, and lack of defined riffles, with moderate amounts of woody material within the channel. Watercress was observed upstream from the site. One Brook Trout was captured at this site. The rest of the species captured were tolerant cyprinids, including Fathead Minnow (*Pimephales promelas*), Creek Chub, and Blacknose Dace. Creek Chub had the highest density (Figure 4), while White Sucker had the highest biomass (Figure 5).

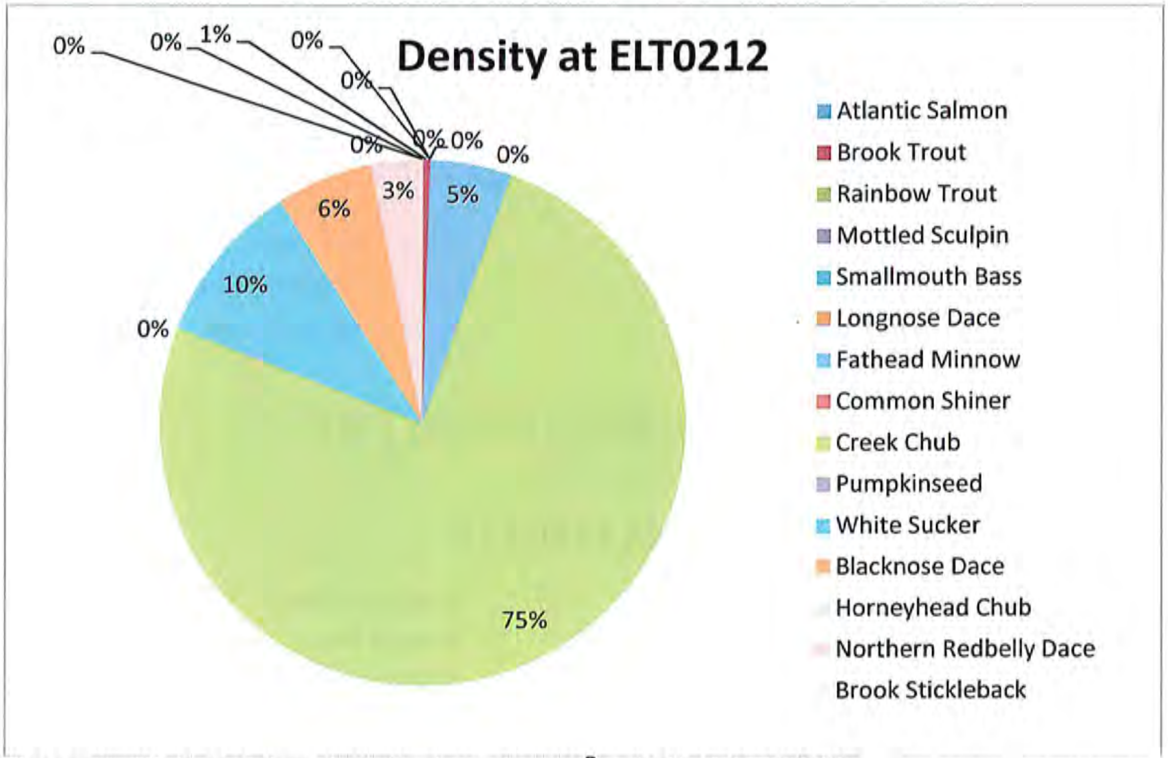


Figure 4. Fish species density (number/m^2) at site ELT 0212

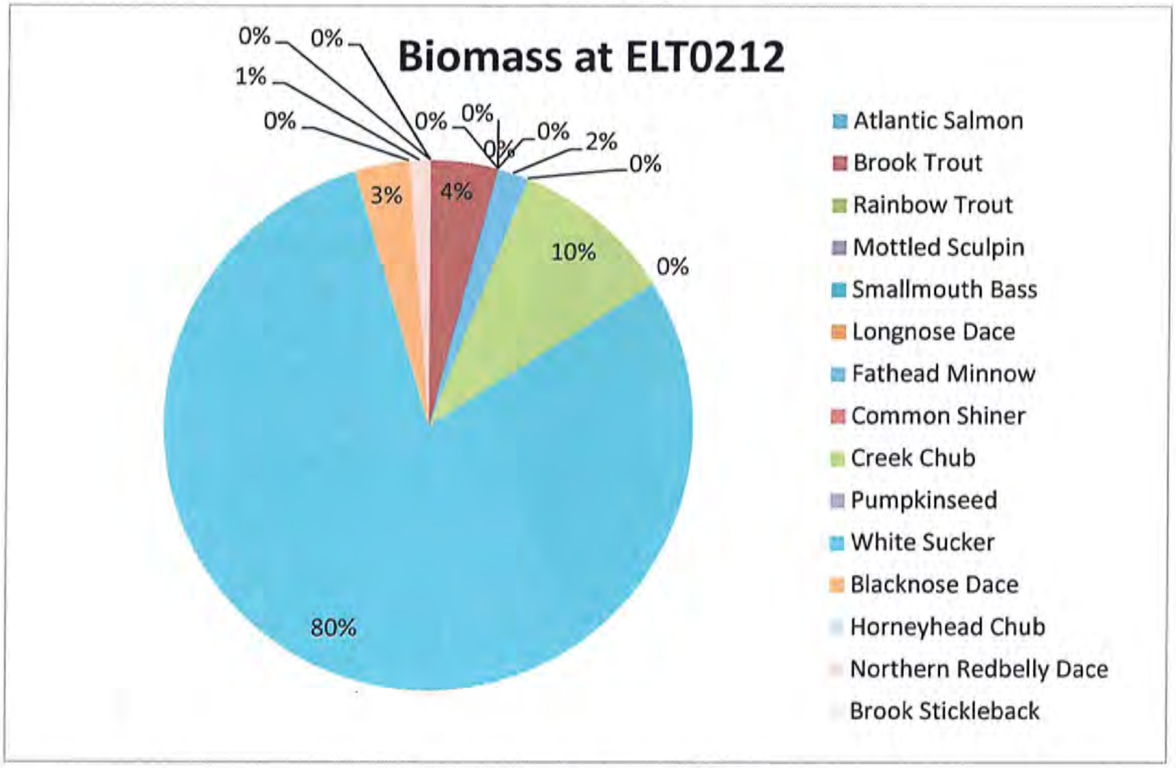


Figure 5. Fish biomass (g/m^2) density at site ELT 0212

ELT 0312

This site is located upstream of Elgin Street. The site is characterized as a riffle/pool morphology, with gravel, sand and silt substrate. Large amounts of watercress are also present at this site. Brook Trout was the dominant species captured at this site, with multiple age classes captured, except young-of-the-year. One age 1+ Rainbow Trout was also captured at this site. Several species of cyprinid were also captured at this site. In addition to these species, one rosy red minnow (*Pimephales promelas*) was captured just downstream from this site, which is a non-native feeder fish aquarium species. Rosy red minnow have also been noted in a stormwater management pond that discharges upstream (east of Birchwood Trail Road) from this sampling location. Frogs were also present at this location. Creek Chub had the highest density at this site (Figure 6), while Brook Trout had the highest biomass (Figure 7).

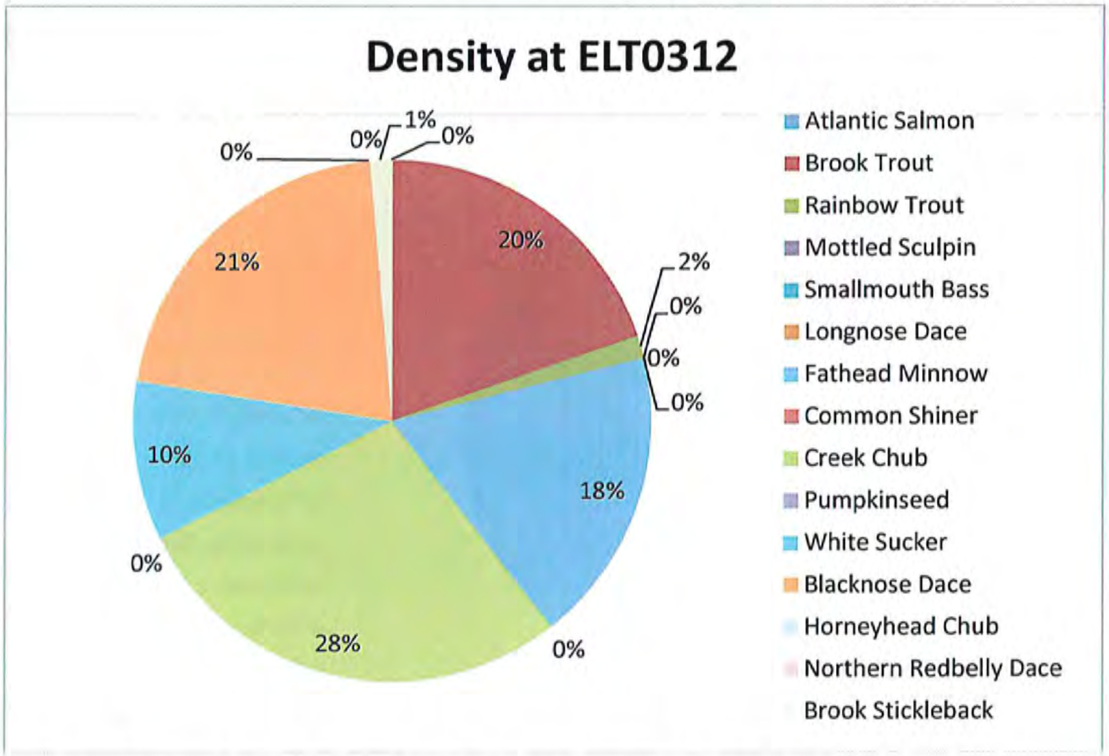


Figure 6. Fish species density (number/m^2) at site ELT 0312

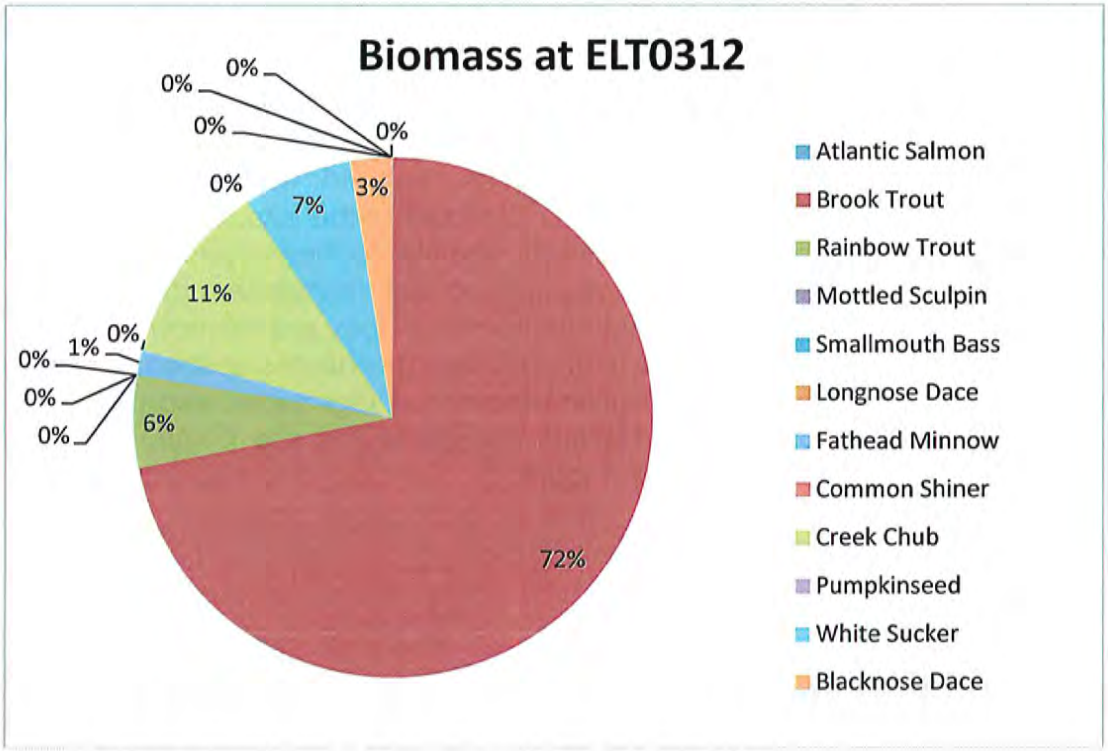


Figure 7. Fish biomass (g/m^2) density at site ELT 0312

2016a

This site is located upstream of Station Street to the unopened allowance at Kerr Street. Creek Chub, Blacknose Dace, White Sucker, and Rainbow Trout were captured at this location. The substrate consisted of a mix of gravel/cobble and sand and silt.

2016b

This site is located upstream of the unopened allowance at Kerr Street to the railway spur behind the Canadian Pallet Factory. Creek Chub, Blacknose Dace, White Sucker, and Rainbow Trout were captured at this location. The substrate consisted primarily of sand and silt, with significant amount of refuse within the channel (e.g. tires, scrap metal, etc.)

Overall, sensitive coldwater species are found throughout Midtown Creek. It is felt that some areas are already showing signs of stress due to degradation of habitat and water quality (e.g. site ELT 0212), and additional stressors may cause the complete loss of coldwater species from these areas, as well as degrade downstream habitats.

The proposed stormwater pond (Figure 8) is located in a well buffered area along Midtown Creek. This areas has aquatic diagnostic indicators of being under stress (high levels of tolerant fish species), but also supports some sensitive coldwater species. This area received urban impacts upstream, which is negatively influencing aquatic community health. The large riparian area helps to buffer these upstream impacts. Additionally, this area serves as a migratory corridor for lake run Rainbow Trout that utilize upstream habitats for spawning and rearing.

It is also noted that existing Stormwater Management Ponds are acting as vectors for the introduction and facilitated colonization of non-native fish species to portions of Midtown Creek (e.g. ponds adjacent Birchwood Trail). Additionally, Midtown Creek has been colonized by juvenile Atlantic Salmon, and is currently acting as a nursery stream. Atlantic Salmon are being actively restored into the Lake Ontario basin and are a priority management species for the Ontario Ministry of Natural Resources and Forestry.

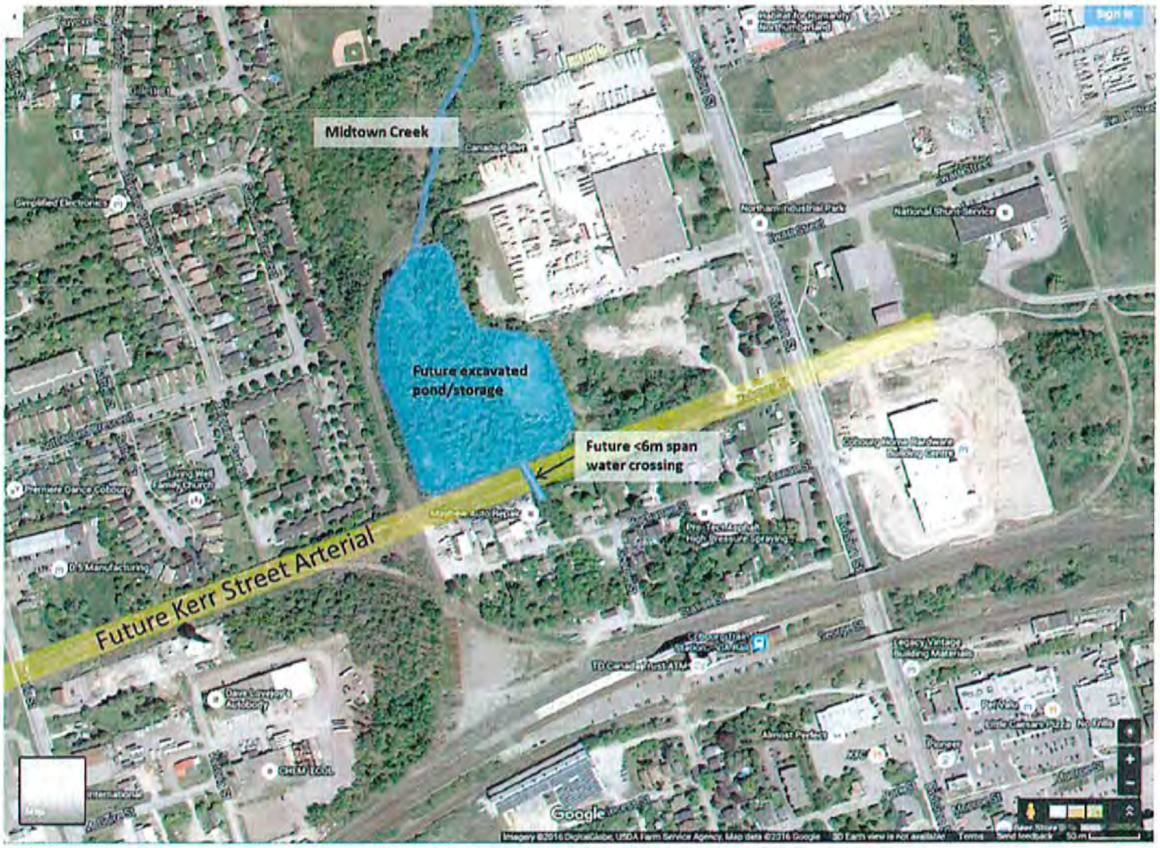


Figure 8. Conceptual Kerr St. Placement and Ponding Area

2.0 Conclusions

The results of this assessment should be taken under consideration when reviewing fisheries considerations against the Midtown Creek flood damage reduction pond conceptual design.

Based upon the assessment undertaken for this report, Midtown Creek is classified as a coldwater watershed, with coldwater species present throughout. The site where the proposed pond is located has undergone degradation, and contains extensive amounts of refuge within the channel and floodplain.

If detailed design work moves forward, and a full environmental assessment required, more detailed information may be required to document and highlight the potential impacts within the plan envelope and receiving waters to fish and aquatic benthic macroinvertebrates. This should also include examining existing and modeled changes to water quality (e.g. thermal regime) and quantity ,to receiving waters, fish passage and fish stranding issues.

Appendix 1: Fish species captured at sampling locations

Site	Species Captured
Midtown Creek	
ELT1806/MDTN0303	Brook Trout, Rainbow Trout, Fathead Minnow, Creek Chub, Blacknose Dace, Brook Stickleback, Lamprey sp.
ELT1906	Brook Trout, Rainbow Trout, Blacknose Dace
MDTN0203	Brook Trout, Creek Chub, Blacknose Dace
ELT 0112	Rainbow Trout, Atlantic Salmon, Mottled Sculpin, Smallmouth Bass, Longnose Dace, Fathead Minnow, Common Shiner, Creek Chub, Pumpkinseed, White Sucker, Blacknose Dace, Hornyhead Chub
ELT 0212	Brook Trout, Fathead Minnow, Creek Chub, White Sucker, Blacknose Dace, Northern Redbelly Dace
ELT 0312	Brook Trout, Rainbow Trout, Fathead Minnow, Creek Chub, White Sucker, Blacknose Dace, Brook Stickleback
2016a	Rainbow Trout, Creek Chub, White Sucker, Blacknose Dace
2016b	Rainbow Trout, Creek Chub, White Sucker, Blacknose Dace

Ganaraska
CONSERVATION

Cobourg
Ontario, Canada

Midtown Creek Terrestrial Ecology Study, 2016

Ken Towle, M.E.S., Terrestrial Ecologist

Background

A flood detention pond is being considered for Midtown Creek north of the railway tracks and just west of the Canada Pallet factory to eliminate chronic flooding in the Buchanan Street and George Street area and to eliminate the threat of flooding of properties and businesses in the flood plain further downstream into the downtown. The detention pond would protect homes and businesses in the Midtown Creek flood plain lands all the way from Canada Pallet south to the harbour including the core downtown area.

The construction of Kerr Street from Westwood Drive to D’Arcy Street is a recommendation in the Town’s Transportation Master Plan to alleviate future east-west traffic congestion. The subject extension of Kerr Street will aid in the construction of flood protection however it is not intended to be completed through to Westwood Drive until traffic demands are warranted.

The construction of the roadway on the existing railway bed with a culvert crossing of Midtown Creek will provide the opportunity to control flood water upstream of Kerr Street that currently flood lands between the CPR/CNR railway corridor and Kerr Street. The scope will include a cross culvert that will control flood waters and excavation of a ponding area upstream of the new road to passively attenuate flows. The environmental assessment and design has to include both elements, the roadway and the pond.

Methods

The site was visited on three occasions during July and August 2016. Fieldwork was restricted to mornings to maximize ability to detect breeding birds and other wildlife. Active searching was the method used to record species. All habitat types were accessed and wildlife identified by sight, sound, or sign (e.g., tracks). The focus was vertebrates, with supplemental, although by no means comprehensive data collected on insects (specifically butterflies) and plant species present.

Species were recorded in a field book as encountered. Where there was uncertainty in plant identification, photos were taken and referred to a professional botanist.

Weather Conditions

Annual weather patterns affect both plant growth and wildlife activity. The summer of 2016 was one of the hottest and driest on record, with temperatures soaring to 30 degrees Celsius or more during site visits. As a result, some wildlife activity may have been reduced, making detection difficult. Some species using the site may therefore not have been recorded. For example, no herpetofauna were detected on the site. Snakes could exist there, but were likely inactive due to the heat, while amphibians may have migrated to other areas in search of pooled water. Because the soils and vegetation would have been altered by the drought conditions, the full extent of the wetland on the site was difficult to determine. In a more typical year higher ground moisture would reflect a more extensive and more diverse community of wetland plants.

Landscape Context of Site

The site can be seen as a core area in a network of habitat corridors through the Town of Cobourg (Figure #1). In this case, from Nickerson’s Woods, down Midtown Creek to the rail line just south of the site, which provides further habitat linkage to the west to Cobourg Creek through to Carr’s Marsh. The Kerr Street arterial corridor supplements this habitat connectivity, creating further linkage to the habitats in Cobourg Conservation Area and south to Cobourg Harbour. Although these linkages are to some degree limited because of major arterial roads such as Elgin Street, Division Street, Ontario Street and William Street, there will nevertheless be movement of some terrestrial species through the network, particularly at night when traffic is at low volume. Species that fly, such as birds and insects, will make full use of the habitat connectivity, and the ecological processes and services they provide, such as pollination and seed dispersal, will follow them.

Figure #1: Habitat corridor network through the Town of Cobourg

Vegetation Communities

Vegetation communities were classified to the most detailed level possible according the Ecological Land Classification (ELC) System for Southern Ontario (Lee et al. 1998). These are presented in Map #1.

The inconsistency of the soil types, combined with the drainage patterns and human disturbance, have influenced the vegetation that has become established. For example, much of the Kerr Street Arterial is made up of sandy soils, and many of the plant species reflect the dry conditions associated with these. In some cases the unnatural soil regime has resulted in corresponding unnatural or “cultural” combinations of vegetation which do not directly match any defined ELC categories.

The largest vegetation community on the site is Fresh-Moist Lowland Deciduous Forest (ELC classification FOD7). This corresponds to the riparian zone of the stream which is subject to flooding. The dominant tree species here are Manitoba Maple (*Acer negundo*) and Crack Willow (*Salix fragilis*) with a dense ground layer dominated by Wild Red Currant (*Ribes triste*) and Tall Meadow Rue (*Thalictrum pubescens*). This community is relatively undisturbed by human activity, likely due to the dense nature of the vegetation.

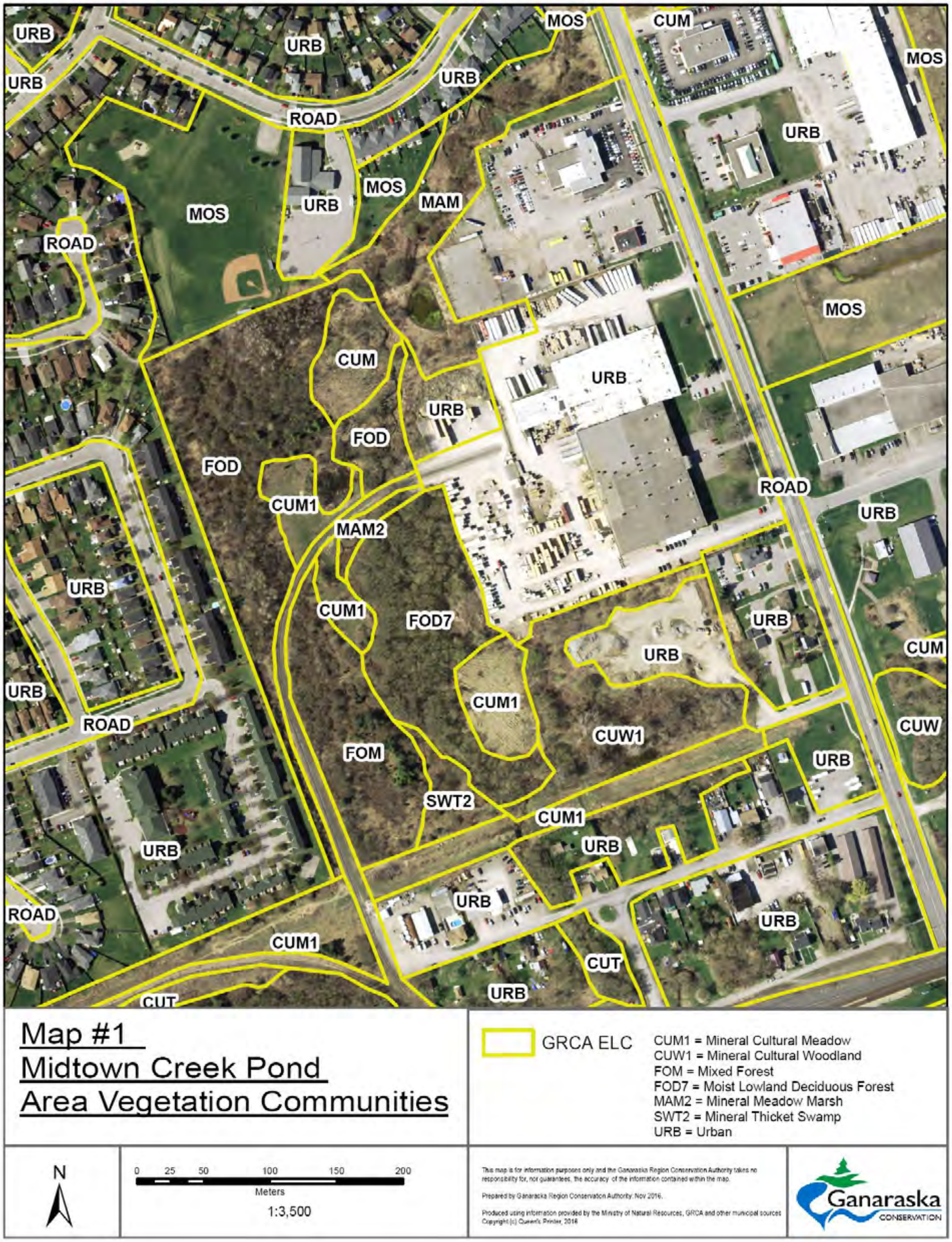
In the south-central portion of the site can be found what can best be defined as a thicket swamp (SWT), although the mix of species in this area does not closely correspond to any defined ELC layer. Dominant shrub species are Red Osier Dogwood (*Cornus serecia*)and Highbush Cranberry (*Viburnum trilobum*), with a herbaceous layer currently dominated by Canada Goldenrod (*Solidago canadensis*), likely due to the 2016 dry conditions, interspersed with moist soil preferring species such as Boneset (*Eupatorium perfoliatum*). This vegetation community is relatively undisturbed.

Bordering the rail spur line is a strip of mixed forest (FOM), which due to its unusual mix of trees might also be classified as cultural woodland. This contains a small area dominated by coniferous trees such as Scotch Pine (*Pinus sivestris*), White Pine (*Pinus strobus*) and White Cedar (*Thuja occidentalis*) which may originally have been deliberately planted. Parts of it have been cut, there is evidence of a fire pit and scattered trash and empty beer cans are present, suggesting that it has been used as a meeting place by local youth. Other parts of this woodland feature more recent successional growth of deciduous tree species such as poplar and Choke Cherry (*Prunus virginiana*).

Between the mixed forest and the lowland deciduous forest, directly south of the spur line, are two small open vegetation communities. One of these is a cultural meadow (CUM) containing a mix of grasses and wildflowers such as Black-eyed Susan (*Rudbeckia hirta*) and Spreading Dogbane (*Apocynum androsaemifolium*), as well as invasive honeysuckle shrubs. Adjacent to this, where the soil contains more loam and is moist, there is a small meadow marsh that features such wet meadow species as Spotted Joe-Pye Weed *Eutrochium maculatum*) and Blue Vervain (*Verbena hastata*). This small wetland area is in good condition, although some Himalayan Balsam (*Impatiens glandulifera*) is present. This invasive plant could spread rapidly throughout the moist area if not removed.

Bordering the south end of the site is the Kerr Street Arterial. This is currently dominated by open cultural meadow (CUM), and because of the sandy soils is extremely dry, as evidenced by the presence of Hoary Vervain (*Verbena stricta*), a species often found in tallgrass prairies. The area is fairly disturbed and contains a large patch of the highly invasive Pale Swallowwort or Dog-strangling Vine (*Cynanchum rossicum*) is located here adjacent to the rail line. Spotted Knapweed (*Centaurea maculosa*), another invasive plant that is typical of sandy areas, was also found here.

On the east side of Midtown Creek, directly south of Canada Pallet yard is another cultural meadow that is surrounded by cultural woodland. This area is noteworthy for the sign of heavy use by coyotes. The woodland itself is dominated by Black Locust (*Robinia pseudoacacia*) and Manitoba Maple (*Acer negundo*), both early successional invasive tree species. A narrow hydro corridor runs north and south through the cultural woodland, and contains considerable trash and wood cuttings. Noteworthy here is the presence of Black Swallowwort (*Cynanchum louiseae*). While still considered invasive, this variety of Dog-strangling Vine is locally uncommon.



Map 1: Vegetation Communities

Species

Six mammal species were recorded on the site, all of which are relatively common. Of particular interest were the hairy-tailed mole and the coyote. The former prefers woodlands with sandy soils and was found dead on the Kerr Street right of way, where these soil conditions are present. Although not seen, signs of coyote were present in the cultural meadow and cultural woodland on the east side of the site. Here, in addition to scat, the skulls and bones of one raccoon and at least two house cats were observed, along with trampled grass and digging in the woodland. These signs indicate that coyotes had a den and were rearing their pups on the site.

A total of 18 bird species were recorded using the site, all of which are likely breeding there given the presence of their required habitat conditions. Common yellowthroat, a warbler that prefers thicket swamps, was observed, indicating the presence of that habitat. Yellow warbler and gray catbird, species that are typical of wetlands and riparian forest were also present, the latter in abundance. Blue gray gnatcatcher, a riparian forest species that has recently been expanding its range to the north, was also recorded.

No amphibians were recorded at the site. This may have been due to the extreme heat and dry conditions. These animals may have been taking shelter or had moved on in search of standing water.

One reptile species, a Northern Redbelly Snake (*Storeria occipitomaculata*) was observed on the site by GRCA staff. This is a common species within the province, and it is often found in natural features within urban areas.

Twelve species of butterflies were recorded during the field surveys. Of these the Monarch is worthy of mention due to its status as a species at risk. However, although milkweed was present on site, there was no evidence that the species is breeding here.

Conclusions

Although there is a high diversity of vegetation community types on the site, none of these is significant with respect to rarity. Most of the relatively natural woodland is early successional, and some is highly disturbed. The remainder is cultural woodland dominated by invasive tree species. The open areas are cultural meadow and highly disturbed.

The wetland communities on the site, specifically the meadow marsh and the thicket swamp, are of higher quality, and are dominated by a greater diversity of native plant species. These communities provide the highest wildlife values in that they support the most sensitive and habitat-specialist plant and vertebrate species.

With the exception of the Monarch, none of the species recorded on the site is provincially significant. The Monarch is listed as a “special concern” species; however there was no evidence of breeding on the site, and given the time of year the adult observed was likely a migrant. All other species can be considered fairly common to abundant. However, it should be emphasized that the 2016 field season was exceptionally hot and dry, restricting some wildlife activity. There are undoubtedly other species of insects, breeding birds, and possibly breeding amphibians that were not detected. It is therefore recommended that further fieldwork be undertaken in the Spring and early summer should the opportunity arise.

The landscape context of the natural features on this site essentially provides a core habitat function within a network of other natural features partially linked by habitat corridors and running all the way through the Town of Cobourg. The area provides a refuge within an otherwise urban landscape for some sensitive wildlife species and the diversity of wildflowers supports many insect pollinators. Although the connectivity function for some species may be restricted by roads, it is nevertheless present for many. Any actions taken at the site should take into consideration this core area function for biodiversity and the potential to improve it, as well as recreational and aesthetic values such a future greenway might provide.

Midtown Creek Study Area Species Lists

Mammals

Hairy-tailed Mole (*Parascaclops breweri*)
Eastern Cottontail (*Sylvilagus floridanus*)
Eastern Chipmunk (*Tamias striatus*)
Eastern Gray Squirrel (*Sciurus carolinensis*)
Coyote (*Canis latrans*)
Common Raccoon (*Procyon lotor*)

Birds

Mourning Dove (*Zeneida macroura*)
Northern Flicker (*Colaptes auratus*)
Downy Woodpecker (*Picoides pubescens*)
Red-eyed Vireo (*Vireo olivaceus*)
Warbling Vireo (*Vireo gilvus*)
Blue Jay (*Cyanocitta cristata*)
American Crow (*Corvus brachyrhynchos*)
Black-capped Chickadee (*Poecile atricapillus*)
House Wren (*Troglodytes aedon*)
Blue-gray Gnatcatcher (*Polioptila nigriceps*)
American Robin (*Turdus migratorius*)
Gray Catbird (*Dumetella carolinensis*)
Yellow Warbler (*Setophaga petechia*)
Common Yellowthroat (*Geothlypis trichas*)
Song Sparrow (*Melospiza melodia*)
Northern Cardinal (*Cardinalis cardinalis*)
Common Grackle (*Quiscalus quiscula*)
American Goldfinch (*Carduelis tristis*)

Butterflies

Black Swallowtail (Papilio polyxenes)
Clouded Sulphur (Colias philodice)
European Cabbage (Pieris rapae)
Summer Azure (*Celastrina neglecta*)
Monarch (Danaus plexippus)
Northern Crescent (Phyciodes cocyta)
Common Ringlet (Coenonympha tullia)
Common Wood Nymph (Cercyonis pegala)
Silver-spotted Skipper (Epargyreus clarus)
Juvenal's Duskywing (Erynnis juvenalis)

Wild Indigo Duskywing (Erynnis baptisiae)
Dun Skipper (Euphyes vestries)

Plants

Trees, Shrubs and Vines
Eastern White Pine (*Pinus strobus*)
Scots Pine (*Pinus sylvestris*)
Northern White Cedar (*Thuja occidentalis*)
Eastern Redcedar (*Juniperus virginiana*)
Green Ash (*Fraxinus pennsylvanica*)
Manitoba Maple (*Acer negundo*)*
Sugar Maple (*Acer saccharum*)
Norway Maple (*Acer platanoides*)*
Trembling Aspen (*Populus tremuloides*)
European White Poplar (*Populus alba*)*
European White Birch (*Butula pendula*)
Black Locust (*Robinia pseudoacacia*)*
Common Blackberry (*Rubus allegheniensis*)
Wild Red Currant (*Ribes triste*)
Red Osier Dogwood (*Cornus stolonifera*)
Gray Dogwood (*Cornus racemosa*)
European Buckthorn (*Rhamnus cathartica*)*
Staghorn Sumac (*Rhus typhina*)
Choke Cherry (*Prunus vi rginiana*)
Slippery Elm (*Ulmus rubra*)
Crack Willow (*Salix fragilis*)
Tartarian Honeysuckle (*Lonicera tartarica*)*
Poison Ivy (*Rhus radicans*)
Riverbank Grape (*Vitis riparia*)
Virginia Creeper (*Parthenocissus vitacea*)
Highbush Cranberry (*Viburnum trilobum*)

Herbaceous Plants
Narrow-leaved Cattail (*Typha angustifolia*)
Queen Anne's Lace (*Daucus carota*)
Wild Parsnip (*Pastinaca sativa*)*
Spreading Dogbane (*Apocynum androsaemfolium*)
Common Milkweed (*Asclepias syriaca*)
Pale Swallowwort (*Cynanchum rossicum*)*
Black Swallowwort (*Cynanchum nigrum*)*
Stoneseed (*Lithospermum officinale*)
Common Yarrow (*Achillia millefolium*)
Common Ragweed (*Ambrosia artemisiifolia*)
Common Burdock (*Arctium minus*)
Tall Wormwood (*Artemisia campestris*)

Chicory (*Chichorium intybus*)
Canada Thistle (*Cirsium arvense*)*
Horseweed (*Conyza canadensis*)
Philadelphia Fleabane (*Erigeron philedelphicus*)
Creeping Bellflower (*Campanula rapunculoides*)
Spotted Joe-Pye-Weed (*Eupatorium maculatum*)
Boneset (*Eupatorium perfoliatum*)
Black-eyed Susan (*Rudbeckia hirta*)
Canada Goldenrod (*Soldago canadensis*)
Gray Goldenrod (*Solidago nemoralis*)
New England Aster (*Symphyotrichum novae-angliae*)
Spotted Knapweed (*Centaurea maculosa*)*
Field Sow Thistle (*Sonchus arvensis*)
Common Tansy (*Tanacetum vulgare*)
Common Dandelion (*Taraxacum officinal*)
Spotted Jewelweed (*Impatiens capensis*)
Himalayan Balsam (*Impatiens glandulifera*)*
Viper's Bugloss (*Echium vulgare*)
Bouncing Bet (*Saponaria officinalis*)
Wild Cucumber (*Echinocystis lobata*)
Birdsfoot Trefoil (*Lotus corniculata*)
White Sweet Clover (*Melilotus alba*)*
Cow Vetch (*Vicia cracca*)
Common St. John's Wort (*Hypericum perforatum*)
Heal-All (*Prunella vulgaris*)
Purple Loosestrife (*Lythrum salicaria*)*
Common Plantain (*Plantago major*)
Japanese Knotweed (*Polygonum cuspidatum*)*
Canada Anenome (*Anenome canadensis*)
Thimbleweed (*Anenome virginiana*)
Virgin's Bower (*Clamatis virginiana*)
Tall Meadow Rue (*Thalictrum pubescens*)
Silverweed (*Potentilla anserine*)
Rough Cinquefoil (*Potentilla recta*)
Common Mullein (*Verbascum thapsus*)
Bittersweet Nightshade (*Solanum dulcamara*)
Blue Vervain (*Verbena hastata*)
Hoary Vervain (*Verbena stricta*)

*Invasive species

Appendix E

Archaeology Study Report

Celebrating
20
YEARS
of Service Excellence
1996-2016

1.0 PROJECT REPORT COVER PAGE

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PROJECT INFORMATION:

Corporate Project Number: 17286
MTCS Project Number: P058-1557-2017
Investigation Type: Stage 1-2 Archaeological Property Assessment
Project Name: Midtown Pond.
Project Location: Part of Lot 17, Concession A (Geographic Township of Hamilton, County of Northumberland) Town of Coburg, County of Northumberland
Project Designation Number: Not Currently Available

MTCS FILING INFORMATION:

Site Record/Update Form(s): N/A
Date of Report Filing: TBD
Type of Report: **ORIGINAL**

2.0 EXECUTIVE SUMMARY

This report describes the results of the 2017 Stage 1-2 Archaeological Assessment of Part of Lot 17, Concession A (Geographic Township of Hamilton, County of Northumberland) Town of Coburg, County of Northumberland, conducted by AMICK Consultants Limited. This study was conducted under Professional Archaeologist License #P058 issued to Michael B. Henry by the Minister of Tourism, Culture and Sport for the Province of Ontario. This assessment was undertaken to support a Municipal Class EA. Within the land use planning and development context, Ontario Regulation 544/06 under the Planning Act (1990b) requires an evaluation of archaeological potential and, where applicable, an archaeological assessment report completed by an archaeologist licensed by the Ministry of Tourism, Culture and Sport (MTCS). Policy 2.6 of the Provincial Policy Statement (PPS 2014) addresses archaeological resources. All work was conducted in conformity with Ontario Ministry of Tourism and Culture (MTC) Standards and Guidelines for Consultant Archaeologists (MTC 2011), the Ontario Heritage Act (RSO 1990a).

