# Environmental Impact Study (EIS)

York Road Environmental Design

City of Guelph

Prepared for:

**City of Guelph**
**River Systems Advisory Committee (RSAC)**

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**Blackport and Associates**

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Project No. TP115100

**Draft Environmental Impact Study (EIS)**
**York Road Environmental Design**
**City of Guelph**

Submitted to:

**City of Guelph River Systems Advisory Committee**

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## TABLE OF CONTENTS

**PAGE**

## TABLE OF CONTENTS (cont'd)

## LIST OF TABLES

## TABLE OF CONTENTS (cont'd)

## LIST OF FIGURES

## TABLE OF CONTENTS (cont'd)

## LIST OF APPENDICES

# 1.0 INTRODUCTION

## 1.1 Project Background and Study Approach

The York Road Environmental Design Study (YREDS) is an important undertaking to support and assist with the implementation of the recommendations stemming from the 2007 York Road Improvements Class Environmental Assessment (EA), the limits of which are indicated in Figure 1.

The 2007 EA made a number of recommendations for roadway improvements along York Road, including road widening to the south for the study area (from Victoria Road to the East City Limits). The proposed road widening (from two lanes to four lanes) is required to assist the City of Guelph achieve its planning and development targets, in particular the proposed development within the Guelph Innovation District lands located to the south of York Road (ref. Figure 1).

As noted within the 2007 EA, the proposed roadway improvements were expected to impact the adjacent watercourse, Clythe Creek; as such, recommendations were made with respect to:

- Extension of the existing Clythe Creek Culvert crossing of York Road;
- Relocation of approximately 135 m +\- of the Clythe Creek Channel to accommodate the proposed road widening; and
- Implementation of riparian plantings to separate the widened roadway from the relocated Clythe Creek channel.

In order to support and assist with the implementation of the EA recommendations, it is necessary to provide further consideration of the numerous environmental, cultural, and engineering factors associated with the foregoing. The proposed York Road Environmental Design Study addresses all of these considerations in greater detail, and ensures that the proposed road widening is conducted in a responsible and well-planned manner.

As a key component of the YREDS, the Environmental Impact Study (EIS) includes a background review of available data and reporting for the area, and includes additional field work activities to further quantify and assess areas of concern or areas where missing or uncertain information has been noted. These environmental data are being used as part of the process of identifying a preferred alternative for the roadway and creek, and where necessary, to develop mitigation measures to reduce or eliminate environmental impacts.

## 1.2 Area Planning Context

The Clythe Creek stream corridor is a significant natural area (ref. City of Guelph Official Plan Schedule 10) that includes wetlands and a Special Study Area (ref. City of Guelph Official Plan Schedule 1). The stream corridor is also part of the City's Natural Heritage System

The City of Guelph commenced preparing a Secondary Plan for the Guelph Innovation District (GID) in 2015, which included developing principles, objectives, and policies for the GID. The City through completion of a three (3) phased Secondary Plan process, with input from the public and numerous stakeholders including the Province, developed the "York District Preferred Land Use Scenario" which led to the preparation and approval of OPA 54 (Guelph Innovation District Secondary Plan) by City Council on May 12, 2014 (currently under appeal before the Ontario Municipal Board).

The Guelph Innovation District (GID) comprises 436 ha (1,077 acres) on Guelph's east side. It is bounded by York Road, Victoria Road South, the York-Watson Industrial Park and the City's southern boundary.

The GID is being planned as a compact mixed-use community that integrates an urban village with an employment area, strives to be carbon neutral and offers meaningful places to live, work, shop, play and learn in a setting rich in natural and cultural heritage. The Innovation District is vital to meeting employment and housing targets consistent with Guelph's Growth Management Strategy and the Province's Growth Plan; supporting an economic cluster focused on green-economy and innovation sector jobs and offering opportunities for integrated energy planning as part of the Community Energy Initiative. The City has developed principles and objectives in accordance with the foregoing.

### 1.3 Policies and Legislative Framework

The policies and legislative framework applicable to the York Road study area and the Clythe Creek Corridor include the City of Guelph's current Official Plan which includes the following regulations and policies:

- Urban Forest (OP Policy 6A.5):
  - Tree destruction or removal of trees on private property is regulated by the City's tree by-law (OP Policy 6A.5.1,City of Guelph, 2001)
  - A permit is required for destruction of trees on private property (Tree Bylaw Policy 2.2, City of Guelph, 2010b).
  - Vegetation Compensation Plans are required for all new development and site alterations involving the destruction of healthy non-invasive trees that cannot be retained (OP Policy 6A5.1, City of Guelph 2001).
- Environmental Study Requirements (OP Policy 6A.7):
  - To be prepared in accordance with the Official Plan (City of Guelph, 2001) where development is proposed within or adjacent to natural heritage features.
- Natural Heritage System Designations applicable to the stream and 15m 30 m stream corridor:
  - Natural Heritage System (OP Policy 2.4.14 and Schedule 10, City of Guelph, 2010a).
  - Water Resources (OP Policy 4.3, City of Guelph, 2010a)
  - Significant Natural Area (OP Policy 6A.1 and 6A.2 and Schedule 10, City of Guelph, 2010a).
  - Warm water, cool water or coldwater fish habitat (OP Policy 6A.1.1 and Schedule 10b, City of Guelph, 2010a).

Normally, development and site alteration is not permitted within the Natural Heritage System including minimum or established buffers (Policy 6A.1.2, City of Guelph, 2001). Development that may negatively affect the Natural Heritage System is subject to City approval. Permitted development and site alteration within and/or adjacent to natural heritage features are required to demonstrate, through an EIS to the satisfaction of the City, in consultation with the GRCA, the Province and Federal government, as applicable, that there will be no negative impacts on the natural heritage features and areas to be protected, or their ecological and hydrologic functions (City of Guelph, 2001). The EIS also addresses any Provincial or Federal requirements as they relate to Species at Risk.

The City of Guelph source protection policies are incorporated into the Grand River Source Water Protection Plan and the Lake Erie Region Source Protection Plan, the latter of which received approval from the Ministry of the Environment and Climate Change in December 2015 and commenced implementation on July 1, 2016. The City of Guelph was required to develop a Source Water Protection Plan due to the requirements of the Province' s Clean Water Act. The City's Source Water Protection Policies serve to protect the 25 municipally-owned wells, of which 21 are operable and to various amounts supply the City with its drinking water. Policies have been developed to address established drinking water threats, with specific focus on water quality threats. Water quantity threats are also addressed in the City's policies. The option exists to either manage the risk associated with drinking water threats activities or to prohibit the activity.

The Source Water Protection Plan Polices were developed with consideration of:

- Protection and safety of the City's drinking water supplies;
- Fairness to landowners;
- Impact on citizens;
- Ease of implementation;
- Consistency across boundaries;
- Cost to City and taxpayers;
- Constraint on economic development and existing businesses.

The York Road study area and Cythe Creek corridor are also part of the Guelph Innovation District (GID). Relevant policies from the GID Storm water Management Study, September 2015, include the following:

- Guelph Innovation District development shall comply with the City of Guelph policies for servicing, storm water management, including water quality and quantity and temperature and water balance. The City of Guelph's Official Plan policies introduced through OPA 48, under appeal, on Water Resources, Source Water Protection and related storm water management policies should be adhered to.
- Storm water management criteria should meet the water quality, water quantity and natural environment objectives of the City of Guelph's Storm water Management Master Plan.

- Reference monitoring requirements and targets to be established in subsequent management plans.
- As per the Clythe Creek Subwatershed Overview, GID development lands draining to Clythe Creek should maintain existing groundwater recharge quantity and quality. Fish barriers along Clythe Creek should be removed to improve fish habitat. Stormwater management practices, in addition to providing as a minimum an *Enhanced* Level of water quality treatment, are also to minimize temperature impacts to runoff discharging to Clythe Creek.
- As per the 1999 Eramosa Blue Springs Watershed Study, the Eramosa River corridor should be enhanced through stream corridor restoration.
- The City shall minimize the amount of chloride (salt) infiltration into groundwater through best management practices when applying salt to streets during winter months in accordance with the City's salt management plan. In addition, the City may consider allowing the use of stormwater winter by-pass systems (bypassing the infiltration best management systems that receive treated runoff from roadways and parking areas); so long as it is demonstrated in technical studies submitted in support of development approvals that a balanced annual water budget (surface runoff, groundwater recharge, evapotranspiration) can still be obtained.
- In order to ensure that a balanced water budget is achieved post-development, the City may require monitoring of stormwater management infrastructure for an appropriate period after development. Where infiltration targets (developed for a balanced water budget) are not being achieved, the City may require additional monitoring for an appropriate period to determine what modifications to the drainage system would be required to try to meet the infiltration targets.
- Stormwater management facilities shall be lined to prevent contaminants infiltrating into the groundwater system. Lining of stormwater management facilities may not be required under the following conditions:
  - Pre-treatment of runoff prior to drainage discharging to the facility; and
  - Winter bypass of first flush runoff to prevent contamination of groundwater by chloride (salt) laden runoff. Diversion of the first flush runoff shall not negatively impact the receiving GID drainage system due to potential increase in peak flows.
- Stormwater management erosion controls should be designed to mitigate the impacts of development on the receiving drainage system. In the absence of determining critical erosion threshold flows for local watercourses (Clythe, Torrance and Haditi Creeks) stormwater erosion controls should be designed using the erosion control sizing guidelines in the MOE's 2003 Stormwater Management Planning and Design Manual. Stormwater erosion controls should be flexible and adaptive in design to facilitate potential changes once critical flows have been established and erosion controls assessed using continuous hydrologic modelling as part of future studies.
- Development within the GID will need to comply with current City of Guelph and Ministry of the Environment and Climate Change (MOECC) stormwater management design requirements and any supplemental conceptual design standards established in the GID Stormwater Management Plan, such as seasonal stormwater management strategies for infiltration.

## 1.4 Role of the River Systems Advisory Committee

As per the terms of reference (TOR) for the York Road Environmental Design Study, a scope of work and associated TOR was developed for the EIS, in particular for the recommended field work investigations (a copy has been included in Appendix A). This document has been prepared in accordance with the TOR. The City's River Systems Advisory Committee (RSAC) has reviewed the TOR, and provided input and comments which have helped to form the final TOR, prior to the Project Team proceeding with field work activities.

RSAC is to review this EIS and the various design alternatives under consideration and provide feedback, including the recommendation for the natural channel design for Clythe Creek, including the required corridor width. Further input and comments from RSAC are to be incorporated into final reporting.

## 1.5 Description of Study Area

The study area for the EIS is indicated in Figure 2, as per the original study TOR included in the original Request for Proposal (RFP). It is noted that the area indicated in Figure 2 is substantial (4 $km^2$ +\-), and has been interpreted by the Project Team to reflect the area associated with background review work only. Detailed field work investigations have been scoped to the area immediately around the primary study area (i.e. York Road from Victoria Road to the East City Limits), and in particular those areas identified in the original (2007) EA as being potentially impacted by the proposed widening of York Road.

The primary watercourse through the study area is Clythe Creek, which crosses York Road approximately 200 m +\- west of Watson Parkway (ref. Figure 2). Clythe Creek is a unique watercourse within the City, as its headwaters are characterized as a coldwater stream that has historically sustained a trout population. It is feasible that at some point in time, the lower section of the creek also supported *cold* to *cool* water fish populations, however current temperature monitoring suggests this is no longer the case. Bands of wetland vegetation are found along the length of Clythe Creek. The abundance of groundwater, near or at the ground surface in this watershed plays a key role in influencing the composition and distribution of vegetation within the watershed.

Presently, the creek is highly altered, with numerous drop structures (many of which have cultural heritage implications, which must be assessed as part of the overall Environmental Design Study) and on-line ponds (or over-widened pools) that restrict fish passage and warm the water. Clythe Creek is further constrained by the available area between York Road and two large on-line ponds (referred to as the Reformatory Ponds). Appendix B includes a photographic inventory of Clythe Creek.

In addition to Clythe Creek, study consideration must also be given to Hadati Creek, which drains in an easterly direction along Elizabeth Street before outletting across York Road to Clythe Creek. Although less of a focus than Clythe Creek, the section of Hadati Creek between Industrial Street and Clythe Creek has also been assessed as part of the EIS (specifically with respect to hydrology, geomorphology, and fisheries considerations), to take into consideration the City's proposed stormwater management and conveyance works upstream of this point along Elizabeth Street. This includes a trunk storm sewer along Elizabeth Street (partially constructed) which is intended to ultimately divert flows from an existing over-capacity storm sewer in the lower Ward One area. This sewer has been known historically as part of the Stevenson Creek system.

Several other minor tributaries of Clythe Creek (through the GID lands) also contribute flow. These other tributaries have also been considered, albeit at a higher level.

## 1.6 Study Staging and Implementation

The following study staging and implementation process has been used for this study:

| | |
|---|---|
| Stage 1 | Background Review |
| Stage 2 | Field Work Investigations |
| Stage 3 | Impact Assessment/Mitigation and Final Management Strategy |

# 2.0 STAGE 1 – BACKGROUND REVIEW

## 2.1 Overview

Stage 1 involves an assessment of multiple environmental disciplines, integrated to develop an improved understanding of existing environmental conditions within the study area. The disciplines considered as part of this background review include:

- Hydrogeology and Geology
- Hydrology and Hydraulics
- Water Quality
- Fluvial Geomorphology
- Fisheries and Aquatic Habitat
- Terrestrial Ecology

A key document to be reviewed as part of this process is the "Environmental Input to the EA for the Widening of York Road, Victoria Road to the East City Limit, Guelph, Ontario", as completed by Natural Resource Solutions Inc. (September 2006), in support of the overall York Road Improvements Environmental Assessment. This report was focused primarily on aquatic habitat considerations.

The background review process is intended to ensure that the history of the study area is fully understood, and that any previously identified constraints or concerns are understood and accounted for prior to proceeding to Stage 2 (Field Work Investigations). In this way, field investigations and modelling assessments can be suitably scoped and focused upon areas of particular sensitivity, or where available information is lacking.

## 2.2 Hydrogeology and Geology

The groundwater flow system within the study area is controlled by the local and more regional geologic setting including the surficial geology, the overburden thickness and related stratigraphy, the characteristics of the shallow underlying bedrock and the bedrock topography.

The surficial geology (Quaternary Geology – Figure B1 in Appendix C) generally indicates the potential for recharge and potential linkage to surface water features. A significant portion of the study area consists of more permeable sand and gravel glaciofluvial deposits. In addition the overburden thickness (Figure B2 in Appendix C) is generally less than 5 metres thus allowing a more direct connection to the underlying bedrock. The underlying bedrock consists of the dolostone of the Guelph Formation. The upper portion of the bedrock is expected to have a relatively high permeability as well. Portions of the Clythe Creek within the study area appear to be in direct contact with the bedrock. This combination of overburden and bedrock hydrostratigraphy provides for a significant groundwater-surface water connection.

Various regional hydrogeologic studies including the Eramosa-Blue Springs Subwatershed Study (Beak International and Aquafor Beech Limited, 1999) and the City of Guelph Groundwater Resources Study for the Northeast Quadrant (Jagger Hims Limited, 1995) indicate the shallow groundwater flow to be generally from northeast to southwest. This flow correlates well with the general regional surficial topography as well as with the bedrock topography. A significant bedrock channel originates to the northeast and appears to intersect Clythe Creek within and adjacent to the study area (Figure B3 in Appendix C). This bedrock channel may act to direct shallow bedrock groundwater to the study area and provide for a significant groundwater discharge potential.

A detailed research study immediately north of the study area by Hailey Ashworth at the University of Guelph (Groundwater-Surface Water Interactions and Thermal Regime of Clythe Creek, Guelph Ontario: Threats and Opportunities for Restoration - M.A.Sc. Thesis, 2012) presents findings supporting the groundwater discharge potential within and adjacent to Clythe Creek.

A natural heritage assessment carried out at the Guelph Correctional Centre (Natural Resource Solutions Inc., January 2013) presents significant observations of water-cress within the study area indicating groundwater discharge. This study also notes shallow groundwater conditions within the city park.

Measurements and observations of the groundwater water table at or near the ground surface have been presented in various hydrogeologic studies in support of development adjacent to the study area along Watson Parkway.

The fisheries background review (Section 2.6) documents Clythe Creek as being classified as coldwater upstream of the confluence of Hadati Creek and coolwater downstream of the confluence of Hadati Creek indicated potential groundwater discharge particularly in the upper reach within the study area.

## 2.3 Hydrology and Hydraulics

### 2.3.1 Hydrology

With respect to subwatershed hydrology, the approved frequency-based peak flows for Clythe Creek (2 through 100 year) are currently sourced from a MIDUSS model using design he storms (ref. Gamsby & Mannerow, 2006), while the Regulatory Event flows (Regional Storm – Hurricane Hazel) are sourced from a GAWSER model (ref. Schroeter & Associates, 1988). The GRCA has noted the need for review, given that the 100-year storm peak flow is greater than that for the Regulatory Event (Hurricane Hazel).

Separate, more refined hydrologic modelling using MIDUSS and design storms has also been completed for Hadati Creek (a tributary of Clythe Creek) to support a study on channel improvements (ref. Gamsby & Mannerow, 2003).

In addition to the foregoing, Amec Foster Wheeler has undertaken a number of different hydrologic modelling assessments within the Clythe Creek watershed, all using the integrated hydrologic-hydraulic modelling platform of PCSWMM (which uses the US-EPA SWMM computational engine). This includes hydrologic modelling of local sewersheds for the City's Stormwater Management Master Plan (2012), modelling of the majority of Hadati Creek to support the design of the Elizabeth Street trunk storm sewer (2015), and on-going stormwater management and hydrologic modelling support for the GID area to the south of York Road (2017, on-going). The first two modelling assessments have used design storm methodology; the latter modelling work for the GID area (on-going) employs continuous simulation.

Based on the foregoing, it has been considered necessary to generate an updated, integrated hydrologic modelling approach that reflects current land use and stormwater management controls (including recent development within the Watson Parkway area) into a single modelling platform. An integrated PCSWMM model has been developed as part of this study accordingly. Although design storms have been employed for the current study, the model can be run in continuous simulation mode if required. The current hydrologic modelling scope does not include the incorporation of a groundwater component to the modelling; the modelling would reflect surface water hydrology only. Notwithstanding, it would be possible to update PCSWMM to include a groundwater component in the future.

The base existing conditions modelling has been updated in order to assess the impacts of the proposed widening of York Road. As part of the stormwater management reporting, the preferred stormwater management strategy will also be modelled.

#### 2.3.2 Hydraulics

For Clythe Creek, a HEC-RAS hydraulic model has been made available from the GRCA, which has been incrementally updated (most recently in 2007) to reflect changes in hydraulic structures and development, particularly in the Watson Parkway area. The model extends from 500 m +\- upstream of Watson Road to just downstream of York Road.

For Hadati Creek, a HEC-2 hydraulic model was developed as part of the 2003 Channel Improvements Study (Gamsby & Mannerow). The HEC-2 model was refined as part of the Elizabeth Street Flow Splitter assessment (ref. Section 4.1.5).

For the Eramosa River, a HEC-2 hydraulic model was made available by the GRCA. The model was developed in 1989 as part of a floodline mapping study completed by Paragon Engineering Limited. The model extends past the confluence of the Eramosa River and Clythe Creek.

For the purposes of the current study, a HEC-RAS hydraulic model of Clythe Creek has been created to assess the hydraulic conditions within the study area. The model extends from the upstream side of York Road, down to the confluence with the Eramosa River. The hydraulic model has been developed based on topographic survey and 2012 contour mapping. Updated peak flow data from the hydrologic modelling effort have been used to verify the expected change in flood levels (if any), and to verify the expected impacts to York Road (i.e. frequency of expected roadway overtopping). The hydraulic modelling has also been used to assess the expected impacts of channel re-alignment and road widening on floodplain extents and depths, to ensure that there are no negative impacts.

## 2.4 Water Quality and Temperature

### 2.4.1 Water Quality

Water quality sampling data are more readily available for larger scale studies for the Speed and Eramosa Rivers. Such information can be found in Beak International and Aquafor Beech (1999). A more general characterization of the overall watershed can be found in the City of Guelph's River System Management Report (ref. Weinstein Leeming + Associates, 1993). More limited information is available for watercourses within the study area (i.e. Clythe Creek). No water quality sampling information was found for Hadati Creek.

A group of University of Waterloo 4$^{th}$ year students (2007) conducted water quality sampling along Clythe Creek as part of their overall assessment of the watercourse. This included sampling for biochemical oxygen demand ($BOD_5$), nitrate, phosphate, and dissolved oxygen (DO). Concentrations of phosphate were found to be below the Provincial Water Quality Objective (PWQO). DO concentrations ranged between 7 and 10 mg/L, which is above the minimum PWQO of 6 mg/L for cold water habitat, based on a water temperature of approximately 15$^{o}$C.

Dissolved oxygen (DO) sampling was completed by Ashworth (2012) using a hand-held probe at 12 different locations along Clythe Creek on five (5) different days. Values ranged between 5 and 10 mg/L, which are consistent with minimum Provincial standards (5-8 mg/L for warm water biota, 4-7 mg/L for cold water biota). Lower values of DO were typically found around a wetland and SWM facility outlet.

### 2.4.2 Water Temperature

Trout Unlimited monitored water temperature at multiple locations in Clythe Creek, from its headwaters to just upstream from the confluence with the Eramosa Rive from May to October of 2007 (Todd and D'Amelio, 2006; D'Amelio, 2007). In both years, temperatures were recorded at half hour intervals using WaterTemp Pro loggers (Onset Corporation). In 2006, a large increase in temperature was documented between County Road 29 and Jones Baseline which was attributed to a large pond that is present through that reach. Mean August temperature decreased at successive stations from Jones Baseline to the furthest downstream station, which was located within this study area, south of York Road. In 2007, summer water temperature was suitable for brook trout in the headwaters, at and upstream from Wellington County Road 29, but was exceeded at all of the monitoring locations further downstream. Clythe Creek through the study area was classified as *cool* to *warm* water, based on the thermal classification system of Stoneman (1996). Maximum water temperatures in Clythe Creek near the confluence with Hadati Creek approached 30°C. The report recommended removal of an impoundment upstream from Jones Baseline in order to potentially return this creek to a coldwater classification capable of sustaining brook trout.

Ashworth monitored the water temperature in Clythe Creek at several locations between an upstream crossing of York Road and a location just downstream from Watson Parkway in the summers of 2010 and 2011. Average maximum water temperatures exceeded 25°C at all locations and approached 30°C at some. Using the thermal classification of Chu et al (2009), the sites would be classified as either *warmwater* or *cool-warmwater*. A decrease in summer water temperature upstream from Watson Parkway was attributed to groundwater discharge and shading by trees.

## 2.5 Fluvial Geomorphology

### 2.5.1 Previous Studies

While numerous reports have been prepared within the vicinity of the Clythe Creek-York Road study area, information on the fluvial geomorphology (the study of the form and function of stream channels through the interaction between water and sediment transport) and existing conditions of the area is lacking and often outdated leading to numerous opportunities, as well as constraints moving forward.

Prior to the initiation of the geomorphic field assessment, a review of background reports and previous studies was conducted to determine any relevant information that may be applicable to this specific study. This background review was intended to identify any reaches that have been delineated and studied by others such that redundancy would not occur. Watershed-based studies (e.g., Ecologistics, 1998 and Beak International and Aquafor Beech, 1999) have been completed during the recent past that report the state of the stream's health, understanding the available geomorphic information and areas where updates are required and gaps to be filled, will be valid.

Overall, none of the available studies provide a detailed characterization of the entire subwatershed; however site specific information on channel dimensions and characteristics were obtained for several locations along the channel and in relation to the current study area adjacent to York Road. Several conceptual channel designs have also been created for Clythe Creek as a result of the proposed York Road widening.

A historical aerial image from 1930 was obtained for the study area during the background review process and was used to infer past and present land uses within the area. This aerial image indicates that the majority of the existing site features were present at that time, with the exception of the Reformatory ponds (both north and south).

### 2.5.2 Reach Break Analysis

Reaches are lengths of channel (typically 200 m to 2 km) that display similarity with respect to valley setting, planform, floodplain materials, and land-use/cover. Reach length will vary with channel scale since the morphology of low-order watercourses will vary over a smaller distance than those of higher-order watercourses. At the reach scale, characteristics of the stream corridor exert a direct influence on channel form, function and processes.

Within the Clythe Creek Subwatershed Overview (ref. Ecologistics, 1998), ten reaches were identified along the watercourse based on habitat characteristics. Of these reaches, two (2) are located within the study area. A summary figure, Figure B4, and table (Table B1) have been included in Appendix F for reference. Generally, the upper reach section (C9) is narrower and more sloped, with more online weir structures, than the lower reach section (C10) downstream of the existing Jaycees Park, which is much wider and stagnant, with cloudier/more turbid water.

### 2.5.3 Field Reconnaissance

Site reconnaissance was performed on December 22, 2015 by Matrix Solutions. The intent of the visit was to observe existing conditions in order to better guide the development of detailed field work and ultimately the conceptual channel design. A photographic inventory containing geomorphic observations has been compiled in Appendix F.

The section of Clythe Creek in the study area flows for approximately 950 m adjacent to the south-east side of York Road, between Industrial Avenue and Watson Parkway, before changing direction to flow south east to confluence with the Eramosa River. Based on the December 22, 2015 site reconnaissance, this section of channel can be sub-divided into two distinct channel reaches based on overall channel gradient and cross section dimensions. The reach divide is located at the Historical Stone Arch Bridge that acts as the main entryway to the Former Guelph Correctional Facility.

From the York Road crossing to the east, downstream to the Historical Stone Arch Bridge, the channel is 2 – 3 m wide and 0.5 m deep at bankfull. The gradient is low to moderate, and is controlled by a series of weir structures. Channel planform is sinuous and banks are protected with stone. Water within the channel is moderately turbid and multiple occurrences of water cress and cattails were observed growing. A groundwater fed tributary enters the channel approximately 140 m upstream from the historic bridge. A pool-riffle morphology was not apparent, and only one true riffle feature was observed immediately downstream from the York Road crossing.

Downstream from the historical stone arch bridge, the channel widens to 4 – 5 m at pinch points to 15 – 18 m at ponded sections. Multiple channel development, due to the introduction of aesthetic islands, attributes in some instances to the widened channel. Bankfull depth was not able to be determined. The channel is generally straight, with a low gradient and stone protection along the banks. Similar to upstream, multiple weir structures are present along with the occurrence of pedestrian bridges and culvert crossings. Beaver activity was also observed between the Industrial Ponds and the confluence with the Eramosa River.

