Draft Terms of Reference

Environmental Impact Study (EIS)

York Road Environmental Design Study

City of Guelph

Prepared for:

City of Guelph
River Systems Advisory Committee (RSAC)

Prepared by:

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Dougan & Associates
Matrix Solutions (including Parish Aquatic Services)
Blackport and Associates

January 2016

Project No. TP115100

DRAFT TERMS OF REFERENCE
ENVIRONMENTAL IMPACT STUDY (EIS)
YORK ROAD ENVIRONMENTAL DESIGN STUDY
CITY OF GUELPH

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1. PROJECT BACKGROUND AND STUDY APPROACH

The proposed York Road Environmental Design Study (YREDS) will be 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 original 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 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.

As noted within the original 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 will address all of these considerations in greater detail, and ensure that proposed road widening is conducted in a responsible and well-planned manner.

A key component of the YREDS will be the completion of an Environmental Impact Study (EIS). This study is to include a background review of available data and reporting for the area, and undertake additional field work activities to further quantify and assess areas of concern or areas where missing or uncertain information has been noted. This environmental data will be 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.

2. AREA PLANNING CONTEXT

The Clythe Creek stream corridor is a significant natural area (City of Guelph Official Plan Schedule 10) that includes wetlands and a Special Study Area (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. 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.

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.

3. POLICIES AND LEGISLATIVE FRAMEWORK

Current Official Plan, regulations, and policies include the following:

- Extension 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 Strategy Designations applicable to the stream and 15 m stream corridor:
    - Natural Heritage System (OP Policy 2.4.14 and Schedule 10, City of Guelph, 2010a).
    - Significant Natural Area (OP Policy 6A.1 and 6A.2 and Schedule 10, City of Guelph, 2010a).
    - Warm water 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 will also address 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 will commence 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' 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 our 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.

4. ROLE OF THE RIVER SYSTEMS ADVISORY COMMITTEE

As per the terms of reference (TOR) for the York Road Environmental Design Study, a TOR is to be developed for the EIS, in particular for the recommended field work investigations. This document is intended to address this requirement. It is expected that the City's River Systems Advisory Committee (RSAC) will review the TOR, and provide input and comments which will help to form the final TOR, prior to the Project Team proceeding with field work activities. It is expected that the findings of the EIS (including field work activities) will be presented to RSAC upon completion, with further input and comments to be incorporated into final reporting.

5. DESCRIPTION OF STUDY AREA

The approximate 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 involved with background review work only. Detailed field work investigations would be 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 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 an interesting watercourse within the City, as its headwaters are 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 A includes a photographic inventory of Clythe Creek.

In addition to Clythe Creek, 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 will also be assessed as part of the EIS (with respect to hydrology, geomorphology, and fisheries considerations specifically), 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.

6. STUDY STAGING AND IMPLEMENTATION

The following study staging and implementation process is envisioned for this study:

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

7. STAGE 1 – BACKGROUND REVIEW

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 includes:

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

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 prior to proceeding to Stage 2 (Field Work Investigations). In this way field investigations can be suitably scoped and focused upon areas of particular sensitivity, or where available information is lacking.

7.1. Hydrogeology and Geology

The groundwater flow system within the study area will be 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 B) 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 B) 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 B). 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.Asc. 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.

7.2. Hydrology and Hydraulics

Hydrology

With respect to watershed hydrology, the approved frequency flows for Clythe Creek (2 through 100 year peak flows) are currently sourced from a MIDUSS model using design storms (Gamsby & Mannerow, 2006), while Regulatory Event flows (Regional Storm – Hurricane Hazel) are sourced from a GAWSER model (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 (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 (2015, on-going). The first two modelling assessments have used design storm methodology; the latter modelling work for the GID area (on-going) will employ continuous simulation.

Based on the foregoing, it is 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 will be developed as part of this study accordingly. While it is anticipated that design storms will be 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 will be updated in order to assess the impacts of the proposed widening of York Road and associated stormwater management strategies. PCSWMM includes a full Low Impact Development/Best Management Practices (LID/BMPs) toolkit, which will facilitate the consideration of these measures, if determined to be appropriate.

Hydraulics

For Clythe Creek, a HEC-RAS hydraulic model is available from the GRCA, which has been incrementally updated (most recently in 2007) to reflect changes in hydraulics structures and development, particularly in the Watson Parkway area. The model extends from 500 m +\- upstream of Watson Road to the confluence with the Eramosa River, with fixed water levels specified for the model boundary condition, based on the expected frequency levels within the Eramosa River.

For Hadati Creek, a HEC2 hydraulic model was developed as part of the 2003 Channel Improvements Study (Gamsby & Mannerow).

For the purposes of the current study, no significant changes are envisioned for these hydraulic models, beyond localized channel geometry updates as required based on the results of the additional survey to be completed as part of field work activities (refer to Sections 8.2 and 8.4). Updated peak flow data from the hydrologic modelling effort will be employed 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). This hydraulic modelling will also be used as required 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.

7.3. Water Quality

Water quality sampling data is 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 (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 4th 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 is 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.

7.4. Fluvial Geomorphology

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 last few decades 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, no study was able to 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).

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 (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 B for reference. It is likely that these reach breaks will be modified as part of the current study with further site reconnaissance and field work. 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.

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 A.

The section of Clythe Creek that is 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 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 York Road 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 low gradient and stone protection along the banks. Similarly with 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.

7.5. Fisheries and Aquatic Habitat

The habitat characteristics and fish communities of Clythe Creek and Hadati Creek within the study area were documented during the preparation of the environmental assessment for the widening of York Road (Natural Resource Solutions, 2006). The stream habitats have been extensively altered. The downstream portion of the study area, including the north 'Reformatory' pond, is accessible to fish from the Eramosa River. The weir upstream from the Innovation Lands driveway blocks upstream fish migration.

Electrofishing in Clythe Creek has resulted in the capture of warm water non-game species. Greenside Darter (Etheostoma blennioides) is considered a species of special concern under the Species at Risk Act, but was assessed to be not at risk in the last (November 2006) COSEWIC assessment (http://www.registrelep-sararegistry.gc.ca/species/speciesDetails_e.cfm?sid=99; accessed January 4, 2016). Centrarchids are known to be present in the ponds.

There is a considerable amount of water temperature information for Clythe Creek including temperature surveys by Trout Unlimited in 2006 and 2007 and by H. Ashworth in 2011 and 2012 as part of her M.Sc. thesis work at the University of Guelph. Additional, more recent temperature data will be provided by Trout Unlimited Canada (J. Imhof, personal communication). The data reviewed to date indicate that summer water temperatures in Clythe Creek within and immediately upstream from the study area are in the range that is typically associated with warm water or warm-cool water fish communities.

Two cooler tributaries have been identified within the study area. One of these discharges directly to Clythe Creek upstream from the connection with the north Reformatory Pond and the second discharges to the pond itself. The latter, therefore, has little or no influence on the temperature of Clythe Creek.

7.6. Terrestrial Ecology

As part of the background review for this project, available information with respect to natural heritage information (as listed in Section 12 – references) have been reviewed for relevant information. In addition to those sources listed in Section 12, the project team has completed a Natural Heritage Information Centre (NHIC) database query, as well as consulting with the Guelph District Ministry of Natural Resources and Forestry (MNRF) for local species at risk (SAR) information, including the City of Guelph's Municipal List of SAR. Information gathered in this ongoing phase will provide surveyors with an initial understanding of the YREDS area, facilitate decision-making during the study, and be incorporated into reporting.

A preliminary review of the background documents indicates records for 22 vascular plant species and 67 wildlife species of significance locally, regionally, and/or provincially. It should be noted that the scale of these studies are often broader than the limits of the current study area and serve only to flag potential species during the forthcoming field investigations. Several Key species were recorded near or within the YREDS area; notably: Snapping Turtle (Chelydra serpentina) and Eastern Milksnake (Lampropeltis Triangulum). Both are included in the Guelph District OMNRF's Species at Risk Records accessed on October 27, 2015, as well as the City of Guelph Municipal List (2015), and Ontario Reptile and Amphibian Atlas (Ontario Nature, 2015). Since both of these species are considered Special Concern Provincially, turtle surveys and Eastern Milksnake surveys are necessary.

7.7. 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 will guide the development of the field work investigations (Section 8), by identifying those data and knowledge gaps that exist and should be addressed in order to ensure a fulsome environmental characterization. Proposed field work investigations are discussed in greater detail in Section 8.

8. STAGE 2 – FIELD WORK INVESTIGATIONS

8.1. 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. A limited spot baseflow monitoring program is proposed in conjunction with the Fluvial Geomorphology field work program (Section 8.4). This monitoring program will be used to estimate groundwater discharge contributions to baseflow. A more detailed site specific assessment of groundwater levels and the potential for upward hydraulic gradients should be carried out as part of a future field program supporting detailed design (beyond the scope of the current assessment).

8.2. Hydrology and Hydraulics

Based on discussions with City staff and staff from the GRCA, no hydrologic field work activities are proposed 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 will be validated using previously completed modelling (as noted in Section 7.2) 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.

Spot flow measurements are to be completed as part of the Hydrogeology and Geology program (Section 8.1) and Fluvial Geomorphology program (Section 8.4). This information will be used where feasible as part of the future hydrologic modelling validation work.

With respect to channel hydraulics, an updated topographic survey will be conducted for selected sections of Clythe Creek to support updated hydraulic modelling and design work. No additional topographic survey is proposed 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 will be used as part of this study.

8.3. Water Quality

No specific water quality testing or field work is proposed 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).

8.4. Fluvial Geomorphology

In order to fill gaps in the fluvial geomorphic understanding of the study area, a detailed field program is required. Information gathered from the proposed fluvial geomorphic field program will provide quantitative data on channel processes which will be valuable in the development of a conceptual design; however, the data may or may not be sufficient to support a detailed design.

Rapid Field Assessments

To further confirm and refine results of the desktop analyses, rapid field assessments (i.e., the Rapid Geomorphic Assessment and Rapid Stream Assessment Technique) and additional field reconnaissance will be 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) will be confirmed. Measurements of pool depth (to provide insight on scour potential) and depth measurements to channel bed in the area of the weirs would be completed. An inventory of all weir structures will be compiled and crossing assessments completed for all bridges and culverts.

Detailed Field Data Collection

In order to better quantify channel dynamics, a detailed field assessment of the study reaches are required. The field work would follow standard field protocols and would include installation of 2 monitoring cross sections as well as 8 additional (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). This survey would be co-ordinated with the overall topographic survey work described in Section 8.2 to avoid a duplication of effort.

A limited spot flow monitoring program will be carried out for two purposes; to measure baseflow (low flows) to help characterize groundwater and surface water interactions and existing aquatic habitat (as per Section 8.1), and to measure wet weather flows in Clythe Creek and through all connecting streams and channels. The spot baseflow monitoring program will be carried out during the summer months following a suitable period without precipitation. The wet weather flow monitoring will completed during the spring freshet if possible. Bankfull flow conditions will be targeted if possible.

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. Spotflow 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.

8.5. Fisheries and Aquatic Habitat

Fish Habitat

The habitat in Clythe Creek will be characterized from the Eramosa River upstream to the railway crossing north of York Road. The habitat in Hadati Creek will be characterized from its confluence with Clythe Creek upstream to Elizabeth Street (i.e. 50 m +\- east of Industrial Street). Parameters documented will include channel form and dimensions, substrate, barriers to fish movement and indicators of groundwater discharge (i.e. seepage areas, watercress). The area characterized will include the Industrial Ponds, and the nearshore habitat along the north side of the north reformatory pond, adjacent to Clythe Creek. Existing information will be relied upon to characterize the two coolwater ‘tributaries’ that enter from the south and the other portions of the reformatory ponds.

Fish Community

No fish sampling is proposed in Clythe Creek or any of the ponds. The assessment will rely on existing information with respect to the fish species present in those areas. Electrofishing will be conducted in Hadati Creek between York Road and Elizabeth Street to characterize the fish community.

Northern Pike Spawning Survey

Northern Pike (Esox lucius) are known to spawn in a wetland area beside the Eramosa River a short distance upstream from its confluence with Clythe Creek. Based on our current knowledge of the study area, it is possible that Northern Pike spawning habitat also exists in the lower reaches of Clythe Creek, particularly in the Industrial ponds. Therefore a Northern Pike spawning survey (visual search) will be undertaken in the early spring (late March – early April) when spawning is occurring at the other known spawning site.

Water Temperature
No additional water temperature monitoring is proposed. The study will rely on existing information, which is considerable.

8.6. Terrestrial Ecology

Surveys will include 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. A summary of all field surveys and their timing is presented in Table 10.1.

Vegetation Field Investigations
Prompt initiation of seasonal field studies will be essential for study timing. Site investigations will be conducted by skilled field staff and will, at a minimum, include: Species at Risk (SAR) surveys, floral, faunal & ELC surveys, and a tree inventory and hazard Assessment.

The following vegetation field surveys are recommended within the York Road Environmental Design Study (YREDS) area, which includes adjacent lands (to 120 metres as per the PPS (2014)):

- Ecological Land Classification (ELC) - Confirmation and refinement of previously identified (NRSI 2013) ELC communities within the YREDS area using Lee et al. (1998), including characterization of soils. Polygons contiguous with and, extending beyond, the YREDS area will be surveyed in entirety to ensure the accurate characterization.
- Vegetation Inventory – conduct spring, summer, and fall vegetation inventories for the YREDS area to update existing vegetation inventories and determine if locally or regionally significant species are present.
- Tree Inventory and hazard assessment – the existing tree inventory (NRSI 2006) will be reviewed and updated through field investigations to determine which trees should be retained based on their health and hazard potential, or appropriate mitigation and compensation measures. Where necessary, trees will be tagged and located using a high-accuracy Trimble GeoXH GPS unit.
- Species at Risk (SAR) – all habitats and observations will be screened against the City of Guelph Municipal List of Species at Risk provided by Guelph District MNRF (September 2015). Some SAR (Endangered and Threatened) have specialized survey protocols required to detect their presence. Therefore, for any SAR that are not identified in the background review or during 2016 field investigations but have potentially suitable habitat found within the YREDS sarea, specialized survey protocols for detection will be recommended for the future (refer to the Potential Additional Field Investigations discussion within this section).
- Significant Wildlife Habitat (SWH) screening – during field investigations, all habitats within the YREDS area will be screened against criteria outlined in the Significant Wildlife Habitat Technical Guide (OMNR 2000) and the Significant Wildlife Habitat Criteria Schedules for Ecoregion 6E (OMNRF 2015) to determine if rare vegetation communities are present. This will include searching for any Special Concern species (not covered under the ESA (2007)) and those with provincial Sranks of S1 to S3.

Wildlife Field Investigations

The following wildlife field surveys are recommended for the YREDS area, which includes adjacent lands (to 120 metres as per the PPS (2014)). The field surveys are recommended owing to routine "due diligence" as well as from information gleaned from background sources (see above).

- Breeding bird surveys following protocols outlined in the Ontario Breeding Bird Atlas (OBBA 2001). These surveys would take place from May 24 to July 10, with a minimum of two surveys taking place at least seven days apart; they will occur between sunrise and approximately 10:00 a.m. and under suitable weather conditions (i.e. light winds, good visibility, and no heavy rain).
- Nocturnal Amphibian Surveys following protocols outlined in the Ontario Marsh Monitoring Program (BSC 2003). At least three surveys would take place from April to June, with at least two weeks between surveys. The surveys would be conducted between sunset and midnight, and under suitable weather conditions (i.e. light winds, no heavy rain, and minimum temperatures of 5℃, 10℃, and 17℃ for the April, May, and June surveys, respectively.
- Turtle surveys following general protocols from a number of sources; these would including basking surveys as well as nesting surveys and road mortality surveys. Basking turtles would occur from mid-April to mid-June, with at least three surveys undertaken; they would occur between mid-morning and late afternoon during warm, sunny weather. High quality optics would be used to scan basking sites (e.g. logs, rocks) for turtles, and the number, species, and locations would be documented. Nesting surveys would be undertaken in late May to early June between dawn and mid-morning, especially within 24 hours of rain when females are more likely to initiate nesting activities; these surveys would take place at any nesting sites (sand and gravel areas with a southerly aspect in proximity to the ponds and creek) that are identified in the YREDS area. Further nest checks could be undertaken in August and September to check for signs of the emergence of young turtles (e.g. eggs shells, signs of nest depredation). Road mortality surveys would be conducted concurrently with any basking or nesting surveys, and would involve checking both sides of York Road for any dead turtles.
- Eastern Milksnake surveys following protocols from the Guelph District MNRF (OMNR 2013). These surveys would involve active hand searches over the entire YREDS area, with at least three surveys done a minimum of two weeks apart from late April to mid-June; the surveys would be conducted under suitable weather conditions (e.g. sunny and temperatures of at least 8℃ (or, if overcast, at least 15℃). Note that this protocol does not recommend the use of cover boards unless they have been in place at least two years.
- Significant Wildlife Habitat (SWH) screening – during field investigations, all habitats within the YREDS area will be screened against criteria outlined in the Significant Wildlife Habitat Technical Guide (OMNR 2000) and the Significant Wildlife Habitat Criteria Schedules for Ecoregion 6E (OMNRF 2015). This will include searching for any Special Concern species (not covered under the ESA (2007)) and those with provincial Sranks of S1 to S3.
- Species at Risk (SAR) screening – all habitats and observations will be screened against the City of Guelph Municipal List of Wildlife Species at Risk provided by Guelph District MNRF (September 2015). Some SAR (Endangered and Threatened) have specialized survey protocols required to detect their presence. Therefore, for any SAR that are not identified in the background review or during 2016 field investigations but have potentially suitable habitat found within the YREDS area, specialized survey protocols for detection will be recommended for the future (see provisional list below).

- Incidental wildlife – groups such as mammals and insects (especially butterflies and odonates) will be noted on an incidental basis during all field investigations.

Potential Additional Field Investigations

The following is a number of extra tasks outside the scope of the above TOR which may become necessary depending on the results of the recommended surveys, or if they were recommended by the earlier reports from the background review. These additional investigations would be beyond the currently agreed upon scope, and would require further discussions with the City of Guelph prior to proceeding.

- Butternut Health Assessment. If Butternut trees (Juglans cinerea) are found during botanical surveys, MNRF may request that a Butternut Health Assessment be carried out. Butternut is designated Endangered in Ontario (OMNRF, 2015) and Canada (COSEWIC, 2014).
- Common Nighthawk: the NRSI report (2013) recommended surveys for this species, which require surveys after dusk; if suitable habitat is identified during spring 2016 surveys, then these surveys will be undertaken in late May and June.
- Other SAR: which require specialized protocols and therefore would not be detected by the general survey protocols in the recommended list. If individuals or suitable habitat for the species are found in the YREDS area, this could include the following species: Least Bittern, Chimney Swift, Jefferson Salamander, Blanding’s Turtle, three bat species (Tricolored Bat, Northern Myotis, and Little Brown Myotis), and West Virginia White. Based on habitat assessments in the YREDS area, these species were not recommended for future surveys by NRSI (2013).
- Butterfly surveys: there are a number of S1 to S3 species that could occur in the YREDS area, including two sedge specialists (Black Dash (S3) and Dion Skipper (S3)), Hickory Hairstreak (S3), and Common Sootywing (S3). Two locally significant species could also occur: Little Glassywing and Delaware Skipper. If required, butterfly surveys would be conducted in June and July to determine the status of these species, and others, in the YREDS area. Also, a habitat assessment for West Virginia White (Special Concern) would also be undertaken in early spring and surveys for this species in early May would be conducted if suitable habitat and hostplants are found. Any significant stands of Common Milkweed, the hostplant of Monarch (Special Concern), will be noted during all field investigations.
- Odonates: according to Table 6 of the 2013 NRSI report, there are eight species of dragonflies and damselflies with Sranks of S1 to S3 that could occur in the YREDS area; in addition, there are 11 species with local significance (i.e. within the City of Guelph) that could occur. Odonate surveys would be conducted in June and July, with a focus along Clythe Creek, the edges of the two ponds, and in any other wetlands within the YREDS area.
- Winter surveys for Bald Eagle: the NRSI report (2013) recommended surveys for this species along the Eramosa River, which is to the north and east of the present YREDS area. This species would not utilize areas along Clythe Creek during winter or the adjacent ponds (which freeze) so it is not likely to be impacted by proposed activities along York Road. Therefore, these surveys are not recommended. If undertaken, however, it would involve two surveys per month in January and February to check for the presence of this species within the YREDS area. Surveys for other winter raptors are not required as the habitat within and adjacent to the YREDS area does not fulfill size or ELC requirements for this Significant Wildlife Habitat category (Raptor Wintering Area).

8.7. Integrated Summary

All field work activities are intended to address the data gaps for the study area identified as part of the background review process discussed in Section 7. The additional data will ensure a 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. All of the sub-disciplines will work collaboratively to ensure that findings and results are shared and that inter-connected constraints and potential mitigation opportunities are understood. Field work activities are expected to commence in the spring (March) of 2016, and extend through to early fall (September); preliminary scheduling is discussed in Section 10 and presented in Table 10.1.

9. STAGE 3 - IMPACT ASSESSMENT/MITIGATION FOR PREFERRED ALTERNATIVE

9.1. Identification of a Preferred Alternative

As part of the overall Environmental Design Study work, a preferred alternative will be identified for the re-alignment of Clythe Creek. This process of developing this preferred alternative will necessarily take into account the environmental sensitivities assessed as part of both the Stage 1 (Characterization) and Stage 2 (Field Work Investigation) works.

9.2. Potential Impact and Mitigation Assessment

Although it is expected that the preferred alternative will necessarily take into account the environmental sensitivities of the study area, there is the potential that environmental impacts could result from the implementation of the preferred alternative. As such, all disciplines will necessarily need to assess the potential for environmental impacts, and generate suggested mitigation measures (if required) to reduce or eliminate these potential impacts. As in previous stages, these environmental disciplines would include:

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

An integrated impact assessment (including the generation of mitigation measures) would also be generated which would consider all of the above-noted disciplines holistically.

10. PROJECT TIMING AND SCHEDULE

Based on the expected EIS activities, a preliminary proposed schedule has been developed. Table 10.1 presents the expected commencement and completion dates for major activities, including required field work. It should be noted that the timelines presented in Table 10.1 may be subject to change; notwithstanding date sensitive field work activities will be taken into consideration by the project team to ensure that relevant and meaningful data is collected. Given the need for spring data collection for many field work activities, it is expected that the current TOR should be finalized by late February 2016.

Table 10.1. Preliminary Proposed Schedule of EIS Activities

Discipline	Task Number	Task and Number of Surveys	Expected Start Date	Expected Completion Date
All	1	Background Review	Nov 2015	Jan 2016
All	2	Development and Approval of TOR	Dec 2015	Feb 2016
Hydrogeology and Geology	3.1	Spot Baseflow Monitoring	Jun 2016	Aug 2016
Fluvial Geomorphology	4.1	Rapid Geomorphic Assessments	Mar 2016	Jun 2016
	4.2	Selected Detailed Geomorphic Assessments (Cross-Sections, Profile, and Structures)	Mar 2016	Jun 2016
	4.3	Spot Flow Monitoring (Higher Flows)	Mar 2016	Jun 2016
Fisheries	5.1	Fisheries Assessment	Mar 2016	Jun 2016
Terrestrial Ecology	6.1	Vegetation Assessment (3)	Mar 2016	Sep 2016
	6.2	Tree Inventory & Hazard Assessment (1)	Mar 2016	Sep 2016
	6.3	Breeding Bird Surveys (2)	May 24 2016	Jul 10 2016
	6.4	Nocturnal Amphibian Survey (3)	Apr 2016	Jun 2016
	6.5	Turtle Surveys – Basking Surveys (3)	Mid Apr 2016	Mid Jun 2016
	6.6	Turtle Surveys – Nesting Surveys (2)	Late May 2016	Sep 2016
	6.7	Turtle Surveys – Road Mortality Surveys	Concurrently with other Surveys	
	6.8	Eastern Milksnake Surveys (3)	Late Apr 2016	Mid Jun 2016
	6.9	Significant Wildlife Habitat (SWH) screening	Concurrently with all Surveys	
	610	Species at Risk (SAR) Screening	Concurrently with all Surveys	
	6.11	Incidental Wildlife	Concurrently with all Surveys	
All	7	Impact Assessment and Mitigation for Preferred Alternative and Completion of EIS	Jul 2016	Oct 2016

11. REPORTING AND DOCUMENTATION

Following the completion of field work activities and the associated environmental impact assessment and mitigation analysis with respect to the preferred alternative, the findings will be incorporated into a technical memorandum, which will in turn be incorporated into the overall project reporting. It is expected that this documentation will be circulated and presented to RSAC for review and comment once a draft is available. Input from RSAC will be documented and taken into consideration along with other stakeholder input as part of the process of revising and refining the project reporting.

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I:\gis_staging\Engineering\GIS Requests\15\024\GIS 15-024(01) York Road - Fig 01 - Study Area.mxd

Produced by the City of Guelph
Infrastructure, Development & Enterprise
Engineering Services
July 31, 2015

Figure 1
York Road from Wyndham Street to East City Limits
Study Area

Figure 2
York Road Environmental Design Study Area

CITY OF Guelph
Making a Difference

Produced by the City of Guelph
Planning, Urban Design and Building Services, Development Planning
July 2015

Matrix Supplied
December 22, 2015

1. York Road crossing of Clythe Creek. Structure is a concrete box culvert , a pool has formed downstream from a transition riffle .

Matrix Supplied
December 22, 2015

2. Looking downstream along Clythe Creek; channel is straight with rock protection located along banks.

Matrix Supplied
December 22, 2015

3. Two clay pipes convey flow downstream from a grade control weir. Channel banks are protected by stone.

Matrix Supplied
December 22, 2015

4. Approximately 250m downstream from York Road, an approximate 1.2m stone weir grade control structure is present.

Matrix Supplied
December 22, 2015

5. Looking downstream along Clythe Creek channel; minor tributary enters the creek in the foreground.

Matrix Supplied
December 22, 2015

6. Looking downstream along Clythe Creek. Slow moving water appears to be just below bankfull height.

Matrix Supplied
December 22, 2015

7. Looking upstream along Clythe Creek from the historic stone bridge (access to institution lands); a grade control weir is present in the background.

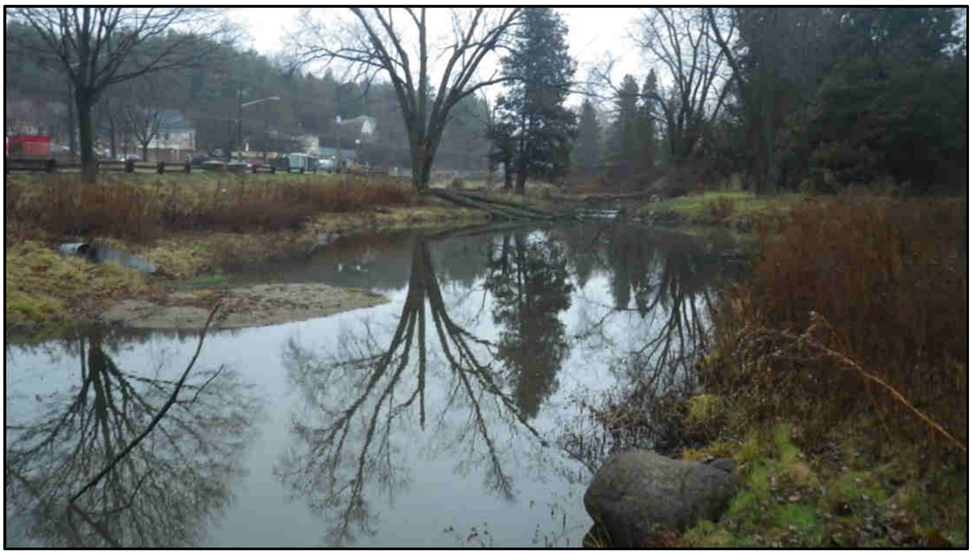
Matrix Supplied
December 22, 2015

8. Historic stone bridge is main access to institution lands.

Matrix Supplied
December 22, 2015

9. Looking downstream along Clythe Creek from the historic stone bridge; aesthetic islands present in the background.

Matrix Supplied
December 22, 2015



10. Looking upstream along Clythe Creek; channel is over widened and stagnant, a CSP culvert contributes surface discharge from the north side of York Road, a sediment bar has formed downstream from the CSP.

Matrix Supplied
December 22, 2015

11. Looking upstream along the North Pond connection channel and pedestrian bridge.

Matrix Supplied
December 22, 2015

12. Looking upstream along Clythe Creek; channel is over widened and slow moving.

Matrix Supplied
December 22, 2015

13. Two CSP culverts convey flows downstream from a parklands access road; channel immediately regains width downstream before Hadati Creek Confluence (background, right bank).

Matrix Supplied
December 22, 2015

14. York Road crossing of Hadati Creek; structure is a concrete box culvert , gabion wing-walls protect the banks.

Matrix Supplied
December 22, 2015

15. Flow control structure downstream from Hadati Creek confluence.

Matrix Supplied
December 22, 2015

16. Channel remains wide and stagnant downstream from Hadati Creek. Water is turbid and woody debris is frequent.

Matrix Supplied
December 22, 2015

17. Beaver dam located approximately 250m upstream from the Eramosa River confluence.

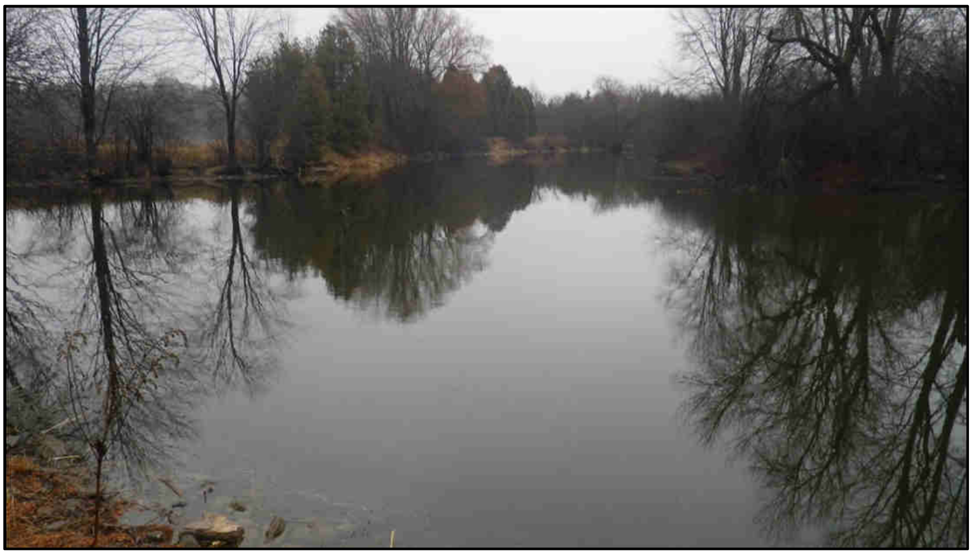
Matrix Supplied
December 22, 2015

18. Clythe Creek flows immediately adjacent to railway embankment; embankment protection appears to be limited to vegetation. Water turbidity changes coulour to appear more beige.

Matrix Supplied
December 22, 2015

19. Looking downstream along the Eramosa River towards the Clythe Creek confluence located to the right. Railway embankment and bridge structure crossing the Eramosa River also present in background.

Matrix Supplied
December 22, 2015



20. Looking upstream along the Eramosa River; embankment separating the South Pond and Eramosa visible in the background left.

Matrix Supplied
December 22, 2015

21. South Pond connection to the Eramosa River through an CSP pipe elevated approximately 30cm; the pipe appears to be blocked and discharge is minimal.

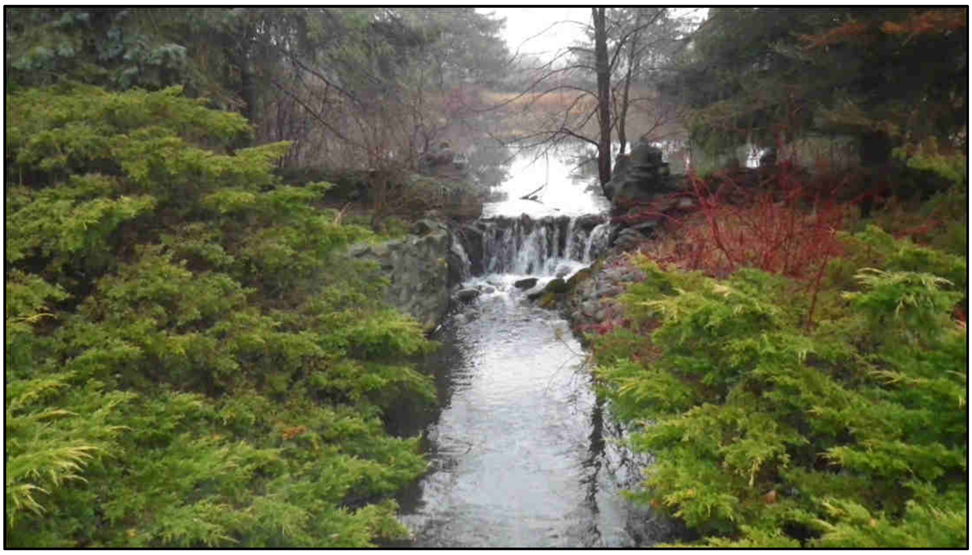
Matrix Supplied
December 22, 2015

22. South pond breaches its banks at the ponds north-east corner; flow is contributed to a surface drainage tributary that flows adjacent to the pond and into the Eramosa River.

Matrix Supplied
December 22, 2015

23. Drainage channel from decorative ponds discharges into the South Pond.

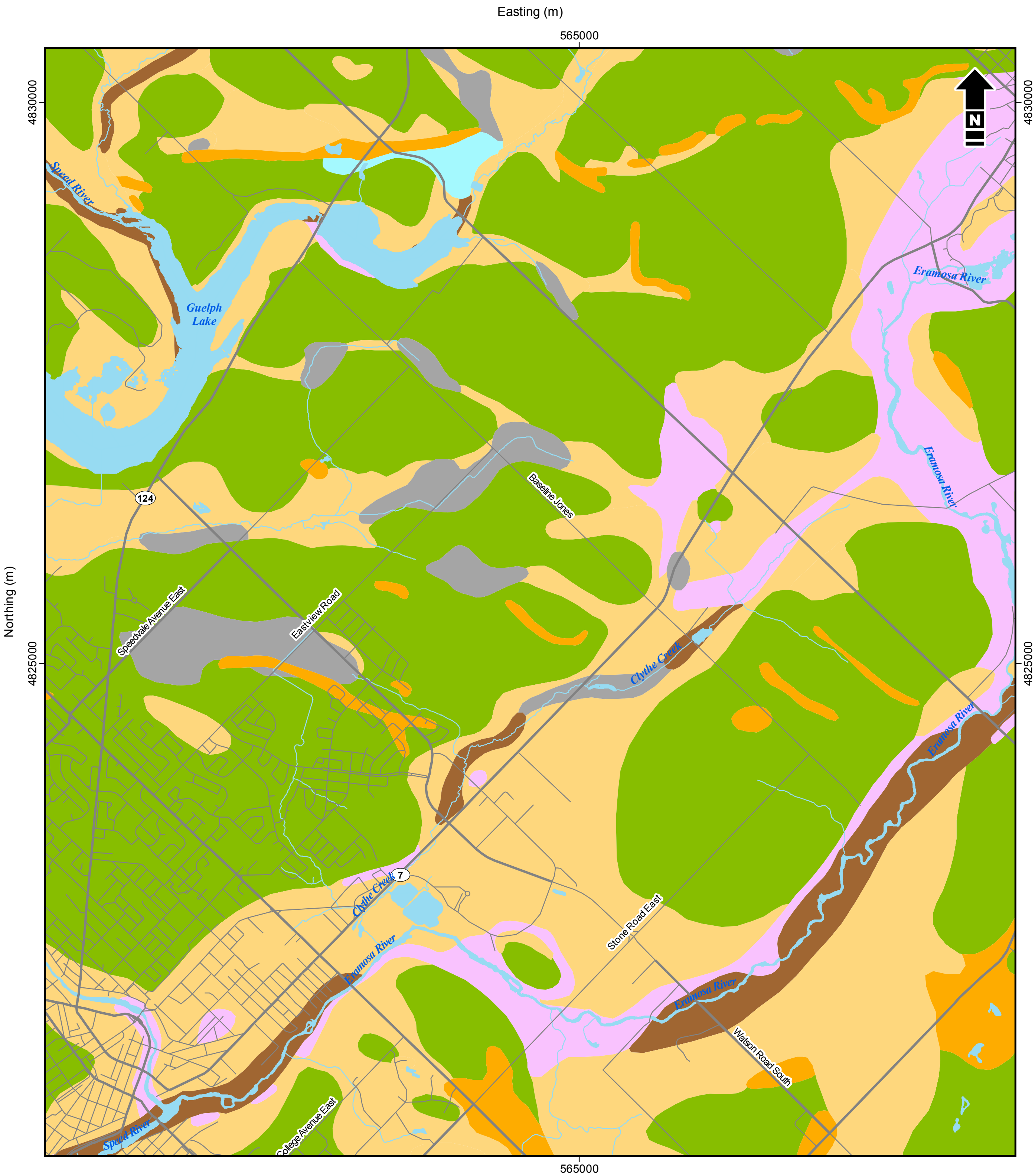
Matrix Supplied
December 22, 2015



24. Decorative pond, grade control feature.

TABLE B1: CLYTHE CREEK REACH BREAK CHARACTERISTICS

REACH CHARACTERISTICS		CLYTHE CREEK REACH BREAK IDENTIFIER									
		C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
Bankfull Width	The width (m) of the channel at its fullest capacity	1.1	Not accessible	30	1.3	Ponded areas ~50 Channelized areas ~5	3	1.6	2.4	1 to 5	10 to 12
Depth of Channel	The depth (m) if the channel at its deepest point	0.10 – 0.12		<2	0.05 – 0.10	Ponded areas >2 Channelized Areas ~0.25	0.25	0.08 – 0.10	0.24	0.5	0.5
Substrate Type	The characteristics of the material found on the streambed	Organic		Organic	Organic	Silt/organic	Organic	Gravel/organ ic	Silt/organic	Gravel and rubble with thin organic layer	Silt/organic
Cover	The type and amount of vegetation found overhanging the stream	Dense jewelweed, cattails and occasional cedar		Mostly open water with cattails	Mainly cattails with scattered cedars	Herbaceous, lily pads around perimeter, red osier dogwood, cedars	Cattails, jewelweed, reed canary grass, areas of dense shrub	Herbaceous, open meadow with small poplar/cedar stand	Dense shrub understory with willow trees	Mowed lawn	Dense shrub species, mixed herbaceous and occasional willow trees
Width of Riparian Zone	The width (m) of the naturally vegetated areas adjacent to the creek	18 – 40	120	90	115	40	40 – 80	80	50	None	1 - 120
Channel Stability	Channel and bank characteristics which indicate stability of channel including erosion, bank failure, etc.	Stable		Stable	Stable, bank heights are low to nil	Stable	Stable	Stable	Stable, however some undercutting is evident	Stable	Generally stable but with some evidence of undercutting
Number of Bridge or Culvert Crossings	Number of “breaks” in channel continuity from bridges, culverts and dams	1	0	0	0	3	1	0	0	13 Culverts, artificial waterfalls and trickle-downs	3
Sinuosity	Length of channel compared to linear distance from upstream to downstream limits of reach	1.32	1.09	1.33	1.1	1.1	1.27	1.25	1.08	1.43	1.3
Other Comments		Cool, clear water		Scattered slumps present	Open marsh, creek becomes braided through marsh	Overflowing outlet in first pond, water very still, landscaped areas	Open marsh, channel is braided in areas	Meanders through open meadow	Good shading, water is cool as is crosses under CNR berm	Occasional landscaped areas, a few storm outfalls	Water very cloudy and slow flowing, lily pads and margins of confluence



Water Body
Watercourse
Highway
Road

Surficial Geology

3,4,4a: Paleozoic bedrock-drift complex
5b: Stone-poor, carbonate-derived silty to sandy till
6: Ice-contact stratified deposit
7,7a,7b: Glaciofluvial deposits- Sandy/Gravelly deposit
8,8a,8b: Fine-textured glaciolacustrine deposit
19: Modern alluvial deposit
20: Organic deposit

1:50,000
500 0 500 1,000 m
NAD 1983 UTM Zone 17N

Reference: Data obtained from GeoBase® used under license.
Surficial geology of Southern Ontario; Ontario Geological Survey, Miscellaneous Release—Data 128 – Revised. Produced using information provided by the Ministry of Northern Development, Mines, and Forestry, Copyright © Queen's Printer, 2015

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

City of Guelph
York Road Environmental Design

Quaternary Geology

Date:	Project:	Technical:	Reviewer:	Drawn:
15 Dec 2015	22257	J. Parish	P. Chin	C. Curry

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Figure B1

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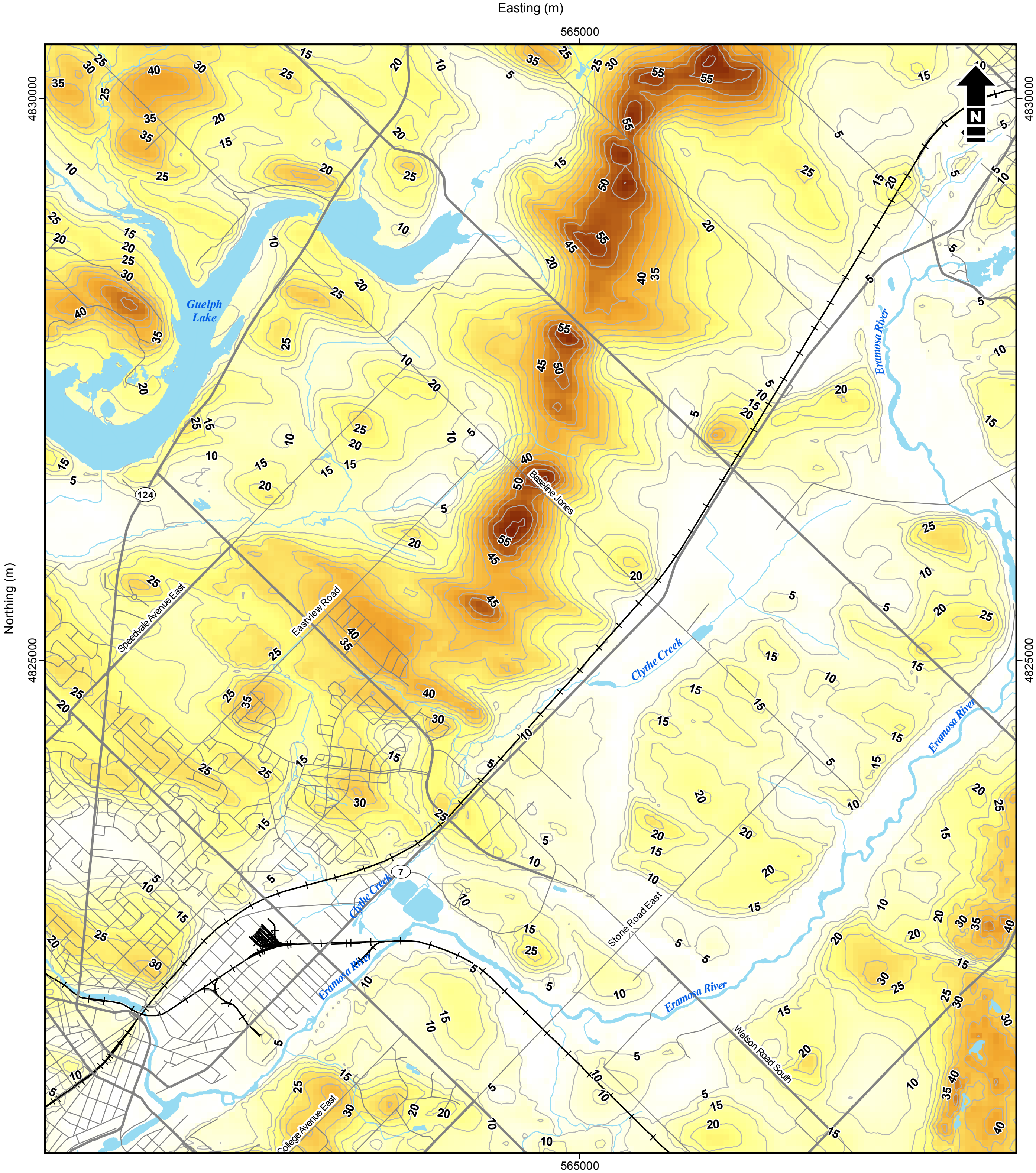

Water Body
Watercourse
Highway
Road
Railway
Contour Interval (5m)

Overburden Thickness
High : 65
Low : 0

1:50,000
500 0 500 1,000 m
NAD 1983 UTM Zone 17N

Reference: Data obtained from GeoBase® used under license.

I:\AMEC\22257\FiguresandTables\SWM\2015\Report\Hydrogeology\Report\Figure-3-Overburden_Thickness.mxd

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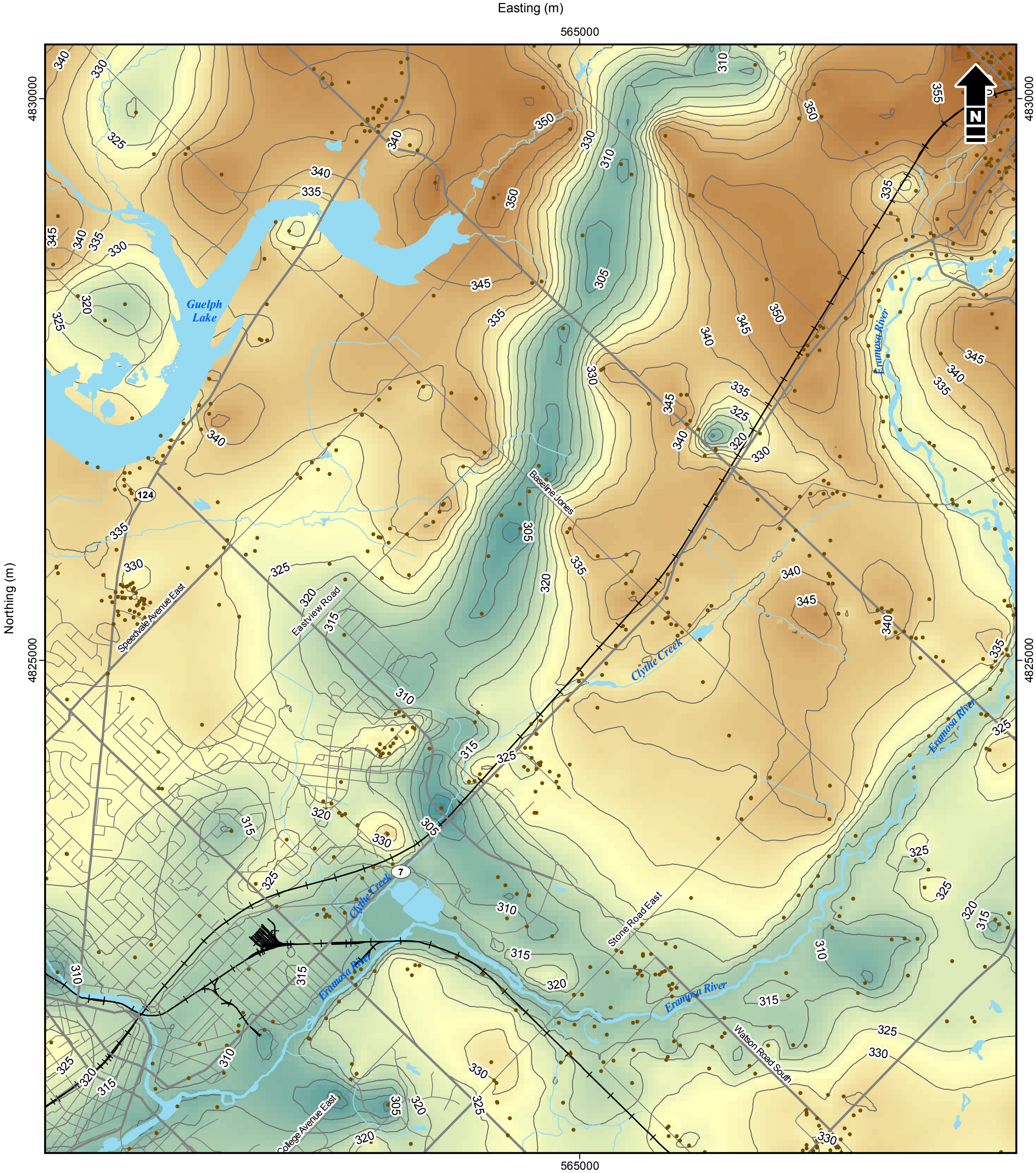
ENVIRONMENT & ENGINEERING

City of Guelph
York Road Environmental Design

Overburden Thickness

Date:	Project:	Technical:	Reviewer:	Drawn:
04 Jan 2016	22257	J. Parish	P. Chin	C. Curry

Figure
B2



Water Body
Watercourse
Highway
Road
Railway
Contour Interval (5m)
Data Point

Elevation (m asl)
High : 365
Low : 290

1:50,000
500 0 500 1,000 m
NAD 1983 UTM Zone 17N

Reference: Data obtained from GeoBase® used under license.