AMICK Consultants Limited was engaged by the proponent to undertake a Stage 1-2 Archaeological Assessment of lands potentially affected by the proposed undertaking and was granted permission to carry out archaeological fieldwork. The entirety of the study area was subject to property inspection and photographic documentation concurrently with the Stage 2 Property Assessment high intensity test pit methodology at a five-metre interval between individual test pits, and by test pit survey at a ten metre interval to confirm disturbance on 25 June, 23 and 26 September 2017. All records, documentation, field notes, photographs and artifacts (as applicable) related to the conduct and findings of these investigations are held at the Lakelands District corporate offices of AMICK Consultants Limited until such time that they can be transferred to an agency or institution approved by the Ontario Ministry of Tourism, Culture and Sport (MTCS) on behalf of the government and citizens of Ontario.

As a result of the Stage 2 Property Assessment of the study area, no archaeological resources were encountered. Consequently, the following recommendations are made:

1. *No further archaeological assessment of the study area is warranted;*
2. *The Provincial interest in archaeological resources with respect to the proposed undertaking has been addressed;*
3. *The proposed undertaking is clear of any archaeological concern.*

3.0 TABLE OF CONTENTS

4.0 PROJECT PERSONNEL

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5.0 PROJECT CONTEXT

5.1 DEVELOPMENT CONTEXT

This report describes the results of the 2017 Stage 1-2 Archaeological Assessment of Part of Lot 17, Concession A (Geographic Township of Hamilton, County of Northumberland) Town of Coburg, County of Northumberland, conducted by AMICK Consultants Limited. This study was conducted under Professional Archaeologist License #P058 issued to Michael B. Henry by the Minister of Tourism, Culture and Sport for the Province of Ontario. This assessment was undertaken to support a Municipal Class EA. Within the land use planning and development context, Ontario Regulation 544/06 under the Planning Act (1990b) requires an evaluation of archaeological potential and, where applicable, an archaeological assessment report completed by an archaeologist licensed by the Ministry of Tourism, Culture and Sport (MTCS). Policy 2.6 of the Provincial Policy Statement (PPS 2014) addresses archaeological resources. All work was conducted in conformity with Ontario Ministry of Tourism and Culture (MTC) Standards and Guidelines for Consultant Archaeologists (MTC 2011), the Ontario Heritage Act (RSO 1990a).

AMICK Consultants Limited was engaged by the proponent to undertake a Stage 1-2 Archaeological Assessment of lands potentially affected by the proposed undertaking and was granted permission to carry out archaeological fieldwork. The entirety of the study area was subject to property inspection and photographic documentation concurrently with the Stage 2 Property Assessment high intensity test pit methodology at a five-metre interval between individual test pits and by test pit survey at a ten metre interval to confirm disturbance on 25 June, 23 and 26 September 2017. All records, documentation, field notes, photographs and artifacts (as applicable) related to the conduct and findings of these investigations are held at the Lakelands District corporate offices of AMICK Consultants Limited until such time that they can be transferred to an agency or institution approved by the Ontario Ministry of Tourism, Culture and Sport (MTCS) on behalf of the government and citizens of Ontario.

The proposed development of the study area includes a future pond and road extension. A preliminary plan of the proposed development has been submitted together with this report to MTCS for review and reproduced within this report as Map 3.

5.2 HISTORICAL CONTEXT

5.2.1 GENERAL HISTORICAL OUTLINE

The United Counties of Northumberland and Durham were established in 1849 and was originally called Newcastle District (ontariogenealogy.com 2010). In 1973, the county was divided into 2 Northumberland and Durham. The township of Hamilton was officially became a township within Upper Canada by Lieutenant-Governor John Graves Simcoe in

1791. Many of the first settlers within the township were from America. Cobourg is situated with the township of Hamilton and is the county town of Northumberland (Milne 2010).

The town of Cobourg was first settled in the 1790's predominately by United Empire Loyalist. By 1827 the town had grown significantly and consisted of 40 residences, 2 inns, stores and several industries such as distilleries and a grist mill. A large part of the development of Cobourg is due to its location on Lake Ontario, by 1832 the construction of the harbour was complete and included 2 piers. The harbour resulted in massive immigration from the U.K. this area would become a thriving centre of administration, education and commerce. Cobourg's leaders originally thought that linking the railway to the harbour would open up markets and eventually they would have as much influence as Toronto or Kingston. Unfortunately due to the location of Rice Lake it was not feasible to connect Cobourg to Peterborough. By 1860's Cobourg saw a significant decline in its' growth, this was due to the failed railway, municipal debt and a province wide economic depression. Eventually settling on being a tourist destination for Americans in the summer (Cobourghistory.ca).

Map 2 is a facsimile segment of the Township of Hamilton map reproduced from The Illustrated Historical Atlas of the Counties of Northumberland and Durham, Ont. (H. Belden & Co. 1878). Map 2 illustrates the location of the study area and environs as of 1878. The study area is shown to be within the town of Coburg; historic roads run through the study area and adjacent to its eastern boundary. The roads within the study area no longer exist but the road adjacent to the east boundary is the current Division Street. In addition, a historic railway corridor ran adjacent to the western boundary of the study area. This demonstrates that the original property of which the study area is a part was settled by the time that the atlas data was compiled. Accordingly, it has been determined that there is potential for archaeological deposits related to early Post-contact settlement within the study area.

It must be borne in mind that inclusion of names of property owners and depictions of structures within properties on these maps were sold by subscription. While information included within these maps may provide information about occupation of the property at a specific point in time, the absence of such information does not indicate that the property was not occupied.

5.2.2 CURRENT CONDITIONS

The present use of the study area is as vacant and overgrown land. The study area is roughly 4.65 hectares in area and is roughly "L" shaped. The study area includes within it mostly woodlot. There is a seasonally low-lying and wet area extending from the northern boundary to the centre of the study area. This area was wet and not viable to assess during the initial visit to the property. However, later in the year this area, as well as seasonal stream channels flowing through the study area through the larger low-lying wet area, was completely dry. The seasonal streams enter the south edge of the study west of the centre of the south property edge and converge approximately 60 metres to the north of the southern boundary; From here one stream channel flows northward and nearly to the north edge where it abruptly turns eastward before exiting the study area near the northeast corner of the property. There are two large patches of disturbed land, one extending the entire length of the southern boundary, and the second extending along nearly the entire eastern boundary of the upper arm of the "L". These areas are open meadowlands. The southern half of the area along the eastern boundary of the study area has been stripped of topsoil in the past. The southern disturbed area appears to be a former railway corridor, which is now a hydro corridor. The remainder of the study area surrounding the above-described features is woodlot. The study area is bounded on the north by empty lot and the railway corridor, on the east by vacant lot, a commercial property and Division Street, on the west by the railway corridor and on the south by commercial properties. The study area is adjacent to the intersection of Division Street and Coburg Street. A plan of the study area is included within this report as Map 3. Current conditions encountered during the Stage 1-2 Property Assessment are illustrated in Maps 4 & 5.

5.2.3 SUMMARY OF HISTORICAL CONTEXT

The brief overview of documentary evidence readily available indicates that the study area is situated within an area that was close to the historic transportation routes, close to historic railway corridors, and in an area well populated during the nineteenth century and as such has potential for sites relating to early Post-contact settlement in the region. Background research indicates the property has potential for significant archaeological resources of Native origins based on proximity to a natural source of potable water in the past.

5.3 ARCHAEOLOGICAL CONTEXT

The Archaeological Sites Database administered by the Ministry of Tourism, Culture and Sport (MTCS) indicates that there are four (4) previously documented sites within 1 kilometre of the study area. However, it must be noted that this is based on the assumption of the accuracy of information compiled from numerous researchers using different methodologies over many years. AMICK Consultants Limited assumes no responsibility for the accuracy of site descriptions, interpretations such as cultural affiliation, or location information derived from the Archaeological Sites Database administered by MTCS. In addition, it must also be noted that a lack of formerly documented sites does not indicate that there are no sites present as the documentation of any archaeological site is contingent upon prior research having been conducted within the study area.

On the basis of information supplied by MTCS, no archaeological assessments have been conducted within 50 metres of the study area. AMICK Consultants Limited assumes no responsibility for the accuracy of previous assessments, interpretations such as cultural affiliation, or location information derived from the Archaeological Sites Database administered by MTCS. In addition, it must also be noted that the lack of formerly documented previous assessments does not indicate that no assessments have been conducted.

Data contained in previous archaeological reports in close proximity to the study area that is relevant to Stage 1 Background Study is defined within the Standards and Guidelines for Consultant Archaeologists in Section 7.5.8 Standard 4 as follows:

> *"Provide descriptions of previous archaeological fieldwork carried out within the limits of, or immediately adjacent to the project area,* ***as documented by all available reports that include archaeological fieldwork carried out on the lands to be impacted by this project, or where reports document archaeological sites immediately adjacent (i.e., within 50 m) to those lands****."*
>
> (MTCS 2011: 126 Emphasis Added)

In accordance with data supplied by MTCS for the purposes of completing this study, there are no previous reports detailing, *"archaeological fieldwork carried out on the lands to be impacted by this project"*, nor do any previous reports document known archaeological sites within 50 metres of the study area.

The Standards and Guidelines for Consultant Archaeologists stipulates that the necessity to summarize the results of previous archaeological assessment reports, or to cite MTCS File Numbers in references to other archaeological reports, is reserved for reports that are directly relevant to the fieldwork and recommendations for the study area (S & Gs 7.5.7, Standard 2, MTC 2011: 125). This is further refined and elaborated upon in Section 7.5.8, Standards 4 & 5, MTC 2011:

> *"4. Provide descriptions of previous archaeological fieldwork carried out within the limits of, or immediately adjacent to the project area, as documented by all available* ***reports that include archaeological fieldwork carried out on the lands to be impacted by this project****,* ***or where reports document archaeological sites immediately adjacent (i.e., within 50m) to those lands."***
>
> *"5.* ***If previous findings and recommendations are relevant*** *to the current stage of work, provide the following:*
>
> a. *a brief summary of previous findings and recommendations*
> b. *documentation of any differences in the current work from the previously recommended work*
> c. *rationale for the differences from the previously recommended work"*
>
> ***(Emphasis Added)***

The study area is situated in area for which there is no archaeological master plan.

It must be further noted that there are no relevant plaques associated with the study area.

5.3.1 PRE-CONTACT REGISTERED SITES

A summary of registered and/or known archaeological sites within a 1-kilometre radius of the study area was gathered from the Archaeological Sites Database, administered by MTCS. As a result it was determined that three (3) archaeological sites relating directly to Pre-contact habitation/activity had been formally registered within the immediate vicinity of the study area. However, the lack of formally documented archaeological sites does not mean that Pre-contact people did not use the area; it more likely reflects a lack of systematic archaeological research in the immediate vicinity. Even in cases where one or more assessments may have been conducted in close proximity to a proposed landscape alteration, an extensive area of physical archaeological assessment coverage is required throughout the region to produce a representative sample of all potentially available archaeological data in order to provide any meaningful evidence to construct a pattern of land use and settlement in the past. One (1) of these sites (AlGn-17) is a multi-component sites listed as both a Pre-contact and Post-contact site. All previously registered Pre-contact sites are briefly described below in Table 1:

TABLE 1 PRE-CONTACT SITES WITHIN 1KM

Site Name	**Borden #**	**Site Type**	**Cultural Affiliation**
Bayne	AlGm-1	Not Determined	Other
Macklin	AlGn-17	Not Determined	Late Archaic
Pre Contact 1	AlGn-31	Not Determined	Indeterminate

None of the above noted archaeological sites are situated within 300 metres of the study area. Therefore, they have no impact on determinations of archaeological potential for further archaeological resources related to Pre-contact activity and occupation with respect to the archaeological assessment of the proposed undertaking.

The study area has an unnamed stream running through it, which is a source of potable water. The distance to water criteria used to establish potential for archaeological sites suggests potential for Pre-contact occupation and land use in the area in the past.

Table 2 illustrates the chronological development of cultures within southern Ontario prior to the arrival of European cultures to the area at the beginning of the 17th century. This general cultural outline is based on archaeological data and represents a synthesis and summary of research over a long period of time. It is necessarily generalizing and is not necessarily representative of the point of view of all researchers or stakeholders. It is offered here as a rough guideline and outline to illustrate the relationships of broad cultural groups and time periods.

TABLE 2 PRE-CONTACT CULTURAL CHRONOLOGY FOR SOUTHERN ONTARIO

Years ago	**Period**	**Southern Ontario**
250	Terminal Woodland	Ontario and St. Lawrence Iroquois Cultures
1000 2000	Initial Woodland	Princess Point, Saugeen, Point Peninsula, and Meadowood Cultures
3000		

4000 5000 6000	Archaic	Laurentian Culture
7000 8000 9000 10000 11000	Palaeo-Indian	Plano and Clovis Cultures
		(Wright 1972)

5.3.2 POST-CONTACT REGISTERED SITES

A summary of registered and/or known archaeological sites within a 1-kilometre radius of the study area was gathered from the Archaeological Sites Database, administered by MTCS. As a result it was determined that two (2) archaeological sites relating directly to Post-contact habitation/activity had been formally registered within the immediate vicinity of the study area. One (1) of these sites (AlGn-17) is a multi-component site listed as both a Pre-contact and Post-contact site. All previously registered Post-contact sites are briefly described below in Table 3:

TABLE 3 POST-CONTACT SITES WITHIN 1KM

Site Name	**Borden #**	**Site Type**	**Cultural Affiliation**
Macklin	AlGn-17	Not Determined	Post-Contact
St. Peter’s Cemetery	AlGn-19	Not Determined	Post-Contact

None of the above noted archaeological sites are situated within 300 metres of the study area. Therefore, they have no impact on determinations of archaeological potential for further archaeological resources related to Post-contact activity and occupation with respect to the archaeological assessment of the proposed undertaking.

5.3.3 LOCATION AND CURRENT CONDITIONS

The study area is described as Part of Lot 17, Concession A (Geographic Township of Hamilton, County of Northumberland) Town of Coburg, County of Northumberland. This assessment was undertaken to support a Municipal Class EA.

The present use of the study area is as vacant and overgrown land. The study area is roughly 4.65 hectares in area and is roughly “L” shaped. The study area includes within it mostly woodlot. There is a seasonally low-lying and wet area extending from the northern boundary to the centre of the study area. This area was wet and not viable to assess during the initial visit to the property. However, later in the year this area, as well as seasonal stream channels flowing through the study area through the larger low-lying wet area, was completely dry. The seasonal streams enter the south edge of the study west of the centre of the south property edge and converge approximately 60 metres to the north of the southern boundary; From here one stream channel flows northward and nearly to the north edge where it abruptly turns eastward before exiting the study area near the northeast corner of the property. There are two large patches of disturbed land, one extending the entire length of the southern boundary, and the second extending along nearly the entire eastern boundary of the upper arm of the "L". These areas are open meadowlands. The southern half of the area along the eastern boundary of the study area has been stripped of topsoil in the past. The southern disturbed area appears to be a former railway corridor, which is now a hydro corridor. The remainder of the study area surrounding the above-described features is woodlot. The study area is bounded on the north by empty lot and the railway corridor, on the east by vacant lot, a commercial property and Division Street, on the west by the railway corridor and on the south by commercial properties. The study area is adjacent to the intersection of Division Street and Coburg Street. A plan of the study area is included within this report as Map 3. Current conditions encountered during the Stage 1-2 Property Assessment are illustrated in Maps 4 & 5.

5.3.4 PHYSIOGRAPHIC REGION

The study area is located in the Iroquois Plain, which is located on the lowland bordering Lake Ontario. This area used to be under Lake Iroquois and the old shorelines can easily be identified based on unique features such as cliffs, beaches, bars and boulder pavements. Due to the fact that this physiographic region was under a lake, the conditions of the soil and landscape vary greatly from land smoothed by wave action to cliffs. Soil types range from a sandy base to a clay base, with poor drainage in some areas. The Iroquois Plains consists of the area from the Niagara River to the Trent River and around the western end of Lake Ontario. (Chapman and Putnam 1984: 190-196).

5.3.5 SURFACE WATER

Sources of potable water, access to waterborne transportation routes, and resources associated with watersheds are each considered, both individually and collectively to be the highest criteria for determination of the potential of any location to support extended human activity, land use, or occupation. Accordingly, proximity to water is regarded as the primary indicator of archaeological site potential. The Standards and Guidelines for Consultant Archaeologists stipulates that undisturbed lands within 300 metres of a water source are considered to have archaeological potential (MTC 2011: 21).

There is a seasonally low-lying and wet area extending from the northern boundary to the centre of the study area. This area was wet and not viable to assess during the initial visit to the property. However, later in the year this area, as well as seasonal stream channels flowing through the study area through the larger low-lying wet area, was completely dry. The seasonal streams enter the south edge of the study west of the centre of the south property edge and converge approximately 60 metres to the north of the southern boundary; From here one stream channel flows northward and nearly to the north edge where it abruptly turns eastward before exiting the study area near the northeast corner of the property.

5.3.6 CURRENT PROPERTY CONDITIONS CONTEXT

Current characteristics encountered within an archaeological research study area determine if property Assessment of specific portions of the study area will be necessary and in what manner a Stage 2 Property Assessment should be conducted, if necessary. Conventional assessment methodologies include pedestrian survey on ploughable lands and test pit methodology within areas that cannot be ploughed. For the purpose of determining where property Assessment is necessary and feasible, general categories of current landscape conditions have been established as archaeological conventions. These include:

5.3.6.1 BUILDINGS AND STRUCTURAL FOOTPRINTS

A building, for the purposes of this particular study, is a structure that exists currently or has existed in the past in a given location. The footprint of a building is the area of the building formed by the perimeter of the foundation. Although the interior area of building foundations would often be subject to property Assessment when the foundation may represent a potentially significant historic archaeological site, the footprints of existing structures are not typically assessed. Existing structures commonly encountered during archaeological assessments are often residential-associated buildings (houses, garages, sheds), and/or component buildings of farm complexes (barns, silos, greenhouses). In many cases, even though the disturbance to the land may be relatively shallow and archaeological resources may be situated below the disturbed layer (e.g. a concrete garage pad), there is no practical means of assessing the area beneath the disturbed layer. However, if there were evidence to suggest that there are likely archaeological resources situated beneath the disturbance, alternative methodologies may be recommended to study such areas.

The study area contains no buildings or structural footprints.

5.3.6.2 DISTURBANCE

Areas that have been subjected to extensive and deep land alteration that has severely damaged the integrity of archaeological resources are known as land disturbances. Examples of land disturbances are areas of past quarrying, major landscaping, and sewage and infrastructure development (MTC 2011: 18), as well as driveways made of gravel or asphalt or concrete, in-ground pools, and wells or cisterns. Surfaces paved with interlocking brick, concrete, asphalt, gravel and other surfaces meant to support heavy loads or to be long wearing hard surfaces in high traffic areas, must be prepared by the excavation and removal of topsoil, grading, and the addition of aggregate material to ensure appropriate engineering values for the supporting matrix and also to ensure that the installations shed water to avoid flooding or moisture damage. All hard surfaced areas are prepared in this fashion and therefore have no or low archaeological potential. Major utility lines are conduits that provide services such as water, natural gas, hydro, communications, sewage, and others. These major installations should not be confused with minor below ground service installations not considered to represent significant disturbances removing archaeological potential, such as services leading to individual structures which tend to be comparatively very shallow and vary narrow corridors. Areas containing substantial and deeply buried services or clusters of below ground utilities are considered areas of disturbance, and may be excluded from Stage 2 Property Assessment. Disturbed areas are excluded from Stage 2 Property Assessment due to no or low archaeological potential and often because they are also not viable to assess using conventional methodology.

> *"Earthwork is one of the major works involved in road construction. This process includes excavation, material removal, filling, compaction, and construction. Moisture content is controlled, and compaction is done according to standard design procedures. Normally, rock explosion at the road bed is not encouraged. While filling a depression to reach the road level,* ***the original bed is flattened after the removal of the topsoil.*** *The fill layer is distributed and compacted to the designed specifications. This procedure is repeated until the compaction desired is reached. The* ***fill material should not contain organic elements,*** *and possess a low index of plasticity. Fill material can include gravel and decomposed rocks of a particular size, but should not consist of huge clay lumps. Sand clay can be used. The area is considered to be adequately compacted when the roller movement does not create a noticeable deformation.* ***The road surface finish is reliant on the economic aspects, and the estimated usage."*** *[Emphasis Added]*
>
> (Goel 2013)

The supporting matrix of a hard paved surface cannot contain organic material which is subject to significant compression, decay and moisture retention. Topsoil has no engineering value and must be removed in any construction application where the surface finish at grade requires underlying support.

Installation of sewer lines and other below ground services associated with infrastructure development often involves deep excavation that can remove archaeological potential. This consideration does not apply to relatively minor below ground services that connect structures and facilities to services that support their operation and use. Major servicing corridors will be situated within adjacent road allowances with only minor, narrow and relatively shallow underground services entering into the study area to connect existing structures to servicing mainlines. The relatively minor, narrow and shallow services buried within a residential property do not require such extensive ground disturbance to remove or minimize archaeological potential within affected areas.

There are two large patches of disturbed land, one extending the entire length of the southern boundary, and the second extending along nearly the entire eastern boundary of the upper arm of the "L". These areas are open meadowlands. The southern half of the area along the eastern boundary of the study area has been stripped of topsoil in the past. The southern disturbed area appears to be a former railway corridor, which is now a hydro corridor. There is a small area of asphalt drive way located at the east end of this part of the property. Asphalt is not viable to assess, but the linear configuration and narrow width of the paved surfaces does not impede systematic survey coverage. Maps 4 & 5 of this report illustrate the locations of these features.

5.3.6.3 LOW-LYING AND WET AREAS

Landscape features that are covered by permanently wet areas, such as marshes, swamps, or bodies of water like streams or lakes, are known as low-lying and wet areas. Low-lying and wet areas are excluded from Stage 2 Property Assessment due to inaccessibility.

There is a seasonally low-lying and wet area extending from the northern boundary to the centre of the study area. This area is associated with the seasonal streams flowing into, and through, the study area. The seasonal streams enter the south edge of the study west of the centre of the south property edge and converge approximately 60 metres to the north of the southern boundary; From here one stream channel flows northward and nearly to the north edge where it abruptly turns eastward before exiting the study area near the northeast corner of the property. These areas were wet at the time of the initial property visit but were all completely dry during return visits to the study area. These areas did not impact the conduct of the Stage 2 Property Assessment.

5.3.6.4 STEEP SLOPE

Landscape which slopes at a greater than (>) 20 degree change in elevation, is known as steep slope. Areas of steep slope are considered uninhabitable, and are excluded from Stage 2 Property Assessment.

Generally, steep slopes are not assessed because steep slopes are interpreted to have low potential, not due to viability to assess, except in cases where the slope is severe enough to become a safety concern for archaeological field crews. In such cases, the Occupational Health and Safety Act takes precedence as indicated in the introduction to the Standards and Guidelines. AMICK Consultant Limited policy is to assess all slope areas whenever it is safe to do so. Assessment of slopes, except where safety concerns arise, eliminates the invariably subjective interpretation of what might constitute a steep slope in the field. This is done to minimize delays due to conflicts in such interpretations and to increase the efficiency of review.

The study area does not contain areas of steep slope.

5.3.6.5 WOODED AREAS

Areas of the property that cannot be ploughed, such as natural forest or woodlot, are known as wooded areas. These wooded areas qualify for Stage 2 Property Assessment, and are required to be assessed using test pit survey methodology.

The study area is predominantly a tree covered woodlot of varying degrees of density, including small open areas of lower or more sporadic growth.

5.3.6.6 PLOUGHABLE AGRICULTURAL LANDS

Areas of current or former agricultural lands that have been ploughed in the past are considered ploughable agricultural lands. Ploughing these lands regularly turns the soil, which in turn brings previously buried artifacts to the surface, which are then easily identified during visual inspection. Furthermore, by allowing the ploughed area to weather sufficiently through rainfall, soil is washed off of exposed artifacts at the surface and the visibility of artifacts at the surface of recently worked field areas is enhanced markedly. Pedestrian survey of ploughed agricultural lands is the preferred method of physical assessment because of the greater potential for finding evidence of archaeological resources if present.

The study area does not contain any ploughable lands.

5.3.6.7 LAWN, PASTURE, MEADOW

Landscape features consisting of former agricultural land covered in low growth, such as lawns, pastures, meadows, shrubbery, and immature trees. These are areas that may be considered too small to warrant ploughing, (i.e. less than one hectare in area), such as yard areas surrounding existing structures, and land-locked open areas that are technically workable by a plough but inaccessible to agricultural machinery. These areas may also include open area within urban contexts that do not allow agricultural tillage within municipal or city limits or the use of urban roadways by agricultural machinery. These areas are required to be assessed using test pit survey methodology.

The larger open areas are coincident with disturbances as noted previously; these areas (excluding the area stripped of topsoil) can be described as meadows where the predominant vegetation is ground cover and tall weeds.

5.3.7 SUMMARY

Background research indicates the vicinity of the study area has potential for archaeological resources of Native origins based on proximity to previously registered archaeological sites of Pre-contact origins and proximity to a source of potable water. Background research also suggests potential for archaeological resources of Post-contact origins based on proximity to previously registered archaeological sites of Post-contact origins, proximity to a historic roadway, proximity to a historic railway corridor and proximity to areas of documented historic settlement.

Current conditions within the study area indicate that some areas of the property may have no or low archaeological potential and do not require Stage 2 Property Assessment or should be excluded from Stage 2 Property Assessment. These areas would include the areas that are not accessible due to the presence of low-lying and wet areas. A significant proportion of the study area does exhibit archaeological potential and therefore a Stage 2 Property Assessment is required.

Archaeological potential does not indicate that there are necessarily sites present, but that environmental and historical factors suggest that there may be as yet undocumented archaeological sites within lands that have not been subject to systematic archaeological research in the past.

6.0 FIELD WORK METHODS AND WEATHER CONDITIONS

This report confirms that the study area was subject to Stage 2 Property Assessment by high intensity test pit methodology at a five-metre interval between individual test pits, and by test pit survey at a ten metre interval to confirm disturbance on 25 June, 23 and 26 September 2017.

The fieldwork undertaken as a component of this study was conducted according to the archaeological fieldwork standards and guidelines (including weather and lighting conditions). Weather conditions were appropriate for the necessary fieldwork required to complete the Stage 2 Property Assessment and to create the documentation appropriate to this study. The locations from which photographs were taken and the directions toward which the camera was aimed for each photograph are illustrated in Maps 4 & 5 of this report. Upon completion of the property inspection of the study area, it was determined that select areas would require Stage 2 Property Assessment.

It must be noted that AMICK Consultants Limited has been retained to assess lands as specified by the proponent. As such, AMICK Consultants Limited is constrained by the terms of the contract in place at the time of the Archaeological Assessment and can only enter into lands for which AMICK Consultants Limited has received consent from the owner or their agent(s). The proponent has been advised that the entire area within the planning application must be subject to archaeological assessment and that portions of the planning application may only be excluded if they are of low potential, are not viable to assess, or are subject to planning provisions that would restrict any such areas from any form of ground altering activities.

6.1 PROPERTY INSPECTION

A detailed examination and photo documentation was carried out on the study area in order to document the existing conditions of the study area to facilitate the Stage 2 Property Assessment. All areas of the study area were visually inspected and photographed. Observations made of conditions within the study area at the time of the inspection were used to inform the requirement for Stage 2 Property Assessment for portions of the study area as well as to aid in the determination of appropriate Stage 2 Property Assessment strategies. The locations from which photographs were taken and the directions toward which the camera was aimed for each photograph are illustrated in Maps 4 & 5 of this report.

6.2 TEST PIT SURVEY

In accordance with the Standards and Guidelines for Consultant Archaeologists, test pit survey is required to be undertaken for those portions of the study area where deep prior disturbance had not occurred prior to assessment or which were accessible to survey. Test pit survey is only used in areas that cannot be subject to ploughing or cultivation. This report confirms that the conduct of test pit survey within the study area conformed to the following standards:

1. *Test pit survey only on terrain where ploughing is not possible or viable, as in the following examples:*

    a. wooded areas
    [Not Applicable – The study area does not contain any wooded areas]

    b. pasture with high rock content
    [Not Applicable - The study area does not contain any pastures with high rock content]

    c. abandoned farmland with heavy brush and weed growth
    [Not Applicable - The study area does not contain any abandoned farmland with heavy brush and weed growth]

    d. orchards and vineyards that cannot be strip ploughed (planted in rows 5 m apart or less), gardens, parkland or lawns, any of which will remain in use for several years after the survey
    [The study area contained a large open meadow that could not be ploughed and was test pit surveyed at an interval of 5m between individual test pits]

    e. properties where existing landscaping or infrastructure would be damaged. The presence of such obstacles must be documented in sufficient detail to demonstrate that ploughing or cultivation is not viable.
    [Not Applicable - The study area does not contain the above-mentioned circumstances]

    f. narrow (10 m or less) linear survey corridors (e.g., water or gas pipelines, road widening). This includes situations where there are planned impacts 10 m or less beyond the previously impacted limits on both sides of an existing linear corridor (e.g., two linear survey corridors on either side of an existing roadway). Where at the time of fieldwork the lands within the linear corridor meet the standards as stated under the above section on pedestrian survey land preparation, pedestrian survey must be carried out. Space test pits at maximum intervals of 5 m (400 test pits per hectare) in areas less than 300 m from any feature of archaeological potential.
    [Not Applicable – The study area does not contain any linear corridors]

2. *Space test pits at maximum intervals of 5 m (400 test pits per hectare) in areas less than 300 m from any feature of archaeological potential.*

[All test pits were spaced at an interval of 5m between individual test pits]

3. *Space test pits at maximum intervals of 10 m (100 test pits per hectare) in areas more than 300 m from any feature of archaeological potential.*
   [The entirety of the test pitted areas of the study area were assessed using high intensity test pit methodology at an interval of 5 metres between individual test pits]

4. *Test pit to within 1 m of built structures (both intact and ruins), or until test pits show evidence of recent ground disturbance.*
   [Not Applicable]

5. *Ensure that test pits are at least 30 cm in diameter.*
   [All test pits were at least 30 cm in diameter]

6. *Excavate each test pit, by hand, into the first 5 cm of subsoil and examine the pit for stratigraphy, cultural features, or evidence of fill.*
   [Regardless of the interval between individual test pits, all test pits were excavated by hand into the first 5 cm of subsoil where possible and examined for stratigraphy, cultural features, or evidence of fill. In areas where topsoil was not present, test pits were excavated to a minimum of 30cm in depth to ensure that suspected subsoils, if present, were not layers of fill or waterborne materials overlying buried topsoil. If these areas consisted of fill soils, test pits were also excavated a minimum of 30 cm below grade in order to ensure disturbance extended below even deep topsoil layers such as those encountered in agricultural fields to ensure that the depth of disturbance was sufficient to remove archaeological potential in most contexts. Where other evidence indicates locations of potentially significant archaeological sites that may include cultural deposits below fill soils, alternative strategies to explore beneath the fill layers found in some areas may be necessary to complete the Stage 2 Property Assessment. In such cases, further Stage 2 Property Assessment may be recommended following completion of the property survey under conventional methodologies.]

7. *Screen soil through mesh no greater than 6 mm.*
   [All soil was screened through mesh no greater than 6 mm]

8. *Collect all artifacts according to their associated test pit.*
   [Not Applicable - No archaeological resources were encountered]

9. *Backfill all test pits unless instructed not to by the landowner.*
   [All test pits were backfilled]

(MTC 2011: 31-32)

"*A combination of property inspection and test pitting may be used when initial Stage 2 results determine that all or part of the project area may in fact be disturbed. The*

> *Stage 2 survey may then consists of a detailed inspection (equivalent to Stage 1), combined with test pitting."*
>
> 2. *Place Stage 2 test pits throughout the disturbed areas according to professional judgment (and where physically viable) as to confirm that these areas have been completely disturbed.*
>   *[*Areas of suspected disturbance was identified during the Property Inspection conducted as part of the Stage 2 Property Assessment. There are two large patches of disturbed land, one extending the entire length of the southern boundary, and the second extending along nearly the entire eastern boundary of the upper arm of the "L". These areas are open meadowlands. The southern half of the area along the eastern boundary of the study area has been stripped of topsoil in the past. The southern disturbed area appears to be a former railway corridor, which is now a hydro corridor. There is a small area of asphalt drive way located at the east end of this part of the property. Asphalt is not viable to assess, but the linear configuration and narrow width of the paved surfaces does not impede systematic survey coverage. Test pits were excavated every 10 metres across the entirety of the suspected areas of disturbance within the study area. The intensity of test pit survey conducted is far in excess of the minimum standard required. AMICK Consultants Limited tested the suspected disturbed area at a 10-metre interval to confirm disturbance in a manner consistent with the objectives to ensure that the area is accurately delimited and properly identified. There is no requirement to systematically examine such areas. The Standards and Guidelines require only judgmental testing based on the professional judgment of the investigating archaeologist. In most typical archaeological assessments the entire area of presumed disturbance will be written off as an area of no archaeological potential without thorough testing to demonstrate that the entire area is disturbed or it will be tested at subjective, irregular and inconsistent intervals, and consequently such testing cannot verify that the entire area contained within the presumed limits of disturbance are, in fact, disturbed. The methodology employed here by AMICK Consultants Limited exceeds any requirements of the Standards and Guidelines and that which is generally applied within the industry.
>
>   The excavated soil and the profiles of these test pits were examined to determine if each represented an area of disturbance. Test pits were excavated a minimum of 30 cm below grade in order to ensure that test pits were excavated to depths below the surrounding natural grade. This procedure demonstrated that the entire study area consists of fill deposited within a deeply disturbed context. There is no archaeological potential within this area.]
>
> (MTC 2011: 38)

Approximately 30% of the study area consisted of disturbed area that was test pit surveyed at an interval of 10 metres between individual test pits to confirm disturbance. Approximately 55% of the study area was woodlot test pit surveyed at an interval of 5 metres between individual test pits. Approximately 15% of the study area was initially not assessable due to the presence of streams and low-lying and wet areas, but was viable to assess later in the year as these areas dried out over the summer months.

7.0 RECORD OF FINDS

Section 7.8.2 of the Standards and Guidelines for Consultant Archaeologists (MTC 2011: 137-138) outlines the requirements of the Record of Finds component of a Stage 2 report:

1. *For all archaeological resources and sites that are identified in Stage 2, provide the following:*
    1. *a general description of the types of artifacts and features that were identified*
    2. *a general description of the area within which artifacts and features were identified, including the spatial extent of the area and any relative variations in density*
    3. *a catalogue and description of all artifacts retained*
    4. *a description of the artifacts and features left in the field (nature of material, frequency, other notable traits).*
2. *Provide an inventory of the documentary record generated in the field (e.g. photographs, maps, field notes).*
3. *Submit information detailing exact site locations on the property separately from the project report, as specified in section 7.6. Information on exact site locations includes the following:*
    1. *table of GPS readings for locations of all archaeological sites*
    2. *maps showing detailed site location information.*

7.1 ARCHAEOLOGICAL RESOURCES

No archaeological resources of any description were encountered anywhere within the study area.

7.2 ARCHAEOLOGICAL FIELDWORK DOCUMENTATION

The documentation produced during the field investigation conducted in support of this report includes: one sketch map, one page of photo log, one page of field notes, and 35 digital photographs.

8.0 ANALYSIS AND CONCLUSIONS

AMICK Consultants Limited was engaged by the proponent to undertake a Stage 1-2 Archaeological Assessment of lands potentially affected by the proposed undertaking and was granted permission to carry out archaeological fieldwork. The entirety of the study area was subject to property inspection and photographic documentation concurrently with the Stage 2 Property Assessment on 25 June, 23 and 26 September 2017, consisting of high-intensity test pit survey at an interval of five metres between individual test pits and test pit survey at an interval of 10 metres to confirm disturbance. All records, documentation, field notes, photographs and artifacts (as applicable) related to the conduct and findings of these investigations are held at the Lakelands District corporate offices of AMICK Consultants Limited until such time that they can be transferred to an agency or institution approved by the Ontario Ministry of Tourism, Culture and Sport (MTCS) on behalf of the government and citizens of Ontario.

8.1 STAGE 1 ANALYSIS AND CONCLUSIONS

As part of the present study, background research was conducted in order to determine the archaeological potential of the proposed project area.

"A Stage 1 background study provides the consulting archaeologist and Ministry report reviewer with information about the known and potential cultural heritage resources within a particular study area, prior to the start of the field assessment." (OMCzCR 1993)

The evaluation of potential is further elaborated Section 1.3 of the Standards and Guidelines for Consultant Archaeologist (2011) prepared by the Ontario Ministry of Tourism and Culture:

" The Stage 1 background study (and, where undertaken, property inspection) leads to an evaluation of the property's archaeological potential. If the evaluation indicates that there is archaeological potential anywhere on the property, the next step is a Stage 2 assessment."
(MTC 2011: 17)

Features or characteristics that indicate archaeological potential when documented within the study area, or within close proximity to the study area (as applicable), include:

" - previously identified archaeological sites
- *water sources (It is important to distinguish types of water and shoreline, and to distinguish natural from artificial water sources, as these features affect site locations and types to varying degrees.):*
    - *primary water sources (lakes, rivers, streams, creeks)*
    - *secondary water sources (intermittent streams and creeks, springs, marshes, swamps)*
    - *features indicating past water sources (e.g., glacial lake shorelines indicated by the presence of raised sand or gravel beach ridges, relic river or stream channels indicated by clear dip or swale in the topography, shorelines of drained lakes or marshes, cobble beaches)*
    - *accessible or inaccessible shoreline (e.g., high bluffs, swamp or marsh fields by the edge of a lake, sandbars stretching into marsh)*
- *elevated topography (e.g., eskers, drumlins, large knolls, plateaux)*
- *pockets of well-drained sandy soil, especially near areas of heavy soil or rocky ground*

> - *distinctive land formations that might have been special or spiritual places, such as waterfalls, rock outcrops, caverns, mounds, and promontories and their bases. There may be physical indicators of their use, such as burials, structures, offerings, rock paintings or carvings.*
> - *resource areas, including:*
>   - *food or medicinal plants (e.g., migratory routes, spawning areas, prairie)*
>   - *scarce raw materials (e.g., quartz, copper, ochre or outcrops of chert)*
>   - *early Post-contact industry (e.g., fur trade, logging, prospecting, mining)*
> - *areas of early Post-contact settlement. These include places of early military or pioneer settlement (e.g., pioneer homesteads, isolated cabins, farmstead complexes), early wharf or dock complexes, pioneer churches and early cemeteries. There may be commemorative markers of their history, such as local, provincial, or federal monuments or heritage parks.*
> - *Early historical transportation routes (e.g., trails, passes, roads, railways, portage routes)*
> - *property listed on a municipal register or designated under the Ontario Heritage Actor that is a federal, provincial or municipal historic landmark or site*
> - *property that local histories or informants have identified with possible archaeological sties, historical events, activities, or occupations"*
>
> (MTC 2011: 17-18)

The evaluation of potential does not indicate that sites are present within areas affected by proposed development. Evaluation of potential considers the possibility for as yet undocumented sites to be found in areas that have not been subject to systematic archaeological investigation in the past. Potential for archaeological resources is used to determine if property assessment of a study area or portions of a study area is required.

> *"Archaeological resources not previously documented may also be present in the affected area. If the alternative areas being considered, or the preferred alternative selected, exhibit either high or medium potential for the discovery of archaeological remains an archaeological assessment will be required."*
>
> (MCC & MOE 1992: 6-7)

> *"The Stage 1 background study (and, where undertaken, property inspection) leads to an evaluation of the property's archaeological potential. If the evaluation indicates that there is archaeological potential anywhere on the property, the next step is a Stage 2 assessment."*
>
> (MTC 2011: 17)

In addition, archaeological sites data is also used to determine if any archaeological resources had been formerly documented within or in close proximity to the study area and if these same resources might be subject to impacts from the proposed undertaking. This data was also collected in order to establish the relative cultural heritage value or interest of any resources that might be encountered during the conduct of the present study. For example, the relative rarity of a site can be used to assign an elevated level of cultural heritage value or interest to a site that is atypical for the immediate vicinity. The requisite archaeological sites data of previously registered archaeological sites was collected from the Programs and Services Branch, Culture Programs Unit, MTCS and the corporate research library of AMICK Consultants Limited. The Stage 1 Background Research methodology also includes a review of the most detailed available topographic maps, historical settlement maps, archaeological management plans (where applicable) and commemorative plaques or monuments. When previous archaeological research documents lands to be impacted by the proposed undertaking or archaeological sites within 50 metres of the study area, the reports documenting this earlier work are reviewed for pertinent information. AMICK Consultants Limited will often modify this basic methodology based on professional judgment to include additional research (such as, local historical works or documents and knowledgeable informants).