## 2.6 Fisheries and Aquatic Habitat

The Eramosa-Blue Springs Watershed Study (Beak International and Aquafor Beach Limited, 1999; Table 4.4) reported that eight fish species were present in the Clythe Creek watershed. These were bluntnose minnow (*Pimephales notatus*), fathead minnow (*Pimephales promelas*), hornyhead chub (*Nocomis biguttatus*), central mudminnow (*Umbra limi*), fantail darter (*Etheostoma flabellare*), northern hogsucker (*Hypentelium nigricans*) and brook trout (*Salvelinus fontinalis*). However, the text of that document states that brook trout appear to be absent from Clythe Creek (p. 4-31) and none have been reported captured in recent years.

Fish capture information summarized in the natural environment report for the environmental assessment for the widening of York Road. (Natural Resource Solutions, 2006) and more recent information contained in OMNR files is presented in Table 2.6.1. The Clythe Creek subwatershed study (Ecologistics Limited, 1997), which appears to have relied on the same sources as the Eramosa-Blue Springs Watershed Study, reported 14 fish species occurred in the Clythe Creek subwatershed, including brook trout and mottled sculpin, which are considered coldwater species. Mottled sculpin were also captured in Clythe Creek, within the study area, on two occasions in 2007 and one occasion in 2009. Several species that are considered coolwater species have also been captured in Clythe Creek within the study area including fantail darter, rainbow darter, northern redbelly dace and central mudminnow. This presence of rainbow and fantail darter was corroborated by Ashworth (2012), who reported that these two species, in addition to creek chub and fathead minnow, were captured in Clythe Creek by Trout Unlimited staff during an electrofishing field day in June 2011 (ref. Appendix G).

The large ponds on the York District Lands are frequented by anglers. Species reported to have been captured by anglers include northern pike (*Esox lucius*), smallmouth bass (*Micropterus dolomieui)*, largemouth bass (*M. salmoides*) crappie (*Pomoxis* sp.), bullheads (*Ameiurus* sp.), sunfish (*Lepomis* sp.) and yellow perch (*Perca flavescens;* ref. Timmerman, 2001).

A 117 m long reach of the tributary that enters Clythe Creek from the south, approximately 150 m upstream from the entrance to the York District Lands, was electrofished by C. Portt and Associates staff on October 8, 2009. No fish were captured (Ontario Ministry of Natural Resources Guelph Office files). There is a record in the OMNR files of unidentified minnows being observed in the lower 10 m of this tributary on August 30, 1994 (Aquatic Habitat Inventory Stream Survey Summary prepared by D. Coulson). This document indicates that the watercourse was channelized circa 1984 and that seepage was observed at a number of locations.

Timmerman (2001) described the habitat conditions in Clythe Creek downstream from confluence with Hadati Creek, noting channel modifications that included excavated pools and a culvert and a weir that may be barriers to upstream fish migration. Timmerman (2001) also reported potential pike (*Esox lucius*) spawning habitat in the lower reaches, closer to the Eramosa River.

Mapping prepared by Fisheries and Oceans Canada indicates that there are no fish or mussel aquatic species at risk present in the study area (http://www.dfo-mpo.gc.ca/Library/356763_GrandRiver_EN.pdf accessed September 2, 2016). Greenside Darter (Etheostoma blennioides), which has been captured in the vicinity, is considered a species of special concern under the Species at Risk Act, but was assessed to be not at risk in the most recent (November 2006) COSEWIC assessment (http://www.registrelep-sararegistry.gc.ca/species/speciesDetails_e.cfm?sid=99; accessed January 4, 2016).

The GRCA has classified Clythe Creek from its headwaters to Hadati Creek as coldwater habitat (GRINS mapping accessed September 2, 2016). The small tributary that enters Clythe Creek from the south approximately 150 m upstream from the entrance to the York District Lands is also classified as coldwater habitat. Clythe Creek is classified as coolwater habitat from the confluence with Hadati Creek downstream to the Eramosa River, which is also classified as coolwater habitat. The large ponds on the York District Lands, including the channel connecting the north pond to

Clythe Creek, are classified as warmwater habitat as is Hadati Creek. It should be noted that Schedule 10B of the City of Guelph Official Plan Amendment 42 (June 4, 2014) indicates that the large ponds on the York District lands and the channel connecting those ponds to Clythe Creek are coolwater.

The Grand River Fisheries Management Plan (Ontario Ministry of Natural Resources and Grand River Conservation Authority, 1998) identifies Clythe Creek as a mixed water tributary. The fish community objective for Clythe Creek and the other mixed water tributaries is a coldwater fish community in areas where geological and biophysical characteristics are present and habitat exists or has been rehabilitated and a warmwater fish community in reaches that cannot support coldwater fish. Management strategies described in the Grand River Fisheries Management Plan for these watercourses include:

- Encourage tributary restoration,
- Consider modifications to remove existing barriers to fish passage, and
- Rehabilitate degraded habitat to restore functional system.

Management tactics identified in the Grand River Fisheries Management Plan for the mixed water tributaries include:

- Prepare habitat rehabilitation plan which incorporates a natural channel design approach to identify priority areas for restoration, and
- Rehabilitate degraded habitat and restore riparian vegetation.

**Table 2.6.1 Fish species captured at various locations in Clythe Creek, compiled from OMNRF files. Source: Natural Resource Solutions, Inc. 2006**

| Source | | | Information compiled by Natural Resource Solutions (2006) | | | | OMNRF files | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Watercourse | | | Clythe Creek Subwatershed | Clythe Creek | | York Lands ponds | Clythe Creek | | | Clythe Creek tributary | Hadati Creek |
| Location description | | | Subwatershed | Upstream of Watson Rd. | Between York Rd. and Watson Rd. | York Lands ponds | From confluence with Hadati Cr. upstream | Between confluence with Hadati Cr. and connection to north pond | | From confluence with Clythe Cr. upstream | From just downstream of Elizabeth St. Upstream |
| Investigator | | | Compilation in Subwatershed Study | GRCA | Fisheries and Oceans Canada | University of Guelph | Stantec (electrofishing course) | | | C. Portt and Associates | Fisheries and Oceans Canada |
| Easting | | | na | na | na | na | 563272.531 | 563181.3 | 563157.4 | 563690 | 562848.2 |
| Northing | | | na | na | na | na | 4822953.355 | 4822851 | 4822842 | 4823286 | 4822838 |
| Date | | | historic to 1998 | 1990 | 2001 | 2005 | 15-May-07 | 15-Oct-07 | 5-May-09 | 8-Oct-09 | 13-Jul-07 |
| Site length (m) | | | na | na | na | na | 600 | ~200 | na | 117 | ~70 |
| Sampling method | | | na | na | na | na | backpack electrofisher | | | | |
| Common Name | Scientific Name | Provincial Rank (S-Rank) | | | | | | | | | |
| black crappie | *Pomoxis nigromaculatus* | S4 | | | | | | | × | | |
| blacknose dace | *Rhinichthys atratulus* | S5 | × | × | | | | × | | | × |
| blacknose shiner | *Notropis heterolepis* | S5 | × | | | | | | | | |
| bluntnose minnow | *Pimephales notatus* | S5 | | | × | × | × | × | × | | |
| brook stickleback | *Culaea inconstans* | S5 | × | × | × | | × | × | × | | × |
| brook trout | *Salvelinus fontinalis* | S5 | × | | | | | | | | |
| brown bullhead | *Ameiurus nebuiosus* | S5 | | | × | | × | | | | |
| central mudminnow | *Umbra limi* | S5 | × | × | × | | × | | | | |
| common shiner | *Luxilus cornutus* | S5 | × | × | | | × | | × | | × |
| creek chub | *Semotilus atromaculatus* | S5 | × | × | | × | × | | × | | × |
| emerald shiner[1] | *Notropis atherinoides* | S5 | | | | | × | | | | |
| fantail darter | *Etheostoma flabellare* | S4 | × | | × | × | | | | | |
| fathead minnow | *Pimephales promelas* | S5 | × | × | | | | × | × | | × |
| finescale dace | *Phoxinus neogaeus* | S5 | × | × | | | | | | | |
| greenside darter | *Etheostoma blennioides* | S4 | | | | × | × | | | | |
| hornyhead chub | *Nocomis biguttatus* | S4 | | | | | × | | | | |
| johnny darter | *Etheostoma nigrum* | S5 | | | | × | × | | | | |
| largemouth bass | *Micropterus salmoides* | S5 | | | | | | × | | | |
| mottled sculpin | *Cottus bairdi* | S5 | × | × | | | × | × | × | | |
| northern hog sucker | *Hypentelium nigricans* | S4 | × | | | | | | | | |
| northern redbelly dace | *Phoxinus eos* | S5 | × | × | | | × | × | × | | × |

**Table 2.6.1 Fish species captured at various locations in Clythe Creek, compiled from OMNRF files. Source: Natural Resource Solutions, Inc. 2006**

| Source | | | Information compiled by Natural Resource Solutions (2006) | | | | OMNRF files | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| pumpkinseed | *Lepomis gibbosus* | S5 | | | | | | × | × | | × |
| rainbow darter | *Etheostoma caeruleum* | S4 | | | | × | × | | | | |
| rock bass | *Ambloplites rupestris* | S5 | | | | | × | | | | |
| white sucker | *Catostomus commersoni* | S5 | × | × | | | × | × | | | |
| yellow perch | *Perca flavescens* | S5 | | | | | × | | | | |

## 2.7 Terrestrial Ecology

As part of the background review, available information with respect to natural heritage information has been reviewed for relevant information. The following sources were checked as part of the background review for vegetation resources and wildlife records for the York Road study area:

- Natural Heritage Information Centre (NHIC) Biodiversity Explorer query (NHIC 2015);
- Consultation with Guelph District MNRF for SAR records (via an Information Request);
- Ontario Breeding Bird Atlas (OBBA), 2001 – 2005 (Cadman et al. 2007);
- Atlas of the Mammals of Ontario (Dobbyn 1994);
- Ontario Reptile and Amphibian Atlas (Ontario Nature 2015);
- Ontario Butterfly Atlas Online (Toronto Entomologists' Association 2015);
- City of Guelph Municipal List of Species at Risk (SAR) – provided by Guelph District MNRF on September 29, 2015;
- Groundwater-Surface Water Interactions and Thermal Regime in Clythe Creek, Guelph, Ontario: Threats and Opportunities for Restoration Thesis (Ashworth 2012);
- Assessment and Remedial Activities for Clythe Creek Phase I Report (Saavedra et al. 2007);
- Rehabilitation of Clythe Creek Phase II Design Report (Saavedra et al. 2008);
- Clythe Creek Subwatershed Overview (Ecologistics Ltd. and Blackport and Associates. 1998);
- Eramosa - Blue Springs Watershed Study Report (Beak International Inc. and Aquafor Beech Ltd. 1999);
- Eramosa River - Blue Springs Creek Linear Corridor Initiative (Proctor & Redfern Ltd. et al. 1995);
- Eramosa – Blue Springs Watershed Study – Part 3: Recommended Plan and Implementation Plan (Beak International Inc. et al. 1999);
- Conservation Plan for the Guelph Correctional Centre Heritage Place (Contentworks Inc. and Tacoma Engineers Inc. 2009); and
- Guelph Correctional Centre Natural Heritage Assessment (Natural Resources Solutions Inc. 2013).

The information gathered provides an initial understanding of the YREDS area, and facilitates decision-making during the study. The species records from the background documents have been compiled in Appendix H-1 and Appendix I-1.

### 2.7.1 Vegetation Resources

#### Natural Heritage Information Centre (NHIC) Biodiversity Explorer query (NHIC 2015)

The NHIC database was queried in October, 2015, to identify any records of SAR and/or provincially significant plant species (Sranks of S1 to S3) in the site vicinity. A total of 20 1 km X 1 km squares were checked; these 20 grid squares included the six (6) squares containing the various sections of the study site and adjacent lands as well as the 14 surrounding squares. The

20 squares queried are as follows: 17NJ6121/22; 17NJ6221/22/23/24/25; 17NJ6321/22/23/24/25; 17NJ6422/23/24/25; and 17NJ6522/23/ 24/25.

Based on this query, one historic record (June 8, 1905) exists for a significant plant species within the grid squares searched the vicinity of the YRED study area: Carey's Sedge (*Carex careyana*). This species has a provincial Srank of S2 and is Rare within Wellington County, but is not a federal or provincial Species at Risk. This species occurs within rich deciduous beech-maple forest (Hipp 2008; Anderson and Frank 2009). Based on the ELC mapping by NRSI (2013), there is limited potential for this species to occur within the YRED study area.

### City of Guelph Municipal List of Species at Risk (SAR) (City of Guelph 2015)

One plant Species at Risk was listed on the City of Guelph Municipal List: Butternut (*Juglans cinerea*); this species is considered Endangered at both the federal and provincial level. The habitat for this species is variable, but typically includes rich, moist, well-drained loam and gravel soils of limestone origin (EC 2010). Butternut is also shade-intolerant, and is therefore most often found in early-successional habitats or sparsely in later successional deciduous forests. Based on the ELC mapping for the study area by NRSI (2013), there is a high potential for Butternut to occur within the YRED study area.

### Wellington Upper Tier SAR List (OMNRF 2013)

Based on the Wellington Upper Tier list of Species at Risk list provided by Guelph District MNRF (OMNRF 2013), several Species at Risk are suspected or known to occur within Wellington County (Table 2.7.1).

**Table 2.7.1 Suspected or known Species at Risk within Wellington County (OMNRF 2013)**

| Scientific Name | Common Name | NHIC Srank | Federal status | Provincial status |
|---|---|---|---|---|
| *Arnoglossum plantagineum* | Tuberous Indian Plantain | S3 | SC | SC |
| *Castanea dentata* | American Chestnut | S2 | END | END |
| *Juglans cinerea* | Butternut | S3? | END | END |
| *Panax quinquefolius* | American Ginseng | S2 | END | END |
| *Potamogeton hillii* | Hill's Pondweed | S2 | SC | SC |

American Chestnut grows in dry, sandy upland deciduous forests, while American Ginseng is found in moist, mature deciduous forest. Based on the ELC mapping for the study area by NRSI (2013), these habitats are likely not present within the YRED study area based on existing Ecological Land Classification for the study area. Hill's Pondweed is associated with clear, cold ponds and slow-moving watercourses, and Tuberous Indian Plantain typically occurs in wet calcium-rich meadows. These habitats may be present along Clythe Creek and Eramosa floodplain. Butternut also has a high potential for occurring within the study area.

**Assessment and Remedial Activities for Clythe Creek Phase I Report (Saavedra et al. 2007)**

Saavedra et al. (2007) do not identify any specific species or vegetation communities along the Clythe Creek, but describe the vegetation as mainly manicured lawn with deciduous trees and shrubs growing along the creek. Based on the presence of 'reeds' (likely *Typha* spp), they suggest that wetland conditions exist along some portions of the creek. No federal or provincial species at risk were reported.

**Rehabilitation of Clythe Creek Phase II Design Report (Saavedra et al. 2008)**

Saavedra et al. (2008) provide no additional observations of vegetation, but do make recommendations for the design of Clythe Creek. They recommend planting a 5m wide riparian buffer strip with native trees to improve bank stabilization, nutrient and temperature control, and to deter wildlife (e.g. Canada Geese). No federal or provincial species at risk were reported.

**Clythe Creek Subwatershed Overview**
**(Ecologistics Ltd. and Blackport and Associates 1998)**

Ecologistics Ltd. et al., (1998) provide a characterization of the biotic and abiotic attributes of the Clythe Creek subwatershed. This document provides a high-level summary of the biological resources found within the subwatershed, including a variety of upland and wetland vegetation communities. Vegetation community descriptions are broad and not ELC-based, so determining if specific rare vegetation communities were present is not possible. Furthermore, no information specific to the YRED study was provided.

Overall, 170 vascular plants species were reported to occur within the Clythe Creek subwatershed, of which 29% are non-native. No federal or provincial Species at Risk were reported. The list of species provided was also reviewed to determine if species that are significant within the City of Guelph or Wellington County were listed. Highbush Blueberry (*Vaccinium corymbosum*) is listed as locally significant within the City of Guelph, and rare (R1) within Wellington County as it is known from only 2 sites. This species occurs in wet, sandy, peaty places, low-woods, and swamp-bog borders (Frank and Anderson 2009), and is unlikely to be present within the study area based on existing ELC mapping (NRSI 2013). No additional locally rare species were reported; however, an unidentified pondweed species (*Potamogeton sp*) was listed, which could potentially have been *P. hillii*, a Species at Risk in Ontario (Table 1).

**Eramosa - Blue Springs Watershed Study Report**
**(Beak International Inc. and Aquafor Beech Ltd., 1999)**

This study identified vegetation resources within the Eramosa-Blue Springs watershed. They report 405 plant species within the watershed, of which 21% are non-native. They also list 13 significant plant species, of which 10 are rare within the City of Guelph, 10 are regionally rare, and 3 are provincially rare. Four of these records are considered historical, occurring prior to 1967.

### Eramosa River - Blue Springs Creek Linear Corridor Initiative (Proctor & Redfern Ltd. et al. 1995)

This study listed twelve rare plant species within the study area, including Closed Gentian (*Gentiana rubrucaulis*) and Kalm's Lobelia (*Lobelia kalmii*); however, a species list was not provided, so the status of the remaining ten species cannot be confirmed.

### Eramosa – Blue Springs Watershed Study – Part 3: Recommended Plan and Implementation Plan (Beak International Inc. et al. 1999)

No specific natural heritage information or data were reported for the Clythe Creek system or YRED study area within this report.

### Conservation Plan for the Guelph Correctional Centre Heritage Place (Contentworks Inc., 2009)

No specific natural heritage information or data were reported for the Clythe Creek system or YRED study area within this report.

### Guelph Correctional Centre Natural Heritage Assessment (Natural Resources Solutions Inc., 2013)

NRSI conducted Ecological Land Classification (Lee et al. 1998) for the Guelph Correctional Centre study area on three dates during December of 2011. They identified 15 vegetation communities within the study area (Lee 2008). Six of these occur within 120m of the York Road corridor, including; Open Aquatic (OA), Landscaped Area (L), Fresh-Moist Manitoba Maple Lowland Deciduous Forest (FODM7-7), Buckthorn Deciduous Shrub Thicket (THDM2-6), and Dry-Fresh Graminoid Meadow (MEGM3). Wetland community boundaries were initially flagged by NRSI staff and later reviewed and approved by the Grand River Conservation Authority on May 14, 2012. No rare vegetation communities are reported to occur within the YRED study area. No soils information was collected or reported for the YRED study area.

Vascular plant surveys were also limited to December of 2011. As a result, species peaking during early- to mid-season may have been missed, including potentially significant species. A total of 130 vascular plant species were observed by NRSI within their study area, and they list an additional 47 species observed in an earlier study (Stantec, 2006). No Species at Risk were found during these surveys; however, they confirmed that Butternut (*Juglans cinerea*) does occur on site through communication with Guelph District OMNRF staff. However, two significant species were observed within landscaped areas; Burning Bush (*Euonymus atropurpurea var. atropurpurea*) and Common Hackberry (*Celtis occidentalis*), which are considered planted. The specific locations of these species were not provided, so it is not known if they occur within the YRED study area.

### 2.7.2 Wildlife Records

**Natural Heritage Information Centre (NHIC) Biodiversity Explorer query (NHIC 2015)**

The NHIC database was queried in October 2015 to identify any records of SAR and/or provincially significant wildlife species (Sranks of S1 to S3) in the site vicinity. A total of 20 1 km X 1 km squares were checked; these 20 grid squares included the six (6) squares containing the various sections of the study site and adjacent lands as well as the 14 surrounding squares. The 20 squares queried are as follows: 17NJ6121/22; 17NJ6221/22/23/24/25; 17NJ6321/22/23/24/25; 17NJ6422/23/24/25; and 17NJ6522/23/ 24/25. The results of the query are displayed below in Table 2.7.2.

**Table 2.7.2 Results of the NHIC database query for the YRED study area and surrounding lands**

| Scientific Name | Common Name | NHIC Srank | Federal status | Provincial status | Last observation date |
|---|---|---|---|---|---|
| **Insects** | | | | | |
| *Libellula semifasciata* | Painted Skimmer | S2 | --- | --- | 1913-05-26 |
| *Polystoechotes punctatus* | Giant Lacewing | SH | --- | --- | 1948-06 |
| **Reptiles** | | | | | |
| *Lampropeltis triangulum* | Eastern Milksnake | S3 | --- | --- | 1978-09-28 |
| *Thamnophis sauritus* | Eastern Ribbonsnake | S3 | SC | SC | 1990-04-25 |
| *Graptemys geographica* | Northern Map Turtle | S3 | SC | SC | 1924-07-? |

Four of the wildlife species found in the query are historic in nature: Painted Skimmer, Giant Lacewing, Eastern Milksnake, and Northern Map Turtle. Although the record of Eastern Milksnake is historic (1978), this species is known to remain extant at isolated sites with suitable habitat, even if surrounding areas become largely developed (Rowell 2012). The preferred habitats of Eastern Milksnake include the edges of woodlands adjacent to open meadows or agricultural fields (ecotones) as well as old foundations, rock piles or hedgerows, and barns, where its main prey (rodents) are present. Given that these habitats are largely absent from the study area, the suitability of the site for this species would be considered low and therefore the species is currently not likely present, even though it may have been in the past. It should be noted that in June 2016, the status of Eastern Milksnake was changed by the MNRF and it is no longer considered a Species at Risk. Finally, two of the species (Eastern Ribbonsnake and Northern Map Turtle) are associated with wetlands and river systems, so these species could persist in the vicinity of the study area, and were targeted in field studies.

### Guelph District MNRF Species at Risk records

On October 27, 2015, an Information Request was submitted to Guelph District MNRF for any SAR records that are on file for the study area and immediate surroundings. A reply was received on November 25, 2015, from Melinda J. Thompson, OMNRF Management Biologist. The Ministry has records of two SAR on file for the study area, both of them reptiles: Eastern Milksnake (*Lampropeltis Triangulum*) and Snapping Turtle (*Chelydra serpentina*). Snapping Turtle is considered Special Concern at both a federal and provincial level; as noted above, Eastern Milksnake has been delisted since June 2016 and is no longer considered Special Concern. Field staff screened for both these species during field studies.

### Ontario Breeding Bird Atlas (OBBA), 2001 – 2005 (Cadman et al. 2007)

The study area is contained within the 10 x 10 km atlas square 17NJ62; a total of 114 species of birds were listed for this square. The significant species from this list are as follows:

- Threatened or Endangered (five species): Barn Swallow, Bobolink, Chimney Swift, Eastern Meadowlark, and Least Bittern;
- Provincial Species of Conservation Concern (Special Concern and SRanks of S1 to S3) (eight species): Bald Eagle, Bank Swallow, Common Nighthawk, Eastern Wood-Pewee, Grasshopper Sparrow, Red-headed Woodpecker, Wood Thrush, and Yellow-breasted Chat;
- Local Species of Conservation Concern: 44 species.

The significant species from the OBBA provides a context for future field studies and is not site specific. Field staff screened for these species during field studies.

### Atlas of the Mammals of Ontario (Dobbyn 1994)

A total of 44 species of mammals were listed for the 10 x 10 km square that contains the present study area. The significant species from this list are as follows:

- Threatened or Endangered (three species): Eastern Small-footed Myotis, Little Brown Myotis, and Northern Myotis;
- Provincial Species of Conservation Concern (Special Concern and SRanks of S1 to S3) (one species): Woodland Vole (Special Concern);
- Local Species of Conservation Concern (16 species): the three bat species listed above plus Deer Mouse, Hairy-tailed Mole, Hoary Bat, Long-tailed Weasel, Northern Flying Squirrel, Red Bat, Silver-haired Bat, Smokey Shrew, Snowshoe Hare, Southern Flying Squirrel, Star-nosed Mole, Water Shrew, and Woodland Jumping Mouse. Note that Woodland Vole is not considered locally significant.

The significant species from the Atlas of Mammals provides a context for future field studies and is not site specific. Field staff screened for these species during field studies.

### Ontario Reptile and Amphibian Atlas (Ontario Nature 2015)

A total of 28 species of reptiles and amphibians have been reported from the 10 x 10 km square that contains the study area. The significant species from this list are as follows:

- Threatened or Endangered (three species): Blanding's Turtle, Jefferson Salamander, and Western Chorus Frog;
- Provincial Species of Conservation Concern (Special Concern and provincial SRanks of S1 to S3) (four species): Eastern Ribbonsnake, Eastern Milksnake, Northern Map Turtle, and Snapping Turtle;
- Local Species of Conservation Concern (17 species): those species listed above plus American Bullfrog, Blue-spotted Salamander, DeKay's Brownsnake, Four-toed Salamander, Mudpuppy, Northern Watersnake, Pickerel Frog, Red-bellied Snake, Red-spotted Newt, and Smooth Greensnake.

The significant species from the Ontario Reptile and Amphibian Atlas provides a context for future field studies and is not site specific. Field staff screened for these species during field studies.

### Ontario Butterfly Atlas Online (Toronto Entomologists' Association 2015)

A total of 73 species of butterflies were found to have records within the 10 x 10 km square that contains the study area. The significant species from this list are as follows:

- Threatened or Endangered: none;
- Provincial Species of Conservation Concern (Special Concern and provincial SRanks of S1 to S3) (nine species): Black Dash, Common Sootywing, Delaware Skipper, Dion Skipper, Giant Swallowtail, Hickory Hairstreak, Little Glassywing, Monarch (Special Concern), and West Virginia White (Special Concern);
- Local Species of Conservation Concern: 8 species; as above, except for Monarch.

The significant species from the Ontario Butterfly Atlas provides a context for future field studies and is not site specific. Field staff screened for these species during field studies.

### City of Guelph Municipal List – Wildlife SAR

On September 29, 2015, the Guelph District MNRF generated a list of wildlife SAR that are known to be present within the City of Guelph. This list contained the following species:

- Birds – 13 species; Bald Eagle, Bank Swallow, Barn Swallow, Bobolink, Canada Warbler, Chimney Swift, Common Nighthawk, Eastern Meadowlark, Eastern Wood-Pewee, Golden-winged Warbler, Red-headed Woodpecker, Wood Thrush, and Yellow-breasted Chat;
- Amphibians – Jefferson Salamander;
- Reptiles – Blanding's Turtle, Eastern Ribbonsnake, Eastern Milksnake (note: no longer a SAR), and Snapping Turtle;

- Mammals – three bat species: Eastern Small-footed Myotis, Little Brown Myotis, and Northern Myotis;
- Insects – Monarch, Rusty-patched Bumble Bee, and West Virginia White.