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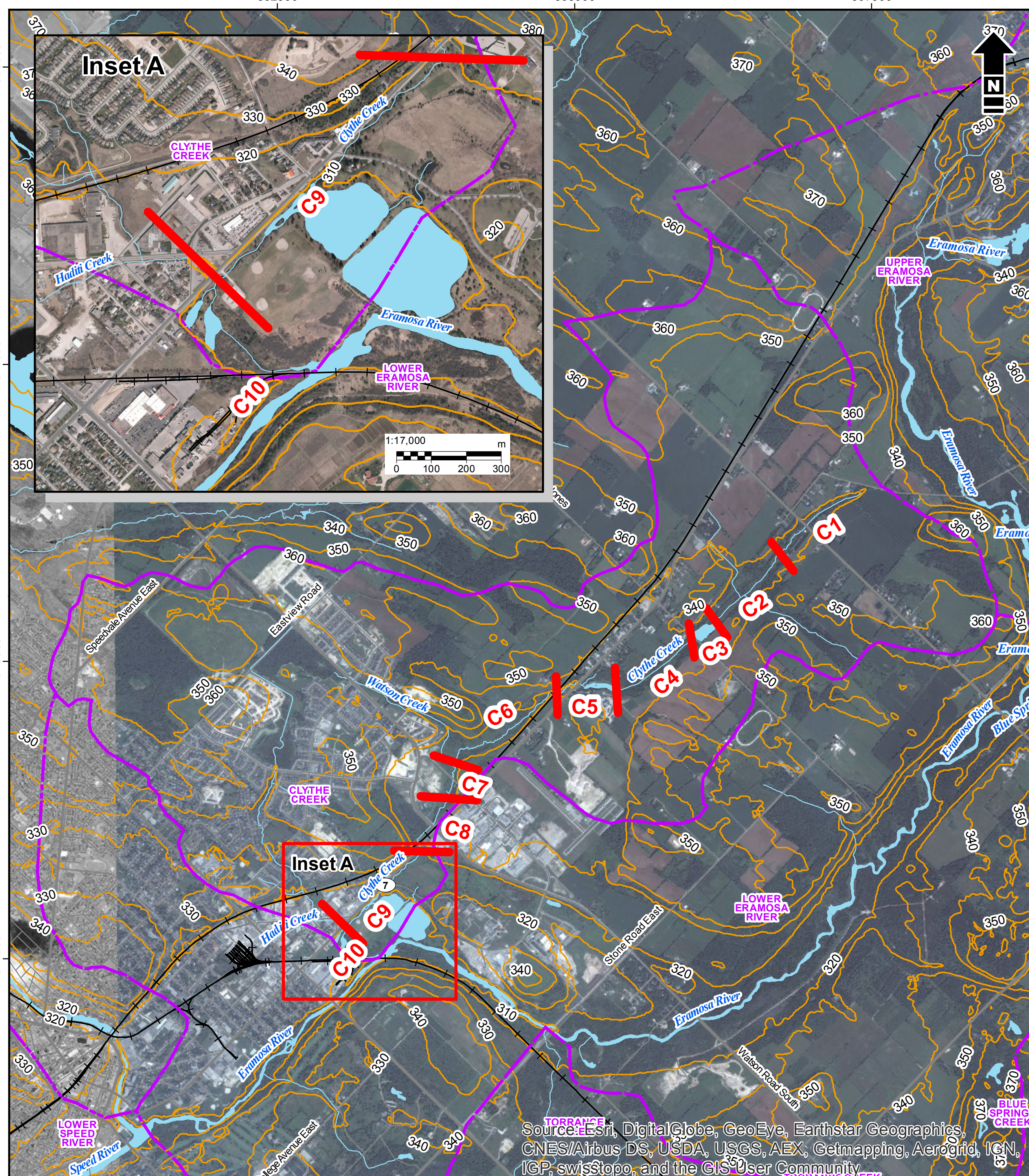
Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

City of Guelph
York Road Environmental Design

Bedrock Topography

Date:	Project:	Technical:	Reviewer:	Drawn:
04 Jan 2016	22257	J. Parish	P. Chin	C. Curry

Figure
B3



Subwatershed Boundary
Water Body
Watercourse
Highway
Road
Railway
Elevation Contour Interval (10m)
Reach Break

1:50,000
500 0 500 1,000 m
NAD 1983 UTM Zone 17N

Reference: Data obtained from GeoBase® used under license. This is version 1.0 of the Open Government Licence – Ontario. Contains Information made available under Grand River Conservation Authority's Open Data Licence v1.0
Imagery (2012) obtained from City of Guelph used under license.

I:\AME\C\22257\FiguresandTables\SWM\2015\Report\Geomorph\Report\Figure-2-Clythe_Creek_ReachBreaks.mxd

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

City of Guelph
York Road Environmental Design

Clythe Creek Reach Breaks

Date:	Project:	Technical:	Reviewer:	Drawn:
17 Dec 2015	22257	J. Parish	P. Chin	C. Curry

Figure B4

York Road east of Clythe Creek crossing

Upstream of York Road

Upstream face of Clythe Creek crossing

Looking upstream of York Road

York Road at Clythe Creek crossing

Downstream face of Clythe Creek

Clythe Creek culvert

Downstream of York Road crossing

Downstream of York Road crossing

Downstream of York Road crossing

Cultural heritage wall close to York Road culvert

Pool feature immediately downstream of culvert

Cultural heritage weird structure

Just west of York Road culvert

Cultural heritage wall in distance

Steep grading along north side of road

Cultural heritage wall south of creek

Pool downstream of culvert

Cultural heritage drop structure with side walls and pipes

Cultural heritage drop structure with side walls and pipes

Creek parallel to road

Cultural heritage drop structure

Cultural heritage drop structure

Cultural heritage drop structure

Gabion baskets next to roadway

Creek moves away from the road

Looking west along York Road


Cultural heritage drop structure

Creek in close proximity to road

Relatively flat floodplain area

Drainage feature confluence with the creek

Creek in close proximity to the roadway

Creek in close proximity to roadway

Cultural heritage wall feature

Cultural heritage wall feature and bus stop in the background

Bus stop just west of former Reformatory driveway

Cultural heritage wall and drop structure just west of former Reformatory driveway

Former Reformatory driveway


Cultural heritage wall along York Road


Creek immediately upstream of former Reformatory driveway
Note creek is in a backwater condition

Creek immediately upstream of former Reformatory driveway
Note creek is in a backwater condition

Looking at Cultural Heritage wall upstream of former Reformatory driveway

Former Reformatory driveway crossing

Former Reformatory driveway crossing

Former Reformatory driveway crossing

Former Reformatory driveway crossing

Downstream of former Reformatory driveway crossing
Note drop structure

Lined channel downstream of former Reformatory driveway

Drop structure downstream of former Reformatory driveway crossing

Ponds adjacent to Clythe Creek

Ponds adjacent to Clythe Creek

Upstream of twin CSP crossing into park parking lot

Downstream of twin CSP culverts

Driveway into park

Clythe Creek at meander downstream of park driveway

Damaged energy dissipation structure upstream of confluence with the Eramosa River

Water Body
Watercourse
Highway
Road

Surficial Geology

3,4,4a: Paleozoic bedrock-drift complex
5b: Stone-poor, carbonate-derived silty to sandy till
6: Ice-contact stratified deposit
7,7a,7b: Glaciofluvial deposits- Sandy/Gravelly deposit
8,8a,8b: Fine-textured glaciolacustrine deposit
19: Modern alluvial deposit
20: Organic deposit

Reference: Data obtained from GeoBase® used under license. Surficial geology of Southern Ontario; Ontario Geological Survey, Miscellaneous Release—Data 128 – Revised. Produced using information provided by the Ministry of Northern Development, Mines, and Forestry, Copyright © Queen's Printer, 2015

1:50,000

500 0 500 1,000 m

NAD 1983 UTM Zone 17N

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

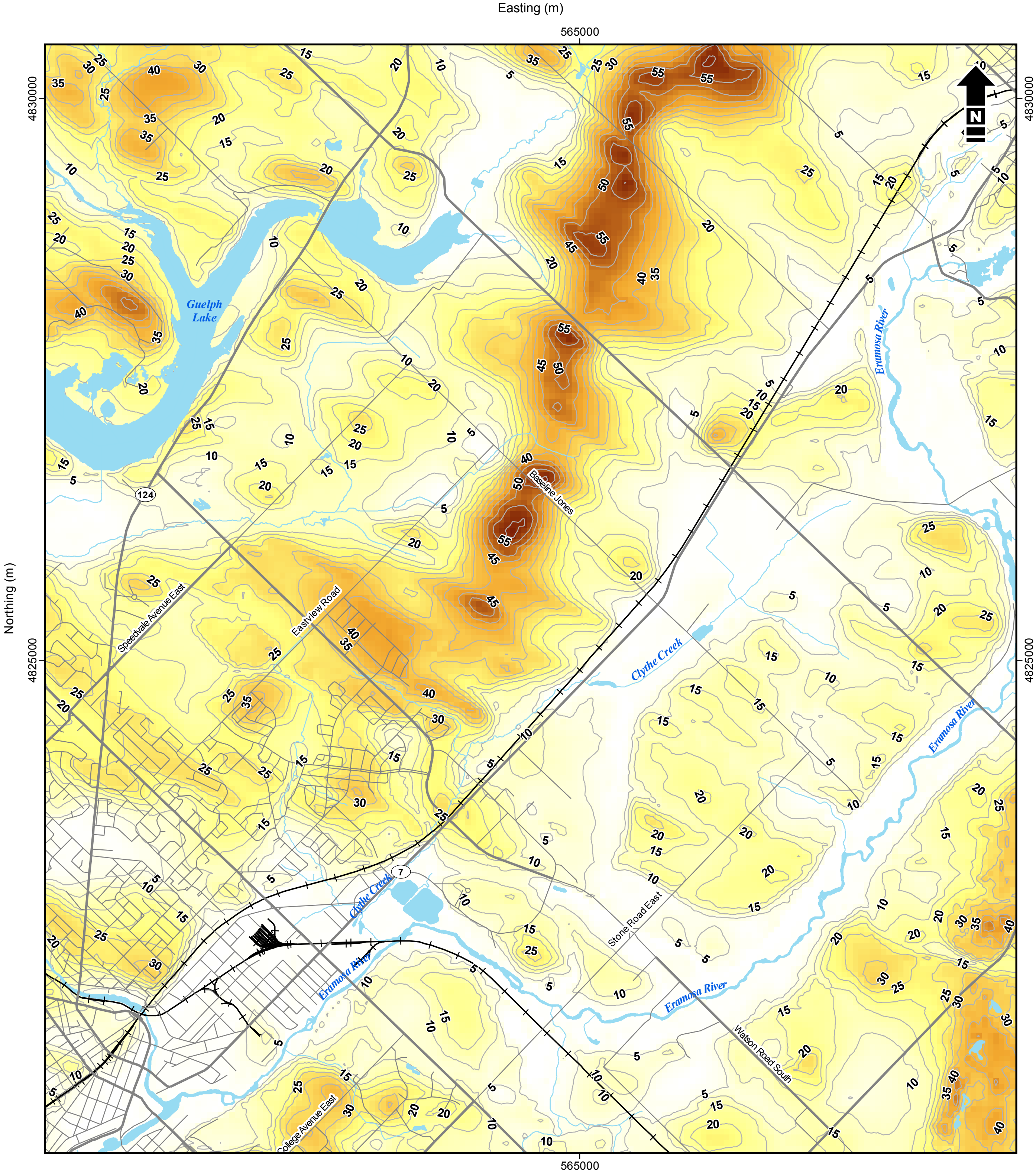
City of Guelph
York Road Environmental Design

Quaternary Geology

Date:	Project:	Technical:	Reviewer:	Drawn:
15 Dec 2015	22257	J. Parish	P. Chin	C. Curry

Figure B1

I:\AMEC\22257\FiguresandTables\SWM\2015\Report\Figure-5-Quaternary_Geology.mxd



Water Body
Watercourse
Highway
Road
Railway
Contour Interval (5m)

Overburden Thickness
High : 65
Low : 0

1:50,000
500 0 500 1,000 m
NAD 1983 UTM Zone 17N

Reference: Data obtained from GeoBase® used under license.

I:\AMEC\22257\FiguresandTables\SWM\2015\Report\Hydrogeology\Report\Figure-3-Overburden_Thickness.mxd

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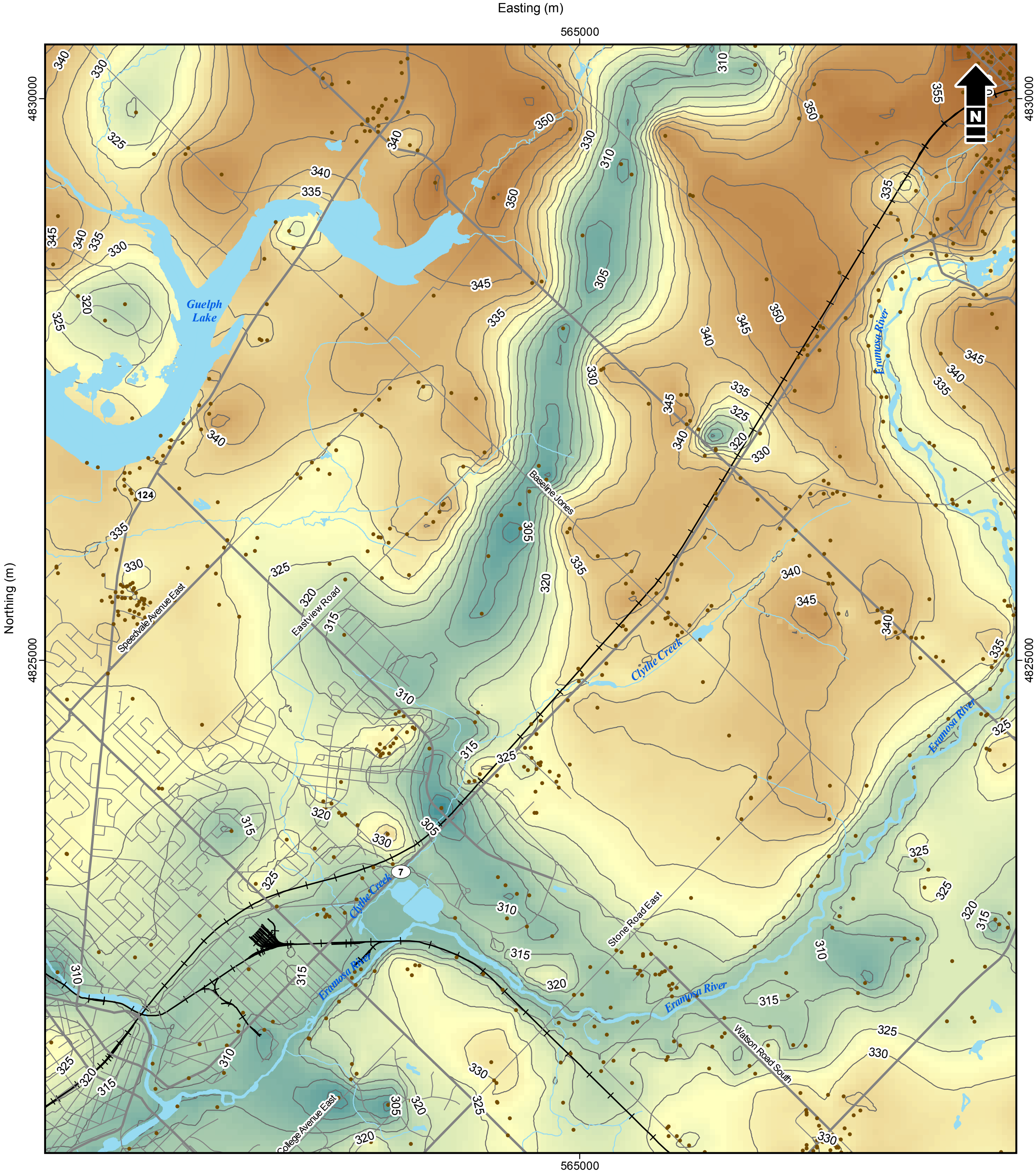
City of Guelph
York Road Environmental Design

Overburden Thickness

Date:	Project:	Technical:	Reviewer:	Drawn:
04 Jan 2016	22257	J. Parish	P. Chin	C. Curry

Figure
B2



Water Body
Watercourse
Highway
Road
Railway
Contour Interval (5m)
Data Point

Elevation (m asl)
High : 365
Low : 290

1:50,000
500 0 500 1,000 m
NAD 1983 UTM Zone 17N

Reference: Data obtained from GeoBase® used under license.

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Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

City of Guelph
York Road Environmental Design

Bedrock Topography

Date:	Project:	Technical:	Reviewer:	Drawn:
04 Jan 2016	22257	J. Parish	P. Chin	C. Curry

Figure
B3

Existing Conditions HEC-RAS Model Results												
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Reach1	1486.058	2 Year	3.5	316.96	317.7	317.7	317.8	0.006044	1.48	4.83	34.7	0.68
Reach1	1486.058	5 Year	5.3	316.96	317.78	317.78	317.88	0.006422	1.68	7.41	37.21	0.72
Reach1	1486.058	10 Year	8.3	316.96	318.22	317.86	318.24	0.000676	0.81	29.17	56.36	0.26
Reach1	1486.058	25 Year	15.5	316.96	318.99	318	318.99	0.000145	0.55	78.55	70.34	0.13
Reach1	1486.058	50 Year	22.8	316.96	320.46	318.14	320.46	0.000023	0.33	203.7	105.04	0.06
Reach1	1486.058	100 Year	32.6	316.96	320.57	318.24	320.57	0.00004	0.44	215.64	106.34	0.08
Reach1	1486.058	Regional	80.7	316.96	320.9	318.61	320.91	0.000158	0.93	251.44	110.17	0.16
Reach1	1477.037	2 Year	3.5	316.47	317.48	317.27	317.57	0.00301	1.45	3.16	10.29	0.52
Reach1	1477.037	5 Year	5.3	316.47	317.73	317.41	317.84	0.002484	1.58	4.41	11.18	0.5
Reach1	1477.037	10 Year	8.3	316.47	318.09	317.6	318.22	0.002082	1.77	6.19	12.09	0.48
Reach1	1477.037	25 Year	15.5	316.47	318.8	317.97	318.97	0.001693	2.1	9.73	50.05	0.46
Reach1	1477.037	50 Year	22.8	316.47	320.42	318.29	320.45	0.000243	1.16	79.99	144.29	0.19
Reach1	1477.037	100 Year	32.6	316.47	320.52	318.67	320.57	0.000346	1.41	95.01	147.56	0.23
Reach1	1477.037	Regional	80.7	316.47	320.8	320.55	320.9	0.000929	2.43	140.24	177.49	0.38
Reach1	1463.072		Bridge									
Reach1	1452.487	2 Year	3.5	316.44	317.03	317.03	317.24	0.011975	2.07	1.73	4.7	0.98
Reach1	1452.487	5 Year	5.3	316.44	317.17	317.17	317.45	0.010868	2.36	2.37	6.06	0.98
Reach1	1452.487	10 Year	8.3	316.44	317.38	317.38	317.73	0.009447	2.69	3.38	8.06	0.96
Reach1	1452.487	25 Year	15.5	316.44	317.75	317.75	318.28	0.008683	3.32	5.24	11.65	0.98
Reach1	1452.487	50 Year	22.8	316.44	318.07	318.07	318.74	0.008188	3.78	6.83	17.06	0.99
Reach1	1452.487	100 Year	32.6	316.44	318.43	318.43	319.29	0.00789	4.29	8.65	27.34	1
Reach1	1452.487	Regional	80.7	316.44	319.32	319.32	319.67	0.003441	3.68	55	49.8	0.71
Reach1	1429.623	2 Year	3.5	316.32	316.72	316.72	316.84	0.009269	1.71	3.15	14.66	0.87
Reach1	1429.623	5 Year	5.3	316.32	316.8	316.8	316.94	0.009445	1.96	4.41	16.96	0.91
Reach1	1429.623	10 Year	8.3	316.32	316.91	316.91	317.08	0.009313	2.23	6.42	20.19	0.93
Reach1	1429.623	25 Year	15.5	316.32	317.1	317.1	317.3	0.009105	2.65	10.65	24.58	0.97
Reach1	1429.623	50 Year	22.8	316.32	317.22	317.22	317.48	0.009666	3.03	13.9	26.36	1.02
Reach1	1429.623	100 Year	32.6	316.32	317.37	317.37	317.67	0.009816	3.38	18.01	28.5	1.06
Reach1	1429.623	Regional	80.7	316.32	318.03	317.89	318.38	0.006947	3.94	39.86	37.64	0.96
Reach1	1428.749	2 Year	3.5	315.53	316.16	316.16	316.37	0.012173	2.05	1.74	4.97	0.99
Reach1	1428.749	5 Year	5.3	315.53	316.33	316.33	316.54	0.008251	2.09	3.1	9.22	0.86
Reach1	1428.749	10 Year	8.3	315.53	316.49	316.49	316.74	0.007802	2.38	4.69	10.66	0.87
Reach1	1428.749	25 Year	15.5	315.53	316.74	316.74	317.1	0.008487	2.99	7.61	12.81	0.95
Reach1	1428.749	50 Year	22.8	315.53	317.02	317.02	317.37	0.006636	3.1	12.2	20.64	0.87
Reach1	1428.749	100 Year	32.6	315.53	317.27	317.27	317.62	0.005754	3.26	18.43	27.83	0.84
Reach1	1428.749	Regional	80.7	315.53	317.87	317.87	318.36	0.00658	4.33	37.53	36.14	0.94
Reach1	1356.024	2 Year	3.7	315.32	315.81	315.81	315.81	0.000671	0.4	17.94	124.48	0.23
Reach1	1356.024	5 Year	6.1	315.32	315.81	315.81	315.82	0.001822	0.67	17.95	124.48	0.37
Reach1	1356.024	10 Year	8.5	315.32	315.81	315.81	315.83	0.003538	0.93	17.95	124.48	0.52
Reach1	1356.024	25 Year	15.5	315.32	315.81	315.81	315.86	0.011765	1.69	17.95	124.48	0.95
Reach1	1356.024	50 Year	22.8	315.32	315.82	315.82	315.93	0.020963	2.32	19.08	124.78	1.27
Reach1	1356.024	100 Year	32.4	315.32	315.88	315.88	316.01	0.022087	2.62	23.42	125.93	1.34
Reach1	1356.024	Regional	81.1	315.32	316	316	316.06	0.005555	1.58	75.77	128.66	0.7
Reach1	1311.56	2 Year	3.7	315.2	315.6	315.6	315.6	0.000006	0.04	86.82	113.8	0.02
Reach1	1311.56	5 Year	6.1	315.2	315.6	315.6	315.6	0.000018	0.06	86.82	113.8	0.03
Reach1	1311.56	10 Year	8.5	315.2	315.6	315.6	315.6	0.000034	0.09	86.82	113.8	0.05
Reach1	1311.56	25 Year	15.5	315.2	315.6	315.6	315.6	0.000113	0.16	86.82	113.8	0.09
Reach1	1311.56	50 Year	22.8	315.2	315.6	315.6	315.6	0.000245	0.24	86.82	113.8	0.13
Reach1	1311.56	100 Year	32.4	315.2	315.6	315.6	315.61	0.000495	0.34	86.82	113.8	0.18
Reach1	1311.56	Regional	81.1	315.2	315.6	315.6	315.64	0.003103	0.86	86.82	113.8	0.46
Reach1	1310.373	2 Year	3.7	314.13	314.7	314.7	314.91	0.012749	1.98	1.86	4.64	1
Reach1	1310.373	5 Year	6.1	314.13	314.88	314.88	315.13	0.011783	2.21	2.76	5.5	0.99
Reach1	1310.373	10 Year	8.5	314.13	314.99	314.99	315	0.001449	0.84	25.03	113.85	0.36
Reach1	1310.373	25 Year	15.5	314.13	314.99	314.99	315.04	0.004816	1.54	25.04	113.85	0.65
Reach1	1310.373	50 Year	22.8	314.13	315.01	315.01	315.09	0.008415	2.06	27.07	114.87	0.86
Reach1	1310.373	100 Year	32.4	314.13	315.06	315.06	315.16	0.009871	2.33	32.61	114.98	0.94
Reach1	1310.373	Regional	81.1	314.13	315.22	315.22	315.41	0.014658	3.32	51.92	115.18	1.19
Reach1	1281.832	2 Year	3.7	314.49	314.8	314.8	314.8	0.000005	0.03	89.07	101.63	0.02
Reach1	1281.832	5 Year	6.1	314.49	314.8	314.8	314.8	0.000014	0.05	89.07	101.63	0.03
Reach1	1281.832	10 Year	8.5	314.49	314.8	314.8	314.8	0.000026	0.07	89.07	101.63	0.04
Reach1	1281.832	25 Year	15.5	314.49	314.8	314.8	314.8	0.000087	0.13	89.07	101.63	0.08
Reach1	1281.832	50 Year	22.8	314.49	314.8	314.8	314.8	0.000189	0.19	89.07	101.63	0.12
Reach1	1281.832	100 Year	32.4	314.49	314.8	314.8	314.81	0.000382	0.26	89.07	101.63	0.16
Reach1	1281.832	Regional	81.1	314.49	314.8	314.8	314.84	0.002393	0.66	89.07	101.63	0.41
Reach1	1280.724	2 Year	3.7	313.6	314.21	314.21	314.42	0.012625	2.01	1.84	4.42	0.99
Reach1	1280.724	5 Year	6.1	313.6	314.39	314.39	314.65	0.010855	2.25	2.78	6.56	0.96
Reach1	1280.724	10 Year	8.5	313.6	314.51	314.51	314.51	0.000073	0.21	65.04	101.69	0.08
Reach1	1280.724	25 Year	15.5	313.6	314.51	314.51	314.51	0.000243	0.38	65.05	101.69	0.15
Reach1	1280.724	50 Year	22.8	313.6	314.51	314.51	314.52	0.000525	0.56	65.05	101.69	0.22
Reach1	1280.724	100 Year	32.4	313.6	314.51	314.51	314.52	0.00106	0.8	65.05	101.69	0.31
Reach1	1280.724	Regional	81.1	313.6	314.54	314.51	314.62	0.00563	1.9	68.36	101.69	0.72

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Reach1	1245.863	2 Year	3.7	314	314.34	314.34	314.34	0.000011	0.05	63.17	77.78	0.03
Reach1	1245.863	5 Year	6.1	314	314.34	314.34	314.34	0.000029	0.08	63.17	77.78	0.05
Reach1	1245.863	10 Year	8.5	314	314.34	314.34	314.34	0.000057	0.11	63.17	77.78	0.06
Reach1	1245.863	25 Year	15.5	314	314.34	314.34	314.34	0.00019	0.19	63.17	77.78	0.12
Reach1	1245.863	50 Year	22.8	314	314.34	314.34	314.35	0.000411	0.29	63.17	77.78	0.17
Reach1	1245.863	100 Year	32.4	314	314.34	314.34	314.35	0.00083	0.41	63.17	77.78	0.24
Reach1	1245.863	Regional	81.1	314	314.36	314.34	314.44	0.004771	1.02	64.97	78.18	0.59
Reach1	1244.83	2 Year	3.7	313.02	313.63	313.63	313.84	0.012559	2.01	1.84	4.42	0.99
Reach1	1244.83	5 Year	6.1	313.02	313.86	313.86	314.06	0.008062	2.03	3.54	14.2	0.84
Reach1	1244.83	10 Year	8.5	313.02	313.9	313.9	313.9	0.000239	0.37	38.99	71.42	0.15
Reach1	1244.83	25 Year	15.5	313.02	313.9	313.9	313.91	0.000796	0.67	39	71.42	0.27
Reach1	1244.83	50 Year	22.8	313.02	313.9	313.9	313.92	0.001721	0.99	39	71.42	0.39
Reach1	1244.83	100 Year	32.4	313.02	313.9	313.9	313.94	0.003476	1.4	39	71.42	0.56
Reach1	1244.83	Regional	81.1	313.02	314.37	313.9	314.44	0.002968	1.86	74.06	79.34	0.57
Reach1	1176.299	2 Year	3.7	313.22	313.33	313.33	313.33	0.000151	0.09	20.03	35.36	0.09
Reach1	1176.299	5 Year	6.1	313.22	313.33	313.33	313.34	0.000409	0.15	20.03	35.36	0.15
Reach1	1176.299	10 Year	8.5	313.22	313.33	313.33	313.34	0.000795	0.21	20.03	35.36	0.21
Reach1	1176.299	25 Year	15.5	313.22	313.33	313.33	313.36	0.002644	0.39	20.03	35.36	0.38
Reach1	1176.299	50 Year	22.8	313.22	313.33	313.33	313.4	0.005721	0.57	20.03	35.36	0.55
Reach1	1176.299	100 Year	32.4	313.22	313.34	313.33	313.47	0.011093	0.83	20.32	35.65	0.78
Reach1	1176.299	Regional	81.1	313.22	314.06	313.62	314.19	0.005239	2.14	54.84	58.76	0.74
Reach1	1175.274	2 Year	3.7	311.79	312.42	312.32	312.51	0.005204	1.36	2.93	9.17	0.66
Reach1	1175.274	5 Year	6.1	311.79	312.51	312.46	312.67	0.007055	1.8	3.85	10.58	0.79
Reach1	1175.274	10 Year	8.5	311.79	312.58	312.58	312.81	0.008878	2.19	4.59	11.66	0.91
Reach1	1175.274	25 Year	15.5	311.79	312.84	312.84	313.13	0.00747	2.55	8.16	15.29	0.88
Reach1	1175.274	50 Year	22.8	311.79	313.19	313.02	313.25	0.001544	1.46	29.68	43.57	0.43
Reach1	1175.274	100 Year	32.4	311.79	313.38	313.15	313.45	0.001542	1.61	38.26	45.86	0.44
Reach1	1175.274	Regional	81.1	311.79	314.07	313.42	314.18	0.001737	2.24	72.79	59.23	0.49
Reach1	1137.794	2 Year	3.7	311.42	312.4	312.14	312.42	0.000962	0.79	10.18	39.39	0.29
Reach1	1137.794	5 Year	6.1	311.42	312.55	312.3	312.56	0.000827	0.82	15.97	41.05	0.28
Reach1	1137.794	10 Year	8.5	311.42	312.66	312.39	312.68	0.000773	0.86	20.8	42.36	0.27
Reach1	1137.794	25 Year	15.5	311.42	312.93	312.51	312.94	0.000727	0.97	32.31	45.3	0.27
Reach1	1137.794	50 Year	22.8	311.42	313.19	312.59	313.21	0.00062	1.02	44.51	48.24	0.26
Reach1	1137.794	100 Year	32.4	311.42	313.38	312.7	313.4	0.000722	1.18	54.01	51.1	0.29
Reach1	1137.794	Regional	81.1	311.42	314.06	313.05	314.12	0.001119	1.84	94.37	71.71	0.38
Reach1	1109.979	2 Year	3.7	311.75	312.31	312.18	312.37	0.003384	1.29	4.6	13.88	0.55
Reach1	1109.979	5 Year	6.1	311.75	312.42	312.31	312.51	0.004432	1.66	6.17	15.89	0.65
Reach1	1109.979	10 Year	8.5	311.75	312.5	312.4	312.63	0.005174	1.95	7.57	17.49	0.72
Reach1	1109.979	25 Year	15.5	311.75	312.65	312.63	312.88	0.007878	2.72	10.49	21.05	0.92
Reach1	1109.979	50 Year	22.8	311.75	313.02	312.8	313.16	0.003655	2.33	19.62	28.88	0.66
Reach1	1109.979	100 Year	32.4	311.75	313.15	312.98	313.35	0.004722	2.82	23.5	31.62	0.76
Reach1	1109.979	Regional	81.1	311.75	313.57	313.57	314.02	0.008515	4.52	38.58	40.19	1.07
Reach1	1108.705	2 Year	3.7	311.29	312.33	312	312.36	0.00108	0.94	6.71	18.87	0.32
Reach1	1108.705	5 Year	6.1	311.29	312.45	312.19	312.5	0.001513	1.21	9.03	20.63	0.39
Reach1	1108.705	10 Year	8.5	311.29	312.54	312.31	312.61	0.00183	1.41	11.02	21.92	0.44
Reach1	1108.705	25 Year	15.5	311.29	312.73	312.52	312.84	0.002712	1.92	15.48	25.56	0.55
Reach1	1108.705	50 Year	22.8	311.29	313.05	312.65	313.14	0.001857	1.85	24.7	31.23	0.47
Reach1	1108.705	100 Year	32.4	311.29	313.19	312.85	313.32	0.00245	2.25	29.28	33.67	0.55
Reach1	1108.705	Regional	81.1	311.29	313.57	313.42	313.92	0.005858	3.97	42.98	40.28	0.88
Reach1	1088.885	2 Year	3.7	311.42	312.31	312.14	312.33	0.00181	0.84	7.02	21.87	0.37
Reach1	1088.885	5 Year	6.1	311.42	312.42	312.24	312.46	0.001999	0.99	9.84	27.01	0.4
Reach1	1088.885	10 Year	8.5	311.42	312.52	312.3	312.56	0.002053	1.1	12.62	32.09	0.42
Reach1	1088.885	25 Year	15.5	311.42	312.72	312.43	312.77	0.002244	1.36	20.16	44.03	0.46
Reach1	1088.885	50 Year	22.8	311.42	313.06	312.56	313.1	0.001086	1.17	35.93	48.1	0.33
Reach1	1088.885	100 Year	32.4	311.42	313.22	312.71	313.26	0.001315	1.39	43.39	50.26	0.38
Reach1	1088.885	Regional	81.1	311.42	313.66	313.12	313.77	0.002526	2.32	67.21	58.16	0.54
Reach1	1033.914	2 Year	3.7	311.77	312.02	312.02	312.11	0.014463	1.56	3.01	16.14	1.01
Reach1	1033.914	5 Year	6.1	311.77	312.09	312.09	312.23	0.013152	1.79	4.3	17.21	1.01
Reach1	1033.914	10 Year	8.5	311.77	312.16	312.16	312.33	0.012419	1.97	5.46	18.04	1.01
Reach1	1033.914	25 Year	15.5	311.77	312.39	312.33	312.57	0.006827	2	10.08	21.24	0.81
Reach1	1033.914	50 Year	22.8	311.77	312.96	312.47	313.02	0.001676	1.53	24.12	33.07	0.45
Reach1	1033.914	100 Year	32.4	311.77	313.07	312.64	313.16	0.002427	1.94	27.93	37.69	0.54
Reach1	1033.914	Regional	81.1	311.77	313.47	313.26	313.62	0.003139	2.65	53.91	67.53	0.65
Reach1	1033.308	2 Year	3.7	310.61	311.43	311.3	311.54	0.004499	1.56	2.75	9.19	0.63
Reach1	1033.308	5 Year	6.1	310.61	311.62	311.52	311.73	0.003407	1.62	4.59	10.67	0.57
Reach1	1033.308	10 Year	8.5	310.61	311.77	311.62	311.89	0.002832	1.66	6.4	12.55	0.54
Reach1	1033.308	25 Year	15.5	310.61	312.48	311.85	312.53	0.000707	1.19	18.35	21.76	0.29
Reach1	1033.308	50 Year	22.8	310.61	312.97	312.03	313.02	0.000564	1.26	31.03	33.61	0.27
Reach1	1033.308	100 Year	32.4	310.61	313.08	312.24	313.16	0.000947	1.69	34.94	38.51	0.36
Reach1	1033.308	Regional	81.1	310.61	313.46	312.98	313.62	0.001906	2.66	60.15	67.37	0.52

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Reach1	1010.387	2 Year	3.7	310.42	311.47	310.91	311.49	0.00046	0.63	6.45	10.8	0.22
Reach1	1010.387	5 Year	6.1	310.42	311.65	311.06	311.68	0.000612	0.82	8.56	13.19	0.26
Reach1	1010.387	10 Year	8.5	310.42	311.8	311.19	311.84	0.000691	0.96	10.68	15.31	0.28
Reach1	1010.387	25 Year	15.5	310.42	312.48	311.47	312.51	0.00032	0.89	24.24	25.34	0.21
Reach1	1010.387	50 Year	22.8	310.42	312.98	311.71	313	0.00022	0.86	45.14	60.11	0.18
Reach1	1010.387	100 Year	32.4	310.42	313.1	311.97	313.13	0.000319	1.07	52.69	67.68	0.22
Reach1	1010.387	Regional	81.1	310.42	313.49	312.71	313.57	0.000704	1.75	83.53	88.96	0.33
Reach1	998.545	2 Year	3.7	310.34	311.47	310.69	311.49	0.000231	0.54	6.87	9.26	0.16
Reach1	998.545	5 Year	6.1	310.34	311.64	310.83	311.67	0.000388	0.77	7.94	9.58	0.22
Reach1	998.545	10 Year	8.5	310.34	311.78	310.94	311.83	0.000533	0.97	8.8	9.84	0.26
Reach1	998.545	25 Year	15.5	310.34	312.43	311.22	312.5	0.000508	1.21	12.82	11.05	0.27
Reach1	998.545	50 Year	22.8	310.34	312.97	311.47	313	0.000215	0.9	36.66	54.64	0.18
Reach1	998.545	100 Year	32.4	310.34	313.09	311.77	313.13	0.000275	1.04	48.51	82.92	0.2
Reach1	998.545	Regional	81.1	310.34	313.48	312.97	313.56	0.000554	1.62	84.92	99.63	0.3
Reach1	993.3976		Bridge									
Reach1	987.5314	2 Year	3.7	310.49	311.44	310.85	311.46	0.000437	0.65	5.68	9.8	0.22
Reach1	987.5314	5 Year	6.1	310.49	311.56	310.98	311.61	0.000767	0.94	6.47	10.4	0.29
Reach1	987.5314	10 Year	8.5	310.49	311.63	311.1	311.71	0.001204	1.23	6.9	10.72	0.37
Reach1	987.5314	25 Year	15.5	310.49	311.66	311.38	311.9	0.00371	2.19	7.06	10.85	0.66
Reach1	987.5314	50 Year	22.8	310.49	311.63	311.63	312.19	0.008614	3.3	6.91	10.73	1
Reach1	987.5314	100 Year	32.4	310.49	311.93	311.93	312.63	0.007942	3.7	8.75	12.12	1
Reach1	987.5314	Regional	81.1	310.49	312.81	312.81	313.14	0.002925	3.01	39.77	54.6	0.65
Reach1	982.615	2 Year	5.1	310.87	311.33	311.33	311.44	0.008491	1.74	4.2	18.13	0.84
Reach1	982.615	5 Year	9	310.87	311.44	311.44	311.58	0.0087	2.05	6.39	20.26	0.88
Reach1	982.615	10 Year	12.2	310.87	311.51	311.51	311.68	0.009003	2.26	7.85	21.18	0.92
Reach1	982.615	25 Year	19.2	310.87	311.64	311.64	311.86	0.009447	2.62	10.63	22.68	0.97
Reach1	982.615	50 Year	26.7	310.87	311.75	311.75	312.02	0.009753	2.92	13.24	23.97	1.01
Reach1	982.615	100 Year	36.5	310.87	311.88	311.88	312.19	0.009521	3.18	16.51	24.92	1.02
Reach1	982.615	Regional	86.6	310.87	312.25	312.25	312.96	0.015524	5	26.25	30.87	1.37
Reach1	980.8696	2 Year	5.1	309.8	310.58	310.43	310.75	0.006505	1.83	2.78	4.15	0.72
Reach1	980.8696	5 Year	9	309.8	310.7	310.7	311.08	0.012358	2.72	3.3	4.34	1
Reach1	980.8696	10 Year	12.2	309.8	310.93	310.93	311.33	0.009873	2.8	4.53	8.57	0.91
Reach1	980.8696	25 Year	19.2	309.8	311.31	311.31	311.59	0.005347	2.57	10.35	19.41	0.71
Reach1	980.8696	50 Year	26.7	309.8	311.47	311.47	311.78	0.005566	2.83	13.66	21.47	0.74
Reach1	980.8696	100 Year	36.5	309.8	311.63	311.63	311.99	0.005903	3.12	17.36	23.57	0.78
Reach1	980.8696	Regional	86.6	309.8	312.12	312.12	312.73	0.008306	4.4	30.26	29.69	0.96
Reach1	947.0903	2 Year	5.1	309.94	310.4	310.4	310.5	0.007342	1.65	4.67	22.27	0.79
Reach1	947.0903	5 Year	9	309.94	310.5	310.5	310.58	0.005861	1.68	8.94	36.38	0.73
Reach1	947.0903	10 Year	12.2	309.94	310.53	310.53	310.64	0.007885	2.02	10	36.93	0.85
Reach1	947.0903	25 Year	19.2	309.94	310.61	310.61	310.76	0.008943	2.35	13.16	38.51	0.93
Reach1	947.0903	50 Year	26.7	309.94	310.69	310.69	310.87	0.0096	2.62	16.12	39.94	0.98
Reach1	947.0903	100 Year	36.5	309.94	310.77	310.77	310.99	0.009994	2.88	19.64	41.24	1.02
Reach1	947.0903	Regional	86.6	309.94	312.06	310.82	312.06	0.000007	0.14	627.3	263.78	0.03
Reach1	943.9661	2 Year	5.1	309.16	310.11	309.81	310.16	0.001283	1.05	6.72	16.28	0.36
Reach1	943.9661	5 Year	9	309.16	310.25	310.03	310.33	0.001944	1.42	9.2	19.57	0.45
Reach1	943.9661	10 Year	12.2	309.16	310.34	310.14	310.44	0.002353	1.66	11.01	21.65	0.51
Reach1	943.9661	25 Year	19.2	309.16	310.49	310.33	310.63	0.002997	2.04	14.57	25.27	0.58
Reach1	943.9661	50 Year	26.7	309.16	310.53	310.48	310.67	0.003363	2.2	20.53	37.14	0.62
Reach1	943.9661	100 Year	36.5	309.16	310.55	310.55	310.79	0.005801	2.92	21.16	37.43	0.82
Reach1	943.9661	Regional	86.6	309.16	312.06	310.81	312.06	0.000006	0.16	641.23	264.59	0.03
Reach1	914.451	2 Year	5.1	309.62	309.97	309.97	310.07	0.011939	1.79	3.95	17.51	0.97
Reach1	914.451	5 Year	9	309.62	310.07	310.07	310.21	0.011864	2.13	5.9	19.77	1.01
Reach1	914.451	10 Year	12.2	309.62	310.14	310.14	310.31	0.011614	2.32	7.36	21.24	1.02
Reach1	914.451	25 Year	19.2	309.62	310.27	310.27	310.48	0.011258	2.65	10.28	23.89	1.05
Reach1	914.451	50 Year	26.7	309.62	310.63	310.39	310.63	0.000004	0.07	349.05	234.36	0.02
Reach1	914.451	100 Year	36.5	309.62	310.47	310.47	310.47	0.000011	0.1	312.31	232.8	0.03
Reach1	914.451	Regional	86.6	309.62	312.06	310.47	312.06	0.000005	0.13	700.5	267.11	0.03
Reach1	913.6924	2 Year	5.1	309.02	309.76	309.76	309.93	0.00686	1.89	3.26	11.68	0.75
Reach1	913.6924	5 Year	9	309.02	309.97	309.97	310.14	0.005721	2.07	6.18	17.76	0.71
Reach1	913.6924	10 Year	12.2	309.02	310.06	310.06	310.25	0.006038	2.28	7.9	19.83	0.75
Reach1	913.6924	25 Year	19.2	309.02	310.21	310.21	310.44	0.006417	2.6	11.24	23.04	0.79
Reach1	913.6924	50 Year	26.7	309.02	310.34	310.34	310.6	0.006751	2.87	14.37	25.67	0.82
Reach1	913.6924	100 Year	36.5	309.02	310.46	310.46	310.46	0.000011	0.12	313.82	233.08	0.03
Reach1	913.6924	Regional	86.6	309.02	312.06	310.46	312.06	0.000005	0.13	704.61	267.24	0.02
Reach1	847.8298	2 Year	5.1	308.3	309.71	308.71	309.71	0.000001	0.03	214.8	239.29	0.01
Reach1	847.8298	5 Year	9	308.3	309.83	308.86	309.83	0.000002	0.05	243.54	241.05	0.01
Reach1	847.8298	10 Year	12.2	308.3	309.9	308.97	309.9	0.000002	0.06	260.76	241.6	0.02
Reach1	847.8298	25 Year	19.2	308.3	310.02	309.22	310.02	0.000004	0.09	290.21	241.94	0.02
Reach1	847.8298	50 Year	26.7	308.3	310.17	309.31	310.17	0.000005	0.1	326.06	242.36	0.03
Reach1	847.8298	100 Year	36.5	308.3	310.29	309.31	310.29	0.000008	0.13	356.64	242.71	0.03
Reach1	847.8298	Regional	86.6	308.3	312.06	309.31	312.06	0.000003	0.13	808.95	282.71	0.02