Section 7.7.3 of the Standards and Guidelines for Consultant Archaeologists (MTC 2011: 132) outlines the requirements of the Analysis and Conclusions component of a Stage 1 Background Study.

1) "Identify and describe areas of archaeological potential within the project area.

2) Identify and describe areas that have been subject to extensive and deep land alterations. Describe the nature of alterations (e.g., development or other activity) that have severely damaged the integrity of archaeological resources and have removed archaeological potential."

CHARACTERISTICS INDICATING ARCHAEOLOGICAL POTENTIAL

Section 1.3.1 of the Standards and Guidelines for Consultant Archaeologists specifies the property characteristics that indicate archaeological potential (MTC 2011: 17-18). Factors that indicate archaeological potential are features of the local landscape and environment that may have attracted people to either occupy the land or to conduct activities within the study area. One or more of these characteristics found to apply to a study area would necessitate a Stage 2 Property Assessment to determine if archaeological resources are present. These characteristics are listed below together with considerations derived from the conduct of this study.

1) *Previously Identified Archaeological Sites*

Previously registered archaeological sites have not been documented within 300 metres of the study area.

2) *Water Sources*

Primary water sources are described as including lakes, rivers streams and creeks. Close proximity to primary water sources (300 metres) indicates that people had access to readily available sources of potable water and routes of waterborne trade and communication should the study area have been used or occupied in the past.

There are no identified primary water sources within 300 metres of the study area.

Secondary water sources are described as including intermittent streams and creeks, springs, marshes, and swamps. Close proximity (300 metres) to secondary water sources indicates that people had access to readily available sources of potable water, at least on a seasonal basis, and in some cases seasonal access to routes of waterborne trade and communication should the study area have been used or occupied in the past.

There is a seasonally low-lying and wet area extending from the northern boundary to the centre of the study area. This area is associated with the seasonal streams flowing into, and through, the study area. The seasonal streams enter the south edge of the study west of the centre of the south property edge and converge approximately 60 metres to the north of the southern boundary; From here one stream channel flows northward and nearly to the north edge where it abruptly turns eastward before exiting the study area near the northeast corner of the property. These areas were wet at the time of the initial property visit but were all completely dry during return visits to the study area.

3) *Features Indicating Past Water Sources*

Features indicating past water resources are described as including glacial lake shorelines indicated by the presence of raised sand or gravel beach ridges, relic river or stream channels indicated by clear dip or swale in the topography, shorelines of drained lakes or marshes, and cobble beaches. Close proximity (300 metres) to features indicating past water sources indicates that people had access to readily available sources of potable water, at least on a seasonal basis, and in some cases seasonal access to routes of waterborne trade and communication should the study area have been used or occupied in the past.

There are identified features indicating past water sources within 300 metres of the study area. The study area is situated within an area once under glacial Lake Iroquois. The study area is now located between the old Lake Iroquois shoreline and the current shoreline of Lake Ontario. During the transition from the glacial Lake Iroquois to the present Lake Ontario the shoreline would have receded through the study area. As the receding process is gradual the study area would have been within close proximity to a shoreline providing access to an abundance of natural resources as well as waterborne trade and communication.

4) *Accessible or Inaccessible Shoreline*

This form of landscape feature would include high bluffs, swamp or marsh fields by the edge of a lake, sandbars stretching into marsh, etc.

There are no shorelines within 300 metres of the study area. However, the study area is situated within an area once under glacial Lake Iroquois. The study area is now located between the old Lake Iroquois shoreline and the current shoreline of Lake Ontario. During the transition from the glacial Lake Iroquois to the present Lake

Ontario the shoreline would have receded through the study area. As the receding process is gradual the study area would have been within close proximity to a shoreline providing access to an abundance of natural resources as well as waterborne trade and communication.

5) *Elevated Topography*

Features of elevated topography that indicate archaeological potential include eskers, drumlins, large knolls, and plateaux.

There are no identified features of elevated topography within the study area.

6) *Pockets of Well-drained Sandy Soil*

Pockets of sandy soil are considered to be especially important near areas of heavy soil or rocky ground.

The soil throughout the study area is dark sandy loam, with a very thin layer of topsoil, which is consistent with the wider area surrounding the property.

The image below (Kuhlmann, Stacy 2017) shows the consistencies of soil types and how they compare to one another. The lower percentage of clay allows the soil to break up from the action of ploughing alone when not compacted or bound by extensive root masses.

(Kuhlmann, Stacy 2017)

7) *Distinctive Land Formations*

These are landscape features that might have been special or spiritual places, such as waterfalls, rock outcrops, caverns, mounds, and promontories and their bases. There may be physical indicators of their use, such as burials, structures, offerings, rock paintings or carvings.

There are no identified distinctive land formations within the study area.

8) *Resource Areas*
Resource areas that indicate archaeological potential include food or medicinal plants (e.g., migratory routes, spawning areas, and prairie), scarce raw materials (e.g., quartz, copper, ochre or outcrops of chert) and resources of importance to early Post-contact industry (e.g., logging, prospecting, and mining).

There are no identified resource areas within the study area.

9) *Areas of Early Post-contact Settlement*
These include places of early military or pioneer settlement (e.g., pioneer homesteads, isolated cabins, and farmstead complexes), early wharf or dock complexes, pioneer churches and early cemeteries. There may be commemorative markers of their history, such as local, provincial, or federal monuments or heritage parks.

The study area is situated in close proximity to a historic community identified on the historic atlas map.

10) *Early Historical Transportation Routes*
This includes evidence of trails, passes, roads, railways, portage routes.

The study area has historic roads that appear within its boundaries and adjacent to the eastern boundary, as depicted on the Historic Atlas Map of 1878. The roads within the boundaries no longer exist, but the road adjacent to the eastern boundary is now known as Division Street. The study area is also situated within 100 metres of a railway line indicated on the historic atlas map.

11) *Heritage Property*
Property listed on a municipal register or designated under the *Ontario Heritage Act* or is a federal, provincial or municipal historic landmark or site.

There are no listed or designated heritage buildings or properties that form a part of the study area. There are no listed or designated heritage buildings or properties that are adjacent to the study area.

12) *Documented Historical or Archaeological Sites*
This includes property that local histories or informants have identified with possible archaeological sites, historical events, activities, or occupations. These are properties which have not necessarily been formally recognized or for which there is additional evidence identifying possible archaeological resources associated with historic properties in addition to the rationale for formal recognition.

There are no known heritage features, or known historic sites, or known archaeological sites within the study area in addition to those formally documented with the appropriate agencies or previously noted under a different criterion.

CHARACTERISTICS INDICATING REMOVAL OF ARCHAEOLOGICAL POTENTIAL

Section 1.3.2 of the Standards and Guidelines for Consultant Archaeologists specifies the property characteristics which indicate no archaeological potential or for which archaeological potential has been removed (MTC 2011: 18-19). These characteristics are listed below together with considerations derived from the conduct of this study.
The introduction of Section 1.3.2 (MTC 2011: 18) notes that *"Archaeological potential can be determined not to be present for either the entire property or a part(s) of it when the area under consideration has been subject to extensive and deep land alterations that have severely damaged the integrity of any archaeological resources. This is commonly referred to as 'disturbed' or 'disturbance', and may include:"*

1) *Quarrying*
   There is no evidence to suggest that quarrying operations were ever carried out within the study area.

2) *Major Landscaping Involving Grading Below Topsoil*
   Unless there is evidence to suggest the presence of buried archaeological deposits, such deeply disturbed areas are considered to have lost their archaeological potential. Properties that do not have a long history of Post-contact occupation can have archaeological potential removed through extensive landscape alterations that penetrate below the topsoil layer. This is because most archaeological sites originate at grade with relatively shallow associated excavations into the soil. Pre-contact sites and early historic sites are vulnerable to extensive damage and complete removal due to landscape modification activities. In urban contexts where a lengthy history of occupation has occurred, properties may have deeply buried archaeological deposits covered over and sealed through redevelopment activities that do not include the deep excavation of the entire property for subsequent uses. Buildings are often erected directly over older foundations preserving archaeological deposits associated with the earlier occupation.

   Surfaces paved with interlocking brick, concrete, asphalt, gravel and other surfaces meant to support heavy loads or to be long wearing hard surfaces in high traffic areas, must be prepared by the excavation and removal of topsoil, grading, and the addition of aggregate material to ensure appropriate engineering values for the supporting matrix and also to ensure that the installations shed water to avoid flooding or moisture damage. All hard surfaced areas are prepared in this fashion and therefore have no or low archaeological potential. Disturbed areas are excluded from Stage 2 Property Assessment due to no or low archaeological potential and often because they are also not viable to assess using conventional methodology.

   There are two large patches of disturbed land, one extending the entire length of the southern boundary, and the second extending along nearly the entire eastern boundary of the upper arm of the "L". These areas are open meadowlands. The southern half of the area along the eastern boundary of the study area has been stripped of topsoil in the past. The southern disturbed area appears to be a former railway corridor, which is now a hydro corridor. There is a small area of asphalt drive way located at the east end of this part of the property. Asphalt is not viable to assess, but the linear configuration and narrow width of the paved surfaces does not impede systematic survey coverage.

It is clear that some activity and landscape alteration did occur within the study area at some point in the past to prepare the area for development and that there has been a loss of archaeological potential within the areas identified as disturbed. Maps 4 & 5 of this report illustrate the locations of these features.

3) *Building Footprints*
Typically, the construction of buildings involves the deep excavation of foundations, footings and cellars that often obliterate archaeological deposits situated close to the surface.

There are no buildings within the study area.

4) *Sewage and Infrastructure Development*
Installation of sewer lines and other below ground services associated with infrastructure development often involves deep excavation that can remove archaeological potential.

There is no evidence to suggest that substantial below ground services of any kind have resulted in significant impacts to any significant portion of the study area. Major utility lines are conduits that provide services such as water, natural gas, hydro, communications, sewage, and others. These major installations should not be confused with minor below ground service installations not considered to represent significant disturbances removing archaeological potential, such as services leading to individual structures which tend to be comparatively very shallow and vary narrow corridors. Areas containing substantial and deeply buried services or clusters of below ground utilities are considered areas of disturbance, and may be excluded from Stage 2 Property Assessment.

"Activities such as agricultural cultivation, gardening, minor grading and landscaping do not necessarily affect archaeological potential."
(MTC 2011: 18)

"Archaeological potential is not removed where there is documented potential for deeply buried intact archaeological resources beneath land alterations, or where it cannot be clearly demonstrated through background research and property inspection that there has been complete and intensive disturbance of an area. Where complete disturbance cannot be demonstrated in Stage 1, it will be necessary to undertake Stage 2 assessment."
(MTC 2011: 18)

SUMMARY

Table 4 below summarizes the evaluation criteria of the Ministry of Tourism and Culture together with the results of the Stage 1 Background Study for the proposed undertaking. Based on the criteria, the property is deemed to have archaeological potential on the basis of proximity to water, proximity to a historic community, and the location of early historic settlement roads adjacent to the study area.

TABLE 4 EVALUATION OF ARCHAEOLOGICAL POTENTIAL

FEATURE OF ARCHAEOLOGICAL POTENTIAL		YES	NO	N/A	COMMENT
1	Known archaeological sites within 300m		**N**		If Yes, potential determined
PHYSICAL FEATURES					
2	Is there water on or near the property?	**Y**			If Yes, what kind of water?
2a	Primary water source within 300 m. (lakeshore, river, large creek, etc.)	**Y**			If Yes, potential determined
2b	Secondary water source within 300 m. (stream, spring, marsh, swamp, etc.)		**N**		If Yes, potential determined
2c	Past water source within 300 m. (beach ridge, river bed, relic creek, etc.)	**Y**			If Yes, potential determined
2d	Accessible or Inaccessible shoreline within 300 m. (high bluffs, marsh, swamp, sand bar, etc.)		**N**		If Yes, potential determined
3	Elevated topography (knolls, drumlins, eskers, plateaus, etc.)		**N**		If Yes, and Yes for any of 4-9, potential determined
4	Pockets of sandy soil in a clay or rocky area		**N**		If Yes and Yes for any of 3, 5-9, potential determined
5	Distinctive land formations (mounds, caverns, waterfalls, peninsulas, etc.)		**N**		If Yes and Yes for any of 3-4, 6-9, potential determined
HISTORIC/PREHISTORIC USE FEATURES					
6	Associated with food or scarce resource harvest areas (traditional fishing locations, agricultural/berry extraction areas, etc.)		**N**		If Yes, and Yes for any of 3-5, 7-9, potential determined.
7	Early Post-contact settlement area within 300 m.	**Y**			If Yes, and Yes for any of 3-6, 8-9, potential determined
8	Historic Transportation route within 100 m. (historic road, trail, portage, rail corridors, etc.)	**Y**			If Yes, and Yes for any 3-7 or 9, potential determined
9	Contains property designated and/or listed under the Ontario Heritage Act (municipal heritage committee, municipal register, etc.)		**N**		If Yes and, Yes to any of 3-8, potential determined
APPLICATION-SPECIFIC INFORMATION					
10	Local knowledge (local heritage organizations, Pre-contact, etc.)		**N**		If Yes, potential determined
11	Recent disturbance not including agricultural cultivation (post-1960-confirmed extensive and intensive including industrial sites, aggregate areas, etc.)	**Y**			If Yes, no potential or low potential in affected part (s) of the study area.

If **YES** to any of 1, 2a-c, or 10 Archaeological Potential is **confirmed**
If **YES** to 2 or more of 3-9, Archaeological Potential is **confirmed**
If **YES** to 11 or No to 1-10 Low Archaeological Potential is **confirmed** for at least a portion of the study area.

8.2 STAGE 2 ANALYSIS AND CONCLUSIONS

Section 7.8.3 of the Standards and Guidelines for Consultant Archaeologists (MTC 2011: 138-139) outlines the requirements of the Analysis and Conclusions component of a Stage 2 Property Assessment.

1. *Summarize all finding from the Stage 2 survey, or state that no archaeological sites were identified.*
2. *For each archaeological site, provide the following analysis and conclusions:*
   a. *A preliminary determination, to the degree possible, of the age and cultural affiliation of any archaeological sites identified.*
   b. *A comparison against the criteria in 2 Stage 2: Property Assessment to determine whether further assessment is required*
   c. *A preliminary determination regarding whether any archaeological sites identified in Stage 2 show evidence of a high level cultural heritage value or interest and will thus require Stage 4 mitigation.*

No archaeological sites or resources were found during the Stage 2 survey of the study area.

9.0 RECOMMENDATIONS

9.1 STAGE 1 RECOMMENDATIONS

Under Section 7.7.4 of the Standards and Guidelines for Consultant Archaeologists (MTC 2011: 133) the recommendations to be made as a result of a Stage 1 Background Study are described.

1) Make recommendations regarding the potential for the property, as follows:
  a. if some or all of the property has archaeological potential, identify areas recommended for further assessment (Stage 2) and areas not recommended for further assessment. Any exemptions from further assessment must be consistent with the archaeological fieldwork standards and guidelines.
  b. if no part of the property has archaeological potential, recommend that the property does not require further archaeological assessment.
2) Recommend appropriate Stage 2 assessment strategies.

9.2 STAGE 2 RECOMMENDATIONS

Under Section 7.8.4 of the Standards and Guidelines for Consultant Archaeologists (MTC 2011: 139) the recommendations to be made as a result o f a Stage 2 Property Assessment are described.

1) *For each archaeological site, provide a statement of the following:*
    - *a. Borden number or other identifying number*
    - *b. Whether or not it is of further cultural heritage value or interest*
    - *c. Where it is of further cultural heritage value or interest, appropriate Stage 3 assessment strategies*
2) *Make recommendations only regarding archaeological matters. Recommendations regarding built heritage or cultural heritage landscapes should not be included.*
3) *If the Stage 2 survey did not identify any archaeological sites requiring further assessment or mitigation of impacts, recommend that no further archaeological assessment of the property be required.*

As a result of the Stage 2 Property Assessment of the study area, no archaeological resources were encountered. Consequently, the following recommendations are made:

1. *No further archaeological assessment of the study area is warranted;*
2. *The Provincial interest in archaeological resources with respect to the proposed undertaking has been addressed;*
3. *The proposed undertaking is clear of any archaeological concern.*

10.0 ADVICE ON COMPLIANCE WITH LEGISLATION

While not part of the archaeological record, this report must include the following standard advisory statements for the benefit of the proponent and the approval authority in the land use planning and development process:

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 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 Ministry of Tourism and Culture, 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 archaeologist to carry out archaeological fieldwork, in compliance with sec. 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 licence.*

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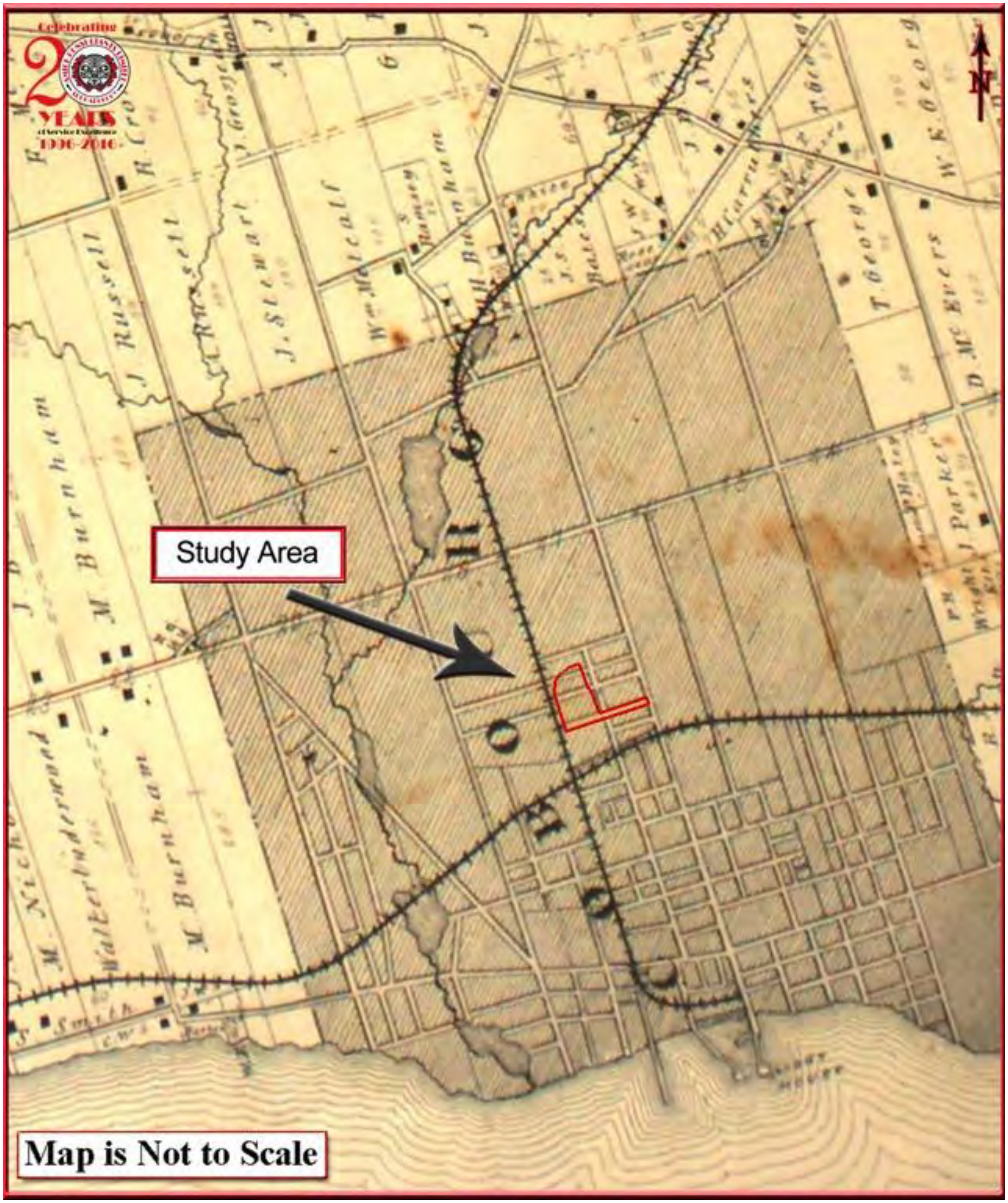
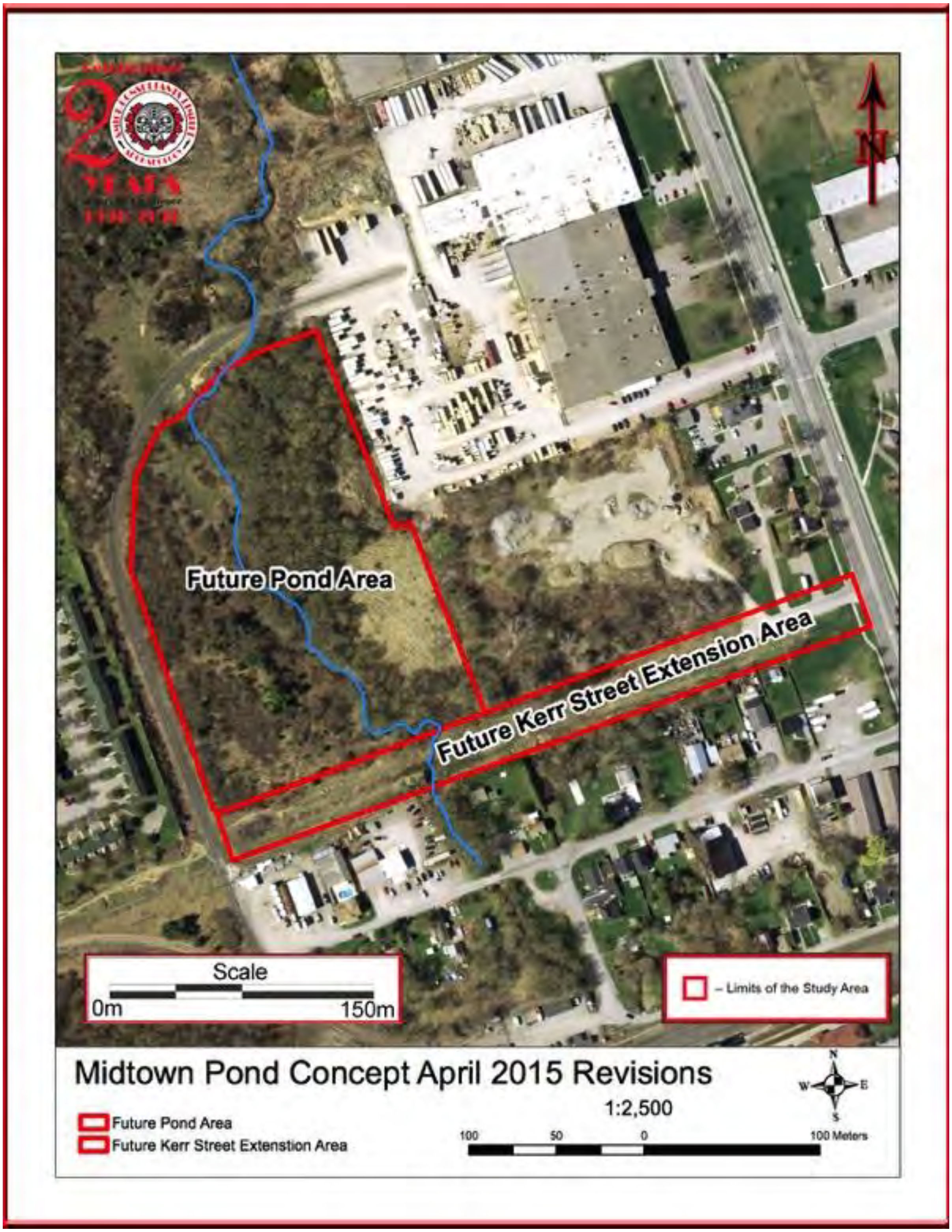
12.0 MAPS

MAP 1 LOCATION OF THE STUDY AREA (GOOGLE MAPS 2012)



MAP 2 FACSIMILE SEGMENT OF THE HISTORIC ATLAS MAP OF THE TOWNSHIP OF HAMILTON (H. BELDEN & CO. 1878)



MAP 3 PLAN OF SURVEY

MAP 4 AERIAL PHOTO OF THE STUDY AREA (GOOGLE EARTH 2011)

MAP 5 DETAILED PLAN OF THE STUDY AREA

13.0 IMAGES

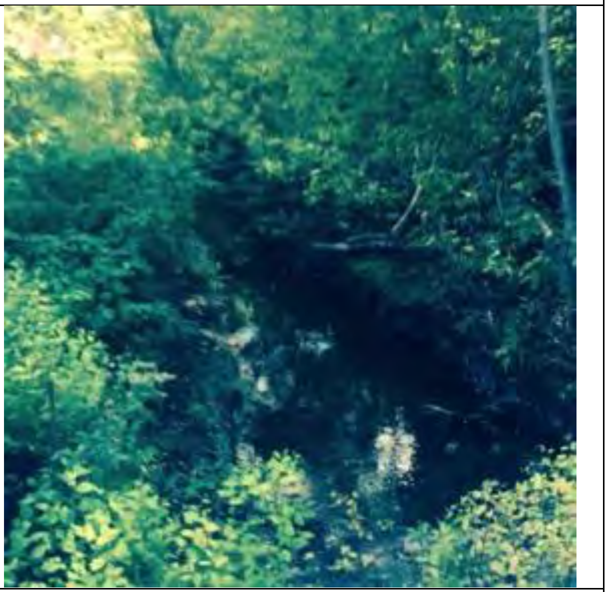
	
IMAGE 1 SURVEY CONDITIONS	**IMAGE 2 SURVEY CONDITIONS**
	
Image 3 Survey Conditions	Image 4 Stream Course

IMAGE 5 SURVEY CONDITIONS

IMAGE 6 SURVEY CONDITIONS

Image 7 Survey Conditions

Image 8 Survey Conditions

IMAGE 9 SURVEY CONDITIONS

IMAGE 10 SURVEY CONDITIONS

Appendix F

Environmental Impact Study

Midtown Creek

Environmental Impact Study

Midtown Creek Flood Ponding Area and Kerr Street Extension

D.M. Wills Project No. 17-5268

D.M. Wills Associates Limited

Partners in Engineering
Peterborough

September 2018

Prepared for:
The Town of Cobourg

Summary of Revisions

Revision No.	Revision Title	Date of Release	Description of Revisions
1	Draft EIS	August 3, 2018	
2	Final EIS	September 06,2018	Edits from Town of Cobourg

This report/proposal has been formatted considering the requirements of the Accessibility for Ontarians with Disabilities Act.

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Executive Summary

D.M. Wills Associates Limited (Wills) has been retained by the Town of Cobourg to undertake an Environmental Impact Study (EIS) to assess the preferred alternative from the Midtown Creek Flood Ponding Area and Kerr Street Extension Municipal Class Environmental Assessment (Midtown Creek EA), which includes an online flood ponding area and a restored natural channel upstream of the Kerr Street right-of-way.

The Study Area generally covers the area north of the CNR and CPR tracks, south of the rear lots of the properties on Ballantine Street, west of Division Street and east of the rear lots of the properties on Sutherland Crescent and Gillett Court in Cobourg, Ontario.

Due to the presence of two (2) wetland communities across a portion of the Study Area, as well as, the presence of Midtown Creek through the Study Area, an EIS was requested by the Town of Cobourg. The purpose of the EIS to identify environmental constraints, develop appropriate setbacks, consult with regulatory agencies and identify the activities required to address project compliance with Provincial and Federal statutes and policies including, but not limited to, the *Planning Act* (R.S.O. 1995), the *Conservation Authorities Act* (R.S.O. 1990), the *Endangered Species Act* (R.O. 2007), the *Provincial Policy Statement* (2014), Section 35 and 37 of the *Fisheries Act* (R.S.C. 1985) and identify associated permitting, if required, based on the results of the EIS and details of the proposed development.

Potential impacts of the Project on existing natural heritage features and associated wildlife, including Species at Risk, were evaluated based on a review of publicly available resources, GRCA background reports and the results of on-site field investigations. Field investigations identified a cold water watercourse that has experienced a large amount of degradation and sedimentation due to industrial practices and construction activities in the area. Proposed channel redesign and restoration efforts will enhance the available habitat for cold water species and provide a greater stream length on site with higher sinuosity and fish passage. Additionally, the removal of invasive vegetation and enhancement of wetland features on site will provide a net benefit to both aquatic and terrestrial species in the area.

Given the results of on-site investigations and background reviews, long-term adverse impacts to natural heritage features, associated habitat, and local wildlife populations are not anticipated to be resultant from the Project provided that successful compensation is achieved and mitigation measures outlined herein, as well as, in the subsequent documents, are implemented. Appropriate execution of the mitigation measures outlined herein will ensure that proposed activities do not conflict with the natural heritage policies set out by the Town of Cobourg, or the Province of Ontario.

In summary, given the environmental mitigation measures described in this report are implemented effectively throughout the construction period and an effective channel restoration plan, wetland compensation plan and monitoring strategy is implemented, Wills is of the opinion that there will be no residual negative impacts to the environment.

Abbreviations and Definitions

bgs	Below Ground Surface
CUM1	Cultural Meadow Ecosite
DA	Designated Area
EIS	Environmental Impact Study
ESA	Endangered Species Act, 2007
ELC	Ecological Land Classification (Lee et al., 1998, as amended)
FOD7	Fresh-Moist Lowland Deciduous Forest Ecosite
GRCA	Ganaraska Region Conservation Authority
MAM2	Mineral Meadow Marsh Ecosite
Masl	Metres Above Sea Level
mbgs	Metres Below Ground Surface
MMP	Marsh Monitoring Program (Bird Studies Canada)
MNRF	Ministry of Natural Resources and Forestry
OBBA	Ontario Breeding Bird Atlas
OP	Official Plan
OWES	Ontario Wetland Evaluation System
PPS	Provincial Policy Statement, 2014
PSW	Provincially Significant Wetland
SAR	Species at Risk (as covered under the ESA Act)
SARA	Species at Risk Act, 2002
SWH	Significant Wildlife Habitat (as defined by MNRF criteria)
SWT2	Mineral Thicket Swamp Ecosite
VEC	Valued Ecosystem Component
Wills	D.M. Wills Associates Limited

1.0 Introduction

D.M. Wills Associates Limited (Wills) has been retained by the Town of Cobourg to undertake an Environmental Impact Study (EIS) for the preferred alternative from the Midtown Creek EA, which includes an online flood ponding area and a restored natural channel upstream of the Kerr Street right-of-way (Project).

Under the Planning Act, R.S.O. 1990, The Town of Cobourg Official Plan and Ganaraska Region Conservation Authority (GRCA) can request an EIS to help guide recommendations for applications for development within or adjacent to natural heritage features or areas. More specifically, under the Development, Interference with Wetlands and Alterations to Shorelines and Watercourses regulation (Ontario Regulation 168/06), the GRCA can request an EIS in support of decision making for development applications where the Subject Property is located within or adjacent to a wetland or watercourse. The Study Area is directly connected to Midtown Creek, a coldwater stream that drains into Lake Ontario.

The purpose of the EIS is to identify environmental constraints, develop appropriate setbacks, consult with regulatory agencies and identify the activities required to address project compliance with Provincial and Federal statutes and policies including but not limited to: the *Planning Act* (R.S.O. 1995), the *Conservation Authorities Act* (R.S.O. 1990), the *Endangered Species Act* (R.O. 2007), the *Provincial Policy Statement* (2014), Section 35 and 37 of the *Fisheries Act* (R.S.C. 1985).

To meet the requirements of the EIS, Wills' biologists undertook field investigations to collect information on existing conditions. This document provides a summary of the existing conditions background review and observations made during site visits. It also outlines the potential impacts of the Project and recommends measures to mitigate impacts.

1.1 Study Area

The Study Area generally covers the area north of the CNR and CPR tracks, south of the rear lots of the properties on Ballantine Street, west of Division Street and east of the rear lots of the properties on Sutherland Crescent and Gillett Court in Cobourg, Ontario. The Study Area includes the light industrial and residential lands fronting on Division Street, Buchanan Street, George Street and Station Street, the Kerr Street Right-of-Way (ROW) and a railway spur that provides access to the rear of the Canada Pallet Company property. Midtown Creek flows from north to south through the Study Area with culvert crossings at Division Street, the railway spur, Buchanan Street, George Street and Station Street and the CNR and CPR tracks. There is currently an open channel through the former railway embankment that is contained within the Kerr Street ROW **(Figure 1 – Location Plan).**

The proposed development includes the construction of an online flood ponding area between the Canada Pallet Railway Spur and Kerr Street to deal with any overflow during periods of high flows **(Figure 2 – Study Area).** Water would then be discharged to Midtown Creek downstream of the Kerr Street ROW. See **Appendix A - Statement of Limitations.**

2.0 Regulatory Context

2.1 Provincial Policy Context

The Provincial Policy Statement (PPS) 2014 was issued under Section 3 of the Planning Act (R.S.O. 1990, as amended May 30, 2017). The PPS is applicable province-wide to all planning decisions made on or after April 30, 2014, and replaces the PPS 2005.

The PPS states:

> *Section 2.1.5: Development and site alteration shall not be permitted in:*
>
> *a) significant wetlands in the Canadian Shield north of Ecoregions 5E, 6E and 7E;*
>
> *b) significant woodlands in Ecoregions 6E and 7E (excluding islands in Lake Huron and the St. Marys River);*
>
> *c) significant valley lands in Ecoregions 6E and 7E (excluding islands in Lake Huron and the St. Marys River);*
>
> *d) significant wildlife habitat;*
>
> *e) significant areas of natural and scientific interest, and;*
>
> *f) coastal wetlands in Ecoregions 5E, 6E and 7E that are not subject to policy 2.1.4 (b).*

Land Information Ontario (LIO) mapping indicates woodlands and a wetland as being present within the Study Area. Further details are provided in **Section 4.4.**

The PPS also states:

> *Section 2.1.6: Development and site alteration shall not be permitted in fish habitat except in accordance with provincial and federal requirements.*

The PPS also states:

> *Section 2.1.7: Development and site alteration shall not be permitted in habitat of endangered species and threatened species except in accordance with provincial and federal requirements.*

Figure 1 – Location Plan

5268 Midtown Creek EIS

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Drawn By TJ

Checked SF

Project No. 17-5268

Scale See Map

Date August 2018

Drawing File No. Figure 1

Figure 2
Midtown Creek EIS
Study Area

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Drawn By	SF	**Scale**	See Map
Checked	TJ	**Date**	August 2018
Project No.	5268	**Drawing File No.**	Figure 2

The proposed works are not planned to encroach into the habitat of any provincially Endangered or Threatened species identified within the Study Area. However, they will encroach on fish habitat. Further details are provided in **Section 5.3** and **Section 6.0**.

Lastly, the PPS states:

> *Section 2.1.8: Development and site alteration shall not be permitted on adjacent lands to the natural heritage features and areas identified in policies 2.1.4, 2.1.5, 2.1.6 and 2.1.7, unless the ecological function of the adjacent lands has been evaluated and it has been demonstrated that there will be no negative impacts on the natural features or on the ecological functions.*

The Ontario Natural Heritage Reference Manual for the Provincial Policy Statement defines adjacent lands as:

- 120 m from PSW.
- 50 m from – significant woodlands; significant valley lands; significant wildlife habitat; significant portions of habitat for threatened or endangered species, significant ANSI's.
- 30 m from fish habitat.

2.2 Local Planning Context

2.2.1 Town of Cobourg Official Plan

The Town of Cobourg Official Plan, 2018 (OP) provides the policy framework which guides decisions related to land use and development. In addition, the OP also provides direction on addressing capital works projects for immediate and long-term requirements, which considers the financial resources available to the Town of Cobourg. The following OP policies are applicable to the lands affected by the Project.

Section 3.3 of the OP provides that watershed management and flood and erosion control projects carried out or supervised by a public authority are permitted in any land use designation, save and except for the Environmental Constraint Area (ECA) designation. These uses are subject to policies located in Section 3.11 and 4.2 of the OP. The lands affected by this project are designated ECA; therefore, Sections 3.11 and 4.2 apply.

Section 3.11 provides that the ECA designation includes those lands which have inherent environmental hazards, are environmentally sensitive or which have a role in the protection of the environment. Section 3.11.2 indicates uses permitted in this designation shall be in accordance with Section 4.2, particularly Sections 4.2.2 and 4.2.3.

Section 4.2.2(i) provides that uses permitted in the ECA designation include: conservation and preservation of the natural environment; and, recreational uses which have minimal impact on the natural environmental features and ecological functions of the area. Exceptions to this provision are identified in Section 4.2.2 (ii)(f) which **permits stormwater control facilities where there will be net environmental benefit as determined by the Town of Cobourg, in consultation with the GRCA.**

Section 4.2.3 identifies the uses, buildings and structures which are prohibited in the ECA designation; however, Section 4.2.3 (ii) provides exceptions to this policy which include: buildings or **structures related to flood, or erosion control;** and where such works are in accordance with the regulations of the GRCA and are approved by the authority.

The OP policies allow for the development of stormwater management and flood or erosion control measures within the ECA designation in consultation with the Town of Cobourg and the GRCA.

Section 4.2.6 (i) of the OP also provides that development and site alteration shall not be permitted on lands adjacent to the natural heritage features identified in Section 4.2.1 (i) through (ix) unless it has been demonstrated that there will no be negative impact on the natural features or their ecological functions through an Environmental Impact Study (EIS). The features listed in Section 4.2.1 include the following:

- Significant woodlands;
- Wetlands including both provincially and non-provincially significant wetlands and coastal wetlands;
- Significant habitat of endangered and threatened species;
- Significant valleylands;
- Significant wildlife habitat;
- Fish habitat;
- Significant areas of natural and scientific interest;
- Groundwater discharge areas; and,
- Steep slopes which are susceptible to erosion or present a danger to development.

Based on a review of the OP policies, the proposed use of a flood detention pond is permitted provided that there will be a net environmental benefit as determined by the Town of Cobourg, in consultation with the GRCA.

3.0 Background Review

3.1 Surrounding Land Use

Properties adjacent to the Study Area are currently designated for commercial and residential purposes. A pallet factory is located to the east, with a rail line crossing the north of the Study Area. North of the rail line is undeveloped land. To the west, the property is bordered by a rail line with residential housing on the west side of the tracks. The Study Area is bordered by industrial facilities to the south.

3.2 Designated Areas

A review of the Ministry of Natural Resources and Forestry (MNRF) natural heritage / resources data obtained through the MNRF Natural Heritage Information Centre (NHIC) database was completed to identify the presence or absence of any Valued Ecosystem Components (VECs) such as local, provincial and federally Designated Areas (DAs). DAs include lands covered under the Provincial Policy Statement (2014) as well as other natural heritage features of local or federal interest including Federal Parks, Environmental Sensitive Landscapes or Areas (ESLs, ESAs), such as significant woodlands, locally significant wetlands or otherwise natural heritage feature identified for conservation.

A summary of the results of the database searches is outlined below:

Areas of Natural and Scientific Interest (ANSI)

Cobourg Conservation Area was identified within one kilometre of the Study Area.

Significant Wildlife Habitat (SWH)

No SWH was identified through field investigations completed by the GRCA or during the background review. See **Section 5.2** for further discussion.