The significant species from Guelph's Wildlife SAR list provides a context for future field studies and is not site specific.

**Clythe Creek Subwatershed Overview**
**(Ecologistics Ltd. and Blackport and Associates, 1998)**

This report gathered background information available at the time; however, no specific wildlife field surveys (such as breeding bird or nocturnal amphibian surveys) were undertaken for the project. In addition, the species listed in the report were based on older sources, such as the first Ontario Breeding Bird Atlas (1981 – 1985); most of these sources are now considered historical, with the information contained therein being out of date.

They reported 57 species of birds within the subwatershed, with one of them (Least Bittern) being considered a SAR at the time. They also found records of four other provincially and locally significant species: Red-shouldered Hawk, Northern Bobwhite, Henslow's Sparrow, and Western Meadowlark[1]. With regard to mammals, a total of nine species were found, including one significant species (Smokey Shrew). Finally, records of 21 species of amphibians and reptiles were listed, including Jefferson Salamander. None of these wildlife records were specific to the present study area along York Road.

**Guelph Correctional Centre Natural Heritage Assessment**
**(Natural Resources Solutions Inc., 2013)**

This report gathered background information available at the time, which included the sources listed above. The project did not conduct any wildlife surveys within the study area, with observations only noted on an incidental basis during other surveys (e.g. vegetation and tree inventory). The sources they checked were also reviewed by D&A staff in 2015, and included the Ontario Breeding Bird Atlas (2001 – 2005), MNRF records, and the Ontario Reptile and Amphibian, Mammal, and Butterfly Atlases; the results of our reviews of these sources and others are outlined in the respective sections above.

In December 2011 and May 2012, NRSI observed 21 species of birds. In 2005 incidental observations of 10 bird species were made by Stantec (2006), for a combined total of 24 species of birds. All of these observations were of common and widespread species in southern Ontario. However, six of the species observed are considered significant within Wellington County; it should be noted that at least three of these six species (Ring-billed Gull, American Redstart, and Dark-eyed Junco) would only be considered as migrants or non-breeders within the study area due to the dates of the survey and the habitat availability. All six of these significant species are not considered rare in Wellington County. Their background review also identified 19 other species of birds that are considered locally significant within Wellington County that could also occur within the study area. It should be noted that the species list generated by NRSI was based on the OBBA (2001 – 2005) so none of these species have confirmed records from the study area and, again, no field surveys for birds were undertaken by NRSI.

No species of reptiles or amphibians were observed by either NRSI in 2011 and 2012, or Stantec in 2005. A total of eight species of mammals were reported by NRSI and Stantec; all of them are considered common and widespread in southern Ontario, with no conservation concerns. Finally, four species of butterflies were observed by NRSI in May 2012, including Monarch (Special Concern).

No odonates were reported from field investigations by NRSI or Stantec; no dedicated odonate surveys were undertaken by either group. A review of odonate records by the then available Ontario Odonate Atlas (online) revealed that 67 species of dragonflies and damselflies had been recorded within the 10 x 10 km square that contained the study area. None of them are considered Species at Risk (including Special Concern), however 14 of them had Sranks of S1 to S3 (indicating vulnerable populations in Ontario). It should be noted that the Sranks of odonates have been updated since the NRSI report, and six of the 14 species then ranked as S1 to S3 have been reclassified as S4 (indicating secure provincial populations). These six species are as follows: Brush-tipped Emerald, Eastern Amberwing, Eastern Red Damsel, Halloween Pennant, Northern Bluet, and Williamson's Emerald. Finally, 25 of the 67 species listed by NRSI are considered locally significant (i.e. within Wellington County).

**Other Reports**

As general reports, these did not provide any field observations, hence there were no relevant wildlife records for the general vicinity of the York Road study area found within the following reports: *Conservation Plan for the Guelph Correctional Centre Heritage Place* (Content Works 2009), *Eramosa - Blue Springs Watershed Study Report* (Beak International Inc. and Aquafor Beech Ltd. 1999), *Eramosa River - Blue Springs Creek Linear Corridor Initiative* (Proctor & Redfern Ltd. 1995), *Assessment and Remedial Activities for Clythe Creek Phase I Report* (Saavedra et al. 2007), and *Rehabilitation of Clythe Creek Phase II Design Report* (Saavedra et al. 2008).

## 2.8 Transportation Facilities

As part the current undertaking, the EA-documented need, justification and design for the widening of York Road between Victoria Avenue and the East City Limits, was reviewed and updated to reflect current objectives and standards in the City of Guelph.  The following sections provide a summary of the previous York Road Class EA (2007) findings.

### 2.8.1 2007 York Road Class Environmental Assessment

In February 2007, the City of Guelph, with assistance from TSH, filed the York Road Improvements: Wyndham Street South to East City Limits Class Environmental Assessment. The following sections briefly outline the transportation-related outcomes of that study.

#### *2.8.1.1 Need and Justification*

Traffic modelling and a general site assessment were completed as a component of the Class EA, using 2006 base and 2016 horizon years. The traffic modelling took into consideration anticipated development of the York District Lands on the south side of York Road, which were to support a residential population of 750, and an employment population of 6,280 by 2021. This development has yet to occur as parts of the proposed plan are currently under review by the Ontario Municipal Board. Based on the results of the aforementioned investigations, the following Need and Justification statement was developed:

*Widening of York Road east of Victoria Road is required because:*

a) *Turning lanes and additional through lanes are required to facilitate better traffic operations as traffic volumes and congestion increase, and service would otherwise be exacerbated by traffic delays and unsafe driving conditions.*
b) *The lack of continuous sidewalks and bicycle routes contributes to unsatisfactory conditions for existing and future bicyclists and pedestrians.*

#### *2.8.1.2 EA-Recommended Roadway Design*

The EA-recommended roadway design was based on results of detailed traffic modelling and consultation with Guelph city staff, key stakeholders and members of the public. The design generally recommended a four-lane cross-section with a continuous on-road cycling lane and sidewalk on the north side. Similar facilities were to be provided on the south side, west of Elizabeth Street. East of Elizabeth Street, a paved shoulder (rural section) would partially serve as a cycling lane, with pedestrian facilities assumed to be provided within the York District Lands. In addition to modifications to the roadway cross-section, the EA also recommended realignment of Elizabeth Street to correct the existing skewed connection to York Road, as well as closure of the Beaumont Crescent and Cityview Drive intersections.

## 2.9 Integrated Summary

Based on the background review process, it is understood that there have been a number of studies completed previously for the current study area. These studies have assisted team members in gaining an initial understanding of the characteristics of the study area, and in identifying analyses and tasks that have been previously completed which do not need to be repeated. Conversely, the background review process has also guided the development of the field work investigations (Section 3), by identifying those data and knowledge gaps that exist and should be addressed in order to ensure a fulsome environmental characterization. .

# 3.0 STAGE 2 – FIELD WORK INVESTIGATIONS

## 3.1 Hydrogeology and Geology

Based on the scope of the current assessment, and the available background information and modelling, no hydrogeologic or geologic field work activities are proposed as part of the current EIS.

The fisheries and terrestrial assessments (Sections 3.5.3 and 3.6.3) both described observations of watercress which can be indicative of groundwater discharge.

## 3.2 Hydrology and Hydraulics

### 3.2.1 Hydrology

Based on discussions with City staff and staff from the GRCA, no hydrologic field work activities have been considered required as part of the current EIS. A flow monitoring program was originally envisioned by the City as part of this study, however it has been agreed that this program will not be conducted as part of this study, primarily due to constraints with respect to the project schedule, and the availability of City monitoring equipment. As such, hydrologic modelling has been validated using previously completed modelling (as noted in Section 3.2) and unitary flow comparisons to similar watersheds in other jurisdictions. It is considered that this approach is defensible and appropriate for the current study purposes.

An integrated PCSWMM hydrologic model has been developed as part of this study. The base PCSWMM model combined the previous hydrologic modelling assessments undertaken by Amec Foster Wheeler in the Clythe Creek Watershed. This includes hydrologic modelling of local sewersheds for the City's Stormwater Management Master Plan (2012), modelling of the majority of Hadati Creek to support the design of the Elizabeth Street trunk storm sewer (2015), and on-going stormwater management and hydrologic modelling support for the GID area to the south of York Road (2017, on-going). The integrated PCSWMM model has been updated to include the Hadati Creek watercourse, as well as the large upstream Clythe Creek watershed, and any contributing drainage areas.

The Hadati Creek Watershed is mostly urbanized with a 50 ha +/- wood stand located south west of Pollinators Park (ref. Figures 3.21 to 3.2.6). Flows in Hadati Creek are attenuated in the existing wetland area upstream of Starwood Drive (ref. Cosburn Patterson Wardman Limited, November 1992). The Starwood Drive crossing and wetland area provides control up to the 100 year storm event. The channel downstream of Starwood Drive continues through a 1 km creek block through residential subdivision with crossings at Chesterton Lane and Grange Road. The flows are attenuated and controlled at the CNR crossing up to and including the 100 year storm event and Regional Storm (ref. Schaeffers, 1997). The flow from the CNR crossing enters a highly urbanized channel prior to crossing York Road where it enters Clythe Creek

With the development of drainage area boundaries, appropriate hydrologic modelling parameters (which represent the runoff potential of each individual subcatchment) are required. The following has been considered in determining the hydrologic modelling parameterization for Hadati Creek.

- Directly connected imperviousness (the value required by PCSWMM) has been calculated based on standard assumed values for different land uses. Total imperviousness has also been calculated in order to properly adjust infiltration parameters using the Green-Ampt methodology.
- Imperviousness for existing residential land uses has been determined using measurements of lot coverage from the 2016 aerial photography.
- Slopes and overland flow lengths have been calculated using available 2012 City of Guelph contour mapping, property boundaries, and 2016 aerial photography.
- Manning's roughness coefficients of 0.013 and 0.2 have been applied for impervious and pervious overland flow components respectively.
- Base depression storage depths of 1 and 5 mm have been applied for impervious and pervious catchment portions respectively.
- The recommended default value of 25% has been applied for the zero depression storage imperviousness ratio (the portion of the impervious area with no depression storage).
- Hydrologic parameters for individual catchments are provided in Appendix D.

The City of Guelph has 4 stormwater management facilities (i.e. ponds) within the Hadati Creek Watershed. There is a water quality stormwater management pond (City pond #54) located in Carter Park in the headwaters of Hadati Creek. The 3 remaining stormwater management ponds are located in the Grangehill Estates subdivisions. City pond #115 located within Grangehill Estates Phase 7 provides control up and including the 100 year storm event. The two remaining ponds (City pond #31 and #37) provide water quality controls and discharge into the wetland area upstream of Starwood Drive.

The Clythe Creek Watershed has headwaters which consist of 1200 ha +/- of predominantly rural land uses (ref. Figure 3.2.1). The Clythe Creek Watershed extends beyond the eastern limits of the City of Guelph and is thus situated beyond the limits of the City's available mapping. For the area of the Clythe Creek Watershed beyond the City's available mapping, aerial photography available from Google Map™ as well as the Grand River Conservation Authority's 2000 DTM 1 m contours was used. The external Clythe Creek catchments have been discretized at a much larger resolution (25 ha +\- to 300 ha +\-) compared to the urban areas in accordance with the available data.

The urban areas within the Clythe Creek Watershed have been parameterized using the same methodology as those in the Hadati Creek Watershed (ref. Figures 3.2.4 and 3.2.6). The large rural headwaters required a different methodology for determining the subcatchment length. Subcatchment length is a key parameter within PCSWMM, as it is used to represent sheet flow/overland flow, and accounts for the expected degree of attenuation (i.e. is a surrogate for time of concentration or time to peak used in unit hydrograph methodologies). Given that in most cases flow is defined by the channel (i.e. ditch) length, the subcatchment length for the large rural areas has been defined using generally accepted relationships between channel length and flow path length, namely the Proctor & Redfern method (Proctor and Redfern, Ltd. And MacLaren, J.F. Ltd, 1976, "Stormwater management model study – Vol 1". Research Rep. No. 7, Canada-Ontario Research Program, Environmental Protection Service, Ottawa), which indicated that the subcatchment width (width of the kinematic wave plane) should be 1.7 times the channel length. Thus subcatchment length has been set equal to the drainage area divided by 1.7 times the channel length.

The City of Guelph has 5 stormwater management ponds within the Clythe Creek Watershed upstream of the York Road crossing. There are 4 stormwater management ponds in the Watson Creek Tributary from the Watson Subdivisions. Three of the stormwater management ponds (City ponds #86, #87, and #111) in the Watson Subdivisions provide control up to and including the 100 year while the fourth (City Pond #88) only provides water quality controls. The fifth pond (City Pond #53) is located upstream of the Watson Parkway crossing and controls flows from the eastern Grangehill Subdivision up to and including the 100 year storm event. There are also 4 stormwater management ponds within the GID lands which contribute to Clythe Creek. These ponds include City Ponds #38 and #96 as well as the two SDP ponds (ref. Figure 3.2.5).

The subcatchments along York Road (ref. Figure 3.2.6) have been discretized at a high resolution in order to isolate the localized road drainage contributing to Clythe Creek and assess the impacts of widening the road and therefore increasing the level of imperviousness (ref. Figure 3.2.6). Impervious areas of the York Road subcatchments have been measured from the 2016 aerial photography. Where drainage from the York Road catchments enter a ditch along the road a nominal 10 percent directly connect imperviousness has been applied for the existing condition. This represents a conservative estimate for comparison to the future alternative which will utilize storm sewers to capture the runoff prior to outletting into Clythe Creek. The City of Guelph 2012 topographic contour mapping and storm drainage layer have been utilized to determine the existing outlets for York Road drainage along Clythe Creek.

An event-based methodology has been applied, based on the City of Guelph's standard 5 and 100 year design storms (Chicago storms with variable durations of approximately 3 hours). The City of Guelph does not have a specified 10 year or 25 year design storm distribution, however the City's design storms are based on Chicago temporal distributions which have variable durations of approximately 3 hours. Accordingly, a 3 hour Chicago distribution storm event has been generated, using the City's current IDF parameters for both a 10 year and 25 year event, and the same peaking factor (approximately 0.42) as was applied in the other storm distributions.

In addition, the Regional Storm for the study area (Hurricane Hazel) has been used for simulation purposes. Given that the study area is less than 25 $km^2$, no reduction factor is required. The Green-Ampt infiltration methodology has been applied in the PCSWMM modelling, as such the 12-hour version of the Regional Storm could not be applied for the study area. The full 48-hour version of the Regional Storm has been simulated to represent AMC-III – saturated conditions for area soils.

The MOECC recommended water quality storm of 25 mm 4 hour storm with a Chicago distribution has also been simulated. The results of the existing conditions for the various storm events are provided in Table 3.2.1.

**Table 3.2.1 Clythe Creek Existing Conditions Peak Flows ($m^3/s$)**

| Location | Node | Area (ha) | 25 mm Chicago | Return Period Flows - 3 Hour Chicago | | | | | | Regional |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 2 | 5 | 10 | 25 | 50 | 100 | |
| York Road | J_CC00 | 1198 | 1.8 | 3.0 | 4.8 | 8.6 | 15.9 | 24.0 | 33.3 | 82.9 |
| Reformatory Driveway | J_York_05 | 1206 | 1.8 | 2.9 | 5.2 | 8.6 | 15.9 | 24.0 | 33.1 | 81.6 |
| Royal City Jacees Park ponds | J_York_03 | 1347 | 2.4 | 4.1 | 7.5 | 10.9 | 19.1 | 28.5 | 37.7 | 89.6 |
| Hadati Creek confluence | J_CC04 | 2130 | 3.8 | 6.4 | 12.8 | 20.4 | 30.0 | 40.7 | 51.2 | 100.8 |
| Eramosa confluence | J_CC05 | 2138 | 6.0 | 8.8 | 15.8 | 23.5 | 33.2 | 43.5 | 53.4 | 100.8 |

Verification of the resulting flows has been conducted by comparing the return period flows to the unitary flow rates of frequency flows from various studies and watercourse systems (ref. Table 3.2.2). The results indicate that the return period flows are reasonable but in the lower range of flows. This is attributed to the use of the 3 hour Chicago design storm versus a longer duration design storm. A sensitivity test on the rainfall determined that the 24 hour Chicago distribution would produce unitary rates of 0.036 $m^3/s/ha$ for Clythe Creek at York Road and 0.029 $m^3/s/ha$ at the Hadati Creek confluence of Clythe Creek.

**Table 3.2.2 Watercourse Unitary Peak Flow Comparison**

| Land Use | Location | Unitary Flow Rates ($m^3/s/ha$) for Design Storms | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 2 | 5 | 10 | 20/25 | 50 | 100 | Regional |
| Urban + Rural | Clythe Creek at York Road | 0.003 | 0.004 | 0.007 | 0.013 | 0.020 | 0.028 | 0.069 |
| | Hadati Creek Confluence | 0.003 | 0.006 | 0.010 | 0.014 | 0.019 | 0.024 | 0.047 |
| Urban + Rural | 14 Mile Creek | 0.0156 | 0.020 | 0.025 | 0.033 | 0.035 | 0.042 | 0.079 |
| Urban + Rural | McCraney | 0.0275 | 0.029 | 0.030 | 0.036 | 0.037 | 0.041 | 0.072 |
| Rural | North Waterdown | 0.006 | 0.011 | 0.014 | 0.018 | 0.021 | 0.023 | 0.090 |
| Rural | Sixteen Mile Creek | 0.003 | 0.006 | 0.009 | 0.012 | 0.016 | 0.019 | 0.075 |
| Urban + Rural | Red Hill Creek | 0.007 | 0.011 | 0.014 | 0.017 | 0.022 | 0.026 | 0.069 |
| 2009 Urban + Rural | Stoney (Escarp.) | 0.004 | 0.007 | 0.011 | 0.015 | 0.018 | 0.022 | 0.073 |
| | Battlefield (Escarp.) | 0.004 | 0.008 | 0.011 | 0.015 | 0.019 | 0.022 | 0.073 |
| | Stoney (Outlet) | 0.004 | 0.007 | 0.01 | 0.014 | 0.017 | 0.020 | 0.063 |

### 3.2.2 Hydraulics

With respect to channel hydraulics, topographic survey has been conducted for selected sections of Clythe Creek to support updated hydraulic modelling and design work. No additional topographic survey was conducted for Hadati Creek, as the channel geometry available within the existing hydraulic modelling is considered sufficient for study purposes. A topographic survey for the York Road right-of-way has been previously completed by the City of Guelph and has been used as part of this study.

As previously mentioned, a HEC-RAS hydraulic model was created for the section of Clythe Creek located within the study area. The model extends form the upstream side of York Road, down to the confluence with the Eramosa River. The model was developed using topographic survey and 2012 contour mapping. Cross-section data were developed using GIS software tools.

Three existing hydraulic crossings were added to the model. The crossings are shown on Figures 3.2.7 and 3.2.8, and are as follows:

- York Road crossing of Clythe Creek, 3.0 m span by 1.3 m rise concrete box culvert;
- Former Reformatory Driveway crossing of Clythe Creek, 4.20 m span by 1.83 m rise concrete arch bridge; and
- Parking Lot Driveway crossing, twin 1.4 m diameter CSP culverts.

Peak flows for the 2 to 100 year and Regional Storm events were obtained from the aforementioned PCSWMM hydrology model created for the current study, and flow change locations were set at key locations within the model. A downstream boundary condition of a known water surface elevation was set for each storm event. Water surface elevations were obtained from the HEC-2 model of the Eramosa Rover (ref. Paragon Engineering Limited, 1989).

As noted in Section 2.5, several in-line weir structures exist along Clythe Creek. Cross-sections were placed on the upstream and downstream sides of each weir structure. The structures were incorporated into the model as blockages on the respective upstream cross-section.

#### Existing Conditions Results

The results for the 2 – 100 year and Regional Storm events are provided in Appendix D. The Regional Storm floodline is represented on Figures 3.2.7 and 3.2.8. It is noted that the downstream boundary conditions of the Eramosa River causes a significant backwater condition in the Regional Storm event that extends up to the downstream side of the Reformatory driveway crossing. York Road is also overtopped due to the backwater condition.

The Eramosa River produces a significant backwater condition for the 2 to 100 year storm events as well. The backwater condition extends up to 130 m downstream of the former Reformatory driveway crossing (cross-section 847.82). Due to the significant backwater conditions, several sections downstream of the former Reformatory driveway crossing do not contain the flood elevations.

Also of note, two spill conditions occur upstream of the former Reformatory driveway crossing. The first spill condition occurs on the upstream side of York Road, where the Regional Storm spills west along the north ditch of York Road. The spilled flows will drain along the ditch and rejoin the system near the downstream side of the former Reformatory driveway crossing. The second spill condition occurs downstream of York Road between cross-sections 1280.724 and 1356.024. The spilled flows will drain overland to the south and join the Eramosa River. The HEC-RAS model has been provided in Appendix D on a CD.

**Existing Culverts**

The hydraulic model was used to assess the performance of the existing York Road crossing of Clythe Creek in order to understand the potential for the existing culvert to satisfy the future needs of the York Road widening.

The existing culvert has been characterized based on its performance with respect to current Ministry of Transportation (MTO) guidelines for conveyance and freeboard (Highway Deign Standards, MTO, January 2008) and Ministry of Natural Resources and Forestry (MNRF) guidelines for safe ingress and egress (Technical Guide – River and Stream Systems: Flooding Hazard Limit, MNR, 2002).

MTO guidelines for culvert and bridge hydraulic design are based on providing a set freeboard and clearance. Freeboard is measured from the design event water surface elevation to the edge of travelled right-of-way. Clearance is measured from the design event water surface elevation to the obvert of the crossing. The design event, freeboard and clearance required consider the road classification and the total structure span. MTO guidelines are summarized in Table 3.2.3.

**Table 3.2.3 Design Flow Return Period for Bridges and Culverts (Years) – Standard Road Classifications**

| Functional Road Classification | MTO[1] | | Freeboard Criteria (m)[1] | Clearance Criteria for Bridges (m)[1] | Clearance Criteria for Open-Footing Culverts (m)[1,2] |
|---|---|---|---|---|---|
| | Total Span less than or equal to 6.0 m | Total Span greater than 6.0 m | | | |
| Freeway, Urban Arterial | 50 | 100 | 1.0 | 1.0 | 0.3 |
| Rural Arterial, Collector | 25 | 50 | 1.0 | 1.0 | 0.3 |
| Local | 10 | 25 | 0.3 | 0.3 | 0.3 |

Note: [1] Highway Drainage Design Standard (MTO, January 2008)
[2] It is noted that there is no clearance criteria for closed-footing culverts.

The MNRF's guidelines relate to the safe passage of pedestrians and passenger and emergency vehicles across the length of road over which the Regulatory event may overtop. Safe passage is determined by overtopping depths, overtopping velocities and consideration for the combined impact (i.e. product of depth and velocity) and represents 'low risk' to the method of transportation (i.e. pedestrian or vehicle). Table 3.2.4 summarizes the maximum allowable depths and velocities.

**Table 3.2.4 Design Criteria for Pedestrian and Vehicular Access**
(Source: MNR Technical Guide – River and Stream Systems)

| Vehicular Access | Maximum Overtopping Depth (m) | Maximum Overtopping Velocity (m/s) | Maximum Product ($m^2/s$) |
|---|---|---|---|
| Pedestrian | 0.3 | 1.7 | 0.4 |
| Passenger Vehicle | 0.3 | 3.0 | N/A |
| Emergency Vehicle | 0.9 | 4.5 | N/A |

York Road is proposed to be classified as Urban Arterial in the future and has been assessed on this basis. The criteria for safe passage has been applied assuming ingress/egress for passenger vehicles. The assessment has been completed using existing conditions peak flows. The results of the crossing performance assessment are summarized in Tables 3.2.5 and 3.2.6. It is noted the existing Reformatory driveway crossing and the existing south parking lot driveway crossing have been included in the tables for the purpose of demonstrating their existing performance. These driveway crossings are privately-owned and are not subject to the aforementioned MTO and MNRF criteria.

**Table 3.2.5 Existing Crossing Performance - MTO Criteria**

| Culvert ID | Structure | | Future Road Classification | Design Criteria (Frequency in Years) | Actual Capacity (Frequency in Years) | Required Freeboard (m) | Provided Freeboard (m)[1] | Required Clearance (m) | Provided Clearance (m)[1] | Criteria Achieved? |
|---|---|---|---|---|---|---|---|---|---|---|
| | Type | Size (m) | | | | | | | | |
| York Road | Concrete Box Culvert - Open Bottom | 3.00 x 1.30 | Urban Arterial | 50 Year | 25 year | 1.00 | <0.00 | 0.30 | <0.00 | No |
| Reformatory Driveway | Concrete Arch Bridge | 4.20 x 1.80 | N/A | N/A | 25 year | N/A | 0.31 | N/A | <0.00 | N/A |
| Parking Lot Driveway | Twin CSP Culvert | 1.40 | N/A | N/A | <2 year | N/A | <0.00 | N/A | 0.02 | N/A |

Notes: [1] Value shown is value at design storm conveyance requirement, or actual design storm capacity

**Table 3.2.6 Existing Crossing Performance - MNRF Criteria**

| Culvert ID | Structure | | Vehicular Access | Max Overtopping Depth (m) | Provided Overtopping Depth (m) | Max Overtopping Velocity (m/s) | Provided Overtopping Velocity (m/s) | Maximum Product | Criteria Achieved? |
|---|---|---|---|---|---|---|---|---|---|
| | Type | Size (m) | | | | | | | |
| York Road | Concrete Box Culvert - Open Bottom | 3.00 x 1.30 | Passenger Vehicle | 0.30 | 1.03 | 3 | 2.43 | N/A | No |
| Reformatory Driveway | Concrete Arch Bridge | 4.20 x 1.80 | N/A | N/A | 0.74 | N/A | 1.62 | N/A | N/A |
| Parking Lot Driveway | Twin CSP Culvert | 1.40 | N/A | N/A | 2.50 | N/A | 0.37 | N/A | N/A |

Notes: *Provided values are for Regulatory event (Regional Storm)

The results in Tables 3.2.5 and 3.2.6 indicate that the existing York Road crossing does not meet the applicable MTO and MNRF design criteria and is therefore considered for upgrade as part of the preferred alternative (ref. Section 4.1.4).

**Hadati Creek**

The HEC-2 hydraulic model of Hadati Creek (ref. Gamsby & Mannerow, 2003) was reviewed to determine the existing performance of the York Road culvert crossing of Hadati Creek. A 5.5 m by 1.7 m concrete box culvert conveys flows from the north side of York Road to the south side, where Hadati Creek joins into Clythe Creek. Based on the review of the HEC-2 model, the 5, 25, 100 and Regional Storm events were modelled in the 2003 study. A boundary condition of known water surface elevations was set at the downstream end of the HEC-2 model, and are noted to be in accordance with the boundary conditions set for the aforementioned HEC-RAS model developed for Clythe Creek.