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Reach1	826.0436	2 Year	5.1	308.34	309.71	308.72	309.71	0.000001	0.03	210.2	234.98	0.01
Reach1	826.0436	5 Year	9	308.34	309.83	308.88	309.83	0.000002	0.05	238.4	236.02	0.01
Reach1	826.0436	10 Year	12.2	308.34	309.9	309	309.9	0.000002	0.06	255.25	236.65	0.02
Reach1	826.0436	25 Year	19.2	308.34	310.02	309.21	310.02	0.000004	0.09	284.13	237.74	0.02
Reach1	826.0436	50 Year	26.7	308.34	310.17	309.46	310.17	0.000006	0.11	319.42	239.16	0.03
Reach1	826.0436	100 Year	36.5	308.34	310.29	309.46	310.29	0.000008	0.13	349.64	240.48	0.03
Reach1	826.0436	Regional	86.6	308.34	312.06	309.46	312.06	0.000003	0.14	807.05	279.17	0.02
Reach1	786.1621	2 Year	5.1	308.37	309.71	308.6	309.71	0.000001	0.03	216.17	257.6	0.01
Reach1	786.1621	5 Year	9	308.37	309.83	308.7	309.83	0.000002	0.05	247.74	269.74	0.01
Reach1	786.1621	10 Year	12.2	308.37	309.9	308.78	309.9	0.000002	0.06	267.22	276.95	0.02
Reach1	786.1621	25 Year	19.2	308.37	310.02	308.92	310.02	0.000004	0.09	301.66	288.18	0.02
Reach1	786.1621	50 Year	26.7	308.37	310.17	309.09	310.17	0.000005	0.11	344.75	294.2	0.03
Reach1	786.1621	100 Year	36.5	308.37	310.29	309.22	310.29	0.000007	0.13	382.14	299.34	0.03
Reach1	786.1621	Regional	86.6	308.37	312.06	309.57	312.06	0.000002	0.11	997.15	377.84	0.02
Reach1	729.9763	2 Year	5.1	308.12	309.7	308.32	309.71	0.000006	0.11	98.64	237.74	0.03
Reach1	729.9763	5 Year	9	308.12	309.82	308.41	309.83	0.000011	0.15	127.07	238.78	0.04
Reach1	729.9763	10 Year	12.2	308.12	309.9	308.47	309.9	0.000015	0.18	144.02	239.36	0.04
Reach1	729.9763	25 Year	19.2	308.12	310.02	308.6	310.02	0.000024	0.24	173.05	240.41	0.06
Reach1	729.9763	50 Year	26.7	308.12	310.16	308.71	310.17	0.000028	0.28	208.99	246.04	0.06
Reach1	729.9763	100 Year	36.5	308.12	310.29	308.86	310.29	0.000036	0.32	240.21	252.05	0.07
Reach1	729.9763	Regional	86.6	308.12	312.06	309.5	312.06	0.000007	0.22	726.57	295.98	0.04
Reach1	677.7048	2 Year	5.1	308.03	309.7	308.26	309.71	0.000004	0.09	146.47	272.05	0.02
Reach1	677.7048	5 Year	9	308.03	309.82	308.37	309.82	0.000007	0.12	178.96	272.9	0.03
Reach1	677.7048	10 Year	12.2	308.03	309.89	308.44	309.9	0.000009	0.15	198.32	273.61	0.03
Reach1	677.7048	25 Year	19.2	308.03	310.02	308.58	310.02	0.000015	0.19	231.49	275.49	0.04
Reach1	677.7048	50 Year	26.7	308.03	310.16	308.72	310.16	0.000017	0.22	272.27	277.3	0.05
Reach1	677.7048	100 Year	36.5	308.03	310.29	308.91	310.29	0.000023	0.26	307.08	278.83	0.06
Reach1	677.7048	Regional	86.6	308.03	312.06	309.52	312.06	0.000005	0.19	863.35	343.51	0.03
Reach1	607.9432	2 Year	5.1	308.04	309.7	308.53	309.7	0.000003	0.07	177.48	267.46	0.02
Reach1	607.9432	5 Year	9	308.04	309.82	308.72	309.82	0.000005	0.1	209.4	268.38	0.03
Reach1	607.9432	10 Year	12.2	308.04	309.89	308.86	309.89	0.000007	0.12	228.41	268.95	0.03
Reach1	607.9432	25 Year	19.2	308.04	310.02	309.07	310.02	0.000012	0.17	260.89	269.84	0.04
Reach1	607.9432	50 Year	26.7	308.04	310.16	309.22	310.16	0.000015	0.19	300.75	270.97	0.04
Reach1	607.9432	100 Year	36.5	308.04	310.29	309.27	310.29	0.00002	0.24	335.75	284.13	0.05
Reach1	607.9432	Regional	86.6	308.04	312.06	309.4	312.06	0.000005	0.17	919.52	360.4	0.03
Reach1	557.6347	2 Year	5.1	307.99	309.7	308.5	309.7	0.000004	0.08	156.66	238.69	0.02
Reach1	557.6347	5 Year	9	307.99	309.82	308.66	309.82	0.000007	0.11	185.13	240.4	0.03
Reach1	557.6347	10 Year	12.2	307.99	309.89	308.77	309.89	0.000009	0.14	202.12	240.69	0.03
Reach1	557.6347	25 Year	19.2	307.99	310.01	308.99	310.01	0.000015	0.18	231.09	241.15	0.04
Reach1	557.6347	50 Year	26.7	307.99	310.16	309.18	310.16	0.000019	0.22	266.86	245.04	0.05
Reach1	557.6347	100 Year	36.5	307.99	310.29	309.25	310.29	0.000025	0.26	297.57	248.67	0.06
Reach1	557.6347	Regional	86.6	307.99	312.06	309.43	312.06	0.000006	0.19	832.03	328.44	0.03
Reach1	523.273	2 Year	5.1	308.01	309.7	308.46	309.7	0.000004	0.08	155.19	236.49	0.02
Reach1	523.273	5 Year	9	308.01	309.82	308.62	309.82	0.000007	0.12	183.36	237.53	0.03
Reach1	523.273	10 Year	12.2	308.01	309.89	308.74	309.89	0.000009	0.14	200.12	238.01	0.03
Reach1	523.273	25 Year	19.2	308.01	310.01	308.97	310.01	0.000015	0.19	228.75	238.81	0.05
Reach1	523.273	50 Year	26.7	308.01	310.16	309.16	310.16	0.000019	0.22	263.93	239.76	0.05
Reach1	523.273	100 Year	36.5	308.01	310.29	309.32	310.29	0.000025	0.27	293.77	241.1	0.06
Reach1	523.273	Regional	86.6	308.01	312.06	309.44	312.06	0.000005	0.19	843.4	336.65	0.03
Reach1	490.7546	2 Year	5.1	308.37	309.68	308.83	309.7	0.000481	0.64	10.4	102.8	0.23
Reach1	490.7546	5 Year	9	308.37	309.79	309.02	309.82	0.000674	0.83	21.19	103.37	0.27
Reach1	490.7546	10 Year	12.2	308.37	309.86	309.16	309.89	0.000761	0.92	27.79	103.71	0.29
Reach1	490.7546	25 Year	19.2	308.37	309.97	309.79	310.01	0.000892	1.07	39.04	104.38	0.32
Reach1	490.7546	50 Year	26.7	308.37	310.13	309.87	310.16	0.000759	1.01	55.5	106.68	0.3
Reach1	490.7546	100 Year	36.5	308.37	310.25	309.94	310.28	0.000786	1.1	68.78	112.24	0.31
Reach1	490.7546	Regional	86.6	308.37	312.06	310.17	312.06	0.000028	0.37	393.78	224.87	0.07
Reach1	483.5387		Culvert									
Reach1	474.6852	2 Year	5.1	308.34	309.32	308.97	309.39	0.001586	1.16	4.59	13.93	0.41
Reach1	474.6852	5 Year	9	308.34	309.6	309.18	309.71	0.001845	1.52	6.23	51.7	0.46
Reach1	474.6852	10 Year	12.2	308.34	309.83	309.32	309.84	0.000257	0.62	37.87	99.05	0.18
Reach1	474.6852	25 Year	19.2	308.34	309.98	309.59	310	0.000288	0.71	54.25	106.42	0.19
Reach1	474.6852	50 Year	26.7	308.34	310.14	309.75	310.15	0.000269	0.74	70.63	106.9	0.19
Reach1	474.6852	100 Year	36.5	308.34	310.26	309.74	310.27	0.000315	0.84	83.64	109.71	0.2
Reach1	474.6852	Regional	86.6	308.34	312.05	310.04	312.05	0.000022	0.35	397.47	219.32	0.06
Reach1	441.3358	2 Year	7.9	308.45	309.32	309	309.34	0.000828	0.76	14.7	32.38	0.29
Reach1	441.3358	5 Year	14.6	308.45	309.63	309.14	309.65	0.000629	0.85	26.11	42.16	0.27
Reach1	441.3358	10 Year	21.9	308.45	309.79	309.26	309.82	0.000872	1.09	34.21	62.57	0.32
Reach1	441.3358	25 Year	30.7	308.45	309.93	309.38	309.98	0.001093	1.32	46.73	100.97	0.37
Reach1	441.3358	50 Year	37.5	308.45	310.1	309.46	310.14	0.000674	1.13	64.78	102.39	0.29
Reach1	441.3358	100 Year	47.8	308.45	310.23	309.57	310.26	0.000657	1.17	77.36	103.39	0.29
Reach1	441.3358	Regional	103.2	308.45	312.04	309.83	312.05	0.00005	0.53	333.1	178.74	0.09

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Reach1	380.4584	2 Year	7.9	308.64	309.29	308.94	309.3	0.000695	0.66	22.11	53.71	0.26
Reach1	380.4584	5 Year	14.6	308.64	309.61	309.05	309.62	0.000345	0.61	49.41	87.94	0.2
Reach1	380.4584	10 Year	21.9	308.64	309.77	309.14	309.78	0.000383	0.71	64.02	96.24	0.21
Reach1	380.4584	25 Year	30.7	308.64	309.91	309.23	309.93	0.000442	0.82	78.21	105.21	0.23
Reach1	380.4584	50 Year	37.5	308.64	310.09	309.32	310.1	0.000339	0.79	97.02	106.14	0.21
Reach1	380.4584	100 Year	47.8	308.64	310.21	309.4	310.23	0.000375	0.87	109.8	106.75	0.22
Reach1	380.4584	Regional	103.2	308.64	312.04	309.7	312.04	0.000068	0.62	334.52	148.98	0.11
Reach1	378.7204	2 Year	7.9	308.02	309.29	308.65	309.3	0.000241	0.53	27.26	56.51	0.16
Reach1	378.7204	5 Year	14.6	308.02	309.61	308.92	309.62	0.000183	0.56	56.12	91.89	0.15
Reach1	378.7204	10 Year	21.9	308.02	309.77	309.05	309.78	0.000229	0.67	71.39	100.95	0.17
Reach1	378.7204	25 Year	30.7	308.02	309.91	309.17	309.93	0.000274	0.77	86.04	105.66	0.19
Reach1	378.7204	50 Year	37.5	308.02	310.09	309.26	310.1	0.00023	0.76	104.93	106.6	0.18
Reach1	378.7204	100 Year	47.8	308.02	310.21	309.36	310.23	0.000265	0.85	117.73	107.22	0.19
Reach1	378.7204	Regional	103.2	308.02	312.04	309.71	312.04	0.000059	0.62	344.89	150.43	0.1
Reach1	294.9459	2 Year	7.9	308.05	309.26	308.58	309.27	0.000287	0.51	29.01	58.74	0.18
Reach1	294.9459	5 Year	14.6	308.05	309.6	308.8	309.61	0.000116	0.4	100.57	130.69	0.12
Reach1	294.9459	10 Year	21.9	308.05	309.76	308.95	309.77	0.000156	0.51	127.06	154.86	0.14
Reach1	294.9459	25 Year	30.7	308.05	309.9	309.1	309.91	0.000202	0.62	148.37	156.05	0.16
Reach1	294.9459	50 Year	37.5	308.05	310.08	309.21	310.08	0.000185	0.64	176.5	157.6	0.16
Reach1	294.9459	100 Year	47.8	308.05	310.19	309.3	310.2	0.000227	0.74	194.93	158.6	0.18
Reach1	294.9459	Regional	103.2	308.05	312.03	309.41	312.04	0.000068	0.64	510.97	199.16	0.11
Reach1	291.1832	2 Year	7.9	307.84	309.26	308.49	309.27	0.000229	0.55	29.91	61.41	0.16
Reach1	291.1832	5 Year	14.6	307.84	309.6	308.73	309.61	0.000111	0.45	106.42	155.26	0.12
Reach1	291.1832	10 Year	21.9	307.84	309.76	308.91	309.76	0.00015	0.56	130.59	156.62	0.14
Reach1	291.1832	25 Year	30.7	307.84	309.89	309.09	309.9	0.000197	0.68	152.07	157.82	0.16
Reach1	291.1832	50 Year	37.5	307.84	310.07	309.21	310.08	0.000184	0.7	180.57	159.4	0.16
Reach1	291.1832	100 Year	47.8	307.84	310.19	309.3	310.2	0.000228	0.81	199.15	160.42	0.18
Reach1	291.1832	Regional	103.2	307.84	312.03	309.49	312.04	0.000072	0.7	517.95	199.37	0.11
Reach1	211.9683	2 Year	7.9	307.86	309.25	308.36	309.26	0.0001	0.4	64.84	184.41	0.11
Reach1	211.9683	5 Year	14.6	307.86	309.6	308.57	309.6	0.000069	0.39	129.52	193.22	0.1
Reach1	211.9683	10 Year	21.9	307.86	309.75	308.75	309.75	0.00009	0.47	159.51	197.17	0.11
Reach1	211.9683	25 Year	30.7	307.86	309.89	308.98	309.89	0.000115	0.55	186.36	200.64	0.13
Reach1	211.9683	50 Year	37.5	307.86	310.07	309.1	310.07	0.000103	0.56	223.07	205	0.12
Reach1	211.9683	100 Year	47.8	307.86	310.18	309.27	310.19	0.000126	0.64	246.77	207.44	0.14
Reach1	211.9683	Regional	103.2	307.86	312.03	309.52	312.03	0.000034	0.49	686.98	297.33	0.08
Reach1	156.9333	2 Year	7.9	307.62	309.25	308.13	309.26	0.000026	0.23	128.77	166.69	0.06
Reach1	156.9333	5 Year	14.6	307.62	309.6	308.38	309.6	0.000031	0.29	188.34	180.31	0.07
Reach1	156.9333	10 Year	21.9	307.62	309.75	308.51	309.75	0.000048	0.37	216.07	182.8	0.08
Reach1	156.9333	25 Year	30.7	307.62	309.88	308.67	309.89	0.000069	0.47	240.68	184.99	0.1
Reach1	156.9333	50 Year	37.5	307.62	310.06	308.75	310.07	0.00007	0.5	274.33	187.15	0.1
Reach1	156.9333	100 Year	47.8	307.62	310.18	308.86	310.18	0.000092	0.58	295.65	187.59	0.12
Reach1	156.9333	Regional	103.2	307.62	312.03	309.13	312.03	0.000035	0.52	708.59	228.29	0.08
Reach1	107.5073	2 Year	10.5	307.38	309.25	308	309.25	0.000027	0.26	155.55	147.39	0.06
Reach1	107.5073	5 Year	17.7	307.38	309.59	308.14	309.6	0.000033	0.32	205.82	147.66	0.07
Reach1	107.5073	10 Year	25.1	307.38	309.75	308.26	309.75	0.000048	0.4	228.25	147.78	0.08
Reach1	107.5073	25 Year	33.9	307.38	309.88	308.46	309.88	0.000068	0.5	247.88	147.89	0.1
Reach1	107.5073	50 Year	40.6	307.38	310.06	308.55	310.06	0.000071	0.53	274.58	148.03	0.1
Reach1	107.5073	100 Year	50.2	307.38	310.17	308.59	310.18	0.00009	0.61	291.27	148.12	0.12
Reach1	107.5073	Regional	103.3	307.38	312.03	308.93	312.03	0.00004	0.58	640.52	191.85	0.09
Reach1	64.59046	2 Year	10.5	307.47	309.25	308.11	309.25	0.000035	0.28	143.97	133.98	0.07
Reach1	64.59046	5 Year	17.7	307.47	309.59	308.21	309.59	0.000042	0.34	189.62	134.18	0.08
Reach1	64.59046	10 Year	25.1	307.47	309.74	308.32	309.75	0.000061	0.43	209.89	134.26	0.09
Reach1	64.59046	25 Year	33.9	307.47	309.87	308.42	309.88	0.000086	0.54	227.58	134.34	0.11
Reach1	64.59046	50 Year	40.6	307.47	310.06	308.53	310.06	0.00009	0.57	251.81	134.44	0.12
Reach1	64.59046	100 Year	50.2	307.47	310.17	308.55	310.17	0.000114	0.67	266.83	134.51	0.13
Reach1	64.59046	Regional	103.3	307.47	312.02	308.9	312.03	0.00005	0.64	567.14	154.83	0.1
Reach1	0	2 Year	10.5	307.35	309.25	307.91	309.25	0.000018	0.21	146.79	114.67	0.05
Reach1	0	5 Year	17.7	307.35	309.59	308.03	309.59	0.000025	0.28	185.88	115.32	0.06
Reach1	0	10 Year	25.1	307.35	309.74	308.14	309.74	0.000038	0.36	203.19	115.61	0.08
Reach1	0	25 Year	33.9	307.35	309.87	308.24	309.87	0.000056	0.45	218.25	115.86	0.09
Reach1	0	50 Year	40.6	307.35	310.05	308.3	310.05	0.00006	0.49	239.12	116.34	0.1
Reach1	0	100 Year	50.2	307.35	310.16	308.39	310.17	0.000078	0.58	251.95	116.85	0.11
Reach1	0	Regional	103.3	307.35	312.02	308.72	312.03	0.00004	0.58	526.41	135.98	0.09

Future Conditions HEC-RAS Model Results

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Reach1	1486.058	2 Year	3.5	316.96	317.7	317.7	317.8	0.006044	1.48	4.83	34.7	0.68
Reach1	1486.058	5 Year	5.3	316.96	317.78	317.78	317.88	0.006422	1.68	7.41	37.21	0.72
Reach1	1486.058	10 Year	8.3	316.96	317.96	317.86	318.02	0.003371	1.47	14.86	44.15	0.55
Reach1	1486.058	25 Year	15.5	316.96	318.44	318	318.46	0.000875	1.05	41.69	61.25	0.3
Reach1	1486.058	50 Year	22.8	316.96	318.82	318.14	318.83	0.000501	0.95	66.84	68.9	0.24
Reach1	1486.058	100 Year	32.6	316.96	319.31	318.24	319.32	0.0003	0.88	102.09	74.96	0.19
Reach1	1486.058	Regional	80.7	316.96	321.12	318.61	321.13	0.000122	0.85	275.66	112.69	0.14
Reach1	1477.037	2 Year	3.5	316.47	317.47	317.28	317.54	0.002671	1.35	4.12	10.23	0.49
Reach1	1477.037	5 Year	5.3	316.47	317.61	317.42	317.71	0.002926	1.58	5.45	10.75	0.53
Reach1	1477.037	10 Year	8.3	316.47	317.9	317.57	317.99	0.002299	1.68	8.21	11.6	0.49
Reach1	1477.037	25 Year	15.5	316.47	318.29	317.85	318.43	0.002587	2.15	12.17	12.86	0.55
Reach1	1477.037	50 Year	22.8	316.47	318.62	318.08	318.81	0.002716	2.5	15.68	46.2	0.58
Reach1	1477.037	100 Year	32.6	316.47	319.04	318.34	319.29	0.002886	2.94	20.89	76.91	0.62
Reach1	1477.037	Regional	80.7	316.47	321.06	319.51	321.12	0.000604	2.04	175.47	204.71	0.31
Reach1	1463.072		Bridge									
Reach1	1452.487	2 Year	3.5	316.44	317.1	317.1	317.34	0.013131	2.15	1.62	3.42	1
Reach1	1452.487	5 Year	5.3	316.44	317.34	317.34	317.51	0.006351	1.93	4.03	22.43	0.74
Reach1	1452.487	10 Year	8.3	316.44	317.47	317.47	317.67	0.00668	2.23	6.02	23.13	0.78
Reach1	1452.487	25 Year	15.5	316.44	317.69	317.69	317.97	0.007963	2.83	9.19	23.13	0.88
Reach1	1452.487	50 Year	22.8	316.44	317.86	317.86	318.22	0.00858	3.26	11.78	23.13	0.94
Reach1	1452.487	100 Year	32.6	316.44	318.07	318.07	318.51	0.008992	3.7	14.79	23.13	0.99
Reach1	1452.487	Regional	80.7	316.44	318.81	318.81	319.6	0.009984	5.15	25.75	23.13	1.12
Reach1	1429.623	2 Year	3.5	315.16	316.43		316.47	0.00082	0.92	4.23	8.29	0.28
Reach1	1429.623	5 Year	5.3	315.16	316.37		316.48	0.002275	1.48	3.81	7.69	0.47
Reach1	1429.623	10 Year	8.3	315.16	316.34	316.19	316.63	0.006266	2.41	3.56	7.34	0.78
Reach1	1429.623	25 Year	15.5	315.16	316.79	316.79	317.09	0.004439	2.61	9.4	18.98	0.69
Reach1	1429.623	50 Year	22.8	315.16	317	317	317.33	0.004612	2.91	13.65	22.84	0.72
Reach1	1429.623	100 Year	32.6	315.16	317.21	317.21	317.57	0.004909	3.25	18.69	26.1	0.76
Reach1	1429.623	Regional	80.7	315.16	317.83	317.83	318.34	0.005957	4.34	37.79	34.83	0.88
Reach1	1428.749	2 Year	3.5	315.16	316.44		316.46	0.000423	0.67	8.22	14.52	0.2
Reach1	1428.749	5 Year	5.3	315.16	316.42		316.46	0.001071	1.05	7.88	14.28	0.32
Reach1	1428.749	10 Year	8.3	315.16	316.49		316.57	0.002	1.49	8.85	14.96	0.45
Reach1	1428.749	25 Year	15.5	315.16	316.6		316.81	0.004419	2.37	10.7	16.14	0.68
Reach1	1428.749	50 Year	22.8	315.16	316.68	316.68	317.03	0.007368	3.18	11.92	16.84	0.88
Reach1	1428.749	100 Year	32.6	315.16	316.93	316.93	317.32	0.006893	3.46	16.77	20.52	0.88
Reach1	1428.749	Regional	80.7	315.16	317.63	317.63	318.15	0.007045	4.46	35.45	32.82	0.94
Reach1	1398.044	2 Year	3.5	315.5	316.16	316.16	316.4	0.013116	2.15	1.63	3.42	1
Reach1	1398.044	5 Year	5.3	315.5	316.32	316.32	316.39	0.004308	1.48	8.29	50.45	0.6
Reach1	1398.044	10 Year	8.3	315.5	316.38	316.38	316.46	0.005319	1.74	11.17	51.4	0.67
Reach1	1398.044	25 Year	15.5	315.5	316.47	316.47	316.59	0.007378	2.23	15.93	52.94	0.81
Reach1	1398.044	50 Year	22.8	315.5	316.54	316.54	316.68	0.008753	2.57	19.78	54.13	0.89
Reach1	1398.044	100 Year	32.6	315.5	316.62	316.62	316.8	0.010144	2.94	24.13	55.43	0.98
Reach1	1398.044	Regional	80.7	315.5	316.92	316.92	317.21	0.01307	4.01	41.09	60.29	1.16
Reach1	1356.024	2 Year	3.7	314.8	315.48	315.48	315.72	0.013187	2.19	1.69	3.46	1
Reach1	1356.024	5 Year	6.1	314.8	315.63	315.63	315.63	0.000181	0.3	33.03	99.88	0.12
Reach1	1356.024	10 Year	8.5	314.8	315.63	315.63	315.63	0.000351	0.42	33.03	99.88	0.17
Reach1	1356.024	25 Year	15.5	314.8	315.63	315.63	315.64	0.001166	0.77	33.03	99.88	0.31
Reach1	1356.024	50 Year	22.8	314.8	315.63	315.63	315.66	0.002524	1.14	33.03	99.88	0.46
Reach1	1356.024	100 Year	32.4	314.8	315.63	315.63	315.68	0.005097	1.62	33.03	99.88	0.65
Reach1	1356.024	Regional	81.1	314.8	315.85	315.73	315.96	0.008553	2.55	59.46	125.29	0.88
Reach1	1311.56	2 Year	3.7	313.5	314.27	314.18	314.44	0.007648	1.85	2.01	3.8	0.78
Reach1	1311.56	5 Year	6.1	313.5	314.47	314.38	314.72	0.007295	2.22	2.88	4.71	0.8
Reach1	1311.56	10 Year	8.5	313.5	314.57	314.56	314.94	0.009227	2.71	3.38	5.16	0.92
Reach1	1311.56	25 Year	15.5	313.5	315.51	314.93	315.51	0.000131	0.52	75.79	108.68	0.12
Reach1	1311.56	50 Year	22.8	313.5	315.07	315.07	315.19	0.003234	2.16	30.65	98.09	0.59
Reach1	1311.56	100 Year	32.4	313.5	315.14	315.14	315.27	0.003937	2.47	37.64	99.81	0.66
Reach1	1311.56	Regional	81.1	313.5	315.37	315.37	315.58	0.006622	3.53	61.19	105.37	0.87
Reach1	1310.373	2 Year	3.7	313.5	314.18	314.18	314.42	0.013069	2.19	1.69	3.46	1
Reach1	1310.373	5 Year	6.1	313.5	314.39	314.39	314.7	0.010738	2.5	2.54	4.74	0.96
Reach1	1310.373	10 Year	8.5	313.5	314.57	314.57	314.93	0.00918	2.69	3.5	5.92	0.92
Reach1	1310.373	25 Year	15.5	313.5	314.81	314.81	315.45	0.012368	3.67	5.11	7.49	1.11
Reach1	1310.373	50 Year	22.8	313.5	315.04	315.04	315.15	0.003107	2.09	33.44	114.95	0.58
Reach1	1310.373	100 Year	32.4	313.5	315.11	315.11	315.22	0.00386	2.4	40.5	115.04	0.65
Reach1	1310.373	Regional	81.1	313.5	315.31	315.31	315.5	0.006631	3.45	64.2	115.28	0.87
Reach1	1281.832	2 Year	3.7	313.34	314.29	314.02	314.29	0.000039	0.16	42.21	80.47	0.06
Reach1	1281.832	5 Year	6.1	313.34	314.1	314.1	314.1	0.000337	0.39	28.16	69.36	0.16
Reach1	1281.832	10 Year	8.5	313.34	314.1	314.1	314.11	0.000654	0.54	28.17	69.37	0.23
Reach1	1281.832	25 Year	15.5	313.34	314.1	314.1	314.12	0.002176	0.98	28.17	69.37	0.42
Reach1	1281.832	50 Year	22.8	313.34	314.1	314.1	314.14	0.004709	1.44	28.17	69.37	0.61
Reach1	1281.832	100 Year	32.4	313.34	314.1	314.1	314.18	0.009509	2.05	28.17	69.37	0.87
Reach1	1281.832	Regional	81.1	313.34	314.55	314.26	314.64	0.005359	2.27	65.41	93.58	0.72
Reach1	1280.724	2 Year	3.7	313.34	314.02	314.02	314.26	0.012874	2.18	1.7	3.46	0.99
Reach1	1280.724	5 Year	6.1	313.34	314.08	314.08	314.08	0.000371	0.39	27.27	69.94	0.17
Reach1	1280.724	10 Year	8.5	313.34	314.08	314.08	314.09	0.00072	0.55	27.27	69.94	0.24
Reach1	1280.724	25 Year	15.5	313.34	314.08	314.08	314.1	0.002395	1	27.27	69.94	0.43
Reach1	1280.724	50 Year	22.8	313.34	314.08	314.08	314.12	0.005182	1.47	27.27	69.94	0.64
Reach1	1280.724	100 Year	32.4	313.34	314.08	314.08	314.16	0.010464	2.1	27.27	69.94	0.91
Reach1	1280.724	Regional	81.1	313.34	314.55	314.25	314.63	0.004731	2.14	70.5	101.69	0.68

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Reach1	1245.863	2 Year	3.7	312.63	313.58	313.31	313.58	0.00015	0.31	20.3	39.33	0.11
Reach1	1245.863	5 Year	6.1	312.63	313.33	313.33	313.35	0.001849	0.84	11.84	29.29	0.38
Reach1	1245.863	10 Year	8.5	312.63	313.33	313.33	313.37	0.003551	1.16	11.88	29.37	0.52
Reach1	1245.863	25 Year	15.5	312.63	313.43	313.33	313.5	0.005912	1.7	15.12	33.96	0.69
Reach1	1245.863	50 Year	22.8	312.63	313.62	313.36	313.69	0.004552	1.78	22.09	41	0.64
Reach1	1245.863	100 Year	32.4	312.63	313.81	313.48	313.88	0.00399	1.92	30.33	48.6	0.62
Reach1	1245.863	Regional	81.1	312.63	314.38	313.93	314.49	0.003362	2.39	67.79	78.53	0.61
Reach1	1244.83	2 Year	3.7	312.63	313.31	313.31	313.55	0.013128	2.19	1.69	3.46	1
Reach1	1244.83	5 Year	6.1	312.63	313.33	313.33	313.35	0.001756	0.82	12.04	29.23	0.37
Reach1	1244.83	10 Year	8.5	312.63	313.33	313.33	313.36	0.00341	1.14	12.04	29.23	0.51
Reach1	1244.83	25 Year	15.5	312.63	313.43	313.33	313.5	0.005811	1.67	15.19	34.24	0.69
Reach1	1244.83	50 Year	22.8	312.63	313.62	313.34	313.69	0.004458	1.76	22.29	41.42	0.63
Reach1	1244.83	100 Year	32.4	312.63	313.8	313.47	313.88	0.003911	1.89	30.7	50.08	0.61
Reach1	1244.83	Regional	81.1	312.63	314.4	313.93	314.47	0.002424	2.05	77.96	79.97	0.52
Reach1	1176.299	2 Year	3.7	311.5	312.78	312.18	312.8	0.000549	0.76	8	17.75	0.23
Reach1	1176.299	5 Year	6.1	311.5	312.53	312.43	312.7	0.004866	1.9	4.32	11.82	0.66
Reach1	1176.299	10 Year	8.5	311.5	312.6	312.6	312.85	0.006586	2.34	5.23	13.56	0.78
Reach1	1176.299	25 Year	15.5	311.5	312.89	312.88	313.16	0.006076	2.69	10.05	20.31	0.79
Reach1	1176.299	50 Year	22.8	311.5	313.08	313.07	313.39	0.006187	3	14.41	24.93	0.82
Reach1	1176.299	100 Year	32.4	311.5	313.29	313.29	313.61	0.005856	3.21	20.1	28.64	0.81
Reach1	1176.299	Regional	81.1	311.5	313.88	313.88	314.25	0.006085	4.04	46.98	51.52	0.87
Reach1	1175.274	2 Year	3.7	311.5	312.78	312.18	312.8	0.000543	0.76	8.1	17.98	0.23
Reach1	1175.274	5 Year	6.1	311.5	312.52	312.43	312.69	0.004939	1.91	4.32	11.83	0.67
Reach1	1175.274	10 Year	8.5	311.5	312.59	312.59	312.84	0.006791	2.36	5.19	13.48	0.79
Reach1	1175.274	25 Year	15.5	311.5	312.88	312.88	313.16	0.006114	2.69	10.09	20.45	0.79
Reach1	1175.274	50 Year	22.8	311.5	313.08	313.08	313.38	0.006123	2.99	14.56	25.15	0.81
Reach1	1175.274	100 Year	32.4	311.5	313.28	313.15	313.37	0.002301	2.01	35.42	44.79	0.51
Reach1	1175.274	Regional	81.1	311.5	313.87	313.41	314.01	0.002721	2.69	64.03	52	0.58
Reach1	1137.794	2 Year	3.7	311.82	312.5	312.5	312.74	0.012972	2.18	1.7	3.46	0.99
Reach1	1137.794	5 Year	6.1	311.82	312.52	312.52	312.55	0.003547	1.16	10.91	37.84	0.52
Reach1	1137.794	10 Year	8.5	311.82	312.54	312.52	312.59	0.00538	1.47	11.84	38.16	0.65
Reach1	1137.794	25 Year	15.5	311.82	312.78	312.56	312.82	0.003004	1.41	21.27	41.29	0.51
Reach1	1137.794	50 Year	22.8	311.82	313.11	312.65	313.14	0.00139	1.21	35.38	45.59	0.37
Reach1	1137.794	100 Year	32.4	311.82	313.27	312.74	313.31	0.001596	1.43	42.99	48.48	0.41
Reach1	1137.794	Regional	81.1	311.82	313.85	313.11	313.93	0.002215	2.17	74.66	61.52	0.51
Reach1	1109.979	2 Year	3.7	311.42	312.14	312.06	312.19	0.003888	1.24	5.57	22.62	0.55
Reach1	1109.979	5 Year	6.1	311.42	312.37	312.16	312.4	0.001628	1.03	11.09	24.88	0.38
Reach1	1109.979	10 Year	8.5	311.42	312.41	312.22	312.46	0.002407	1.3	12.2	25.32	0.46
Reach1	1109.979	25 Year	15.5	311.42	312.66	312.36	312.72	0.002391	1.55	18.77	28.41	0.48
Reach1	1109.979	50 Year	22.8	311.42	313.04	312.48	313.08	0.001353	1.43	30.29	32.97	0.38
Reach1	1109.979	100 Year	32.4	311.42	313.17	312.62	313.24	0.001849	1.78	34.86	34.6	0.45
Reach1	1109.979	Regional	81.1	311.42	313.61	313.13	313.81	0.003974	3.08	51.46	40.63	0.69
Reach1	1108.705	2 Year	3.7	311.42	312.14	311.84	312.18	0.003212	1.13	5.53	16.66	0.5
Reach1	1108.705	5 Year	6.1	311.42	312.36	312.06	312.39	0.002071	1.15	10.15	25.08	0.43
Reach1	1108.705	10 Year	8.5	311.42	312.39	312.16	312.45	0.003153	1.46	11.07	25.41	0.53
Reach1	1108.705	25 Year	15.5	311.42	312.65	312.4	312.71	0.002767	1.65	17.76	27.97	0.52
Reach1	1108.705	50 Year	22.8	311.42	313.03	312.52	313.08	0.001474	1.49	29.56	33.26	0.4
Reach1	1108.705	100 Year	32.4	311.42	313.16	312.63	313.24	0.002005	1.84	34.08	34.92	0.47
Reach1	1108.705	Regional	81.1	311.42	313.59	313.17	313.8	0.004341	3.19	50.33	40.78	0.72
Reach1	1088.885	2 Year	3.7	311.12	311.8	311.8	312.04	0.012883	2.18	1.7	3.46	0.99
Reach1	1088.885	5 Year	6.1	311.12	312.1	312.1	312.31	0.006461	2.1	3.88	14.42	0.76
Reach1	1088.885	10 Year	8.5	311.12	312.28	312.2	312.38	0.003235	1.71	9.32	22.64	0.56
Reach1	1088.885	25 Year	15.5	311.12	312.49	312.39	312.64	0.004157	2.2	14.59	30.08	0.65
Reach1	1088.885	50 Year	22.8	311.12	313	312.57	313.05	0.001136	1.47	35.58	46.76	0.36
Reach1	1088.885	100 Year	32.4	311.12	313.13	312.79	313.2	0.001481	1.76	41.78	49.12	0.42
Reach1	1088.885	Regional	81.1	311.12	313.56	313.18	313.71	0.002806	2.8	64.33	55.86	0.6
Reach1	1033.914	2 Year	3.7	310.62	311.42	311.3	311.58	0.006348	1.75	2.12	3.58	0.72
Reach1	1033.914	5 Year	6.1	310.62	311.49	311.49	311.83	0.011703	2.57	2.38	3.63	1
Reach1	1033.914	10 Year	8.5	310.62	311.66	311.66	312.08	0.010794	2.86	3.01	3.76	0.99
Reach1	1033.914	25 Year	15.5	310.62	312.48	312.12	312.53	0.000738	1.17	17.09	22.5	0.29
Reach1	1033.914	50 Year	22.8	310.62	312.98	312.24	313.02	0.000425	1.06	29.79	33.36	0.23
Reach1	1033.914	100 Year	32.4	310.62	313.09	312.37	313.15	0.000625	1.33	33.66	35.15	0.28
Reach1	1033.914	Regional	81.1	310.62	313.48	312.88	313.61	0.001474	2.27	59.09	67.71	0.44
Reach1	1033.308	2 Year	3.7	310.62	311.51	311.1	311.53	0.000801	0.69	6	13.11	0.26
Reach1	1033.308	5 Year	6.1	310.62	311.7	311.24	311.72	0.000803	0.8	8.55	15.21	0.27
Reach1	1033.308	10 Year	8.5	310.62	311.85	311.37	311.88	0.000778	0.88	11	17.13	0.28
Reach1	1033.308	25 Year	15.5	310.62	312.5	311.59	312.52	0.000264	0.71	24.51	22.24	0.17
Reach1	1033.308	50 Year	22.8	310.62	312.99	311.76	313.01	0.000212	0.75	37.22	33.81	0.16
Reach1	1033.308	100 Year	32.4	310.62	313.11	311.94	313.14	0.000332	0.97	41.37	36.39	0.21
Reach1	1033.308	Regional	81.1	310.62	313.51	312.52	313.59	0.000916	1.8	68.41	68.38	0.35
Reach1	1010.387	2 Year	3.7	310.42	311.5	310.91	311.52	0.000405	0.61	6.77	11.21	0.21
Reach1	1010.387	5 Year	6.1	310.42	311.67	311.06	311.7	0.000553	0.8	8.91	13.56	0.25
Reach1	1010.387	10 Year	8.5	310.42	311.82	311.19	311.86	0.000639	0.93	11.03	15.63	0.27
Reach1	1010.387	25 Year	15.5	310.42	312.48	311.47	312.51	0.00032	0.89	24.24	25.34	0.21
Reach1	1010.387	50 Year	22.8	310.42	312.98	311.71	313	0.00022	0.86	45.14	60.11	0.18
Reach1	1010.387	100 Year	32.4	310.42	313.1	311.97	313.13	0.000319	1.07	52.69	67.68	0.22
Reach1	1010.387	Regional	81.1	310.42	313.49	312.71	313.57	0.000704	1.75	83.53	88.96	0.33
Reach1	998.545	2 Year	3.7	310.34	311.5	310.69	311.51	0.000212	0.52	7.05	9.32	0.16
Reach1	998.545	5 Year	6.1	310.34	311.67	310.83	311.7	0.000363	0.75	8.1	9.63	0.21
Reach1	998.545	10 Year	8.5	310.34	311.8	310.94	311.85	0.000507	0.95	8.94	9.88	0.25
Reach1	998.545	25 Year	15.5	310.34	312.43	311.22	312.5	0.000508	1.21	12.82	11.05	0.27
Reach1	998.545	50 Year	22.8	310.34	312.97	311.47	313	0.000215	0.9	36.66	54.64	0.18
Reach1	998.545	100 Year	32.4	310.34	313.09	311.77	313.13	0.000275	1.04	48.51	82.92	0.2
Reach1	998.545	Regional	81.1	310.34	313.48	312.97	313.56	0.000554	1.62	84.92	99.63	0.3

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Reach1	993.3976		Bridge									
Reach1	987.5314	2 Year	3.7	310.49	311.47	310.85	311.49	0.00039	0.63	5.88	9.95	0.21
Reach1	987.5314	5 Year	6.1	310.49	311.6	310.98	311.64	0.000696	0.91	6.67	10.55	0.28
Reach1	987.5314	10 Year	8.5	310.49	311.66	311.1	311.74	0.001098	1.2	7.1	10.87	0.36
Reach1	987.5314	25 Year	15.5	310.49	311.69	311.38	311.93	0.003349	2.13	7.28	11.01	0.63
Reach1	987.5314	50 Year	22.8	310.49	311.65	311.63	312.19	0.008258	3.26	7	10.8	0.98
Reach1	987.5314	100 Year	32.4	310.49	311.93	311.93	312.63	0.007942	3.7	8.75	12.12	1
Reach1	987.5314	Regional	81.1	310.49	312.81	312.81	313.14	0.002925	3.01	39.77	54.6	0.65
Reach1	982.615	2 Year	5.1	310.87	311.36	311.36	311.47	0.007388	1.68	4.4	18.92	0.78
Reach1	982.615	5 Year	9	310.87	311.47	311.47	311.61	0.008264	2.03	6.52	20.72	0.85
Reach1	982.615	10 Year	12.2	310.87	311.54	311.54	311.71	0.008702	2.25	7.98	21.5	0.89
Reach1	982.615	25 Year	19.2	310.87	311.66	311.66	311.88	0.009287	2.61	10.76	23	0.95
Reach1	982.615	50 Year	26.7	310.87	311.78	311.78	312.04	0.00927	2.87	13.57	24.26	0.97
Reach1	982.615	100 Year	36.5	310.87	311.91	311.91	312.22	0.009418	3.16	16.69	25.09	1
Reach1	982.615	Regional	86.6	310.87	312.25	312.25	312.99	0.016785	5.11	25.71	30.85	1.4
Reach1	947.0903	2 Year	5.1	310.12	310.54	310.4	310.56	0.002755	0.7	7.89	28.28	0.44
Reach1	947.0903	5 Year	9	310.12	310.61	310.5	310.66	0.004132	0.97	9.97	29.29	0.55
Reach1	947.0903	10 Year	12.2	310.12	310.71	310.53	310.76	0.003361	1.01	12.96	30.57	0.51
Reach1	947.0903	25 Year	19.2	310.12	310.91	310.63	310.96	0.002513	1.06	19.1	32.71	0.45
Reach1	947.0903	50 Year	26.7	310.12	310.72	310.72	310.93	0.015636	2.19	13.08	30.61	1.1
Reach1	947.0903	100 Year	36.5	310.12	310.82	310.82	311.08	0.014887	2.38	16.26	31.74	1.09
Reach1	947.0903	Regional	86.6	310.12	312.05	310.92	312.05	0.000007	0.12	618.33	259.36	0.03
Reach1	914.451	2 Year	5.1	309.83	310.49	310.11	310.52	0.001231	0.66	7.75	14.34	0.31
Reach1	914.451	5 Year	9	309.83	310.26	310.26	310.45	0.015525	1.69	4.7	12.05	1.04
Reach1	914.451	10 Year	12.2	309.83	310.35	310.35	310.58	0.015557	1.98	5.84	12.95	1.07
Reach1	914.451	25 Year	19.2	309.83	310.53	310.53	310.8	0.01482	2.37	8.22	14.66	1.09
Reach1	914.451	50 Year	26.7	309.83	310.63	310.63	310.63	0.000004	0.05	340.57	234.39	0.02
Reach1	914.451	100 Year	36.5	309.83	310.63	310.63	310.63	0.000008	0.06	340.57	234.39	0.03
Reach1	914.451	Regional	86.6	309.83	312.05	310.63	312.05	0.000005	0.11	687.42	266.58	0.03
Reach1	847.8298	2 Year	5.1	309.3	310.04	310.04	310.3	0.012279	2.25	2.27	4.38	1
Reach1	847.8298	5 Year	9	309.3	310.1	310.1	310.1	0.000001	0.02	291.24	242.11	0.01
Reach1	847.8298	10 Year	12.2	309.3	310.1	310.1	310.1	0.000002	0.03	291.25	242.11	0.01
Reach1	847.8298	25 Year	19.2	309.3	310.1	310.1	310.1	0.000004	0.04	291.25	242.11	0.02
Reach1	847.8298	50 Year	26.7	309.3	310.17	310.1	310.17	0.000006	0.06	309.19	242.33	0.02
Reach1	847.8298	100 Year	36.5	309.3	310.3	310.1	310.3	0.000009	0.08	339.31	242.71	0.03
Reach1	847.8298	Regional	86.6	309.3	312.05	310.1	312.05	0.000003	0.11	785.25	282.35	0.02
Reach1	786.1621	2 Year	5.1	308.9	309.56	309.29	309.58	0.001297	0.68	9.57	28.08	0.32
Reach1	786.1621	5 Year	9	308.9	309.71	309.39	309.71	0.000003	0.04	195.46	237.99	0.02
Reach1	786.1621	10 Year	12.2	308.9	309.89	309.46	309.89	0.000003	0.05	237.22	239.04	0.02
Reach1	786.1621	25 Year	19.2	308.9	310.03	309.57	310.03	0.000005	0.06	272.61	239.89	0.02
Reach1	786.1621	50 Year	26.7	308.9	310.17	309.57	310.17	0.000007	0.08	306.18	240.7	0.03
Reach1	786.1621	100 Year	36.5	308.9	310.3	309.57	310.3	0.000009	0.1	336.08	241.43	0.03
Reach1	786.1621	Regional	86.6	308.9	312.05	309.57	312.05	0.000002	0.09	970.86	377.75	0.02
Reach1	729.9763	2 Year	5.1	308.75	309.5	309.24	309.56	0.002278	1.08	4.92	15.63	0.45
Reach1	729.9763	5 Year	9	308.75	309.71	309.41	309.71	0.000159	0.35	68.31	237.77	0.12
Reach1	729.9763	10 Year	12.2	308.75	309.88	309.55	309.89	0.000066	0.26	110.35	239.27	0.08
Reach1	729.9763	25 Year	19.2	308.75	310.03	309.55	310.03	0.000068	0.29	145.72	240.69	0.09
Reach1	729.9763	50 Year	26.7	308.75	310.17	309.55	310.17	0.000067	0.31	179.5	242.94	0.09
Reach1	729.9763	100 Year	36.5	308.75	310.3	309.57	310.3	0.000076	0.35	209.75	246.79	0.09
Reach1	729.9763	Regional	86.6	308.75	312.05	309.76	312.05	0.00001	0.21	690.18	295.73	0.04
Reach1	677.7048	2 Year	5.1	308.66	309.32	309.15	309.41	0.003743	1.28	3.99	7.73	0.57
Reach1	677.7048	5 Year	9	308.66	309.71	309.33	309.71	0.000036	0.18	118.78	272.06	0.06
Reach1	677.7048	10 Year	12.2	308.66	309.88	309.45	309.88	0.000022	0.16	167.09	273.43	0.05
Reach1	677.7048	25 Year	19.2	308.66	310.03	309.46	310.03	0.000027	0.19	207.52	275.67	0.05
Reach1	677.7048	50 Year	26.7	308.66	310.17	309.46	310.17	0.00003	0.21	246.05	277.38	0.06
Reach1	677.7048	100 Year	36.5	308.66	310.29	309.46	310.29	0.000036	0.25	280.31	278.89	0.07
Reach1	677.7048	Regional	86.6	308.66	312.05	309.57	312.05	0.000006	0.18	831.32	343.15	0.03
Reach1	607.9432	2 Year	5.1	308.35	309.37	308.92	309.38	0.000031	0.15	85.75	264.96	0.06
Reach1	607.9432	5 Year	9	308.35	309.71	309.09	309.71	0.00001	0.11	173.64	267.46	0.03
Reach1	607.9432	10 Year	12.2	308.35	309.88	309.26	309.88	0.000009	0.11	221.22	268.88	0.03
Reach1	607.9432	25 Year	19.2	308.35	310.03	309.3	310.03	0.000012	0.14	260.81	269.95	0.04
Reach1	607.9432	50 Year	26.7	308.35	310.17	309.3	310.17	0.000015	0.17	298.45	271.01	0.04
Reach1	607.9432	100 Year	36.5	308.35	310.29	309.3	310.29	0.000021	0.21	332.94	283.64	0.05
Reach1	607.9432	Regional	86.6	308.35	312.05	309.36	312.05	0.000005	0.16	910.46	359.97	0.03
Reach1	557.6347	2 Year	5.1	308.45	309.37	308.94	309.37	0.000054	0.2	68.69	237.05	0.07
Reach1	557.6347	5 Year	9	308.45	309.7	309.11	309.7	0.000015	0.13	147.6	238.69	0.04
Reach1	557.6347	10 Year	12.2	308.45	309.88	309.28	309.88	0.000012	0.13	190.17	240.65	0.04
Reach1	557.6347	25 Year	19.2	308.45	310.03	309.28	310.03	0.000018	0.17	225.51	241.53	0.05
Reach1	557.6347	50 Year	26.7	308.45	310.17	309.28	310.17	0.000022	0.2	259.32	245.23	0.05
Reach1	557.6347	100 Year	36.5	308.45	310.29	309.3	310.29	0.000029	0.24	289.44	246.73	0.06
Reach1	557.6347	Regional	86.6	308.45	312.05	309.41	312.05	0.000006	0.18	818.88	328.02	0.03
Reach1	523.273	2 Year	5.1	308.36	309.37	308.85	309.37	0.000052	0.21	67.65	233.37	0.07
Reach1	523.273	5 Year	9	308.36	309.7	309.03	309.7	0.000015	0.14	145.93	236.49	0.04
Reach1	523.273	10 Year	12.2	308.36	309.88	309.32	309.88	0.000012	0.14	188.08	237.93	0.04
Reach1	523.273	25 Year	19.2	308.36	310.03	309.32	310.03	0.000018	0.18	223.01	238.91	0.05
Reach1	523.273	50 Year	26.7	308.36	310.17	309.32	310.17	0.000022	0.21	256.22	239.8	0.05
Reach1	523.273	100 Year	36.5	308.36	310.29	309.32	310.29	0.000029	0.25	285.58	241.26	0.06
Reach1	523.273	Regional	86.6	308.36	312.05	309.43	312.05	0.000006	0.18	830.33	336.33	0.03
Reach1	490.7546	2 Year	5.1	308.26	309.34	308.75	309.37	0.000495	0.68	7.95	11.79	0.23
Reach1	490.7546	5 Year	9	308.26	309.67	308.93	309.7	0.000413	0.76	19.89	102.76	0.22
Reach1	490.7546	10 Year	12.2	308.26	309.86	309.05	309.88	0.000262	0.66	39.13	103.74	0.18
Reach1	490.7546	25 Year	19.2	308.26	310.01	309.3	310.03	0.000321	0.78	53.64	105.02	0.2
Reach1	490.7546	50 Year	26.7	308.26	310.14	309.73	310.16	0.000365	0.88	68.01	106.9	0.22
Reach1	490.7546	100 Year	36.5	308.26	310.26	309.82	310.29	0.000437	1.01	80.92	112.38	0.24
Reach1	490.7546	Regional	86.6	308.26	312.04	310.12	312.05	0.000026	0.39	401.33	224.73	0.07