Provincially Significant Wetlands (PSWs)

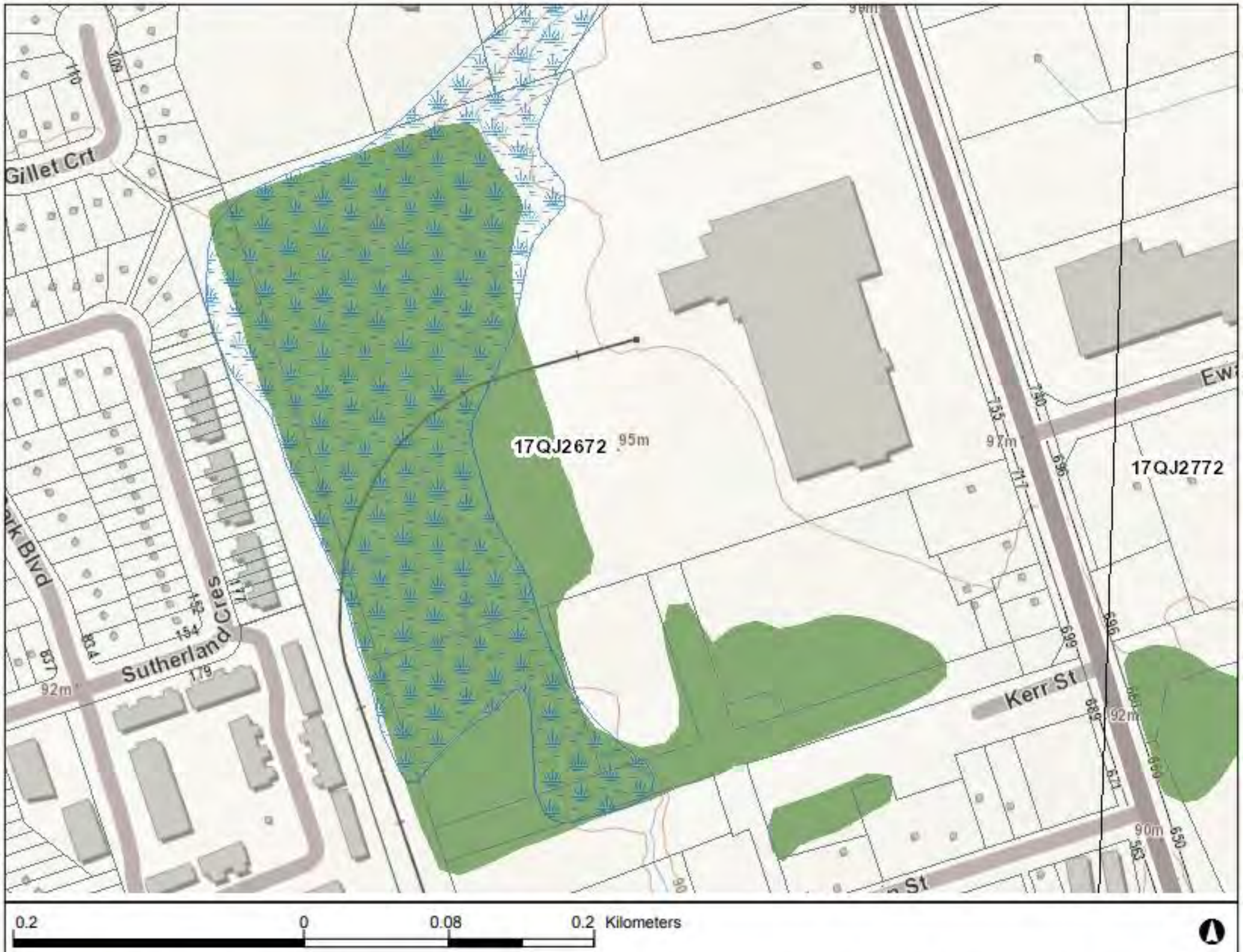
No PSWs were identified on or within 120 m of the Study Area based on background review. The nearest PSW (Cobourg Northwest Complex) is located approximately 1.2 km to the northwest.

Locally Significant Natural Heritage Features

No locally significant natural heritage features (e.g. locally significant wetlands, ESLs, ESAs, Environmental Protection, Environmental Constraint zones, etc.) were identified on or directly adjacent to the Study Area through background review.

Other Wetlands

The NHIC database identifies an unevaluated wetland covering a portion of land on the west side of the Study Area (see **Figure 3 – NHIC Map**).



This map should not be relied on as a precise indicator of routes or locations, nor as a guide to navigation. The Ontario Ministry of Natural Resources and Forestry(OMNRF) shall not be liable in any way for the use of, or reliance upon, this map or any information on this map.

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Legend

- ☐ Assessment Parcel
- 🟩 Woodland
- 🟩 Conservation Reserve
- ▨ Provincial Park
- 🟩 Natural Heritage System
- ☐ Ecoregion

Wetland

- 🟦 Provincially Significant Wetland Evaluated
- 🟦 Non - Provincially Significant Wetland Evaluated
- ▨ Unevaluated Wetland

Area of Natural Heritage & Scientific Interest (ANSI)

- 🟨 Provincially Significant Life Science ANSI
- 🟪 Provincially Significant Earth Science ANSI

Greenbelt Plan

- ☐ Boundary
- – – – River Valley Connections

Land Use Designations

- 🟩 Protected Countryside
- 🟫 Towns and Villages
- ● Hamlets
- 🟧 Urban River Valley
- 🟪 Specialty Crop Area

Niagara Escarpment Plan (NEP)

- ☐ Boundary
- ▨ Parks and Open Space System

Land Use Designations

- 🟩 Escarpment Natural Area
- 🟧 Escarpment Protection Area
- 🟨 Escarpment Rural Area
- 🟦 Mineral Resource Extraction Area
- 🟦 Escarpment Recreation Area
- 🟪 Urban Area
- ▨ Minor Urban Centre

Oak Ridges Moraine Conservation Plan (ORM)

- ☐ Boundary

Land Use Designations

- 🟩 Natural Core Area
- 🟩 Natural Linkage Area
- 🟫 Countryside Area
- 🟫 Rural Settlement
- ▨ Palgrave Estates Residential Community
- ▨ Settlement Area

Figure 3 - NHIC Map

5268 Midtown Creek EIS

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Drawn By	JB	**Scale**	See Map
Checked	TJ	**Date**	August 2018
Project No.	17-5268	**Drawing File No.**	Figure 3

4.0 Existing Conditions

4.1 Biophysical Environment

4.1.1 Hydrogeological and Geotechnical Background

An assessment of the subsurface conditions was carried out by WSP Canada Inc. in 2016. The existing Kerr Street railway berm is to be enhanced to contain periodic flood water, and will eventually be upgraded to support a 4-lane roadway. The adjacent properties are municipally serviced and no potable wells are within 250 m of the site.

Eight (8) test pits were carried out and advanced to depths ranging between 2.1 m BGS and 2.5 m BGS within the proposed pond footprint. Six (6) boreholes were advanced to a depth of 5 m BGS. Four (4) of the boreholes were completed as monitoring wells to facilitate groundwater measurements and sampling within the proposed flood control pond footprint. Groundwater levels measured in the monitoring wells on March 8, 2016 were between 89.4 and 91.1 masl. Groundwater on the site is anticipated to flow in a southerly to southeasterly direction with regional drainage being toward Lake Ontario, approximately 1.6 km to the south. Bedrock was documented at the site at depths greater than 2 m, and is anticipated between 75 masl and 80 masl from known bedrock topography mapping. The borehole and test pit locations are included in **Figure 4 - Borehole and Test Pit Locations (WSP 2016).**

Topsoil was encountered at each test pit and borehole location and ranged in thickness from 200 mm to 460 mm. A sandy silt to silt and sand layer was encountered beneath the topsoil in test pits TP16-4 to TP16-8 on the west side of Midtown Creek. A discrete sand and gravel layer exists in TP16-2 overlying sand. A sand layer was encountered at BH16-3 and test pits TP16-2 to TP16-6. Clayey silt was encountered at all borehole and test pit locations with the exception of TP16-1 to TP16-4. This material was found to underlie topsoil or sandy deposits where it was found.

A layer of fill material was encountered at TP16-1 and TP16-3 in a grassy clearing that may have been used as a dump site. The fill deposit ranges in thickness from greater than 2.1 m at TP-16-1 to 1.3 m at TP16-3, and consists of silty sand fill containing concrete slabs, bricks, plastic and other construction waste debris. The fill is covered by 150 mm thick concrete and topsoil in these areas.

Figure 4 – Borehole and Test Pit Locations (WSP 2016)

4.1.2 Hydrology

The Midtown Creek Hydrology Report (GRCA, 2007) included digital hydrology models for Midtown Creek using the Visual OTTHYMO (VO2) hydrologic modelling software to predict existing and future flows in the creek at key locations. Approximately 552 ha drain to the proposed site at Kerr Street. The peak flows corresponding to various storm events in the 2007 report were used in the Environmental Assessment and Detailed Design of the preferred alternative. The peak flows are presented in **Table 1.**

Table 1 – Existing Midtown Creek Peak Flows at the Site Location

Return Period	Flow at Chris Garrett Park (m^3/s)	Flow at Kerr Street (m^3/s)
2-year	1.42	4.11
5-year	2.39	5.69
10-year	3.15	6.76
25-year	4.22	8.09
50-year	5.13	9.12
100-year	6.06	10.16
Regional (Hazel)[1]	37.18	44.85

Note:

1. Regional flow reflects future land use conditions, since SWM criteria does not reduce post-development runoff flows to existing levels for Regional storm flows.
2. Values obtained from Draft Report: Preliminary Design of Conceptual Detention Pond on Midtown Creek (GRCA 2012).

The VO2 model from the GRCA was imported into a later version of the software (VO3) and was used moving forward to include the reservoir model of the flood ponding area.

The Midtown Creek Hydraulic Assessment and Flood Plain Mapping Final Report (Greenland Consulting Engineers, 2008) included a HEC-RAS hydraulic model of Midtown Creek using the flows in the 2007 GRCA Hydrology Report. The floodplain maps that were created were adopted by the Town of Cobourg and the GRCA Board of Directors in September 2010, subject to approval of the Town of Cobourg Special Policy Area.

Baseflows for Midtown Creek were provided by the GRCA, and include instantaneous flow measurements taken at the mouth of Midtown Creek at Rotary Park in Cobourg. These measurements represent the lowest annual flow. A summary of the baseflow measurements is included in **Table 2 – Baseflow Data**.

Table 2 – Baseflow Data

Year	Date	Time (24-hr)	Flow (m^3/s)	Flow (L/s)
2001	24-Aug-01	11:00	0.0196	19.60
2011	19-Aug-11	9:20	0.0175	17.48
2013	5-Sep-13	13:15	0.0135	13.47
2015	24-Jul-15	9:48	0.0103	10.27
2016	22-Jul-16	10:00	0.0063	6.35
2017	22-Aug-17	13:30	0.0250	25.01

A value of 0.010 m^3/s was used as the low-flow in the natural channel design, which represents the average less one standard deviation of low flows sampled. This was done to design a channel with depth at low flows in drier years.

4.1.3 Existing Topography

Topographic information for the flood ponding area was initially taken from the Cobourg Digital Elevation Model (DEM), which was collected using LiDAR. A detailed site survey of the flood ponding area was completed by Wills in the spring of 2018 to define the existing grades in more detail. Generally, the site slopes toward the existing watercourse and towards Kerr Street.

IBW Surveyors conducted a detailed topographic survey of the Kerr Street ROW in 2017 to assist with the detailed design of Kerr Street and determine preliminary elevation restrictions for the flood ponding area.

4.2 Natural Channel Existing Conditions

4.2.1 Flood Ponding Area

The reach of Midtown Creek within the proposed flood ponding area extends from the Canada Pallet Railway spur culvert to the existing berm that will support the proposed Kerr Street ROW. According to the Midtown Creek Fisheries Assessment (GRCA, 2016b), this reach of Midtown Creek is characterized by large amounts of sand and silt, a low gradient and a lack of defined riffles, with moderate amounts of woody material and refuse within the channel (i.e., tires, scrap metal, etc.). The refuse and debris within the channel has created several stepped barriers to fish passage, specifically for non-jumping fish species. Watercress was observed upstream from the site, indicating groundwater inputs. Species captured during fish sampling by the GRCA in 2016 included one brook trout, and the rest of the species captured were described as tolerant cyprinids.

The section of Midtown Creek within the proposed flood ponding area is approximately 350 m long starting from the railway spur culvert to the Kerr Street ROW.

4.3 Field Investigations

Field investigations by Wills' staff took place on May 22 and 30, 2018, and June 19 and 21, 2018 to evaluate existing ecological conditions within the Study Area. The field program included the following surveys:

- A breeding bird survey, following Ontario Breeding Bird Atlas (OBBA) standard procedures and protocols. Field investigations took place on May 30 and June 21, 2018.
- An amphibian call survey completed in general conformance with the Marsh Monitoring Program (MMP) standard procedures and protocols. Field investigations took place on May 22 and June 19, 2018.
- Incidental wildlife and wildlife habitat observations (auditory, visual, tracks, scat, burrows, nests, etc.) throughout the Study Area throughout the day, as well as the evening/night-time surveys with particular attention to any species of conservation concern noted to be present within the area.

4.4 Ecological Features

4.4.1 Aquatic Habitat

Midtown Creek is a small, coldwater watercourse with a drainage area of approximately 6.4 km^2, generally flowing in a southerly direction. South of the Study Area, the creek is piped underground through the Town of Cobourg before ultimately discharging into Lake Ontario. The creek is classified as a coldwater stream even though fish species found in the stream are typical of both warmwater and coldwater environments (GRCA, 2016b).

A Fisheries Assessment Report, outlining existing conditions, was prepared for Midtown Creek (GRCA, 2016b) as part of the Midtown Creek EA. Species captured by the GRCA within the Midtown Creek included brook trout, rainbow trout, mottled sculpin, and juvenile atlantic salmon. Other species found within Midtown Creek consist of tolerant cyprinids such as fathead minnow, creek chub and blacknose dace. The site is characterized by large amounts of silt, is of a low gradient, lacks defined riffles and has been described as showing signs of stress due to degradation of habitat and water quality. The area serves as a migratory corridor for lake run rainbow trout that utilize the upstream habitats for spawning and rearing (GRCA, 2016b). The Fisheries Assessment Report is included in **Appendix B.**

4.4.2 Ecological Characterization

Field visits to the study area were completed by GRCA on three (3) separate occasions during July and August of 2016. Ecological Land Classification (ELC) mapping was completed to determine habitat community types throughout the study area. Results of these investigations determined that the area of the proposed flood ponding contains five (5) community types including; CUM1 (Culteral Meadow), FOD7 (Fresh-Moist Lowland Decidous Forest), FOW (Mixed Forest), SWT2 (Mineral Thicket Swamp), CUW1 (Mixed Cultural Woodland), and MAM2 (Meadow Marsh); see **Figure 5 - Ecological Land Classification Map - 2016**. Soil samples were also taken and it was found that inconsistency of soil types combined with drainage patterns and human disturbance are the determining factor for the vegetation present in the area.

Wills conducted confirmatory field investigations on June 21, 2018 to document current ELC communities. Wills staff documented four (4) ELC communities including; CUM1 (Cultural Meadow), FOD7 (Fresh-Moist Lowland Deciduous Forest), SWT2 (Mineral Thicket Swamp), MAM2 (Meadow Marsh), see **Figure 6 - Ecological Land Classification (ELC) Map - 2018**.

Although there are a number of vegetation community types on the site, none are considered significant with respect to rarity and the majority of the site is highly disturbed. Most of the relatively natural woodland is early successional. The remainder is cultural woodland dominated by invasive tree species. The open areas are cultural meadow and highly disturbed. The surrounding land is residential and commercial buildings dominate the urban lands.

The wetland communities on the site, specifically the meadow marsh and the thicket swamp, are of higher quality, and dominated by a greater diversity of native plant species. These communities provide the highest wildlife values in that they support the most sensitive and habitat-specialist plant and vertebrate species.

The ELC communities currently found within the Study Area are described below:

1. Fresh-Moist Lowland Deciduous Forest (ELC classification FOD7).

This corresponds to the riparian zone of the stream that is subject to flooding. The dominant tree species here are Manitoba Maple (Acer negundo) and Crack Willow (Salix fragilis) with a dense ground layer dominated by Wild Red Currant (Ribes triste) and Tall Meadow Rue (Thalictrum pubescens). This community is relatively undisturbed by human activity, likely due to the dense nature of the vegetation.

2. Cultural Meadow (CUM1)

This disturbed, culturally-influenced area is the largest vegetation community on the site. Due to the high level of disturbance soils within this area are inconsistent ranging from dry and sandy to loam that is moderately moist. Species range from a mix of grasses and wildflowers such as Black-eyed Susan (*Rudbeckia hirta*) and Spreading

Figure 5 – Ecological Land Classification Map - 2016

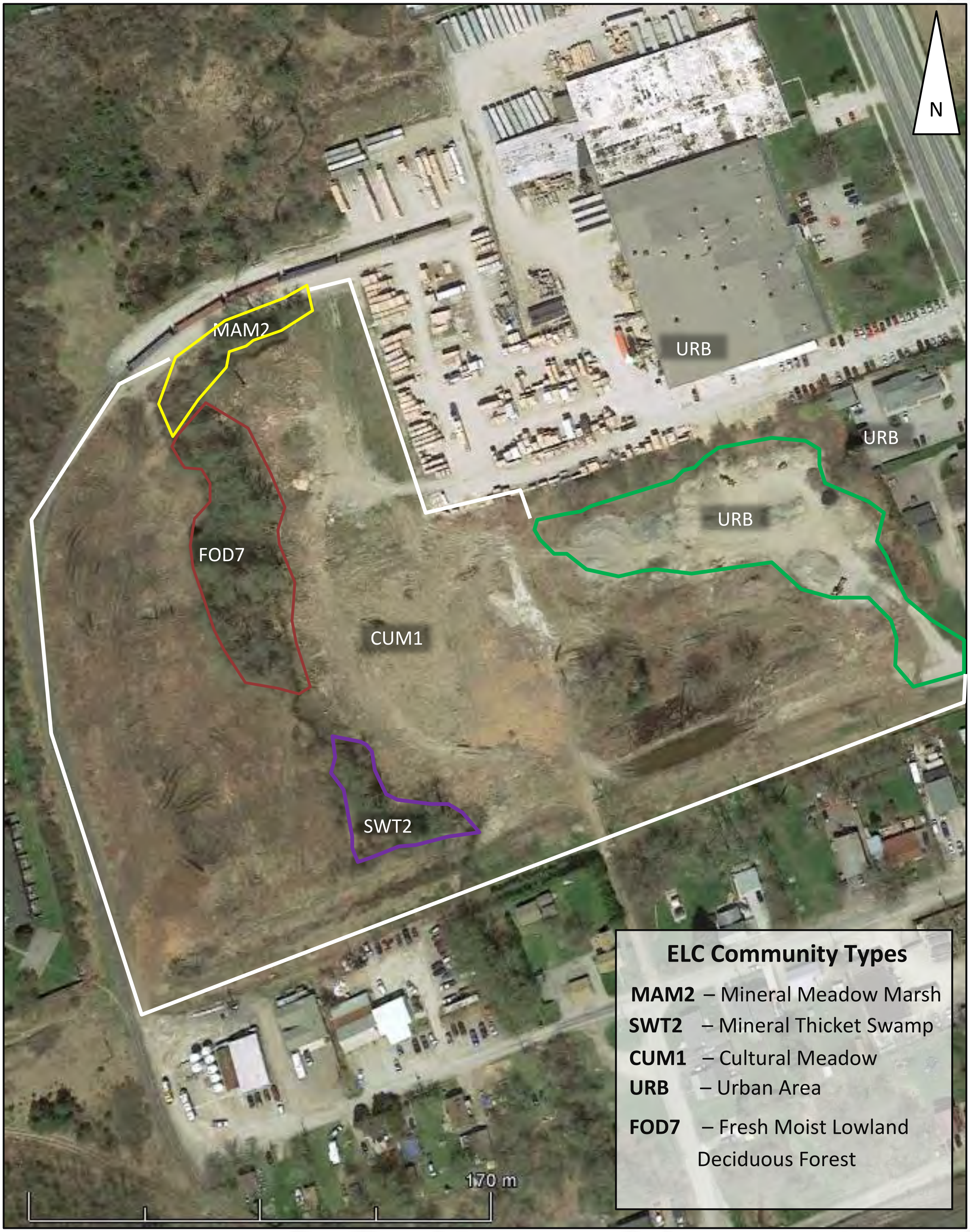

Figure 6 – Ecological Land Classification Map - 2018

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Drawn By	JB	Scale	N/A
Checked	TJ	Date	August 2018
Project No.	17-5268	Drawing File No.	Figure 6

Source: Image obtained from Google Earth. Image © 2018 Cnes/Spot Image.

Dogbane (*Apocynum androsaemifolium*), as well as invasive honeysuckle shrubs to Gray Dogwood (*Cornus racemose*), European Buckthorn (*Rhamnus cathartica*) and Sedges (*Carex sp.*).

3. Thicket Swamp (SWT2)

In the south-central portion of the site can be found what can best be defined as a thicket swamp (SWT), although the mix of species in this area does not closely correspond to any defined ELC layer. Dominant shrub species are Red Osier Dogwood (*Cornus serecia*) and Highbush Cranberry (*Viburnum trilobum*).

4. Mineral Meadow Marsh (MAM2)

On the North side of the property there is a small meadow marsh that features such wet meadow species as Spotted Joe-Pye Weed *Eutrochium maculatum*) and Blue Vervain (*Verbena hastata*). This small wetland area is in good condition, although some Himalayan Balsam (*Impatiens glandulifera*) is present. This invasive plant could spread rapidly throughout the moist area if not removed.

4.5 Wildlife

Incidental mammal observations were completed during field investigations by Wills. Gray Squirrel (*Sciurus carolinensis*) were observed on multiple occasions, as well as an unknown bat species. Previous studies by the GRCA identified Hairy-tailed Mole (*Parascaclops breweri*), Eatern Cottontail (*Sylvilagus floridanus)*, Eastern Chipmunk (*Tamias striatus)*, Coyote (*Canis latrans)* and Common Raccoon (*Procyon lotor)* in addition to the species identified by Wills' staff.

4.6 Avifauna

4.6.1 Database Reviews

A review of the Ontario Breeding Bird Atlas (OBBA) (accessed May, 2018) and Ebirds Canada databases was completed to obtain information regarding known species occurrences within the Study Area that may utilize existing natural heritage features. 185 species are known to occur within 10 km of the Study Area (see **Appendix C – Biological Inventory Lists** for details). Of the 185 species, breeding records have been confirmed for 72 species, 24 were identified as probable breeders, 30 possible breeders, and the remaining 59 were simply observed (see **Table 3 – Species of Conservation Concern**).

Table 3 – Species of Conservation Concern

Species Observed	Status
Henslow's Sparrow	Endangered provincially and federally
Grasshopper Sparrow	Special concern provincially and federally
Eastern Whip-poor-will	Threatened provincially and federally
Short-eared Owl	Special concern provincially and federally
Red-shouldered Hawk	Not at risk provincially, special concern federally
Canada Warbler	Special concern provincially, threatened federally
Chimney Swift	Threatened provincially and federally
Black Tern	Special concern provincially, not at risk federally
Common Nighthawk	Special concern provincially, threatened federally
Olive-sided Flycatcher	Special concern provincially, threatened federally
Eastern Wood-pewee	Special concern both provincially and federally
Bobolink	Threatened both provincially and federally
Barn Swallow	Threatened both provincially and federally
Wood Thrush	Special concern provincially, threatened federally
Least Bittern	Threatened both provincially and federally
Loggerhead Shrike	Endangered both provincially and federally
Red-headed Woodpecker	Special concern provincially, threatened federally
King Rail	Endangered both provincially and federally

Bank Swallow	Threatened both provincially and federally
Cerulean Warbler	Threatened provincially, Endangered federally
Eastern Meadowlark	Threatened both provincially and federally
Golden-winged Warbler	Special Concern provincially, Threatened federally

All species of conservation concern identified from the Natural Heritage Information Centre, and any other SAR species identified through other data sources (Ebirds and OBBA atlases) were included in the SAR Screening Assessment to evaluate known occurrences within the area against specific local habitat features identified within the Study Area, see **Section 5.3** for details.

4.6.2 Breeding Bird Surveys

Breeding bird surveys (Surveys) were completed on May 30, 2018 and June 21, 2018 following Ontario Breeding Bird Atlas (OBBA) standard procedures and protocols. Three (3) listening stations were determined prior to arriving at site **(Figure 7 – Amphibian Call and Breeding Bird Survey Locations)** following OBBA protocols. Surveys on May 29, 2018 commenced at 7:58 a.m. and at 8:15 a.m. on June 21, 2018. Audio recordings were taken at each listening station.

During the two (2) Surveys, a total of 28 species were observed through auditory or visual cues. Only one SAR, Barn Swallow, was heard during the Surveys, on May 30, 2018. **Table 4 - 2018 Breeding Bird Survey Results** provides full details of species found during the Surveys. See **Appendix D - Field Notes** for full details of the surveys.

Legend

🟨 Breeding Bird Survey Location

🟩 Amphibian Call Listening Station

Figure 7
Amphibian and Breeding Bird Survey Locations

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Table 4 – 2018 Breeding Bird Survey Results

Common Name	Scientific Name	BB01		BB02		BB03	
		Visit 1	Visit 2	Visit 1	Visit 2	Visit 1	Visit 2
Red-winged Blackbird	*Agelaius phoeniceus*	x	x	x		x	x
Cedar Waxwing	*Bombycilla cedrorum*	x		x			
Northern Cardinal	*Cardinalis cardinalis*	x	x	x		x	
Killdeer	*Charadrius vociferus*	x	x	x		x	x
Northern Flicker	*Colaptes auratus*	x	x	x			
Rock Dove	*Columba livia*	x					
American Crow	*Corvus brachyrhynchos*	x	x	x	x	x	
Blue Jay	*Cyanocitta cristata*		x	x		x	
Gray Catbird	*Dumetella carolinensis*	x				x	x
Barn Swallow	*Hirundo rustica*	x					
Herring Gull	*Larus smithsonianus*	x	x	x		x	x
Song Sparrow	*Melospiza melodia*	x		x		x	
Brown-headed Cowbird	*Molothrus ater*		x		x		
Great Crested Flycatcher	*Myiarchus crinitus*			x			
Black-capped Chickadee	*Poecile atricapillus*			x		x	x
Common Grackle	*Quiscalus quiscula*		x				
Eastern Phoebe	*Sayornis phoebe*			x			
Chestnut-sided Warbler	*Setophaga pensylvanica*	x					
Yellow Warbler	*Setophaga petechia*	x		x			
American Redstart	*Setophaga ruticilla*	x		x			

White-breasted Nuthatch	*Sitta carolinensis*					x	
American Goldfinch	*Spinus tristis*	x		x	x	x	x
Chipping Sparrow	*Spizella passerina*		x				
Field Sparrow	*Spizella pusilla*		x	x			x
European Starling	*Sturnus vulgaris*	x	x		x		x
American Robin	*Turdus migratorius*	x	x	x	x	x	
Eastern Kingbird	*Tyrannus tyrannus*		x		x		x
Mourning Dove	*Zenaida macroura*	x	x		x		x

No avifauna nesting structures were observed on the nearby buildings (e.g. Barn Swallow or Bank Swallow nests), in culverts, in the canopy, understory or groundcover within the Study Area at the time of the field investigations.

4.7 Herpetofauna

4.7.1 Database Review

A review of the Ontario Reptile and Amphibians Atlas (ORAA) (accessed July, 2018) identified 15 herpetofauna species within the 10 km^2 grid encompassing the Study Area **(Appendix C).** Of the 15 species observed, six (6) species of conservation concern (listed under the SARO and / or SARA acts) were among the list (see **Table 5 - Ontario Reptile and Amphibians Atlas SAR Summary**).

Table 5 – Ontario Reptile and Amphibians Atlas SAR Summary

Common Name	Scientific Name	SARO Status	SARA Status	Last Observed
Frogs				
Western Chorus Frog	*Pseudacris Triseriata*	N/A	THR	April 28, 2008
Turtles				
Snapping Turtle	*Chelydra Serpentina*	SC	SC	June 12, 2018
Painted Turtle	*Chrysemys Picta*	N/A	SC	June 11, 2016
Snakes				
Eastern Hognose Snake	*Heterodon Platirhinos*	THR	THR	July 10, 2008

Milksnake	*Lampropeltis Triangulum*	SC	SC	August 12, 2017
Eastern Ribbon Snake	*Thamnophis Sauritus Sauritus*	SC	SC	September 27, 1987

4.7.2 Amphibian Call Surveys

Amphibian Call Surveys were completed on May 22, 2018 and June 19, 2018 following Marsh Monitoring Program (MMP) standard procedures and protocols. The Amphibian Call Surveys took place at three (3) listening stations in the Study Area and commenced after sunset. Listening stations were strategically chosen to optimize coverage while preventing overlap of species calls **(Figure 7 - Amphibian and Breeding Bird Survey Locations**). Amphibian Call Surveys were conducted based on auditory cues for mating purposes, with incidental visual observations noted as well. Three (3) species of amphibians were heard during surveys including American Toad (*Anaxyrus americanus),* Gray Treefrog (*Hyla versicolor)* and Spring Peeper (*Pseudacris crucifer).* These three species are not SAR. See **Appendix D – Field Notes** for full details of the surveys.

5.0 Determination of Significance

Valued Ecosystem Components (VECs) are broadly defined as any part of the environment that is considered important by the proponent, public, scientists and government involved in the assessment process. Importance may be determined on the basis of cultural values or scientific concern. For the purposes of the Environmental Impact Study, VECs will be limited to any part of the biophysical environment that is considered important by the proponent, public, scientists and government involved in the assessment process.

5.1 Significant Woodlands

While woodlands exist within the Study Area as indicated through NHIC mapping, field investigations completed by Wills revealed that the Study Area is predominately cleared and can be classified as a Cultural Meadow (CUM1) Ecosite. The only area of woodlands on the property is a section of deciduous forest (Fresh-Moist Lowland Deciduous Forest Ecosite) aporoximately 0.45 ha in size acting as a riparian buffer along Midtown Creek. While the woodlands likely provide a benefit to Midtown Creek, they have not been classified as Significant and therefore are not protected as a Natural Heritage Feature. No vascular plant species of conservation concern were observed or inventoried during on-site field investigations (see **Appendix C - Biological Inventory Lists for details**).

5.2 Significant Wildlife Habitat (SWH)

In accordance with the Provincial Policy Statement (2014) and the MNRF's Significant Wildlife Habitat Technical Guide (2000), Significant Wildlife Habitat (SWH) is generally defined as areas where wild mammals, birds, reptiles, amphibians, fishes, invertebrates, plants, fungi, algae, bacteria and / or other wild organisms live, and find adequate amounts of food, water, shelter, and space needed to sustain their populations and where areas are considered ecologically important in terms of features, functions, representation or amount, and contributing to the quality and diversity of an identifiable geographic area or Natural Heritage System. Specific wildlife habitats of concern may include:

- Seasonal Concentration Areas of Animals;
- Rare Vegetation Communities or Specialized Habitats;
- Habitat of Species of Conservation Concern;
- Animal Movement Corridors.

Based on the results of background review, no SWH was identified within the Study Area.

5.3 Species at Risk (SAR)

The status of species within Ontario is determined by the Committee on the Status of Species at Risk in Ontario, which is an independent body that classifies native flora and fauna. The four (4) categories of conservation concern include:

- Extirpated: no longer lives within a certain region of Ontario, although still lives somewhere in the world.
- Endangered: lives in the wild in Ontario but is facing imminent extinction or extirpation.
- Threatened: lives in the wild in Ontario, is not endangered, but is likely to become endangered if steps are not taken to address factors threatening it.
- Special Concern: lives in the wild in Ontario, is not Endangered or Threatened, but may become Threatened or Endangered due to a combination of biological characteristics and identified threats.

Habitat for Endangered or Threatened species is protected under the Endangered Species Act (ESA, 2007).

All species of conservation concern identified from (1) 2018 field investigations, (2) Land Information Ontario Natural Heritage Areas database (formerly operated under the Natural Heritage Information Centre), and (3) any other SAR species identified through other data sources (e.g. herpetofauna atlases) were included in the SAR Screening Assessment to evaluate known occurrences within the area against specific local habitat features identified within the Study Area to determine whether the Project will come into conflict with the ESA, 2007 (see **Table 6 – Species at Risk (SAR) Screening Assessment** for details).

Table 6 – Species at Risk (SAR) Screening Assessment

Species	Ontario Status	COSEWIC Status	Federal SARA Status	Habitat Requirements	Likelihood of Occurrence	Site Area Suitability/Observations
Bank Swallow (Riparia riparia)	Threatened	Threatened	Threatened	The bank swallow breeds in a wide variety of natural and artificial sites with vertical banks, including riverbanks, lake and ocean bluffs, aggregate pits, road cuts, and stock piles of soil. Sand-silt substrates are preferred for excavating nest burrows. Breeding sites tend to be somewhat ephemeral due to the dynamic nature of bank erosion. Breeding sites are often situated near open terrestrial habitat used for aerial foraging. Large wetlands are used as common nocturnal roost sites during post-breeding, migration, and wintering periods (COSEWIC, 2013).	Negligible	While Bank Swallow was confirmed within the OBBA 10 km² grid, it was not identified within the MNRF’s NHIC 1 km² grid that encompasses the study area. Additionally it was not identified during any field surveys. No nesting structures or evidence of past nesting was observed within the Study Area at the time of the site investigations.

Species	Ontario Status	COSEWIC Status	Federal SARA Status	Habitat Requirements	Likelihood of Occurrence	Site Area Suitability/Observations
Barn Swallow (*Hirundo rustica*)	Threatened	Threatened	Threatened	Terrestrial open and man-made structures. Barn Swallow nesting sites include the use of a variety of artificial structures (e.g. beams, posts, light fixtures, ledges over windows and doors) that provide either a horizontal nesting surface or a vertical face, often with some sort of overhang that provides shelter. Often nesting sites are associated with open barns, sheds, garages, and docks.	Medium	While Barn Swallows were confirmed within the OBBA 10 km² grid, it was not identified within the MNRF's NHIC 1km² grid that encompasses the Study Area. No nesting structures or evidence of past nesting was observed within the Study Area at the time of the site investigations. Barn Swallows were identified during the May 30, 2018 Breeding Bird Survey. **Mitigation measures have been proposed, see Section 6.0 for details.**
Black Tern (*Chlidonias niger*)	Special Concern	Not at Risk	Not listed	Nests on inland marsh complexes, ponds, mouths of rivers and shores of large lakes.	Negligible	Habitat requirements not present within the site. No Black Terns were observed or heard during Breeding Bird Surveys.

Species	Ontario Status	COSEWIC Status	Federal SARA Status	Habitat Requirements	Likelihood of Occurrence	Site Area Suitability/Observations
Bobolink (*Dolichonyx oryzivorus*)	Threatened	Threatened	Threatened	Bobolink prefers tall grass prairies, but is also known to nest in forage crops (e.g. hayfields and pastures dominated by a variety of species such as clover, Timothy, Kentucky Bluegrass, and broadleaved plants).	Negligible	Habitat requirements not present within the site. No Bobolink were observed or heard during Breeding Bird Surveys.
Canada Warbler (*Wilsonia canadensis*)	Special Concern	Threatened	Threatened	The Canada Warbler uses a wide range of deciduous, coniferous and mixed forests, with a well-developed shrub layer and a structurally complex forest floor. It is most abundant in moist, mixed forests. It also occurs in riparian shrub forest on slopes and in ravines, in stands regenerating after natural and anthropogenic disturbances and in old-growth forests with canopy openings and a well-developed shrub layer.	Low	While Canada Warbler was considered a possible breeder within the OBBA 10 km² grid, it was not identified within the MNRF's NHIC 1 km² grid that encompasses the study area. No nesting structures or evidence of past nesting was observed within the Study Area at the time of the site investigations. **Mitigation measures have been proposed, see Section 6.0 for details.**

Species	Ontario Status	COSEWIC Status	Federal SARA Status	Habitat Requirements	Likelihood of Occurrence	Site Area Suitability/Observations
Chimney Swift (*Chaetura pelagica*)	Threatened	Threatened	Threatened	Chimney swift occurrence is largely associated with available nesting sites and insect abundance (its main food source); correlated with nearby waterbodies. As their name suggests, chimney swift often nest in man-made structures, namely in chimneys.	Negligible	Habitat requirements not present. No Chimney Swift were observed or heard during Breeding Bird Surveys.
Cerulean Warbler (*Dendroica cerulea*)	Threatened	Endangered	Endangered	On the breeding grounds, Cerulean Warblers are associated with large tracts of undisturbed mature deciduous forest with tall trees and an open understory. They are found in both wet bottomland forests and upland areas.	Low	While Cerulean Warbler was observed within the OBBA 10 km² grid, it was not identified within the MNRF's NHIC 1 km² grid that encompasses the study area. No nesting structures or evidence of past nesting was observed within the Study Area at the time of the site investigations. Large tracts of Mature Deciduous forest do not exist within the Study Area. **Mitigation measures have been proposed, see Section 6.0 for details.**

Species	Ontario Status	COSEWIC Status	Federal SARA Status	Habitat Requirements	Likelihood of Occurrence	Site Area Suitability/Observations
Common Nighthawk (*Chordeiles minor*)	Special Concern	Special Concern	Threatened	The Common Nighthawk occurs in mixed and coniferous forests, where breeding habitat generally includes open habitats, such as sand dunes, beaches, recently logged areas, recently burned over areas, forest clearings, short-grass prairies, pastures, open forests, peatbogs, marshes, lakeshores, gravel roads, river banks, rocky outcrops and rock barrens, railways, quarries, urban parks, etc. It should also be noted that this species has also been known to nest in parks and gardens in residential areas.	Low/Medium	While Common Nighthawk was considered a probable breeder within the OBBA 10 km² grid, it was not identified within the MNRF's NHIC 1 km² grid that encompasses the study area. No nesting structures or evidence of past nesting was observed within the Study Area at the time of the site investigations; however, potential habitat does exist. **Mitigation measures have been proposed, see Section 6.0 for details.**

Species	Ontario Status	COSEWIC Status	Federal SARA Status	Habitat Requirements	Likelihood of Occurrence	Site Area Suitability/Observations
Eastern Meadowlark (*Sturnella magna*)	Threatened	Threatened	Threatened	Native grasslands, pastures and savannahs. Eastern meadowlark also uses a wide variety of other anthropogenic grassland habitats, including hayfields, weedy meadows, young orchards, golf courses, restored surface mines, grassy roadside verges, young oak plantations, grain fields, herbaceous fencerows, and grassy airfields. Eastern Meadowlarks occasionally nest in crop fields such as corn and soybean, but these crops are considered low-quality habitat.	Low	While Eastern Meadowlark was confirmed within the OBBA 10 km² grid, it was not identified within the MNRF's NHIC 1 km² grid that encompasses the study area. No nesting structures or evidence of past nesting was observed within the Study Area at the time of the site investigations.

Eastern Whip-poor-will (Antrostomus vociferous)	Threatened	Threatened	Threatened	Whip-poor-will breeding habitat is not dependent upon species composition, but rather on forest structure. The species shuns both wide-open spaces and dense forest. Common habitat choices include rock or sand barrens with scattered trees, savannahs, old burns or other disturbed sites in a state of early to mid-forest succession, or open conifer plantations. Accordingly, pine (barrens and plantations), oak (barrens and savannahs), and aspen and birch (early to mid-succession) are common tree species associations. Individuals will often feed in nearby shrubby pastures or wetlands with perches, and power-line and roadway corridors are also occupied, presumably for feeding. Areas with decreased light levels where forest canopies are closed are generally not occupied likely due to reduced foraging success for this visual insectivore.	Low / Negligible	While Eastern Whip-poor-will was observed within the OBBA 10 km² grid, it was not identified within the MNRF's NHIC 1 km² grid that encompasses the study area. No nesting structures or evidence of past nesting was observed within the Study Area at the time of the site investigations.

Species	Ontario Status	COSEWIC Status	Federal SARA Status	Habitat Requirements	Likelihood of Occurrence	Site Area Suitability/Observations
Eastern Wood-pewee	Special Concern	Special Concern	Special Concern	In Canada, the Eastern Wood-pewee is mostly associated with the mid-canopy layer of forest clearings and edges of deciduous and mixed forests. It is most abundant in forest stands of intermediate age and in mature stands with little understory vegetation.	Low	While Eastern Wood-pewee was not observed during field observations it is confirmed within the OBBA 10 km² grid, as well as within the MNRF's NHIC 1 km² grid that encompasses the study area. It has also been recorded within the local 10 km² grid by eBirds.