As York Road is proposed to be classified as Urban Arterial, the applicable MTO criteria requires the existing culvert to convey the 50 year design storm without overtopping York Road. Although the HEC-2 model did not simulate the 50 year the design storm, the results of the 100 year design storm were provided. The results indicate that the 100 year design storm does not overtop York Road, therefore indicating that the 50 year design storm should not overtop as well.

As shown on Figure 3.2.7., the backwater condition produced by Eramosa River results in an overtopping of York Road at the Hadati Creek crossing during the Regional Storm event, with a flood depth of approximately 1.40 m. In order to reduce the flood depth to satisfy the cited ingress/egress criteria, the only solution would be to propose significant increases in the vertical profile of York Road. Given the impracticality of this solution, it is not recommended that this be advanced. Furthermore, it is understood that the City is not expecting the existing culvert to be improved to satisfy the applicable MTO and MNRF criteria. Reference Section 4.1.4 for the preferred alternative of the Hadati Creek culvert.

## 3.3 Water Quality

No specific water quality testing or field work has been conducted as part of the current EIS. It is not considered that additional sampling information would impact upon the likely mitigation strategy for the proposed roadway widening given the relatively minor contributing drainage area in this case. Water quality impacts associated with the proposed road widening will be addressed directly as part of the Environmental Design Study, specifically Stage 3 (Impact Assessment/Mitigation for Preferred Alternative) and the subsequent detailed stormwater management report. Longer term water quality monitoring as part of future works and detail design of York Road could include collecting baseline data along Clythe Creek both upstream and downstream of Hadati Creek, including the identification of the primary sources of sediment loading.

## 3.4 Fluvial Geomorphology

In order to fill gaps in the fluvial geomorphic understanding of the study area, a detailed field program was completed with results outlined in detail in the Fluvial Geomorphic Existing Conditions Report (Matrix, 2016) (ref. Appendix F). Information gathered during the field activities provides quantitative data on channel processes which will be valuable in the development of a preliminary channel design however the data collected are likely not sufficient to support a detailed design.

### 3.4.1 Desktop Assessments

Previously conducted studies and reports of Clythe Creek and the broader area were reviewed for relevant geomorphic information. This review included previous studies within the subwatershed, stormwater management and drainage studies, geographic information, aerial photography and additional information provided by the City of Guelph and interested proponents. Channel reaches were delineated for the study area including three along Clythe Creek and one on Hadati Creek within the area of interest.

### 3.4.2 Rapid Field Assessments

To further confirm and refine results of the desktop analyses, rapid field assessments (i.e., the Rapid Geomorphic Assessment (RGA) and Rapid Stream Assessment Technique RSAT)) and additional field reconnaissance have been conducted to confirm the reach setting and the dominant geomorphic forces impacting Clythe Creek adjacent to York Road. During this evaluation, areas of active channel adjustments (e.g., erosion, deposition) have been identified. Measurements of pool depth and average depth measurements to channel bed in the area of the in-stream weirs have been documented. An inventory of all weir structures was compiled and crossing assessments completed for all bridges and culverts.

#### *3.4.2.1 Rapid Assessment Results*

- Four study reached were identified within the study area; three along Clythe Creek and one on Hadati Creek upstream from the confluence.
- Rapid Assessment results for each reach are summarized; the reaches of Clythe Creek are generally transitional or stressed and should be considered as moderately sensitive to future change in sediment or flow regimes. Field indicators of channel morphology are within the range of variance for streams of similar characteristics however there is frequent evidence of instability.
- Aggradation is the dominant geomorphic process contributing to instability, including evidence of embedded riffles, siltation in pools, deposition in overbank zone and poor sorting.
- Hadati Creek is considered to be in a transitional or stressed state with degradation as the dominant geomorphic process; undermined bank stabilization, knick-point formation, exposed bedrock, elevated outfalls, scour pools downstream from outfalls.

The study reaches are considered to be in low to moderate overall health with limiting factors found relating to instream habitat, water quality, riparian conditions and biological indicators.

### 3.4.3 Clythe Creek Detailed Field Data Collection

In order to better quantify channel dynamics, a detailed field assessment of the study reaches was completed. The field work follows standard geomorphic field protocols and included the total station survey of nine (9) (non-monumented) bankfull cross-sections, a longitudinal profile survey from York Road to the Eramosa River confluence, characterization of the bed and banks and documentation of any other features that may be affecting flow and sediment movement (i.e., weir structures, tributaries, stormwater outflows).

#### *3.4.3.1 Existing Bankfull Geometry*

Five bankfull channel cross sections were surveyed between York Road and the main Reformatory entrance (Historical Stone Bridge) within Reach C-9A. An additional four bankfull cross sections were surveyed between the Reformatory entrance and the confluence with Hadati Creek within Reach C-9B.

The typical cross-section for Reach C-9A (see Appendix F) depicts generally consistent bank heights and a U-shape channel bed. Due to the U-shape cross-section, the thalweg through the reach is typically located in the center of the channel. Bankfull channel width ranged from 3 to 4 m, with an average of 3.39 m. Bankfull hydraulic depths (i.e., average depth across the cross-section) varied between 0.29 and 0.42 m, averaging 0.36 m. The average maximum depth was 0.64 m. These recorded channel widths and depths form cross-sections with areas between 0.93 and 1.75 $m^2$ and an average width to depth ratio of 9.67. The long profile (Figure 5) shows that the gradient along through Reach C-9A from York Road to the Reformatory entrance is low-moderate, with an average slope of 0.012 m/m.

The typical cross-section for Reach C-9B (see Appendix F) is drastically different from what is observed upstream. Bankfull channel widths range from 9 to 11 m, with an average of 10.19 m. Bankfull hydraulic depths varied between 0.31 and 0.53 m, averaging 0.44 m. The average maximum depth was 0.8 m. The recorded channel widths and depths form cross-sections with areas averaging 6 $m^2$ and an average width to depth ratio of 23.83. The long profile shows that the gradient through this reach is low, with an average slope of 0.0049 m/m. Although the gradient throughout the reach is predominantly flat, several weir structures controlling the gradient are located within the upstream quarter of the reach near the historic bridge. A reverse gradient is observed within the reach upstream from the Hadati Creek confluence, contributing to the observed standing water downstream from the pond outlet.

#### *3.4.3.2 Existing Channel Profile*

The existing channel profile indicates that the gradient along through Reach C-9A from York Road to the Reformatory entrance is low-moderate, with an average slope of 0.012 m/m. Within Reach C-9B the profile shows that the gradient through this reach is low, with an average slope of 0.0049 m/m. Although the gradient throughout the reach is predominantly flat, several weir structures controlling the gradient are located within the upstream quarter of the Reach C-9B near the Reformatory entrance. A reverse gradient is observed within the reach upstream from the Hadati Creek confluence, contributing to the observed standing water downstream from the pond outlet.

### 3.4.4 Hadati Creek

While the primary focus of the fluvial geomorphology field work will be on Clythe Creek, given the direct impacts to York Road, additional field work will be conducted on Hadati Creek to support the proposed upstream flow diversion assessment (Elizabeth Street trunk storm sewer and upstream flow splitter).

The Hadati Creek Characterization will include a reach walk from Elizabeth Street and Industrial Avenue to the confluence with Clythe Creek. During the walk, both the Rapid Geomorphic Assessment and Rapid Stream Assessment Technique will be carried out in order to identify dominant factors contributing to existing channel form and function as well as overall channel health. Spot flow measurements will be conducted within the reach and a representative cross section measured in order to identify bankfull channel dimensions. This work will occur simultaneously with the Clythe Creek assessments.

## 3.5 Fisheries and Aquatic Habitat

### 3.5.1 Field Investigations

The study area was examined by C. Portt on April 18, 2016, to observe spring conditions and, in particular, assess the potential for northern pike spawning. The study area was examined again on August 31 and September 1, 2016, to observe summer habitat conditions. Habitat conditions were observed and key locations were photographed.

### 3.5.2 Habitat Assessment

No northern pike spawning was observed during the April 18, 2016, site visit. It should be noted that the site visit was conducted later in the spring, after pike spawning would normally occur, due to the unusually cold spring weather in 2016. Patches of emergent macrophytes that could be used by spawning northern pike were present in the lower reaches of Clythe Creek, near the Eramosa River, however better quality spawning habitat is present in a number of locations in the flood plain along the south side of the Eramosa River (C. Portt has observed spawning pike at those locations). No habitat suitable for northern pike spawning was observed in the Reformatory ponds, in the reach of Clythe Creek that is parallel to York Road, or in Hadati Creek between Clythe Creek and Elizabeth Street.

### 3.5.3 Clythe Creek

Clythe Creek has been extensively modified through the study area, from the culvert that conveys it beneath York Road to its confluence with the Eramosa River. The modifications include a series of dams and weirs whose vertical drops are partial or complete barriers to upstream fish migration. From a fish habitat standpoint, the creek can be divided into two (2) sections with the break occurring at the road entrance into the York District Lands. Upstream from that entrance the channel dimensions appear appropriate to the flow, although the channel does appear to have been straightened and the banks are armoured with boulder and cobble along most of this reach. The substrate is varied, ranging from silt to cobble and boulder. There are numerous patches of watercress (*Nasturtium officinale*) along this reach which is typically indicative of groundwater discharge, A small (ditched) tributary enters this reach from the south. There was a small amount of flow in this tributary on September 1, 2016.

The existing culvert beneath York Road has natural substrate thoughout and is not a barrier to upstream fish migration. There are six structures between the entrance to the York District Lands and the culvert beneath York Road that block or impede upstream fish migration. Three of these are rock structures that may be passable by some fish under some flow conditions. Two have vertical drops of 1 – 1.5 m and are considered to be complete barriers to upstream migration. One is a concrete and rock structure with a vertical drop of approximately 1 m and a perched pipe through the structure; it is also probably a complete barrier to upstream migration.

Downstream from the entrance to the York District Lands the channel has been widened to create a series of ‘ponds’ separated by dams/weirs that block or impede upstream fish migration. This landscaping, which included digging the two large ponds on the site, was initiated in the early 1930’s (Guelph Correctional Centre, 2002). The result is a series wide, slow-moving sections with fine substrate and, in many locations, dense submergent aquatic vegetation. The banks are armoured with boulder and cobble and short sections of coarse substrate occur immediately downstream from the dams/weirs.

Moving upstream from the Eramosa River, the first concrete weir is located approximately 75 m downstream from the confluence of Hadati and Clythe Creeks. It may be possible for fish to move upstream via a second, more westerly channel although an abandoned culvert on that branch is also an impediment to upstream fish movement. On November 1, 2016, this weir was observed to be submerged and no longer a barrier to upstream fish migration, as a result of backwater conditions created by a downstream beaver dam that was constructed in the fall of 2016. The two (2) large corrugated steel pipes which convey Clythe Creek beneath the driveway to the former playing fields are not barriers to upstream fish migration.

There are four structures between the channel connecting Clythe Creek to the north pond and the entrance to the York District Lands. Two of these are concrete and stone structures that are probably passable by fish, at least during higher flows. One is a vertical stone and concrete structure approximately 0.8 m high with a perched pipe through it that passes low flows. This may be a complete barrier to upstream fish migration. The structure closest to the entrance is a concrete ramp with embedded stones that may by passable at high flows but is a barrier to upstream fish migration at low flows.

### 3.5.4 Hadati Creek

Immediately upstream from York Road, Hadati Creek flows in a constructed channel with straight banks armoured with stone and concrete. The channel is shallow with substrate ranging from sand to cobble to bedrock. No barriers to upstream fish migration were observed between York Road and Elizabeth Street. Cyprinids (minnows) and small sunfish (Lepomis spp.) were observed in a number of locations when this watercourse was examined on September 1, 2016.

### 3.5.5 North Reformatory Pond

The shoreline of the north pond is armoured with boulder and cobble, much like the landscaped portion of Clythe Creek. Submergent macrophytes are sparse and there is a narrow band of emergents along the shoreline in many places. The bottom of this pond is relatively flat with depths, determined by Trout Unlimited investigators, of between 2.5 m and 2.7 m (unpublished data provided by J. Imhoff, Trout Unlimited).

## 3.6 Terrestrial Ecology

Surveys (ref. Appendices H and I) have included a Vegetation Assessment including Ecological Land Classification (ELC) and a vegetation inventory, tree inventory and hazard assessment, breeding bird surveys, turtle surveys, Eastern Milksnake surveys, Significant Wildlife Habitat (SWH) screening, and Species at Risk (SAR) screening. Incidental wildlife observations will be recorded as part of all field surveys.

The following vegetation field surveys were completed within the YREDS area, which includes adjacent lands (to 120 metres as per the PPS (2014)):

- Ecological Land Classification (ELC);
- Vegetation Inventory;
- Tree Inventory and hazard assessment;
- Species at Risk (SAR);
- Breeding bird surveys;
- Nocturnal Amphibian Surveys;
- Turtle surveys;
- Eastern Milksnake surveys;
- Significant Wildlife Habitat (SWH) screening;
- Species at Risk (SAR) screening; and
- Incidental wildlife.

### 3.6.1 Methods: Vegetation Resources

#### Ecological Land Classification (ELC)

The vegetation community survey was conducted within the lands shown on Figure 3.6.1. Ecological Land Classification for Southern Ontario (Lee et al, 1998) was utilized to characterize the landscape in order to develop an understanding of impacts to the natural heritage systems within the study area. No soil texture or moisture information was collected at the request of the landowners; therefore, soil texture and moisture regime was approximated based on visual assessment of the soils. ELC was previously completed for the study area in 2012 (NRSI 2012); this mapping served as a base for updates based on changes to the land cover, or where the previous mapping was insufficient ELC Community data observed in the field were mapped using ESRI ArcGISv10. Surveys were completed on May 12, 2016, June 17th, 2016, and August 8th, 2016 by Dougan NS Asc. (Table 3.6.1).

#### Vegetation Inventory

A survey of the dominant flora was conducted in each vegetation community polygon within the study area. Surveys took place on May 12, 2016, June 17th, 2016, and August 8th, 2016, Incidental wildlife observations were also noted on these dates. The data were corroborated with current status lists applied to identify species of significant conservation status. The data from NRSI (2012) were also incorporated to provide a comprehensive list of species for the study area. All nomenclature is based on the Natural Heritage Information Centre's list of species for Ontario (NHIC 2016).

#### Tree Inventory and Hazard Assessment

An inventory and assessment of all potentially impacted trees of 10cm DBH (diameter at breast height) or larger was conducted within the area shown on Figure 3.6.2. Surveys were conducted on June 14th, 2016 by Zack Harris and Kristen Beauchamp and on June 17th by Zack Harris (Table 3.6.2).

Trees were assessed for species, size, structural condition and biological health. Tree location data were collected using a Trimble GeoXH unit to facilitate data collection. In optimal conditions this hand-held global positioning system (GPS) provides real-time sub-meter accuracy of tree locations. Data collection was combined with tree tagging using a metal forestry tag to allow for effective future identification of each tree.

Once GPS data had been recorded, each tree was identified, assessed for biological and structural health, assigned a preservation priority value and its size including DBH, height, and crown reserve were recorded.

#### Species at Risk (SAR)

During the flora surveys, the habitats present were assessed as to its suitability to Species-at-Risk (SAR) vegetation and wildlife species that may be present in the area. A short-list of potential SAR species was generated during the background review. For each of these species, the study was assessed as to the likelihood of that species occurring, whether presently or in the future.

### 3.6.2 Methods: Wildlife Resources

#### Breeding Bird Surveys

Two breeding bird surveys were conducted on June 3 and June 17, 2016, following the protocols outlined by the Ontario Breeding Bird Atlas (OBBA 2001). This protocol stipulates that the surveys be conducted between sunrise and 10:00 a.m., between May 24 and July 12, during appropriate weather conditions (i.e., light winds, no heavy rains).

#### Nocturnal Amphibian Surveys

Three nocturnal amphibian surveys were conducted on April 21, May 9, and June 21, 2016, following protocols outlined by the Ontario Marsh Monitoring Program (BSC 2003). These protocols stipulate that surveys take place from April 15 – 30, May 15 – 31, and June 15 – 30, from sunset until midnight, with temperatures of at least 5 °C, 10 °C, and 17 °C, respectively. Three point count stations were established within the study area (Table 3.6.1).

**Table 3.6.1 Point Count Station Locations**

| Point Count Station | Easting | Northing |
|---|---|---|
| 1 | 563101.00 m E | 4822695.00 m N |
| 2 | 563343.00 m E | 4822688.00 m N |
| 3 | 563567.00 m E | 4823002.00 m N |

### Turtle Surveys

Basking turtle surveys were undertaken on May 3, May 20, and June 17, 2016. Surveys were conducted during warm sunny weather, and involved scanning all rocks, floating logs, and shoreline within the two main ponds and also along Clythe Creek for the presence of basking turtles. During other surveys, such as ELC and breeding bird surveys, these searches were also undertaken although the weather and timing may have not been as ideal. High quality optics were used to search for turtles and the location, number, and species sighted were noted. In addition, suitable areas for nesting (i.e., exposed areas of sand or gravel with a southerly aspect) were searched for, especially in areas adjacent to Clythe Creek and York Road. York Road was walked during all wildlife surveys to check for the presence of dead or injured turtles.

### Eastern Milksnake Surveys

Three Milksnake surveys were conducted on the subject lands on May 3, May 20, and June 17, 2016, during warm and sunny weather, and after mid-morning to ensure that any snakes present would be active. The dates of the surveys coincided with the peak activity period of this species, which is generally late April to late June in southern Ontario. The methodology followed draft protocols provided by the Guelph District OMNR, dated June 2013 (OMNR 2013). The methodology parameters, as per the protocol, were as follows:

- Active hand searches were conducted over the entire site, with all objects (where possible) such as rocks, logs, and other cover, turned over and replaced;
- Careful attention was paid to areas on the property such as forest edges, compost, rock and woody debris piles, old foundations, and exposed bedrock fractures;
- Surveys were conducted between early May and mid-June;
- All surveys occurred on sunny days, with air temperatures between 8ºC and 25ºC (when overcast, with temperatures above 15 ºC);
- Three surveys (minimum number required under protocol) were conducted, with the surveys separated by at least 14 days.

Artificial cover boards were not utilized as the protocol stipulates against it unless they can be placed at least two or three years ahead (if placed for less time, negative results are considered inconclusive).

### Significant Wildlife Habitat (SWH) Screening

During all field investigations, habitats on site were screened against the Significant Wildlife Habitat (SWH) categories contained within the *Significant Wildlife Habitat Technical Guide*

(OMNR 2000) and the *Significant Wildlife Habitat Criteria Schedules for Ecoregion 6E* (OMNRF 2015) (Appendix I-2).

**Species at Risk (SAR) Screening**

A screening of all known wildlife Species at Risk (SAR) that have been known to occur in the City of Guelph through 2015 was undertaken; the list was obtained from the Guelph District MNRF office. The known habitats for these wildlife species were screened against the habitats contained within the subject lands, based on 2016 field investigations, with the likelihood of their presence being indicated. The full screening is presented as Appendix H-2.

**Table 3.6.5 Summary of wildlife survey visits in 2016 to the study area**

| Date (2016) | Observer | Time | Weather Conditions | Purpose |
|---|---|---|---|---|
| April 21 | Zack Harris, Heather Schibli | 20:44 – 21:18 | Cloudy, calm, 11 – 14 °C | Nocturnal Amphibian Survey #1 |
| May 3 | Ian Richards | 10:00 – 15:00 | Clear to partly cloudy, calm, 9 – 14 °C | Snake & Turtle Survey #1 |
| May 9 | Zack Harris, Heather Schibli | 21:13 – 21:45 | Partly cloudy, calm, 9 – 11 °C | Nocturnal Amphibian Survey #2 |
| May 12 | Zack Harris | 09:00 – 16:30 | Clear, calm, 12-24°C | Ecological Land Classification and Vegetation Inventory, Incidental Wildlife Observations |
| May 20 | Ian Richards | 10:30 – 15:30 | Partly cloudy, light north winds, 18 – 20 °C | Snake & Turtle Survey #2 |
| June 3 | Ian Richards | 06:15 – 09:45 | Clear, calm, 14 – 19 °C | Breeding Bird Survey #1 |
| June 14 | Zack Harris, Kristen Beauchamp | 08:30 – 17:00 | Clear, calm, 16 – 22 °C | Tree Inventory |
| June 17 | Ian Richards | 06:30 – 10:30 | Clear, calm, 17 – 20 °C | Breeding Bird Survey #2 and Turtle & Snake Survey #3 |
| June 17 | Zack Harris | 08:30 – 13:00 | Clear to partly cloudy, calm, 20 - 29°C | Tree Inventory, Ecological Land Classification and Vegetation Inventory, Incidental Wildlife Observations |

| Table 3.6.5 Summary of wildlife survey visits in 2016 to the study area | | | | |
|---|---|---|---|---|
| **Date (2016)** | **Observer** | **Time** | **Weather Conditions** | **Purpose** |
| June 21 | Zack Harris | 21:47 – 22:16 | Partly cloudy, calm, 21 °C | Nocturnal Amphibian Survey #3 |
| August 8 | Zack Harris | 12-00 – 17:00 | Clear, slight wind, 25 - 28°C | Ecological Land Classification and Vegetation Inventory, Incidental Wildlife Observations |

**Incidental Wildlife**

No surveys were conducted for other wildlife groups, such as mammals and insects. Any sightings of these groups were done on an incidental basis during all other surveys.

### 3.6.3 Findings: Vegetation Resources

**Ecological Land Classification (ELC)**

A total of 21 vegetation community polygons were mapped for the study area, as shown on Figure 3.6.1. These polygons are comprised of 10 different ELC vegetation types or ecosites, which are described below. A complete list of the vascular plants observed within each polygon, including previous studies by NRSI (2012) and Stantec (2006) is provided in Appendix H-3.

No soils information was collected at the request of the landowner; therefore, the identification of wetland vegetation communities was based on whether or not the relative abundance of wetland indicator species was greater than 50%. Visual assessment of the soil surface throughout the study area, other than the upland landscaped areas (polygon 4), suggest that the soils were rich with organics, and contained a moderate sand component. The study area is located in an area that is typically Till Plain with Drumlins surrounded by Spillway (Chapman and Putman, 1984). Based on the Soil Survey of Wellington County Ontario, the soils are Burford Loam which tend to be "well drained soils consisting of loam surface horizons on gravel deposits" (Hoffman et al. 1963).

***Anthropogenic (ANTH)***

Anthropogenic areas include 3 polygons (1, 2, and 4) and account for 6.71 ha of the study area. Polygons 1 and 2 are located within the northwestern portion of the study area near the intersection of Watson Road and York Road (Figure 3.6.1), and polygon 4 is located within the central portion of the study are and surrounds several large ponds (polygons 17 and 18). All anthropogenic areas are dominated by mowed grass, with scattered, mostly planted, trees and shrubs. Tree species included Norway Maple (*Acer platanoides*), Silver Maple (*Acer saccharinum*), Norway Spruce (*Picea abies*), White Spruce (*Picea glauca*), Red Pine (*Pinus resinosa*), Eastern White Pine (*Pinus strobus*), and Scotch Pine (*Pinus sylvestris*). Occasional shrubs include Common Buckthorn (*Rhamnus cathartica*), Red osier Dogwood (*Cornus stolonifera*), Serviceberry (*Amelanchier* species), Rugosa Rose (*Rosa rugosa*), and Ground

Juniper (*Juniperus communis*). The ground cover is dominated by lawn grasses, with scattered Dandelion (*Taraxacum officinale*) and Common Plantain (*Plantago major*). These areas were previously mapped as Landscaped Areas by NRSI (2012).

***Buckthorn Cultural Thicket Type (CUT2-6)***

Polygons 7, 11, and 14 are located along the north shore of the Eramosa River (ref. Figure 3.6.1), and consist of Buckthorn Cultural Thicket. Combined, these polygons make up 5.77ha of the study area. Most of these polygons are a near monoculture of Common Buckthorn, but also contained other exotic and invasive shrubs such as European Privet (*Ligustrum vulgare*) and Glossy Buckthorn (*Frangula alnus*) to the exclusion of other trees, shrubs, and ground cover species. As a result of these species and historic disturbance, these polygons were generally low in diversity ranging from 55% - 60% native species. Mature tree cover was low, and was mostly restricted to Manitoba Maple (*Acer negundo*) and exotic tree willows (e.g. *Salix x fragilis*) along the Eramosa River and small plantations of spruce (*Picea* spp). Groundcover composition within drier areas of these polygons was general low, with Yellow Avens (*Geum aleppicum*), Dame’s Rocket (*Hesperis matronalis*), Braod-leaved Enchanter’s Nightshade (*Circaea canadensis*), and Creeping Buttercup (*Ranunculus acris*).

These polygons also contained pockets of Broadleaved Sedge Mineral Meadow Marsh (MAM2-6), which tended to have the highest native species diversity, including wetland species such as Eastern White Cedar, Lake Sedge (*Carex lacustris*), White Turtlehead (*Chelone galbra*), Spotted Joe Pye Weed (*Eutrochium maculatum var maculatum*), Stinging Nettle (*Urtica dioica* s.l), and Blue Vervain (*Verbena hastata*).

***Dry-Moist Old Field Meadow Type (CUM1-1)***

Polygons 3 and 16 are located along the northwestern edge of the study area, make up approximately 7.34ha of the study area (ref. Figure 3.6.1). Polygon 16, being slightly up gradient from Clythe Creek, was drier and less diverse than polygon 3 which contained moist pockets of Forb Mineral Meadow Marsh (MAM2-10) throughout riparian areas. The vegetation within polygon 16 was typical of old field conditions, and included species such as Orchard Grass (*Dactylis glomerata*), Queen Anne’s Lace (*Daucus carota*), Goldenrod (*Solidago altissima ssp. altissima* and *S. Canadensis*), Canary Reed Grass (*Phalaris arundinacea*), and Common Mullen (*Verbascum thapsus*). There was little tree cover within polygon 16 except for occasional Spruce (*Picea* sp) along a small channel and tributary flowing into Clythe Creek. This channel did contain come wetland and aquatic species, including Watercress (*Nasturtium officinale*) and Great Angelica (*Angelica atropurpurea*).