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Reach1	483.5387		Bridge									
Reach1	474.6852	2 Year	5.1	308.23	309.33	308.72	309.35	0.000476	0.67	8.06	12.06	0.22
Reach1	474.6852	5 Year	9	308.23	309.63	308.9	309.66	0.000518	0.84	12	51.79	0.24
Reach1	474.6852	10 Year	12.2	308.23	309.82	309.01	309.83	0.000256	0.65	36.08	89.84	0.17
Reach1	474.6852	25 Year	19.2	308.23	309.97	309.26	309.99	0.000296	0.75	52.56	105.95	0.19
Reach1	474.6852	50 Year	26.7	308.23	310.12	309.49	310.14	0.000287	0.79	68.42	106.71	0.19
Reach1	474.6852	100 Year	36.5	308.23	310.24	309.71	310.26	0.000337	0.89	81.06	109.17	0.21
Reach1	474.6852	Regional	86.6	308.23	312.04	310.05	312.05	0.000022	0.36	395.47	219.28	0.06
Reach1	441.3358	2 Year	7.9	308.2	309.28	308.8	309.32	0.001171	1.01	9.97	30.8	0.34
Reach1	441.3358	5 Year	14.6	308.2	309.6	309.06	309.64	0.000833	1.05	21.55	41.1	0.3
Reach1	441.3358	10 Year	21.9	308.2	309.75	309.39	309.81	0.00109	1.3	28.69	56.86	0.35
Reach1	441.3358	25 Year	30.7	308.2	309.87	309.52	309.96	0.001504	1.61	38.18	100.57	0.42
Reach1	441.3358	50 Year	37.5	308.2	310.07	309.6	310.12	0.000821	1.3	58.45	102.15	0.32
Reach1	441.3358	100 Year	47.8	308.2	310.2	309.65	310.24	0.000797	1.34	70.91	103.12	0.32
Reach1	441.3358	Regional	103.2	308.2	312.04	310.15	312.04	0.000053	0.55	328.61	178.58	0.09
Reach1	380.4584	2 Year	7.9	308.08	309.28	308.68	309.29	0.000221	0.48	30.84	63.47	0.15
Reach1	380.4584	5 Year	14.6	308.08	309.6	308.94	309.61	0.000191	0.54	55.2	87.47	0.15
Reach1	380.4584	10 Year	21.9	308.08	309.76	309.08	309.77	0.000235	0.64	69.4	95.35	0.17
Reach1	380.4584	25 Year	30.7	308.08	309.9	309.15	309.91	0.000289	0.75	83.11	105.11	0.19
Reach1	380.4584	50 Year	37.5	308.08	310.08	309.21	310.09	0.000244	0.74	102.09	106.05	0.17
Reach1	380.4584	100 Year	47.8	308.08	310.19	309.29	310.21	0.000285	0.83	114.53	106.65	0.19
Reach1	380.4584	Regional	103.2	308.08	312.03	309.5	312.04	0.000066	0.62	340.78	148.85	0.1
Reach1	378.7204	2 Year	7.9	308.08	309.28	308.68	309.29	0.000155	0.4	36.28	67.35	0.13
Reach1	378.7204	5 Year	14.6	308.08	309.6	308.94	309.61	0.000147	0.47	61.97	91.42	0.13
Reach1	378.7204	10 Year	21.9	308.08	309.76	309.08	309.77	0.000186	0.57	76.89	100.24	0.15
Reach1	378.7204	25 Year	30.7	308.08	309.9	309.08	309.91	0.000231	0.67	91.16	105.59	0.17
Reach1	378.7204	50 Year	37.5	308.08	310.08	309.1	310.09	0.000201	0.67	110.18	106.54	0.16
Reach1	378.7204	100 Year	47.8	308.08	310.19	309.18	310.21	0.000238	0.76	122.7	107.14	0.17
Reach1	378.7204	Regional	103.2	308.08	312.04	309.5	312.04	0.000061	0.6	351.15	150.34	0.1
Reach1	294.9459	2 Year	7.9	307.92	309.25	308.42	309.27	0.000336	0.66	12.65	14.49	0.19
Reach1	294.9459	5 Year	14.6	307.92	309.6	308.64	309.6	0.000089	0.4	116.53	131.84	0.1
Reach1	294.9459	10 Year	21.9	307.92	309.75	308.84	309.76	0.000124	0.51	142.68	154.81	0.12
Reach1	294.9459	25 Year	30.7	307.92	309.89	309.05	309.9	0.000167	0.62	163.66	155.97	0.15
Reach1	294.9459	50 Year	37.5	307.92	310.07	309.2	310.08	0.00016	0.64	191.88	157.53	0.15
Reach1	294.9459	100 Year	47.8	307.92	310.18	309.38	310.19	0.000201	0.75	210.01	158.52	0.16
Reach1	294.9459	Regional	103.2	307.92	312.03	309.4	312.04	0.000071	0.68	527.35	198.99	0.11
Reach1	291.1832	2 Year	7.9	307.92	309.25	308.42	309.27	0.000337	0.66	12.71	14.96	0.19
Reach1	291.1832	5 Year	14.6	307.92	309.6	308.64	309.6	0.000087	0.4	117.91	135.33	0.1
Reach1	291.1832	10 Year	21.9	307.92	309.75	308.84	309.76	0.00012	0.5	145.72	156.57	0.12
Reach1	291.1832	25 Year	30.7	307.92	309.89	309.05	309.89	0.000162	0.61	166.93	157.76	0.14
Reach1	291.1832	50 Year	37.5	307.92	310.07	309.2	310.07	0.000155	0.63	195.47	159.34	0.14
Reach1	291.1832	100 Year	47.8	307.92	310.18	309.33	310.19	0.000195	0.74	213.8	160.35	0.16
Reach1	291.1832	Regional	103.2	307.92	312.03	309.42	312.04	0.000069	0.67	533.65	199.22	0.11
Reach1	211.9683	2 Year	7.9	307.76	309.25	308.22	309.26	0.00006	0.31	83.56	184.37	0.08
Reach1	211.9683	5 Year	14.6	307.76	309.59	308.43	309.6	0.000053	0.34	147.99	193.15	0.08
Reach1	211.9683	10 Year	21.9	307.76	309.75	308.62	309.75	0.000074	0.42	177.67	197.06	0.1
Reach1	211.9683	25 Year	30.7	307.76	309.88	308.82	309.88	0.0001	0.51	204.12	200.48	0.11
Reach1	211.9683	50 Year	37.5	307.76	310.06	309	310.06	0.000094	0.52	240.77	204.86	0.11
Reach1	211.9683	100 Year	47.8	307.76	310.17	309.08	310.18	0.000117	0.6	264.06	207.26	0.13
Reach1	211.9683	Regional	103.2	307.76	312.03	309.41	312.03	0.000038	0.51	705.32	297.11	0.08
Reach1	107.5073	2 Year	10.5	307.6	309.25	308.11	309.25	0.00002	0.19	164.98	147.39	0.05
Reach1	107.5073	5 Year	17.7	307.6	309.59	308.3	309.59	0.000025	0.24	215.21	147.66	0.06
Reach1	107.5073	10 Year	25.1	307.6	309.74	308.47	309.75	0.000037	0.31	237.55	147.78	0.07
Reach1	107.5073	25 Year	33.9	307.6	309.88	308.6	309.88	0.000052	0.39	257.03	147.88	0.08
Reach1	107.5073	50 Year	40.6	307.6	310.06	308.6	310.06	0.000055	0.42	283.92	153.3	0.09
Reach1	107.5073	100 Year	50.2	307.6	310.17	308.6	310.17	0.00007	0.49	301.4	159.35	0.1
Reach1	107.5073	Regional	103.3	307.6	312.03	308.72	312.03	0.000035	0.51	649.92	191.85	0.08
Reach1	0	2 Year	10.5	307.3	309.25	307.81	309.25	0.000014	0.18	163.71	126.02	0.04
Reach1	0	5 Year	17.7	307.3	309.59	308	309.59	0.00002	0.24	206.75	127.29	0.05
Reach1	0	10 Year	25.1	307.3	309.74	308.17	309.74	0.000031	0.32	225.88	127.85	0.07
Reach1	0	25 Year	33.9	307.3	309.87	308.3	309.87	0.000046	0.4	242.55	128.33	0.08
Reach1	0	50 Year	40.6	307.3	310.05	308.3	310.05	0.00005	0.44	265.69	129.13	0.09
Reach1	0	100 Year	50.2	307.3	310.16	308.3	310.17	0.000066	0.51	279.94	129.84	0.1
Reach1	0	Regional	103.3	307.3	312.02	308.6	312.03	0.000039	0.56	531.17	135.98	0.08

TABLE C3: FUTURE CONDITIONS HYDROLOGIC MODELLING PARAMETERS

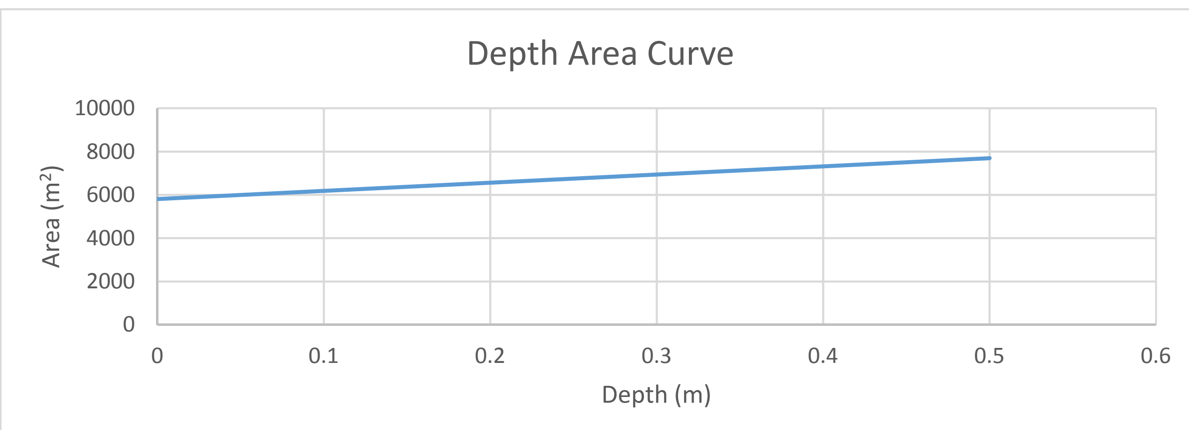
Sub-catchment	Area (ha)	Direct Connect Imperv (%)	Width (m)	Length (m)	Average Slope (%)	Pervious Suction Head (mm)	Pervious Saturated Hydraulic Conductivity (mm/hr)	Total Imperv. (%)	Direct Connect Imperv (%)	Percent Impervious Not Directly Connected	Overall Saturated Hydraulic Conductivity (mm/hr)
YRK-EXT04	1.08	0.0	241	45	2	147.0	11.0	0.0%	0.0%	0.0%	10.4
YRK-EXT05	0.97	0.0	194	50	2	144.0	11.0	0.0%	0.0%	0.0%	8.8
YRK-EXT06	0.35	0.0	174	20	2	144.0	11.0	0.0%	0.0%	0.0%	8.2
YRK-EXT07	0.32	0.0	160	20	2	144.2	11.0	0.0%	0.0%	0.0%	7.8
YRK-EXT08	0.60	0.0	171	35	2	144.0	11.0	0.0%	0.0%	0.0%	8.1
YRK-EXT09	1.39	0.0	199	70	2	144.0	11.0	0.0%	0.0%	0.0%	8.6
YRK-EXT10	0.95	34.2	316	30	2	144.0	11.0	34.2%	34.2%	0.0%	7.7
YRK-N-01-FUT	0.20	90.3	98	20	2	144.0	4.0	27.5%	90.3%	0.0%	4.0
YRK-N-02-FUT	0.57	92.3	284	20	2	144.0	4.4	53.8%	92.3%	0.0%	4.4
YRK-N-03-FUT	0.13	93.2	63	20	2	144.0	2.1	24.5%	93.2%	0.0%	2.1
YRK-N-04-FUT	0.33	83.2	164	20	2	144.0	1.6	27.5%	83.2%	0.0%	1.6
YRK-N-05-FUT	0.39	85.5	194	20	2	144.0	1.6	5.8%	85.5%	0.0%	1.6
YRK-N-06-FUT	0.62	55.9	310	20	2	188.0	1.4	86.0%	55.9%	0.0%	1.4
YRK-N-07-FUT	1.08	75.1	538	20	2	144.0	1.8	86.0%	75.1%	0.0%	1.8
YRK-N-08-FUT	0.54	71.4	271	20	2	144.0	1.6	95.0%	71.4%	0.0%	1.6
YRK-S-01-FUT	0.17	81.0	83	20	2	144.0	4.0	65.0%	81.0%	0.0%	4.0
YRK-S-02-FUT	0.54	78.4	269	20	2	144.0	4.4	27.5%	78.4%	0.0%	4.4
YRK-S-03-FUT	0.13	65.4	65	20	2	144.0	1.6	27.5%	65.4%	0.0%	1.6
YRK-S-04-FUT	0.29	66.1	147	20	2	144.0	1.6	35.0%	66.1%	0.0%	1.6
YRK-S-05-FUT	0.38	67.8	192	20	2	144.0	1.6	5.0%	67.8%	0.0%	1.6
YRK-S-06-FUT	0.44	77.8	221	20	2	188.0	1.4	20.0%	77.8%	0.0%	1.4
YRK-S-07-FUT	1.06	80.3	529	20	2	144.0	1.8	27.5%	80.3%	0.0%	1.8
YRK-S-08-FUT	0.58	66.7	288	20	2	144.0	1.6	42.5%	66.7%	0.0%	1.6

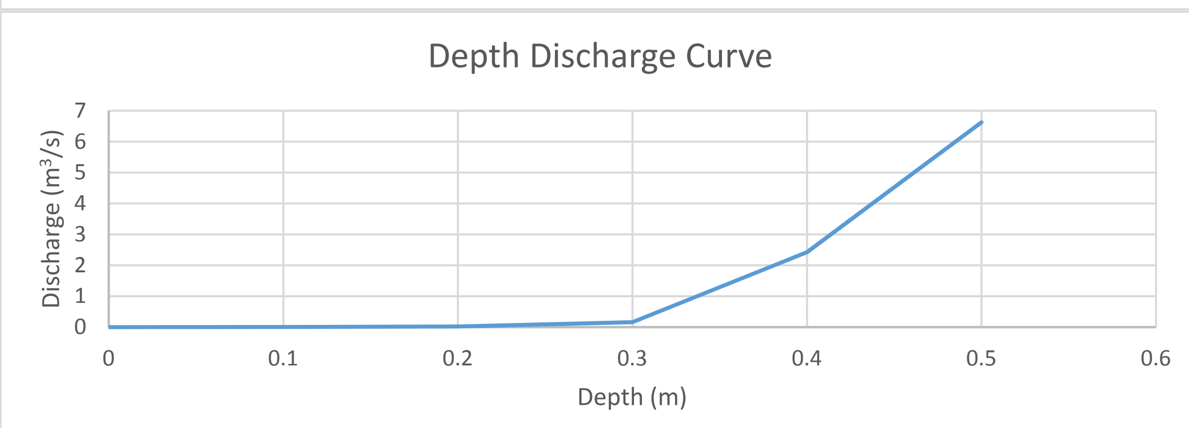
City Pond #31

Grangehill Estates Subdivision Phase 4
Stantec Consulting Ltd. June 2005
MIDUSS Outputs - December 15, 2004

Depth	Area
(m)	(m^2)
0	5806
0.1	6184
0.2	6562
0.3	6939
0.4	7317
0.5	7695

Depth	Outflow
(m)	(m^3/s)
0	0
0.1	0.0075
0.2	0.0195
0.3	0.161
0.4	2.424
0.5	6.624



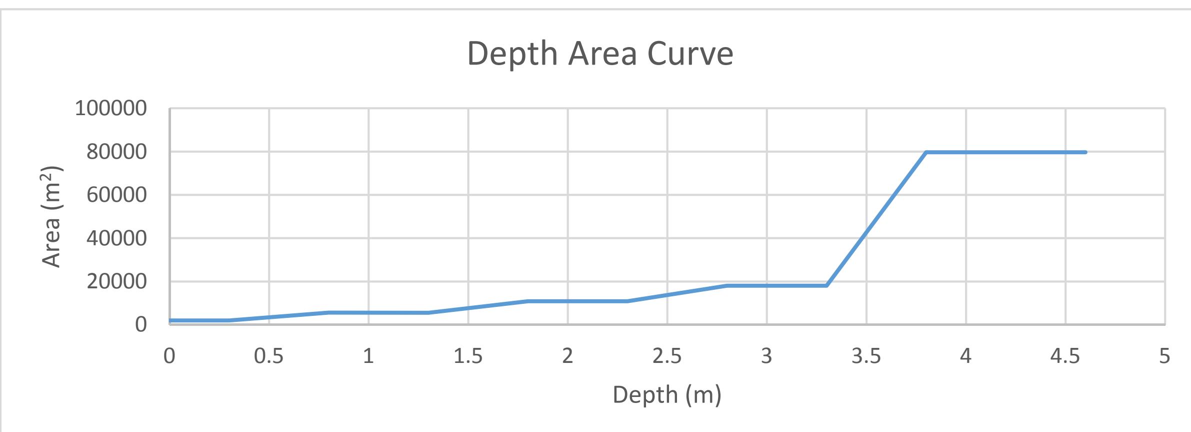


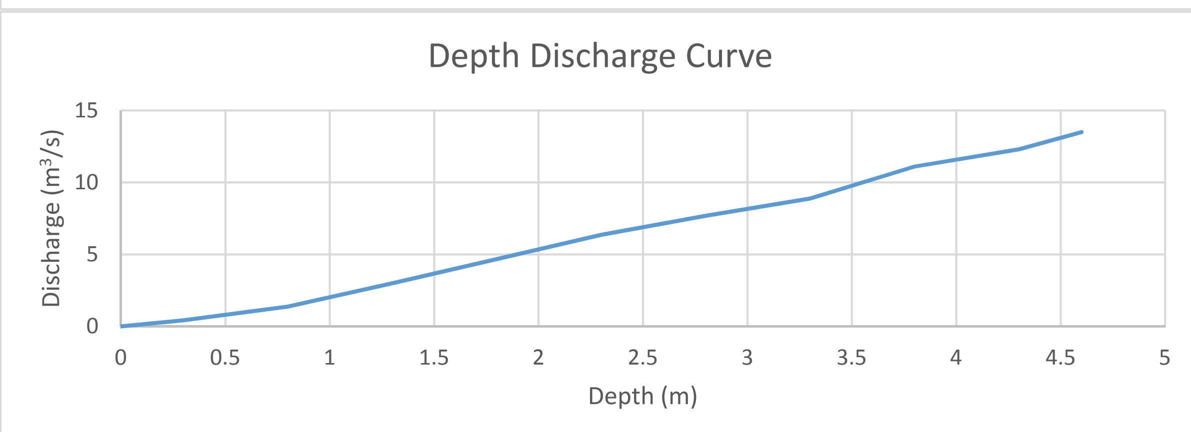
City Pond #35

Box Culvert Extension Under CN Tracks
Schaeffers May 1997

Depth	Area
(m)	(m^2)
0	2000
0.3	2000
0.8	5600
1.3	5560
1.8	10900
2.3	10880
2.8	18080
3.3	18080
3.8	79700
4.3	79700
4.6	79700

Depth	Outflow
(m)	(m^3/s)
0	0
0.3	0.42
0.8	1.38
1.3	3
1.8	4.68
2.3	6.36
2.8	7.68
3.3	8.88
3.8	11.1
4.3	12.3
4.6	13.5



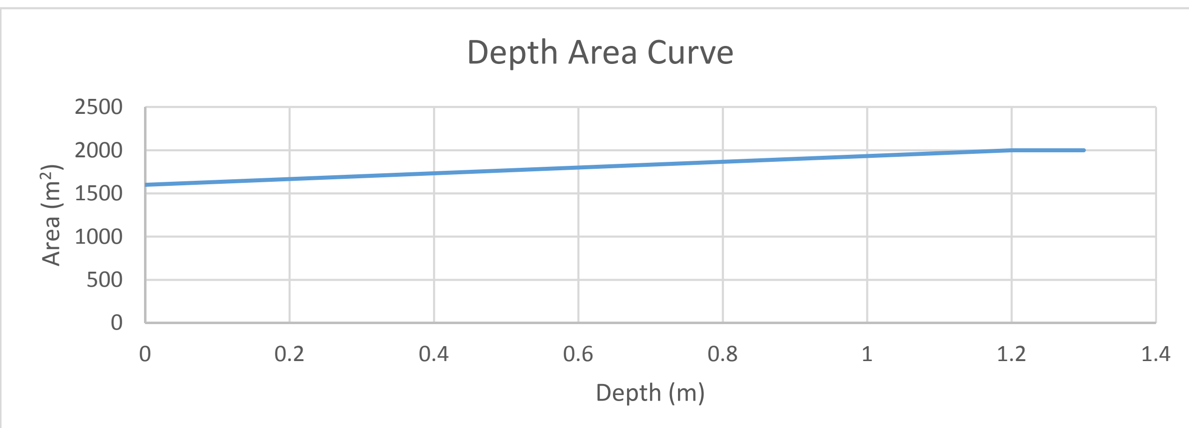


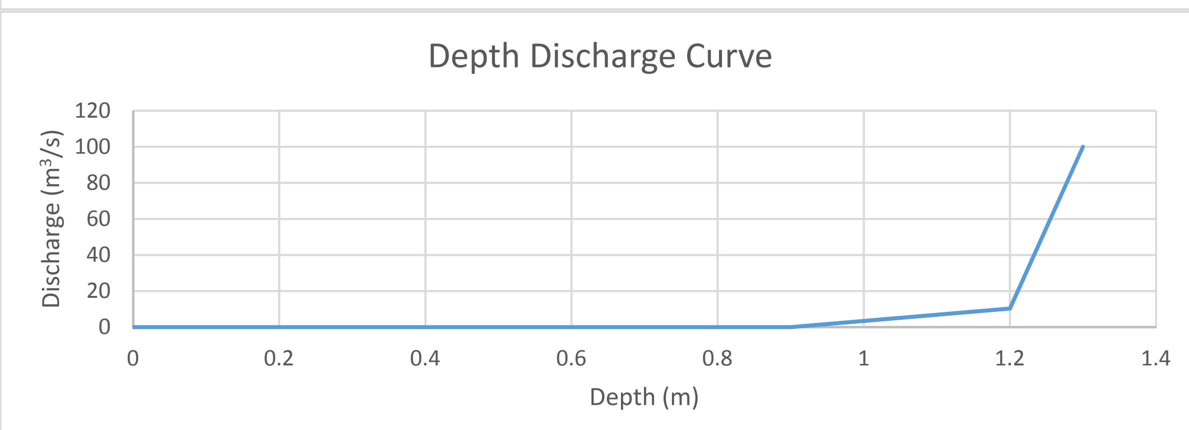
City Pond #37

Grangehill Subdivision Phase 2
Buckthorn Crescent to Pond
DWG Y-10

Depth	Area
(m)	(m^2)
0	1600
1.2	2000
1.3	2000

Depth	Outflow
(m)	(m^3/s)
0	0
0.07	0.002
0.9	0.01
1.2	10.284
1.3	100



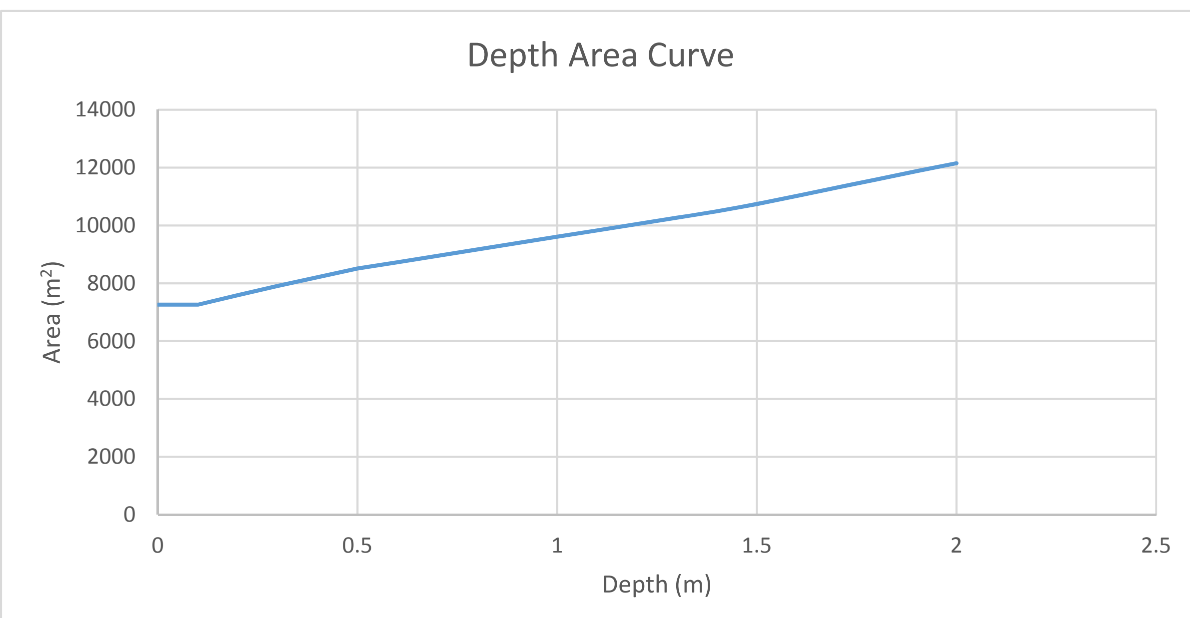


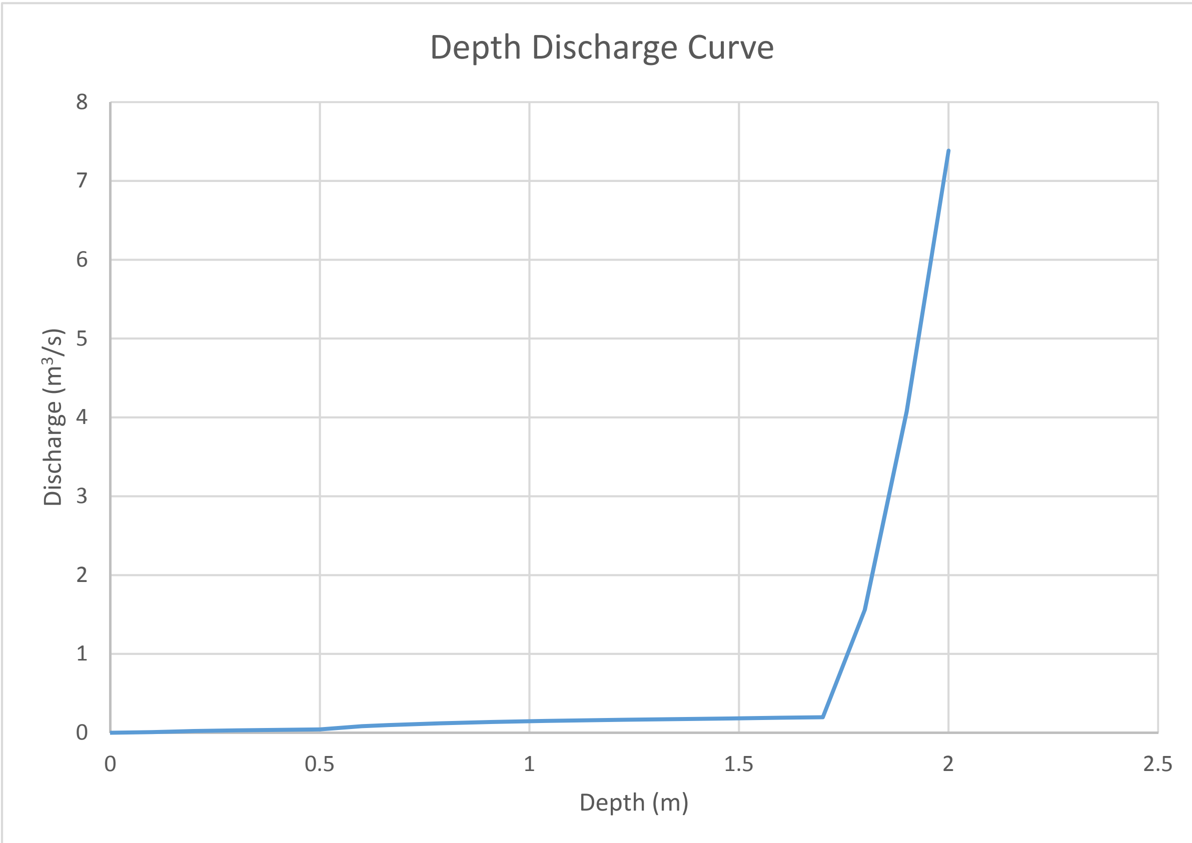
City Pond #53

Grangehill Estates SWM Design Brief
Stanley Consulting October 1998
8787 - Grangehill Subdivision SWM Facility (Appendix B)

Depth	Area
(m)	(m^2)
0	7260
0.1	7260
0.2	7590
0.3	7910
0.5	8510
0.6	8730
0.7	8950
0.8	9170
0.9	9390
1	9610
1.1	9830
1.2	10050
1.3	10270
1.4	10490
1.5	10740
1.6	11020
1.7	11310
1.8	11590
1.9	11880
2	12150

Depth	Outflow
(m)	(m^3/s)
0	0
0.1	0.007
0.2	0.022
0.3	0.031
0.4	0.037
0.5	0.043
0.6	0.083
0.7	0.106
0.8	0.124
0.9	0.135
1	0.145
1.1	0.154
1.2	0.162
1.3	0.17
1.4	0.177
1.5	0.184
1.6	0.19
1.7	0.196
1.8	1.558
1.9	4.077
2	7.384



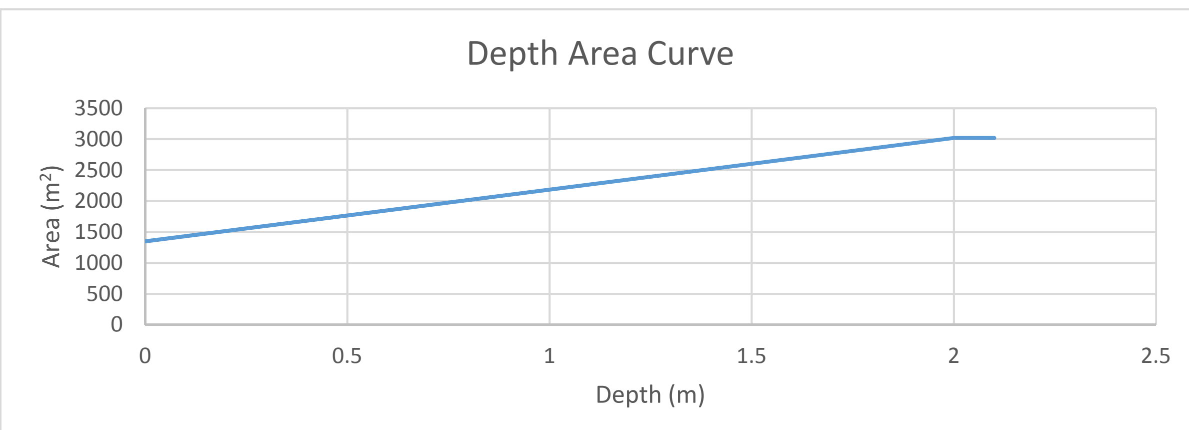

Depth Discharge Curve
Discharge (m³/s)
0
1
2
3
4
5
6
7
8
0
0.5
1
1.5
2
2.5
Depth (m)

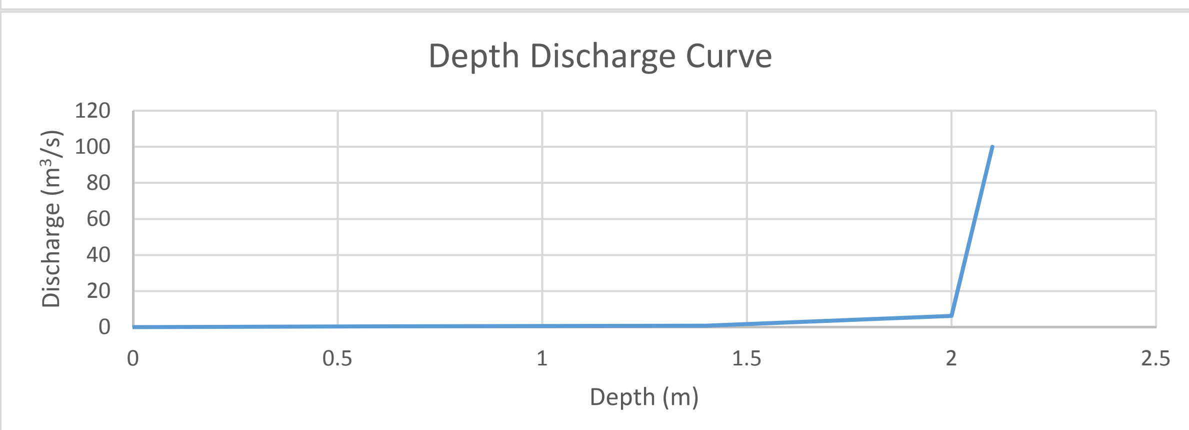
City Pond #54

CheltonWood Subdivision
S.W.M. Pond Detail
DWG SWM-6

Depth	Area
(m)	(m^2)
0	1350
2	3020
2.1	3020

Depth	Outflow
(m)	(m^3/s)
0	0
0.6	0.412
1.4	0.788
2	6.263
2.1	100



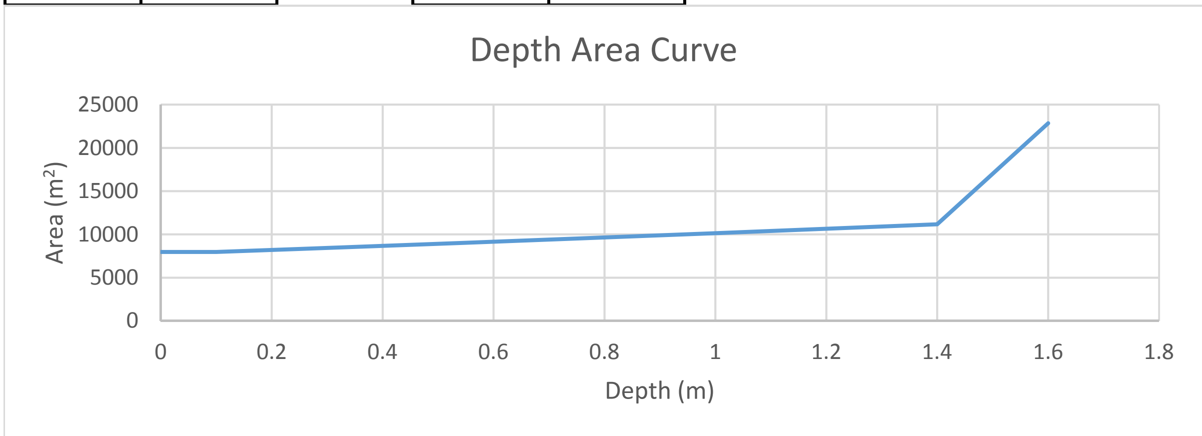


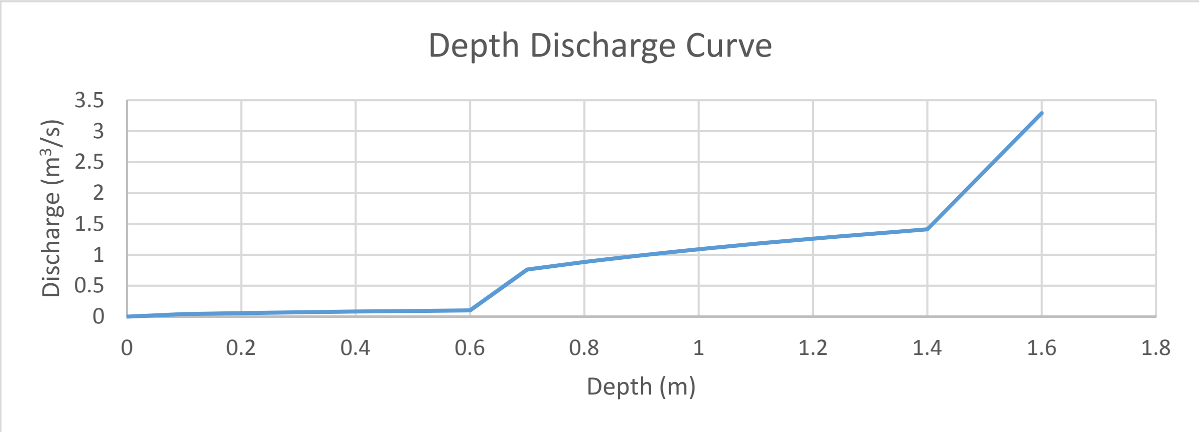
City Pond #86

Watson Pond 2001
excel design calcs date modified 2005

Depth (m)	Area (m^2)
0	7963
0.1	7963
0.2	8197.5
0.3	8433.5
0.4	8672
0.5	8912.5
0.6	9154.5
0.7	9399
0.8	9645.5
0.9	9893.5
1	10143.5
1.1	10396
1.2	10650
1.3	10906
1.4	11164.5
1.6	22849

Depth (m)	Outflow (m^3/s)
0	0
0.1	0.041192
0.2	0.058254
0.3	0.071346
0.4	0.082383
0.5	0.092107
0.6	0.100899
0.7	0.761759
0.8	0.884371
0.9	0.991941
1	1.088936
1.1	1.177972
1.2	1.260735
1.3	1.33839
1.4	1.41178
1.6	3.29098



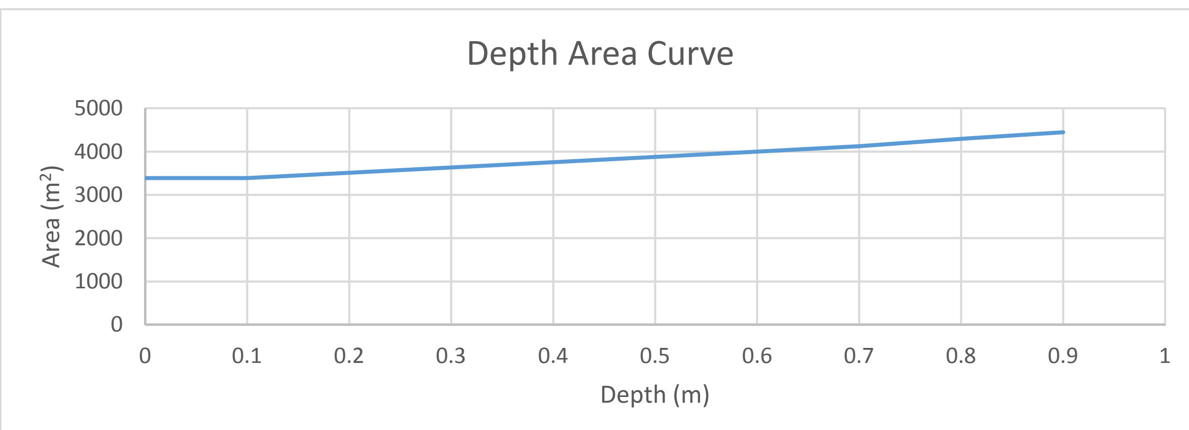


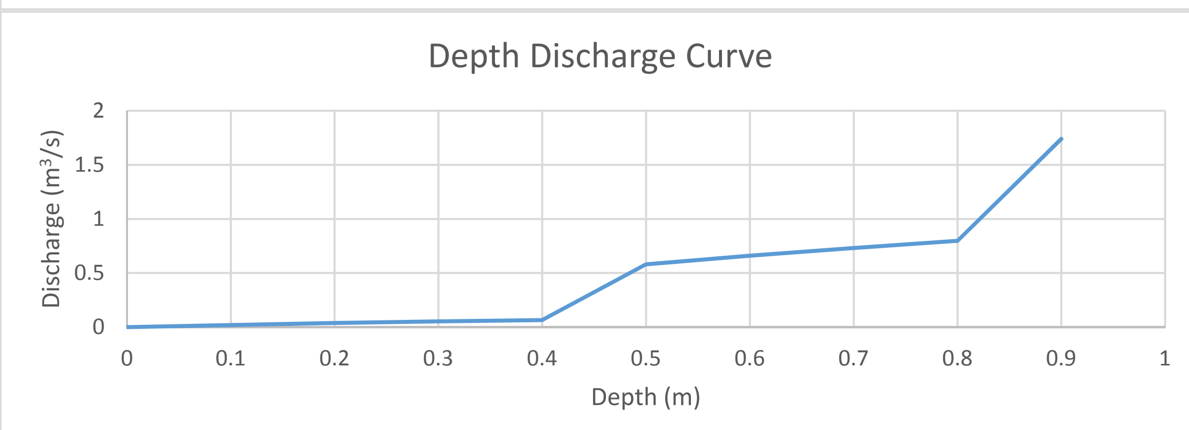
City Pond #87

Watson Pond 1001
excel design calcs dated 2007

Depth	Area
(m)	(m^2)
0	3388
0.1	3388
0.2	3509
0.3	3631
0.4	3754
0.5	3876
0.6	3999
0.7	4124
0.8	4295
0.9	4447

Depth	Outflow
(m)	(m^3/s)
0	0
0.1	0.02
0.2	0.039
0.3	0.054
0.4	0.065
0.5	0.58
0.6	0.661
0.7	0.732
0.8	0.798
0.9	1.74



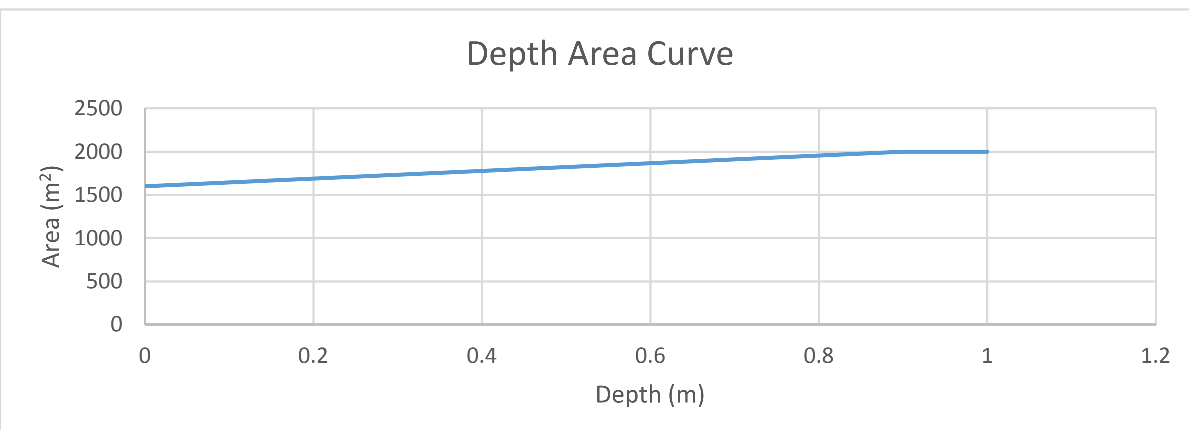


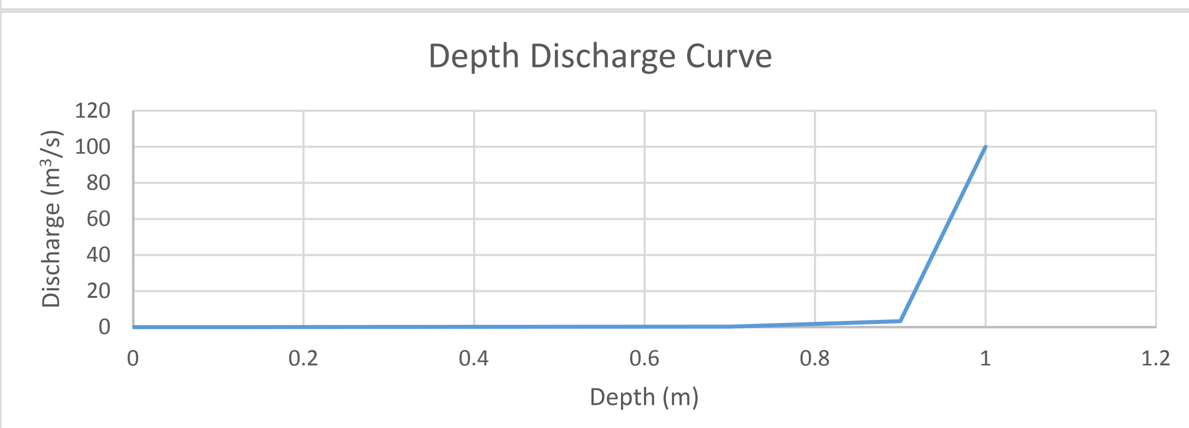
City Pond #88

Watson Creek Subdivision Phase II
SWM Pond 7001
DWG 13

Depth	Area
(m)	(m^2)
0	1600
0.9	2000
1	2000

Depth	Outflow
(m)	(m^3/s)
0	0
0.125	0.008
0.4	0.196
0.7	0.317
0.9	3.275
1	100



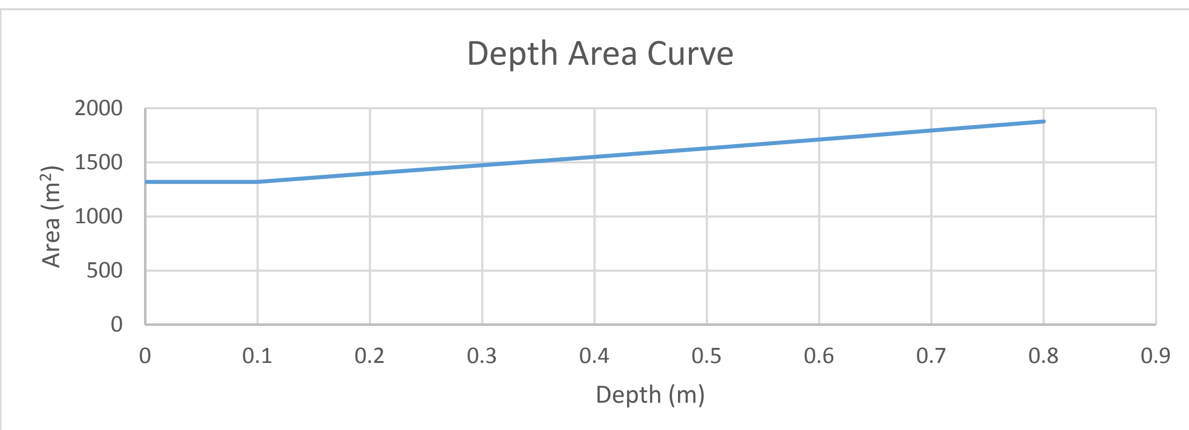


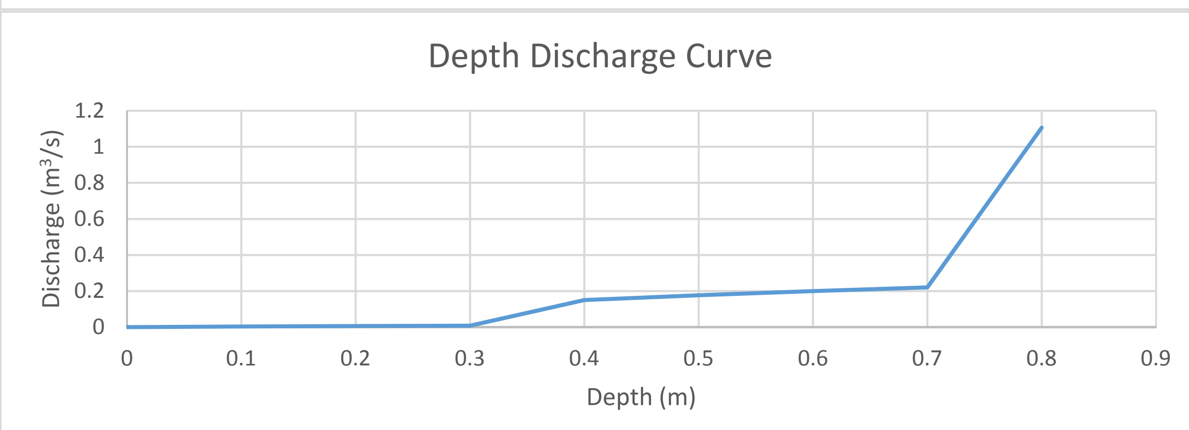
<u>City Pond #111</u>

Watson Pond 4001
excel design calcs dated 2007

Depth	Area
(m)	(m^2)
0	1320
0.1	1320
0.2	1398
0.3	1473
0.4	1551
0.5	1631
0.6	1711
0.7	1794
0.8	1878