Species	**Ontario Status**	**COSEWIC Status**	**Federal SARA Status**	**Habitat Requirements**	**Likelihood of Occurrence**	**Site Area Suitability/Observations**
Golden-winged Warbler (Vermivora chrysoptera)	Special Concern	Threatened	Threatened	In their breeding areas, Golden-winged Warblers seem to be fond of regeneration zones where young shrubs grow, surrounded by mature forest, and characterized by plant succession of 10 to 30 years. The warblers frequent clusters of herbaceous plants and low bushes (where they place their nests, which are built on the ground). They favour environments where the trees are spread out, as well as the forest edge, and use this setting for perching, singing and looking for food. Golden-winged Warblers are found in dry uplands, swamp forests and marshes. This warbler shows a preference for public utility (hydro-electric) rights-of-way, the edges of fields, areas where logging has recently occurred, beaver ponds and burned-out or intermittently cultivated areas.	Low	While Golden-winged Warbler was observed within the OBBA 10 km² grid, it was not identified within the MNRF's NHIC 1 km² grid that encompasses the study area. No nesting structures or evidence of past nesting was observed within the Study Area at the time of the site investigations.

Species	**Ontario Status**	**COSEWIC Status**	**Federal SARA Status**	**Habitat Requirements**	**Likelihood of Occurrence**	**Site Area Suitability/Observations**
Grasshopper Sparrow (Ammodramus savannaru)	Special Concern	Special Concern	Special Concern	In Canada, the Eastern Grasshopper Sparrow typically breeds in large human-created grasslands (5 ha or greater), such as pastures and hayfields, and natural prairies, such as alvars, characterized by well-drained, often poor soil dominated by relatively low, sparse perennial herbaceous vegetation. The habitat used by the Grasshopper Sparrow in its wintering range is generally similar to that used in the breeding range.	Low	While Grasshopper Sparrow was confirmed within the OBBA 10 km² grid, it was not identified within the MNRF's NHIC 1km² grid that encompasses the study area. No nesting structures or evidence of past nesting was observed within the Study Area at the time of the site investigations. No large grasslands are located on the subject property.

Species	Ontario Status	COSEWIC Status	Federal SARA Status	Habitat Requirements	Likelihood of Occurrence	Site Area Suitability/Observations
Henslow's Sparrow (*Ammodramus henslowii*)	Endangered	Endangered	Endangered	The Henslow's Sparrow is a grassland-obligate bird; in Ontario, Henslow's Sparrow colonies have been located in abandoned fields, ungrazed and lightly grazed pasture, fallow hayfields with high clover and alfalfa content, grassy swales in open farmland, wet meadows, infrequently mowed fields, and recent reports of colonies located in tallgrass prairie systems in southwestern Ontario.	Low	While Henslow's Sparrow was observed within the OBBA 10 km² grid, it was not identified within the MNRF's NHIC 1 km² grid that encompasses the study area. No nesting structures or evidence of past nesting was observed within the Study Area at the time of the site investigations. No large grasslands or hayfields are located in the Study Area.

Species	**Ontario Status**	**COSEWIC Status**	**Federal SARA Status**	**Habitat Requirements**	**Likelihood of Occurrence**	**Site Area Suitability/Observations**
King Rail (Rallus elegans)	Endangered	Endangered	Endangered	This species occupies a wide variety of freshwater marsh habitat types. In many parts of its range, cattail marshes are important. Large marshes, especially those that contain a range of water level conditions and a mosaic of habitats, are thought to be the preferred habitat in Canada, but smaller wetlands are also sometimes used.	Low	While King Rail has been observed within the OBBA 10 km² grid, it was not identified within the MNRF's NHIC 1 km² grid that encompasses the study area. No nesting structures or evidence of past nesting was observed within the Study Area at the time of the site investigations. No large cattail marshes are present in the Study Area.
Least Bittern (*Ixobrychus exilis*)	Threatened	Threatened	Threatened	Least Bitterns preferentially breed in marshes with tall emergent vegetation (usually cattails, Typha spp.), relatively stable water levels (less than 1 m, and usually 10-50 cm), and about 50% open water interspersed in small pockets throughout the vegetated areas ("hemi-marsh").	Low	While Least Bittern has been observed within the OBBA 10 km² grid, it was not identified within the MNRF's NHIC 1 km² grid that encompasses the study area. No nesting structures or evidence of past nesting was observed within the Study Area at the time of the site investigations. No large marshes are present in the Study Area.

Species	**Ontario Status**	**COSEWIC Status**	**Federal SARA Status**	**Habitat Requirements**	**Likelihood of Occurrence**	**Site Area Suitability/Observations**
Loggerhead Shrike (*Lanius ludovicianu*)	Endangered	Endangered	Endangered	Inhabits open ranges with occasional trees and shrubs that provide nesting sites and perches from which to hunt. This species uses grazing areas where the grass is short.	Low	While Loggerhead Shrike has been observed within the OBBA 10 km² grid, it was not identified within the MNRF's NHIC 1 km² grid that encompasses the study area. No nesting structures or evidence of past nesting was observed within the Study Area at the time of the site investigations.
Northern Bobwhite (Colinus virginianus)	Endangered	Endangered	Endangered	The Northern Bobwhite requires an early successional habitat that can be provided in a variety of vegetation types. Minimally, it requires an interspersion of grassland, cropland, and brushy cover. In Ontario it is now usually associated with cultivated lands rather than native prairie fringes.	Low	While Northern Bobwhite has been observed within the OBBA 10 km² grid, it was not identified within the MNRF's NHIC 1 km² grid that encompasses the study area. No nesting structures or evidence of past nesting was observed within the Study Area at the time of the site investigations. No cultivated lands are located in the Study Area.

Species	Ontario Status	COSEWIC Status	Federal SARA Status	Habitat Requirements	Likelihood of Occurrence	Site Area Suitability/Observations
Olive-sided Flycatcher (Contopus cooperi)	Special Concern	Special Concern	Threatened	The Olive-sided Flycatcher is most often associated with open areas containing tall live trees or snags for perching. These vantage points are required for foraging. This species generally forages from a high, prominent perch from which it sallies forth to intercept flying insects and then returns to the same perch. Open areas may be forest clearings, forest edges located near natural openings (such as rivers or swamps) or human-made openings (such as logged areas), burned forest or openings within old-growth forest stands; these forests are characterized by mature trees and large numbers of dead trees. Generally, forest habitat is either coniferous or mixed wood.	Low	While Olive-sided Flycatcher has been observed within the OBBA 10 km² grid, it was not identified within the MNRF's NHIC 1 km² grid that encompasses the study area. No nesting structures or evidence of past nesting was observed within the Study Area at the time of the site investigations.

Species	**Ontario Status**	**COSEWIC Status**	**Federal SARA Status**	**Habitat Requirements**	**Likelihood of Occurrence**	**Site Area Suitability/Observations**
Red-headed Wood-pecker (*Melanerpes erythrocephalus*)	Special Concern	Endangered	Threatened	The Red-headed Woodpecker occupies a variety of habitats, including oak and beech forests, flood plain forests, grasslands, forest edges, orchards, pastures, riparian forests, roadsides, urban parks, and beaver ponds. The open areas where this species breeds tend to contain a high density of dead trees that can be used for nesting and perching.	Medium	While Red-headed Woodpecker has been confirmed within the OBBA 10 km² grid, it was not identified within the MNRF's NHIC 1 km² grid that encompasses the study area. No nesting structures or evidence of past nesting was observed within the Study Area at the time of the site investigations. Potential habitat does exist on the subject property. **Mitigation measures have been proposed, see Section 6.0 for details.**

Species	**Ontario Status**	**COSEWIC Status**	**Federal SARA Status**	**Habitat Requirements**	**Likelihood of Occurrence**	**Site Area Suitability/Observations**
Red-shouldered Hawk (Buteo lineatus)	Not Listed	Not at Risk	Special Concern	The Red-shouldered Hawk prefers deciduous or mixed-wood forests containing shade-tolerant hardwood trees close to wetland areas. Large woodlots (10 to 100 hectares) can sustain viable Red-shouldered Hawk populations provided larger raptors do not interfere.	Low	While Red-shouldered Hawk has been observed within the OBBA 10 km² grid, it was not identified within the MNRF's NHIC 1 km² grid that encompasses the study area. No nesting structures or evidence of past nesting was observed within the Study Area at the time of the site investigations.
Short-eared Owl (*Asio flammeus*)	Special Concern	Special Concern	Special Concern	Short-eared Owls use a large number of open unforested habitats including grasslands, arctic tundra, taiga, bogs, marshes, old pastures, and sand-sage. They also occasionally breed in agricultural fields.	Low	While Short-eared Owl has been observed within the OBBA 10 km² grid, it was not identified within the MNRF's NHIC 1 km² grid that encompasses the study area. No nesting structures or evidence of past nesting was observed within the Study Area at the time of the site investigations.

Species	Ontario Status	COSEWIC Status	Federal SARA Status	Habitat Requirements	Likelihood of Occurrence	Site Area Suitability/Observations
Wood Thrush (Hylocichla mustelina)	Special Concern	Threatened	Threatened	During the breeding season, the Wood Thrush is found in moist, deciduous hardwood or mixed stands, often previously disturbed, with a dense deciduous undergrowth and with tall trees for singing perches (Gauthier and Aubry 1995; Friesen et al. 1999; Holmes and Sherry 2001; Friesen 2007; Evans et al. 2011; Suarez-Rubio et al. 2011). It is noted that in southern Ontario, the Wood Thrush prefers second-growth over mature forests (Peck and James, 1987).	Medium	While Wood Thrush has been confirmed within the OBBA 10 km² grid, it was not identified within the MNRF's NHIC 1 km² grid that encompasses the study area. No nesting structures or evidence of past nesting was observed within the Study Area at the time of the site investigations. Potential habitat does exist on the subject property. **Mitigation measures have been proposed, see Section 6.0 for details.**
Northern Brook Lamprey (*Ichthyomyzon fossor*)	Special Concern	Special Concern	Special Concern	Rocky or gravel substrate with swift-flowing water is the preferred spawning area. This species requires a small amount of silt-free sand or some other fine material to which the eggs can adhere, uni-directional current, and suitable water temperatures.	Low	While Midtown creek is a cold water stream DFO SAR maps do not identify Brook Lamprey within Midtown Creek. Additionally, the study area consists of a silt substrate which is not ideal for Northern Brook Lamprey spawning.

Species	**Ontario Status**	**COSEWIC Status**	**Federal SARA Status**	**Habitat Requirements**	**Likelihood of Occurrence**	**Site Area Suitability/Observations**
Western Chorus Frog	Not Listed	Threatened	Threatened	The Western Chorus Frog is primarily a lowland terrestrial species. In marshes or wooded wetland areas, it is found on the ground or in low shrubs and grass. It is a poor climber. Like all other frogs, the Western Chorus Frog requires both terrestrial and aquatic habitats in close proximity. For breeding and tadpole development, it requires seasonally dry temporary ponds devoid of predators, particularly fish. The Western Chorus Frog is very rarely found in permanent ponds. Although it uses aquatic habitat during the breeding season, the Western Chorus Frog is a poor swimmer. The species hibernates in its terrestrial habitat, under rocks, dead trees or leaves, or in loose soil or animal burrows, even though these sites are sometimes flooded.	Medium	The temporarily flooding of the areas surrounding Midtown Creek within the Study Area provide breeding habitat for the Western Chorus Frog. Overwintering habitat is also present on the property. **Mitigation measures have been proposed, see Section 6.0 for details.**

Species	Ontario Status	COSEWIC Status	Federal SARA Status	Habitat Requirements	Likelihood of Occurrence	Site Area Suitability/Observations
Eastern Hog-nosed Snake (*Heterodon platirhinos)*	Threatened	Threatened	Threatened	The Eastern Hog-nosed Snake prefers habitats with sandy, well-drained soil and open vegetative cover, such as open woods, brushland, fields, forest edges and disturbed sites. The species is often found near water. Eastern Hog-nosed Snakes in shoreline areas often rely on driftwood and other ground cover in beach and beach dune habitats, where toads, their prey of choice, are found. South of Parry Sound, in the Georgian Bay region, the species appears to prefer fields and forest habitats that have been modified by people rather than rock, wetland or aquatic habitats. They can live in slightly cooler areas if there are exposed south-facing sandy slopes that provide soil conditions that are warm enough for incubation.	Low	Habitat and food requirements are limited within the Study Area. Affinity for Project site given low quality habitat, limited breadth and extent, and adjacent disturbance regimes, is considered low.

Species	Ontario Status	COSEWIC Status	Federal SARA Status	Habitat Requirements	Likelihood of Occurrence	Site Area Suitability/Observations
Eastern Ribbon-snake (*Thamnophis sauritus*)	Special Concern	Special Concern	Special Concern	Eastern Ribbon-snakes are semi-aquatic and found in a variety of wetland habitats with both flowing and standing water including marshes, bogs, fens, ponds, lake shorelines and wet meadows (Behler and King 1979; Ernst and Barbour 1989). They are sometimes found in vernal pools and moist woods (Conant 1938). Eastern Ribbon-snakes have been reported or suspected of overwintering in a variety of sites such as dens in grassy pastures (Rossman et al. 1996), ant mounds, vole tunnels and crayfish burrows (Carpenter 1953), Muskrat (Ondatra zibethicus) lodges (Ernst and Barbour 1989), and underground tunnels at rocky forested sites (NS Ribbonsnake Recovery Team 2011) and rocky areas at wetland peripheries.	Low/Medium	Flowing water in the Midtown Creek is found on the project site, as well as occasionally flooded areas of standing water. Potential habitat does exist in the Study Area, although limited.

Species	Ontario Status	COSEWIC Status	Federal SARA Status	Habitat Requirements	Likelihood of Occurrence	Site Area Suitability/Observations
Eastern Milksnake (*Lampropeltis triangulum*)	Not Listed	Special Concern	Special Concern	The Eastern Milksnake is quite often found in prairies, meadows, pastures, hayfields, rock outcrops, and rocky hillsides. The Eastern Milksnake can also be found in a variety of forest types such as deciduous forests, pine plantations, bog forests, pine forests, and mixed pine-hardwoods. In Ontario, this snake is also found in the edge habitat of these woods in areas such as power-line cuts and railway embankments.	Low/Negligible	While there is some forest edge habitat on the subject property as well as a rail line, neither prairie or rocky areas are located on the subject property and, as such, Eastern Milksnake habitat in the Study Area is limited.

Common Five-lined Skink (*Plestiodon fasciatus*)	Special Concern (Great Lakes/St. Lawrence Population)	Special Concern	Special Concern	The Common Five-lined Skink is largely limited to the southern edge of the Canadian Shield. Within this area, Common Five-lined Skinks are generally restricted to rocky outcrops in an area of mixed coniferous or deciduous forest (Howes and Lougheed 2004). The presence of loose cover rocks on the exposed bedrock was the most important variable in predicting the presence of Common Five-lined Skinks (Howes and Lougheed 2004). In general, Common Five-lined Skinks selected rocks that were longer than average (55.2 ± 2.1 cm) and in more open areas than randomly selected areas (Quirt et al. 2006). Additionally, rocks on a bedrock substrate were commonly used. This species has also been found to be associated with permanent or temporary sources of water, including ponds, streams or even temporary pools in rock outcrops (Lang 1982).	Low	No Common Five-lined Skinks were observed at the time of the field investigations, habitat requirements are limited throughout the Study Area.
Midland Painted Turtle (*Chrysemys picta marginata)*	Not Listed	Special Concern	No Status	Painted turtles inhabit waterbodies, such as ponds, marshes, lakes and slow-moving creeks that have a soft	Low	While no open water wetlands are located on the subject property, there is woody material within the

Species	Ontario Status	COSEWIC Status	Federal SARA Status	Habitat Requirements	Likelihood of Occurrence	Site Area Suitability/Observations
				bottom and provide abundant basking sites and aquatic vegetation. These turtles often bask on shorelines or on logs and rocks that protrude from the water. The midland painted turtle hibernates on the bottom of waterbodies.		channel of Midtown creek. The substrate of the creek is also comprised primarily of silt providing a soft bottom as preferred by the Midland painted Turtle.
Snapping Turtle (*Chelydra serpentine*)	Special Concern	Special Concern	Special Concern	Slow-moving water with a soft mud bottom and dense aquatic vegetation. Established populations are most often located in ponds, sloughs, shallow bays or river edges and slow streams, or areas combining several types of wetland habitat (Harding 1997).	Low	No dense aquatic vegetation is located in the Study Area., nor are there several types of wetlands or standing open water.

6.0 Mitigation

The proposed development includes the construction of an online flood ponding area between the Canada Pallet Railway Spur and Kerr Street to deal with any overflow during periods of high flows. This requires the entire Study Area to be cleared of all vegetation, the existing fish habitat within and surrounding Midtown Creek to be removed and a new stream channel to be designed. As such, all impacts to the natural environment should be addressed and appropriate mitigation measures should be implemented prior to any work being completed.

To address any potential impacts to the natural environment, or any potential wildlife species of conservation concern which may reside in the area (**Table 6 - Species at Risk (SAR) Screening Assessment**), the following mitigation measures should be implemented:

6.1 Turtles

Although no turtles were observed on site, turtle habitat is present both in Midtown Creek and the two (2) wetland communities. To prevent impact on local turtle populations that may utilize this habitat, the following mitigation measures are recommended:

- If work is to be completed during the turtle breeding season (May 1 – July 30), turtle exclusionary fencing should be installed around the watercourse to exclude turtles from the work areas prior to May 1.
- Protection of nesting sites in close proximity to the construction site.

6.2 Breeding Birds

Any clearing of trees or vegetation poses potential impacts on nesting birds. These impacts can come directly from construction equipment or through construction activities such as removal, clearing, or grubbing of trees or riparian vegetation communities. The following mitigation measures relating to breeding birds should be applied to any vegetation removal:

- Any tree removal must occur outside of the breeding bird timing window (May 1 to August 31).
- If tree or vegetation removal is necessary during the timing window, a nest sweep must be completed by a trained biologist prior to construction activities.
- If any nests are found subsequent to the nest sweep, construction activities should cease and a 15 m buffer should be applied to the area surrounding the nest. The buffer should remain until all young have fledged.

6.3 Fish

Fisheries and Oceans Canada (DFO) will receive a Request for Review package with respect to this project. Upon review from DFO, the project will be able to proceed as submitted or a Fisheries Act Authorization will be required. Based on the quality of the existing habitat and proposed upgrades to the entire reach, Wills staff anticipate that DFO will approve the project without requiring a Fisheries Act Authorization. Outlined in the submission to DFO include the mitigation measures, construction details, planting plans and overall benefits to Midtown Creek and the fishery. Wills recommends that no construction activities take place until DFO has made a decision on the project.

Proposed work includes a watercourse realignment that will increase the amount of fish habitat, provide increased opportunity for fish passage across the site, and provide better quality habitat for both warm and coldwater species.

6.4 Wetlands

Site development will result in an unavoidable impact to wetland function within approximately 0.34 ha (3,432 m^2) of existing wetland area. The Conservation Authorities Act 168/06 prohibits development in any wetland. However, development can be granted under the discretion of the Conservation Authority, provided that habitat is created (compensated) at a rate of 2:1. Concurrent with the submission of this report, a Wetland Compensation Plan (WCP) will be submitted to the GRCA detailing the proposed plan to compensate for the lost wetland habitat. The WCP will outline the design specifications, as well as, subsequent monitoring required to ensure successful completion of the project.

6.5 Sediment and Erosion Control Monitoring

An Erosion and Sediment Control Plan (ESCP) should be developed and implemented to minimize the risk of sedimentation into the creek during all phases of the Project. Erosion and sediment control measures should be maintained until all disturbed ground has been permanently stabilized and runoff water is clear. The plan should include:

- Installation of erosion and sediment control measures (e.g. sediment fences) before construction activities commence to prevent soil deposition into Midtown Creek.
- Any construction activities and staging areas will be isolated from Midtown Creek.
- Waste material should be contained and stabilized above the high water mark. Alternatively, waste materials should be removed off-site.
- Inspection and maintenance of erosion and sediment control measures and structures should take place during the course of construction. This should occur on a weekly basis and before/ after significant rain events.

- Erosion and sediment control measures and structures should be repaired, if damage occurs.
- Non-biodegradable erosion and sediment control materials are to be removed after all disturbed ground has been permanently stabilized.
- Site isolation measures for containing stockpiled material should be implemented.
- All equipment operating near the watercourse shall be properly maintained in order to avoid contaminant leakage.
- A response plan should be developed that will be implemented immediately in the event of a sediment release or spill of a deleterious substance.
- An emergency spill response kit, including the appropriate absorbency materials, will be on site at all times. Proper containment, clean up and reporting, in accordance with provincial requirements, is required.
- All necessary precautions must be taken to prevent the accumulation of litter and construction debris within any natural areas outside of the construction limits. Daily inspections and clean-up must take place. A log is to be maintained.
- Measures for managing water flowing onto the site, as well as water being pumped / diverted from the site such that sediment is filtered out prior to the water entering a waterbody. For example, pumping/diversion of water to a vegetated area, construction of a settling basin or other filtration system.

7.0 Conclusions

Given the results of on-site investigations and background reviews, Wills is of the opinion that the proposed development will result in a net environmental benefit to the site and will provide flood control. Long-term adverse impacts to natural heritage features, associated habitat, and local wildlife populations are not anticipated to be resultant from the Project provided that successful compensation is achieved and mitigation measures outlined herein, as well as in the subsequent documents, are implemented. Appropriate execution of the mitigation measures outlined herein will ensure that proposed activities do not conflict with the natural heritage policies set out by the Town of Cobourg, or the Province of Ontario (Provincial Policy Statement, 2014) or other relevant environmental legislation (Endangered Species Act, 2007, Fisheries Act, 1985).

If you have any further questions please do not hesitate to contact the undersigned.

Respectfully submitted,

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BM/TJ/af

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Appendix A

Statement of Limitations

Statement of Limitations

This report is provided solely for the benefit of the Town of Cobourg and not for the benefit of any other party. No other party shall be entitled to rely on this report or any information, documents, records, data, interpretations, advice or opinions or other materials given to the Town of Cobourg by D.M. Wills Associates Limited (Wills). The report relates solely to the specific project for which Wills has been retained and shall not be used or relied upon by any third party for any variation or extension of this project or any other purpose. Any unpermitted use by any third party shall be at such party's own risk.

The conclusions and recommendations outlined in the Environmental Impact Study are based on the results and findings associated with the scope of field investigations as outlined in **Section 4.2.1** of this report, as they relate to The Project, as described in **Section 1.0**.

Appendix B

Supporting Documents

Ganaraska Region Conservation Authority
Midtown Creek Fisheries Assessment

Prepared By:
Brian Morrison, B.Sc., Fisheries Biologist
Ganaraska Region Conservation Authority

December 20, 2016

1.0 Fisheries Assessment Background

Midtown Creek is classified as 'coldwater' under the Ontario Ministry of Natural Resources – Peterborough District's Coldwater Streams Strategy, and contain sensitive species such as Brook Trout (*Salvelinus fontinalis*), Rainbow Trout (*Oncorhynchus mykiss*), Mottled Sculpin (*Cottus Bairdii*), and lamprey species (*Lampetra* sp.).

Sampling was conducted by a minimum of two staff from the Ganaraska Region Conservation Authority (GRCA) using the Ontario Stream Assessment Protocol (OSAP) single pass electrofishing module, or spot sampling to determine presence/absence of different fish species. All fish were identified to species, counted, and a total weight per species was collected and used to calculate density (number per m^2) and biomass (weight per m^2) of each species for each sampling location for OSAP sites, or just presence/absence noted. General field conditions were also noted, including dominant stream substrate, and indicators of groundwater inputs into the active channel (e.g., watercress). Fisheries data utilized within this assessment were assimilated from 2003, 2006, 2012, and 2016 with all existing information (2003, 2006, 2012) relative to the assessment undertaken (Figure 1).

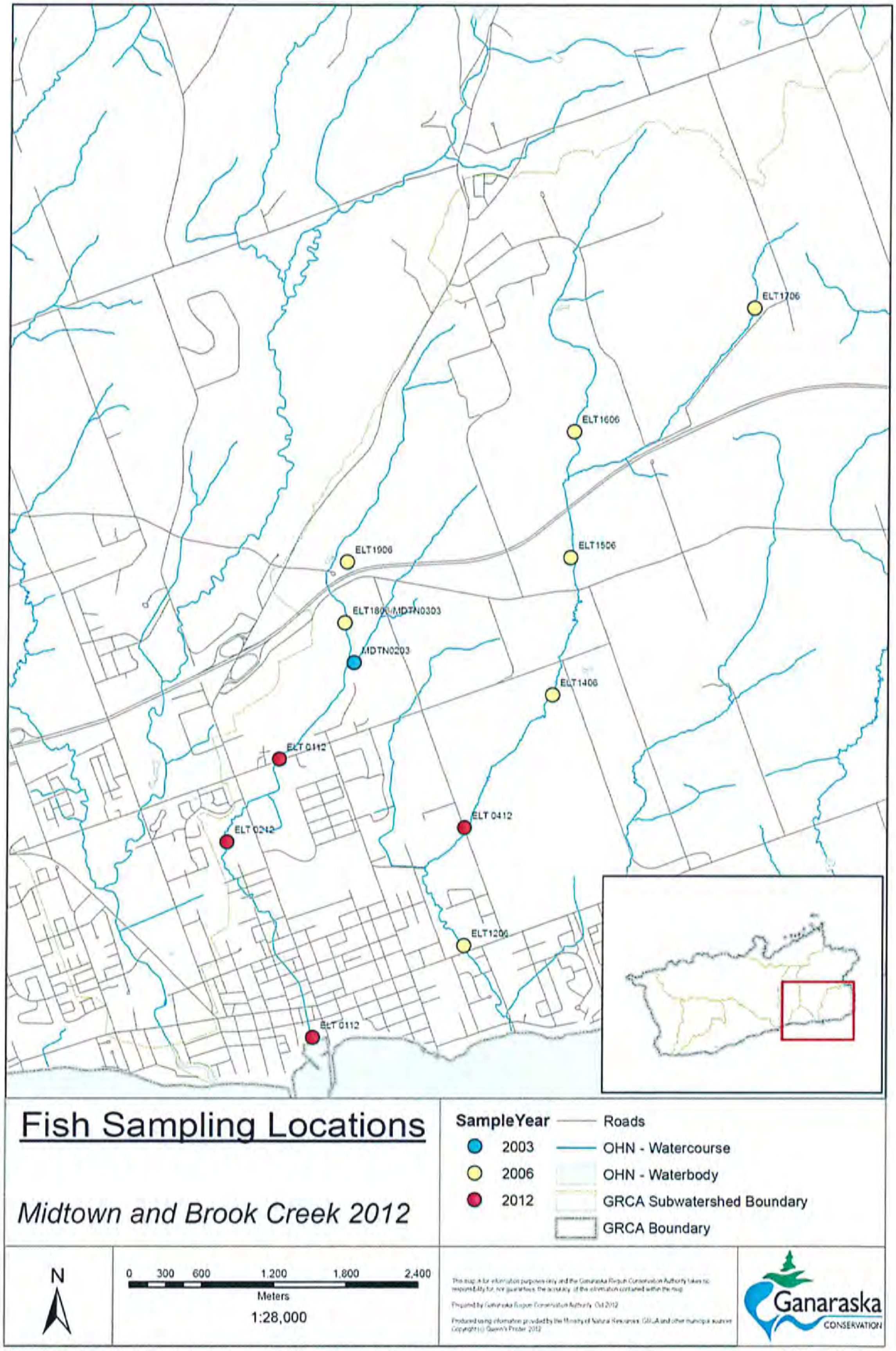


Figure 1. Fisheries monitoring locations in Midtown Creek

1.1 Midtown Creek

Midtown Creek is a small 6.4 km^2 coldwater watercourse. The GRCA had three existing sampling sites on Midtown Creek from 2006, with all three capturing coldwater species. Three additional sites were sampled during the 2012 summer period on Midtown Creek and two additional sites in the fall of 2016 (Figure 1). Brook Trout were captured at five of the eight sites, with Brook Trout being absent at the site at the downstream section of Midtown Creek, below the buried section flowing under downtown Cobourg. Rainbow Trout were captured at six sites, with juveniles captures upstream of the buried section of creek. This indicates that adult Rainbow Trout are capable of migrating upstream through the buried section of Midtown Creek to approximately Highway 401.

ELT 0112

This site is at the downstream extent of Midtown Creek. The site is downstream of a buried section of Midtown Creek, which may preclude upstream passage of certain groups of fish (e.g. cyprinids, centrarchids). The site is characterized as a riffle/pool morphology, with gravel, cobble substrate. Watercress was also present at this site. Coldwater species were captured at this site, including Rainbow Trout, Mottled Sculpin, and Atlantic Salmon (*Salmo salar*). All of the Rainbow Trout captured were young-of-the-year, indicating that there may be poor habitat for age 1+ fish. Two juvenile Atlantic Salmon were captured at the lowest site on Midtown Creek. At this time, it is unknown if these were strays from nearby Cobourg Creek, a stocking location for Atlantic Salmon, or if they were naturally produced within Midtown Creek. In addition to coldwater species, sensitive warmwater species were also present. These include juvenile Smallmouth Bass (*Micropterus dolomieu*) and adult Pumpkinseed (*Lepomis gibbosus*). In addition to the noted fish species, crayfish and tadpoles were also observed at this site. Creek Chub had the highest density (Figure 2), while Creek Chub (*Semotilus atromaculatus*) and Blacknose Dace (*Rhinichthys atratulus*) had the highest biomass (Figure 3) at this site.

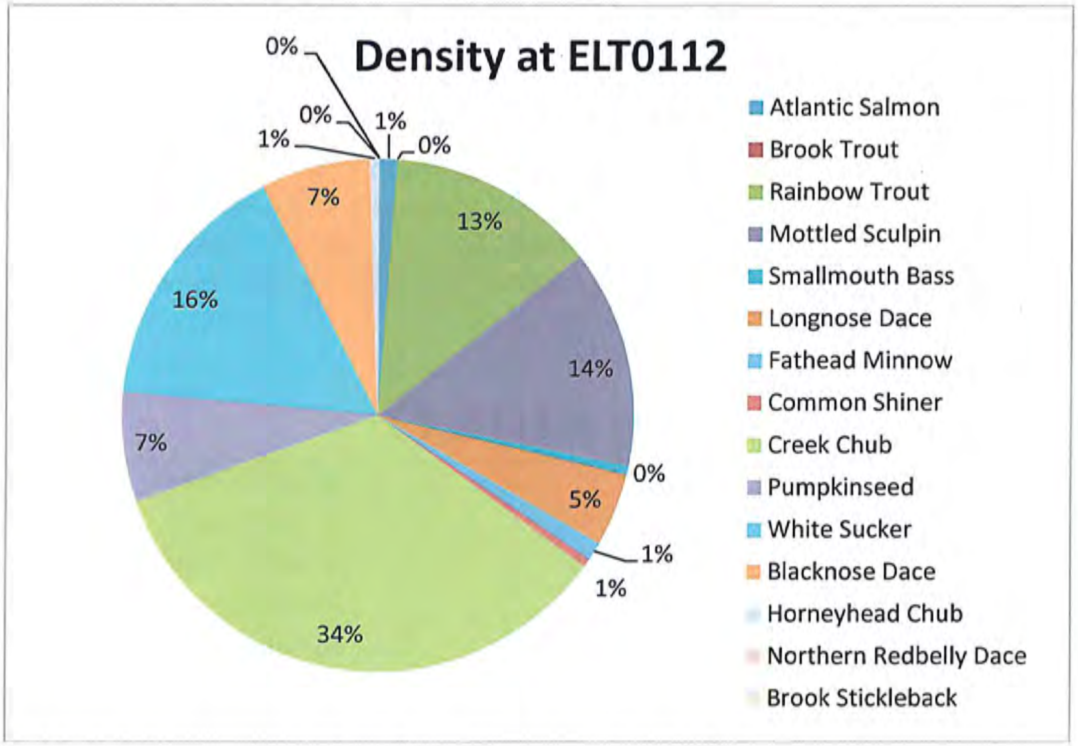


Figure 2. Fish species density (number/m^2) at site ELT 0112

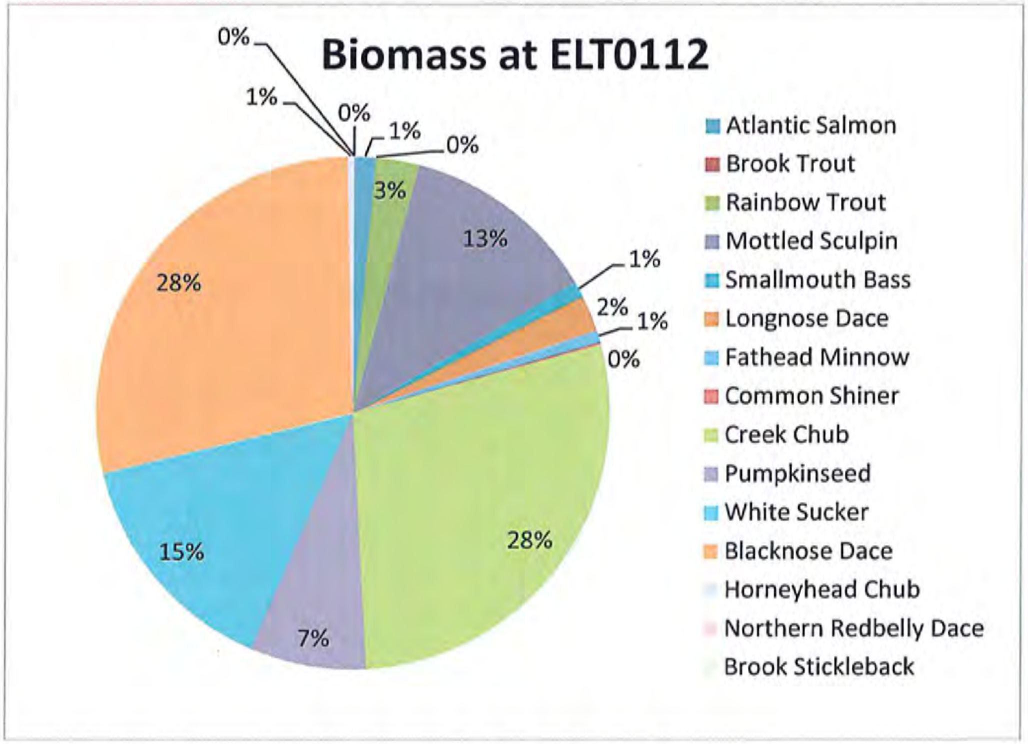


Figure 3. Fish biomass (g/m^2) density at site ELT 0112

ELT 0212

This site is located behind the Canadian Pallet Factory, immediately downstream from a railway line spur. This site is characterized by large amounts of silt, low gradient, and lack of defined riffles, with moderate amounts of woody material within the channel. Watercress was observed upstream from the site. One Brook Trout was captured at this site. The rest of the species captured were tolerant cyprinids, including Fathead Minnow (*Pimephales promelas*), Creek Chub, and Blacknose Dace. Creek Chub had the highest density (Figure 4), while White Sucker had the highest biomass (Figure 5).

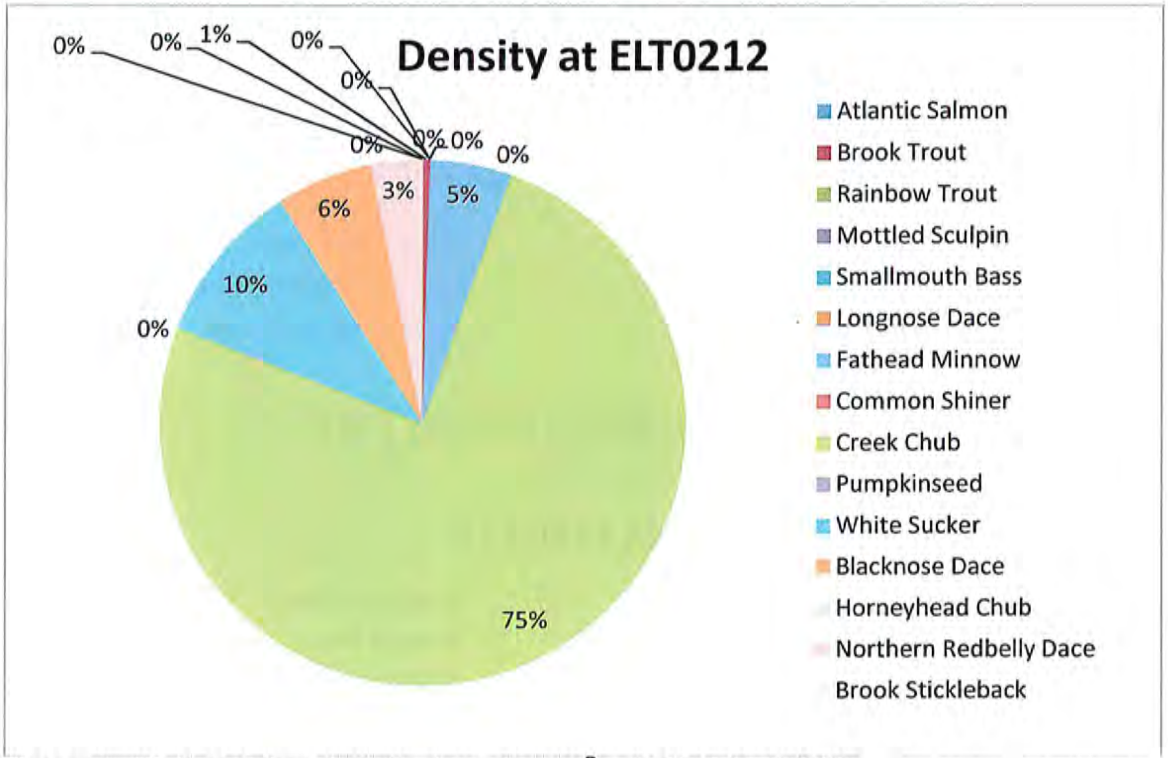


Figure 4. Fish species density (number/m^2) at site ELT 0212

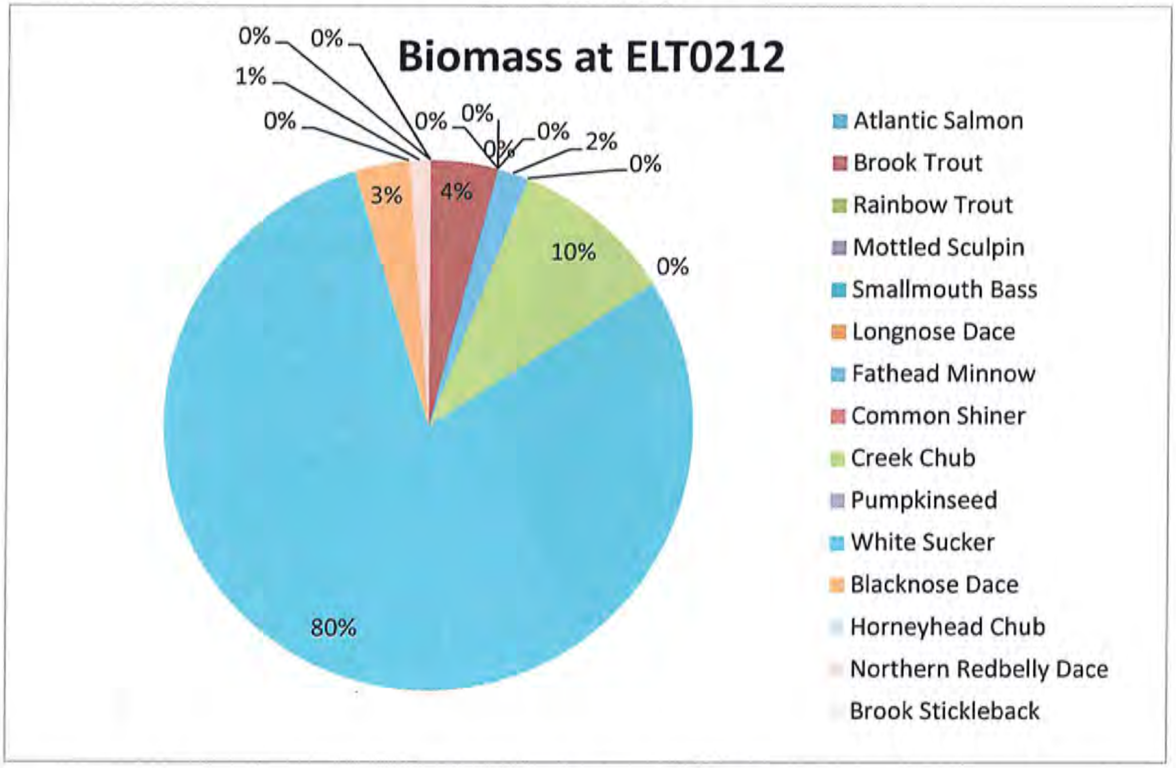


Figure 5. Fish biomass (g/m^2) density at site ELT 0212

ELT 0312

This site is located upstream of Elgin Street. The site is characterized as a riffle/pool morphology, with gravel, sand and silt substrate. Large amounts of watercress are also present at this site. Brook Trout was the dominant species captured at this site, with multiple age classes captured, except young-of-the-year. One age 1+ Rainbow Trout was also captured at this site. Several species of cyprinid were also captured at this site. In addition to these species, one rosy red minnow (*Pimephales promelas*) was captured just downstream from this site, which is a non-native feeder fish aquarium species. Rosy red minnow have also been noted in a stormwater management pond that discharges upstream (east of Birchwood Trail Road) from this sampling location. Frogs were also present at this location. Creek Chub had the highest density at this site (Figure 6), while Brook Trout had the highest biomass (Figure 7).