The vegetation community within polygon 3 is similar to polygon 16 in dry areas. However, The low-lying meadow marsh riparian areas along Clythe creek contain a variety of wetland and aquatic species, including Watercress, sedges (*Carex bebii*, *C. flava*, *C. stipata*, *C. stricta*, and *C. vulpenoidea*), Bulb-bearing Water-hemlock (*Cicuta bulbifera*), Spotted Water-hemlock (*C. maculata*), Hairy Willowherb (*Epilobium hirsutum*), Spotted Joe Pye Weed, Marsh Bedstraw (*Galium palustre*), Harlequin Blue Flag (*Iris versicolor*), Mannagrass (*Glyceria striata* and *G.*

*grandis*), and Soft Rush (*Juncus effusus*). Tree and shrub cover is low overall (<25%) within polygon 3, however some areas contained small but dense stands of Eastern Red Cedar, and Red Osier Dogwood lined the banks of Clythe Creek in some areas. Most trees are assumed to be planted, and included Silver Maple, Norway Maple, and Eastern Red Cedar.

### *Cattail Mineral Shallow Marsh Type (MAS2-1)*

Polygon 8 is a small (0.46ha) Cattail Mineral Meadow Marsh located along the Eramosa River in the southern portion of the study area (ref. Figure 3.6.1). This polygon contained is dominated by Broad-leaved Cattail (*Typha latifolia*),but contained forbs such as Canada Anemone (*Anemone canadensis*), Bul-bearing Water-hemlock, Stinging Nettle, as well as Lake Sedge. Shrubs such as willows (*Salix discolor, S. eriocephala*), Nannyberry (*Viburnum lentago*), and Red-osier Dogwood were uncommon and mostly along the edge. At the southern portion of polygon 8, a small inclusion of Reed-canary Grass Mineral Meadow Marsh (MAM2-2) inclusion borders the Eramosa River. Several small drainage features flowed from this area into the Eramosa, and were dry by the June 17th, 2016 visit.

### *Fresh-Moist Lowland Deciduous Forest Type (FOD7-4)*

This 0.71ha forest is located in the south western portion of the study area (ref. polygon 10; Figure 3.6.1). This feature is defined by a canopy of Crack Willow (*Salix x fragilis*) and Manitoba Maple with an understory and shrub layer of Glossy and Common Buckthorn, Riverbank Grape (*Vitis riparia*), and Red-osier Dogwood. Herbaceous species included Spotted Jewelweed (*Impatiens capensis*), Ostrich Fern (*Matteuccia struthiopteris*), and Stinging Nettle (*Urtica dioica* s.l.), and Panicled Aster (*Symphyotrichum lanceolatum ssp lanceolatum*). This feature contains the lower portion of Clythe Creek as it flows from polygon 19 into the Eramosa River.

### *Forb Mineral Meadow Marsh Type (MAM2-10)*

Polygon 13, a 4.35ha Forb Mineral Meadow Marsh, has regenerated from former parkland, including portions of old baseball diamonds. The inner portions of this feature were flooded to a depth of 5-10cm in some areas in early spring. The vegetation is abundant with wetland species such as Canada Anemone, Late Goldenrod (*Solidago gigantea*), Field Mint (*Mentha arvensis*), Northern Rough-leaved Goldenrod (*Solidago rugosa var. rugosa*), Swamp Aster (*Symphyotrichum puniceum*), Fox Sedge (Carex bebbii), Bebb’s Sedge, Dark-green Bulrush (*Scirpus atrovirens*), and Spotted Joe Pye Weed. Few trees are present, though Peach-leaved Willow (*Salix amygdaloides*), Balsam Poplar (*Populus balsamifera*), and Red-osier Dogwood are beginning to establish. A small watercourse through polygon 2 indicates that the hydrology of this feature is most likely driven by season flooding of the large southern pond, polygon 17. Given the state of this feature during the dry conditions in 2016, it is likely that this feature will continue to succeed to a marsh community in the future.

### *Mineral Cultural Savannah Ecosite (CUS1)*

This community type was found within polygon 6, a 3.53ha polygon located in the eastern portion of the study area. A sparse canopy of scattered Northern White Cedar and Spruce species (*Picea* sp) define this community. Shrub species included Glossy Buckthorn, Choke Cherry (*Prunus virginiana*), Common Bucjthorn, Staghorn Sumac (*Rhus typhina*), and young American Elm (*Ulmus americana*). Groundcover species included White Sweet Clover (*Melilotus alba*), Common Evening Primrose (*Oenothera biennis*), Goldenrod (*Solidago* sp), and Queen Anne's Lace (*Daucus carota*). In moist areas, Canada Anemone, Blue Vervain, Bebb's Sedge, and Reed Canary Grass were also present.

### *Mineral Cultural Woodland Ecosite (CUW1)*

A narrow patch of Mineral Cultural Woodland approximately 0.33 ha in size extends along a slope bordering the north east end of the large south pond (polygon 17). This feature contains elements of a small Northern White Cedar hedgerow, and a canopy of American Elm, Black Cherry (*Prunus serotina*), European Mountain-ash, Scotch Pine (*Pinus sylvestris*), Downy Serviceberry (*Amelanchier arborea*) and Dotted Hawthorn (*Crataegus punctata*). The shrub layer is mostly exotic, included Tatarian Honeysuckle (*Lonicera tatarica*), Wayfaring-tree (*Viburnum lantata*), Common Buckthorn, and Common Lilac (*Syringa vulgaris*), as well as Chokecherry and Red Raspberry (*Rubus idaeus*). Due to the dense canopy cover, herbaceous groundcover was sparse, and included Common Dandelion, Avens Species (*Geum sp*), Broad-leaved Enchanter's Nightshade, and Goldenrod species along the edge.

### *Mineral Meadow Marsh Ecosite (MAM2)*

Mineral Meadow Marsh Ecosite was present in two locations; polygons 12 (1.94ha) and 15 (0.63ha) (Figure 3.6.1). Like polygon 13, polygon 12 has regenerated from abandoned baseball diamonds, and was flooded in 2016 until late spring. The most abundant groundcover species were Creeping Bentgrass (*Agrostis stolonifera*), Many-headed Sedge (*Carex synchocephala*), Spikerush (*Eleocharis sp*), True Forget-me-not, and Mints (*Mentha arvensis, M. spicata, M. x piperita*), witch occasional patches of Retrorse Sedge (*Carex retrorsa*) and Fox Sedge. No tree or shrub species have yet established. As with polygon 13, the hydrology of this feature is driven by the flooding of polygon 17, and will likely continue succeeding to wetland.

### *Open Aquatic Community Series (OAO)*

Two large (polygon 17, 7.43ha; polygon 18, 3.45ha) and three small artificial ponds (polygon 9, 0.10ha; polygon 19, 0.26ha; polygon 20, 0.17ha; Figure 3.6.1). Polygons 17 and 18 contained very low cover of submergent, floating, or emergent vegetation except for along the ponds edges, whereas polygons 9, 19, and 20 had more substantial cover throughout. Aquatic species included Curly-leaved Pondweed (*Potamogeton crispus*), Broad-leaved Arrowhead (*Sagittaria latifolia*), Eurasian Watermilfoil (*Myriophyllum spicatum*), and Fragrant Waterlily (*Nyphaea odorata ssp. odorata*). The ponds were bordered by vegetation typical of the surrounding polygons, including Crack Willow, Manitoba Maple, Northern White Cedar, and Red-osier Dogwood.

### Vegetation Inventory

A complete list of vascular plants observed within the study area is provided in Appendix H, including species listed in NRSI (2012). A total of 285 vascular plants have been observed to-date including the two previous studies by NRSI (2012) and Stantec (2006), though some of the species listed in these reports may have occurred outside of the study area. A total of 251 species, including 145 (58%) native species were observed in the study area in 2016. No species with Species at Risk status in Ontario were observed, though Downy Serviceberry (*Amelanchier arborea*), Red Fescue (*Festuca rubra ssp. rubra*), Rough Aven's (*Geum laciniatum*), and Hairy Solomon's Seal (*Polygonatum pubescens*) are considered rare in Wellington County (Appendix H-3). Furthermore, Rough Avens, Variegated Horsetail (*Equisetum variegatum*), and Many-headed Sedge (*Carex synchnocephala*) are considered significant in Wellington County (ref. Appendix H-3). Only one species noted in the background studies, Prairie Willow (*Salix humilis*), was observed within the study area. This species is not considered provincially or regionally rare in Wellington County (Frank and Anderson 2009), but is rare throughout much of south central and south western Ontario.

**Tree Inventory and Hazard Assessment**

A total of 228 trees were tagged within the study area boundary during the tree inventory and assessment. A total of 20 species of trees were tagged and evaluated. Figure 3.6.2 shows the locations of the trees surveyed, their respective crown reserve (diameter of the canopy), and preservation priority. Appendix H-4 contains a summary of all tagged tree data including definitions of the parameters used in the arborist assessment.

Of the species identified, 11 are native to Ontario, 8 are non-native, and 1 was identified to the genus level. The most abundant species was Eastern White Cedar (*Thuja occidentalis*), a native tree, with a total of 58 trees tagged, followed by Silver Maple (*Acer saccharinum*) at 55 trees and Norway Maple (*Acer platanoides* ) at 47 trees. Chart 1 illustrates the count of each tree species tagged during the survey. The majority of trees surveyed were native to Ontario – a total of 137 native trees and 90 non-native trees.

The trees surveyed were generally scattered throughout ELC polygons 1, 2 and 3 (Figures 3.6.1 and 3.6.2). The proposed development extends outside of the surveyed area and a supplemental survey will be completed at a later date. Planted Silver and Norway Maples border York Road near the inter section with Watson Road within polygon 1 and along the driveway leading into the house within polygon 2. The canopy structure within the north east half of polygon 3 consists of mature Silver Maple over Northern White Cedar that border much of Clythe Creek. Towards the south west end the canopy is more sparse and immature, and consists of more Spruce species (*Picea sp*).

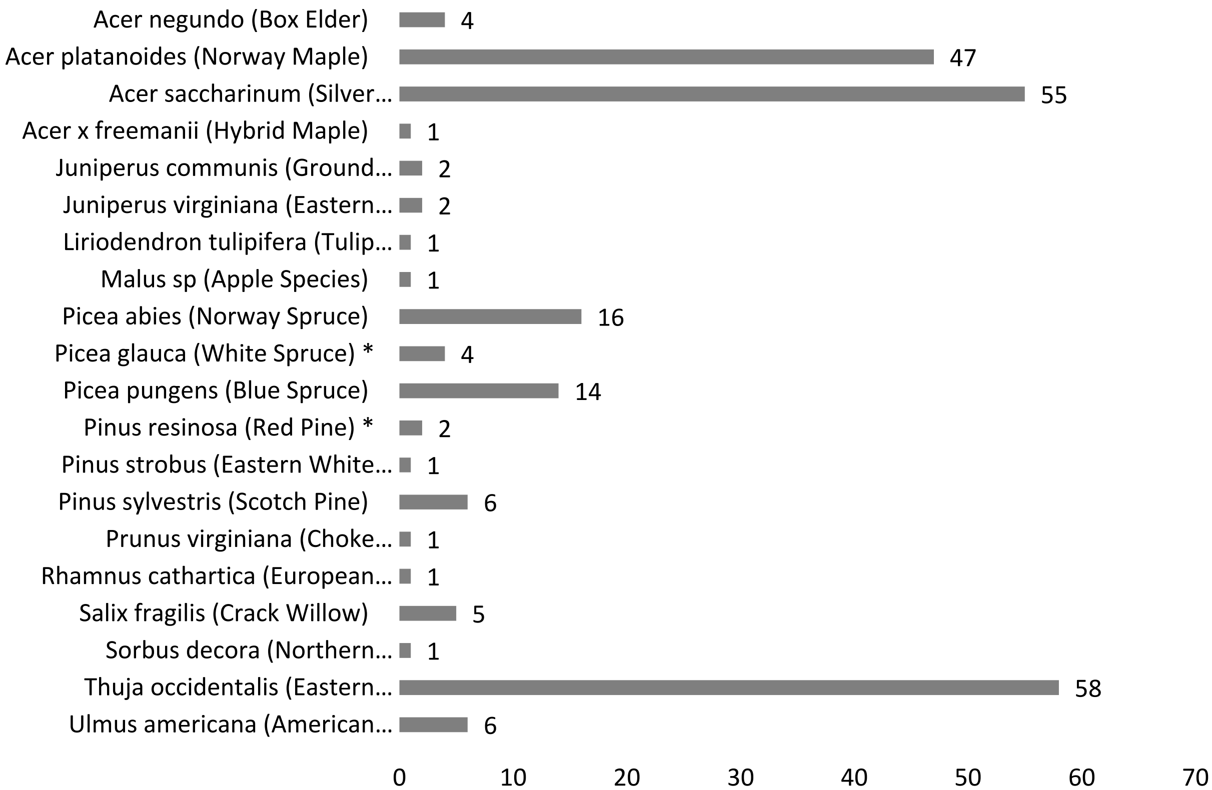



**Chart 3.6.1: Overall Tree Tally by Species**

**indicates tree is native to Ontario*

The largest trees surveyed were Crack Willow (*Salix fragilis*) with 2 trees with a dbh of 200cm followed by Silver Maple (*Acer saccharinum*), with 6 trees between 115 cm and 140 cm dbh. Including these trees, 50 trees surveyed were of a large trunk diameter (50cm DBH or larger) which including 30 Silver Maple, 7 Norway Maple (ref. Table 3.6.3). Chart 3.6.2 provides a breakdown of the size distribution of the trees surveyed.

**Table 6.6.3 Surveyed Tree Species with greater than or equal to 50cm DBH**

| Scientific Name | Tree Count >= 50 cm DBH |
|---|---|
| *Acer saccharinum* | 30 |
| *Acer platanoides* | 7 |
| *Salix fragilis* | 3 |
| *Picea abies* | 2 |
| *Picea pungens* | 2 |
| *Pinus resinosa* | 2 |
| *Thuja occidentalis* | 2 |
| *Ulmus americana* | 2 |
| *Picea glauca* | 1 |

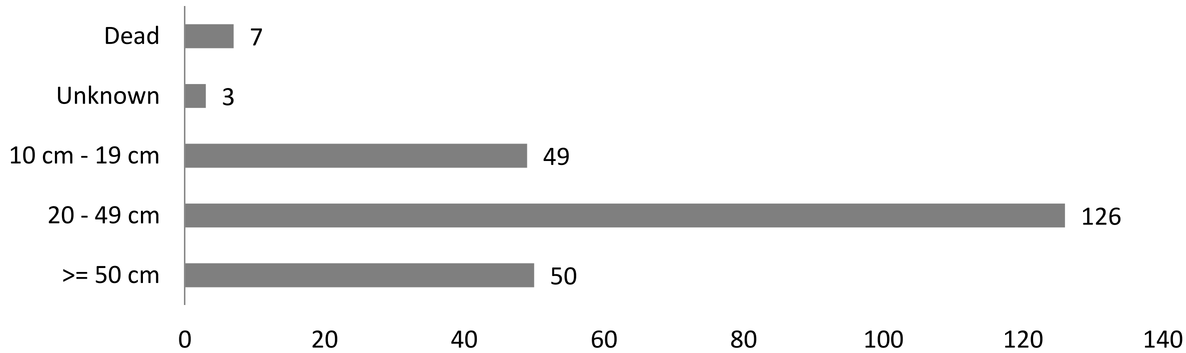



**Chart 3.6.2: Size Distribution of Trees by DBH**

Table 3.6.4 provides a breakdown of the number of specimens that ranked either High, Medium, or Low for Structural Condition, Biological Health, and Preservation Priority parameters. Data were collected on the Structural Condition, Biological Health, and Preservation Priority for each tree tagged. The term Structural Condition refers to the physical structure of the tree. Trees with poor condition may be leaning or have cracks, multiple stems, or broken branches. Biological Health was assessed by observing signs of tree health such as rot, cavities, epicormic shoots, crown dieback, bulges, fissures, and insect holes. Preservation Priority is a function of size, desirable species, high condition ranking, and/or high health ranking; of the remaining trees. The primary biological issues included crown and branch dieback, as many of the trees are mature for their species in a landscape setting, while structural defects included cracks and poor form (e.g. leaning) (ref. Appendix H-4).

**Table 3.6.7 Summary of Structural Condition, Biological Health, and Preservation Priority rankings**

| | Structural Condition (No. of Trees) | Biological Health (No. of Trees) | Preservation Priority (No. of Trees) |
|---|---|---|---|
| **High** | 36 | 109 | 58 |
| **Medium** | 112 | 75 | 76 |
| **Low** | 66 | 29 | 80 |
| **Unknown (previous survey)** | 14 | 15 | 14 |
| **Dead** | 7 | 7 | 7 |

### Species at Risk (SAR)

No plant Species at Risk were observed within the study area.

### 3.6.4 Findings: Wildlife Resources

#### Breeding Bird Surveys

A total of 50 species of birds were detected during the breeding bird surveys and other wildlife surveys; 42 of these species were considered as at least possibly breeding on the site. Six species – Great Blue Heron, Green Heron, Turkey Vulture, Osprey, Herring Gull, and Rock Pigeon – were observed flying over the site only, and are not considered breeding within or adjacent to the site. Two other species – Ring-necked Duck and Sharp-shinned Hawk – were considered migrants only. Of the 42 species of breeding birds, three of them are considered introduced (non-native): Mute Swan, European Starling, and House Sparrow. Of the remaining 39 species, three of them are considered Species at Risk (SAR): Chimney Swift (*Chaetura pelagica*), Barn Swallow (*Hirundo rustica*), and Eastern Meadowlark (*Sturnella magna*), all of which are designated as "Threatened" at both a federal level (COSEWIC 2015) and a provincial level (OMNRF 2016). See the "Species at Risk" section for further details.

At a provincial level, all of the 39 native breeding species have been assigned an Srank of either S4 or S5 by the Natural Heritage Information Centre (NHIC 2016b), which indicates that their provincial populations are "apparently secure" or "secure", respectively (NHIC 2016a).

At a local level, none of the breeding species are considered "rare" within either the Regional Municipality of Waterloo (RMW 1996) or Wellington County (D&A 2009).

The Ontario Ministry of Natural Resources and Forestry (OMNR 2000) considers two species – Savannah Sparrow and Eastern Meadowlark – as being area sensitive, which indicates that they require large areas of suitable habitat for their long-term survival and thus are more sensitive to development.

The highest level of breeding evidence obtained during the surveys was "confirmed" breeding (OBBA 2001), as indicated by the presence of fledged young (FY). This evidence was collected for the following five species: American Robin, European Starling, Song Sparrow, Common Grackle, and Brown-headed Cowbird. The next highest level of breeding evidence was "probable" breeding (OBBA 2001), either by the observation of pairs of birds (code P) or territorial males (code T), which is defined as a singing male being present at the same location at least seven days apart). This evidence was the highest level obtained for 31 species. The next highest level of breeding evidence was "possible" breeding (OBBA 2001), as seen with singing males (code S) or birds being present in appropriate breeding habitat during the breeding season (code H); this evidence was the highest breeding level for 5 species.

For application of the Migratory Birds Convention Act (MBCA 1994), 34 of the 42 species recorded as at least possibly breeding are protected by the Act. As such, it means that it is illegal to harm or kill these species, or to harm or destroy their nests and nesting habitat. The eight species that are afforded no protection from the Act are Red-tailed Hawk, Blue Jay, American Crow, European Starling, Red-winged Blackbird, Common Grackle, Brown-headed Cowbird, and House Sparrow.

### Species at Risk

For application of the Endangered Species Act (ESA) and the Species at Risk Act (SARA), there were three avian Species at Risk detected on the site, as follows:

- Chimney Swift – Threatened (federal and provincial); up to three birds were seen foraging over the main ponds on May 20, June 3, and June 17. However, they are not suspected as nesting on site as there are no suitable chimneys or large (dbh greater than 50 cm) trees with cavities present; these birds were likely nesting offsite and using the ponds for foraging. The foraging habitat will not be negatively impacted by the proposed works nor will any suitable nesting trees or structures be damaged or removed.
- Barn Swallow – Threatened (federal and provincial); during the breeding bird surveys, up to four birds were seen foraging over the baseball fields on the west side of the study area and also up to four birds in the open field on the east side of the study area. There are no suitable structures on site to support their nesting although there are many in surrounding areas. The foraging habitat on site will not be negatively impacted by the proposed works nor will any suitable nesting structures be damaged or removed.
- Eastern Meadowlark – Threatened (federal and provincial); one pair was present during both breeding bird surveys in the fields on the east side of the study area (south of polygon 16 on Figure 3.6.1), south of Clythe Creek and east of the driveway to the correctional institute. The proposed work will be confined to the creek corridor and, as such, will not negatively impact these fields.

For full details on the breeding bird surveys for this site, refer to Appendix I-3.

### Nocturnal Amphibian Surveys

Overall, the number and diversity of amphibians calling on the three dates were very low, with a total of three species detected: American Toad (*Anaxyrus americanus*), Spring Peeper (*Pseudacris crucifer*), and Green Frog (*Lithobates clamitans*). Survey station 1 had no species calling on all three dates; survey station 2 only had American Toad and Spring Peeper on the April and May surveys while survey station 3 only had Spring Peeper on the May survey. Green Frog was not detected at any of the three survey stations but was heard on the June 21 survey in three areas outside of the survey areas. This species was also recorded incidentally during daytime surveys. Given these results, it seems that the study area does not contain significant amphibian breeding habitat.

Appendix I-3 provides details on the nocturnal amphibian surveys.

### Turtle Surveys

Three species of turtles were detected during the 2016 field investigations. One of these – Pond or Red-eared Slider (*Trachemys scripta*) – is an introduced species and was likely released at the site. A low number of Painted Turtles were observed, mostly basking on rocks on the west side of the northernmost pond. Finally, a Snapping Turtle was observed on June 17, 2016 within the small pond, just east of the main correctional institution driveway (outside of the study area).

Although turtles are likely nesting in the general vicinity, such as along the Eramosa River to the south, there were no significant areas of potential nesting habitat along Clythe Creek and York Road. The two main ponds likely represent overwintering habitat for all three turtle species.

No dead or injured turtles were found along York Road during the field investigations.

**Eastern Milksnake Surveys**

No Milksnakes were found during the surveys. The habitat on-site is not optimal for the species but they could persist in the area or adjacent lands. Therefore, general mitigation measures are recommended for the construction works (see section 4.3).

**Significant Wildlife Habitat (SWH) Screening**

Of the 38 categories of SWH, the following categories have candidate habitats present within or adjacent to the study area:

- Seasonal Concentration of Animals: Turtle Wintering Areas;
- Specialized Habitat for Wildlife: Turtle Nesting Areas;
- Habitats for Species of Conservation Concern (not including Endangered and Threatened Species): Special Concern and Rare Wildlife Species;
- Animal Movement Corridors: Amphibian Movement Corridor

For details on these four categories, refer to the SWH screening table (Appendix I-2).

**Species at Risk (SAR) Screening**

A list of SAR for the City of Guelph, updated to September 29, 2015, was provided by Guelph District MNRF. The habitats on site were screened against known habitat requirements of these species to determine if any potential species could be present. The results of this screening is found in Appendix I-1.

Five SAR were documented during 2016 field investigations: Chimney Swift, Barn Swallow, Eastern Meadowlark, Snapping Turtle, and Monarch. From the list of SAR for the City of Guelph, the following species could potentially be present:

- Bald Eagle (Special Concern) – although not found during 2016 breeding bird surveys, this species could be present along the Eramosa River in the winter. No negative impacts to this area are anticipated from the proposed works;
- Eastern Wood-Pewee (Special Concern) – potential habitat on site and in adjacent lands; however, none were detected during the 2016 breeding bird surveys;
- Wood Thrush (Special Concern) – potential habitat in adjacent lands; however, none were detected during the 2016 breeding bird surveys;
- Eastern Ribbonsnake (Special Concern) – habitat occurs along the southern sections of the site within wetland areas and along the Eramosa River; the species could also occur along Clythe Creek. However, none were found during the snake surveys;

Three species of Endangered bats are known from the City of Guelph: Eastern Small-footed Myotis (*Myotis leibii*), Little Brown Myotis (*Myotis lucifugus*), and Northern Myotis (*Myotis septentrionalis*). As outlined elsewhere in this report, there are no suitable overwintering sites for any of these three species on site, nor are there any suitable large trees (25+ cm dbh with snags) for setting up maternity roosts. There are also no habitats on-site that would be considered significant from a SWH perspective (e.g. Seasonal Concentration Areas of Animals: Bat Hibernacula and Bat Maternity Colonies). Furthermore, there are no buildings on site that could be utilized for roosting by any of the three species, especially Little Brown Myotis. The species may be present during migration roosting in buildings adjacent to the study area and likely use the open fields, ponds, and river as foraging habitat; none of these habitats are going to be negatively impacted by the proposed creek alignment works.

**Incidental Wildlife**

No surveys were conducted for other wildlife groups, such as mammals and insects. Any sightings of these groups were done on an incidental basis during all other surveys.

One snake species was seen during the field investigations: Eastern Gartersnake (*Thamnophis sirtalis sirtalis*). This species is common and widespread in Wellington County (D&A 2009) and the Region of Waterloo (RMW 1985) and has an Srank of S5 in Ontario, indicating that its populations is “secure” (NHIC 2015).

Three species of mammals were detected: Gray Squirrel (*Sciurus carolinensis*), Raccoon (*Procyon lotor*), and Beaver (*Castor canadensis*). All of these species are common and widespread in Wellington County (D&A 2009) and the Region of Waterloo (RMW 1985) and have Sranks of S5 in Ontario, indicating that their populations are “secure” (NHIC 2015).

One species of amphibian was observed on an incidental basis during the 2016 field investigations: Green Frog (*Lithobates clamitans*). Several individuals of this species were seen around the edges of the main ponds diurnal surveys. This species was also detected during the nocturnal amphibian surveys in May and June.

Thirteen (13) species of butterflies were observed during the 2016 field investigations. Twelve of these species are considered common and widespread in Wellington County (D&A 2009) and the Region of Waterloo (RMW 1985) and have Sranks of S5 in Ontario, indicating that their populations are “secure” (NHIC 2015). Monarch is considered Special Concern at a provincial and federal level, and has a Srank of S2 (imperiled population) and is considered rare in Wellington County (D&A 2009). Two individuals of this species were seen in the northeast field (polygon 6) on June 17; its hostplant (Common Milkweed) is present here so they are potentially breeding. See Appendix I-3 for details on lepidoptera.

## 3.7 Transportation Network

Since completion of the 2007 York Road Class EA, the City of Guelph has committed to putting a greater focus on active transportation facilities, as well as protection of built and cultural heritage features. As a result, the limited cycling and pedestrian facilities contemplated as part of the original 2007 EA are no longer sufficient to meet City objectives. Removal of some key heritage features are likewise no longer acceptable. These changes in policy necessitated an update to the original design, as discussed in the following sections.