Depth	Outflow
(m)	(m^3/s)
0	0
0.1	0.004
0.2	0.006
0.3	0.008
0.4	0.15
0.5	0.177
0.6	0.2
0.7	0.22
0.8	1.106



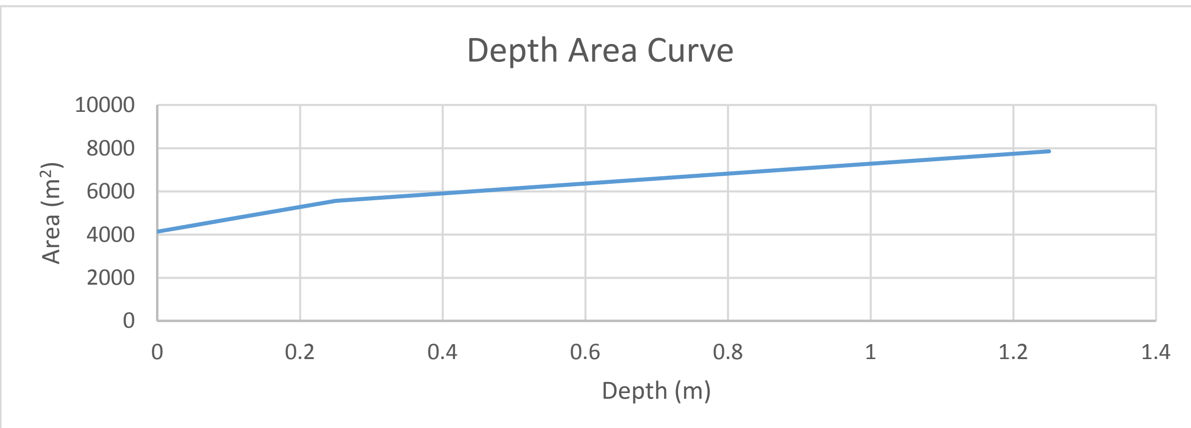


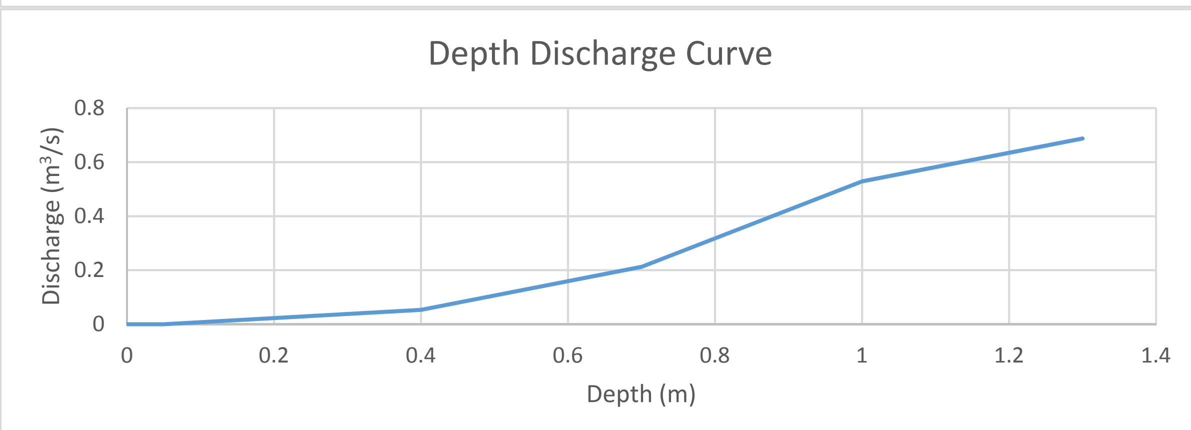
City Pond #115

Grangehill Estates Phase 7 SWM Report
exp February 2012
Design Calcs February 2012

Depth	Area
(m)	(m^2)
0	4140
0.05	4424.6
0.1	4715.74
0.25	5563
0.35	5792.2
0.45	6021.4
0.55	6250.6
0.65	6479.8
0.75	6709
0.85	6938.2
0.95	7167.4
1.05	7396.6
1.25	7855

Depth	Outflow
(m)	(m^3/s)
0	0
0.05	1E-07
0.4	0.05345
0.7	0.2126
1	0.5291
1.3	0.6876



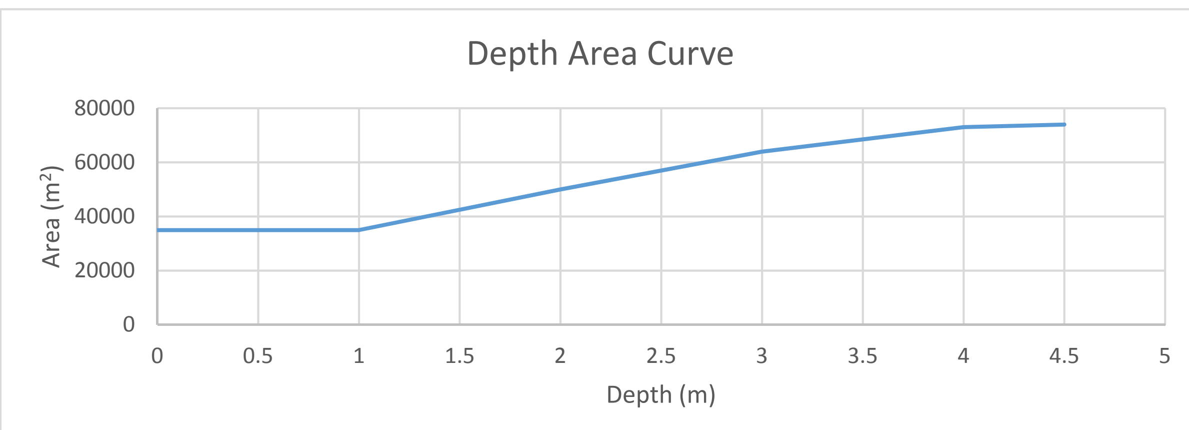


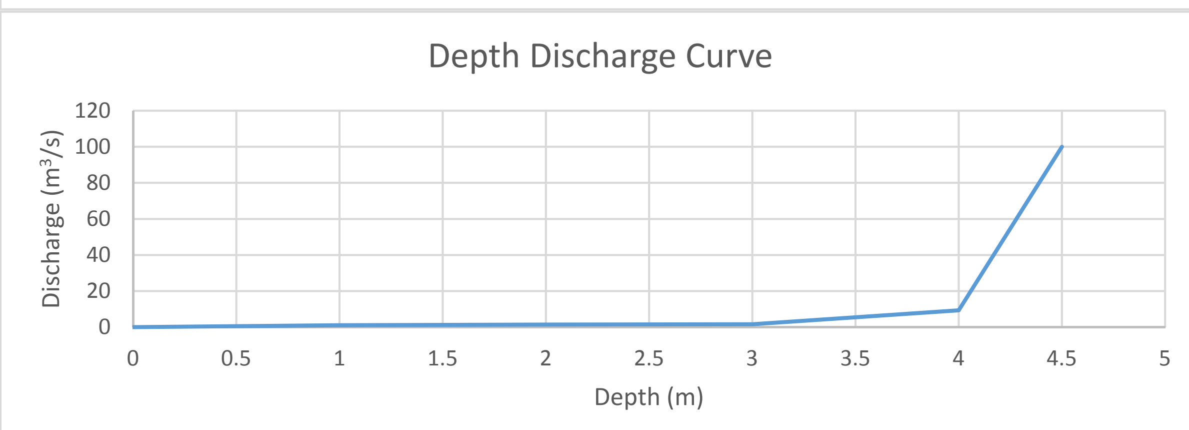
Starwood Drive Online

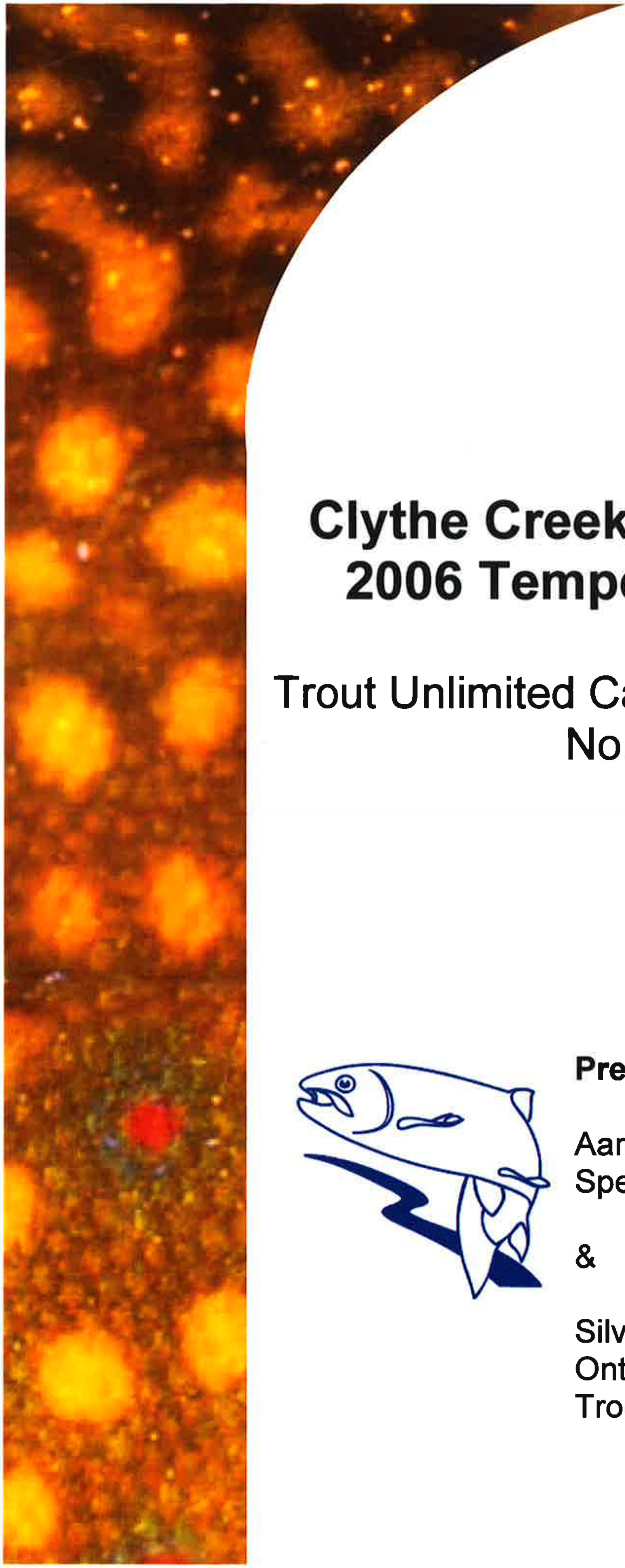
Grangehill Estates Phase 4 SWM RPT
Stantec June 2005

Depth	Area
(m)	(m^2)
0	35000
1	35000
2	50000
3	64000
4	73000
4.5	74000

Depth	Outflow
(m)	(m^3/s)
0	0
1	1.1
2	1.4
3	1.6
4	9.3
4.5	100







Clythe Creek, Guelph, Ontario
2006 Temperature Report

Trout Unlimited Canada Technical Report
No. ON-019

Prepared by:

Aaron Todd, Member
Speed Valley Chapter

&

Silvia D'Amelio
Ontario Provincial Biologist
Trout Unlimited Canada

Clythe Creek, Guelph, Ontario
2006 Temperature Report

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Trout Unlimited Canada

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Background

Clythe Creek is a small watershed (21 km^2) that drains to the Eramosa River on the east side of the City of Guelph. The Eramosa River and its tributaries (including Blue Springs Creek) have some of the highest quality water and stream habitat in southern Ontario.

Historical monitoring studies found coldwater species in Clythe Creek, including brook trout. A 1952 field survey of fish communities in the Speed Valley found brook trout in Clythe Creek at Highway 7 (York Road) and Watson Road North (*GRCA 1953*). The Ontario Ministry of Natural Resources currently classifies Clythe Creek as coldwater habitat.

Land use in the Clythe Creek watershed is dominated by agriculture; however, urban development is expanding in the lower portion of the watershed. The Eramosa-Blue Springs Watershed Study identified Clythe Creek as the most impacted tributary of the Eramosa River due to channel alteration and erosion, removal of riparian vegetation and online ponds and weirs (*Beak International et al. 1999*). These changes typically result in the degradation of water quality including temperature which in turn impacts the aquatic communities within the creek.

Salmonids, especially brook trout, are considered indicators of good water quality. Data collected in this study have been compared to the thermal preferences of brook trout. Though the upper thermal tolerance of brook trout is commonly known to be approximately 24°C (*Power 1980, Grande and Andersen 1991*), the optimal range for physical activity, growth and metabolism is 10-19 °C (*Power 1980* and references therein). Critical temperatures further limit available brook trout habitat at particular life history stages. Summer temperatures should not exceed 16 °C and spawning maximums should not exceed 12 °C with the optimum below 9 °C.

This study investigates the temperature profiles of Clythe Creek to assess its current temperature regimes. Information derived from the temperature profiles will be used in the identification of potential rehabilitation projects and stewardship activities to restore and improve coldwater habitat in Clythe Creek.

Methods

Water temperature monitoring was initiated at four sites (Sites 1-4) in the Clythe Creek watershed in June 2006. Two additional sites (Sites 5 and 6) were added in July 2006 to enhance the spatial resolution of the monitoring. Temperature data were collected at each site until the end of October 2006. The locations of the monitoring sites are illustrated in Figure 1. Photos of the watershed are presented Appendix B.

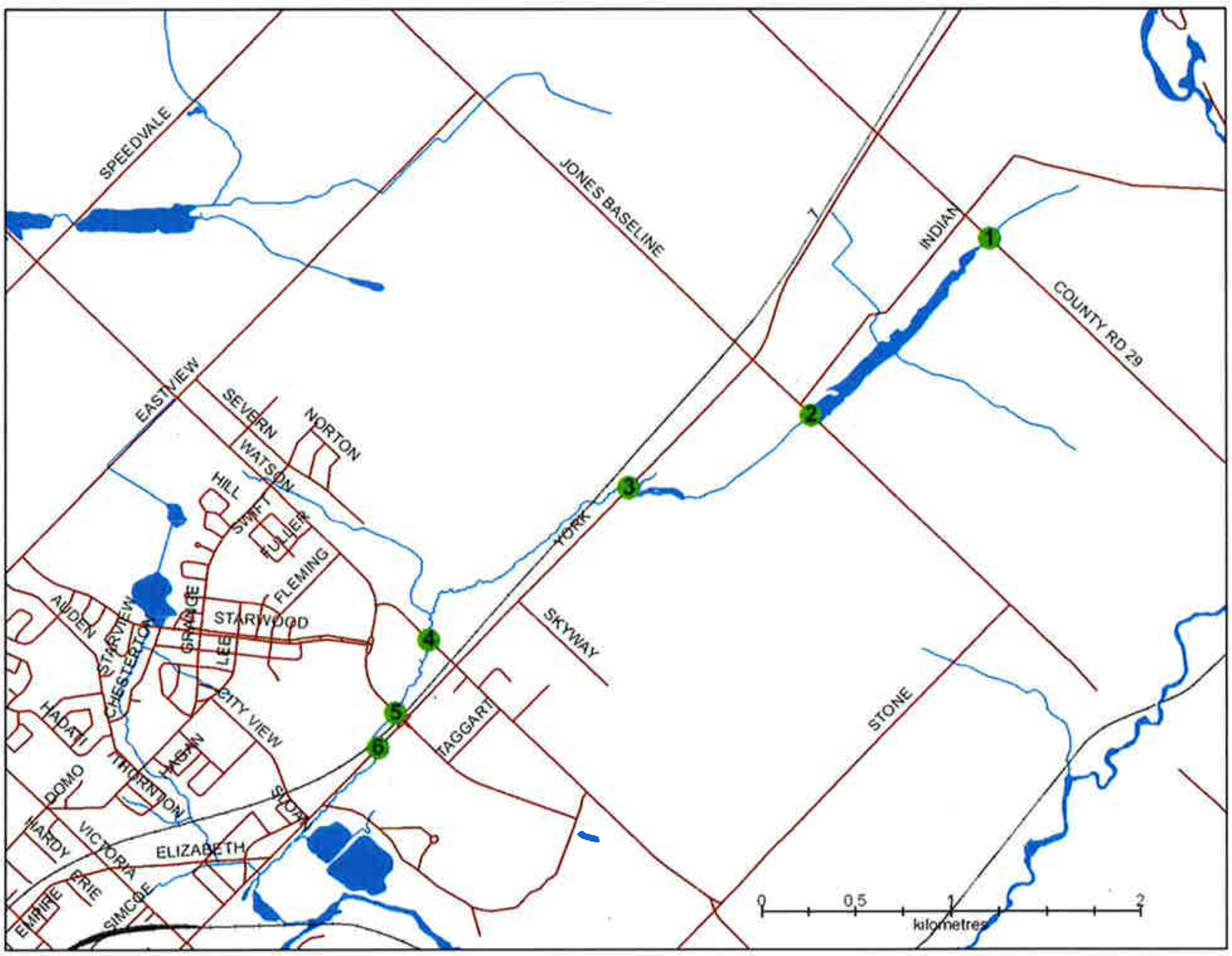


Figure 1: Map of Clythe Creek showing the locations of the sites (number 1 to 6) where water temperatures were monitored in 2006.

Water temperature data were collected at 30 minute intervals using Hobo Water Temp Pro loggers (Onset Computer Corporation). The loggers were periodically retrieved and redeployed throughout the study period to download the data. Logger malfunction resulted in the loss of some data at Site 3. The loggers were attached to a brick or cinder block using cable ties and placed in the centre of the stream channel. Efforts were made to eliminate direct warming from sunlight by placing the loggers in culverts beneath road crossings.

Temperature data were compiled using Microsoft Excel to create a seamless seasonal temperature plot for each location within the Creek. Erroneous data were removed where justification existed (e.g. where the logger was exposed to air due to low water levels, or following removal and before downloading). Daily averages, maximums, minimums and temperature ranges were plotted for each sampling location and compared among sampling sites. Trimean average and maximum temperatures were calculated weekly to identify potential sustained temperature trends. These trends account for the degree of temperature variability during the course of a week and may be indicative of the temperature stress felt by aquatic organisms within the Creek.

Data and Results

Water temperature monitoring results are shown in Figure 2. Monthly minimum, maximum and average water temperatures are shown in Table 1.

Table 1. Monthly minimum (min), maximum (max) and average (avg) water temperatures (°C) for monitoring sites in the Clythe Creek watershed.

	JULY			AUGUST			SEPTEMBER		
SITE	min	max	avg	min	max	avg	min	max	avg
1	9.7	17.1	13.4	9.8	18.1	13.1	8.1	15.2	11.9
2	16.1	29.8	23.1	15.7	32.4	22.1	8.6	23.9	16.1
3				17.2	27.0	21.2	11.1	20.8	16.1
4	15.0	27.1	21.0	13.3	28.3	19.4	8.4	19.7	14.5
5				13.1	28.3	19.2	9.6	19.1	14.7
6				13.1	26.4	18.3	9.5	17.5	14.3

Water temperatures in the headwaters of the Creek (Site 1 - Wellington Road 29) reached a maximum of 18.1 °C on August 3, 2006. Average water temperatures in the headwaters of the Creek for the months of July and August were 13.4 and 13.1 °C, respectively (Figure 2).

Water temperatures increased significantly between Wellington Road 29 (Site 1) and Jones Baseline (Site 2) which is located 1.3 km downstream (Figure 2, 3, 5, 8, 9 and 10). A maximum temperature of 32.4 °C was reached at Site 2 on August 1 (Figure 3). Average temperatures for the months of July and August at Site 2 were 23.1 and 22.1 °C, respectively (Figure 5).

Daily ranges and hourly rates of change are greatest at Site 2 (Figure 6 and 7). Trimean maximum and average temperatures illustrate that all sites except Site 1 reach lethal temperatures for brook trout (Figure 9 and 10).

All sites downstream of Site 1 are classified as warm or warm/cool water habitats, whereas Site 1 is clearly a coldwater section (Figure 11).

Site 2 displays an extremely high frequency of days of sustained high temperatures, but the frequency decreases with downstream sites (Figure 12).

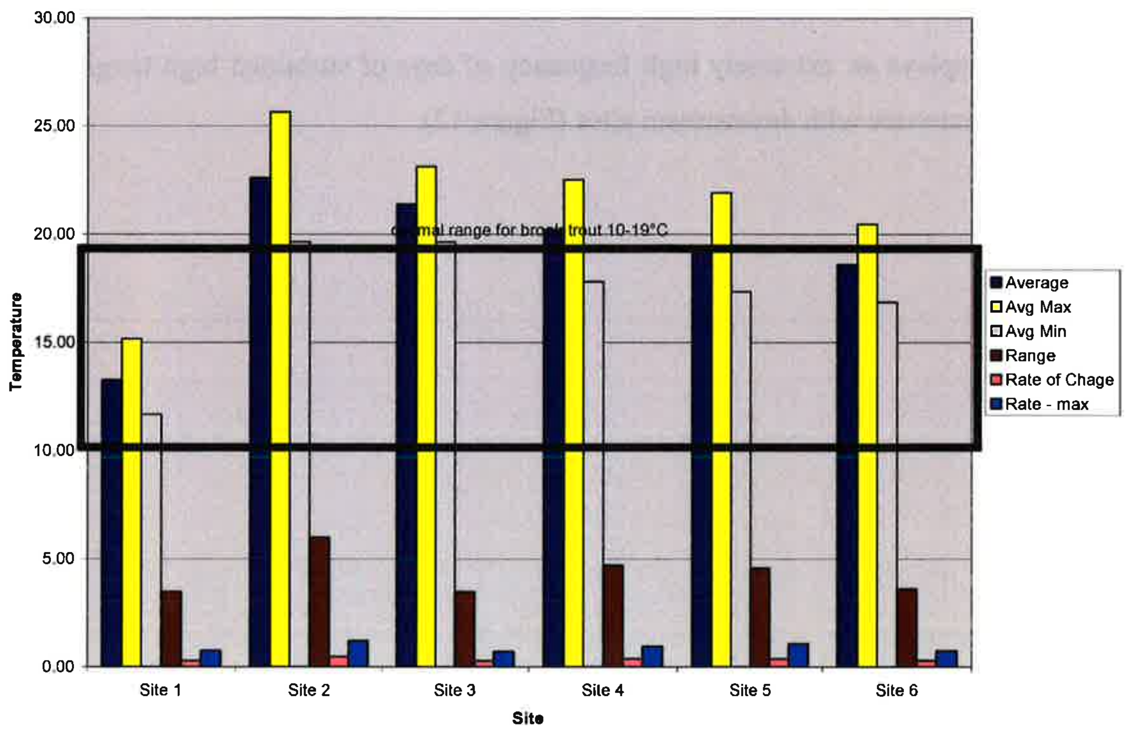


Figure 2: Summary of summer data from all sites. Average daily temperature, average maximum and minimum temperature, average daily range, average daily rate of change and absolute maximum rate of change were calculated for July and August.

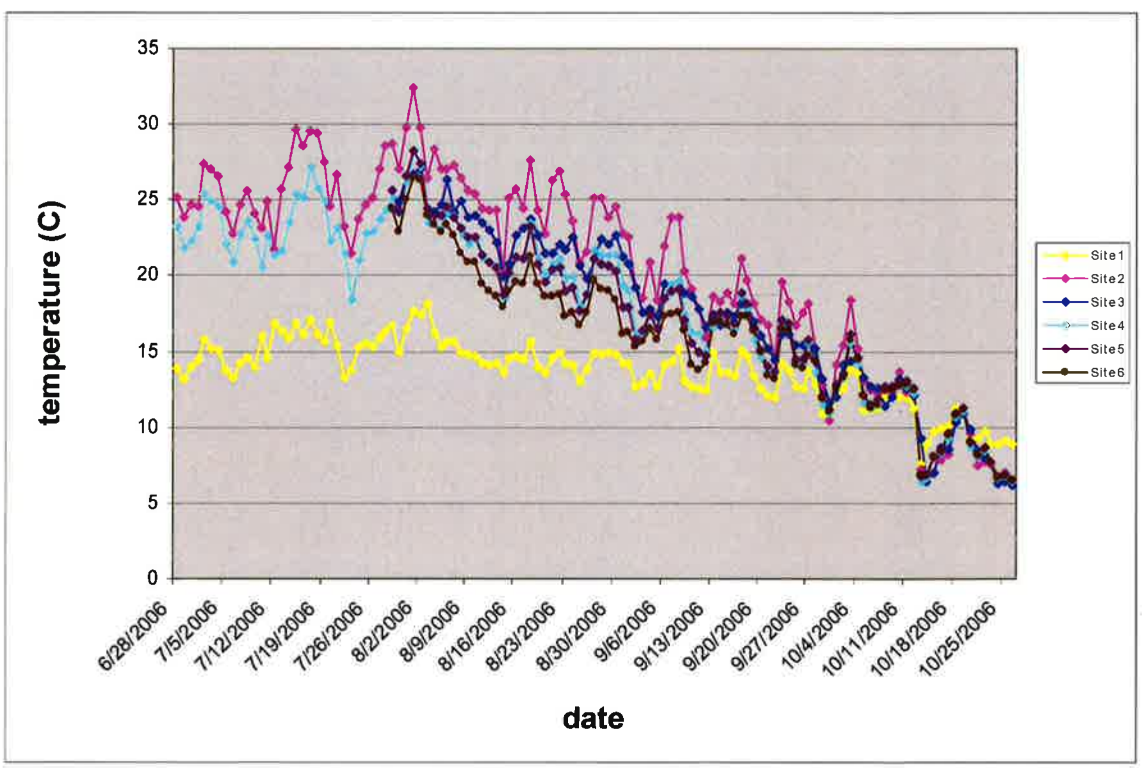


Figure 3: Maximum daily temperature. Sites are listed upstream (Site 1) to downstream (Site 6).

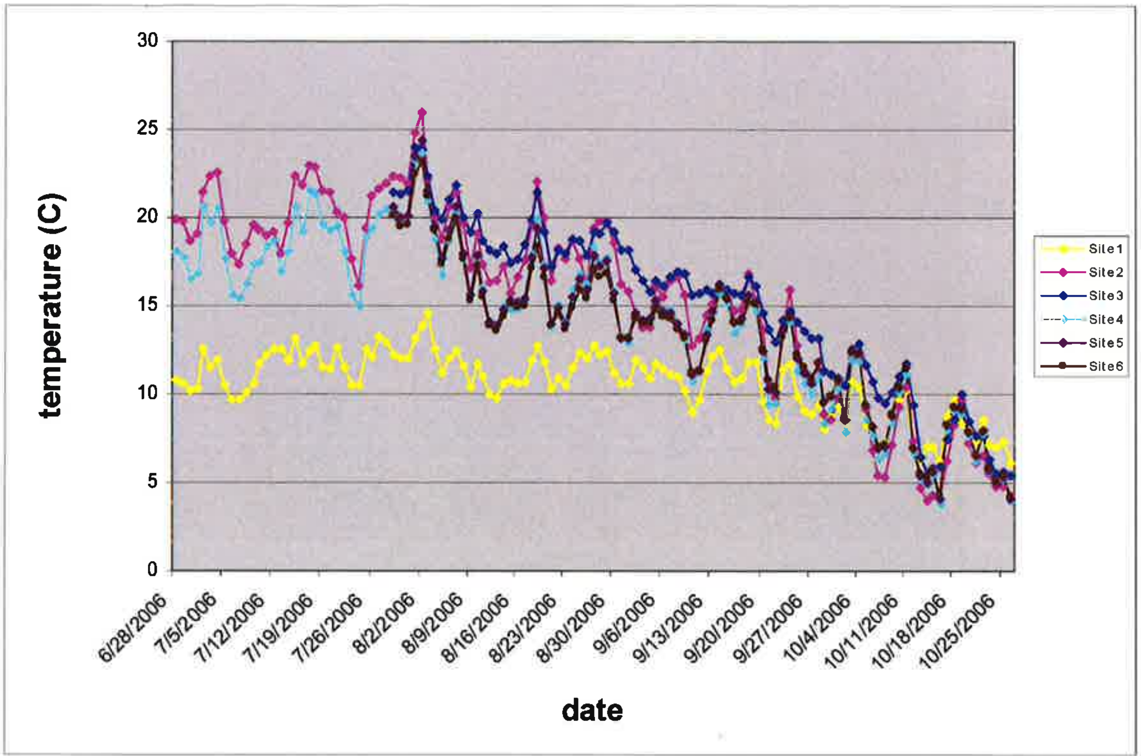


Figure 4: Minimum daily temperature.

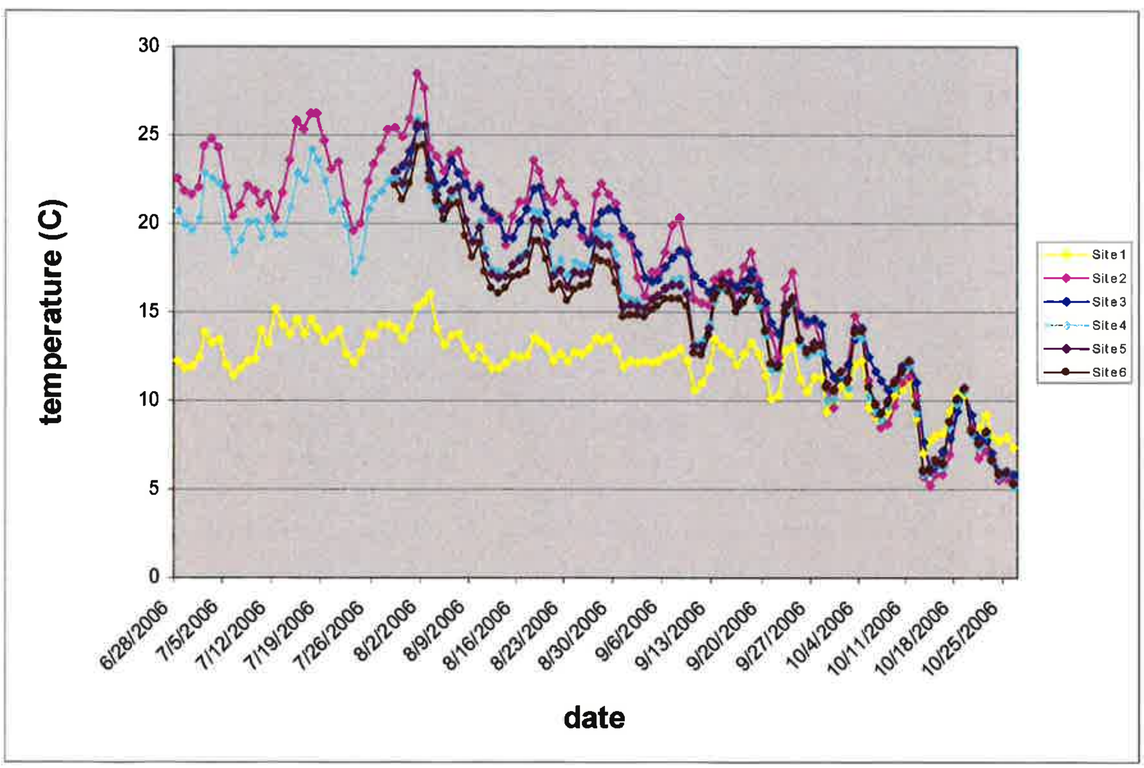


Figure 5: Average daily temperature.

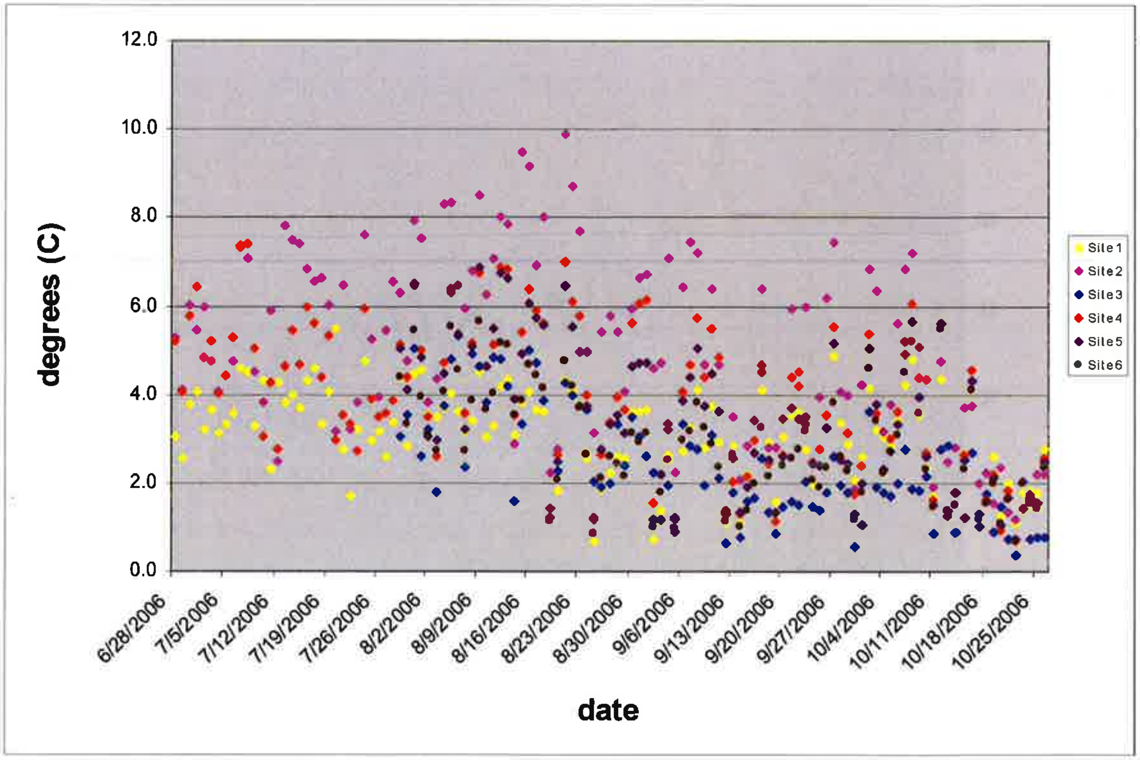


Figure 6: Daily range in temperature.

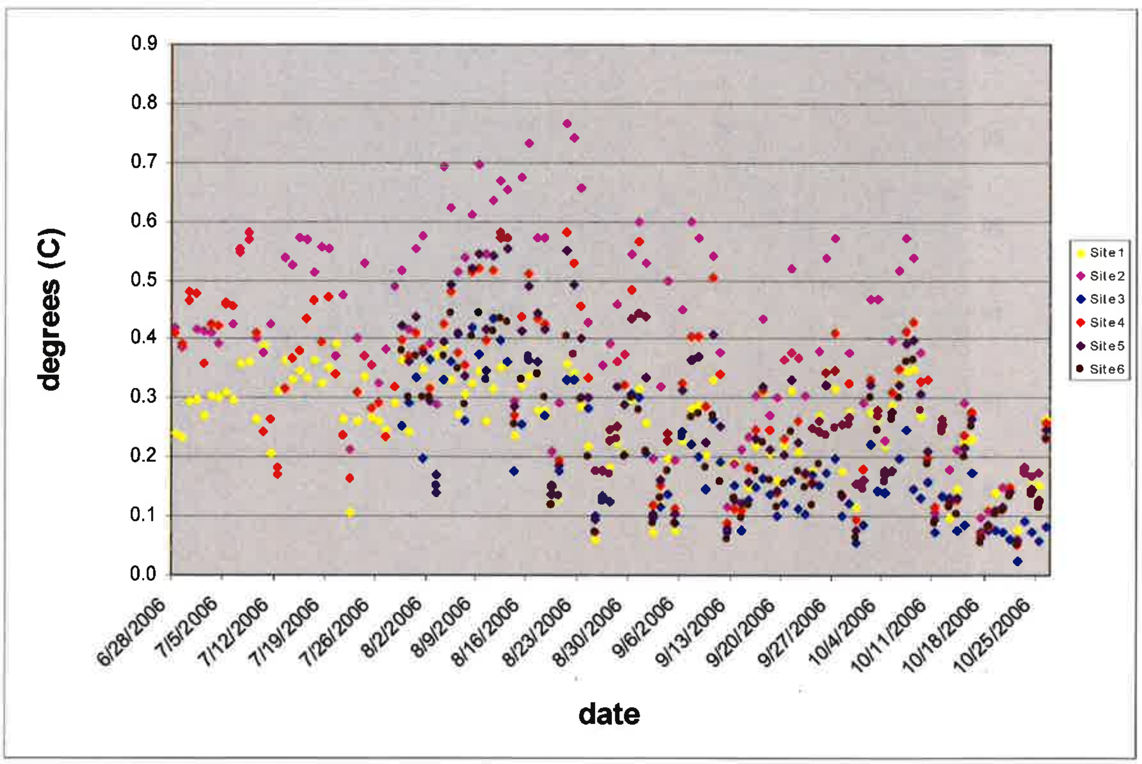


Figure 7: Daily average hourly rate of change in temperature.

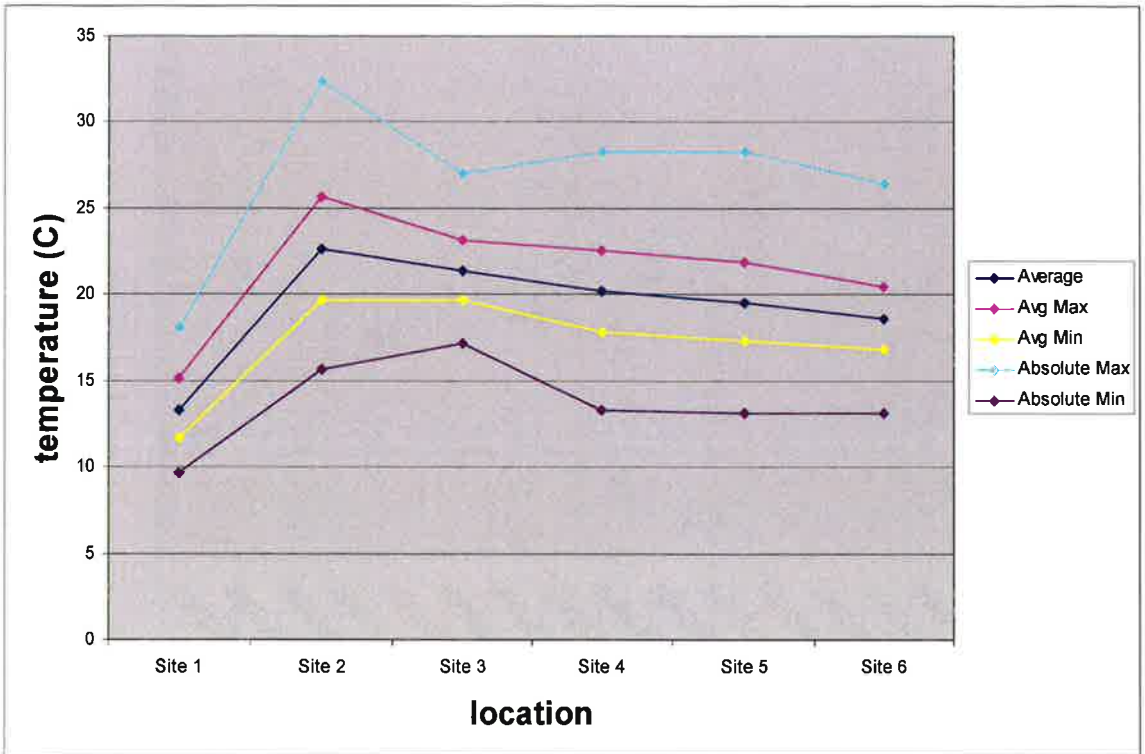


Figure 8: Longitudinal chart showing change in temperature from upstream to downstream during the summer months (July and August).

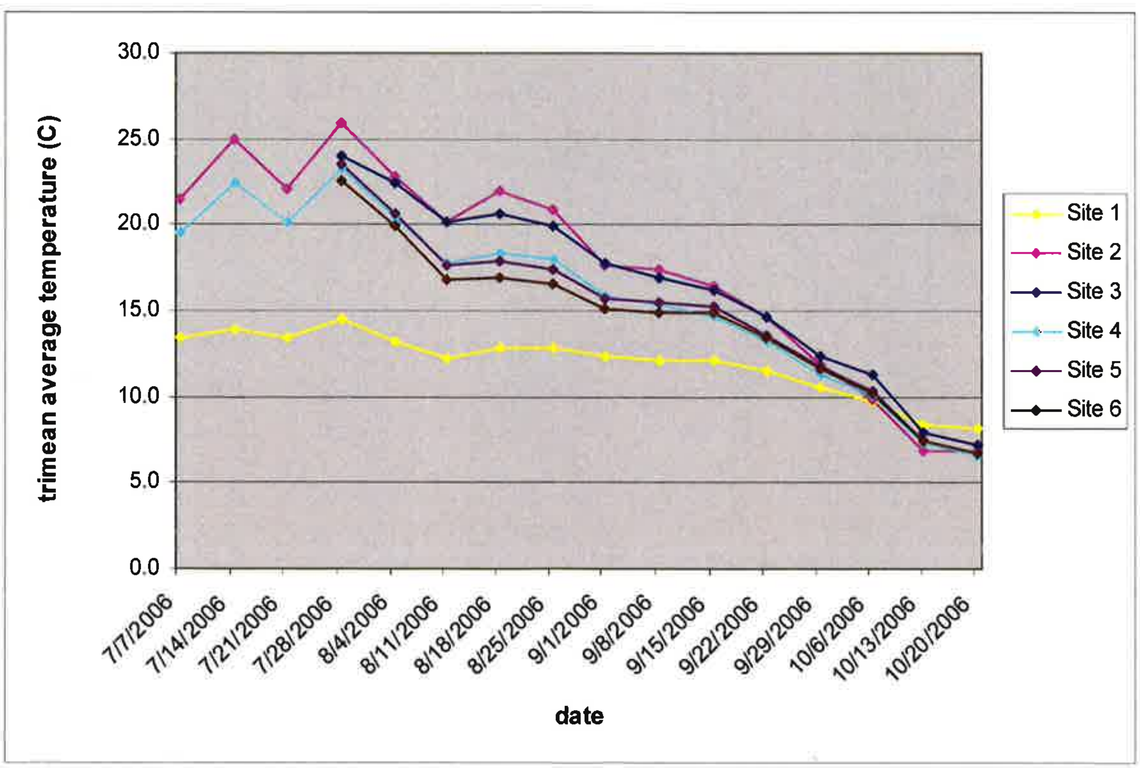


Figure 9: Trimean weekly average temperatures by site.