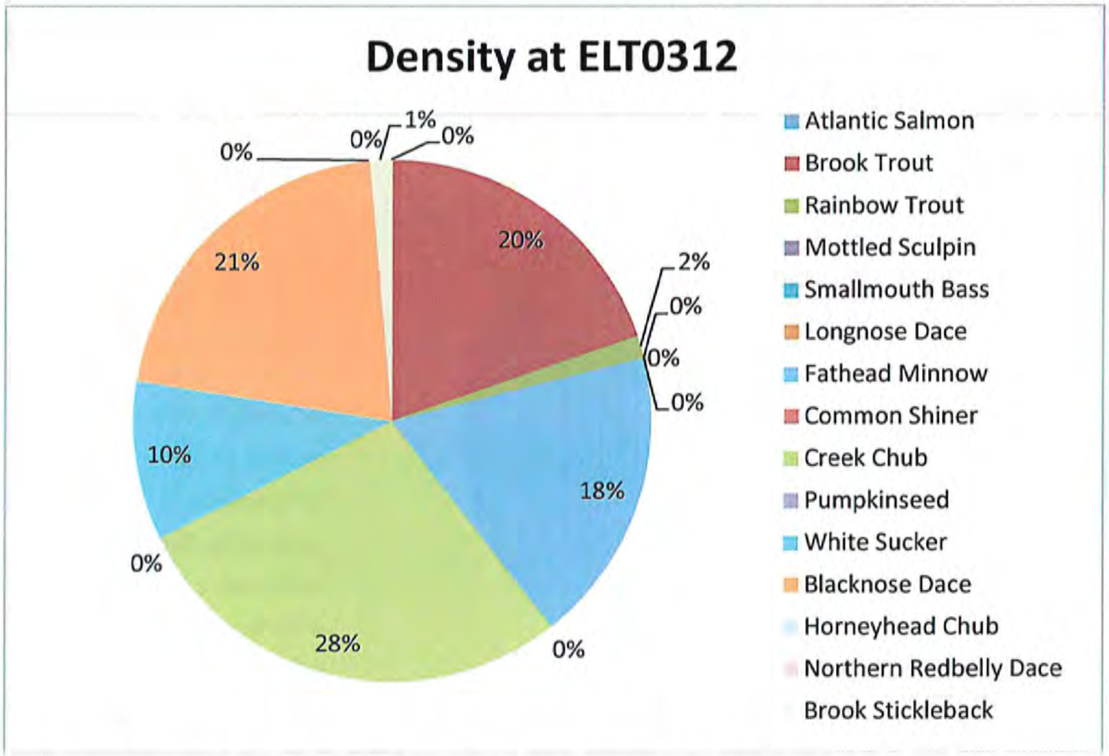


Figure 6. Fish species density (number/m^2) at site ELT 0312

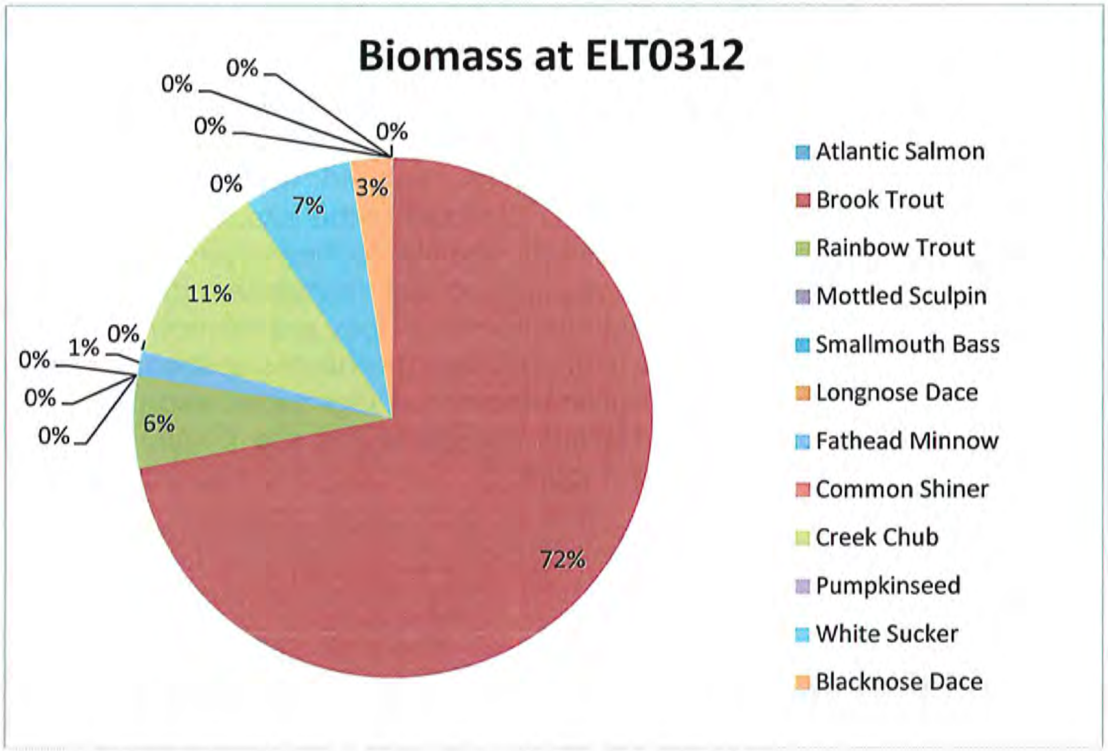


Figure 7. Fish biomass (g/m^2) density at site ELT 0312

2016a

This site is located upstream of Station Street to the unopened allowance at Kerr Street. Creek Chub, Blacknose Dace, White Sucker, and Rainbow Trout were captured at this location. The substrate consisted of a mix of gravel/cobble and sand and silt.

2016b

This site is located upstream of the unopened allowance at Kerr Street to the railway spur behind the Canadian Pallet Factory. Creek Chub, Blacknose Dace, White Sucker, and Rainbow Trout were captured at this location. The substrate consisted primarily of sand and silt, with significant amount of refuse within the channel (e.g. tires, scrap metal, etc.)

Overall, sensitive coldwater species are found throughout Midtown Creek. It is felt that some areas are already showing signs of stress due to degradation of habitat and water quality (e.g. site ELT 0212), and additional stressors may cause the complete loss of coldwater species from these areas, as well as degrade downstream habitats.

The proposed stormwater pond (Figure 8) is located in a well buffered area along Midtown Creek. This areas has aquatic diagnostic indicators of being under stress (high levels of tolerant fish species), but also supports some sensitive coldwater species. This area received urban impacts upstream, which is negatively influencing aquatic community health. The large riparian area helps to buffer these upstream impacts. Additionally, this area serves as a migratory corridor for lake run Rainbow Trout that utilize upstream habitats for spawning and rearing.

It is also noted that existing Stormwater Management Ponds are acting as vectors for the introduction and facilitated colonization of non-native fish species to portions of Midtown Creek (e.g. ponds adjacent Birchwood Trail). Additionally, Midtown Creek has been colonized by juvenile Atlantic Salmon, and is currently acting as a nursery stream. Atlantic Salmon are being actively restored into the Lake Ontario basin and are a priority management species for the Ontario Ministry of Natural Resources and Forestry.

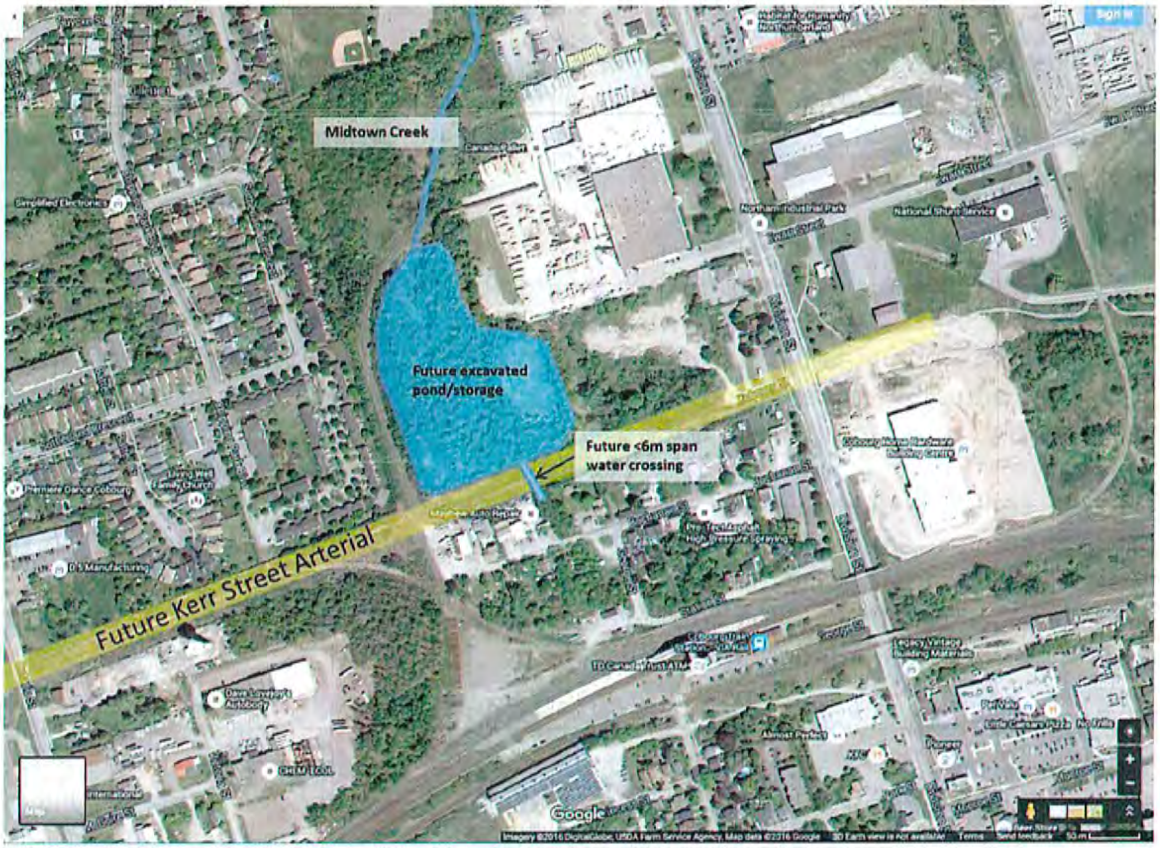


Figure 8. Conceptual Kerr St. Placement and Ponding Area

2.0 Conclusions

The results of this assessment should be taken under consideration when reviewing fisheries considerations against the Midtown Creek flood damage reduction pond conceptual design.

Based upon the assessment undertaken for this report, Midtown Creek is classified as a coldwater watershed, with coldwater species present throughout. The site where the proposed pond is located has undergone degradation, and contains extensive amounts of refuge within the channel and floodplain.

If detailed design work moves forward, and a full environmental assessment required, more detailed information may be required to document and highlight the potential impacts within the plan envelope and receiving waters to fish and aquatic benthic macroinvertebrates. This should also include examining existing and modeled changes to water quality (e.g. thermal regime) and quantity ,to receiving waters, fish passage and fish stranding issues.

Appendix 1: Fish species captured at sampling locations

Site	Species Captured
Midtown Creek	
ELT1806/MDTN0303	Brook Trout, Rainbow Trout, Fathead Minnow, Creek Chub, Blacknose Dace, Brook Stickleback, Lamprey sp.
ELT1906	Brook Trout, Rainbow Trout, Blacknose Dace
MDTN0203	Brook Trout, Creek Chub, Blacknose Dace
ELT 0112	Rainbow Trout, Atlantic Salmon, Mottled Sculpin, Smallmouth Bass, Longnose Dace, Fathead Minnow, Common Shiner, Creek Chub, Pumpkinseed, White Sucker, Blacknose Dace, Hornyhead Chub
ELT 0212	Brook Trout, Fathead Minnow, Creek Chub, White Sucker, Blacknose Dace, Northern Redbelly Dace
ELT 0312	Brook Trout, Rainbow Trout, Fathead Minnow, Creek Chub, White Sucker, Blacknose Dace, Brook Stickleback
2016a	Rainbow Trout, Creek Chub, White Sucker, Blacknose Dace
2016b	Rainbow Trout, Creek Chub, White Sucker, Blacknose Dace

Ganaraska
CONSERVATION

Cobourg
Ontario, Canada

Midtown Creek Terrestrial Ecology Study, 2016

Ken Towle, M.E.S., Terrestrial Ecologist

Background

A flood detention pond is being considered for Midtown Creek north of the railway tracks and just west of the Canada Pallet factory to eliminate chronic flooding in the Buchanan Street and George Street area and to eliminate the threat of flooding of properties and businesses in the flood plain further downstream into the downtown. The detention pond would protect homes and businesses in the Midtown Creek flood plain lands all the way from Canada Pallet south to the harbour including the core downtown area.

The construction of Kerr Street from Westwood Drive to D'Arcy Street is a recommendation in the Town's Transportation Master Plan to alleviate future east-west traffic congestion. The subject extension of Kerr Street will aid in the construction of flood protection however it is not intended to be completed through to Westwood Drive until traffic demands are warranted.

The construction of the roadway on the existing railway bed with a culvert crossing of Midtown Creek will provide the opportunity to control flood water upstream of Kerr Street that currently flood lands between the CPR/CNR railway corridor and Kerr Street. The scope will include a cross culvert that will control flood waters and excavation of a ponding area upstream of the new road to passively attenuate flows. The environmental assessment and design has to include both elements, the roadway and the pond.

Methods

The site was visited on three occasions during July and August 2016. Fieldwork was restricted to mornings to maximize ability to detect breeding birds and other wildlife. Active searching was the method used to record species. All habitat types were accessed and wildlife identified by sight, sound, or sign (e.g., tracks). The focus was vertebrates, with supplemental, although by no means comprehensive data collected on insects (specifically butterflies) and plant species present.

Species were recorded in a field book as encountered. Where there was uncertainty in plant identification, photos were taken and referred to a professional botanist.

Weather Conditions

Annual weather patterns affect both plant growth and wildlife activity. The summer of 2016 was one of the hottest and driest on record, with temperatures soaring to 30 degrees Celsius or more during site visits. As a result, some wildlife activity may have been reduced, making detection difficult. Some species using the site may therefore not have been recorded. For example, no herpetofauna were detected on the site. Snakes could exist there, but were likely inactive due to the heat, while amphibians may have migrated to other areas in search of pooled water. Because the soils and vegetation would have been altered by the drought conditions, the full extent of the wetland on the site was difficult to determine. In a more typical year higher ground moisture would reflect a more extensive and more diverse community of wetland plants.

Landscape Context of Site

The site can be seen as a core area in a network of habitat corridors through the Town of Cobourg (Figure #1). In this case, from Nickerson's Woods, down Midtown Creek to the rail line just south of the site, which provides further habitat linkage to the west to Cobourg Creek through to Carr's Marsh. The Kerr Street arterial corridor supplements this habitat connectivity, creating further linkage to the habitats in Cobourg Conservation Area and south to Cobourg Harbour. Although these linkages are to some degree limited because of major arterial roads such as Elgin Street, Division Street, Ontario Street and William Street, there will nevertheless be movement of some terrestrial species through the network, particularly at night when traffic is at low volume. Species that fly, such as birds and insects, will make full use of the habitat connectivity, and the ecological processes and services they provide, such as pollination and seed dispersal, will follow them.

Figure #1: Habitat corridor network through the Town of Cobourg

Vegetation Communities

Vegetation communities were classified to the most detailed level possible according the Ecological Land Classification (ELC) System for Southern Ontario (Lee et al. 1998). These are presented in Map #1.

The inconsistency of the soil types, combined with the drainage patterns and human disturbance, have influenced the vegetation that has become established. For example, much of the Kerr Street Arterial is made up of sandy soils, and many of the plant species reflect the dry conditions associated with these. In some cases the unnatural soil regime has resulted in corresponding unnatural or "cultural" combinations of vegetation which do not directly match any defined ELC categories.

The largest vegetation community on the site is Fresh-Moist Lowland Deciduous Forest (ELC classification FOD7). This corresponds to the riparian zone of the stream which is subject to flooding. The dominant tree species here are Manitoba Maple (*Acer negundo*) and Crack Willow (*Salix fragilis*) with a dense ground layer dominated by Wild Red Currant (*Ribes triste*) and Tall Meadow Rue (*Thalictrum pubescens*). This community is relatively undisturbed by human activity, likely due to the dense nature of the vegetation.

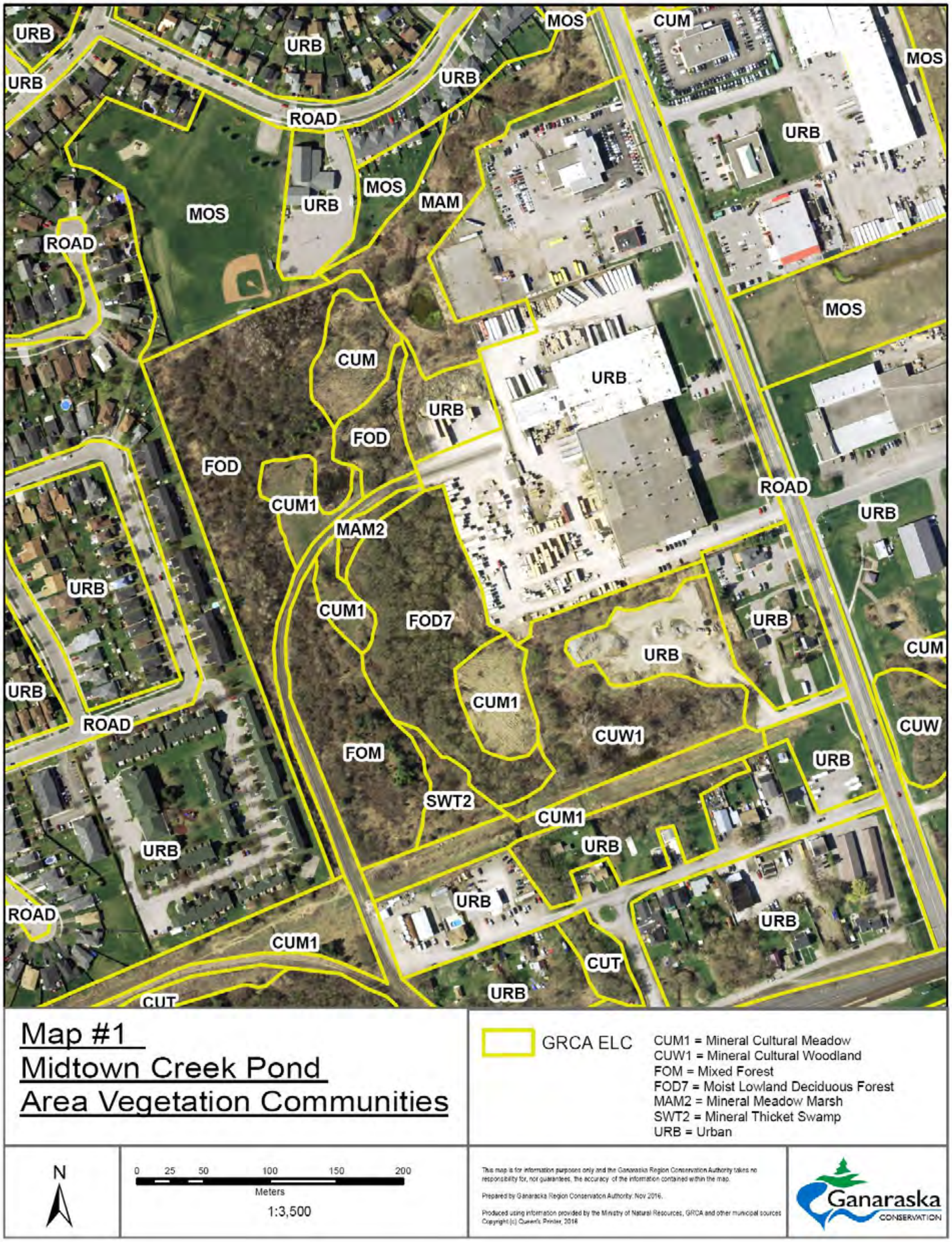
In the south-central portion of the site can be found what can best be defined as a thicket swamp (SWT), although the mix of species in this area does not closely correspond to any defined ELC layer. Dominant shrub species are Red Osier Dogwood (*Cornus serecia*)and Highbush Cranberry (*Viburnum trilobum*), with a herbaceous layer currently dominated by Canada Goldenrod (*Solidago canadensis*), likely due to the 2016 dry conditions, interspersed with moist soil preferring species such as Boneset (*Eupatorium perfoliatum*). This vegetation community is relatively undisturbed.

Bordering the rail spur line is a strip of mixed forest (FOM), which due to its unusual mix of trees might also be classified as cultural woodland. This contains a small area dominated by coniferous trees such as Scotch Pine (*Pinus sivestris*), White Pine (*Pinus strobus*) and White Cedar (*Thuja occidentalis*) which may originally have been deliberately planted. Parts of it have been cut, there is evidence of a fire pit and scattered trash and empty beer cans are present, suggesting that it has been used as a meeting place by local youth. Other parts of this woodland feature more recent successional growth of deciduous tree species such as poplar and Choke Cherry (*Prunus virginiana*).

Between the mixed forest and the lowland deciduous forest, directly south of the spur line, are two small open vegetation communities. One of these is a cultural meadow (CUM) containing a mix of grasses and wildflowers such as Black-eyed Susan (*Rudbeckia hirta*) and Spreading Dogbane (*Apocynum androsaemifolium*), as well as invasive honeysuckle shrubs. Adjacent to this, where the soil contains more loam and is moist, there is a small meadow marsh that features such wet meadow species as Spotted Joe-Pye Weed *Eutrochium maculatum*) and Blue Vervain (*Verbena hastata*). This small wetland area is in good condition, although some Himalayan Balsam (*Impatiens glandulifera*) is present. This invasive plant could spread rapidly throughout the moist area if not removed.

Bordering the south end of the site is the Kerr Street Arterial. This is currently dominated by open cultural meadow (CUM), and because of the sandy soils is extremely dry, as evidenced by the presence of Hoary Vervain (*Verbena stricta*), a species often found in tallgrass prairies. The area is fairly disturbed and contains a large patch of the highly invasive Pale Swallowwort or Dog-strangling Vine (*Cynanchum rossicum*) is located here adjacent to the rail line. Spotted Knapweed (*Centaurea maculosa*), another invasive plant that is typical of sandy areas, was also found here.

On the east side of Midtown Creek, directly south of Canada Pallet yard is another cultural meadow that is surrounded by cultural woodland. This area is noteworthy for the sign of heavy use by coyotes. The woodland itself is dominated by Black Locust (*Robinia pseudoacacia*) and Manitoba Maple (*Acer negundo*), both early successional invasive tree species. A narrow hydro corridor runs north and south through the cultural woodland, and contains considerable trash and wood cuttings. Noteworthy here is the presence of Black Swallowwort (*Cynanchum louiseae*). While still considered invasive, this variety of Dog-strangling Vine is locally uncommon.



Map 1: Vegetation Communities

Species

Six mammal species were recorded on the site, all of which are relatively common. Of particular interest were the hairy-tailed mole and the coyote. The former prefers woodlands with sandy soils and was found dead on the Kerr Street right of way, where these soil conditions are present. Although not seen, signs of coyote were present in the cultural meadow and cultural woodland on the east side of the site. Here, in addition to scat, the skulls and bones of one raccoon and at least two house cats were observed, along with trampled grass and digging in the woodland. These signs indicate that coyotes had a den and were rearing their pups on the site.

A total of 18 bird species were recorded using the site, all of which are likely breeding there given the presence of their required habitat conditions. Common yellowthroat, a warbler that prefers thicket swamps, was observed, indicating the presence of that habitat. Yellow warbler and gray catbird, species that are typical of wetlands and riparian forest were also present, the latter in abundance. Blue gray gnatcatcher, a riparian forest species that has recently been expanding its range to the north, was also recorded.

No amphibians were recorded at the site. This may have been due to the extreme heat and dry conditions. These animals may have been taking shelter or had moved on in search of standing water.

One reptile species, a Northern Redbelly Snake (*Storeria occipitomaculata*) was observed on the site by GRCA staff. This is a common species within the province, and it is often found in natural features within urban areas.

Twelve species of butterflies were recorded during the field surveys. Of these the Monarch is worthy of mention due to its status as a species at risk. However, although milkweed was present on site, there was no evidence that the species is breeding here.

Conclusions

Although there is a high diversity of vegetation community types on the site, none of these is significant with respect to rarity. Most of the relatively natural woodland is early successional, and some is highly disturbed. The remainder is cultural woodland dominated by invasive tree species. The open areas are cultural meadow and highly disturbed.

The wetland communities on the site, specifically the meadow marsh and the thicket swamp, are of higher quality, and are dominated by a greater diversity of native plant species. These communities provide the highest wildlife values in that they support the most sensitive and habitat-specialist plant and vertebrate species.

With the exception of the Monarch, none of the species recorded on the site is provincially significant. The Monarch is listed as a “special concern” species; however there was no evidence of breeding on the site, and given the time of year the adult observed was likely a migrant. All other species can be considered fairly common to abundant. However, it should be emphasized that the 2016 field season was exceptionally hot and dry, restricting some wildlife activity. There are undoubtedly other species of insects, breeding birds, and possibly breeding amphibians that were not detected. It is therefore recommended that further fieldwork be undertaken in the Spring and early summer should the opportunity arise.

The landscape context of the natural features on this site essentially provides a core habitat function within a network of other natural features partially linked by habitat corridors and running all the way through the Town of Cobourg. The area provides a refuge within an otherwise urban landscape for some sensitive wildlife species and the diversity of wildflowers supports many insect pollinators. Although the connectivity function for some species may be restricted by roads, it is nevertheless present for many. Any actions taken at the site should take into consideration this core area function for biodiversity and the potential to improve it, as well as recreational and aesthetic values such a future greenway might provide.

Midtown Creek Study Area Species Lists

Mammals

Hairy-tailed Mole (*Parascaclops breweri*)
Eastern Cottontail (*Sylvilagus floridanus*)
Eastern Chipmunk (*Tamias striatus*)
Eastern Gray Squirrel (*Sciurus carolinensis*)
Coyote (*Canis latrans*)
Common Raccoon (*Procyon lotor*)

Birds

Mourning Dove (*Zeneida macroura*)
Northern Flicker (*Colaptes auratus*)
Downy Woodpecker (*Picoides pubescens*)
Red-eyed Vireo (*Vireo olivaceus*)
Warbling Vireo (*Vireo gilvus*)
Blue Jay (*Cyanocitta cristata*)
American Crow (*Corvus brachyrhynchos*)
Black-capped Chickadee (*Poecile atricapillus*)
House Wren (*Troglodytes aedon*)
Blue-gray Gnatcatcher (*Polioptila nigriceps*)
American Robin (*Turdus migratorius*)
Gray Catbird (*Dumetella carolinensis*)
Yellow Warbler (*Setophaga petechia*)
Common Yellowthroat (*Geothlypis trichas*)
Song Sparrow (*Melospiza melodia*)
Northern Cardinal (*Cardinalis cardinalis*)
Common Grackle (*Quiscalus quiscula*)
American Goldfinch (*Carduelis tristis*)

Butterflies

Black Swallowtail (Papilio polyxenes)
Clouded Sulphur (Colias philodice)
European Cabbage (Pieris rapae)
Summer Azure (*Celastrina neglecta*)
Monarch (Danaus plexippus)
Northern Crescent (Phyciodes cocyta)
Common Ringlet (Coenonympha tullia)
Common Wood Nymph (Cercyonis pegala)
Silver-spotted Skipper (Epargyreus clarus)
Juvenal’s Duskywing (Erynnis juvenalis)

Wild Indigo Duskywing (Erynnis baptisiae)
Dun Skipper (Euphyes vestries)

Plants

Trees, Shrubs and Vines
Eastern White Pine (*Pinus strobus*)
Scots Pine (*Pinus sylvestris*)
Northern White Cedar (*Thuja occidentalis*)
Eastern Redcedar (*Juniperus virginiana*)
Green Ash (*Fraxinus pennsylvanica*)
Manitoba Maple (*Acer negundo*)*
Sugar Maple (*Acer saccharum*)
Norway Maple (*Acer platanoides*)*
Trembling Aspen (*Populus tremuloides*)
European White Poplar (*Populus alba*)*
European White Birch (*Butula pendula*)
Black Locust (*Robinia pseudoacacia*)*
Common Blackberry (*Rubus allegheniensis*)
Wild Red Currant (*Ribes triste*)
Red Osier Dogwood (*Cornus stolonifera*)
Gray Dogwood (*Cornus racemosa*)
European Buckthorn (*Rhamnus cathartica*)*
Staghorn Sumac (*Rhus typhina*)
Choke Cherry (*Prunus vi rginiana*)
Slippery Elm (*Ulmus rubra*)
Crack Willow (*Salix fragilis*)
Tartarian Honeysuckle (*Lonicera tartarica*)*
Poison Ivy (*Rhus radicans*)
Riverbank Grape (*Vitis riparia*)
Virginia Creeper (*Parthenocissus vitacea*)
Highbush Cranberry (*Viburnum trilobum*)

Herbaceous Plants
Narrow-leaved Cattail (*Typha angustifolia*)
Queen Anne's Lace (*Daucus carota*)
Wild Parsnip (*Pastinaca sativa*)*
Spreading Dogbane (*Apocynum androsaemfolium*)
Common Milkweed (*Asclepias syriaca*)
Pale Swallowwort (*Cynanchum rossicum*)*
Black Swallowwort (*Cynanchum nigrum*)*
Stoneseed (*Lithospermum officinale*)
Common Yarrow (*Achillia millefolium*)
Common Ragweed (*Ambrosia artemisiifolia*)
Common Burdock (*Arctium minus*)
Tall Wormwood (*Artemisia campestris*)

Chicory (*Chichorium intybus*)
Canada Thistle (*Cirsium arvense*)*
Horseweed (*Conyza canadensis*)
Philadelphia Fleabane (*Erigeron philedelphicus*)
Creeping Bellflower (*Campanula rapunculoides*)
Spotted Joe-Pye-Weed (*Eupatorium maculatum*)
Boneset (*Eupatorium perfoliatum*)
Black-eyed Susan (*Rudbeckia hirta*)
Canada Goldenrod (*Soldago canadensis*)
Gray Goldenrod (*Solidago nemoralis*)
New England Aster (*Symphyotrichum novae-angliae*)
Spotted Knapweed (*Centaurea maculosa*)*
Field Sow Thistle (*Sonchus arvensis*)
Common Tansy (*Tanacetum vulgare*)
Common Dandelion (*Taraxacum officinal*)
Spotted Jewelweed (*Impatiens capensis*)
Himalayan Balsam (*Impatiens glandulifera*)*
Viper's Bugloss (*Echium vulgare*)
Bouncing Bet (*Saponaria officinalis*)
Wild Cucumber (*Echinocystis lobata*)
Birdsfoot Trefoil (*Lotus corniculata*)
White Sweet Clover (*Melilotus alba*)*
Cow Vetch (*Vicia cracca*)
Common St. John's Wort (*Hypericum perforatum*)
Heal-All (*Prunella vulgaris*)
Purple Loosestrife (*Lythrum salicaria*)*
Common Plantain (*Plantago major*)
Japanese Knotweed (*Polygonum cuspidatum*)*
Canada Anenome (*Anenome canadensis*)
Thimbleweed (*Anenome virginiana*)
Virgin's Bower (*Clamatis virginiana*)
Tall Meadow Rue (*Thalictrum pubescens*)
Silverweed (*Potentilla anserine*)
Rough Cinquefoil (*Potentilla recta*)
Common Mullein (*Verbascum thapsus*)
Bittersweet Nightshade (*Solanum dulcamara*)
Blue Vervain (*Verbena hastata*)
Hoary Vervain (*Verbena stricta*)

*Invasive species

Appendix C

Biological Inventory Lists

OBBA and Ebirds Data Summary

SCIENTIFIC_NAME	ENGLISH_COMMON_NAME	S_RANK	COSEWIC STATUS	SARO STATUS	OBBA	Ebird
Bonasa umbellus	Ruffed Grouse	S4			Co	
Branta canadensis	Canada Goose	S5			Co	
Anas strepera	Gadwall	S4			Co	
Anas rubripes	American Black Duck	S4			Co	X
Anas platyrhynchos	Mallard	S5			Co	
Anas discors	Blue-winged Teal	S4			Co	
Lophodytes cucullatus	Hooded Merganser	S5B,S5N			Co	
Butorides virescens	Green Heron	S4B			Co	
Circus cyaneus	Northern Harrier	S4B	NAR	NAR	Co	
Accipiter striatus	Sharp-shinned Hawk	S5		NAR	Co	X
Accipiter cooperii	Cooper's Hawk	S4	NAR	NAR	Co	
Buteo jamaicensis	Red-tailed Hawk	S5	NAR	NAR	Co	X
Rallus limicola	Virginia Rail	S5B			Co	
Charadrius vociferus	Killdeer	S5B,S5N			Co	
Actitis macularius	Spotted Sandpiper	S5			Co	
Scolopax minor	American Woodcock	S4B			Co	
Columba livia	Rock Pigeon	SNA			Co	
Zenaida macroura	Mourning Dove	S5			Co	
Bubo virginianus	Great Horned Owl	S4			Co	
Asio otus	Long-eared Owl	S4			Co	
Chaetura pelagica	Chimney Swift	S4B,S4N	THR	THR	Co	
Archilochus colubris	Ruby-throated Hummingbird	S5B			Co	
Megaceryle alcyon	Belted Kingfisher	S4B			Co	X
Melanerpes erythrocephalus	Red-headed Woodpecker	S4B	THR	SC	Co	
Picoides pubescens	Downy Woodpecker	S5			Co	
Colaptes auratus	Northern Flicker	S4B			Co	
Falco sparverius	American Kestrel	S4			Co	
Contopus virens	Eastern Wood-pewee	S4B	SC	SC	Co	X
Empidonax traillii	Willow Flycatcher	S5B			Co	
Empidonax minimus	Least Flycatcher	S4B			Co	
Sayornis phoebe	Eastern Phoebe	S5B			Co	

Myiarchus crinitus	Great Crested Flycatcher	S4B			Co	
Tyrannus tyrannus	Eastern Kingbird	S4B			Co	
Vireo gilvus	Warbling Vireo	S5B			Co	
Vireo olivaceus	Red-eyed Vireo	S5B			Co	X
Cyanocitta cristata	Blue Jay	S5			Co	X
Corvus brachyrhynchos	American Crow	S5B			Co	X
Bombycilla cedrorum	Cedar Waxwing	S5B			Co	
Poecile carolinensis	Carolina Chickadee	SNA			Co	
Eremophila alpestris	Horned Lark	S5B			Co	
Progne subis	Purple Martin	S4B			Co	
Tachycineta bicolor	Tree Swallow	S4B			Co	
Stelgidopteryx serripennis	Northern Rough-winged Swallow	S4B			Co	
Riparia riparia	Bank Swallow	S4B	THR	THR	Co	
Hirundo rustica	Barn Swallow	S4B	THR	THR	Co	
Sitta carolinensis	White-breasted Nuthatch	S5			Co	
Thryothorus ludovicianus	Carolina Wren	S4			Co	
Troglodytes aedon	House Wren	S5B			Co	
Dumetella carolinensis	Gray Catbird	S4B			Co	
Toxostoma rufum	Brown Thrasher	S4B			Co	
Sturnus vulgaris	European Starling	SNA			Co	X
Hylocichla mustelina	Wood Thrush	S4B	THR	SC	Co	
Turdus migratorius	American Robin	S5B			Co	X
Haemorhous mexicanus	House Finch	SNA			Co	
Spinus tristis	American Goldfinch	S5B			Co	X
Geothlypis trichas	Common Yellowthroat	S5B			Co	
Setophaga ruticilla	American Redstart	S5B			Co	
Setophaga petechia	Yellow Warbler	S5B			Co	
Dolichonyx oryzivorus	Bobolink	S4B	THR	THR	Co	
Agelaius phoeniceus	Red-winged Blackbird	S4			Co	
Sturnella magna	Eastern Meadowlark	S4B	THR	THR	Co	
Quiscalus quiscula	Common Grackle	S5B			Co	
Molothrus ater	Brown-headed Cowbird	S4B			Co	
Icterus galbula	Baltimore Oriole	S4B			Co	
Spizella passerina	Chipping Sparrow	S5B			Co	

Spizella pusilla	Field Sparrow	S4B			Co	
Passerculus sandwichensis	Savannah Sparrow	S4B			Co	
Ammodramus savannarum	Grasshopper Sparrow	S4B	SC	SC	Co	
Melospiza melodia	Song Sparrow	S5B			Co	X
Cardinalis cardinalis	Northern Cardinal	S5			Co	
Pheucticus ludovicianus	Rose-breasted Grosbeak	S4B			Co	
Passerina cyanea	Indigo Bunting	S4B			Co	
Meleagris gallopavo	Wild Turkey	S5			Po	X
Cygnus olor	Mute Swan	SNA			Po	
Anas clypeata	Northern Shoveler	S4			Po	
Mergus merganser	Common Merganser	S5B,S5N			Po	
Ardea herodias	Great Blue Heron	S4			Po	
Pandion haliaetus	Osprey	S5B			Po	
Accipiter gentilis	Northern Goshawk	S4	NAR	NAR	Po	
Buteo platypterus	Broad-winged Hawk	S5B			Po	
Gallinago gallinago	Common Snipe				Po	
Chlidonias leucopterus	White-winged Tern	SNA			Po	
Coccyzus erythropthalmus	Black-billed Cuckoo	S5B			Po	
Melanerpes carolinus	Red-bellied Woodpecker	S4			Po	
Sphyrapicus varius	Yellow-bellied Sapsucker	S5B			Po	
Dryocopus pileatus	Pileated Woodpecker	S5			Po	X
Falco columbarius	Merlin	S5B	NAR	NAR	Po	X
Vireo solitarius	Blue-headed Vireo	S5B			Po	
Petrochelidon pyrrhonota	Cliff Swallow	S4B			Po	
Cistothorus platensis	Sedge Wren	S4B	NAR	NAR	Po	
Certhia americana	Brown Creeper	S5B			Po	
Sialia sialis	Eastern Bluebird	S5B	NAR	NAR	Po	
Haemorhous purpureus	Purple Finch	S4B			Po	
Loxia leucoptera	White-winged Crossbill	S5B			Po	
Spinus pinus	Pine Siskin	S4B			Po	
Parkesia noveboracensis	Northern Waterthrush	S5B			Po	
Oreothlypis ruficapilla	Nashville Warbler	S5B			Po	
Setophaga coronata	Yellow-rumped Warbler	S5B			Po	
Cardellina canadensis	Canada Warbler	S4B	THR	SC	Po	