### 3.7.1 Recommendations for Additional Improvements

Consultation with City staff, stakeholders and members of the public through a Public Information Centre held at City Hall on February 23, 2016 for this project resulted in the design recommendations outlined in the following sections.

#### *3.7.1.1 City Staff*

Alternative roadway cross-sections were circulated to City of Guelph staff to solicit input on design preferences. The following comments were received:

- Preferred offset from face of curb to sidewalks or multi-use pathways is to be 1.5 m to ensure adequate space for snow storage (later comments indicated a preference for a minimum of 2.0 m adjacent to heritage features);
- Required minimum lane widths of 3.5 m (as a component of an MTO ‘Connecting Link’);
- On-road cycle lanes require a buffer per OTM Book 18; and
- Listed and designated heritage features to be protected from roadway and grading encroachment.

#### *3.7.1.2 Key Stakeholders*

Agency stakeholders were asked to provide comment on the proposed road widening and creek realignment. Individual agencies that provided comments included the Ministry of Natural Resources and Forestry (MNRF), Ministry of the Environment and Climate Change (MOECC), Ministry of Tourism, Culture and Sport (MTCS), Infrastructure Ontario (IO), Trout Unlimited, Grand River Consultation Authority (GRCA) and the Ministry of Transportation Ontario (MTO). The only road-related comments were received from the MTO as York Road functions as a ‘Connecting Link’ between portions of provincial Highway 7. Certain rules and regulations apply to ‘Connecting Link’ highways, including:

- There shall be no new installations of traffic control signal systems without explicit approval of the MTO;
- All replacement traffic control systems must undergo MTO review and approval;
- All staging plans must undergo MTO review and approval;
- MTO review is required for any by-laws that affect traffic on the connecting link (i.e. Elizabeth Street realignment and the closer of Beaumont Crescent);
- No sidewalks or cycle lanes must be located within the designated Highway 7 right-of-way;
- The transition between 2 and 4 lanes must utilize proper geometrics; and
- The intersection of Skyway Drive and Highway 7 must be constructed to MTO standards.

The MTCS provided comment that appropriate Stage 2 Archaeological Assessments must be completed, and that the heritage value of any existing features was to be assessed per its published guidelines.

#### *3.7.1.3 First Nations*

Consultation was conducted with representatives of the following First Nations communities:

- Six Nations Elected Council (SNEC),
- Six Nations of the Grand River (SNGR),
- Haudensaunee Development Institute (HDI),
- Mississaugas of the New Credit First Nation (MCFN), and
- Metis Nation of Ontario (MNO).

No road design-related comments were received from any of the First Nations representatives.

#### *3.7.1.4 General Public*

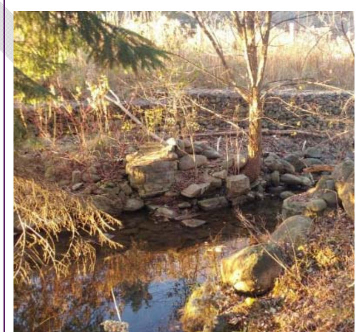
Comments were solicited from members of the public through a Public Information Centre held at City Hall on February 23, 2016, as well as via email and written letters throughout the duration of the study. The primary road design-related comments can be summarized as follows:

- Requirement for provision of multi-use pathways which are set back from the roadway, and/or physically separated cycle lanes (commented in all submissions);
- Provision of safe signalized or bridged pedestrian crossing locations;
- Conservation of heritage features;
- Implementation of traffic calming features; and
- Provisions for turning lanes.

### 3.7.2 Built Heritage

In addition to design changes to address updated stakeholder concerns, several man-made structures on the adjacent Reformatory (York District) property have been designated by the MTCS as having heritage value following completion of the York Road Class EA in 2007. As such, it was necessary to shift the southern limit of roadway construction to the north, providing a minimum 2.0 m buffer between any new infrastructure and the identified heritage features (to allow for adequate protection and snow storage). Of particular concern with respect to design of the roadway was preservation of the following:

| | |
|---|---|
| **Reformatory Entranceway**<br>This feature includes hand-laid stone walls, bridge, weirs and circular wall terminus structures. As with the other features on the Reformatory property, these features were built by inmates and help to tell the story of the site. |  |
| **Gateway**<br>This high-integrity hand-laid stone gateway is located at the east extent of the York District (Reformatory) property. |  |
| **Bridge Railing**<br>Although currently partially embedded within a gabion basket wall, an existing bridge railing located on the north side of the culvert immediately east of 850 York Road, holds heritage value as it bears the mark of an architect who was instrumental in forming the City of Guelph. As this culvert will require resizing, this railing will require relocation. |  |

| | | |
|---|---|---|
| **Stone Retaining Wall**<br>A stone wall with identified heritage value is located immediately east of the Publix Variety/Lewis Upholstery complex located at 804 York Road. |  | |
| **In-Water Features**<br>Preservation of two weirs located in close proximity to the proposed roadway are to potentially be maintained through the use of retained soil systems (RSS). These two features are located approximately midway between the Reformatory Entrance and the eastern limits of the Reformatory property. |  |  |

### 3.7.3 Design Revisions

In order to accommodate changes in City-wide policy and meet the needs of the public and other key stakeholders, revisions to the proposed cross-section and alignment of York Road are being proposed as part of this study. These revisions are summarized in Table 3.7.1.

**Table 3.7.1 Summary of Roadway Design Revisions**

| Design Component | 2006 EA Recommendation | 2016 Update | Reason for Change |
|---|---|---|---|
| Through Lanes | 4 x 3.5 m Through Lanes | No Change | No Change |
| Pedestrian Facilities | 1.5 m sidewalk on north side only | 3.0 m multi-use pathways on north and south sides | Public and city interest in providing pedestrian facilities on the north side to link commercial and residential areas, and on the south side to allow for enjoyment of the cultural heritage lands. |
| Cycling Facilities | 1.5 m cycle lanes on north and south sides | | In accordance with OTM Book 18, use of a multi-use pathway is |

**Table 3.7.1 Summary of Roadway Design Revisions**

| Design Component | 2006 EA Recommendation | 2016 Update | Reason for Change |
|---|---|---|---|
| | | | recommended[2] for 85th percentile operating speeds of greater than 50 km/h and AADTs >15,000 (York Road EA traffic study estimated AADTs of >18,000 with an 85th percentile operating speed of 80 km/h). |
| Cross-Section Type | Partial rural | Urban | Allow for collection and pre-treatment of roadway runoff. Additionally, barrier curb provides protection for adjacent features when 85th percentile operating speeds are <60 km/h (clear zone reduced to 0.5 m). |
| Horizontal Alignment | Maintain existing centerline with exception of the portion between the entrances to the Reformatory and 919 York Road, where the alignment was shifted to the south. | Shift centerline south between Victoria Road and Wells Road, then north of existing east to Watson Parkway. | Shift to the south at Victoria Road was made to maintain existing north right-of-way limit as identified in the 2007 EA. East of Wells Road, York Road is shifted north as necessary to provide required setback from heritage features. |
| Vertical Alignment | Maintain existing | Maintain existing with exception of segment between Elizabeth Street and Cityview Drive which is steepened to 0.5%. | Urban cross-section requires a minimum longitudinal slope of 0.5% to facilitate drainage of stormwater. |



### 3.8 Integrated Summary

All field work activities have been intended to address the data gaps for the study area identified as part of the background review process discussed in Section 2. The additional data provide a

[2] Ontario Ministry of Transportation (2013). *Ontario Traffic Manual Book 18 – Cycling Facilities*. Figure 3.3 – Desirable Bicycle Facility Pre-Selection Nomograph.

full environmental characterization of the study area, and will support the Environmental Impact Study process by ensuring that all constraints, opportunities, and environmental considerations are understood.

# 4.0 STAGE 3 - IMPACT ASSESSMENT/MITIGATION FOR PREFERRED ALTERNATIVE

As part of the overall Environmental Design Study work, a number of potential alternatives have been examined, leading to the identification of a preferred alternative for the re-alignment of Clythe Creek. The process of developing this preferred alternative has taken into account the environmental sensitivities assessed as part of both the Stage 1 (Characterization) and Stage 2 (Field Work Investigation) works.

The preferred alternative consists of the road section(s), alignment and profile. The selection of the preferred road alternative is discussed in Section 4.1.1. In summary the road section has been further developed from the 2007 Class EA road section of four (4) lanes and one (1) sidewalk through consultation with City staff, stakeholder groups and the public. In addition selection of the preferred alternative has had consider City's operational requirements, cultural heritage features and recommended setbacks, property requirements and mobility requirements along the road corridor.

The process for selection of the preferred creek treatment has been similar to the determining the preferred road alternative. The 2007 Class EA recommended that 135 m of creek be realigned to the south due to grading requirements for the road intruding into the creek upstream of the former Reformatory driveway. Consultation has occurred with the public, City staff from the relevant City groups, private stakeholder groups such as Trout Unlimited, government agencies including Grand River Conservation Authority (GRCA), Ministry of Natural Resources and Forestry (MNRF), Infrastructure Ontario (IO) and Ontario Heritage Trust (OHT). The preferred creek realignment has considered the preferred road alignment, natural stream morphology, fish passage and habitat and minimizing impacts to cultural heritage features.

The process for selection of the preferred stormwater management has considered input from City staff that would prefer to see a treatment train approach integrating low impact development (LID) best management measures (BMPs). City staff has also expressed concerns with salt, however as discussed with staff, unless salt is not used, it will infiltrate into the groundwater system and discharge to the surface water systems.

## 4.1 Preferred Alternative

The preferred alternative has been developed from the recommendations of the Class EA with consideration to input from the public, stakeholder groups, City staff and government agencies. The preferred alternative has been summarized as per the following, with additional detail in the subsequent report sections:

- Four (4) lanes 3.5 m wide with two (2) 3 m wide multi-use pathways, one (1) on either side of the road. The south multi-use pathway would be located adjacent to the road where space allows, and moves to the south side of the Clythe Creek where there is inadequate space between the road and the creek.
- Clythe Creek will be realigned upstream of the former Reformatory driveway, with the creek partially realigned and altered downstream of the driveway to the confluence with

Hadati Creek. Downstream of the confluence, Clythe Creek will be realigned to facilitate an improved outlet with the Eramosa Creek. The connection between the ponds would be relocated from Clythe Creek to the Eramosa River; there is already a connection to the river from the south pond. Both the York Road and Royal Jaycees' Park driveway crossings would be replaced to improve hydraulics and for stream morphology considerations.

- Roadway stormwater management would include a treatment train of bio-filtration within swales (where space allows), oil/grit separators and combinations of infiltration/ cooling trenches to provide an *Enhanced* Level of stormwater quality treatment and erosion control (25 mm). The multi-use pathway would be constructed from pervious pavement where it does not cross vehicle travelled areas.

### 4.1.1 York Road

A number of alternatives were investigated as part of this undertaking to determine a preferred cross-section that will meet the needs of the City, stakeholders and public, while minimizing impacts to the adjacent development, creek, and heritage features. A summary of the investigated alternatives is provided in Appendix J.

The preferred cross-section consists of four 3.5 m through lanes (two in each direction), with 1.5 m wide boulevards and 3.0 m wide multi-use pathways provided on both the north and south sides. On the south side, the multi-use pathway is to be located south of the creek from the realigned Elizabeth Street to east of the Reformatory entrance in order to limit the required length of creek realignment. Typical sections are provided below in Figure 4.1.2.

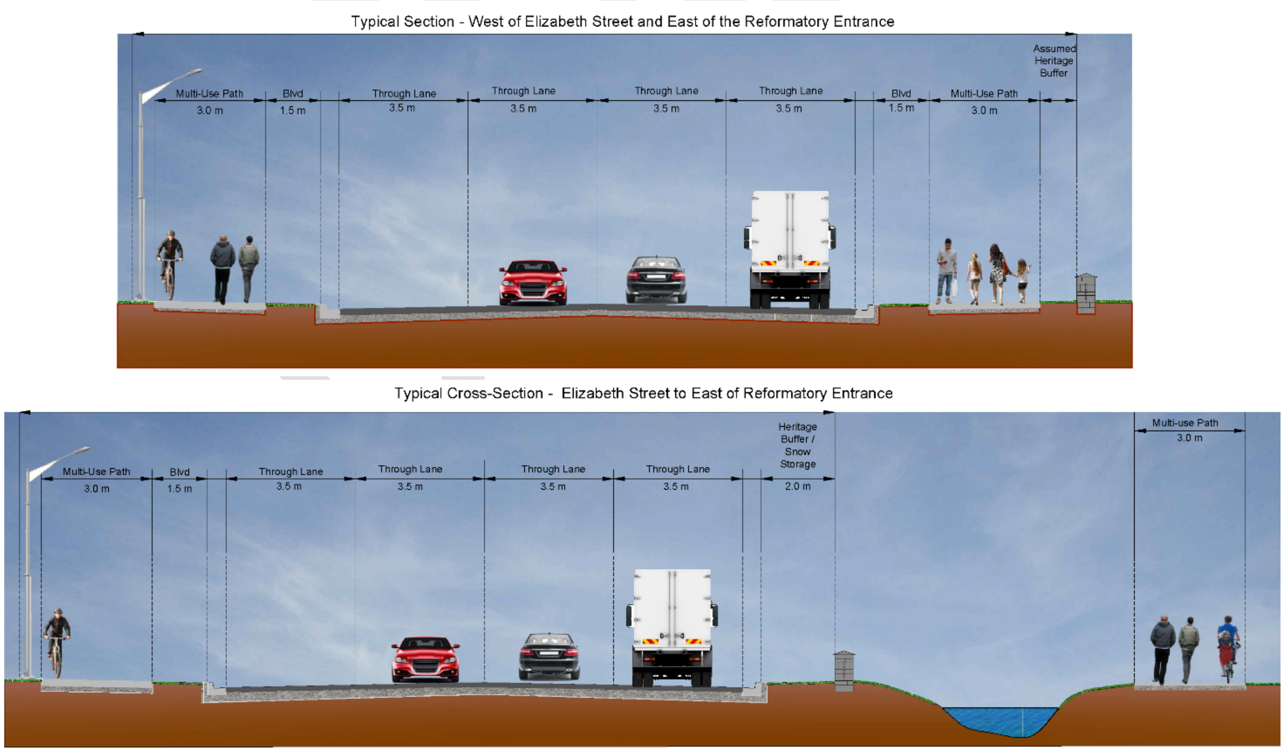



**Figure 4.1.2: Revised Typical Cross-Sections.**

Note that due to right-of-way constraints, no additional width is available for provision of turning lanes at intersections adjacent to the York District (Reformatory) Lands.

### Preferred Alignment

#### *Horizontal Alignment*

The recommended horizontal alignment primarily parallels the existing centerline, with the exception of a few critical locations where it shifts to avoid impacts to property limits, Clythe Creek and various heritage features. Starting at Victoria Road, the York Road alignment curves to the south to limit the amount of property required on the north side. East of Wells Road, the alignment moves back to the north, bringing the north edge of the proposed multi-use pathway in line with the EA-proposed north property limit. From Elizabeth Street, the alignment moves further to the north of the existing centerline (~ 2.75 m) to maintain a minimum separation of 2.0 m between the Reformatory entrance features and the back of the proposed curb. Beyond the Reformatory entrance, the alignment shifts back to the south to maintain suitable grades on the steep entrances to 820 and 840 York Road. The alignment then shifts to follow the existing centerline from the heritage gateway feature at the eastern limit of the Reformatory property to Watson Parkway. Between Watson Parkway and Skyway Drive, the proposed centerline follows south of the existing centerline such that the proposed infrastructure is centered within the available right-of-way (ref. Figures 4.1.2 to 4.1.10)

#### *Vertical Alignment (Profile)*

The recommended vertical alignment for the widened York Road primarily follows that of the existing two-lane roadway to minimize impacts to adjacent properties. The only significant variance from the existing profile is proposed for between Elizabeth Street and Cityview Drive, in order to provide the minimum 0.5% longitudinal grade required for drainage of the urbanized cross-section.

### Intersections and Traffic Calming

A number of comments raised by members of the public included the need for improved pedestrian crossing facilities, as well as traffic calming features. As the study portion of York Road functions as an MTO 'Connecting Link' bringing Highway 7 through the City of Guelph, the implementation of these types of measures must be confirmed with the Ministry during the detailed design phase.

### 4.1.2 Roadway Stormwater Management

To determine the preferred stormwater management for the recommended road works, the impact of the proposed road widening on Clythe Creek peak flows needed to be determined. The existing condition PCSWMM model has been updated for the proposed road widening and improvements.

York Road subcatchments have been measured from the proposed widened York Road (ref. Figure 4.1.11). The multi-use pathway has been assumed to be directly connected impervious where it runs parallel to York Road and indirectly connected impervious where it turns to the south in Royal City Jaycees Park. The future York Road catchments range from 65% to 90%

impervious. The outlets of the York Road catchments have been adjusted to match the updated profile of York Road (ref. Figure 4.1.11). The outlets along Clythe Creek have been placed in locations where there would be the most space to place stormwater management controls.

The updated future conditions PCSWMM model has been simulated using the 3 hour Chicago distribution design storms, as well as the MOECC 25 mm 4 hour Chicago design storm. Additionally, the Regional Storm (Hurricane Hazel) has been simulated using the full 48-hour duration event. The resulting peak flows are provided in Table 4.1.1 and a comparison to the existing conditions peak flows is provided in Table 4.1.2.

**Table 4.1.1 Clythe Creek Future Condition Peak Flows ($m^3/s$)**

| Location | Node | Area (ha) | 25mm Chicago | Return Period Flows - 3 Hour Chicago | | | | | | Regional |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 2 | 5 | 10 | 25 | 50 | 100 | |
| York Road | J_CC00 | 1198 | 1.9 | 3.0 | 4.7 | 8.6 | 15.9 | 24.0 | 33.2 | 82.9 |
| Reformatory Driveway | J_York_05 | 1206 | 1.9 | 3.0 | 5.1 | 8.7 | 15.9 | 24.0 | 33.1 | 81.6 |
| Royal City Jacees Park ponds | J_York_03 | 1347 | 2.6 | 4.2 | 7.5 | 11.0 | 19.2 | 28.5 | 37.7 | 89.6 |
| Hadati Creek confluence | J_CC04 | 2130 | 3.9 | 6.5 | 12.8 | 20.4 | 30.4 | 40.7 | 51.2 | 100.8 |
| Eramosa confluence | J_CC05 | 2138 | 6.0 | 8.9 | 15.8 | 23.5 | 33.5 | 43.5 | 53.4 | 100.8 |

**Table 4.1.2 Clythe Creek Difference between Future and Existing Peak Flows ($m^3/s$)**

| Location | Node | Area (ha) | 25mm Chicago | Return Period Flows - 3 Hour Chicago | | | | | | Regional |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 2 | 5 | 10 | 25 | 50 | 100 | |
| York Road | J_CC00 | 1198 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Reformatory Driveway | J_York_05 | 1206 | 0.1 | 0.1 | -0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Royal City Jacees Park ponds | J_York_03 | 1347 | 0.1 | 0.1 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 |
| Hadati Creek confluence | J_CC04 | 2130 | 0.1 | 0.1 | 0.0 | 0.0 | 0.4 | 0.0 | 0.1 | 0.0 |
| Eramosa confluence | J_CC05 | 2138 | 0.1 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 |

The results in Table 4.1.2 show that the impact of the York Road widening on the peak flows of Clythe Creek is negligible. This is attributed to the 1,198 ha+/- drainage area upstream of York Road (versus 1347 ha upstream of Hadati Creek) which has a delayed runoff response and peak flow timing compared to the localized runoff from the York Road catchments. The peak flow results indicate that quantity controls are not required for the York Road widening.

Notwithstanding quality and erosion controls are still considered necessary. In general, there are numerous stormwater management practices, which can be used to provide either erosion control and/ or treatment of contaminated stormwater runoff from roadway surfaces. These include the following:

i. Wet ponds/wetlands/hybrids (generally linear facilities)
ii. Enhanced grass swales
iii. Filter Strips
iv. Bioretention Systems
v. Infiltration Systems
vi. Oil and grit separators
vii. Off-site stormwater management facilities
viii. Cash-in-lieu of on-site treatment

The respective characteristics, advantages and disadvantages of the foregoing have been well documented in previous municipal and provincial literature and hence this information has not been repeated within this document. The advantages and disadvantages of the various Best Management Practices associated with both quantity (erosion) and quality control measures are as follows:

### Erosion Control

Controlling runoff in stormwater management facilities requires land and future management/maintenance by municipal forces. The advantages relate to maintaining existing sizing of drainage infrastructure or smaller infrastructure across the roadway, as well as downstream. Disadvantages include the cost of land, infrastructure and maintenance. Increasing the size of drainage infrastructure, while somewhat more costly to the roadway authority, reduces the need for future maintenance and eliminates the need for the dedication of stand-alone land for surface controls. Inter-subcatchment diversions can be effective on a minor scale in optimizing and/or reducing the number of crossings and are typically followed to address both major and minor runoff conditions.

For erosion control, on-site measures to temporarily detain runoff volume and reduce peak flow impacts can be highly constraining due to the general lack of properly configured land. Roadway corridors, due to their inherent linear nature, can only effectively manage relatively small volumes of increased runoff (peak flows), in the absence of stand-alone land acquisition. Combination of measures to mitigate impacts through some on-site storage, along with off-site upgrades as necessary, can be required to offset impacts.

### Quality Control

#### i. Wet ponds, Wetlands, Hybrids

These systems generally require the dedication of land that most often is not available in linear corridors for roadway projects. Most often when applied to roadway runoff, these SWMP's are located adjacent to creek crossings of roads. For York Road, this particular opportunity (new stormwater management facilities) is not considered practical, although retrofitting the existing Industrial ponds is being considered and is discussed in Section 4.1.8. Typically these systems provide an excellent level of treatment and as end-of-pipe systems, the management and performance is more visible, hence less prone to failure.

#### ii. Enhanced Grassed Swales

Grassed swales designed with a trapezoidal geometry and flat longitudinal profiles with largely un-maintained turf can provide excellent filtration and treatment for storm runoff from roadways. It is generally conceded that treatment levels are at a minimum, *Normal* (formerly Level 2) treatment, and combined with other practices can provide Enhanced treatment. Their application in linear corridors is also particularly appropriate and can be further enhanced through the introduction of check dams to provide additional on-line storage. The application in urbanized roadway cross-sections (i.e. curb and gutter) often requires alternative grading and roadway configurations which can compromise the function of the roadway itself, and are therefore typically not preferred. Notwithstanding, gutter outlets along outside lanes have functioned effectively in the past where the right-of-way can accommodate the design.

#### iii. Filter Strips

Filter strips typically are designed for small drainage areas less than 2 ha, and are applied as part of a treatment train. Filter strips require flat areas with slopes ranging from 1 to 5% and are usually in the range of 10 to 20 m in length in the direction of flow. Flow leaving filter strips should be a maximum of 0.10 m depth, based on a 10 mm storm event.

#### iv. Oil and Grit Separators

These systems tend to serve limited drainage areas and provide levels of treatment (less than Enhanced, formerly Level 1). They are typically encouraged as part of a "treatment train" approach. Disadvantages include the need for frequent maintenance, as well as relatively high capital costs and the ability to serve small drainage areas.

#### v. Off-Site Stormwater Management Facilities

While facilities can often not be constructed within roadway right-of-way lands, roadway runoff can be directed towards adjacent subdivisions, which would have their runoff managed by future stormwater management facilities. There are no options for this alternative to be implemented for the York Road improvements.

### vi. Cash-in-Lieu of On-Site Treatment

Often, due to the sensitivity of downstream systems (i.e. low habitat potential) and the difficulty of providing affordable and effective stormwater management on-site, roadway authorities have proposed the contribution of cash-in-lieu of on-site stormwater management, to be directed towards other environmental enhancement projects. These can either be identified in subwatershed planning studies or addressed on a site-specific basis. The priority of application usually relates first to improving watershed conditions in the directly affected watershed. This approach is supported by both Provincial and Municipal policy. That said this approach would not be supported for the York Road stormwater management strategy as it does not address the road runoff being directed to Clythe Creek.

### vii. Low Impact Development Best Management Practices

Low Impact Development represents the application of a suite of BMPs normally related to source and conveyance storm water management controls to promote infiltration and pollutant removal on a local site by site basis. These measures rely on eliminating the direct connection between impervious surfaces such as roofs, roads, parking areas, and the storm drainage system, as well as the promotion of infiltration on each development or redevelopment site. General design guidelines and considerations for source and conveyance controls have been advanced since the early 1990's as part of the MMAH "Making Choices" and in 1994 as part of the Ministry of the original Environment Best Management Practices Guidelines.

Subsequent to the 1994 MOE Guidelines, technologies and standards have been developed further for the application of source and conveyance controls. These have evolved into a class of Best Management Practices (BMPs) referred to as Low Impact Development (LID) practices, which have advanced as an integrated form of site planning and storm servicing to maintain water balance and providing storm water quality control for urban developments. Initial results from studies in other settings have demonstrated that LID practices may also provide benefits by way of reducing the erosion potential within receiving watercourses and thereby reducing the total volume of end-of-pipe storm water erosion control requirements. In addition, due to volumetric controls afforded by LID BMP's, water quality is also improved through a reduction in mass loading of urban contaminants. The benefits from LID storm water management practices are generally focused on the more frequent storm events (e.g. 2 year storm) of lower volumes as opposed to the less frequent storm events (e.g. 100 year storm) with higher volumes. It is also recognized that the forms of LID practices which promote infiltration or filtration through a granular medium provide thermal mitigation for storm runoff.

Guidelines regarding the application of LID practices and techniques have been developed within various jurisdictions in the United States and Canada. The Toronto and Region Conservation Authority and Credit Valley Conservation have produced the 2010 Low Impact Development Storm water Management Manual, for the design and application of LID measures. Various LID techniques, as well as their function that are applicable to road projects, are summarized in Table 4.1.3. While LID includes additional planning and design to implement and can also lead to a requirement to change urban design standards, the information provided in Table 4.1.3

specifically addresses those techniques and technologies related to storm water management practices.