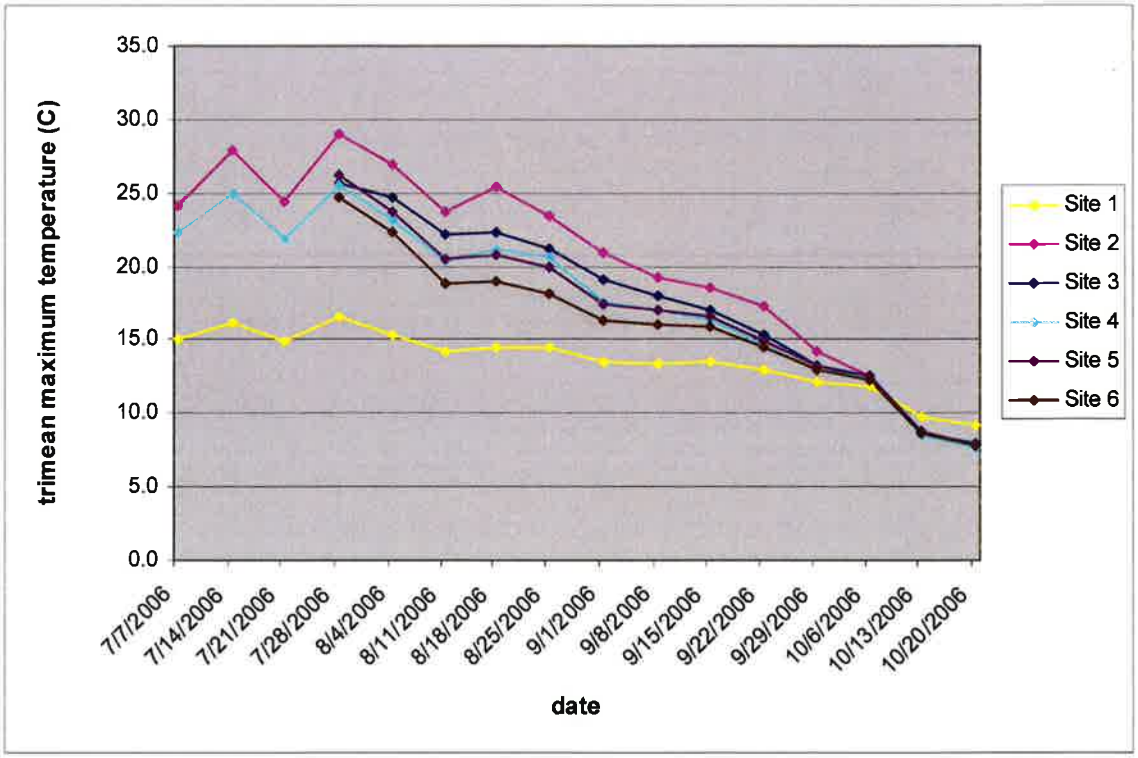


Figure 10: Trimean weekly maximum temperatures by site.

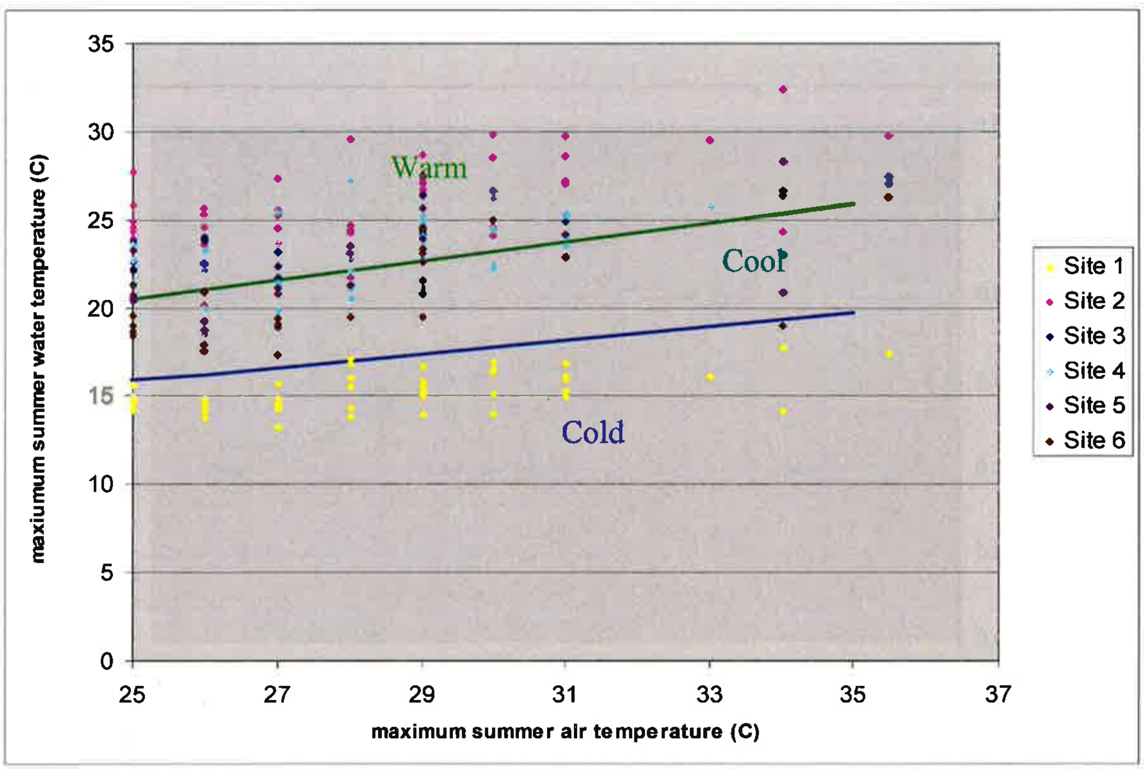


Figure 11: Stream classification of all sites (format from Stoneman and Jones 1996). Sites plotted below blue line classify as cold water, between blue and green classified as cool water and above green classified as warm water sites.

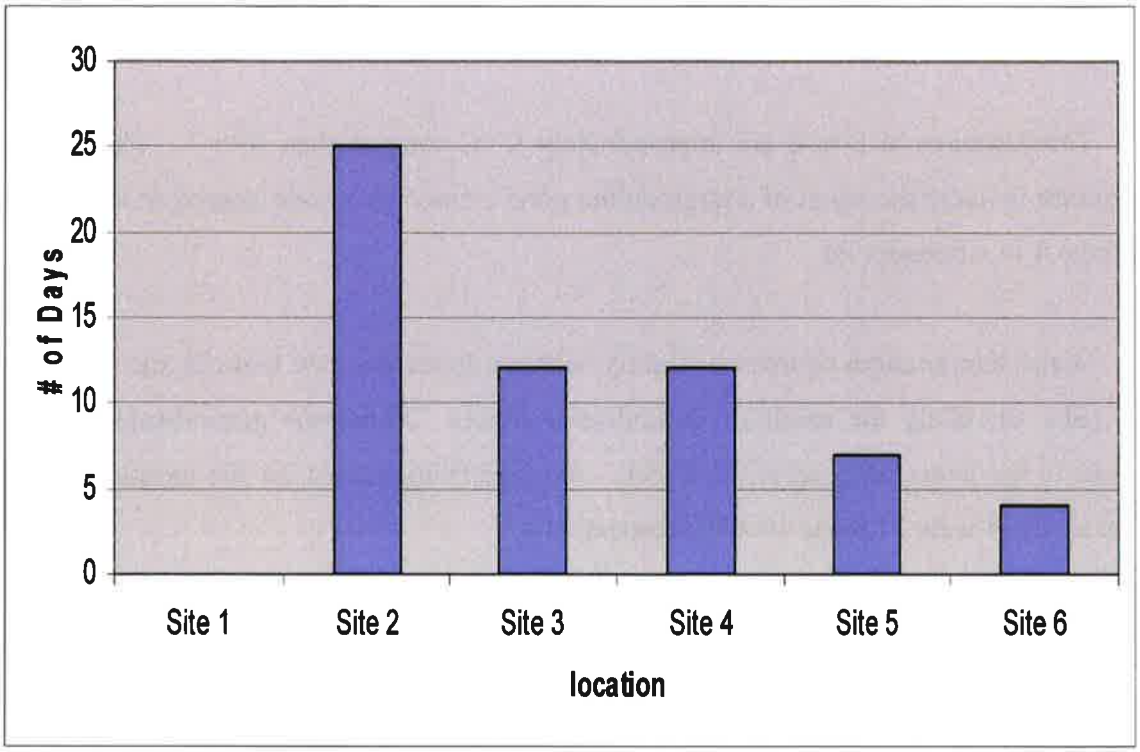


Figure 12: Number of days by site where temperatures ≥ 20°C were sustained for a 24h period.

Implications

Temperatures at Site 2 are approximately 9 °C warmer than Site 1. The increase in temperature is likely the result of a large online pond created by a weir located at Jones Baseline (see Photo 1 in Appendix B).

Water temperatures decreased slightly between Jones Baseline (Site 2) and Watson Road North (Site 4); likely the result of groundwater inputs. Numerous groundwater seeps were observed in the lower sections of the Creek. Average temperatures for the months of July and August at Site 4 were 21.0 and 19.4 °C, respectively.

The combination of cold headwaters at Site 1 and the cooling of the creek due to coldwater inputs downstream of Site 2 illustrate significant potential for coldwater restoration. The removal of the barrier and associated impoundment just upstream of Site 2 would allow for the movement of coldwater further down the system. The coldwater inputs may mitigate general warming of the system allowing this creek to be cooled from top to bottom.

Additional potential thermal inputs have been identified downstream of Site 2. The effects of these inputs will be much better understood with the mitigation of Site 2. For example the slight increase in temperatures between Sites 3 and 4 can be investigated more clearly when the confounded effects of the upstream impoundment are removed.

It is recommended that the temperature loggers are redeployed in 2007 to collect another season of data and to enhance spatial resolution to assess specifically the impact of online ponds. In addition, the collection of water quality (chemistry) information at strategic locations would be beneficial in the assessment of the influence of land use activities; specifically the impacts of storm water management ponds in the developing lower portion of the watershed.

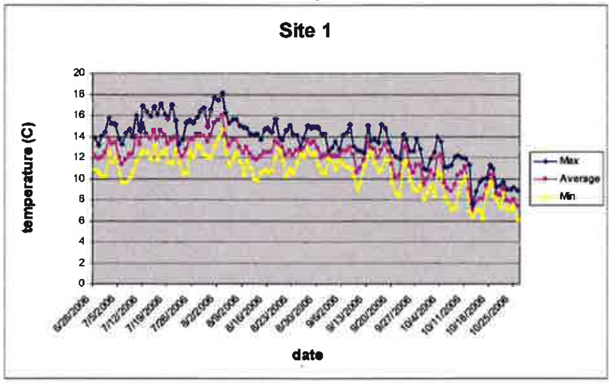
Based on these data it would be beneficial to survey the fish community composition in selected sections of the Creek to identify remnant coldwater communities. Sections sampled should include upstream of Wellington Road 29 (Site 1) and between Highway 7 (Site 3) and Watson Road North (Site 4). These are the most likely areas to support remnant populations of coldwater species. The results should be compared to historical surveys to assess changes in community composition.

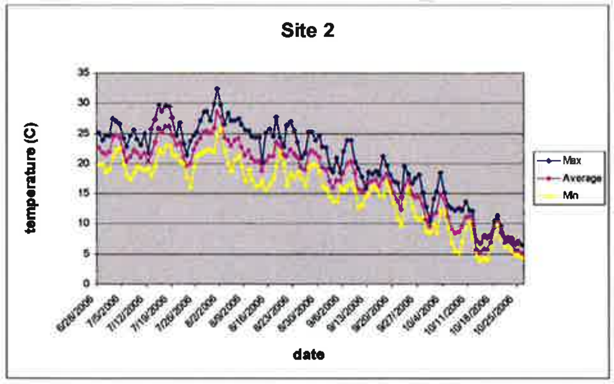
Acknowledgements

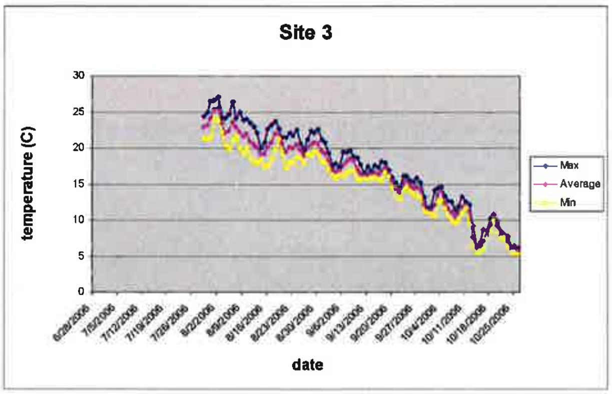
The late Walt Crawford provided the inspiration for this study.

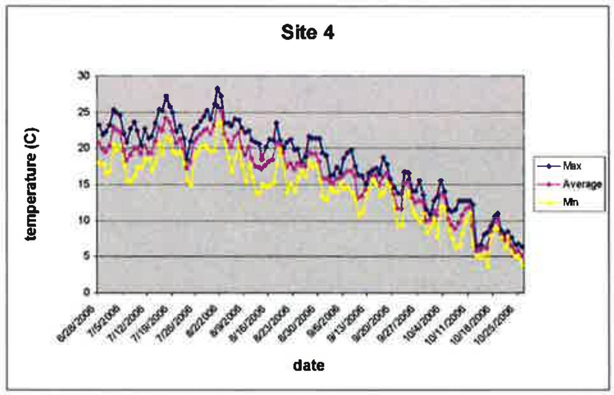
The Environmental Monitoring and Reporting Branch of the Ontario Ministry of the Environment provided the water temperature loggers used in this study.

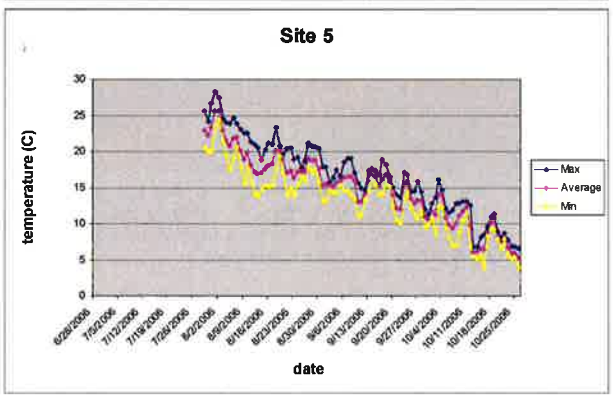
Appendix A: Individual Site Data
Displaying Daily Maximum, Average & Minimum Temperatures

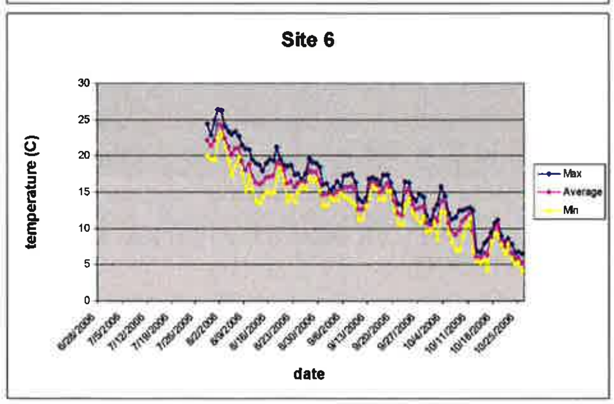












Appendix B: Site Photographs

Photo 1: Large online pond created by a weir at Jones Baseline. The pond is located downstream of Site 1 and immediately upstream of Site 2. The pond is likely the primary cause of the observed increase in water temperature.

Photo 2: Dense vegetation downstream of Jones Baseline (Site 2) presents a challenge to exploring the Creek. A pump used for taking water for the irrigation of a garden was observed in the Creek just downstream of Site 2.

Photo 3: Dense riparian vegetation typical of the Creek between Highway 7 (Site 3) and Watson Road North (Site 4). Groundwater seeps were observed in this section of Creek and watercress was observed in the channel.

Photo 4: The Creek meanders through a wetland immediately upstream of Watson Road North (Site 4). Hills to the north of the Creek have been cleared for development (construction in progress) and storm water ponds have been constructed.

Photo 5: Perched culvert at Watson Road North (Site 4) presents a significant barrier to fish migration. Large schools of minnows (and minnow traps) can usually be observed in the pool below the culvert.

Photo 6: Sections of the Creek between Watson Road North (Site 4) and Watson Parkway (Site 5) have been channelized; however, the Creek is relatively narrow with areas of gravel streambed and some riparian cedar trees.

Photo 7: Damselfly observed in the section of Creek between Watson Road North (Site 4) and Watson Parkway (Site 5). Various insects hatches were observed over the summer in this section of the Creek.

Photo 8: Storm water management pond collects runoff from the developing portion of the watershed near Starwood Drive and Grange Road. The pond discharges to the Creek just upstream of Watson Parkway (Site 5).

Photo 9: Discharge from the storm water pond was consistently turbid throughout the summer. Water quality in Clythe Creek was noticeably impacted and sedimentation of the Creek channel downstream of the pond outlet was observed.

Photo 10: The Creek flows through a small patch of dense cedar forest between Watson Parkway (Site 5) and Highway 7 (Site 6). Numerous groundwater seeps can be found in this area. Sedimentation of the Creek channel is evident.

Photo 11: A long, dual-channelled, concrete culvert diverts the Creek from the north to the south side of the railway line.

Photo 12: The Creek passes under Highway 7 (Site 6) and flows along the north side of the highway toward its confluence with the Eramosa River. This section of the Creek is highly altered with numerous dams, weirs and ponds.

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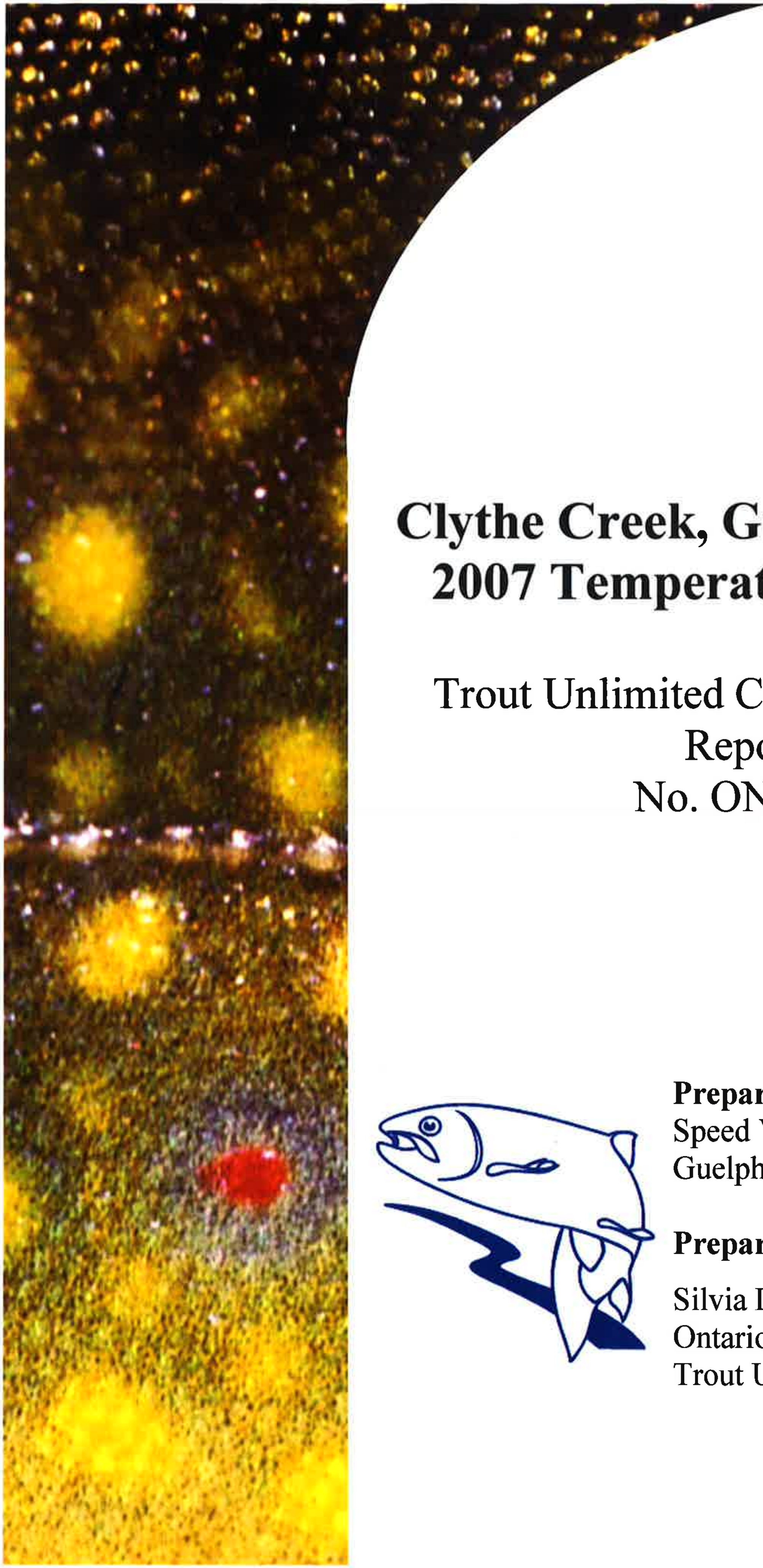

Clythe Creek, Guelph, Ontario
2007 Temperature Report

Trout Unlimited Canada Technical Report
No. ON-036

Prepared for:
Speed Valley Chapter
Guelph

Prepared by:

Silvia D'Amelio
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Background

Clythe Creek is a small watershed (21 km^2) that drains to the Eramosa River on the east side of the City of Guelph. The Eramosa River and its tributaries (e.g. Blue Springs Creek) have some of the highest quality water and stream habitat in southern Ontario.

Historical monitoring studies found cold water species in Clythe Creek. A 1952 field survey of fish communities in the Speed Valley found brook trout in Clythe Creek at Highway 7 (York Road) and Watson Road North (GRCA 1953). As a result, the Ontario Ministry of Natural Resources has classified Clythe Creek as coldwater habitat.

Land use in the Clythe Creek watershed is dominated by agriculture. However, urban development is expanding in the lower portion of the watershed. As a result, the Eramosa-Blue Springs Watershed Study identified Clythe Creek as the most impacted tributary of the Eramosa River. This is mainly due to channel alteration and erosion, removal of riparian vegetation and online ponds and weirs (Beak International et al. 1999). These types of changes typically result in the degradation of water quality, including temperature, which has negative impacts on aquatic communities in the creek.

Salmonids, especially brook trout, are often considered indicators of good water quality. Therefore the data collected from this study will be compared to the thermal preferences of brook trout documented in scientific literature. Although the upper thermal tolerance of brook trout is commonly known to be approximately 24°C (Ricker 1934, Power 1980, Grande and Andersen 1991), it has been well documented that their preferred range is 4°C to 20°C (Power 1980 and references therein). In order to better understand a brook trout's ability to fully and efficiently utilize its environment, it is necessary to understand that neither of these temperature ranges illustrates optimums for specific life stages. The optimal range for physical activity, growth and metabolism is 10°C to 19°C (Baldwin 1948, Graham 1949, MacCrimmon and Campbell 1969, Power 1980 and references therein, Dwyer et al 1983) with trout selecting a preferred range of 15°C to 17°C (Cherry et al. 1975). Optimal maximum temperatures to sustain a healthy brook trout population are 18°C to 19°C (Powers

1929, Creaser 1930, Ferguson 1958) and they actively avoid areas where temperatures approach 24°C (Meisner 1990). Critical temperatures further limit available brook trout habitat at particular life history stages. During the summer season, temperatures should not exceed 19°C and spawning maximums should not exceed 12°C with the optimum range of 6°C to 8°C (Hokanson 1973, Witzel and MacCrimmon 1983). It is well documented that temperature affects swimming performance and the overall cost of swimming. As a result, increases in temperature lead to increases in critical swimming velocity (Heggenes and Traaen 1988, Tang and Boisclair 1995).

This study investigates the temperature profiles of Clythe Creek to assess its current temperature regimes. In addition, the temperature profiles derived from the data will be utilized to identify future rehabilitation projects. The goal of this study is expand the monitoring program initiated in 2006 and to provide information for the restoration and maintenance of cold water habitats in Clythe Creek.

Methods

Temperature data loggers (Hobo Water Temp Pro loggers produced by Onset Computer Corporation) were launched at 17 sites in Clythe Creek, Blue Springs Creek and the Eramosa River. The locations of the monitoring sites are illustrated in Figure 1. For data analysis, sites are labelled by their stream and site number (C = Clythe Creek, E = Eramosa, BS = Blue Springs). Site C18 was located in the outflow of a stormwater management pond which drains directly into Clythe Creek.

Water temperature data were collected at 30 minute intervals. These data were compiled using Microsoft Excel to create seamless seasonal temperature plots for each location within the tributary. Data were summarized and daily averages, maximums, minimums and temperature ranges were plotted for each sampling location and compared among sampling sites. Additionally, longitudinal trends were compared among years and stream classification was identified using a method outlined by Stoneman and Jones (1996). Trimean average and maximum temperatures were calculated weekly to identify potential sustained temperature trends. These trends account for the degree of temperature variability within the system during the course of a week and may be more indicative of the actual temperature stress felt by aquatic organisms within the system. Baldwin (Hansen 2001) showed that a Trimean maximum of 22°C correlates to an overall maximum of 25.6°C, well over brook and brown trout tolerances.

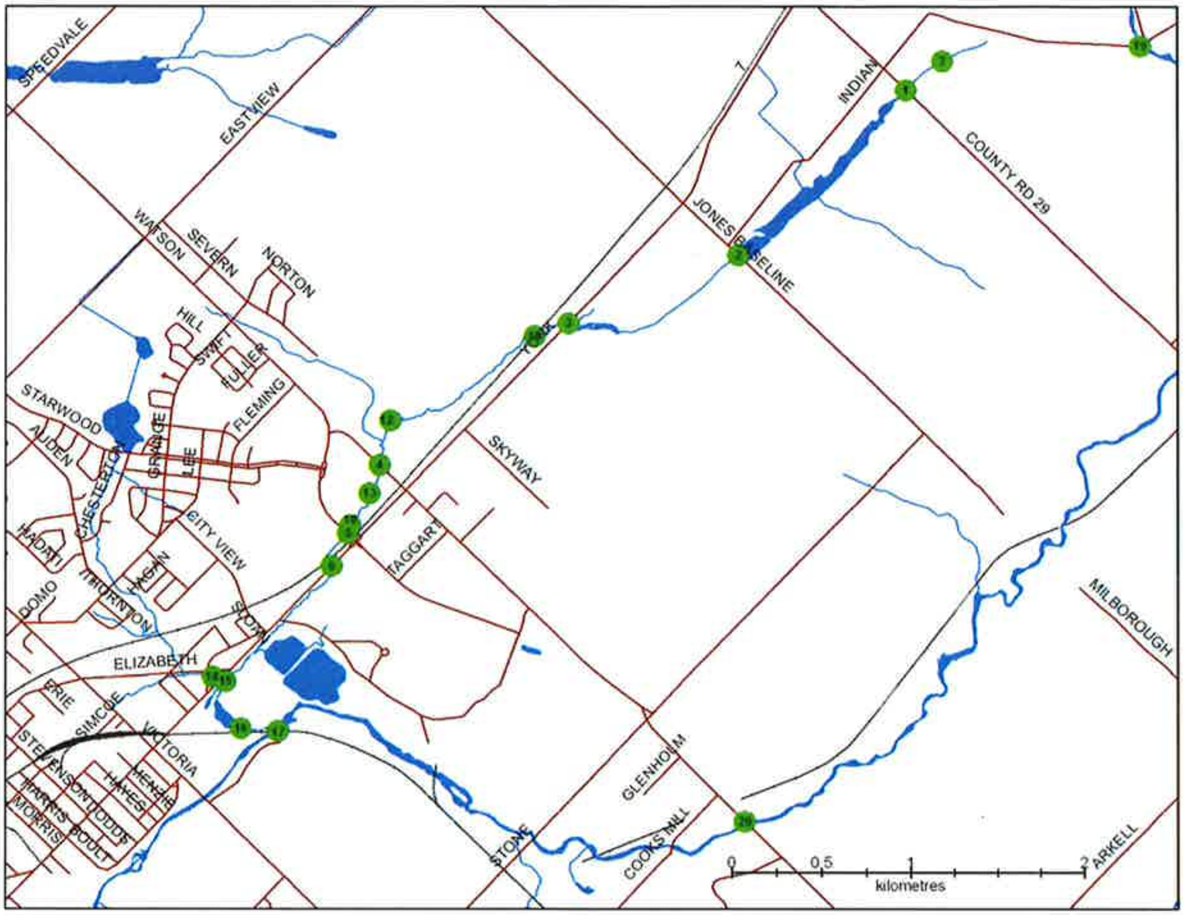


Figure 1: Study Site – Clythe Creek temperature monitoring locations (locations are approximate).

Data and Results

Of the 17 logger launched, 14 were retrieved and successfully downloaded. Water temperatures were captured from May 30 to November 21, 2007. Sites 14, 6 and 20 were either lost or were not retrievable due to water level changes. A cursory review of data collected revealed profiles consistent with air and not water temperatures for a portion of the monitoring period, at some sites. As a result data from sites C13, C18, C5, C15 and BS21 was removed prior to analysis.

For the period spanning July and August, summary data for Clythe Creek display optimal average, maximum and minimum temperatures for trout in its upper reaches, sites C7 and C1 (Figure 2). Sites C2 through E20 display average maximum temperatures above optimum, but most C2, C12, C4, C13, C18, C5 and C16, display minimum temperatures with the optimum range (Figure 2). Interestingly, temperatures generally rise from site C7 to C13 but fall at site C12 and again at C5 before rising significantly at site C15 (Figure 2). Sites in the Eramosa River (E17 and E20) display relatively high temperatures outside of the optimal range for brook trout. The most significant temperature difference exists between sites C1 and C2 (Figure 2). The single site in Blue Springs Creek (BS21) displays temperatures well within the optimum for brook trout (Figure 2).

Detailed daily temperatures reveal the highest maximum daily temperature recorded in Clythe Creek surpassed 30°C at site C2 at the end of June and at sites C4 and C13 at the beginning of August (Figure 3). Sites C15 and E16 also showed high daily temperatures and peaked at 29°C and 28°C respectively (Figure 4). Sites Site C7 maintained maximum daily temperatures below 16°C for the entire sampling period (Figure 3). Sites C7, C1 and BS21 were the only sites that did not reach lethal temperatures for book trout (Figures 3 and 4). All sites, except for C7 and C1, maintained maximum daily temperatures between 15° and 32° C from May to the beginning of October, with most surpassing 25 °C frequently (Figures 3 and 4).

Minimum daily temperatures for sites C3, C18, C16, E17 and E20 are often at or above 20°C (Figures 5 and 6). Sites C2, C12, C4, C13 and C5 display minimum daily temperatures that reach 20°C but do not sustain these high temperatures (Figures 5 and 6). Sites C7, C1 and BS2 never reach a minimum temperature of 20°C.

The average daily temperatures for sites C7, C1 and BS21 are consistently below 20°C for the entire sampling period (Figures 7 and 8). All other sites exceed 20°C, with sites C2, C18, C16 and E17 reaching or exceeding 25°C for short periods of time (Figures 7 and 8). Maximum, minimum and average daily temperatures show a decreasing trend for all sites from mid-September to the end of November (Figures 3, 4, 5, 6, 7, and 8). The single most significant difference in temperature between neighbouring sites was observed between C1 and C2 (Figures 3, 5, and 7). Site C18 (stormwater management pond outflow) displays the greatest degree of variability, relatively hot in June and August, but cooler in July (Figures 4, 6 and 8).

The highest daily range and daily average hourly rate of change in temperature was recorded at sites C4, C13 and C18 (Figures 9 and 10). Sites C7 and C3 showed consistently the least amount of variation in daily average hourly rate of change in temperature (Figures 9 and 10). The greatest variability in range and rate of change was observed at C18 (Figures 9 and 10).

According to the stream classification developed by Stoneman and Jones (1996), Figure 14 shows that sites C1 and C7 are classified as cold water. However, the remaining temperature monitoring sites show that Clythe Creek is classified as cool to warm water due to overlap between warm and cool water classifications for most sites (Figure 11). E17 displays a warm water classification, while E20 is mixed warm-cool (Figure 11). BS21 displays a cool to cold water classification (Figure 11).

The longitudinal profile for Clythe Creek indicates that water temperatures generally increase from C7 to C3 but minimum temperatures decrease from C7 to C1 (Figure 12). Average, minimum and absolute minimum temperatures also decrease from C3 to C4, while maximums and absolute maximums increase (Figure 12). An increase from C4 to C13 is followed by a decrease to C18 and a narrowing of range to C5 (Figure 12). Temperature increases again to C15 before one final decrease to C16 (Figure 12). The most significant increase in temperature is between sites is between C1 and C2 (Figure 12). Data from 2006 (Todd and D'Amelio 2006) show that average, minimum and absolute minimums are lower in 2007, whereas maximums and absolute maximums show no consistent trends in comparison with 2007 (Figure 12).

Trimean averages at C2, C3, C18, C15, C16 and E17 surpass the 22°C maximum for brief periods (Figure 13). All other sites remain below the maximum (Figure 13). Trimean maximums above 22°C were observed at all sites with the exception of C7, C1 and BS21 (Figure 14).

Sites C3, C18 and C2 showed the greatest numbers of days where temperatures were greater than or equal to 20°C for a 24h period with a total of 14, 13 and 9 days respectively (Figure 15). Sites C1, C7 and BS21 did not experience any days where temperatures were greater than or equal to 20°C for a 24h period (Figure 15).

Summary Plots

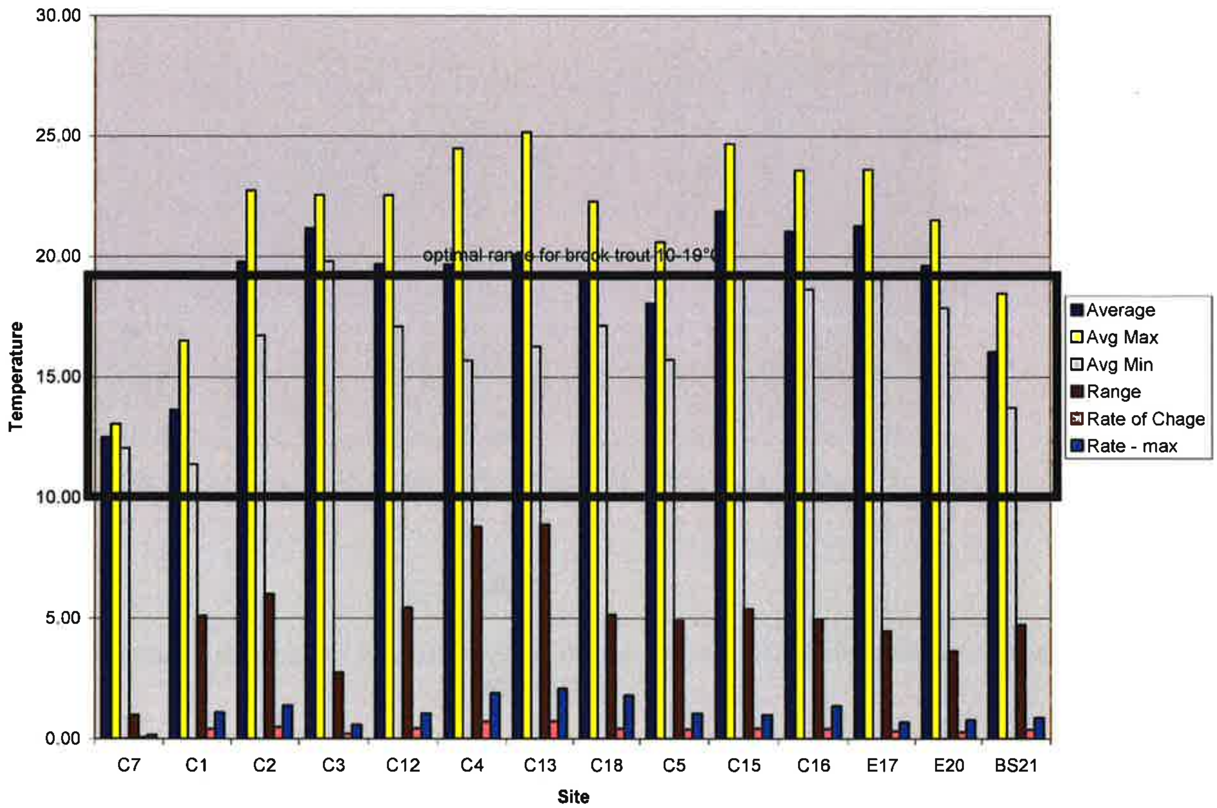


Figure 2: Summary of summer data from all sites. Average daily temperatures, average maximum and minimum temperatures, average daily range, average daily rate of change and absolute maximum rate of change were calculated for July and August.

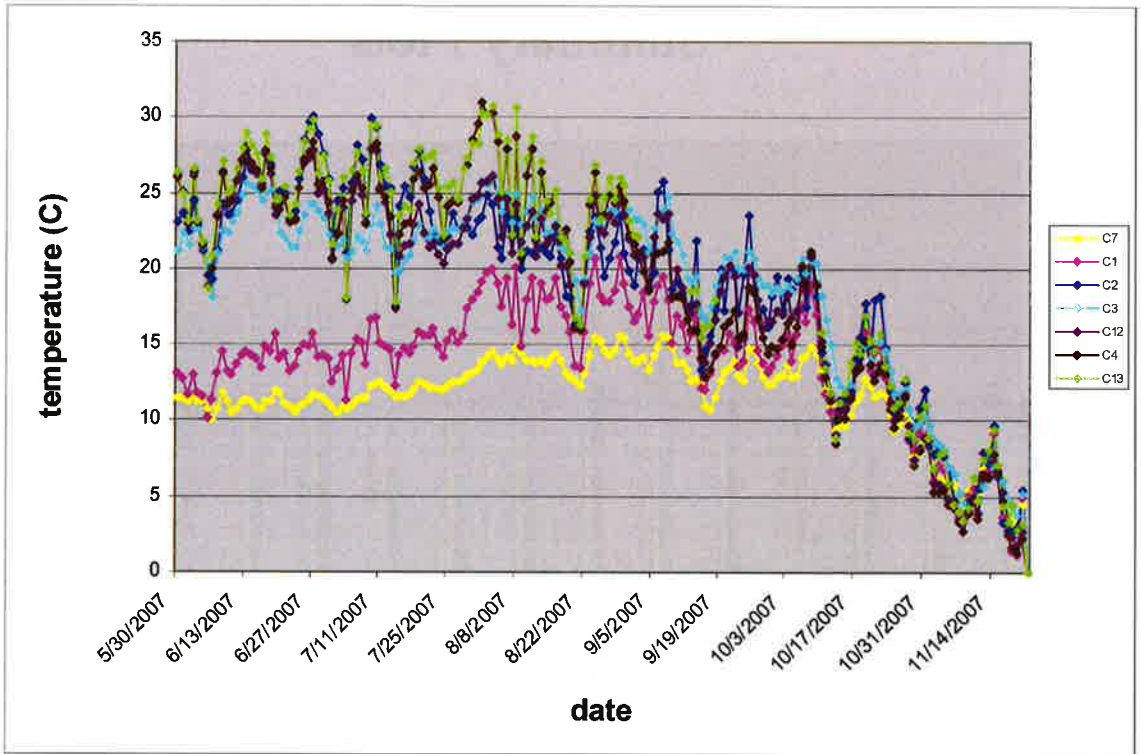


Figure 3: Maximum daily temperature for Clythe Creek (sites C7 to C13 are listed upstream to downstream).

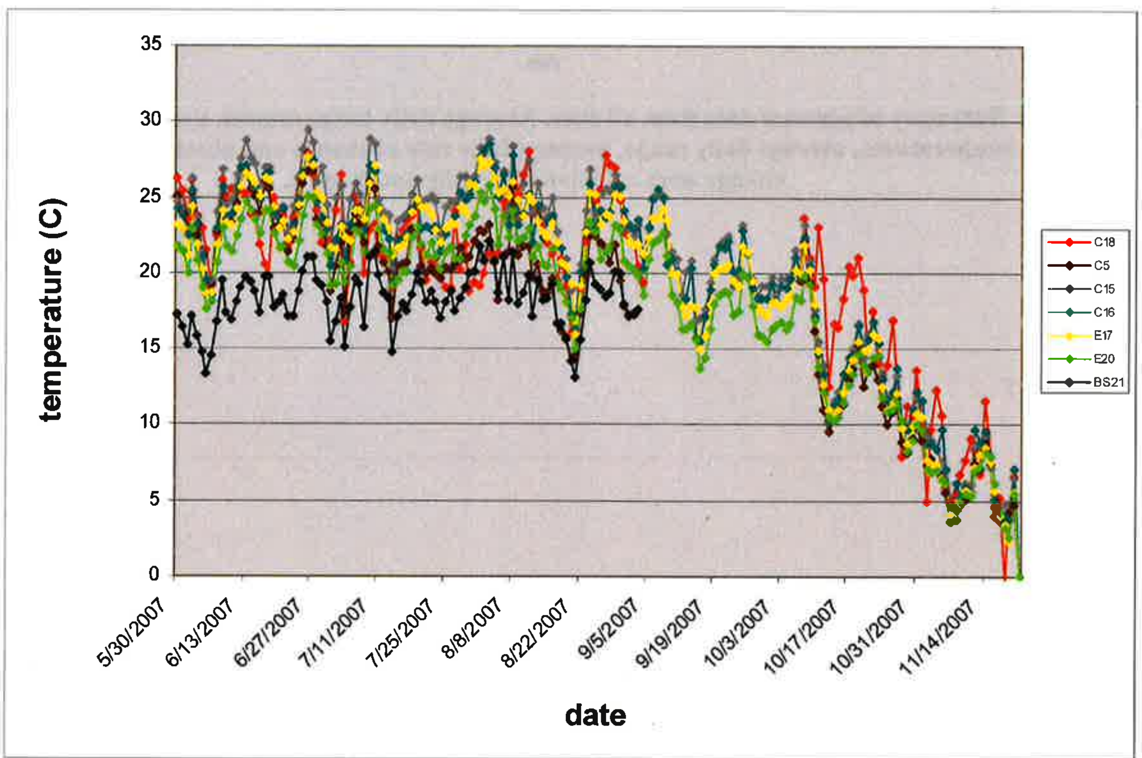


Figure 4: Maximum daily temperature for Clythe Creek (sites C18 to BS21 are listed upstream to downstream).

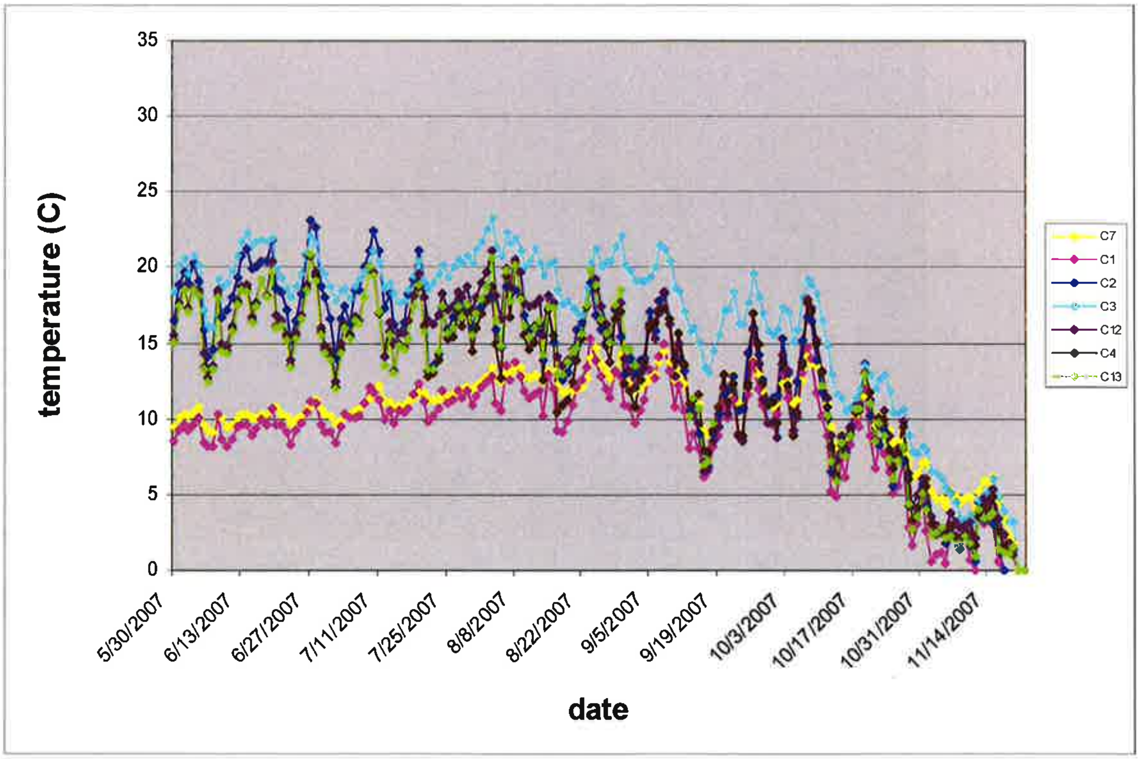


Figure 5: Minimum daily temperature for Clythe Creek (sites C7 to C13 are listed upstream to downstream).

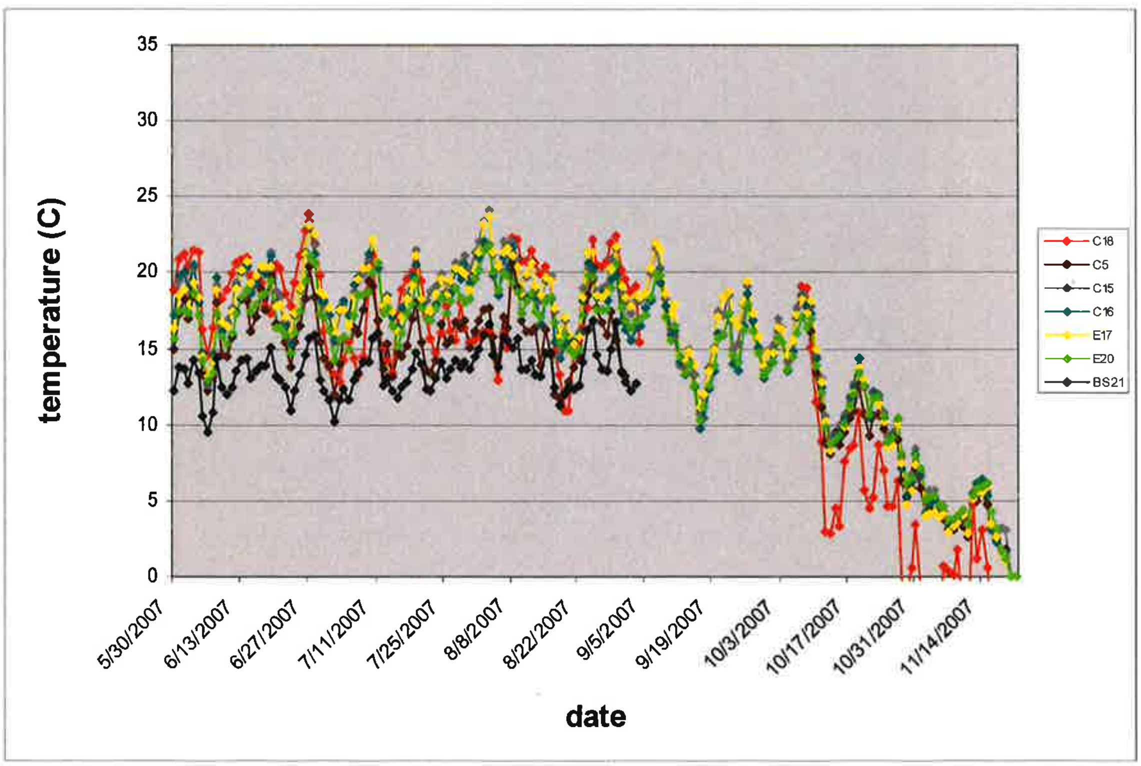


Figure 6: Minimum daily temperature for Clythe Creek (sites C18 to BS21 are listed upstream to downstream).