Icterus spurius	Orchard Oriole	S4B			Po
Pipilo erythrophthalmus	Eastern Towhee	S4B			Po
Piranga olivacea	Scarlet Tanager	S4B			Po
Aix sponsa	Wood Duck	S5			Pr
Cathartes aura	Turkey Vulture	S5B			Pr
Porzana carolina	Sora	S4B			Pr
Gallinula chloropus	Common Gallinule	S4B			Pr
Bartramia longicauda	Upland Sandpiper	S4B			Pr
Megascops asio	Eastern Screech-Owl	S4	NAR	NAR	Pr
Chordeiles minor	Common Nighthawk	S4B	THR	SC	Pr
Picoides villosus	Hairy Woodpecker	S5			Pr
Empidonax alnorum	Alder Flycatcher	S5B			Pr
Sitta canadensis	Red-breasted Nuthatch	S5			Pr
Cistothorus palustris	Marsh Wren	S4B			Pr
Polioptila caerulea	Blue-gray Gnatcatcher	S4B			Pr
Mimus polyglottos	Northern Mockingbird	S4			Pr
Catharus fuscescens	Veery	S4B			Pr
Seiurus aurocapilla	Ovenbird	S4B			Pr
Mniotilta varia	Black-and-white Warbler	S5B			Pr
Geothlypis philadelphia	Mourning Warbler	S4B			Pr
Setophaga pensylvanica	Chestnut-sided Warbler	S5B			Pr
Setophaga pinus	Pine Warbler	S5B			Pr
Setophaga virens	Black-throated Green Warbler	S5B			Pr
Spizella pallida	Clay-colored Sparrow	S4B			Pr
Pooecetes gramineus	Vesper Sparrow	S4B			Pr
Melospiza georgiana	Swamp Sparrow	S5B			Pr
Zonotrichia albicollis	White-throated Sparrow	S5B			Pr
Colinus virginianus	Northern Bobwhite	S1	END	END	X
Phasianus colchicus	Ring-necked Pheasant	SNA			X
Anas americana	American Wigeon	S4			X
Anas acuta	Northern Pintail	S5			X
Anas crecca	Green-winged Teal	S4			X
Aythya americana	Redhead	S2B,S4N			X
Aythya collaris	Ring-necked Duck	S5			X

Aythya affinis	Lesser Scaup	S4			X	
Mergus serrator	Red-breasted Merganser	S4B,S5N			X	
Oxyura jamaicensis	Ruddy Duck	S4B,S4N			X	
Gavia immer	Common Loon	S5B,S5N	NAR	NAR	X	
Podilymbus podiceps	Pied-billed Grebe	S4B,S4N			X	
Botaurus lentiginosus	American Bittern	S4B			X	
Ixobrychus exilis	Least Bittern	S4B	THR	THR	X	
Ardea alba	Great Egret	S2B			X	
Nycticorax nycticorax	Black-crowned Night-heron	S3B,S3N			X	
Phalacrocorax auritus	Double-crested Cormorant	S5B	NAR	NAR	X	
Buteo lineatus	Red-shouldered Hawk	S4B	SC	NAR	X	
Rallus elegans	King Rail	S2B	END	END	X	
Fulica americana	American Coot	S4B	NAR	NAR	X	
Grus canadensis	Sandhill Crane	S5B			X	
Larus delawarensis	Ring-billed Gull	S5B,S4N			X	X
Larus argentatus	Herring Gull	S5B,S5N			X	
Larus marinus	Great Black-backed Gull	S2B			X	
Hydroprogne caspia	Caspian Tern	S3B	NAR	NAR	X	
Chlidonias niger	Black Tern	S3B	NAR	SC	X	
Coccyzus americanus	Yellow-billed Cuckoo	S4B			X	
Strix varia	Barred Owl	S5			X	X
Asio flammeus	Short-eared Owl	S2N,S4B	SC	SC	X	
Aegolius acadicus	Northern Saw-whet Owl	S4			X	
Antrostomus vociferus	Eastern Whip-poor-will	S4B	THR	THR	X	
Picoides arcticus	Black-backed Woodpecker	S4			X	
Contopus cooperi	Olive-sided Flycatcher	S4B	THR	SC	X	
Lanius ludovicianus	Loggerhead Shrike	S2B	END	END	X	
Vireo flavifrons	Yellow-throated Vireo	S4B			X	
Vireo philadelphicus	Philadelphia Vireo	S5B			X	
Corvus corax	Common Raven	S5			X	
Regulus satrapa	Golden-crowned Kinglet	S5B			X	
Regulus calendula	Ruby-crowned Kinglet	S4B			X	
Troglodytes hiemalis	Winter Wren	S5B			X	
Catharus guttatus	Hermit Thrush	S5B			X	

Passer domesticus	House Sparrow	SNA			X
Pinicola enucleator	Pine Grosbeak	S4B			X
Loxia curvirostra	Red Crossbill	S4B			X
Coccothraustes vespertinus	Evening Grosbeak	S4B			X
Vermivora chrysoptera	Golden-winged Warbler	S4B	THR	SC	X
Vermivora cyanoptera	Blue-winged Warbler	S4B			X
Setophaga citrina	Hooded Warbler	S4B	NAR	NAR	X
Setophaga tigrina	Cape May Warbler	S5B			X
Setophaga cerulea	Cerulean Warbler	S3B	END	THR	X
Setophaga americana	Northern Parula	S4B			X
Setophaga magnolia	Magnolia Warbler	S5B			X
Setophaga fusca	Blackburnian Warbler	S5B			X
Setophaga caerulescens	Black-throated Blue Warbler	S5B			X
Setophaga discolor	Prairie Warbler	S3B	NAR	NAR	X
Sturnella neglecta	Western Meadowlark	S3B			X
Ammodramus henslowii	Henslow's Sparrow	SHB	END	END	X
Melospiza lincolnii	Lincoln's Sparrow	S5B			X
Junco hyemalis	Dark-eyed Junco	S5B			X

ORAA Data Summary

Common Name	Scientific Name	Cosewic	Saro
Frogs			
American Toad	*Anaxyrus americanus*	N/A	N/A
Gray Treefrog	*Hyla versicolor*	N/A	N/A
American Bullfrog	*Lithobates catesbeianus*	N/A	N/A
Green Frog	*Lithobates clamitans*	N/A	N/A
Norther Leopard Frog	*Lithobates pipiens*	N/A	N/A
Wood Frog	*Lithobates sylvaticus*	N/A	N/A
Spring Peeper	*Pseudacris crucifer*	N/A	N/A
Western Chorus Frog	*Pseudacris triseriata*	THR	N/A
Turtles			
Snapping Turtle	*Chelydra serpentina*	SC	SC
Painted Turtle	*Chrysemys picta*	SC	N/A
Snakes			
Eastern Hognose Snake	*Heterodon platirhinos*	THR	THR
Milksnake	*Lampropeltis triangulum*	SC	SC
Smooth Green Snake	*Opheodrys vernalis*	N/A	N/A
Eastern Ribbon Snake	*Thamnophis sauritus sauritus*	SC	SC
Garter Snake	*Thamnophis sirtalis*	N/A	N/A

Wills 2018 Field Investigations

Scientific Name	Common Name
Amphibians	
Anaxyrus americanus	American Toad
Hyla versicolor	Gray Treefrog
Pseudacris crucifer	Spring Peeper
Birds	
Agelaius phoeniceus	Red-winged Blackbird
Bombycilla cedrorum	Cedar Waxwing
Cardinalis cardinalis	Northern Cardinal
Charadrius vociferus	Killdeer
Colaptes auratus	Northern Flicker
Columba livia	Rock Pigeon
Corvus brachyrhynchos	American Crow
Cyanocitta cristata	Blue Jay
Dumetella carolinensis	Gray Catbird
Hirundo rustica	Barn Swallow
Larus argentatus	Herring Gull
Melospiza melodia	Song Sparrow
Molothrus ater	Brown-headed Cowbird
Myiarchus crinitus	Great Crested Flycatcher
Poecile atricapillus	Black-capped Chickadee
Quiscalus quiscula	Common Grackle
Sayornis phoebe	Eastern Phoebe
Seiurus aurocapilla	Ovenbird
Setophaga pensylvanica	Chestnut-sided Warbler
Setophaga petechia	Yellow Warbler
Setophaga ruticilla	American Redstart
Sitta carolinensis	White-breasted Nuthatch
Spinus tristis	American Goldfinch
Spizella passerina	Chipping Sparrow
Spizella pusilla	Field Sparrow
Sturnus vulgaris	European Starling
Turdus migratorius	American Robin
Tyrannus tyrannus	Eastern Kingbird
Zenaida macroura	Mourning Dove
Mammals	
Chiroptera sp.	Bat sp.
Sciurus carolinensis	Eastern Gray Squirrel
Vegetation	
Acer negundo	Manitoba Maple
Acer saccharum	Sugar Maple
Arctium sp.	Burdock sp.
Barbarea vulgaris	Yellow Rocketcress
Carex sp.	Sedge sp.
Cirsium vulgare	Bull Thistle

Cornus racemosa	Gray Dogwood
Cornus sp.	Dogwood sp.
Cynanchum rossicum	Dog-strangling Vine
Daucus carota	Queen Anne's Lace
Echinocystis lobata	Wild Cucumber
Equisetum fluviatile	Water Horsetail
Erigeron sp.	Fleabane sp.
Fallopia japonica	Japanese knotweed
Fragaria virginica	Woodland Strawberry
Hieracium caespitosum	Yellow hawkweed
Hypericum perforatum	St john Wart
Leucanthemum vulgare	Oxeye Daisy
Lonicera sp.	Honeysuckle sp.
Lotus corniculatus	Birds Foot Tefoil
Onoclea sensibilis	Sensitive Fern
Parthenocissus quinquefolia	Virginia Creeper
Plantago major	Common Plantain
Poaceae sp.	Grasses sp.
Ranunculus acris	Field Buttercup
Rhamnus cathartica	European Buckthorn
Rhus typhina	Staghorn Sumac
Rubus idaeus	Red Raspberry
Salix petiolaris	Slender Willow
Salix sp.	Willow sp.
Silene vulgaris	Bladder Campion
Solidago sp.	Goldenrod sp.
Sonchus	Sow Thistle
Taraxacum sp.	Dandelion
Thuja occidentalis	Eastern White Cedar
Toxicodendron radicans	Poison ivy
Tussilago farfara	Colts Foot
Vicia cracca	Cow Vetch
Vitis labrusca	Fox Grape
Vitis riparia	Riverbank Grape

Appendix D

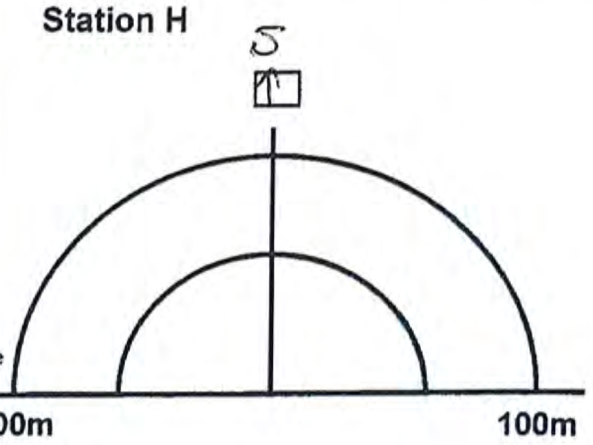
Field Notes

0'266 Midtown Creek ACS 1

LS 1 17T 726609mE 4872573mN

Species	In*	Out*
AMTO		
BCFR		
BULL		
CHFR		
CGTR		
FOTO		
GRTR		
GRFR		
MIFR		
NLFR		
PIFR		
SPPE		
WOFR		

* Check if species calling from inside and/or outside 100-metre station area.



Background Noise: 2/4

Amphibian Data Form

Return by 31 July to Aquatic Surveys Officer, Bird Studies Canada, P.O. Box 160, Port Rowan, Ontario, Canada, N0E 1M0

Please write legibly (in pen).

Observer: Ben Radford, Kyle Plumpton

Route name: LS1

22-05-2018

Date (dd-mm-yr): ~~05-22-2018~~	Visit No.: 1	Start time (24 hr clock): 21:24
Beaufort Wind Scale No.: 0	Cloud Cover (10ths): 9/10	Air Temp (°C or °F): 12°C

Precipitation (check one): None/dry: ✓ Damp/Haze/Fog:_____ Drizzle:_____ Rain:_____

Has the habitat on your route changed from previous years: Yes:_____ No:_____ Not applicable: ✓

Remarks: Factory noise in background. Bat observed flying overhead.

CALL LEVEL CODES
Code 1: Calls not simultaneous, number of individuals can be accurately **counted**
Code 2: Some calls simultaneous, number of individuals can be reliably **estimated**
Code 3: Full chorus, calls continuous and overlapping, number of individuals cannot be reliably estimated

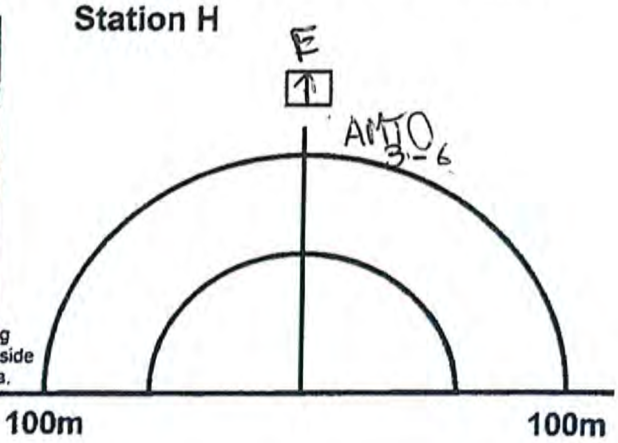
LS2 - at edge of creek

17T 726705mE 4872386mN

Station H

Species	In*	Out*
AMTO		
BCFR		
BULL		
CHFR		
CGTR		
FOTO		
GRTR		
GRFR		
MIFR		
NLFR		
PIFR		
SPPE		
WOFR		

* Check if species calling from inside and/or outside 100-metre station area.



Background Noise: 3/4

Amphibian Data Form

Return by 31 July to Aquatic Surveys Officer, Bird Studies Canada, P.O. Box 160, Port Rowan, Ontario, Canada, N0E 1M0

Please write legibly (in pen).

Observer: Ben Radford, Kyle Plumpton

Route name: LS2

Date (dd-mm-yr): 22-05-2018	Visit No.: 1	Start time (24 hr clock): 21:39
Beaufort Wind Scale No.: 0	Cloud Cover (10ths): 9/10	Air Temp (°C or °F): 12°C

Precipitation (check one): None/dry: ✓ Damp/Haze/Fog:_____ Drizzle:_____ Rain:_____

Has the habitat on your route changed from previous years: Yes:_____ No:_____ Not applicable: ✓

Remarks: Jet, factory noise in background.

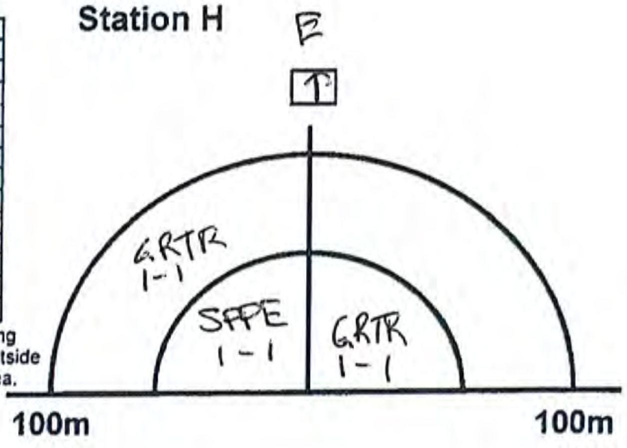
CALL LEVEL CODES
Code 1: Calls not simultaneous, number of individuals can be accurately **counted**
Code 2: Some calls simultaneous, number of individuals can be reliably **estimated**
Code 3: Full chorus, calls continuous and overlapping, number of individuals cannot be reliably estimated

LS3   17T 726809mE 4872403mN

Station H

Species	In*	Out*
AMTO		
BCFR		
BULL		
CHFR		
CGTR		
FOTO		
GRTR		
GRFR		
MIFR		
NLFR		
PIFR		
SPPE		
WOFR		

* Check if species calling from inside and/or outside 100-metre station area.



Background Noise: 2/4

Amphibian Data Form

Return by 31 July to Aquatic Surveys Officer, Bird Studies Canada, P.O. Box 160, Port Rowan, Ontario, Canada, N0E 1M0

Please write legibly (in pen).

Observer: Ben Radford, Kyle Plumpton

Route name: LS3

Date (dd-mm-yr): 22-05-2018	Visit No.: 1	Start time (24 hr clock): 21:49
Beaufort Wind Scale No.: 0	Cloud Cover (10ths): 9/10	Air Temp (°C or °F):

Precipitation (check one): None/dry: ✓ Damp/Haze/Fog:____ Drizzle:____ Rain:____

Has the habitat on your route changed from previous years: Yes:____ No:____ Not applicable: ✓

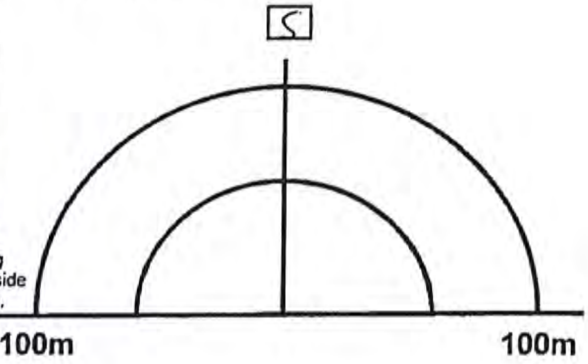
Remarks: Factory noise in background.

CALL LEVEL CODES
Code 1: Calls not simultaneous, number of individuals can be accurately **counted**
Code 2: Some calls simultaneous, number of individuals can be reliably **estimated**
Code 3: Full chorus, calls continuous and overlapping, number of individuals cannot be reliably estimated

Station H

Species	In*	Out*
AMTO		
BCFR		
BULL		
CHFR		
CGTR		
FOTO		
GRTR		
GRFR		
MIFR		
NLFR		
PIFR		
SPPE		
WOFR		

* Check if species calling from inside and/or outside 100-metre station area.



Amphibian Data Form

Return by 31 July to Aquatic Surveys Officer, Bird Studies Canada, P.O. Box 160, Port Rowan, Ontario, Canada, N0E 1M0

Please write legibly (in pen).

Observer: Tyler J. / Shaun F.

Route name: LS1

Date (dd-mm-yr): 19/06/2018

Visit No.: 2

Start time (24 hr clock): 9:30pm

Beaufort Wind Scale No.: 1

Cloud Cover (10ths): 2

Air Temp (°C or °F):

Precipitation (check one): None/dry: ✓ Damp/Haze/Fog:____ Drizzle:____ Rain:____

Has the habitat on your route changed from previous years: Yes: ✓ No:____ Not applicable:____

Remarks: Oven bird - Cleared vegetation in area

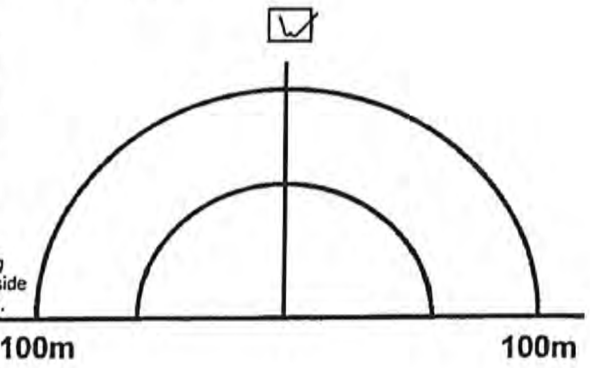
CALL LEVEL CODES
Code 1: Calls not simultaneous, number of individuals can be accurately **counted**
Code 2: Some calls simultaneous, number of individuals can be reliably **estimated**
Code 3: Full chorus, calls continuous and overlapping, number of individuals cannot be reliably estimated

No Frogs Heard

Station H

Species	In*	Out*
AMTO		
BCFR		
BULL		
CHFR		
CGTR		
FOTO		
GRTR		
GRFR		
MIFR		
NLFR		
PIFR		
SPPE		
WOFR		

* Check if species calling from inside <u>and/or</u> outside 100-metre station area.



Amphibian Data Form

Return by 31 July to Aquatic Surveys Officer, Bird Studies Canada, P.O. Box 160, Port Rowan, Ontario, Canada, N0E 1M0

Please write legibly (in pen).

Observer: Tyler J. / Shaun F.
Route name: LS2

Date (dd-mm-yr): 19/06/2018	Visit No.: 2	Start time (24 hr clock): 9:40pm
Beaufort Wind Scale No.: 1	Cloud Cover (10ths): 2	Air Temp (°C or °F): 20°C

Precipitation (check one): None/dry: ✓ Damp/Haze/Fog:____ Drizzle:____ Rain:____

Has the habitat on your route changed from previous years: Yes: ✓ No:____ Not applicable:____

Remarks: Cardinal - Area cleared up to watercourse
Passing Train

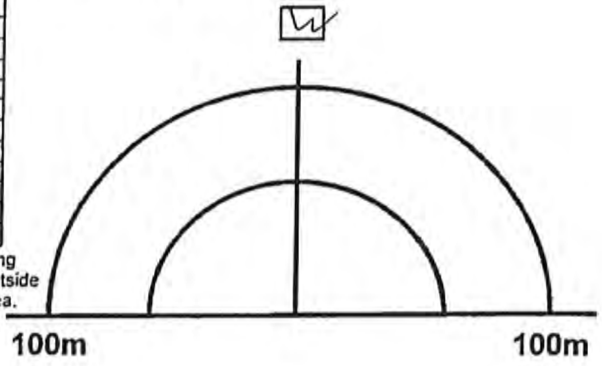
CALL LEVEL CODES
Code 1: Calls not simultaneous, number of individuals can be accurately **counted**
Code 2: Some calls simultaneous, number of individuals can be reliably **estimated**
Code 3: Full chorus, calls continuous and overlapping, number of individuals cannot be reliably estimated

No Frogs heard or observed.

Station H

Species	In*	Out*
AMTO		
BCFR		
BULL		
CHFR		
CGTR		
FOTO		
GRTR		
GRFR		
MIFR		
NLFR		
PIFR		
SPPE		
WOFR		

* Check if species calling from inside <u>and/or</u> outside 100-metre station area.



Amphibian Data Form

Return by 31 July to Aquatic Surveys Officer, Bird Studies Canada, P.O. Box 160, Port Rowan, Ontario, Canada, N0E 1M0

Please write legibly (in pen).

Observer: Tyler J. / Shan T.

Route name: LS3

Date (dd-mm-yr): 19-06-2018

Visit No.: 2

Start time (24 hr clock): 9:50pm

Beaufort Wind Scale No.: 1

Cloud Cover (10ths): 2

Air Temp (°C or °F): 20

Precipitation (check one): None/dry: ✓ Damp/Haze/Fog:_____ Drizzle:_____ Rain:_____

Has the habitat on your route changed from previous years: Yes: ✓ No:_____ Not applicable:_____

Remarks: Cleared vegetation 2m from watercourse.

CALL LEVEL CODES
Code 1: Calls not simultaneous, number of individuals can be accurately **counted**
Code 2: Some calls simultaneous, number of individuals can be reliably **estimated**
Code 3: Full chorus, calls continuous and overlapping, number of individuals cannot be reliably estimated

Land Train in area of floody timber

No Frogs Observed

S200 [illegible] → [illegible] Creek

Ontario Breeding Bird Atlas - Point Count Form - South Central

Zone	Block	Square	Atlasser Number	Atlasser Name	Year
					2 0 0

Point	Designated Number	UTM (if not designated point)	Mon / Day	Start Time (24-hr)	UTM Easting	UTM Northing	Habitat: Class Sub. 1st	Habitat: Class Sub. 2nd	Structure (Optional)	Modification (Optional)
D	01	○ On Road ○ GPS ○ NAD83 ○ Off Road ○ Map ○ NAD27	5/30	07:58						
E	02	○ On Road ○ GPS ○ NAD83 ○ Off Road ○ Map ○ NAD27	5/30	08:10						
F	03	○ On Road ○ GPS ○ NAD83 ○ Off Road ○ Map ○ NAD27	5/30	08:30						

Species Name	Point D <100m	Point D >100m	Point E <100m	Point E >100m	Point F <100m	Point F >100m
Killdeer	✓		✓		✓	
Ring-billed Gull						
Rock Dove	✓					
Mourning Dove	✓					
Downy Woodpecker						
Northern Flicker	✓		✓			
Eastern Wood-Pewee						
Least Flycatcher						
Eastern Phoebe			✓			
Great Crested Flycatcher			✓			
Eastern Kingbird						
Warbling Vireo						
Red-eyed Vireo						
Blue Jay			✓		✓	
American Crow	✓		✓		✓	
Tree Swallow						
Barn Swallow	✓					
Black-capped Chickadee			✓		✓	
White-breasted Nuthatch					✓	
House Wren						
Veery						
Wood Thrush						
American Robin	✓		✓		✓	
Gray Catbird	✓				✓	
Brown Thrasher						
European Starling	✓					
Cedar Waxwing	✓		✓			
Yellow Warbler	✓		✓			
Black-and-white Warbler						
American Redstart	✓		✓			
Ovenbird						
Northern Waterthrush						
Common Yellowthroat						
Scarlet Tanager						
Chipping Sparrow						
Savannah Sparrow						
Song Sparrow	✓		✓		✓	
Swamp Sparrow						
White-throated Sparrow						
Northern Cardinal	✓		✓		✓	
Rose-breasted Grosbeak						
Indigo Bunting						
Bobolink						
Red-winged Blackbird	✓		✓		✓	
Eastern Meadowlark						
Common Grackle						
Brown-headed Cowbird						
Baltimore Oriole						
American Goldfinch	✓		✓		✓	
House Sparrow						

Additional species or species with > 100 individuals

Species Name	Species Code	Point D <100m	Point D >100m	Point E <100m	Point E >100m	Point F <100m	Point F >100m
Chestnut S.d. warbler		✓					
Herring Gull		✓		✓		✓	
Field Sparrow				✓			

This form will be read by computer. Please print neatly with pen or dark pencil (not felt pen) so numbers do not touch lines. Put only one character per box except additional species counts.

Midtown Creek 00 #1

BB01 Loud background noise

7:55am

Rock Dove
American goldfinch
Barn swallow
Mourning Dove
northern Flicker
Starling
Am. Robin
Red wing Blackbird

Gray Catbird
"killdeer" -> far off -> south
"sweet sweet shelel wheat!"
Song sparrow
field sparrow
"zee zee - zee zoo"
/ American Crow

Herring Gull fly over

5268

- Dandelion
- Cow vetch
- Sow thistle

-> Open area trees
-> Dog strangling vine
-> knotweed -> [illegible]
-> Flocks
-> Burdock
-> grasses sp
-> goldenrod sp.

WPT 095 - Cutdown trees -> Dogwood Stumps

-> Tracks through wetland.

WPT Jap 1 Large stand of knotweed 10m x 35m

Jap 2 Spread of knotweed.

Dog 1 Dog Strangling Vine through land open area

Jap 3 10 x 10

Jap 4 -> 10 x 25

Creek 1 -> Pool with garbage

Creek 2 -> Pool followed by Run & Riffle.

East Bank -> Dogwood

West Bank -> Red Rasp
-> Poison Ivy.

BB03

- Nuthatch.

-> unidentified Call in willows. refer to recording.
-> red wing Blackbird
-> kill deer
-> Song sparrow
-> Am Robin
-> chickadee
-> Herring Gull
-> Am Crow
- Gray Catbird

Am goldfinch

Canopy - Willows
Understory - Dogwood
-> Elm -> willow
- Honeysuckle (tartarian)
See BB02 for additional species

Black Ash
Poplar sp. (Trembles)

BB02 -

-> Robin
-> Flicker
-> Am Robin
-> Blue Jay
-> Northern Cardinal
-> Am Goldfinch

Background noise - vehicles.

- greatcrested Flycatcher or willow?
- Field sparrow
- Red wing Blackbird
- Herring Gull (flyover)
- Am Crow

- eastern phoebe
- Black capped chickadee
-> killdeer
- cedar waxwing

- grey squirrel

- Canopy - Willow (crack)
Sub canopy - man maple, buckthorn
Understory -> grey dogwood
-> honeysuckle
groundcover -> water hemlock
-> golden rod
-> dog strangling vine
-> Sensitive fern
-> yellow rocket
-> Flocks

Ontario Breeding Bird Atlas - Point Count Form - South Central

Zone | Block | Square | Atlasser Number | Atlasser Name | Year 2 0 0

Point A
Designated Number
UTM (if not designated point) ○ On Road ○ GPS ○ NAD83 ○ Off Road ○ Map ○ NAD27
Mon 6 / Day 21
UTM Easting
Start Time (24-hr) 08:15
UTM Northing
Habitat: Class Sub. | Structure (Optional) | Modification (Optional)
1st
2nd

Point B
Designated Number
UTM (if not designated point) ○ On Road ○ GPS ○ NAD83 ○ Off Road ○ Map ○ NAD27
Mon 6 / Day 21
UTM Easting
Start Time (24-hr) 08:20
UTM Northing
Habitat: Class Sub. | Structure (Optional) | Modification (Optional)
1st
2nd

Point C
Designated Number
UTM (if not designated point) ○ On Road ○ GPS ○ NAD83 ○ Off Road ○ Map ○ NAD27
Mon 6 / Day 21
UTM Easting
Start Time (24-hr) :
UTM Northing
Habitat: Class Sub. | Structure (Optional) | Modification (Optional)
1st
2nd

Species Name	Point A <100m	Point A >100m	Point B <100m	Point B >100m	Point C <100m	Point C >100m
Killdeer	X				X	
Ring-billed Gull						
Rock Dove						
Mourning Dove	X		X		X	
Downy Woodpecker						
Northern Flicker	X					
Eastern Wood-Pewee						
Least Flycatcher						
Eastern Phoebe						
Great Crested Flycatcher						
Eastern Kingbird	X		X		X	
Warbling Vireo						
Red-eyed Vireo						
Blue Jay	X					
American Crow	X		X			
Tree Swallow						
Barn Swallow						
Black-capped Chickadee					X	
White-breasted Nuthatch						
House Wren						
Veery						
Wood Thrush						
American Robin	X		X			
Gray Catbird					X	
Brown Thrasher						
European Starling	X		X		X	
Cedar Waxwing						
Yellow Warbler						
Black-and-white Warbler						
American Redstart						
Ovenbird						
Northern Waterthrush						

Species Name	Point A <100m	Point A >100m	Point B <100m	Point B >100m	Point C <100m	Point C >100m
Common Yellowthroat						
Scarlet Tanager						
Chipping Sparrow	X					
Savannah Sparrow						
Song Sparrow						
Swamp Sparrow						
White-throated Sparrow						
Northern Cardinal	X					
Rose-breasted Grosbeak						
Indigo Bunting						
Bobolink						
Red-winged Blackbird	X				X	
Eastern Meadowlark						
Common Grackle	X					
Brown-headed Cowbird	X		X			
Baltimore Oriole						
American Goldfinch			X		X	
House Sparrow						

Additional species or species with > 100 individuals

Species Name	Species Code	Point A <100m	Point A >100m	Point B <100m	Point B >100m	Point C <100m	Point C >100m
Herring gull		X				X	
Field Sparrow		X				X	

This form will be read by computer. Please print neatly with pen or dark pencil (not felt pen) so numbers do not touch lines. Put only one character per box except additional species counts.

Appendix E

Photographic Log

Client Name: Town of Cobourg

Site Location: Midtown Creek Flood Ponding Area

Photo Number: 1

Date:
June 21, 2018

Direction Photo Taken:
West

Description:
Looking West across Midtown Creek from Cultural Meadow Polygon

Photo Number: 2

Date:
June 21, 2018

Direction Photo Taken:
North West

Description:
View looking West across Midtown Creek showing Woody Debris

Photo Number: 3
Date: June 21, 2018
Direction Photo Taken: N/A
Description: View looking upstream of Midtown Creek showing riffles

Photo Number: 4
Date: June 21, 2018
Direction Photo Taken: North
Description: View looking upstream showing dense vegetation bordering Midtown Creek

Photo Number: 5	
Date: June 21, 2018	
Direction Photo Taken: West	
Description: View looking West across Cultural Meadow Polygon	

Photo Number: 6	
Date: June 21, 2018	
Direction Photo Taken: North West	
Description: View looking North West from West side of Midtown Creek through Cultural Meadow Polygon	

Photo Number: 7 Date: June 21, 2018 Direction Photo Taken: South West Description: View looking downstream Midtown Creek through Cultural Meadow Polygon	

Photo Number: 8 Date: June 21, 2018 Direction Photo Taken: N/A Description: View of woody debris in Midtown Creek	

Photo Number: 9
Date: June 21, 2018
Direction Photo Taken: N/A
Description: View of Midtown Creek showing vegetative cover

Photo Number: 10
Date: June 21, 2018
Direction Photo Taken: South
Description: View looking downstream Midtown Creek from culvert at rail spur at the North Side of the subject property

Appendix G

Tree Inventory and Mitigation Plan

Tree Inventory and Mitigation Plan

Town of Cobourg
Midtown Creek Ponding Area
Cobourg, ON

Prepared for:
Ms Laurie Wills, P.Eng.
Deputy Director of Public works
Corporation of the Town of Cobourg
740 Division Street, Building 7
Omemee, ON K9A 0H6

Prepared by:
Andrew Smit
ISA Certified Arborist Municipal Specialist
Certified Tree Risk Assessor (TRAQ, QTRA)

April 2018

Treescape Consulting Project TC264

Introduction

Treescape Certified Arborists was retained by Laurie Wills on behalf of the Corporation of the Town of Cobourg to complete a Tree Inventory and Mitigation Plan for a 5 hectare parcel of land located north of the Kerr Street road allowance between Division Street and the Canada Pallet railway spur in Cobourg, Ontario.

The work plan for the tree inventory included the following:

- Conduct a ground survey to create and outline tree cover by species areas (tree stand delineations -TSD). These areas will be defined by their top two (2) or three (3) tree species.
- Estimate the percent for these species within the TSD areas. More than the top dominate species can be represented in the survey TSD area.
- Estimate the stocking density within the TSD. Identify the number of trees over 75mm in diameter.
- Provide averaged data for the species types within the TSD areas including but not limited by: diameter range, height, density, condition, health, etc.
- Ash trees over 30 cm DBH to be plotted on the drawing and shown in the data collected. Detailed data is not required however it must be noted if the signs of Emerald Ash Borer (EAB) are present.
- Invasive Species: identify and outline areas of invasive tree species on the site. Provide general description of size, numbers and estimated percentage of coverage on the site.
- Species at risk: The GRCA's 2016 Terrestrial Ecology Study did not recognize any tree species at risk on the Site. Confirm through ground survey of the site that no species at risk are present.
- Plot any significant historic trees or noteworthy species located on the Site. Outline findings and make recommendations for protection and preservation for those trees identified, if any.
- Link all collected data to a drawing of the Site.
- Identify potential areas or trees within and surrounding the Site for consideration to be preserved or protected.
- As part of the Towns Official Plan regarding natural environmental areas, the principal of protecting and enhancing environmental area must be taken. Make recommendations on how this Site can be mitigated on or off-site to achieve a net zero loss of canopy within the Town.
- Provide a cost estimate associated with the proposed mitigation plan.
- All statistical methods used and that lead to recommendations or conclusions should be made clear and understandable.

Deliverables for the scope of work include the following:

1. Aerial image of Site showing numbered TSD's (aerial image provided by Town).

2. Spreadsheet/reference table illustrating all data associated with each TSD.

Table 1 below includes the assessment of all trees and treed compartments within the proposed development area. The appended plan TC264-01 identifies the locations of the individual trees and treed compartments. Plan TC264-02 shows removals and recommended trees and treed areas worthy of retention and suggested limits of tree protection.

Limitations of Assessment

The assessment of the tree resources presented in this report has been made using accepted arboricultural techniques. These include a visual examination of the above ground parts of the trees for structural defects, scars, external indications of decay such as fungal fruiting bodies, evidence of attack by insects, discoloured foliage (if in leaf), the condition of any visible root structures, the degree and direction of lean (if any), the general condition of the trees and the surrounding site and the proximity of property and people and the frequency of use within the context of development. Except where specifically noted, the trees were not cored, probed or climbed and there was no detailed inspection of the root crowns involving excavations.

Notwithstanding the recommendations and conclusions made in this report, it must be recognized that trees are living organisms, and their health and vigour constantly change over time. They are not immune to site changes or seasonal variations in weather conditions.

Although every effort has been made to ensure that this assessment is accurate, the trees must be re-assessed periodically. The assessment presented in this report is valid at the time of inspection.

Results

Detailed results of individual and small compartment tree assessment are reproduced in Table 1 below. The data establishes:

- predominant species
- upper and lower diameter range
- average diameter at breast height (1.4m)
- approximate numbers of significant ***stems***
- age range
- crown radius (where possible)
- overall condition (structural and physiological)

Table 1
Midtown Creek
Tree Inventory Data

CPT 1 Summary

Stand Size (hectare)	0.40
Stand Size (acre)	0.98
Non-treed portion	25%
Survey Area Size (acre)	0.73
Total Stems Counted	219
Avg. Stems per acre (TPA)	297
Species Composition	
Trembling Aspen	56.6%
Black Locust	33.3%
Manitoba Maple	8.2%
Sugar Maple	0.9%
Black Walnut	0.5%
Eastern Cottonwood	0.5%

Species	# of Stems	Dbh Range (cm)	Avg. DBH (cm)	Max Height (m)	Overall Condition	TPA
Trembling Aspen	124	7.5-55	30	23	F	169.46
Black Locust	73	7.5-45	20	20	F	99.76
Manitoba Maple	18	10-33	20	16	F	24.60
Black Walnut	1	9	9	7	G	1.37
Eastern Cottonwood	1	45	45	22	F	1.37
Sugar Maple (ID #1022)	1		98	20	G-F	1.37
Sugar Maple (ID #1023)	1		98	20	G-F	1.37

Invasive Species:
Small amounts of Buckthorn located around tree #1023

General CPT Comments:
Some larger Poplar trees at east end of compartment that are post-mature.
Dogwood underbrush spuratic throughout compartment

CPT 2 Summary

Stand Size (hectare)	0.27
Stand Size (acre)	0.66
Non-treed portion	10%
Survey Area Size (acre)	0.60
Total Stems Counted	51
Avg. Stems per acre (TPA)	86
Species Composition	
Trembling Aspen	64.7%
Black Locust	27.5%
Manitoba Maple	7.8%

Species	# of Stems	Dbh Range (cm)	Avg. DBH (cm)	Max Height (m)	Overall Condition	TPA
Trembling Aspen	33	8-60	30	25	F	55.39
Black Locust	14	10-60	25	15	F	23.50
Manitoba Maple	4	20-36	20	10	F	6.71

Invasive Species:
NO significant amounts of Buckthorn in this compartment

General CPT Comments:
5 larger Trembling Aspen at west end of compartment
A parcel of land being retained is located at the centre of this compartment

CPT 3 Summary

Stand Size (hectare)	0.01
Stand Size (acre)	0.03
Non-treed portion	0%
Survey Area Size (acre)	0.03
Total Stems Counted	12
Avg. Stems per acre (TPA)	20
Species Composition	
Red Pine	83.3%
Black Cherry	8.3%
Trembling Aspen	8.3%

Species	# of Stems	Dbh Range (cm)	Avg. DBH (cm)	Max Height (m)	Overall Condition	TPA
Red Pine	10	7-31	25	15	G	16.79
Black Cherry	1		29	17	G	1.68
Trembling Aspen	1		30	17	F	1.68

Invasive Species:
NO significant amounts of Buckthorn in this compartment

General CPT Comments:
This compartment consists of desireable specimens worthy of retention.
This compartment is situated on a private lot that is being retained.