**Table 4.1.3 LID Source And Conveyance Controls**

| Technique | Function |
|---|---|
| **Bio-retention Cells** | ► Vegetated technique for filtration of storm runoff<br>► Storm water quality control provided through filtration of runoff through soil medium and vegetation<br>► Infiltration/ evapotranspiration/ water balance maintenance and additional erosion control may be achieved if no subdrain provided |
| **Grassed Swales** | ► Vegetated technique to provide storm water quality control<br>► Storm water quality control provided by filtration through vegetated system<br>► Runoff volume reduction may be achieved by supplementing with soil amendments |
| **Infiltration Trenches** | ► Infiltration technique to provide storm water quality control and maintain water balance<br>► Erosion controls may be achieved depending upon soil conditions |
| **Permeable Pavers/Pavement** | ► Infiltration technique to reduce surface runoff volume<br>► Benefits to storm water quality and erosion control are informal |
| **Pervious Pipes** | ► Technique to reduce storm runoff through the implementation of perforated pipes within storm sewers<br>► Promotion of infiltration maintains water balance and provides storm water quality and erosion control benefits |

**Short-listed Stormwater Management Alternatives**

Assessment of stormwater management alternatives for both quantity (erosion) and quality control has been conducted as per the following:

***Quantity (Erosion) Control***

**i. End-of-Pipe Stormwater Management Facilities**

As discussed previously, using proposed stormwater management facilities for quantity control is not considered an option, as the City does not have the space within the York Road Corridor to construct a new stormwater management facility to provide erosion control. As such other erosion controls are required to provide a minimum of 24 hour detention of the 25 mm storm event as per the 2003 MOE SWM Guidelines.

To determine the feasibility of various stormwater quantity control measures for proposed road conditions, a unitary assessment of maximum storage requirements for storage of the 25 mm storm event for a minimum of 24 hrs has been conducted. The proposed additional pavement width is 7.5 m with an additional 3 m either side of the road for the multi-use path. The multi-use path to reduce runoff-volumes is proposed to use a permeable pavement as such 50% of the path has been considered to be pervious. Based on the foregoing, the 25 mm runoff from a 100 m section of roadway (for additional paved area) would be 26.25 $m^3$, while the entire roadway would be 42.5 $m^3$. The detention volumes do not consider reduced runoff coefficients for the paved areas and volume being released over 24 hours minimum, as such the runoff volumes would be less than noted.

#### ii. Enhanced Swales

Enhanced swales for the purpose of erosion control, typically are not used due to the space required along urban right-of-ways, that said limited locations along the proposed York Road corridor on the south side of the road may be appropriate. The use of enhanced swales would be further assessed within the stormwater management reporting.

#### iii. Underground Storage

Underground storage for providing erosion control for the proposed York Road improvements could utilize cellular tank systems, stone trench systems or combination thereof. Based upon the anticipated limited storage volumes required to provide 24 hours of detention of the 25 mm storm event, underground storage could be considered feasible. Proposed storm sewer depths, bedrock and water table elevations (based on available information) will have to be considered prior to the preliminary design. Further consideration of this alternative will be provided within the stormwater management reporting.

#### iv. Super Pipe Storage

Super pipes can provided temporary storage, that said the alternative is considered expensive and has not been considered further.

### *Quality Control*

#### i. Wet ponds/wetlands/hybrids

Constructing a new wet pond, wetland or hybrid pond is not feasible within the York Road right of way based on space constraints, as such this alternative has not been considered further.

#### ii. Off-site stormwater management facilities

No existing stormwater management facilities are able to receive drainage from the York Road corridor based on existing grading constraints. The closest stormwater facility is on Watson Parkway South, upstream of York Road and Clythe Creek.

#### iii. Cash-in-lieu of on-site treatment

Cash-in-lieu is typically considered the last alternative for stormwater quality when all other alternatives have been considered. In this situation, other alternatives are available for the provision of stormwater quality treatment as such this alternative has been screened from further consideration.

### iv. Bioretention Systems

Bioretention systems provide effective removal of pollutants by sedimentation, filtering, soil adsorption, microbial processes and plant uptake. Bioretention systems should be approximately 10 to 20% in size of the contributing drainage area, with typical drainage areas of 0.50 ha and a maximum drainage area of 0.8 ha. Slopes within bioretention systems are typically 1 % to 5 %. Bioretention systems are preferred in areas that have reasonable infiltration properties (15 mm/ hr, $1x10^{-6}$ cm/s), but can be implemented in all soil types as long as the water quality event can be temporarily stored (typical depths 0.15 m to 0.25 m) before infiltrating and an underdrain is provided. The issue with bioretention is that road runoff is required to be pre-treated before being infiltrated in the Study Area, as such bioretention systems would have to be lined as surface drainage would not be able to be pre-treated prior to draining overland to a bioretention system. Therefore, due to the limited usefulness of bioretention without infiltration, this alternative is no longer being considered, rather underground infiltration trenches could be used, as surface runoff could be pre-treated by other measures.

### v. Enhanced grass swales

Enhanced grass swales have been short-listed as an alternative as a quantity control measure. Enhanced grass swales facilitate sediment settling within the vegetation, side slopes should be 3:1 or less, longitudinal slopes should be less than 1 %, flow velocities within the swale should be less than 0.5 m/s for a 4 hour 25 mm Chicago Storm.

### vi. Filter Strips

Filter Strips require long flow paths, with a minimum flow path of 10 m with slopes at 1% to 5% and slope and 15 m to 20 m with sheet flow at maximum slopes of 10 % to 15 %. These requirements are considered infeasible within the Upper Middle Road right-of-way for the west road section, but could be implemented for the easterly road section within the landscaped area near the intersection of Upper Middle Road and Winston Churchill Boulevard.

The filter strip will require a level spreader, similar to a small swale 1 m in width and approximately 0.30 m in depth, with a perforated and socked 100 mm diameter pipe installed to allow drainage behind the spreader to drain through the spreader. The filter strip would be sized for the 4 hour 10 mm storm event to result in a maximum flow depth of 50 to 100 mm over the vegetation. The filter strip would only be considered for pre-treatment as part of a treatment train approach.

### vii. Infiltration Systems

Underground storage for water quality control for the proposed York Road improvements could be used and would have the added benefit of providing thermal mitigation of road runoff. Based upon the anticipated limited storage volumes required to provide storage of a 13 mm storm water quality event, infiltration trenches could be considered feasible. Proposed storm sewer depths, bedrock and water table elevations (based on available information) will have to be considered prior to the preliminary design. Further consideration of this alternative will be provided within the stormwater management reporting.

### viii. Oil/ Grit Separators

To provide a *Normal* Level of water quality treatment, oil/grit separators could be used as part of a treatment train approach. Each storm sewer outlet could use a small sized oil/grit separator in combination with vegetative filtering (where space is available) and infiltration systems.

**Preferred Stormwater Management Alternatives**

The preferred roadway stormwater management would include a treatment train of bio-filtration within swales (where space allows), oil/grit separators and combination infiltration/ cooling trenches to provide an *Enhanced* Level of stormwater quality treatment and erosion control (25 mm). The multi-use pathway would be constructed from pervious pavement where it does not cross vehicle travelled areas.

### 4.1.3 Clythe Creek

While improvements will be made to the overall function and habitat of Clythe Creek should Option 2 be implemented, further channel works should be considered in order to maximize the restoration potential within Clythe Creek (Appendix F).

For Option 3, works within Reach C-9A will correspond to works proposed under Option 2. An extensive channel realignment will bring the creek well away from the York Road right-of-way and utilize more of the existing floodplain. The realignment will also utilize the existing groundwater tributary planform. The realignment for Reach C-9A has an optional fish passage channel that would split flow around a significant cultural heritage feature. As a result of this channel realignment, the majority of the cultural heritage features will be taken off-line but remain within the landscape.

In order to improve the functioning of Reach C-9B, significant grading work is proposed along both the bed and the banks in order to narrow the channel and create a steeper bed profile. The outlet of the northern Reformatory Pond will also be narrowed in addition to the outlet elevation being raised in an effort to limit interactions between the pond and creek channel. The bed and bank grading will continue downstream with Reach C-10, where a full channel realignment will occur downstream from the Hadati Creek confluence. As a result, the existing flow splitter will be taken off-line. The existing channel extends downstream from the realignment will be repurposed as necessary to accommodate storm water management practices.

### 4.1.4 Clythe Creek and Hadati Creek Hydraulics

The HEC-RAS model has been revised to reflect the hydraulic impacts to Clythe Creek resulting from the York Road widening and the channel realignment. HEC-RAS cross-sections were modified, added and removed where necessary. The results for the 2 – 100 year and Regional Storm events are provided in Appendix D. The Regional Storm floodline is represented on Figures 4.1.12 to 4.1.15. It is noted that the significant backwater condition remains under future conditions, with the Regional Storm backwatering up to the downstream side of the Reformatory driveway crossing, and the 2 – 100 year storm events backwatering up to 135 m downstream of the Reformatory driveway crossing (cross-section 765.49). The overtopping of York Road during the Regional Storm remains as well.

As shown on Figures 4.1.12 to 4.1.15 the aforementioned spill conditions on the upstream and downstream side of York Road occurring under existing conditions remain under future conditions. The HEC-RAS model is provided in Appendix D on a CD.

**Assessment of Crossings**

As outlined in Section 3.2.3, the existing York Road crossing of Clythe Creek does not meet the applicable MTO and MNRF criteria for culvert performance outlined in Tables 3.2.3 and 3.2.4. As such, the HEC-RAS model was used to complete a preliminary resizing of this culvert. The resulting structure size required is a 12.81 m by 2.74 m CON/SPAN™ arch culvert.

**Table 4.1.3 Future Culvert Performance - MTO Criteria**

| Culvert ID | Structure | | Future Road Classification | Design Criteria (Frequency in Years) | Actual Capacity (Frequency in Years) | Required Freeboard (m) | Provided Freeboard (m)[1] | Required Clearance (m) | Provided Clearance (m)[1] | Recommended? |
|---|---|---|---|---|---|---|---|---|---|---|
| | Type | Size (m) | | | | | | | | |
| York Road | Concrete Arch Culvert - Open Bottom | 12.81 x 2.74 | Urban Arterial | 100 Year | 100 Year | 1.00 | 1.11 | 0.30 | 0.27 | Yes |
| Former Reformatory Driveway | Concrete Arch Bridge | 4.20 x 1.80 | N/A | N/A | 25 year | N/A | 0.31 | N/A | <0.00 | N/A |
| Parking Lot Driveway | Concrete Arch Culvert - Open Bottom | 10.97 x 1.44 | N/A | N/A | <2 year | N/A | 0.22 | N/A | 0.02 | N/A |

Note: [1] Value shown is value at design storm conveyance requirement, or actual design storm capacity

**Table 4.1.4 Future Culvert Performance - MNRF Criteria**

| Culvert ID | Structure | | Vehicular Access | Max Overtopping Depth (m) | Provided Overtopping Depth (m) | Max Overtopping Velocity (m/s) | Provided Overtopping Velocity (m/s) | Maximum Product | Recommended? |
|---|---|---|---|---|---|---|---|---|---|
| | Type | Size (m) | | | | | | | |
| York Road | Concrete Arch Culvert - Open Bottom | 12.81 x 2.74 | Passenger Vehicle | 0.30 | 0.91 | 3 | 2.04 | N/A | Yes |
| Former Reformatory Driveway | Concrete Arch Bridge | 4.20 x 1.80 | N/A | N/A | 0.74 | N/A | 1.62 | N/A | N/A |
| Parking Lot Driveway | Concrete Arch Culvert - Open Bottom | 10.97 x 1.44 | N/A | N/A | 2.48 | N/A | 0.39 | N/A | N/A |

Note: *Provided values are for Regulatory event (Regional Storm)

As outlined in Tables 4.1.3 and 4.1.4, the proposed York Road crossing achieves the applicable MTO and MNRF criteria, with the exception of the minimum clearance and maximum flooding depth requirements. Although the culvert does not explicitly meet the criteria for clearance, the performance should be considered satisfactory, as the deficiency is considered insignificant. The provided overtopping depth of 0.91 m significantly surpasses the criteria of 0.30 m. In order to achieve this criteria, both the proposed culvert and the vertical profile of York Road would require a significant increase. Given the costs versus. benefits associated with this capital work, it does not seem practical to satisfy this criteria.

It is noted the existing Reformatory driveway crossing has been included in the assessment to demonstrate that the crossing performance will not be hindered due to the proposed York Road widening and Clythe Creek channel modifications. The south parking lot driveway crossing has also been included in the assessment. Per the requirements of the Geomorphology portion of the current study, the existing twin 1.40 m diameter CSP culverts require replacement to accommodate the proposed channel works. The proposed channel through this culvert will have a bankfull width of 8.0 m, and requires a culvert with a minimum span of 24.0 m (i.e. three (3) times the bankfull width). A culvert of such span would require a cast-in-place type design/construction which would be costly. Furthermore, a culvert of this span would likely require a large rise resulting in significant grade increases along the south parking lot driveway. Additionally, the existing south parking lot driveway experiences a backwater conditions in all storm events, and increasing the structure size would not have any significant benefit to the hydraulics of Clythe Creek. For these reasons, it is not recommended that a culvert with a 24.0 m span be provided for this crossing. Rather, a culvert with a span that accommodates the proposed channel is recommended. Therefore, a 10.97 m by 2.44 m CON/SPAN arch culvert is proposed. In an effort to minimize the grade changes to the south parking lot driveway, the culvert would be sunk 1.0 m into the ground, providing an effective rise of 1.44 m. Furthermore, CON/SPAN culverts require a minimum 0.60 m of cover, however it is recommended that a 0.30 m thick concrete transfer slab be implemented in place of the 0.60 m cover depth. The concrete transfer slab will accommodate vehicular passage, while reducing the driveway grade increases by 0.30 m.

**Hadati Creek**

As outlined in Section 3.2.3, the York Road crossing of Hadati Creek conveys the 50 year storm event, as required per MTO criteria. Given the significant backwater over this section of York Road during the Regional Storm event, it is not feasible to achieve all applicable MTO and MNRF criteria for freeboard, clearance and passenger vehicle ingress/egress. Therefore, it is recommended that the only modifications to the existing culvert be the extension required to accommodate the widening of York Road.

### 4.1.5 Elizabeth Street Flow Splitter (Hadati Creek)

In 2013, WalterFedy was retained by the City of Guelph to undertake the detailed design of the reconstruction of Elizabeth Street, including the proposed trunk storm sewer (and interim outlet to Hadati Creek). Amec Foster Wheeler provided support to the project by conducting PCSWMM hydrologic and hydraulic modelling (ref Appendix D). Interim conditions reflected the proposed reconstruction works along Elizabeth Street including the proposed trunk storm sewer with the interim outlet to Hadati Creek. To summarize the hydrologic/hydraulic modelling under interim conditions the following were considered:

- New trunk storm sewer along Elizabeth Street from Victoria Road (connecting in to the existing trunk sewer) to Industrial Avenue, with an interim outlet to Hadati Creek
- Roadway re-grading along Elizabeth Street for the same extents, including the proposed modifications to the number and locations of all inlets/catchbasins (as per the detailed design completed by Walter Fedy)
- The Elizabeth flow splitter had been considered as part of the assessment of interim conditions however, since without the flow splitter box, inflows to the trunk storm sewer would be minimal (from local drainage only), and would not be representative of expected flows. The flow splitter preliminary design as completed by Amec Foster Wheeler was incorporated into the interim assessment. A 900 mm equivalent pipe (1145x735 horizontal elliptical pipe) was selected for the direction of low flows towards the PDI lands (and future Ward One SWM facility) given capacity constraints in this location. The balance of the flows within the splitter box were directed towards the trunk storm sewer system along Elizabeth Street.

The proposed interim outlet for the Elizabeth Street trunk storm sewer resulted in temporary peak flow increases to the lower sections of Hadati Creek. The simulated increases in peak flows under less formative, more frequent storm events (2-10 year storm events) were considered minor. Similarly, the simulated hydraulic impact to Hadati Creek under the 5-year storm event was also considered to be minor, with an average water surface elevation increase of 0.015 m, and a maximum simulated increase in channel velocity of 0.04 m/s, both of which are considered to be nominal.

In addition to the previously noted interim conditions scenario (which reflect the proposed construction works along Elizabeth Street, as well as the proposed flow splitter at 292 Elizabeth Street), an ultimate conditions scenario has also been assessed. This scenario would reflect a full build-out of all currently considered or proposed works within the Ward One area. To summarize the additional changes considered within the updated hydrologic/hydraulic modelling under ultimate conditions (in addition to those discussed previously under interim conditions):

- Construction of the proposed Ward One SWM facility adjacent to the PDI lands
- Re-construction of Victoria Road between Elizabeth Street and the Reformatory ditch to include a new storm sewer (against grade) which will connect in to the 1200 mm storm sewer stub at Victoria Road and Elizabeth Street constructed as part of the currently proposed works; additional inlet capacity improvements (catch basins) at the existing sag point along Victoria Road (refer to Drawing 2 for details)
- Re-direction of the trunk storm sewer along Elizabeth Street from its interim outlet to Hadati Creek to a new outlet to Clythe Creek, via Industrial Avenue

Table 4.1.5 provides a comparison of the existing versus interim conditions scenario peak flows for Hadati Creek, demonstrating a minimal increase in peak flows for the interim conditions.

**Table 4.1.5 Interim Conditions Estimated Peak Flows ($m^3/s$) for Hadati Creek**

| Location | Simulated Peak Flow ($m^3/s$) for Specified Land Use | | | | | |
|---|---|---|---|---|---|---|
| | 5 year | | 25 year | | 100 year | |
| | Existing | Interim | Existing | Interim | Existing | Interim |
| D/S of Elizabeth Street | 10.5 | 10.7 | 15.7 | 16.2 | 18.4 | 19.5 |
| D/S of Beaumont Crescent | 12.8 | 13.0 | 18.5 | 19.0 | 22.6 | 22.7 |
| D/S of York Road | 12.9 | 13.1 | 18.7 | 19.2 | 22.9 | 24.0 |
| Outflow to Clythe Creek (Eramosa River) | 12.9 | 13.1 | 18.7 | 19.2 | 22.9 | 24.0 |

Tailwater conditions from Hadati Creek have a significant impact upon surcharging within the Elizabeth Street trunk storm sewer system. Accordingly, it was determined that the most effective solution would be to outlet the proposed storm sewer to Clythe Creek at York Road, via Industrial Avenue. Tailwater conditions in Clythe Creek (based on levels within the Eramosa River) would be significantly lower, up to 2.57 m lower for the 100 year storm event.

A preliminary design for the Industrial Avenue sewer was incorporated into the ultimate conditions modelling. The updated ultimate conditions modelling has also included additional expected drainage areas from Industrial Avenue, as well as from areas to the west along York Road (refer to Drawings 1 and 2, Appendix D). Due to the need for sufficient cover, and the presence of a trunk sanitary sewer at York Road which must be crossed to reach Clythe Creek, the downstream limits of the proposed trunk sewer transition from a 3000 mm x 1500 mm box to twin 1800 mm x 900 mm boxes (refer to drawings in Appendix D). Table 4.1.6 provides the ultimate conditions scenario peak flows at key locations relevant to the York Road Corridor, Hadati Creek and Clythe Creek.

**Table 4.1.6 Simulated Peak Flow Summary ($m^3/s$) – Ultimate Conditions**

| Location Reference | Node | 24-Hour Chicago Distribution | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2 Year | 5 Year | 10 Year | 25 Year | 50 Year | 100 Year |
| 9 | Total Discharge to Hadati Creek at Elizabeth Street and Industrial Avenue | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | Flow to Industrial Avenue (Clythe Creek) | 3.61 [3.83] (0) | 5.21 [5.54] (0) | 6.43 [6.85] (0) | 7.65 [8.05] (0) | 8.51 [9.04] (0) | 9.17 [9.83] (0) |
| 11 | Discharge to Clythe Creek from Existing 1650 mm | 1.93 | 2.25 | 2.34 | 2.45 | 2.55 | 2.68 |

**Table 4.1.6 Simulated Peak Flow Summary ($m^3/s$) – Ultimate Conditions**

| Location Reference | Node | 24-Hour Chicago Distribution | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2 Year | 5 Year | 10 Year | 25 Year | 50 Year | 100 Year |
| | Storm Sewer | | | | | | |

Notes: 1 Where relevant, bracketed values indicate major system (overland) flows, preceding values are minor system flows (storm sewer).
2 Values in square brackets indicate the total flow within the minor system at the downstream limits of the proposed ultimate storm sewer (i.e. the outlet to Clythe Creek) as compared to the upstream limits of Industrial Avenue.

Under ultimate conditions, there would clearly be a reduction in peak flows to Hadati Creek; as evident from Table 4.1.7, the 100 year discharge to Hadati Creek would be reduced by some 5.66 $m^3/s$ as compared to existing conditions (since all flow other than overland would be directed towards Clythe Creek via Industrial Avenue). Although not assessed in detail, this would clearly be beneficial in further reducing flood risk to downstream properties adjacent to Hadati Creek.

**Table 4.1.7 Simulated Difference in Peak Flows ($m^3/s$) between various Scenarios**

| Location Reference | Node | Scenario Comparison | 24-Hour Chicago Distribution | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2Year | 5 Year | 10 Year | 25 Year | 50 Year | 100 Year |
| 9 | Total Discharge to Hadati Creek at Elizabeth Street and Industrial Avenue | Existing | -1.40 | -2.43 | -3.39 | -4.42 | -5.06 | -5.66 |
| | | Interim | -3.53 | -4.86 | -5.91 | -7.09 | -7.86 | -8.34 |
| 10 | Flow to Industrial Avenue (Clythe Creek) | Existing | +3.61 (-0.04) | +5.21 (-0.09) | +6.43 (-0.17) | +7.65 (-0.36) | +8.51 (-0.63) | +9.17 (-0.91) |
| | | Interim | +3.61 (-0.02) | +5.21 (-0.03) | +6.43 (-0.05) | +7.65 (-0.08) | +8.51 (-0.10) | +9.17 (-0.13) |
| 11 | Discharge to Clythe Creek from Existing 1650 mm Storm Sewer | Existing | -1.14 | -0.84 | -0.76 | -0.66 | -0.56 | -0.44 |
| | | Interim | -0.57 | -0.49 | -0.54 | -0.53 | -0.48 | -0.37 |

Notes: 1 Where relevant, bracketed values indicate major system (overland) flows, preceding values are minor system flows (storm sewer).

Additional assessment of the simulated peak flow increases due to the proposed flow splitter at 292 Elizabeth Street will be incorporated into the detailed stormwater management assessment.

## 4.2 Potential Impacts

The preferred alternative has considered and taken into account the environmental sensitivities of the study area. Notwithstanding, there are environmental impacts could result from the implementation of the preferred alternative. As such, all disciplines have assessed the potential for environmental impacts, and have generated mitigation measures to reduce or eliminate these potential impacts.

Impacts can be defined as the consequences that result from an activity or site alteration and can be either positive, neutral, or negative. Impacts can be divided into three categories as defined by the City of Guelph's Guidelines for the Preparation of Environmental Impact Studies (2014).

> **Direct Impact:** Impacts that specifically result from the proposed development layout and/or construction activities. These impacts can be mitigated through modification of site plans and managing construction practices.
> **Indirect Impact:** Impacts that may be caused by altered uses and activities after construction is completed.
> **Induced Impact:** These impacts are a subset of indirect impacts and are the consequences of the changes in human behaviours resulting from the new development.

Direct, indirect, and induced impacts have been considered along with potential avoidance measures. The time period of any identified impacts (i.e. short-term vs. long-term) has also been taken into consideration.

### 4.2.1 Changes to Permeability

Soil permeability is the measure of how well a fluid passes through it. A soil with high permeability such as sand, allows for faster and greater infiltration than a soil with low permeability such as clay. Changes in the soil permeability will be a one-time occurrence (i.e., during construction). All effort to use in situ soils for creek and road works should be made. It is understood that compaction of the soils within the proposed road widening would occur, that said beyond the road area the area for machinery access should be minimized to reduce soil compaction.

### 4.2.2 Changes to Water Balance

Water balance analysis allows the quantification of different components of a hydrologic cycle. Water balance analysis is an integral part of the decision support or policy evaluation process at the strategic or functional planning stages of the project. Water balance models are decision support and scenario management tools for promoting rainwater management and stream health protection. Changes in the water balance will be a one-time occurrence (i.e., during construction). Wetland communities have the greatest sensitivity to changes in water balance. The communities along the existing watercourse are likely to be impacted directly but can be compensated for along the relocated watercourse. Wetland vegetation can be salvaged during the construction process to help expedite the naturalization process of the new creek alignment. Wildlife that relies on the impacted wetland communities will be temporarily indirectly negatively impacted during the construction and planting phases. There are no expected induced impacts.

As previously discussed the potential for groundwater discharge exists along the Clythe Creek reaches within the study area. The potential exists due to the permeable nature and thickness of the overburden and the existence of a bedrock channel within the larger scale hydrogeologic setting. This setting is prevalent within the study area including the proposed realigned reach. As such it is expected there would be no significant change to the groundwater discharge potential.

### 4.2.3 Potential Alteration of Drainage Patterns

Grading activities are often required to accommodate the relocation of the creek and may also alter the way water flows on the study area. Proposed site development will result in an alteration of drainage pattern of the existing study area. Changes in the grading will be a one-time occurrence (i.e., during construction) and will result in a permanent alteration of drainage patterns. The proposed changes are not likely to change the drainage pattern to the catchment but local changes to permeability could directly negatively impact wetlands by modifying the amount of water they retain as well as the duration of the hydroperiod. Wetland communities along the existing watercourse are going to be impacted but can be mitigated though compensating wetland area along the proposed watercourse. Wildlife that relies on the impacted wetland communities will be temporarily indirectly negatively impacted during the construction and planting phases. There are no expected induced impacts.

It is understood that sections of Clythe Creek upstream of the former Reformatory will not be receiving external contributing flow due to the proposed partial creek realignment. Under less frequent storm events, commencing at the 5 year storm, flow would overtop the proposed low flow channel and enter the existing low flow channel. In addition local drainage from York Road will drain to the existing low flow channel via proposed storm sewer outlets. Additional detail on the storm sewer outlets will be provided in the detailed stormwater management reporting.

Drainage patterns would also change from removing the connection from the Royal Jaycees Park north pond to Clythe Creek. The south pond is currently connected to the north pond and the Eramosa River, as such there would be additional flow contribution directly to the Eramosa River from both ponds. Assessment of the thermal benefits to Clythe Creek and potential impacts to the Eramosa River are beyond the scope of this EIS.

### 4.2.4 Potential Increases in Runoff

The addition of two (2) road lanes each 3.5 m in width will increase the runoff from York Road to Clythe Creek.  The proposed two (2) multi-use paths each 3 m wide will not have a considerable impact to runoff as it proposed to use permeable pavement (apart from driveway areas). To offset the increase in runoff from York Road, it is proposed to use infiltration cells along the corridor, capable of storing approximately the 25 mm storm event, sized for the additional road paved area. The infiltration of 25 mm would mean no increase in runoff volume from the additional paved road areas for up to 90% of local storm events. Additional detail will be provided in the stormwater management reporting.