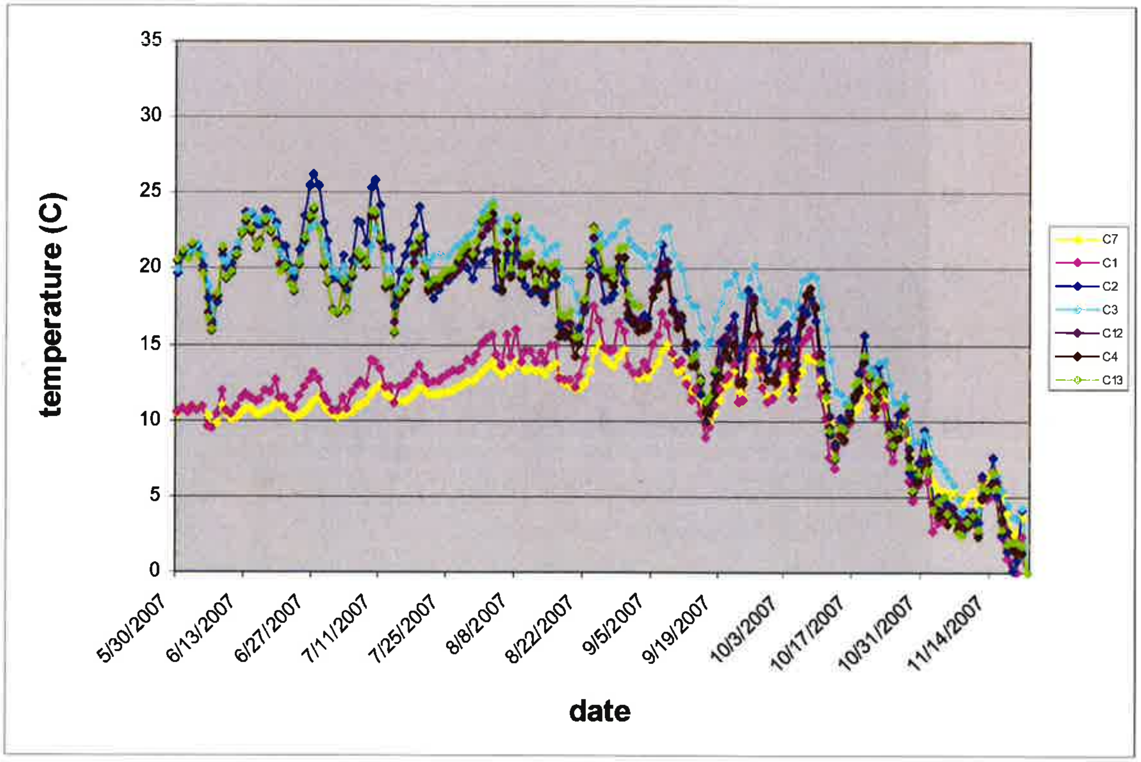


Figure 7: Average daily temperature for Clythe Creek (sites C7 to C13 are listed upstream to downstream).

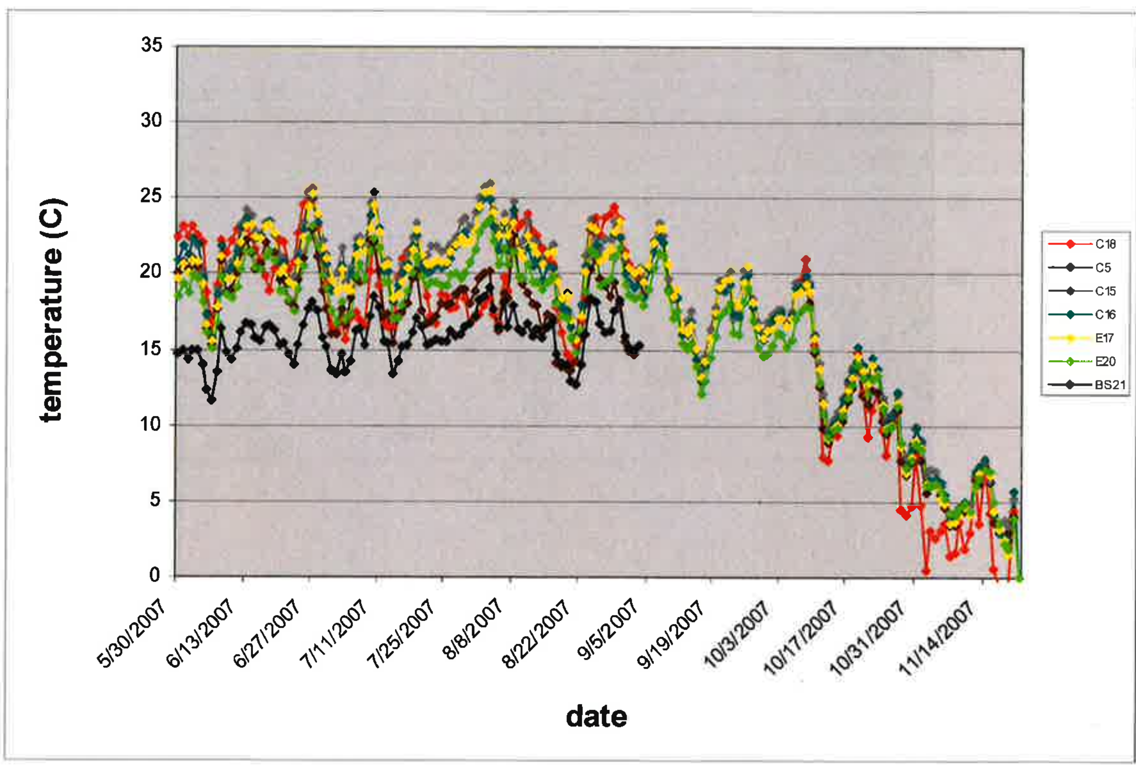


Figure 8: Average daily temperature for Clythe Creek (sites C18 to BS21 are listed upstream to downstream).

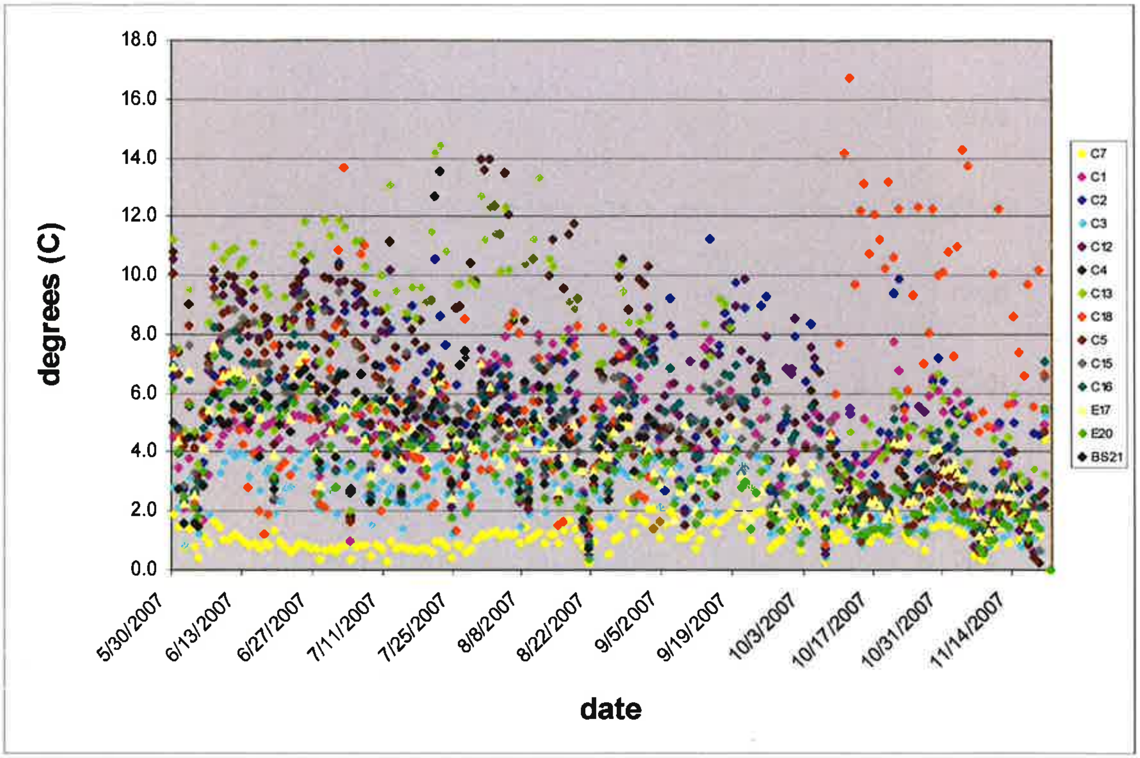


Figure 9: Daily range in temperature at all sites.

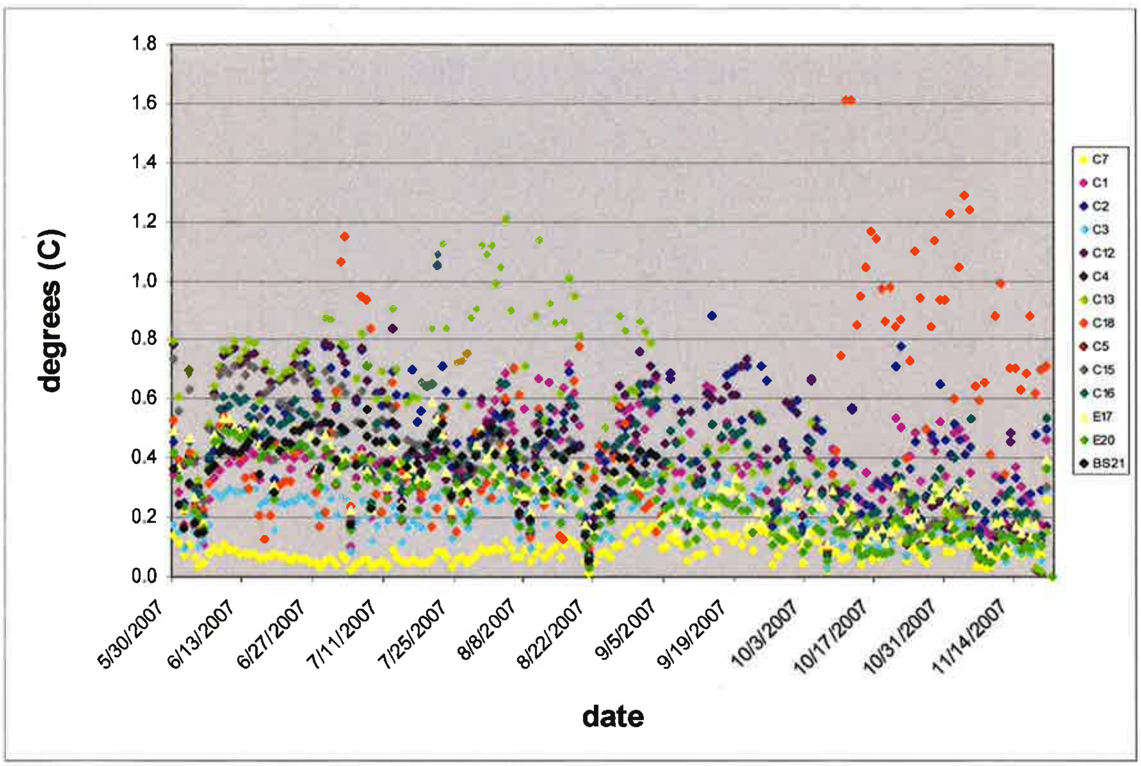


Figure 10: Average hourly rate of change in temperature per day at all sites

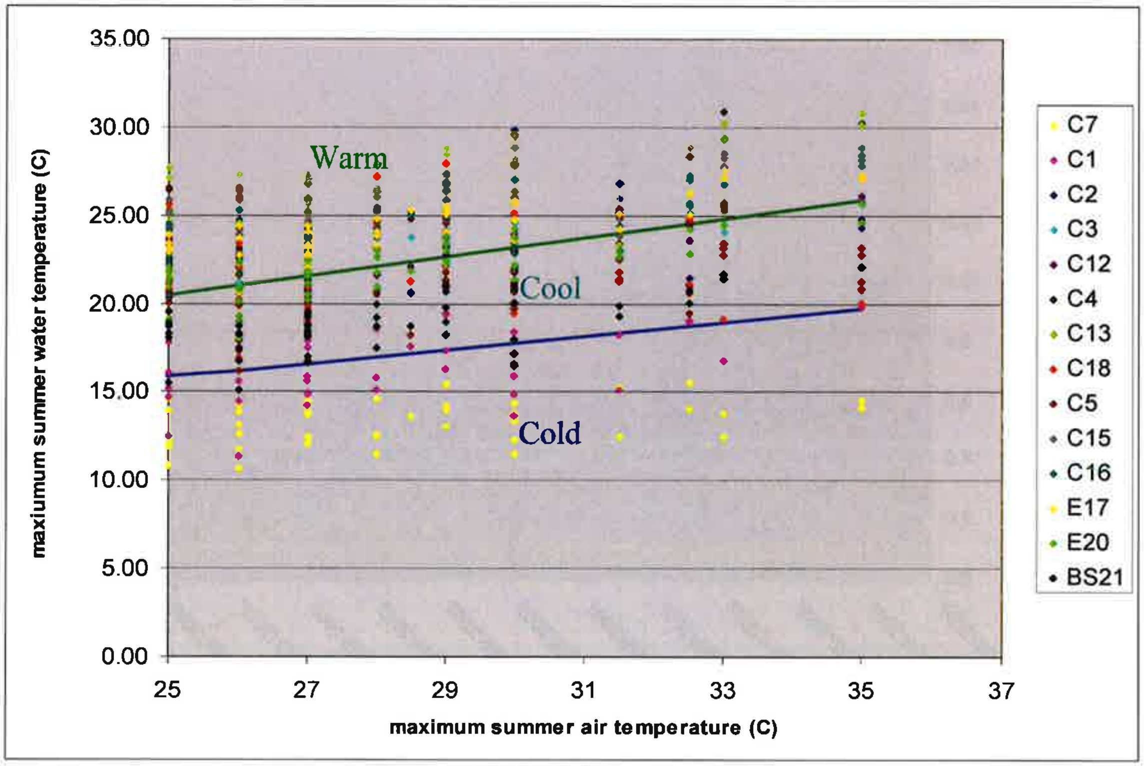


Figure 11: Stream classification of all sites (format from Stoneman and Jones 1996). Sites plotted below blue line classify as cold water, between blue and green classified as cool water and above green classified as warm water sites.

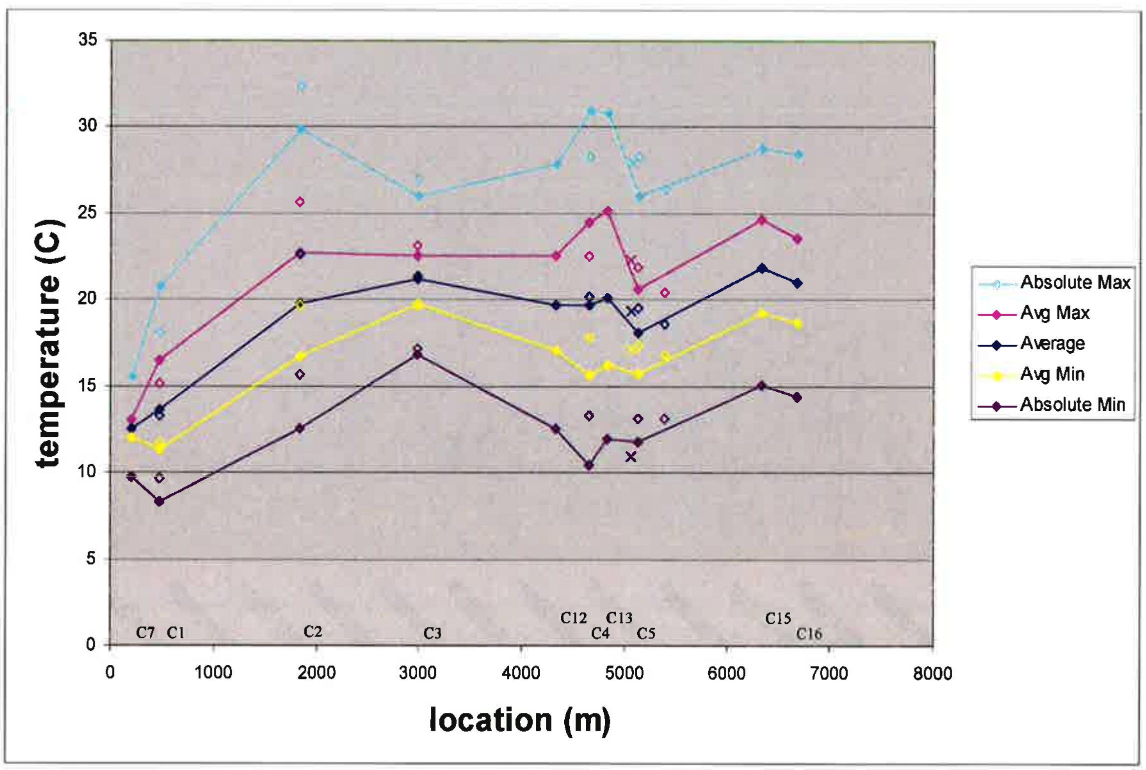


Figure 12: Longitudinal chart showing change in temperature from upstream to downstream during peak summer months (July and August). Solid points represent 2007 data, hollow points represent 2006, 'X' represent the stormwater outflow (C18).

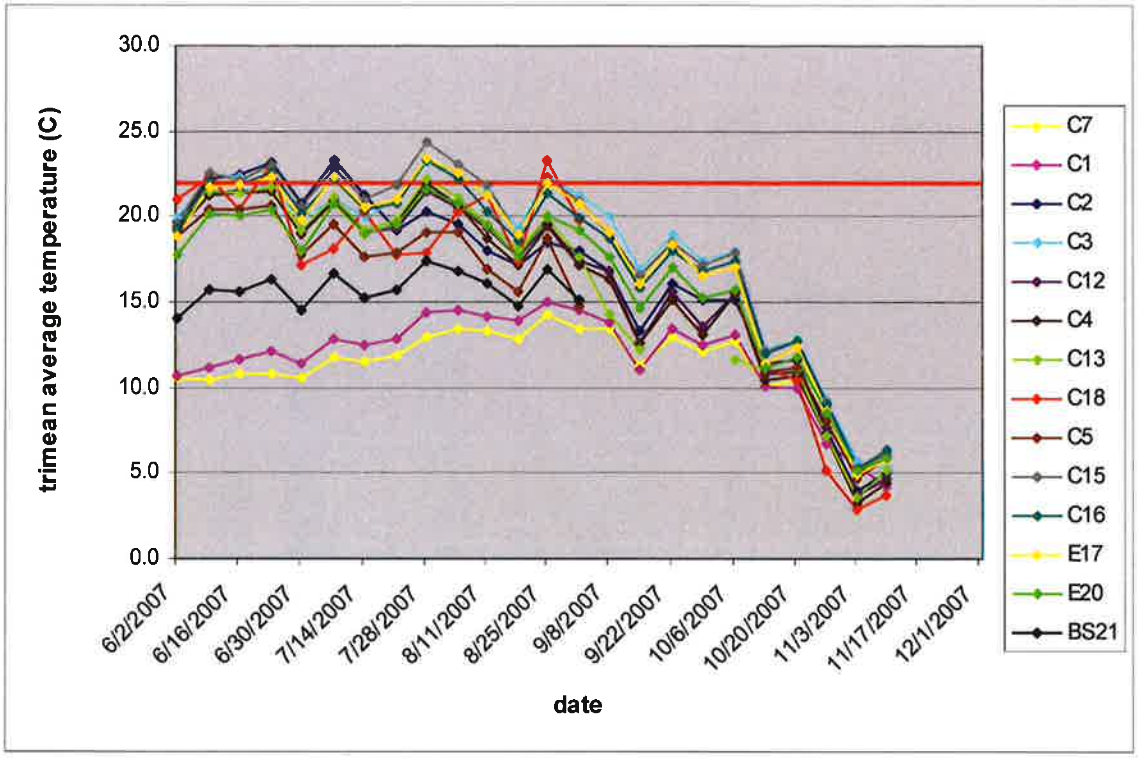


Figure 13: Trimean average temperature for Clythe Creek (sites are listed upstream to downstream). The red line marks 22°C.

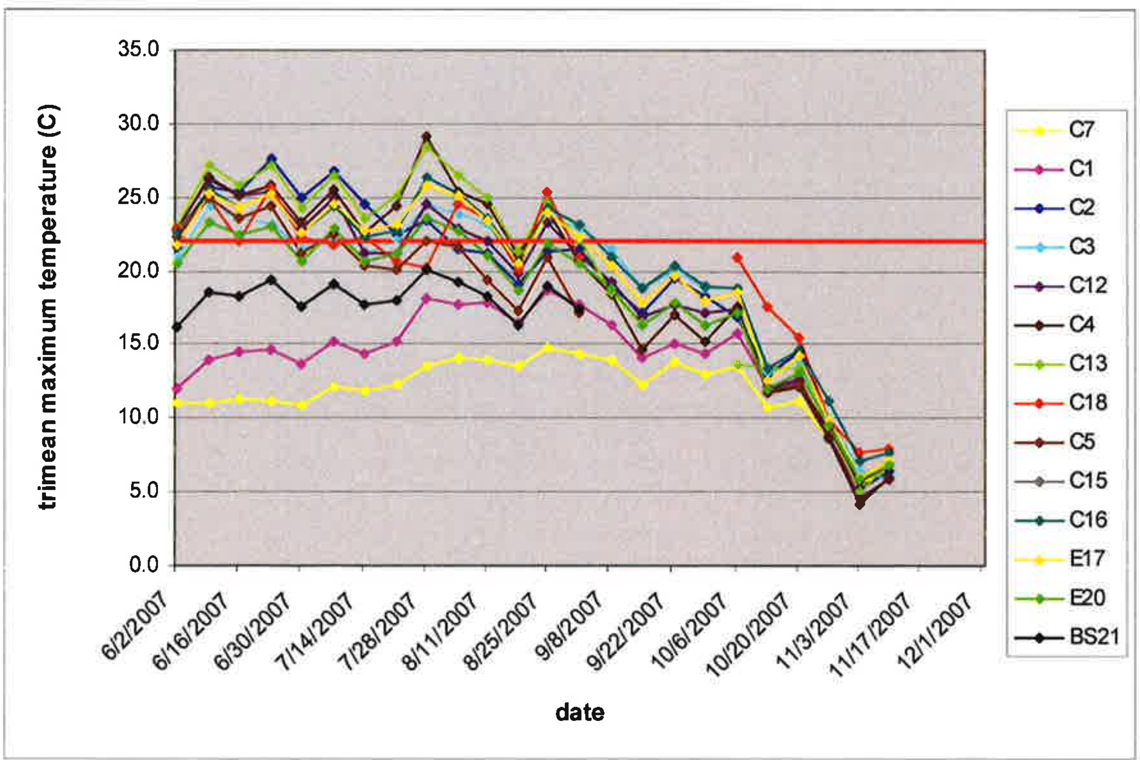


Figure 14: Trimean maximum temperature for Clythe Creek (sites are listed upstream to downstream). The red line marks 22°C.

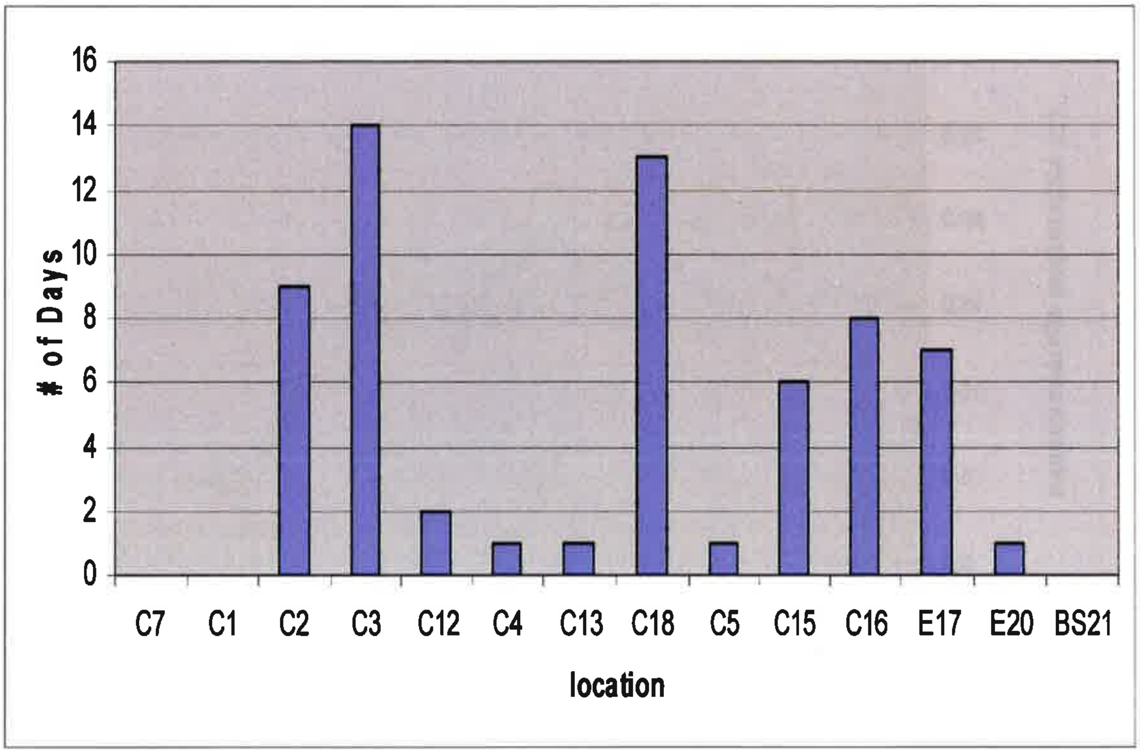


Figure 15: Number of days where temperatures were sustained over 19°C for a 24h period.

Implications

There is a great deal of variability in temperature trends throughout the length of Clythe Creek. This is likely due to the large number of online ponds combined with multiple areas of groundwater seepage. The most significant increase in water temperatures is between site C1 to site C2. This is likely due to the online pond created by a weir located at Jones Baseline. Water temperatures decrease between Jones Baseline (C2) and Watson Road North (C4), likely as a result of groundwater inputs, which is consistent with observations of numerous groundwater seeps in this reach of the creek in 2006. The effects of the warm water from the storm water management pond (C18) on minimum temperatures of the creek is seasonal. However, the degree of cooling in this area (between C13 and C5) could be greater if not for the effects of the stormwater management pond.

The presence of groundwater inputs in the upper reaches of Clythe Creek provide great potential for coldwater restoration. With the removal of the impoundment upstream of Jones Baseline, the increase in water flow combined with coldwater inputs will likely mitigate general warming of the system allowing this creek to be cooled from top to bottom. This mitigation could potentially return this creek to a coldwater classification capable of sustaining brook trout.

It is strongly recommended that an attempt is made to contact landowners and neighbours of Clythe Creek and discuss the implications of online ponds and the benefits of removal. Mitigation of these impoundments should be prioritized with impoundments further upstream holding the highest priority. Monitoring of any physical changes to the creek will aid in our understanding of the degree of benefit to this system and will further aid in the understanding of temperature regimes downstream.

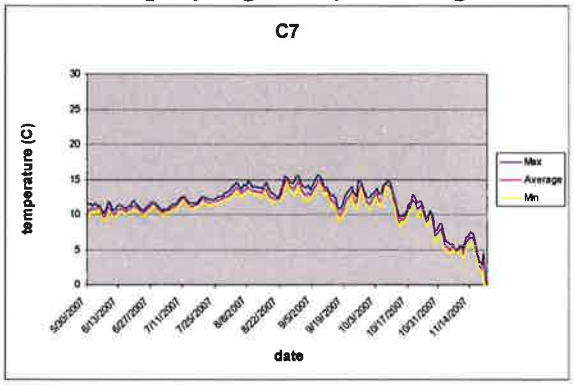
It is recommended that water quality (chemistry) information at strategic locations be collected to help assess the influence of land use activities, specifically, the impacts of storm water management ponds in the developing lower portion of the watershed. Measurements should include variables such as turbidity, conductivity, pH and dissolved oxygen.

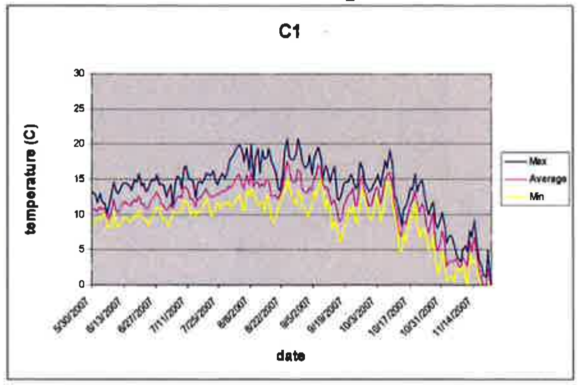
Based on these data it would be beneficial to survey the fish community composition in selected sections of the creek to identify any remnant coldwater communities. Anicdotal evidence from preliminary surveying by the Speed Valley Chapter of Trout Unlimited Canada in 2007 revealed the presence of central mudminnow, pearl dace, brook stickleback, northern redbelly dace and sculpin in Clythe Creek. Brook stickleback and sculpin are commonly found in the same habitats as brook trout and can be considered indicators of aquatic health. Future surveys should include reaches upstream of Wellington Road 29 and between Highway 7 and Watson Road North. These are the most likely areas to support remnant populations of coldwater species such as brook trout and these results should be compared to historical surveys to assess changes in community composition.

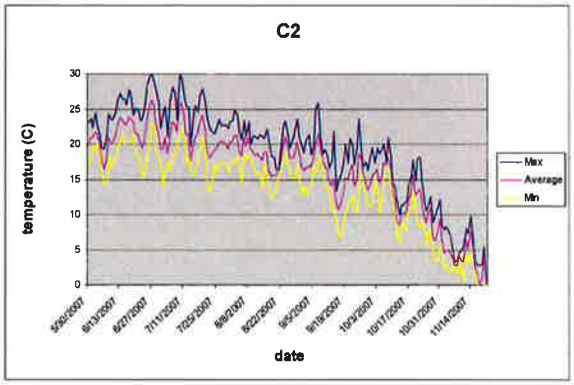
Clythe Creek holds great potential for restoration. The available groundwater and gradient allow for cooling downstream which will mitigate some of the warming caused by impoundments. Increasing water flow by removing impoundments will increase this mitigation potentially creating coldwater habitats.

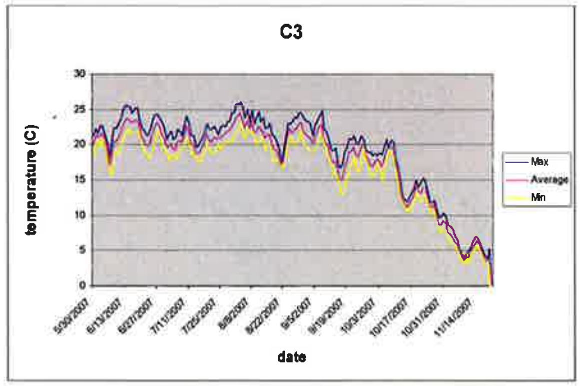
Appendix A Individual Site Data

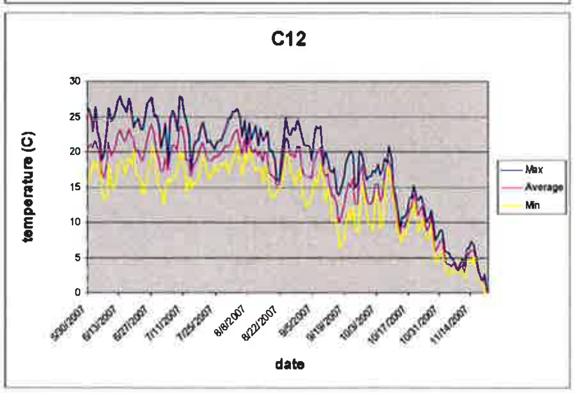
Displaying Daily Average & Minimum/Maximum Temperatures

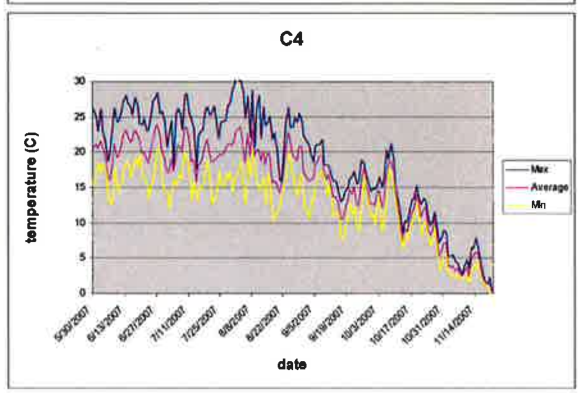


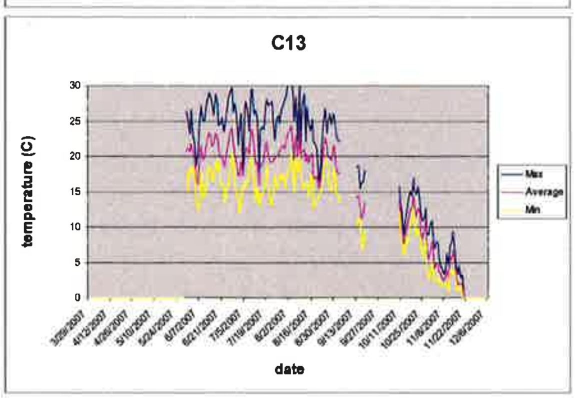


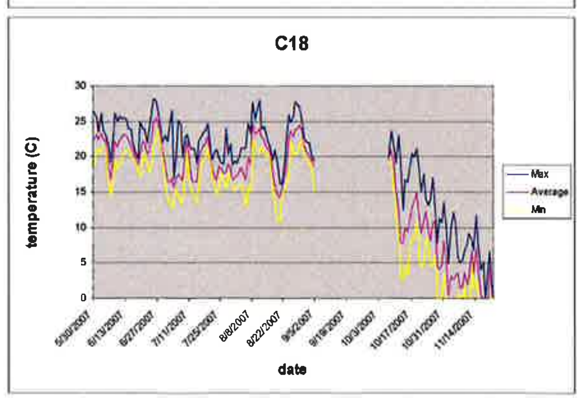


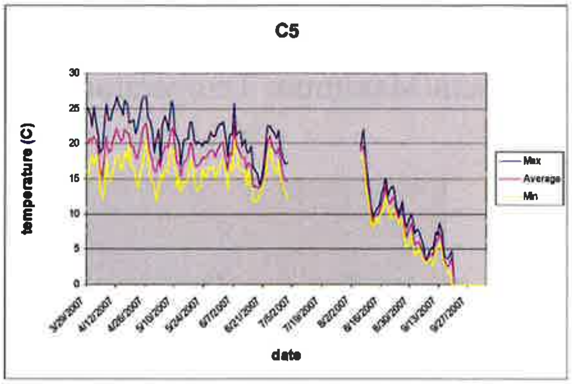











C5
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Max
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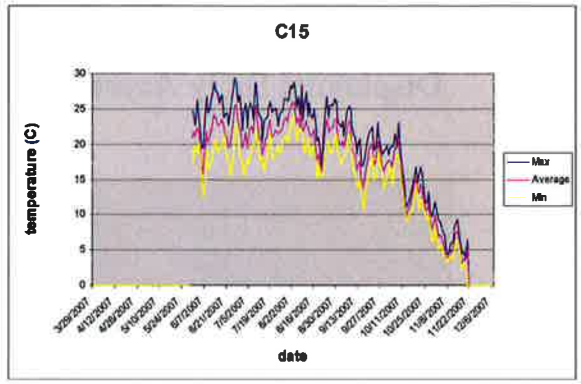
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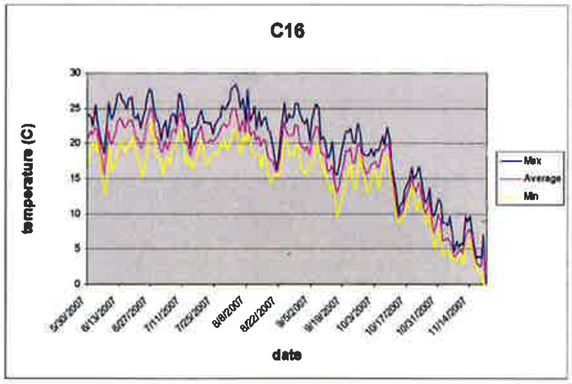
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Max
Average
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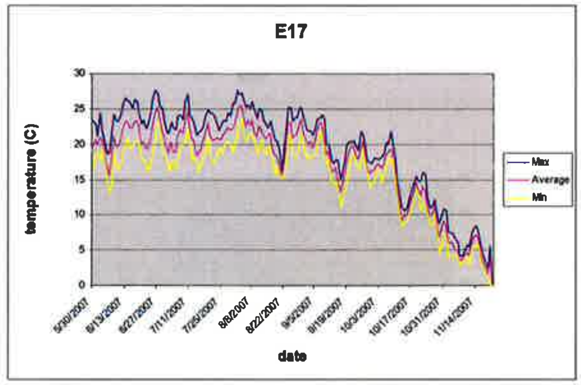
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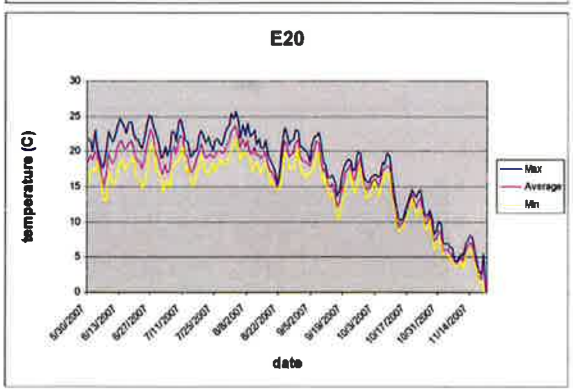
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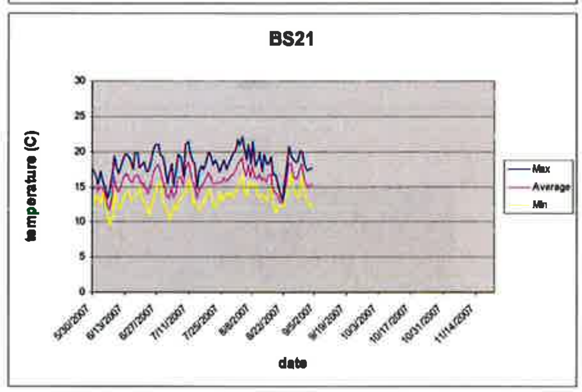
BS21
temperature (C)
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Max
Average
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PARISH aquatic services
A Division of Matrix Solutions Inc.

DRAFT

YORK ROAD ENVIRONMENTAL STUDY DESIGN
GEOMORPHIC BACKGROUND REVIEW
TECHNICAL MEMORANDUM #1

Report Prepared for:
AMEC FOSTER WHEELER

Prepared by:
PARISH AQUATIC SERVICES
a Division of Matrix Solutions Inc.

February 2016
Mississauga, Ontario

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YORK ROAD ENVIRONMENTAL STUDY DESIGN

GEOMORPHIC BACKGROUND REVIEW

TECHNICAL MEMORANDUM #1

Report prepared for AMEC Foster Wheeler, February 2016

Jennifer Henshaw, M.Sc.
Fluvial Geomorphology Specialist

reviewed by
John Parish, P.Geo.
Principal Geomorphologist

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APPENDICES

1 INTRODUCTION

PARISH Aquatic Services, a division of Matrix Solutions Inc., has been retained by AMEC Foster Wheeler to provide support in the form of fluvial geomorphic expertise and guidance with regards to the York Road environmental study design in which project objectives are intended to assist with the implementation of the recommendations stemming from the 2007 York Road improvements class environmental assessment (EA; NRSI 2006). Specifically, the 2007 EA recommended that York Road be widened from Victoria Road to the East City Limits from its existing 2-lane footprint to a 4-lane roadway with a 1.5 m bicycle lane in each direction and associated curbs, sidewalks, and gutters. As a result of the proposed road widening, there will be impacts to the Clythe Creek watercourse that flows adjacent to York Road between Watson Parkway and Industrial Avenue. Due to these impacts, recommendations for the channel included the following:

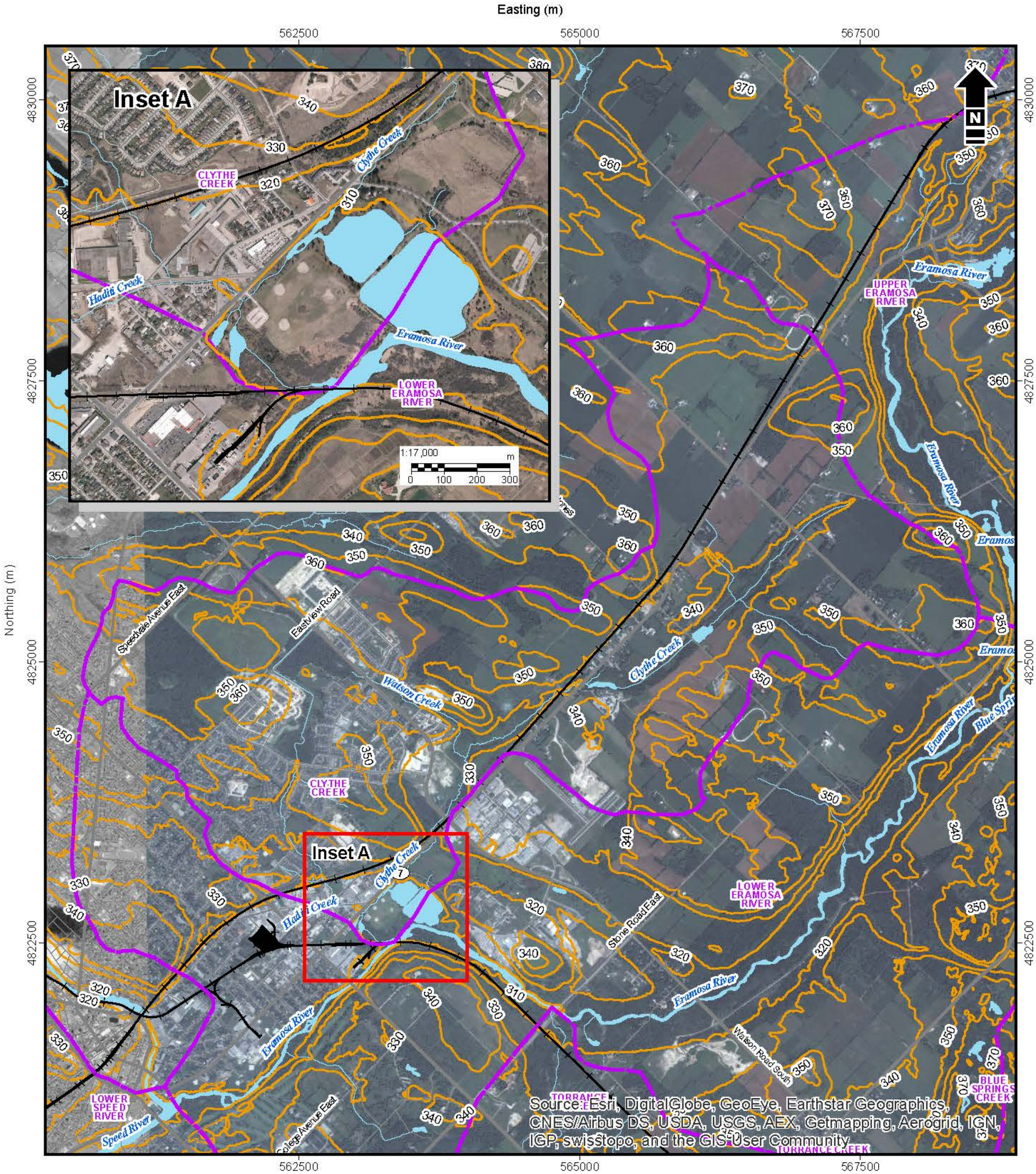
- extension of the existing Clythe Creek culvert crossing of York Road
- relocation of approximately 135 m of Clythe Creek to accommodate the proposed road widening
- implementation of riparian plantings to separate the widened roadway from the relocated Clythe Creek channel

1.1 Study Area

Located within the City of Guelph, the local study area of Clythe Creek is situated south of York Road between Watson Parkway and Industrial Avenue. **Figure 1** depicts the Clythe Creek subwatershed and the study area.

The Clythe Creek subwatershed is composed of Clythe Creek and its two tributaries, Watson Creek and Hadati Creek. Clythe Creek joins with the Eramosa River south of York Road and east of Victoria Road. The Clythe Creek subwatershed is approximately a 21 km^2 drainage area dominated by both agricultural and urban land uses. Clythe Creek is considered a cold water stream with a band of wetland vegetation found along its length. 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.

The study area of Clythe Creek is located within lands associated with the former Guelph Correctional Centre (GCC) in operation from 1910 to 2001, and which is currently owned by Infrastructure Ontario. The close proximity to the GCC facility buildings has had a large impact on the overall fluvial form and functioning of Clythe Creek within the study area, as numerous culverts, bridges, dams, and weirs have been installed along the channel by inmates of the facility. Additionally, two on-line ponds have been created with drainage directly into Clythe Creek as well as the Eramosa River.



Subwatershed Boundary
Water Body
Watercourse
Highway
Road
Railway
Elevation Contour Interval (10m)

Reference: Data obtained from GeoBase® used under license. This is version 1.0 of the Open Government Licence – Ontario. Contains information made available under Grand River Conservation Authority's Open Data Licence v1.0
Imagery (2012) obtained from City of Guelph used under license.

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NAD 1983 UTM Zone 17N

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

City of Guelph
York Road Environmental Design

Clythe Creek Subwatershed

Date:	Project:	Technical:	Reviewer:	Drawn:
17 Dec 2015	22257	J. Parish	P. Chin	C. Curry

Disclaimer: The information contained herein may be compiled from numerous third party materials that are subject to periodic change without prior notification. While every effort has been made by Matrix Solutions Inc. to ensure the accuracy of the information presented at the time of publication, Matrix Solutions Inc. assumes no liability for any errors, omissions, or inaccuracies in the third party material.

Figure
1

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2 PREVIOUS STUDIES

Before initiation of the geomorphic field assessment, PARISH conducted a review of background reports and previous studies to determine any relevant information applicable to this specific study. This background review identified reaches that have been delineated and studied by others such that redundancy would not occur. Watershed-based studies (e.g., Eramosa River and Clythe Creek) on the state of the stream's health have been completed during the last few decades. Understanding the available geomorphic information, areas where updates are required, and gaps to be filled will be valid.