CPT 4 Summary

Stand Size (hectare)	0.02
Stand Size (acre)	0.05
Non-treed portion	0%
Survey Area Size (acre)	0.05
Total Stems Counted	17
Avg. Stems per acre (TPA)	313
Species Composition	
Manitoba Maple	100.0%

Species	# of Stems	Dbh Range (cm)	Avg. DBH (cm)	Max Height (m)	Overall Condition	TPA
Manitoba Maple	17	10-32	25	16	F	312.85

Invasive Species:
NO significant amounts of Buckthorn in this compartment

General CPT Comments:

CPT 5 Summary

Stand Size (hectare)	0.44
Stand Size (acre)	1.09
Non-treed portion	10%
Survey Area Size (acre)	0.98
Total Stems Counted	250
Avg. Stems per acre (TPA)	200
Species Composition	
Manitoba Maple	54.8%
Black Locust	32.4%
Black Willow	8.8%
Balsam Poplar	1.2%
Ash	0.8%
Norway Maple	0.8%
American Elm	0.8%
European Mountain Ash	0.4%

Species	# of Stems	Dbh Range (cm)	Avg. DBH (cm)	Max Height (m)	Overall Condition	TPA
Manitoba Maple	137	7.5-35	20	12	F	109.72
Black Locust	81	15-55	20	18	F	64.87
Black Willow	22	10-65	40	17	F	17.62
Balsam Poplar	3	20-87	30	18	F	2.40
Ash	2		10	10	P	1.60
Norway Maple	2	15-18	15	10	G	1.60
American Elm	2	8-22	15	12	G	1.60
European Mountain Ash	1		10	10	G	0.80

Invasive Species:
NO significant amounts of Buckthorn in this compartment

General CPT Comments:
Dogwood underbrush spuratic throughout compartment

CPT 6 Summary

Stand Size (hectare)	0.15
Stand Size (acre)	0.36
Non-treed portion	5%
Survey Area Size (acre)	0.34
Total Stems Counted	111
Avg. Stems per acre (TPA)	89
Species Composition	
Manitoba Maple	42.3%
Black Locust	28.8%
Black Willow	27.9%
Black Walnut	0.9%

Species	# of Stems	Dbh Range (cm)	Avg. DBH (cm)	Max Height (m)	Overall Condition	TPA
Manitoba Maple	47	10-27	18	10	F	37.64
Black Locust	32	10-15	13	10	F	25.63
Black Willow	31	13-28	20	17	F	24.83
Black Walnut	1	24	24	15	G	0.80

Invasive Species:
Small amounts of Buckthorn found throughout compartment

General CPT Comments:

CPT 7 Summary

Stand Size (hectare)	0.08
Stand Size (acre)	0.21
Non-treed portion	10%
Survey Area Size (acre)	0.19
Total Stems Counted	45
Avg. Stems per acre (TPA)	36
Species Composition	
Manitoba Maple	75.6%
Balsam Poplar	17.8%
Black Willow	4.4%
Crabapple	2.2%

Species	# of Stems	Dbh Range (cm)	Avg. DBH (cm)	Max Height (m)	Overall Condition	TPA
Manitoba Maple	34	8-35	20	13	F	27.23
Balsam Poplar	8	8-35	10	15	F	6.41
Black Willow	2	40	40	20	F	1.60
Crabapple	1	18	18	7	G-F	0.80

Invasive Species:

NO significant amounts of Buckthorn in this compartment

Grapevine prevalent throughout compartment

General CPT Comments:

Many manitoba maples with significant phototopic growth due to supression from large Willows to the west

CPT 8 Summary

Stand Size (hectare)	0.96
Stand Size (acre)	2.38
Non-treed portion	10%
Survey Area Size (acre)	2.14
Total Stems Counted	307
Avg. Stems per acre (TPA)	246
Species Composition	
Manitoba Maple	57.3%
Black Willow	41.4%
Black Locust	0.3%
Norway Maple	0.3%
Balsam Poplar	0.3%
Crabapple	0.3%

Species	# of Stems	Dbh Range (cm)	Avg. DBH (cm)	Max Height (m)	Overall Condition	TPA
Manitoba Maple	176	11-45	30	13	F	140.96
Black Willow	127	18-55	35	20	F	101.72
Black Locust	1	30	30	15	F	0.80
Norway Maple	1	8	8	8	G	0.80
Balsam Poplar	1	43	43	15	F	0.80
Crabapple	1	30	30	10	G	0.80

Invasive Species:

Some Buckthorn located at south end of compartment as well as along east-west fenceline located mid compartment.

Grapevine also prevalent throughout compartment

General CPT Comments:

CPT 9 Summary

Stand Size (hectare)	0.04
Stand Size (acre)	0.10
Non-treed portion	25%
Survey Area Size (acre)	0.07
Total Stems Counted	17
Avg. Stems per acre (TPA)	14
Species Composition	
Balsam Poplar	58.8%
Crabapple	17.6%
Eastern White Cedar	11.8%
Black Willow	5.9%
Black Locust	5.9%

Species	# of Stems	Dbh Range (cm)	Avg. DBH (cm)	Max Height (m)	Overall Condition	TPA
Balsam Poplar	10	7.5-25	15	17	F	8.01
Crabapple	3	12-30	20	10	G	2.40
Eastern White Cedar	2	12-25	15	11	G	1.60
Black Willow	1	15	15	6	F	0.80
Black Locust	1	10	10	7	G-F	0.80

Invasive Species:

NO significant amounts of Buckthorn in this compartment

General CPT Comments:

CPT 10 Summary

Stand Size (hectare)	0.16
Stand Size (acre)	0.39
Non-treed portion	25%
Survey Area Size (acre)	0.29
Total Stems Counted	65
Avg. Stems per acre (TPA)	52
Species Composition	
Balsam Poplar	61.5%
Trembling Aspen	26.2%
Black Willow	3.1%
American Elm	3.1%
Paper Birch	3.1%
Eastern White Cedar	1.5%
Crabapple	1.5%

Species	# of Stems	Dbh Range (cm)	Avg. DBH (cm)	Max Height (m)	Overall Condition	TPA
Balsam Poplar	40	8-24	15	12	F	32.04
Trembling Aspen	17	8-18	12	15	F	13.62
Black Willow	2	15-40	25	15	F	1.60
American Elm	2	7.5-15	10	6	G	1.60
Paper Birch	2	10-15	12	9	G	1.60
Eastern White Cedar	1	12-15	15	7	G	0.80
Crabapple	1	8	8	5	G	0.80

Invasive Species:
Large/tall thickets of Buckthron in and adjacent to compartment

General CPT Comments:

CPT 11 Summary

Stand Size (hectare)	0.67
Stand Size (acre)	1.66
Non-treed portion	25%
Survey Area Size (acre)	1.25
Total Stems Counted	214
Avg. Stems per acre (TPA)	171
Species Composition	
Scots Pine	26.2%
Eastern White Cedar	25.2%
Crabapple	10.3%
Black Cherry	9.8%
Sugar Maple	9.8%
Ash	6.5%
Grey Birch	3.3%
Eastern Red Cedar	2.3%
European Mountain Ash	1.9%
American Elm	1.4%
Eastern White Pine	0.9%
Black Walnut	0.9%
Black Locust	0.9%
Red Pine	0.5%

Species	# of Stems	Dbh Range (cm)	Avg. DBH (cm)	Max Height (m)	Overall Condition	TPA
Scots Pine	56	16-30	20	9	G	44.85
Eastern White Cedar	54	8-30	15	10	P	43.25
Crabapple	22	10-30	20	7	G	17.62
Black Cherry	21	11-42	20	11	G	16.82
Sugar Maple	21	8-15	12	10	G	16.82
Ash	14	15-22	18	10	P	11.21
Grey Birch	7	13-22	18	15	G	5.61
Eastern Red Cedar	5	8-11	10	8	G	4.00
European Mountain Ash	4	16-19	18	13	G-F	3.20
American Elm	3	8-30	20	13	G	2.40
Eastern White Pine	2	21-44	25	17	G	1.60
Black Walnut	2	10-24	18	10	G	1.60
Black Locust	2	13-23	18	12	G-F	1.60
Red Pine	1	18	18	10	G	0.80

Invasive Species:
Buckthorn spread consistently throughout compartment

General CPT Comments:
The northern portion of this compartment has a very lush and diverse grouping of desireable trees worthy of retention.

CPT 12 Summary

Stand Size (hectare)	0.06
Stand Size (acre)	0.16
Non-treed portion	10%
Survey Area Size (acre)	0.14
Total Stems Counted	37
Avg. Stems per acre (TPA)	30
Species Composition	
Trembling Aspen	54.1%
American Elm	13.5%
American Basswood	13.5%
Scots Pine	8.1%
Ash	5.4%
Paper Birch	5.4%

Species	# of Stems	Dbh Range (cm)	Avg. DBH (cm)	Max Height (m)	Overall Condition	TPA
Trembling Aspen	20	7.5-20	15	12	F	16.02
American Elm	5	15	15	12	G	4.00
American Basswood	5	8-19	15	12	G-F	4.00
Scots Pine	3	11-25	15	10	G	2.40
Ash	2	12	12	11	P	1.60
Paper Birch	2	7.5-10	10	10	G	1.60

Invasive Species:
Moderate amounts of Buckthorn found throughout compartment

General CPT Comments:

Retained Area Summary

Stand Size (hectare)	0.05
Stand Size (acre)	0.12
Non-treed portion	0%
Survey Area Size (acre)	0.12
Total Stems Counted	17
Avg. Stems per acre (TPA)	140
Species Composition	
Trembling Aspen	35.3%
Red Pine	29.4%
Black Locust	29.4%
Manitoba Maple	5.9%

Species	# of Stems	Dbh Range (cm)	Avg. DBH (cm)	Max Height (m)	Overall Condition	TPA
Trembling Aspen	6	10-60	15	23	F	49.57
Red Pine	5	15-31	25	15	G	41.31
Black Locust	5	12-25	15	10	F	41.31
Manitoba Maple	1	10	10	10	F	8.26

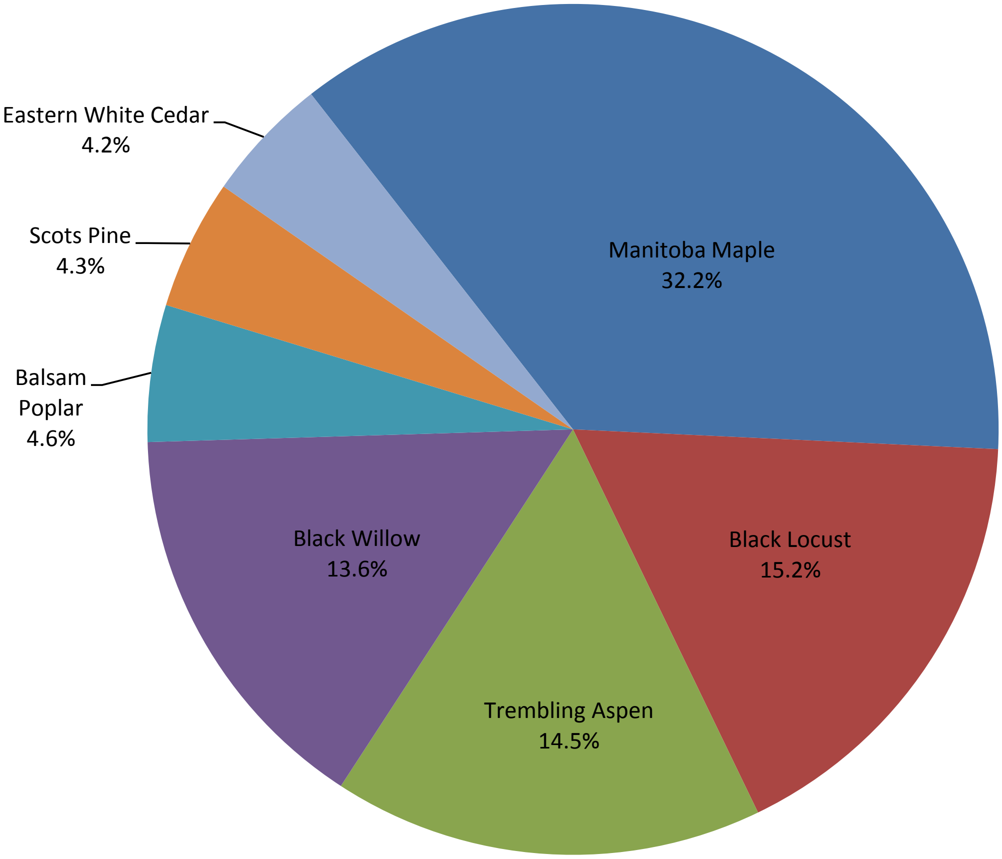
Invasive Species:
NO significant amounts of Buckthorn in this compartment

General CPT Comments:

CPT 13 Summary

Large area of varying species of small scrub brush.
Heavy amounts of Buckthorn located throughout this compartment. The most significant concentrations can be found in the north and mid sections of the compartment.

Overall Prevalent Species Composition



Ash Tree Summary

The amount of Ash in the overall species compostion for this site is extremely small (< 2%) and is concentrated in the southwest portion of the property with some individual specimens found at the northwest side of property. Of all Ash inventoried, there are only 5 that measure < 30cm Ø. Refer to drawing TC264-01 for exact location of these trees.

In the absence of foliage, it is difficult to assess the amount of viable canopy to assist in diagnosing the presences of the Emerald Ash Borer (EAB). There were no other typical outward indicators condusive with EAB infections visible at time of assessment. Despite this, it is quite likely that EAB populations are present in these trees due their proximity to other known EAB infected areas within the Town of Cobourg. Ash trees can be infected for 2-3 years and not display any visible sgins of distress or decline to the EAB.

Species at Risk Summary

The tree inventory and assessment performed on this property did NOT identify any species at risk.

Canopy Cover and Replacement Tree Calculations

Development Site Area (m^2)	61,950
Site Canopy Cover	
CPT canopy area (m^2)	**28,100**
As a percentage of development site area	45%
Removed Canopy Cover (requiring replacement)	
Removed CPT canopy area (m^2)	25,140
Less canopy area of retained stature trees (m^2)	400
Less estimated Ash canopy cover (m^2)	700
Total Removed CPT canopy area (m^2)	24,040
Total proposed removed canopy cover (m^2)	**24,040**
As a percentage of total site canopy cover	85.6%
Estimated number of replacement trees	
Replacement seedlings	3,606
Equivalent 50mm Ø replacement trees	481

A combination of seedling and larger caliper plantings to be incorporated into the Landscape Design Plan or planted off-site in appropriate locations across the Town of Cobourg in order to achieve a net zero loss of canopy cover

Estimated supply/install costs for replanting (refer to Appendix 1)	
Replacement seedlings ($25.69/seedling)	$92,638.14
Equivalent 50mm Ø replacement trees ($500/tree)	$240,400.00

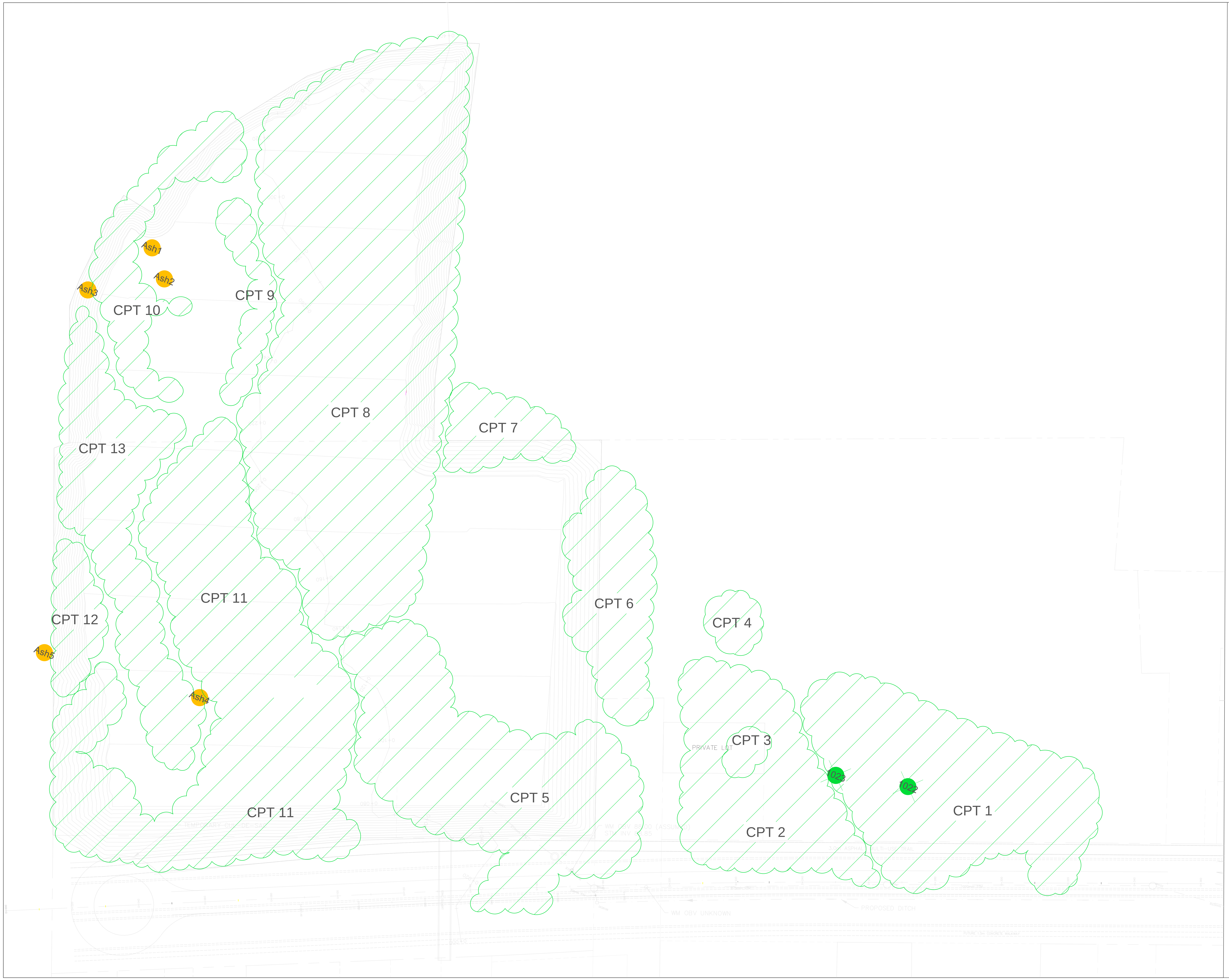
Calculation Notes (adopted from the City of Peterborough By-law 17-120 and 17-12	1,500
Replacement seedlings per Hectare (Ha) to reach canopy cover parity in 25 years	

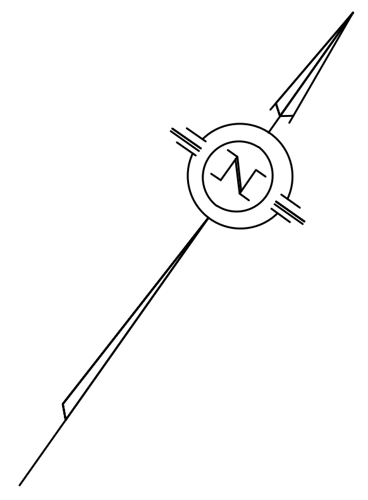
Larger caliper replanting equivalencies

An individual 50mm caliper replacement tree is equivalent to 7.5 seedlings.
An individual 20mm caliper replacement tree is equivalent to 5.75 seedlings

The equivalency calculations above are based on the following assumptions:

1. Average annual growth rate for an average tree under average conditions is 1cm/year
2. Crown spread (CS) to trunk diameter correlation calculated as:
   (-0.0013*Dbh^2+0.2837*Dbh+0.7856,0)





REVISIONS:

NO.	DMY	REVISIONS

● 993 Assessed individual or significant tree

● 1820 Assessed individual Ash tree over 30cm Dbh

▨ Assessed compartment of trees

ROOTED IN EXCELLENCE
treescape
CERTIFIED ARBORISTS

CLIENT

Town of Cobourg
740 Division Street, Building 7
Cobourg, ON

SHEET

Tree Inventory Plan

PROJECT

TC264 Midtown Creek Ponding Area

REVIEWED

DRAWN

AWS

DATE

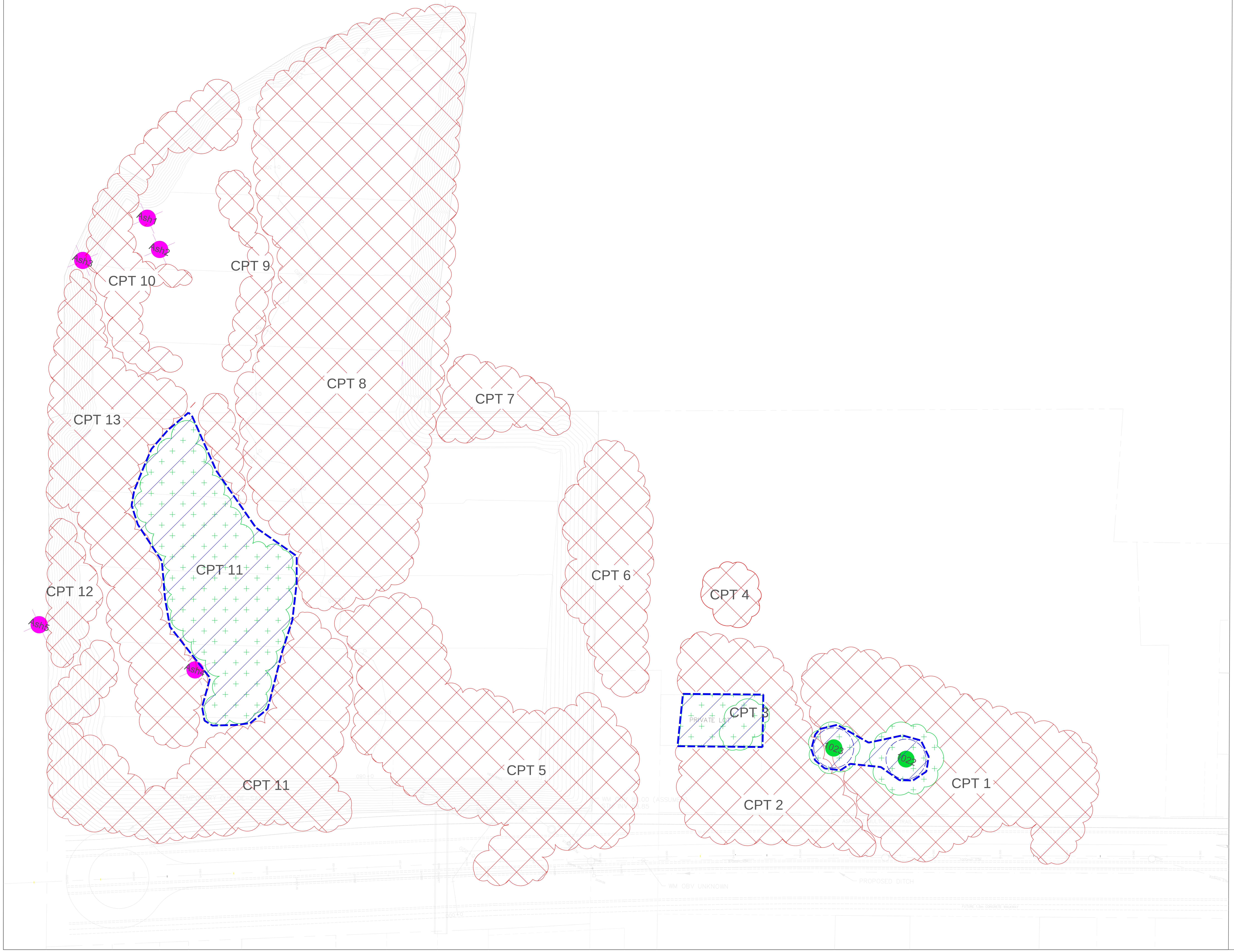
April 26, 2018

SCALE

DO NOT SCALE

SHEET

TC264-01



REVISIONS:

NO.	DMY	REVISIONS

933	Retained tree requiring protection Crown spread Tree Protection Zone
989	Tree to be removed to accommodate development
993	Tree to be removed due to poor overall condition (Ash)
1816	Shared or Neighbouring tree requiring permission to remove
▨	Tree protection area Protective fencing
+	Tree compartment portion to be preserved
☒	Tree compartment portion to be removed

ROOTED IN EXCELLENCE
treescape
CERTIFIED ARBORISTS

CLIENT

Town of Cobourg
740 Division Street, Building 7
Cobourg, ON

SHEET

Tree Retention & Removals Plan

PROJECT

TC264 Midtown Creek Ponding Area

REVIEWED

DRAWN

AWS

DATE

April 26, 2018

SCALE

DO NOT SCALE

SHEET

TC264-02

Appendix 1

Schedule B – Costs for Replanting

If a Woodland or a Plantation Woodland or a remnant of the foregoing, or if a group of Trees or and a hedgerow is removed, replanting shall occur on an equal area basis and with a species composition designed to replicate the lost diversity of Trees.

Each Woodland and Plantation Woodland will be classified under the Ministry of Natural Resources and Forestry's **Ontario Ecological Land Classification for Southern Ontario**.

The replanting cost for a Woodland or Plantation Woodland will vary depending on the diversity of Tree species found within the foregoing.

If the area available for replacing Trees is insufficient to permit replanting the required number and species of replacement Trees on the Owner's land, the Owner shall pay to the City the average of the lowest and highest unit price contained in the Woodland or Plantation Woodland Replanting Costs as set out in the then current Table 1.

Table 1 – Woodland and Plantation Woodland Replanting Costs

Replanting to achieve reforestation assumes planting of seedlings (50/50 mix of coniferous and deciduous species). All Trees shall receive a mulch mat for suppression of weed growth. All hardwoods shall be contained in a tubex tree shelter installed on a metal T-post. The Owner shall guarantee Tree survival and installed materials for a minimum of 2 years.

Materials Item	Pricing					
	Unit			Total (1,500 trees/hectare)*		
	Lowest	Highest	Average	Lowest	Highest	Average
Conifer seedlings	$0.90	$3.00	$1.66	$1,350.00	$4,500.00	$2,485.92
Deciduous seedlings	$1.25	$12.00	$4.88	$1,875.00	$18,000.00	$7,318.95
Average seedling	$1.08	$7.50	$3.27	$1,612.50	$11,250.00	$4,902.43
Tree shelters (based on 50% conifer (no shelter needed) and 50% deciduous planting)	$3.62	$4.86	$4.24	$2,715.00	$3,645.00	$3,180.00
Metal T-bars for tree shelters	$4.50	$9.99	$7.25	$3,375.00	$7,492.50	$5,433.75
Mulch mat (TassuCol)	$1.07	$1.07	$1.07	$1,605.00	$1,605.00	$1,605.00
Staples for mulch mat (2 staples per mat)	$0.20	$0.20	$0.20	$295.20	$295.20	$295.20
Total materials	**$6.40**	**$16.19**	**$10.28**	**$9,602.70**	**$24,287.70**	**$15,416.38**
Installed cost**				**$24,006.75**	**$60,719.25**	**$38,540.96**
Installed cost / tree**				**$16.00**	**$40.48**	**$25.69**

* 1500 trees/hectare (2.58 m x 2.58 m) based on minimum density to achieve a productive forest. Source: Forests Ontario 50 Million Tree Program Outline. Density range 1,500 to 2,200 trees/ha.

** Installed tree cost is based on 2.5x the cost of tree and materials. Includes a 2-year guarantee. Source: ww.isaontario.com/news/plant-appraisal-guide-status-update, accessed May 19, 2017.

Source: The Corporation of the City of Peterborough By-Law Number 17-121 - "Woodlands Conservation By-law", 2017.

Appendix H

Noise Study

600 Southgate Drive
Guelph, ON N1G 4P6
Canada

Tel: +1.519.823.1311
Fax: +1.519.823.1316

MEMORANDUM

DATE:	2018-09-11	**RWDI REFERENCE #:** 1803121	
TO:	Terry Hoekstra | Town of Cobourg Laurie Wills | Town of Cobourg	**EMAIL:**	thoekstra@cobourg.ca lwills@cobourg.ca
FROM:	Melissa Annett | RWDI Nghi Nguyen | RWDI Michael Bolduc | RWDI	**EMAIL:**	melissa.annett@rwdi.com nghi.nguyuen@rwdi.com michael.bolduc@rwdi.com
RE:	**Kerr Street Ambient Monitoring** **Cobourg, Ontario**		

INTRODUCTION

RWDI was retained by the Town of Cobourg to conduct background (baseline) sound level measurements in the vicinity of the Kerr Street expansion in Cobourg, Ontario. An Environmental Assessment for the new dead-end road and pond area north of the road does not require a noise assessment, however the Town of Cobourg wishes to understand the baseline sound levels in the area with the removal of some of the trees and shrubberies as part of the roadway expansion. The results presented in this memorandum will be included in the eventual Environmental Study Report being prepared by the Town's consultant for the Environmental Assessment.

PROJECT SITE DESCRIPTION

A site visit was conducted on June 21, 2018 to measure background sound at two separate measurement stations adjacent to existing residences located to the south and west of the proposed roadway expansion. A separate meteorological station was also set up near one measurement station to capture local meteorological conditions. Additional sources of sound were determined from on-site observations. The two measurement stations and the additional sources of sound in relation to the proposed roadway are illustrated in Image 1. The additional sources of sound are described in the paragraphs below.

Located to the north of the proposed roadway is Canada Pallet Corporation which manufactures wood pallets and wood box springs. Connected to Canada Pallet Corporation to the west is a spur line at which rail deliveries occur approximately once per week. The spur line is connected to the nearby Cobourg train station. During the site visit both VIA rail and Freight trains were observed to be travelling through the station.

There was industry activity at the termination of Buchanan Street where trucks arrived on site, were loaded, and then departed. During the site visit, activity at this location was intermittent, depending on whether trucks were present.

To the north of the proposed road is a contractor construction yard. During the site visit, the yard was in operation with an excavator loading trucks on the western portion of its property.

Additional sounds observed during the daytime site visit included noise from crickets as well as birds chirping.

Two measurement locations (ML1 and ML2) were selected to capture the current background sound levels at the nearby residences with the recent partial removal of trees and shrubs between Canada Pallet and the residences located to the south and the west.

Image 1: Measurement Locations ML1 and ML2 in Relation to Significant Sources of Sound

EQUIPMENT AND ENVIRONMENTAL CONDITIONS

The measurement stations shown in Image 1 were set up on June 21, 2018 and operated continuously to June 22, 2018. Approximately 24 hours of data were gathered during this time period. All measurements were conducted in accordance with the applicable requirements of the Ontario Ministry of the Environment (MOE) Publication NPC-103.

Sound level readings were obtained using a Larson-Davis Model 831 precision integrating sound level meters, configured to log LEQ (1 minute) levels during the monitoring. The sound level meters were field-calibrated at the beginning and end of measurements to ensure accuracy for all monitoring events. No significant drift from the calibration target was observed.

Each microphone was mounted on a tripod, with the microphone located approximately 1.5-2 m above grade. Environmental microphone kits were used to provide protection from wind and rain. Each kit includes a wind screen with bird spikes to reduce wind noise and interference from birds perching on the station. Desiccant was used to sustain dryness of the environmental kit to prevent damage from rain.

Weather data were recorded using a meteorological logging instrument at measurement Location 2. Wind speed, wind direction, temperature and relative humidity were recorded at 1-minute intervals. All data recorded within the measurement period complied with the meteorological conditions specified in the NPC-103.

MONITORING RESULTS

Figures 1 and 2 graphically display the measured LEQ, LMIN and LMAX for the duration of the study for both measurement locations. All data in these graphs are based on 1-minute intervals.

For measurement Location 1 shown in Figure 1, the initial average LEQ is around 57 dBA until around 14:30 at which the levels drop to around 47 dBA. It stays at this range until around 19:00 at which the levels steadily increase back to 57 dBA at around 22:00. At this time, the LMIN and LMAX are relatively much closer together, due to what is likely a steady continuous noise from adjacent facilities. The LEQ remains at 57 dBA until the following day. It was observed during the initial part of the monitoring period that operations at Canada Pallet was audible over other background sound at this location.

For measurement Location 2 shown in Figure 2, the average LEQ is around 50 dBA, with more variation, due to the aggregate activity to the northeast, until around 19:00 at which the levels steadily increase to around 54 dBA at around 22:00. This trend is similar to that shown in Location 1. Once again, the LMIN and LMAX are relatively much closer together, due to what is likely a steady continuous noise from adjacent facilities. The LEQ remains at

54 dBA until around 6:30 where it slightly drips to around 52 dBA for the remainder of the measurement period. Operations at Canada Pallet was also audible over other background sound at this location.

DISCUSSION

If the Town were to undertake complete removal of shrubs and trees (foliage for simplicity) between Canada Pallet and the residences located to the south and west, sound levels may increase from Canada Pallet at adjacent residences, but this increase is expected to be minor. The total increase in sound would depend on several factors including density, type (deciduous/coniferous), and relative height and distance of foliage between source and receiver. For example, assuming an 80 m field of dense foliage with an average 4 m height above both source and receptor is removed, an increase in around 4 dB is anticipated. However, the majority of the area between Canada Pallet and the residences consists primarily of shrubs, and sparsely spaced trees. Thus, the removal of this vegetation is predicted to have a marginal impact on nearby residences rather than the 4 dB increase detailed above.

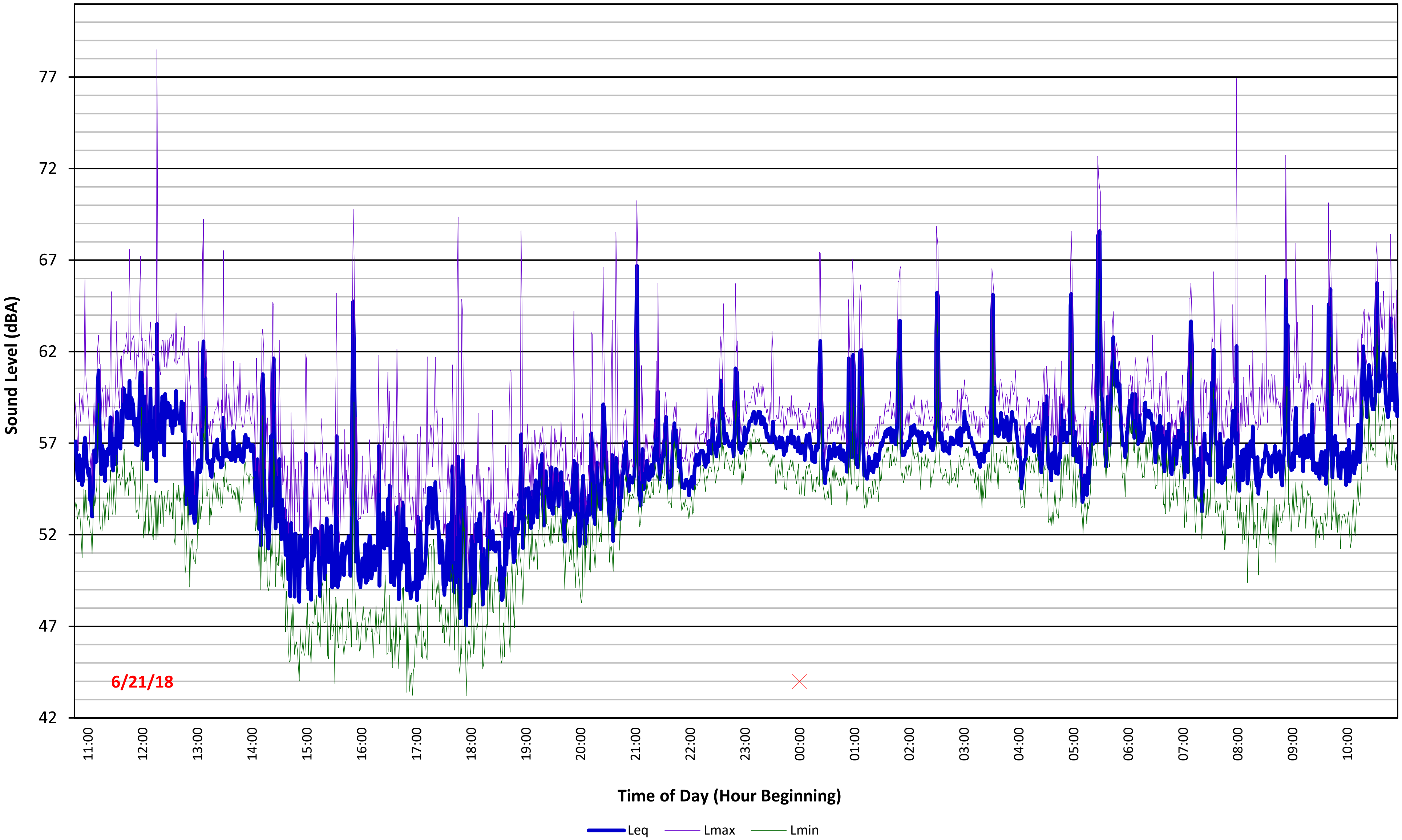
Further, foliage brings additional sounds of nature including wildlife (birds/crickets) as well as sound due to leaves rustling in the wind. The sounds of nature are generally perceived to be less annoying than sound from an industry because it is expected in the environment.

CLOSURE

RWDI was retained by the Town of Cobourg to conduct background sound level measurements to understand the current sound levels at nearby residences to the proposed road expansion. We trust that this assessment of sound levels surrounding the proposed Kerr Street expansion in Cobourg, Ontario meets your needs.

FIGURES

Long-Term Measurement Results
Location 1

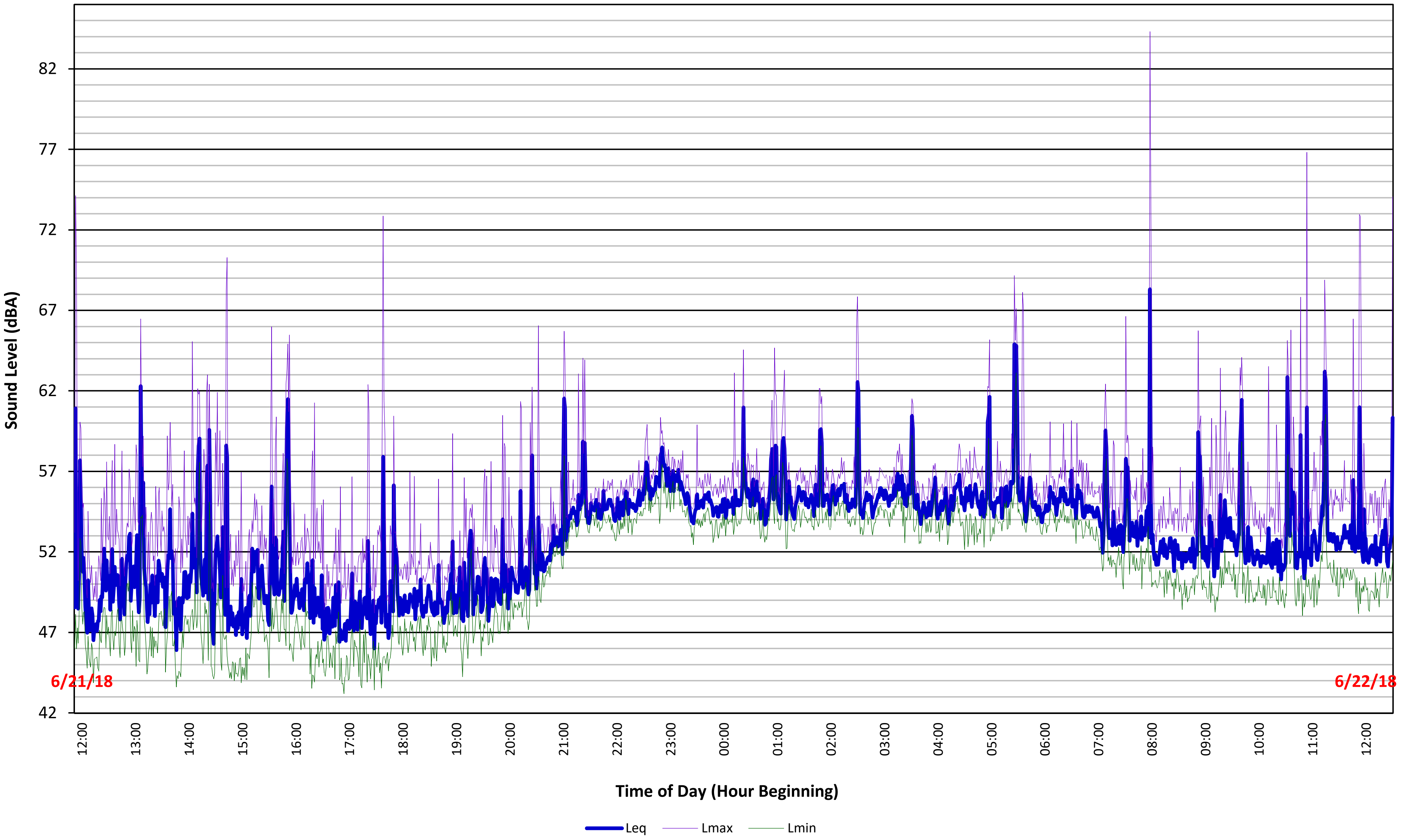


Measured Ambient Sound Levels
From 21/06/18 10:46:00 to 22/06/18 11:49:00

Project # 1803121

Figure No.	1
Date:	Jul. 20, 2018

Long-Term Measurement Results
Location 2



Measured Ambient Sound Levels
From 21/06/18 11:52:00 to 22/06/18 12:30:00

Project # 1803121

Figure No. **2**

Date: Jul. 20, 2018