### 4.2.5 Potential Changes in Water Quality and Temperature

Stormwater water quality will be provided in a treatment train approach, using bio-filtering (when space allows), oil/grit separators and infiltration trenches. The recommended infiltration stormwater trenches would also act as cooling trenches for any flow that is not infiltrated from the paved area of York Road. The water temperature of Clythe Creek should also benefit from the removal of the north pond connection to the creek.

### 4.2.6 Potential Changes in Channel Erosion and Stability

The preferred alternative channel alignment eliminates contact with the majority of instream cultural heritage features. As a result, backwatering and local increases in channel velocity and scour associated with the features will not be a controlling aspect of channel morphology. The preferred alternative channel alignment will improve the functionality of Clythe Creek in terms of downstream sediment transport and flow connection. In addition proposed channel geometries have been developed to remain stable up to the anticipated 2-year return period flow with the overall goal of improving channel stability.

### 4.2.7 Potential Changes in Fish Passage

Clythe Creek has been extensively altered through the study area and contains several barriers to upstream fish migration. The existing barriers only allow downstream fish movement, thus creating a series of semi-isolated reaches. Barriers such as these are considered detrimental, as they prevent fish from undertaking movements such as spawning migrations or seasonal movements to locations with more favourable temperatures. Such movements allow fish to make optimal use of the available habitats. Removing such barriers, as recommended in the Grand River Fisheries Management Plan (Ontario Ministry of Natural Resources and Grand River Conservation Authority, 1998), is therefore considered to be positive.

### 4.2.8 Potential Changes in Fish Habitat

There do not appear to be any critical habitats present within the study area, such as spawning areas for fish from the Eramosa River, where modification would have a negative impact that would extend beyond the modification footprint. The elimination of several barriers to upstream migration, can be expected to provide benefits that extend throughout and beyond the study area by allowing fish to move freely between habitats, thus making use of seasonally optimal conditions and avoiding seasonally incompatible conditions, such as high summer water temperatures.

The series of small ponds that has been created along Clythe Creek downstream from the entrance to the York District lands differs from the stream habitat that would originally have been present. The decreased water velocity and large surface area probably results in increased summer water temperatures and the submergent aquatic vegetation may cause low night-time dissolved oxygen concentrations during the summer. These ponds provide habitat for tolerant fish species and restoring Clythe Creek to a more natural channel configuration would reduce the amount of that habitat present. The proposed channel realignment is a return to conditions that would naturally occur in a stream of this nature, as recommended in the Grand River Fisheries Management Plan (Ontario Ministry of Natural Resources and Grand River Conservation Authority, 1998).

The proposed plan does result in a reduction in the length of the small tributary that enters Clythe Creek upstream from the York District Lands entrance (Feature #13). Currently, however, this watercourse is only contiguous, in a fish utilization sense, with the short reach of Clythe Creek that is between the barriers to fish movement identified as Features #11 and #14. Elimination of the migration barriers would make this watercourse contiguous with a much longer reach of Hadati Creek. It should be noted that no fish were captured when 117 m of this tributary were electrofished in 2009 (Table 2.6.1).

### 4.2.9 Modification of Vegetation Communities

The modification of existing vegetation communities to accommodate the relocation of the creek and widening of York Road. Vegetation Removal will be a one-time occurrence (i.e. during construction) and will result in permanent shift in vegetation community composition (ref. Figure 3.6.1). The proposed development will directly impact vegetation communities by removing a total of 3.41 ha of vegetation communities from the study area (Table 4.2.1). The majority of the removed vegetation occurs in cultural communities. There will be removals of some Forest communities and some marsh communities. Planting along the proposed creeks of equal or greater area will replace natural cover removed.

**Table 4.2.1 Vegetation Removal Areas**

| ELC Code | Vegetation Community Name | Total Area (ha) | Area to be Impacted (ha) | Area to be Impacted (%) |
|---|---|---|---|---|
| **Cultural Communities** | | | | |
| CUM1-1 | Dry-Moist Old Field Meadow | 2.39 | 0.13 | 5.4 |
| CUT2-6 | Buckthorn Cultural Thicket Type | 3.69 | 0.33 | 8.9 |
| CUM1-1/MAM2-10 | Dry-Moist Old Field Meadow Type/Forb Mineral Meadow Marsh Type Complex | 4.94 | 2.86 | 57.9 |
| ANTH | Anthropogenic | 2.05 | 0.19 | 9.3 |
| **Natural Communities** | | | | |
| FOD7-4 | Fresh-Moist Lowland Willow Deciduous Forest Type | 0.71 | 0.07 | 9.9 |
| MAM2-10 | Forb Mineral Meadow Marsh Type | 4.35 | 0.06 | 1.4 |
| OAO | Open Aquatic | 12.10 | 0 | 0 |

Wildlife that relies on the impacted vegetation communities will be temporarily indirectly negatively impacted during the construction and planting phases. There are no expected induced impacts. Restoration along the proposed creek alignment, implementing vegetation salvages can compensate for the removed communities. Salvaging vegetation can advance the rehabilitation of vegetation communities, making them accessible to wildlife sooner.

### 4.2.10 Modification of Arboricultural Resources

Modification of arboricultural resources includes the proposed removal and/or potential injury of trees to accommodate the creek realignment. The location and extent of arboricultural resources were considered during site plan development with the intent to avoid impacts wherever feasible. The arborist study completed in 2016 did not survey the extent of the proposed creek realignment and a supplemental survey is proposed for the remaining portion of the modification footprint and will be included in the Vegetation Compensation Plan (Figure 3.6.2). Tree removal is to be a one-time event during construction. The loss will be temporary as new plantings are proposed to replace trees being removed.

The proposed actions summarized in Section 4.1 will apply to accommodate the site alterations. The realignment along York Road will require 115 trees removed and may injure an additional 79 trees (ref. Table 4.2.2); refer to Section 3.6.3 for details. Additional trees may be injured or removed pending the results of the remaining arborist assessment.

**Table 4.2.2 Tree Impact Summary**

| Proposed Action | Total (No. of Trees) |
|---|---|
| Preserve | 20 |
| Injure | 79 |
| Remove | 115 |
| **Replacement Requirement (1:1)** | **194** |

The permanent removal of trees will result in a loss of canopy habitat. The removed trees will be compensated at a ratio of 1:1 or greater depending on size to comply with City of Guelph polices. Within the surveyed section of the modification footprint, 194 trees are required to replace the trees proposed for removal or injury. An additional arborist assessment will determine the remaining replacement requirements. If replacement planting is not achievable on the subject land, a cash in lieu amount of $500.00 per tree destroyed or injured is to be paid as a substitute. Given time to grow, the canopy will increase in size and will consist of more native species. No induced impacts are expected. A Vegetation Compensation Plan and Tree Protection Plan are required as a part of Guelph Tree By-law (2010).

### 4.2.11 Construction Disturbance of Wildlife

Construction activities often result in a number of direct impacts to wildlife inhabiting the study area, including but not limited to: increased noise, light pollution, and vibrations which may result in avoidance behaviors of local wildlife. Clearing and grading operations may disturb wildlife and interfere with nesting birds if conducted during breeding season. Impacts are possible from the commencement of construction activities, and could range between 6 months to a year. Construction activities are a single occurrence activity. Clearing and grading activities could directly negatively impact birds by interfering with nesting. There is specific concern for Eastern Meadowlark which was recorded on the adjacent property. Avoidance behaviour of wildlife may occur for a short period after construction activities have ceased. Minor increases in noise and light pollution may also deter area sensitive species, (ref. Section 4.2.16 for more details). No induced impacts are expected. Impacts prior to mitigation measures are negative and of moderate significance. Construction activities including, but not limited to, clearing and grading activities should occur outside of the breeding season (April 15$^{th}$ and July 31$^{st}$) to avoid impacts to nesting of significant species. Impacts after mitigation measures are neutral, and of moderate significance as impacts are temporary and can be avoided by timing activities outside of breeding season. It is possible to avoid or reduce the magnitude of the disturbance if clearing, grading, and/or general construction works take place outside the breeding bird season. In Guelph the breeding bird season corresponds roughly to the period of April 15th and July 31st.

### 4.2.12 Decreased Soil Stability

Decreased soil stability is caused by clearing of vegetation and grading activities as it breaks up soil layers, reduces compaction, and increases bare soil which is more susceptible to erosion and/or sedimentation leading to loss of soil. Impacts are possible from the commencement of construction activities and could range between 6 months to a year. Construction activities are a single occurrence activity and soil stability will be restored upon revegetation of the site. Construction activities are a single occurrence short term activity. Soil stability will be restored upon revegetation of the site, therefore impacts are temporary. Decreased soil stability can cause more erosion and sedimentation resulting in reduced vegetation vigor and decreased water quality and fish habitat. By adhering to Greater Golden Horseshoe Area Conservation Authorities (GGHACA) 2006 Erosion and Sedimentation Control Guidelines for Urban Construction, little soil erosion and sedimentation should occur, minimizing the indirect impacts. If guidelines are not adhered to, prolonged reduction in plant vigor and fish habitat quality may occur. There are no expected induced impacts.

Impacts prior to mitigation and compensation measures are negative and of moderate significance due to:

- Minimal magnitude relative to area disturbed;
- Duration is temporary; and
- The frequency is a single occurrence event.

Soil destabilization is reversible through revegetation following construction using temporary seed mix/annual nurse crop grass species within limits of disturbance. Adjacent natural feature should be protected from sedimentation through the use of siltation fencing outlined in GGHACA's Erosion and Sedimentation Control Guidelines for Urban Construction (2006).

The proposed site alterations were developed to require minimal grading, but some grading is still required to accommodate site activities. It is not possible to avoid soil disturbance in order to grub out the root systems of trees and other vegetation to accommodate construction. Sedimentation in the adjacent natural areas can be avoided through use of siltation fencing erected around disturbance zone in conformance with GGHACA 2006 Erosion and Sedimentation Control Guidelines for Urban Construction. Soil destabilization is reversible through revegetation following construction.

Impacts after mitigation and compensation measures are neutral, as negative impacts can be avoided through the use of GGHACA 2006 Erosion and Sedimentation Control Guidelines for Urban Construction, and soil destabilization can be reversed through revegetation.

### 4.2.13 Import/Export of Fill

Imported fill will be of divergent origin and character to that of existing soils and may affect stability and/or permeability functions. However, as the imported material will be used primarily as a base for the road widening and the overall magnitude will be commensurate to that caused by the construction of new roads, and proposed creek. Importation of topsoil may bring in weed seed from non-native invasive species. Once imported, the duration of the fill placement is considered permanent. This is a single occurrence event. Some top soil may be imported to amend landscaping areas. It is not likely that this presents a significant source of non-native invasive seeds. Introduction of non-native invasive seeds may lower the quality of vegetation communities by out competing native species for resources, reducing the biodiversity of the study area, and the resiliency of the plant communities. The plant communities are all cultural in nature and many non-native invasive species are already present, therefore the impacts are likely insignificant. No induced impacts are expected.

Impacts prior to mitigation measures are negative and of low significance due to sensitivity of target is low and the extent is limited and the effect of the impact is permanent. Careful stockpiling and amendment of existing topsoil may allow avoidance of importing additional topsoil. If importing soil is unavoidable, top soil should be sourced in a manner that has the least potential for containing invasive exotic seeds. Granular fill is required to construct stable foundation for proposed roads and is therefore unavoidable. Once imported and placed it is not possible to reverse this impact while maintaining the proposed roads. Impacts after mitigation measures are neutral.

### 4.2.14 Removal of Open Country Bird Habitat

A pair of Eastern Meadowlark was recorded during the 2016 breeding bird survey on the property adjacent to the east of the study area (south of polygon 16 on Figure 3.6.1), south of Clythe Creek and east of the driveway to the correctional institute. The proposed work will be confined to the creek corridor and, as such, will not negatively impact these fields, therefore, there are no direct impacts expected. The pair may be indirectly impacted by the noise and other indirect pollution created during the construction period. No induced impacts are expected. Indirect impacts can be avoided by limiting construction activities to outside of the breeding season (April 15$^{th}$ to July 31$^{st}$).

### 4.2.15 Encroachment of Natural Areas

Encroachment is the induced impact caused by human occupation or use of land adjacent to natural areas and the associated buffers. Encroachment activities following establishment of buffers could affect the long term success of NHS features and functions if encroachment is severe or excessive. Construction activities will result in avoidance behaviour of many wildlife species, see Section 4.2.11 for details. Noise and light pollution is likely limited to the lands immediately adjacent to York Road, see Section 4.2.16 for further details. Impacts would likely occur post construction and are potentially long term and iterative. Increased encroachment to the natural areas is not expected to increase significantly and would only incurred by the increased traffic on York Rd. Very little to no induced impacts are expected as the land use is not changing from parkland.

### 4.2.16 Indirect Pollution

Pollution from the creek realignment and road widening include noise, light, and chemicals. Wildlife tend to respond through behavior modifications such as avoidance. Introduction of chemicals into the environment leads to reduced fecundity of aquatic and terrestrial wildlife and flora. Dust can cause avoidance behavior from wildlife and reduce the success of flora along roadsides. Potential effects of indirect pollution on wildlife include:

- Reduced habitat quality;
- Potential loss of habitat due to quality reduction;
- Reduced population densities (particularly breeding birds);
- Reduced species diversity;
- Increased susceptibility to predation;
- Negative physiological effect; and
- Alteration of reproductive behavior (particularly herpetofauna).

Impacts would likely occur post-construction and are potentially long-term and iterative.
Construction activities will likely result in noise, light, and chemical pollution which may cause avoidance behaviours in many wildlife species, see Section 4.2.11 for details.

Based on available information and the existing park lands surrounding the natural features, lighting is not expected to change and, therefore, is expected to have a negligible effect on wildlife habitat use or bird migration. Wildlife species that are crepuscular (active during dawn and dusk) or nocturnal may avoid suitable habitat located near roadways due to light pollution. The study area is likely to be occupied mostly during daylight hours, reducing the amount of noise and light pollution during key times for crepuscular species.

Contaminants from York Rd are not likely to change dramatically but may increase slightly due to increased road use. Contaminants can directly impact vegetation community, resulting in increased abundance of salt tolerant weedy species. It can indirectly impact wildlife by modifying the habitat adjacent to the road. The impacts are not expected to be significant as the communities adjacent to the roadways are cultural. No induced impacts are expected.

### 4.2.17 Removal of Species at Risk

The Endangered Species Act (2007) (O. Reg. 242/08) protects flora and fauna that is Threatened, Endangered or Special Concern at the provincial level. Significant habitats of provincially Endangered and Threatened species are specifically protected from development in the PPS, and habitats of provincial Special Concern species are recognized under the Province's Significant Wildlife Habitat categories.

Three Species at Risk birds were recorded including Chimney Swift – Threatened (federal and provincial); Barn Swallow – Threatened (federal and provincial); and Eastern Meadowlark – Threatened (federal and provincial). Chimney Swift and Barn Swallow are not suspected to be nesting in the study area, there is no suitable habitat present. Barn Swallows are known to be nesting in the vicinity and four birds were seen foraging over the baseball fields on the west side of the study area and in the open field on the east side of the study area. Eastern Meadowlark was recorded in the field east of the study area (south of polygon 16 on Figure 3.6.1), south of Clythe Creek and east of the driveway to the correctional institute. The proposed work will be confined to the creek corridor and, as such, will not negatively impact these fields.

A Snapping Turtle – Special Concern (federal and provincial) was observed in the pond. Although turtles are likely nesting in the general vicinity, such as along the Eramosa River to the south, there were no significant areas of potential nesting habitat along Clythe Creek and York Road. The two main ponds likely represent overwintering habitat for all three turtle species.

Downy Serviceberry, Red Fescue, Rough Aven's, and Hairy Solomon's Seal were found in the study area and are considered rare in Wellington County (Appendix H-3). Rough Aven's were recorded near the watercourse in polygon 3 as well as in polygon 11 and will likely be removed when the creek is relocated. Red Fescue and Hairy Solomn's Seal were recorded in the Meadow Marsh (polygon 13) and may be impacted by the footprint of the proposed watercourse.

Construction activities could result in avoidance behaviours of Eastern Meadowlark in the field adjacent to the study area and Snapping Turtles in the pond. During the 2016 wildlife surveys, there was no evidence of snapping turtles nesting along the existing watercourse, or anywhere else within the study area. It is likely that they are nesting offsite. As stated in section 4.2.11, construction should occur outside of the breeding window to mitigate any impacts to breeding birds. No induced impacts are expected.

Although there is open country bird habitat, no habitat is to be removed as a part of the road widening and creek relocation. Three locally rare species may be impacted. Locally rare plants found within the creek modification footprint could be salvaged and relocated on site outside of the footprint prior to construction.

## 4.3 Proposed Mitigation Measures

The following summarizes proposed mitigative measures.

### 4.3.1 Sediment & Erosion Control

Silt fencing should be maintained around the construction areas to ensure that no terrestrial wildlife, such as snakes or amphibians, can access the site and potentially be injured; a protocol should be in place to guide workers with regards to actions to take to minimize injury to wildlife and procedures to follow should they discover wildlife within restricted areas.

### 4.3.2 Migratory Birds

To ensure compliance with the Endangered Species Act (2007), the habitat of Eastern Meadowlark (Threatened) should not be negatively impacted; works along Clythe Creek should stay as confined as possible to the creek and its associated riparian habitats; in addition, these open fields represent foraging for Barn Swallow (Threatened) which nest in the vicinity; any removal of this open field habitat will potentially require approval from the MNRF.

To be in compliance with the Migratory Bird Convention Act (MBCA 1994), any vegetation removal on the site should be done outside of the breeding bird window, which for this site would be approximately May 1 to July 31. If any vegetation removal is to occur within this window, a qualified avian ecologist should first check the vegetation to be removed to ensure that there are no migratory birds covered by the Act nesting within it. If any birds are found nesting then, in consultation with Environment Canada, a suitable buffer should be established around the nest, and no activities will be permitted with this buffer until the birds have left.

#### 4.3.3 Arboricultural Resources

The removed trees will be compensated at a ratio of 1:1 or greater depending on size to comply with City of Guelph polices. If replacement planting is not achievable on the subject land, a cash in lieu amount of $500.00 per tree destroyed or injured is to be paid as a substitute.

Trees within the portion of the modification footprint not previously surveyed should be assessed to better determine the replacement requirements prior to construction.

Vegetation Compensation Plan and Tree Protection Plan must be completed to comply with City of Guelph Tree-Bylaw (2010).

### 4.4 Compensation Measures

The following summarizes the proposed compensation measures.

#### 4.4.1 Open Country Bird Habitat

To ensure compliance with the Endangered Species Act (2007), the habitat of Eastern Meadowlark (Threatened) should not be negatively impacted; works along Clythe Creek should stay as confined as possible to the creek and its associated riparian habitats; in addition, these open fields represent foraging for Barn Swallow (Threatened) which nest in the vicinity; any removal of this open field habitat will potentially require approval from the MNRF.

#### 4.4.2 Tree Replacement

The removed trees will be compensated at a ratio of 1:1 or greater depending on size to comply with City of Guelph polices. If replacement planting is not achievable on the subject land, a cash in lieu amount of $500.00 per tree destroyed or injured is to be paid as a substitute.

### 4.5 Enhancement Measures

The following summarizes the recommended enhancement measures.

#### 4.5.1 Wildlife

- Do not remove Common Milkweed, which is the hostplant for Monarch (Special Concern); if this plant is to be removed, it must be replaced elsewhere on the site.
- Turtles – areas of sand and gravel should be constructed in areas to the west and south of the two main ponds; these areas will encourage turtles to nest and will also entice them away from York Road to the north, which is a potential source of mortality. The two main ponds and areas along Clythe Creek should have logs and rocks provide to be utilized as

basking sites. A permanent fence should be installed along the south side of York Road to stop turtles from attempting to cross York Road.

- Addition of turtle nesting habitat along the proposed creek alignment will better support the 3 turtle species observed on site.
- Nesting boxes for Wood Duck and platforms for Osprey should be considered in the pond redesign.
- Snake hibernacula could be designed into the edges of the main ponds to provide overwinter sites; the locations should be in southern portions of the ponds to be as far away from York Road as possible.

### 4.5.2 Vegetation

- The low-lying meadow marsh riparian areas along Clythe creek contain a variety of wetland and aquatic species that could be salvaged and transplanted along the new creek alignment.
- Regionally rare vegetation within the modification footprint could be transplanted elsewhere on site.
- Native flower patches with Common Milkweed could be incorporated into the pond and creek designs to provide nectar sources for Monarch butterfly.

### 4.5.3 Industrial Pond Retrofits

- The recommended retrofit of the 'Industrial Ponds' will provide an Enhanced water quality treatment to approximately 50 ha of existing development (ref. Figure 4.1.16).
- The pond retrofit would also result in reduced thermal impacts from the Industrial ponds to Clythe Creek, through mitigative measures that could be implemented within the retrofit design.

# 5.0 CONCLUSIONS

The following conclusions have been prepared based on the findings documented herein.

## 5.1 Road Design

As part of the current undertaking, the 2007 Class EA-proposed York Road design between Victoria Street and the East City Limits was reviewed and revised to reflect updated City policies, as well as the desires of the public and other stakeholders. Since 2007, the City has placed an increased emphasis on provision of active transportation facilities – a shift which is being driven by demands of the general public. Retention of heritage features has also become increasingly important, as they help to tell the City's history and create places of interest for the public. With an increased emphasis on Active Transportation and heritage, the York Road cross-section was revised to provide multi-use pathways on both sides of the road, as well as a minimum 2.0 m buffer between any designated heritage features and the edge of the travelled way. The EA-proposed cross-section did not consider impacts to heritage features, but did provide cycle lanes and sidewalks on the both sides of the road away from the York District (Reformatory) lands. Adjacent to the York District lands, the sidewalk was dropped on the south side. The recommendation to modify the proposed cross-section was based on extensive consultation and evaluation of feasible alternatives. The current study also recommends the realignment of York Road in order to provide enhanced active transportation and limit impacts to adjacent heritage features and Clythe Creek while maintaining the EA-approved north property limit.

## 5.2 Hydrology and Hydraulics

Hydrology and hydraulics for existing and proposed Clythe Creek and York Road corridor has been developed. Based on no impact on Clythe Creek peak flows resulting from the proposed road improvements, stormwater management is only required for erosion and quality control, consisting of bio-filtration, oil/grit chambers and infiltration/ cooling trenches along the road right-of-way.

The proposed Clythe Creek realignment and culvert replacements will provide a slight reduction to the Regulatory floodplain and will reduce overtopping depths of York Road at the Clythe Creek crossing.

## 5.3 Stream Morphology

The existing fluvial geomorphic conditions along Clythe Creek within the study area are severely impaired with aggradation of fine grain sediment observed throughout the watercourse corresponding to a RGA stability index value indicating the channel is stressed or transitional. Overall channel health was also determined to be low to moderate throughout the system. The opportunity exists, however, to improve overall health and function of the creek. Following a review and analysis of existing conditions, a preferred alternative for channel improvements has been identified as 'Option 3' (ref. Appendix F). By implementing this channel improvements option, barriers to downstream sediment transport will be removed or mitigated as a result of channel works which greatly improve the fluvial form and function of Clythe Creek. As a result, it is expected that there would also be a corresponding improvement to overall fish passage through the channel.

## 5.4 Fisheries

From a fish habitat perspective, the proposed realignment using natural channel design can be considered a restoration of the existing channel and is entirely consistent with the recommendations of the Grand River Fisheries Management Plan (Ontario Ministry of Natural Resources and Grand River Conservation Authority, 1998). The proposed works will change the nature and amount of fish habitat that is present and the proposed works will require review by Fisheries and Oceans Canada under the Fisheries Act. A quantitative assessment of the proposed works will be required during detailed design to support that review. The restoration will result in a reduction in the area of habitat that is present due to the narrowing of the channel between the entrance to the York District Lands and the confluence with Hadati Creek and shortening of the channel between the confluence with Hadati Creek and the confluence with the Eramosa River. Support for the current proposal, which is based on the position that the benefits that will occur as a result of the channel restoration would offset the reduction in pond-like habitat along the existing channel should be sought from the relevant agencies, including Fisheries and Oceans, as soon as it is feasible. It can be anticipated that a Fisheries Act authorization will be required for the channel works.

## 5.5 Wildlife and Vegetation

The study area and the adjacent lands present several ecological sensitivities including but not limited to natural vegetation communities, open country bird habitat, turtle habitat, three Species at Risk birds, and existing trees. The widening of York Road and the creek realignment will cause some direct negative impacts, specifically to trees and natural vegetation. The negative impacts can be compensated for as a part of the new creek realignment design. Further arboricultural assessment is required to properly evaluate the number of trees that will be removed or injured but replacement will occur at a 1:1 ratio. Area of natural communities will be compensated for at a 1:1 ratio and the selection of native species will improve the biodiversity onsite. Salvaging riparian vegetation from the existing creek will both expedite the naturalization of the new alignment and benefit from the existing mycorrhizae and propagules in the soil. The proposed development may indirectly impact wildlife including turtles, open country birds, and Species a Risk birds. No habitat for any of the species is proposed to be removed but avoidance during construction is possible. This can be mitigated through limiting construction to outside of the breeding window (April 15$^{th}$ to July 31$^{st}$). If any vegetation removal is to occur within this window, a qualified avian ecologist should first check the vegetation to be removed to ensure that there are no migratory birds covered by the Act nesting within it. Although turtles are not currently breeding along the existing creek alignment, the addition of turtle breeding habitat in the proposed design will benefit turtles present onsite. There are no expected induced impacts. York Road is already a heavily used road, therefore widening it is not likely to cause a noticeable change in human use. The park land is remaining parkland with not additional programming. In conclusion, the widening of York Road and the realignment of the creek will cause some negative impacts but can be mitigated and compensated completely, resulting a net neutral or positive impact.

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# Appendix A

# EIS Terms of Reference

## Appendix B

## Clythe Creek Site Photographs

**Appendix C**

**Hydrogeology and Geology**

# Appendix D

# Hydrology and Hydraulics

# Appendix E

# Water Quality and Temperature

# Appendix F

# Fluvial Geomorphology

**Appendix G**

**Fisheries and Aquatic Habitat**

**Appendix H**

**Terrestrial Ecology**
**(Vascular Plants)**

**Appendix I**

**Terrestrial Ecology (Wildlife)**

**Appendix J**

**Road Assessment**