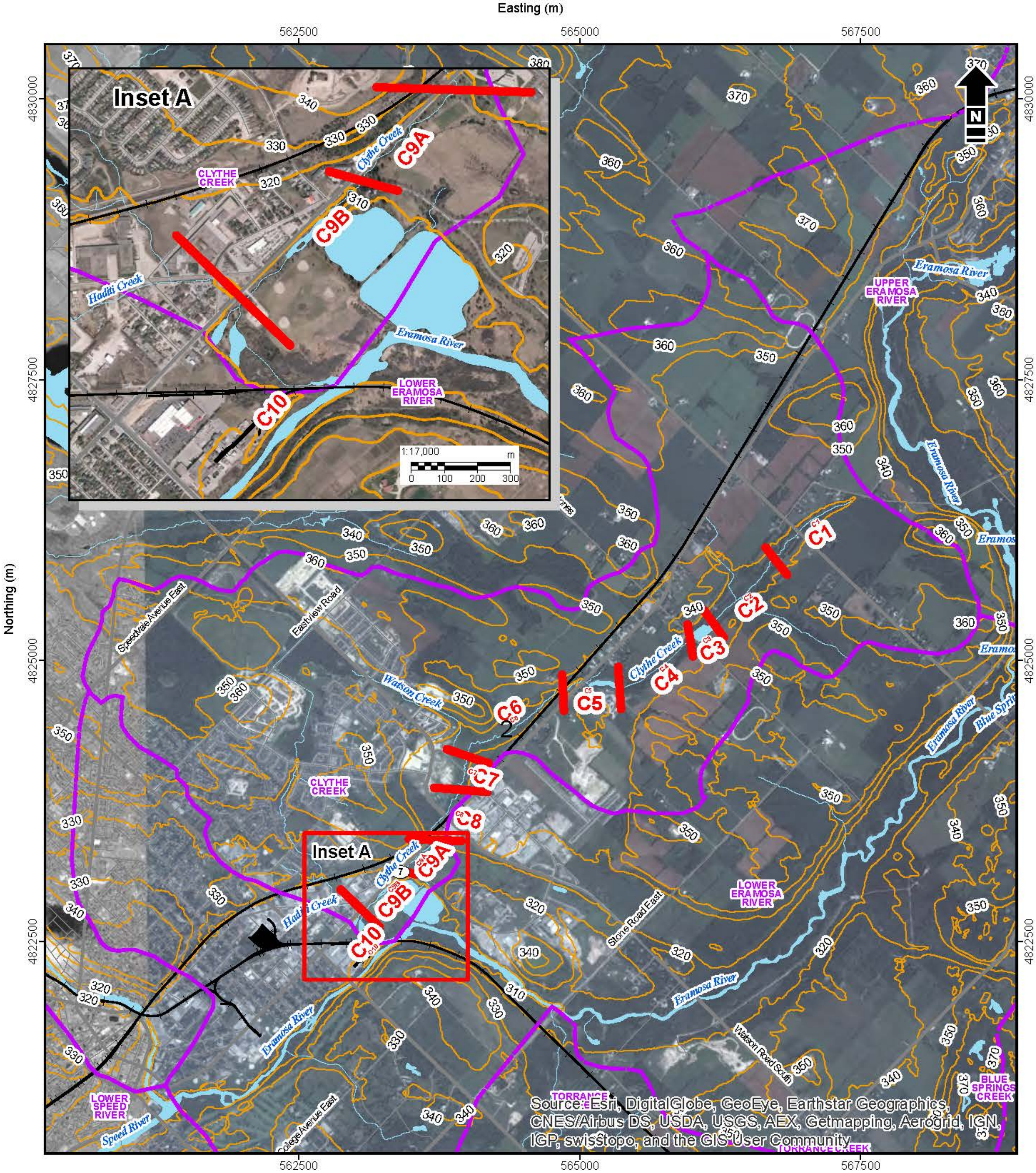
PARISH reviewed the following studies for background information pertaining to the fluvial geomorphic aspects of Clythe Creek. Overall, no study was able to provide a detailed characterization of the entire subwatershed; however, site-specific information on channel dimensions and characteristics were 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.

Clythe Creek Subwatershed Overview (Ecologistics Limited 1998)

This report, and environmental studies contained within, was commissioned as a result of numerous development proposals within the subwatershed, including residential housing, support services, and industrial facilities. The subwatershed study contains a complete overview of existing conditions in the Clythe Creek subwatershed, including land use, soils and topography, groundwater resources, upland vegetation patterns, wetlands, wildlife, rare species, and aquatic resources.

The study identifies ten reaches of Clythe Creek (**Figure 2**), from its headwaters east of Regional Road 29 to its confluence with the Eramosa River. Reach descriptions detail bankfull dimensions, substrate type, riparian conditions, and overall channel stability (**Table 1**).

Study objectives were to provide direction to future land use decisions in the subwatershed in order to maintain and enhance (where feasible) wetlands, watercourses, and terrestrial resources, and to maintain and enhance hydrogeological characteristics of the area.



Subwatershed Boundary

Water Body

Watercourse

Highway

Road

Railway

Elevation Contour Interval (10m)

Reach Break

Reference: Data obtained from GeoBase® used under license. This is version 1.0 of the Open Government Licence – Ontario. Contains Information made available under Grand River Conservation Authority's Open Data Licence v1.0
Imagery (2012) obtained from City of Guelph used under license.

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NAD 1983 UTM Zone 17N

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

City of Guelph
York Road Environmental Design

Clythe Creek Reach Breaks

Date:	Project:	Technical:	Reviewer:	Drawn:
29 Jan 2016	22257	J. Parish	P. Chin	C. Curry

Figure
2

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TABLE 1 Clythe Creek Subwatershed Reach Delineations

Reach Characteristics		Clythe Creek									
		C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
Bankfull Width	The width (m) of the channel at its fullest capacity	1.1	Not accessible	30	1.3	Ponded areas ~50; channelized areas ~5	3	1.6	2.4	1 to 5	10 to 12
Depth of Channel	The depth (m) of the channel at its deepest point	0.10 to 0.12		<2	0.05 to 0.10	Ponded areas >2; channelized areas ~0.25	0.25	0.08 to 0.10	0.24	0.5	0.5
Substrate Type	The characteristics of the material found on the streambed	Organic		Organic	Organic	Silt/organic	Organic	Gravel/organic	Silt/organic	Gravel and rubble with thin organic layer	Silt/organic
Cover	The type and amount of vegetation found overhanging the stream	Dense jewelweed, cattails, and occasional cedar		Mostly open water with cattails	Mainly cattails with scattered cedars	Herbaceous; lily pads around perimeter; red osier dogwood; cedars	Cattails, jewelweed, reed canary grass, and areas of dense shrub	Herbaceous; open meadow with small poplar/cedar stand	Dense shrub understory with willow trees	Mowed lawn	Dense shrub species; mixed herbaceous and occasional willow trees
Width of Riparian Zone	The width (m) of the naturally vegetated areas adjacent to the creek	18 to 40	120	90	115	40	40 to 80	80	50	None	1 to 120
Channel Stability	Channel and bank characteristics that indicate stability of channel, including erosion, bank failure, etc.	Stable		Stable	Stable; bank heights are low to nil	Stable	Stable	Stable	Stable; however, some undercutting is evident	Stable	Generally stable but with some evidence of undercutting
Number of Bridge or Culvert Crossings	Number of breaks in channel continuity from bridges, culverts, and dams	1	0	0	0	3	1	0	0	13 culverts, artificial waterfalls, and trickle-downs	3
Sinuosity	Length of channel compared to linear distance from upstream to downstream limits of reach	1.32	1.09	1.33	1.1	1.1	1.27	1.25	1.08	1.43	1.3
Other Comments		Cool, clear water		Scattered slumps present	Open marsh; creek becomes braided through marsh	Overflowing outlet in first pond; water very still; landscaped areas	Open marsh; channel is braided in areas	Meanders through open meadow	Good shading; water is cool as is crosses under Canadian National Railway berm	Occasional landscaped areas; a few storm outfalls	Water very cloudy and slow flowing; lily pads and margins of confluence

~ approximately

Eramosa-Blue Springs Watershed Study Report (Beak International and Aquafor Beech 1999)

This study was initiated to address several comprehensive watershed-scale issues that remained outstanding from the Eramosa River-Blue Springs Creek Linear Corridor Initiative (1995). Clythe Creek is the largest tributary of the Lower Eramosa River. Within the watershed, channel and streambank erosion is not significant and is limited to localized areas along a number of tributaries where alteration has occurred as a result of livestock access, municipal drainage practices, bridge construction, channel improvement, on-line ponds, and sources of high sediment delivery. Lack of erosion was assessed to be the result of hummocky topography, extensive wetlands, and healthy streamside vegetation, as well as stable stream morphology.

General subwatershed descriptions contained within the study report reveal that Clythe Creek has been ranked as the most impacted tributary within the watershed. The channel has been extensively impacted by both rural and urban land uses, and the overall health of the channel, in terms of fluvial form and function as well as ecological conditioning, is under stress from species introduction, channel alterations, and riparian vegetation loss. Several areas of medium to high sediment delivery potential were noted, as well as numerous important recharge areas.

Assessment and Remedial Activities for Clythe Creek (UW 2007)

Prompted by the widening of York Road, which will conflict with the current alignment of Clythe Creek, this study was conducted by University of Waterloo fourth-year engineering students for Trout Unlimited Canada. The study area is approximately 1 km in length and runs parallel, along the south side of York Road between Watson Parkway and Elizabeth Street in Guelph, Ontario.

The objective of the study was to determine appropriate remedial activities through the selection of a preferred alternative. Criteria of the considered alternatives included improving the thermal regime of the stream, maintaining and promoting water quality suitable for cold water biota, and retaining the current aesthetic and recreational properties of the study area. The preferred alternative selected was the realignment of the entire study reach.

The study develops a further understanding of current channel conditions south of York Road through the assessments of channel morphology, sediment sampling, and water quality.

Rehabilitation of Clythe Creek (UW 2008)

Upon the selection of the preferred alternative from the 2007 Phase I report, which included the realignment of the entire study reach to improve the fluvial form and functioning and aquatic habitat within the channel, a conceptual channel design was established for Clythe Creek south of York Road between Watson Parkway and Elizabeth Street in Guelph. The Phase II deliverables include the proposed channel geometry and alignment, a comparison between the current and proposed channel alignments, a proposed construction schedule, and a cost estimate.

"Groundwater-Surface Water Interactions and Thermal Regime in Clythe Creek, Guelph, Ontario: Threats and Opportunities for Restoration." (Ashworth 2012)

Through the investigation of the groundwater-surface water interaction and thermal regime of Clythe Creek, channel morphology was recorded through a series of monumented cross-sections between Watson Parkway and Watson Road.

Conservation Plan for the Guelph Correctional Centre Heritage Place **(ORC 2009)**

The GCC has been identified as a provincially significant property as a result of a comprehensive study of Ontario's correctional facilities undertaken by the Ontario Realty Corporation in 2006. Thirteen buildings at the GCC (which closed as a correctional centre in 2001) were identified for their heritage value, chosen either because they uniquely represent the GCC as a correctional centre of heritage value, or because they support the heritage values of the correctional centre in a meaningful way. The associated cultural landscape was also identified as a significant heritage resource.

Clythe Creek runs parallel to the GCC heritage lands, south of York Road, specifically flowing through the ornamental landscape of the GCC. The ornamental landscape consists of the park-like landscape between York Road and the GCC administration building, wrapping around the west façade of the detention complex, and stretching from the former farmlands on the east side of the property west to the banks of the Eramosa River. It includes broad lawns, ornamental ponds and watercourses, winding drives, a circular vehicle turn-about, stone walls and remnants of stone walls, ornamental bridges, lines of mature trees, and specimen plantings.

Alterations and realignment of Clythe Creek within the study area must take into consideration the impact to heritage features associated with the GCC.

Stormwater Management Master Plan, City of Guelf **(AMEC 2012)**

A desktop assessment with and scoped field activities was undertaken as part of the fluvial geomorphic component of the stormwater management master plan to determine the relative conditions of several watercourses within the City of Guelph. Within this report, fluvial geomorphic investigations were conducted along both Hadati Creek and Watson Creek, which are tributaries to Clythe Creek. Analysis from the investigation identified the relative stability of subject watercourse reaches, as well as zones of potentially increased stream power. Hadati Creek, upstream from the railway line was identified as being highly sensitive to the channel processes, as well as being an area of increased stream power. Both Watson Creek and Clythe Creek (upstream from the railway line were identified as being stable to moderately sensitive reaches with lower stream power.

Guelph Correctional Centre, Natural Heritage Assessment **(NRSI 2013)**

The Natural Heritage Assessment (NHA) focused on identifying and delineating natural heritage features (e.g., wetland communities, candidate significant wildlife habitat, aquatic habitat) within the GCC property and developing a rehabilitation concept for Clythe Creek within the subject property.

Specifically, the NHA identified terrestrial and aquatic features within the landscape, such as creeks, tributaries, drainage areas, wetlands, forested communities, significant wildlife habitat, and suitable habitat for species at risk. The report provides higher level documentation of the existing natural environment conditions and an analysis of the significance and sensitivity of the natural features. Appropriate buffers are recommended to facilitate an assessment of opportunities and constraints on the property for future redevelopment concepts.

The current proposal to widen York Road will have an impact on Clythe Creek; specifically, it was identified that approximately 135 m of Clythe Creek will need to be relocated within the GCC lands due to a conflict with the proposed road works. Within the report, opportunities were assessed, and a preliminary development concept plan, including Clythe Creek channel realignment and associated 30 m buffer through the GCC lands, was created.

3 CLYTHE CREEK CHANNEL CHARACTERIZATION

The geomorphic characterization of Clythe Creek focused on a desktop analysis of existing conditions. The analysis optimized the existing available information obtained through the review of previous studies for the subwatershed, including existing subwatershed, stormwater management and drainage studies, geographic information, and aerial photography. A synoptic site visit was conducted on December 22, 2015, to clarify existing conditions and further identify where gaps exist in the background data. A photographic inventory of the site visit is displayed in **Appendix A**.

3.1 Historical Assessment

A historical aerial image from 1930 was obtained for the study area and was used to infer past and present land uses within the area. Within the image, several features that are consistent with current land use are present, including the GCC (buildings and access roads), York Road, railway alignments, and the Eramosa River. Two aesthetic ponds are located on opposite sides of the correctional facility main driveway, and several small drainage features, originating to the west of the correctional facility, are present and discharge directly into the Eramosa River. Clythe Creek flows adjacent to York Road, becoming wider with multiple flow pathways in the downstream direction. Both the north and south ponds are absent from the image.

3.2 Reach Breaks

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 (Ecologistics Limited 1997), ten reaches were identified along the watercourse based on habitat characteristics. The reaches are named based on position along the watercourse chainage, with reach C1 located furthest upstream within the headwaters and reach C10 located furthest downstream extending to the confluence with the Eramosa River. The Clythe Creek reach delineation is displayed on **Figure 2**; reach characteristics are displayed in **Table 1**.

The local study area is located within Reach 9, which corresponds with the Clythe Creek channel corridor downstream from York Road to the confluence with Hadati Creek. The subwatershed study describes this reach as having bankfull width of 1 to 5 m wide and bankfull depths of 0.5 m. Channel substrate is described as gravel and rubble with a thin organic layer. Riparian cover is mowed lawn with landscaping, numerous artificial waterfalls and weirs to control channel gradient, and several culverts and storm outfalls adding discharge.

Further refinement of this previous delineation is warranted for the current study due to the changes in channel morphology and planform that exist. For the purposes of the existing study, Reach 9A represents the upstream segment, extending for approximately 445 m downstream from York Road to the historical stone arch bridge that is the main access to the former reformatory facilities. Reach 9B represents the downstream segment, extending from the historical stone arch bridge 500 m downstream to the confluence with Hadati Creek. The extent of these reaches was walked as part of a synoptic level site assessment conducted on December 22, 2015.

3.3 Existing Site Conditions

PARISH performed site reconnaissance on December 22, 2015. The intent of the visit was to observe existing conditions to better guide the development of detailed field work and ultimately the conceptual channel design. A photographic inventory has been compiled from the site visit and is displayed in **Appendix A**.

3.3.1 Reach C9A

Downstream from the York Road crossing, Reach C9A is a moderately sinuous to straight channel with numerous grade control weirs, waterfalls, and culverts controlling gradient and the downstream movement of water. Bankfull dimensions were measured at 2 to 3 m wide and 0.4 to 0.5 m deep. Throughout most of the reach, water was elevated nearly to the bankfull level; this is associated with backwatering behind weirs. Average channel substrate was undetermined; however, the water was generally turbid, and bank materials are a sandy-clay mix. Lack of riffle and pool bed morphology is also likely a result of the numerous weirs impeding the natural function of the channel. A tributary enters Clythe Creek approximately 300 m downstream from the York Road crossing; minimal baseflow contributions were observed at the time of the site visit.

3.3.2 Reach C9B

Downstream from the historical stone arch bridge, Reach C9B is a predominantly straight, low-gradient channel that has been over-widened due improper drainage throughout the reach. Two engineered decorative islands are located within the reach. Bankfull dimensions were measured to be 15 to 18 m in ponded sections and 4 to 5 m at pinch points associated with pedestrian crossings. Bankfull depth was observed to be 0.5 m; however, it is expected that this will increase within pools. Channel banks are lines with angular stone throughout the reach. Bed sediment appears to be mainly fine-grained sands with limited gravels and cobbles. Sediment deposits are also observed at the outlet of storm drains, which brig surface runoff from the north side of York Road.

A previously dug pond (northern reformatory pond) outlets to the channel approximately 215 m downstream from the start of the reach; however, due to the overall low gradient of the area, water is largely stagnant and not flowing through the pond outlet or Clythe Creek. Flow remains stagnant throughout most of the reach; velocity is only locally increased at weir and waterfall locations. Along the reach, there are three pedestrian bridge crossings and one driveway access. The pedestrian crossings are all single-span bridges not suitable for vehicular travel, whereas the driveway access crosses the creek channel with two corrugated steel pipe culverts.

3.3.3 Geomorphic Conditions and Rapid Geomorphic Assessments

A detailed geomorphic investigation has been completed to provide insight into existing conditions of the Clythe Creek study area. Review of topographic mapping and aerial photography, as well as preliminary field reconnaissance conducted on December 22, 2015, suggest that the channel segment of interest (i.e., between the York Road crossing and the Hadati Creek confluence) is in fact two geomorphic reaches with distinct parameters such as channel geometry, floodplain access and characteristics, adjacent land use, and valley setting. The extents of the reach and local study area where works will take place are illustrated on **Figure 2**.

Preliminary geomorphic assessments were conducted to characterize the current geomorphic state of Clythe Creek using background information, field reconnaissance, and the Rapid Geomorphic Assessment (RGA) protocol. The RGA protocol was designed by the Ontario Ministry of Environment (1999) to assess urban stream channels. It is a qualitative technique based on the presence and (or) absence of key indicators of channel instability, such as exposed tree roots, bank failure, excessive deposition, etc. The various indicators are grouped into four categories representing specific geomorphic process: 1) Aggradation, 2) Degradation, 3) Channel Widening, and 4) Planimetric Form Adjustment. Over the course of the field reconnaissance, the existing geomorphic conditions of the reach are noted, and the presence or absence of the specific geomorphic indicators is documented. Upon completion of the field inspection, the indicators are tallied within each category, and the subsequent results are used to calculate an overall reach stability index value. This index value corresponds to one of three stability classes representing the relative degree of channel adjustment and (or) sensitivity to altered sediment and flow regimes (**Table 2**). While the RGA is a valuable tool to assess watercourse conditions, many fluvial processes are natural, and instability does not strictly indicate impacts of urban development.

TABLE 2 Rapid Geomorphic Assessment Classification

Index	Classification	Interpretation
≤0.20	In Regime or Stable (Least Sensitive)	The channel morphology is within a range of variance for streams of similar hydrographic characteristics - evidence of instability is isolated or associated with normal river meander propagation processes. Channels are in good condition with minor adjustments that do not impact the function of the watercourse.
0.21 to 0.40	Transitional/Stressed (Moderately Sensitive)	Channel morphology is within the range of variance for streams of similar hydrographic characteristics, but the evidence of instability is frequent. Significant channel adjustments have occurred, and additional adjustment may occur.
≥0.41	In Adjustment (Most Sensitive)	Channel morphology is not within the range of variance, and evidence of instability is wide spread. Significant channel adjustments have occurred and are expected to continue.

Results of the field assessment, including RGA classification and channel parameters, are summarized in **Table 3** below.

TABLE 3 Summary of the 2015 Rapid Geomorphic Assessment Scores for the West Credit River through the Belfountain Dam Complex

Clythe Creek Study Reach	Factor Value				Stability Index	Condition
	Aggradation	Degradation	Widening	Planimetric Adjustment		
9A	0.29	0.2	0.4	0.29	0.30	Transitional
9B	0.4	0	0.3	0.43	0.28	Transitional

Within reach 9A, the dominant process contributing to fluvial form and function of the channel was channel widening, with a Factor Value of 0.4. Evidence of widening was observed in fallen trees, exposed roots, outflanked concrete walls, and fracture lines along the banks at outer meander bends. Evidence of aggradation and planimetric form adjustment was also observed with siltation in pools, poor sorting of bed material, lack of riffle-pool morphology, and absence of bar forms.

Within reach 9B, the dominant processes were planimetric adjustment and aggradation. High amounts of siltation and deposition, embedded cobbles, and overbank deposition contributed to the scoring.

Both study reaches are classified as transitional, or stressed, indicating that channel morphology is within the range of variance for streams of similar characteristics; however, evidence of instability is frequent; both study reaches of Clythe Creek are considered moderately sensitive to future adjustments.

4 NEXT STEPS

During the spring of 2016, a detailed geomorphic investigation will be conducted within the Clythe Creek study area, including a total station survey of the study area extents (profile and cross-sections), inventory of weirs and waterfall structures, spot flow measurements at select locations along the channel, and rapid assessment and characterization of Hadati Creek. Results of the field work will be analyzed and reported within the environmental impact Study document.

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APPENDIX A
Site Photographs

Matrix Supplied
December 22, 2015

1. York Road crossing of Clythe Creek. Structure is a concrete box culvert. A pool has formed downstream from a transition riffle.

Matrix Supplied
December 22, 2015

2. Looking downstream along Clythe Creek; channel is straight with rock protection located along banks.

Matrix Supplied
December 22, 2015

3. Two clay pipes convey flow downstream from a grade control weir. Channel banks are protected by stone.

Matrix Supplied
December 22, 2015

4. Approximately 250 m downstream from York Road, an approximate 1.2 m stone weir grade control structure is present.

Matrix Supplied
December 22, 2015

5. Looking downstream along Clythe Creek channel; minor tributary enters the creek in the foreground.

Matrix Supplied
December 22, 2015

6. Looking downstream along Clythe Creek. Slow-moving water appears to be just below bankfull height.

Matrix Supplied
December 22, 2015

7. Looking upstream along Clythe Creek from the historical stone bridge (access to institution lands); a grade control weir is present in the background.

Matrix Supplied
December 22, 2015

8. Historical stone bridge is main access to institution lands.

Matrix Supplied
December 22, 2015

9. Looking downstream along Clythe Creek from the historical stone bridge; aesthetic islands are present in the background.

Matrix Supplied
December 22, 2015

10. Looking upstream along Clythe Creek; channel is over-widened and stagnant; a CSP culvert contributes surface discharge from the north side of York Road; a sediment bar has formed downstream from the CSP.

Matrix Supplied
December 22, 2015

11. Looking upstream along the north pond connection channel and pedestrian bridge.

Matrix Supplied
December 22, 2015

12. Looking upstream along Clythe Creek; channel is over-widened and slow moving.

Matrix Supplied
December 22, 2015

13. Two CSP culverts convey flows downstream from a parklands access road; channel immediately regains width downstream before Hadati Creek Confluence (background, right bank).

Matrix Supplied
December 22, 2015

14. York Road crossing of Hadati Creek; structure is a concrete box culvert; gabion wing-walls protect the banks.

Matrix Supplied
December 22, 2015

15. Flow control structure downstream from Hadati Creek confluence.

Matrix Supplied
December 22, 2015

16. Channel remains wide and stagnant downstream from Hadati Creek. Water is turbid, and woody debris is frequent.

Matrix Supplied
December 22, 2015

17. Beaver dam located approximately 250 m upstream from the Eramosa River confluence.

Matrix Supplied
December 22, 2015

18. Clythe Creek flows immediately adjacent to railway embankment; embankment protection appears to be limited to vegetation. Water turbidity changes colour to appear more beige.

Matrix Supplied
December 22, 2015

19. Looking downstream along the Eramosa River towards the Clythe Creek confluence located to the right. Railway embankment and bridge structure crossing the Eramosa River also present in background.

Matrix Supplied
December 22, 2015

20. Looking upstream along the Eramosa River; embankment separating the south pond and Eramosa River visible in the background left.

Matrix Supplied
December 22, 2015

21. South pond connection to the Eramosa River through a CSP pipe elevated approximately 30 cm; the pipe appears to be blocked, and discharge is minimal.

Matrix Supplied
December 22, 2015

22. South pond breaches its banks at the pond's northeast corner; flow is contributed to a surface drainage tributary that flows adjacent to the pond and into the Eramosa River.

Matrix Supplied
December 22, 2015

23. Drainage channel from decorative ponds discharges into the south pond.

Matrix Supplied
December 22, 2015

24. Decorative pond, grade control feature.

YORK ROAD ENVIRONMENTAL DESIGN STUDY:
FLUVIAL GEOMORPHIC EXISTING CONDITIONS AND DESIGN OPTIONS

Report Prepared for:
AMEC FOSTER WHEELER

Prepared by:
MATRIX SOLUTIONS INC.

March 2017
Mississauga, Ontario

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YORK ROAD ENVIRONMENTAL DESIGN STUDY:

FLUVIAL GEOMORPHIC EXISTING CONDITIONS AND DESIGN OPTIONS

Report prepared for AMEC Foster Wheeler, March 2017

Jennifer Henshaw, M.Sc.
Fluvial Geomorphology Specialist

reviewed by
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Principal Geomorphologist

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APPENDICES

1 INTRODUCTION

Matrix Solutions Inc. has been retained by AMEC Foster Wheeler to provide fluvial geomorphic expertise and guidance with regards to the York Road environmental study design. The project objectives are intended to assist with the implementation of the recommendations stemming from the 2007 York Road Improvements Class Environmental Assessment (EA). Specifically, the 2007 EA recommended that York Road be widened from Victoria Road to the East City Limits from its existing 2-lane footprint to a 4-lane roadway with a 1.5 m bicycle lane in each direction and associated curbs, sidewalks, and gutters (NRSI, 2006). As a result of the proposed road widening, there will be impacts to Clythe Creek which flows adjacent to York Road between Watson Parkway and Industrial Avenue. Due to these impacts, recommendations for the channel included the following:

- extension of the existing Clythe Creek culvert crossing of York Road
- relocation of approximately 135 m of Clythe Creek to accommodate the proposed road widening
- implementation of riparian plantings to separate the widened roadway from the relocated Clythe Creek channel

1.1 Aims and Objectives

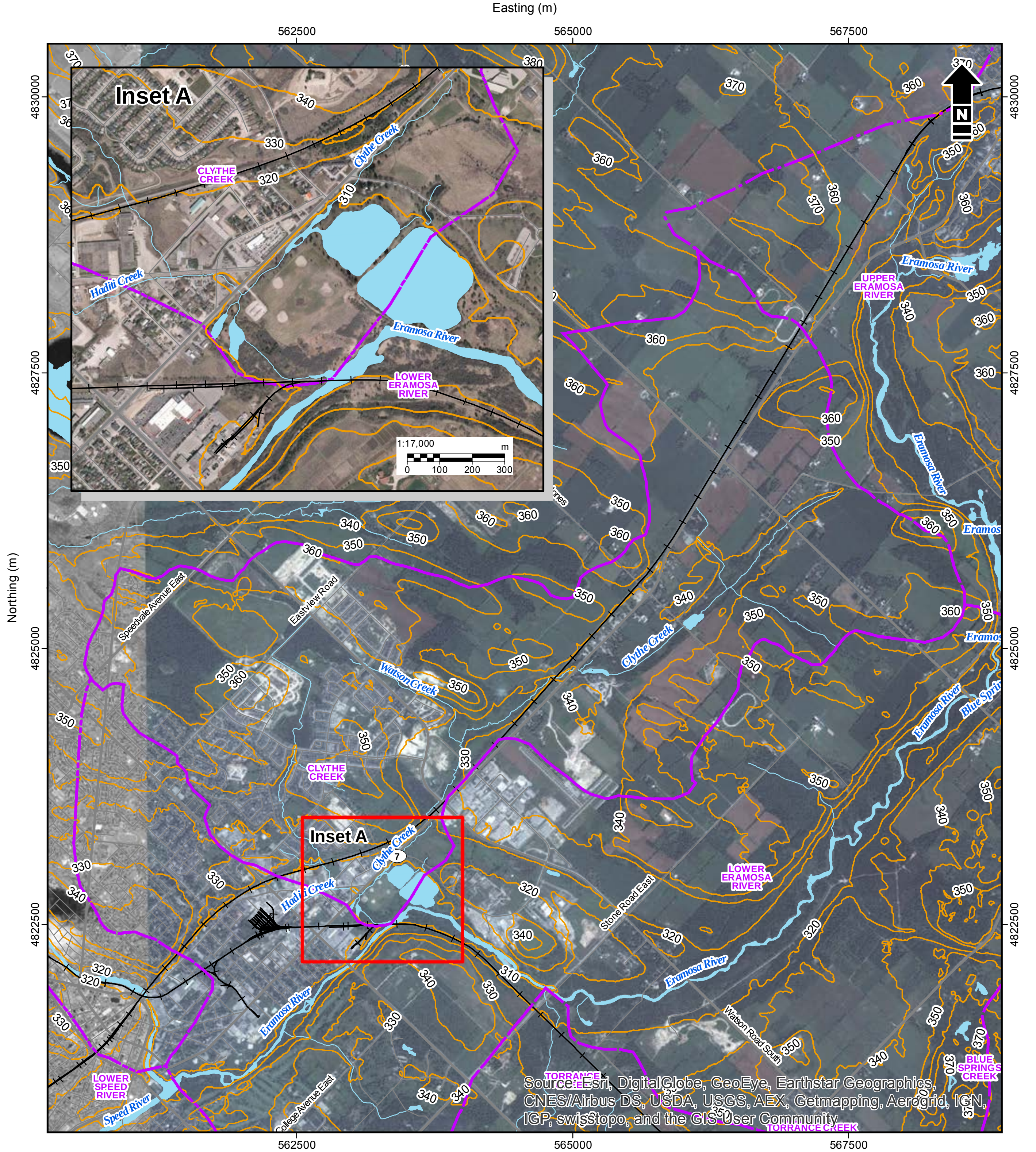
This report aims to provide an updated baseline inventory of existing fluvial geomorphic conditions with results of detailed field investigations, as well as provide options for preliminary channel realignments required for the widening of York Road.

2 BACKGROUND REVIEW

The background review of Clythe Creek focused on a desktop analysis of existing conditions. The analysis optimized the existing available information obtained through the review of previous studies for the subwatershed, including existing subwatershed, stormwater management, and drainage studies, geographic information, and aerial photography.

2.1 Study Area

Located within the City of Guelph, the local study area of Clythe Creek is situated south of York Road between Watson Parkway and Industrial Avenue. **Figure 2.1** depicts the Clythe Creek subwatershed and the study area.



- Subwatershed Boundary
- Water Body
- Watercourse
- Highway
- Road
- Railway
- Elevation Contour Interval (10m)

Reference: Data obtained from GeoBase® used under license. This is version 1.0 of the Open Government Licence – Ontario. Contains Information made available under Grand River Conservation Authority's Open Data Licence v1.0
Imagery (2012) obtained from City of Guelph used under license.

1:50,000

500 0 500 1,000 m

NAD 1983 UTM Zone 17N

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Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

City of Guelph
York Road Environmental Design

Clythe Creek Subwatershed

Date:	Project:	Technical:	Reviewer:	Drawn:
17 Dec 2015	22257	J. Parish	P. Chin	C. Curry

Figure
2.1

The Clythe Creek subwatershed is composed of Clythe Creek and its two tributaries, Watson Creek, and Hadati Creek. Clythe Creek joins with the Eramosa River south of York Road and east of Victoria Road. The Clythe Creek subwatershed is approximately a 21 km^2 drainage area dominated by both agricultural and urban land uses. Clythe Creek is considered a cold water stream with a band of wetland vegetation found along its length. 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.

The study area of Clythe Creek is located within lands associated with the former Guelph Correctional Centre (GCC) in operation from 1910 to 2001, which is currently owned by Infrastructure Ontario. The close proximity to the GCC buildings has had a large impact on the overall fluvial form and functioning of Clythe Creek within the study area, as numerous culverts, bridges, dams, and weirs have been installed along the channel by inmates of the facility. Additionally, two online ponds have been created with drainage directly into Clythe Creek, as well as the Eramosa River.

2.2 Historical Assessment

A historical aerial image from 1930 (**Figure 2.2**) was obtained for the study area and was used to infer past and present land uses within the area. Within the image, several features that are consistent with current land use are present, including the GCC (buildings and access roads), York Road, railway alignments, and the Eramosa River. Two aesthetic ponds are located on opposite sides of the correctional facility main driveway, and several small drainage features, originating to the west of the correctional facility, are present and discharge directly into the Eramosa River. Clythe Creek flows adjacent to York Road, becoming wider with multiple flow pathways in the downstream direction. Both the north and south ponds are absent from the image.

FIGURE 2.2 1930 Historical Aerial Image for the Study Area

2.3 Previous Studies

Before initiation of the geomorphic field assessment, Matrix conducted a review of background reports and previous studies to determine any relevant information applicable to this specific study. This background review identified reaches that have been delineated and studied by others to reduce redundancy. Watershed based studies (e.g., Eramosa River and Clythe Creek) on the state of the stream's health have been completed during the last few decades. Understanding the available geomorphic information, areas where updates are required, and gaps to be filled will be important to the completion of the study.

Matrix reviewed studies for background information pertaining to the fluvial geomorphic aspects of Clythe Creek. Overall, no study was able to 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 within 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 full list and overview of the background reports reviewed can be found in the Geomorphic Background Review Report (Tech Memo #1), (Matrix, 2016).

3 METHODOLOGY

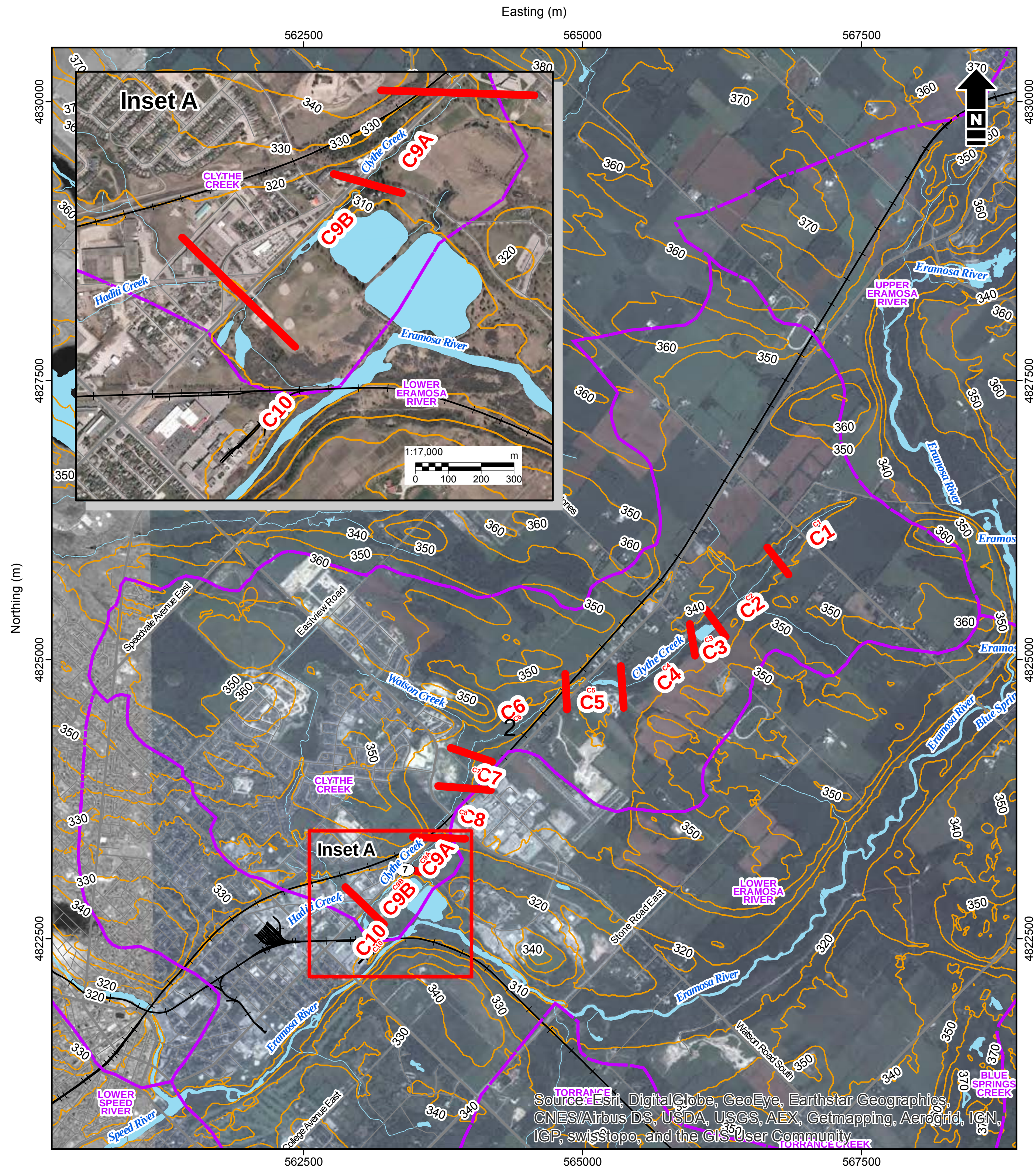
3.1 Reach Delineation

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 reviewed as part of the background review assessment (Ecologistics, 1997), ten reaches were identified along the Clythe Creek based on habitat characteristics. The reaches are named based on position along the watercourse chainage; with reach C1 located furthest upstream within the headwaters and reach C10 located furthest downstream extending to the confluence with the Eramosa River. The Clythe Creek reach delineation is displayed on **Figure 3.1**; reach characteristics are displayed in **Table 4.1**.

The study area is located within Reach C-9, which corresponds with the Clythe Creek channel corridor downstream from York Road to the confluence with Hadati Creek. The subwatershed study describes this reach as having bankfull width of 1 to 5 m wide and bankfull depths of 0.5 m. Channel substrate is described as gravel and rubble with a thin organic layer. Riparian cover is mowed lawn with landscaping, numerous artificial waterfalls and weirs to control channel gradient, and several culverts and storm outfalls adding discharge. Reach C-10 extends from the Hadati Creek confluence downstream to the Eramosa River. This reach is described as having bankfull widths range from 10 to 12 m and a bankfull depth of 0.5 m, with silty organic material composing the bed substrate. Riparian cover consists of dense cedar forest with mixed herbaceous an occasional willow trees (Ecologistics, 1997).

Further refinement of this previous delineation is warranted for the current study due to the changes in-channel morphology and planform that exist. For the purposes of the existing study, Reach C-9A represents the upstream segment of Clythe Creek Reach C-9; extending for approximately 445 m downstream from York Road to the historical stone arch bridge that is the main access to the former reformatory facilities. Reach C-9B represents the downstream segment, extending from the historical stone arch bridge 500 m downstream to the confluence with Hadati Creek.



Subwatershed Boundary
Water Body
Watercourse
Highway
Road
Railway
Elevation Contour Interval (10m)
Reach Break

Reference: Data obtained from GeoBase® used under license. This is version 1.0 of the Open Government Licence – Ontario. Contains Information made available under Grand River Conservation Authority's Open Data Licence v1.0
Imagery (2012) obtained from City of Guelph used under license.

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Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

City of Guelph
York Road Environmental Design

Clythe Creek Reach Breaks

Date:	Project:	Technical:	Reviewer:	Drawn:
29 Jan 2016	22257	J. Parish	P. Chin	C. Curry

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Figure 3.1

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3.2 Field Reconnaissance

In order to provide insight regarding existing geomorphic conditions and document any evidence of active erosion, a site visit was conducted on May 14, 2015. During the visit, channel conditions along the Clythe Creek study reaches were evaluated using two established synoptic surveys: the Rapid Geomorphic Assessment (RGA) and the Rapid Stream Assessment Technique (RSAT). Results from the rapid assessments are detailed in Section 4.

3.2.1 Rapid Geomorphic Assessment

The RGA was designed by the Ontario Ministry of Environment (1999) to assess urban stream channels. It is a qualitative technique based on the presence and/or absence of key indicators of channel instability such as exposed tree roots, bank failure, excessive deposition, etc. The various indicators are grouped into four categories representing specific geomorphic process: 1) Aggradation, 2) Degradation, 3) Channel Widening, and 3) Planimetric Form Adjustment. Over the course of the survey, the existing geomorphic conditions of each reach are noted and the presence or absence of the specific geomorphic indicators is documented. Upon completion of the field inspection, the indicators are tallied within each category and the subsequent results are used to calculate an overall reach stability index. This index value corresponds to one of three stability classes representing the relative degree of channel adjustment and/or sensitivity to altered sediment and flow regimes (**Table 3.1**).

TABLE 3.1 Rapid Geomorphic Assessment Classification

Index	Classification	Interpretation
≤0.20	In Regime or Stable (Least Sensitive)	The channel morphology is within a range of variance for streams of similar hydrographic characteristics - evidence of instability is isolated or associated with normal river meander propagation processes
0.21 to 0.40	Transitional/Stressed (Moderately Sensitive)	Channel morphology is within the range of variance for streams of similar hydrographic characteristics but the evidence of instability is frequent
≥0.41	In Adjustment (Most Sensitive)	Channel morphology is not within the range of variance and evidence of instability is wide spread

3.2.2 Rapid Stream Assessment Technique

The RSAT (Galli, 1996) provides a purely qualitative assessment of the overall health and function of a reach in order to provide a quick assessment of local stream conditions and to identify and prioritize restoration needs on a watershed scale. This system integrates visual estimates of channel conditions and numerical scoring of stream parameters using six categories:

1. Channel Stability
2. Erosion and Deposition
3. Instream Habitat
4. Water Quality
5. Riparian Conditions
6. Biological Indicators

Once each condition has been assigned a score, values are totaled to produce an overall stream stability score, or health rating, based on a 50 point total. The final value is then categorized into one of three classes: low (poor health), moderate (moderate health), and high (good health).

Low (Poor Health)	<20
Moderate	=20 to 35
High (Good Health)	>35

Although the RSAT grades streams from a more biological and water quality perspective than the RGA, this information is still relevant within a geomorphic context. In general, the types of physical features that generate good habitat for aquatic organisms tend to represent healthy geomorphic systems as well (e.g., native fish may prefer a well-established riffle-pool sequence with little fine material on the riffles, quality riparian conditions provide food and shade to streams, woody debris and overhanging banks provide habitat structure, etc.).

3.3 Detailed Assessment Survey

Detailed geomorphic assessment surveys were be performed within the study area to support design recommendations. This included cross-section surveys and a longitudinal profile surveyed with a Total Station along with substrate characterization, following a modified Wolman pebble count, and characterization of bank properties. The surveys were used to determine channel bankfull dimensions and provide indications of bed morphology and local energy gradient.

4 FLUVIAL GEOMORPHIC EXISTING CONDITIONS

4.1 Rapid Assessment Results

General observations of channel dimensions, such as bankfull width and depth, substrate size, bank height, in-channel and riparian cover, channel hardening, and other disturbances (e.g., excessive erosion), were documented as part of the overall geomorphic assessment on Clythe Creek and Hadati Creek.

The following section provides results of the rapid assessments for Clythe Creek (Reaches C-9A, C-9B, and C-10) and Hadati Creek (Reach HC-1) within the study area. A summary of channel characteristics describing the reaches is provided in **Table 4.1**. The RGA scores are summarized in **Table 4.2**, and the RSAT scores are presented in Table 4. Additionally, a photographic record of each Reach at the time of the field evaluation is included in **Appendix A**.

TABLE 4.1 General Channel Characteristics as Described by Visual Observations During Rapid Assessments

Channel Characteristic	C-9A	C-9B	C-10	HC-1
Bankfull Width (m)*	3.5	10 to 19	8.5	3.0
Bankfull Depth (m)*	0.5	0.4 to 0.5	1.0	1.0
Width:Depth Ratio	6.0	20 to 47.5	8.5	3.0
Slope (m/m)	0.0132	0.0018	0.0024	-
Bank Height (m)	0.4	0.4	0.6	1.5 to 2.0
Bed Substrate	Silts and sands with few cobbles	Silts	Silts	Cobbles with some gravels and pebbles
Riparian Vegetation	Some mature willow and cedar	Some mature willows	Mature cedar forest	-
Evidence of Hardening	Stone boulders along banks	Stone boulders along banks	-	Concrete lined

*Bankfull widths and depths were measured with metre stick.

TABLE 4.2 Summary of the 2015 RGA Scores for Clythe Creek and Hadati Creek

Reach	Factor Value				Stability Index	Condition
	Aggradation	Degradation	Widening	Planimetric Adjustment		
C-9A	0.43	0.2	0.4	0.29	0.33	Transitional
C-9B	0.7	0.2	0.1	0.29	0.32	Transitional
C-10	0.57	0.1	0.3	0.29	0.32	Transitional
HC-1	0.29	0.5	0.3	0.14	0.30	Transitional

TABLE 4.3 Summary of the 2015 RSAT Scores for Clythe Creek and Hadati Creek

Reach	Factor Value						Overall Score	Condition
	Channel Stability	Scour / Deposition	Instream Habitat	Water Quality	Riparian Condition	Biological Indicators		
Max. Score	**11**	**8**	**8**	**8**	**7**	**8**	**50**	
C-9A	6	5	5	3	4	2	25	Moderate
C-9B	6	2	3	2	3	3	19	Low
C-10	6	4	3	3	6	2	24	Moderate
HC-1	5	5	3	4	2	3	22	Moderate

4.1.1 Reach C-9A

Reach C-9A extends downstream from York Road (approximately 175 m west of Watson Parkway) following a generally sinuous planform. The downstream reach break is located at the historical stone arch bridge that serves as entrance to the former GCC. The overall reach length is approximately 455 m. Within the reach, eight historical instream structures have been identified, as well as two outfalls and one tributary confluence. Due to the extent of instream structures which control flow within the reach, the majority of the channel is backwatered into pools. Only two riffle features were observed, comprising of cobble and gravel substrate. Substrate in the pools was predominantly unconsolidated silts and sands. Bankfull width within the reach was measured at 3 m, with bankfull depth at 0.5 m. Due to backwatering effects, water levels throughout the reach were at or near bankfull during the time of the onsite assessments, leading to oversaturated bank material and fracture lines along the top of bank. Bank undercutting was also observed at a few locations towards the downstream extent of the reach; however bolder stone placement along the bank toe throughout the majority of the reach prevents substantial erosion. The RGA score for Reach C-9A is 0.33 indicating a channel in transition, with evidence of aggradation being the dominant geomorphic factor influencing channel function. The RSAT score of 25 indicated the channel in generally in moderate health, however major limiting factors in the reach include water quality, riparian conditions, and biological indicators.

4.1.2 Reach C-9B

Reach C-9B extends downstream from the historical stone arch ridge to the confluence with Hadati Creek. The overall reach length is approximately 500 m. Within the reach is the outlet to the Reformatory Ponds. Active wetted width ranges from 2 m at pinch points to 20 m, with water depth ranging from 0.2 to 0.4 m. Riffle-pool morphology was not observed and the overall channel gradient is low with extensive aggradation of unconsolidated fine silts. Unconsolidated sediment was measured along the bed and ranged from 0.5 to over 1 m in depth downstream from the Reformatory Ponds outlet. The extensive aggradation observed within the reach is likely a result of the low gradient and stagnant flow throughout the reach. Apart from local increases in velocity at drop-structures, flow was barely observed as moving until the downstream reach break. Several mature willow trees are located along the channel banks, however there are broad gaps in cover over the channel. Channel banks have been hardened with boulder placement similar to the upstream reach. In total, four bridges, three drop-structures, and one corrugated steel pipe (CSP) outlet were observed within the reach. Each of the bridges and drop-structures are found at pinch points along the channel. An additional bridge is located over the Reformatory Ponds outlet channel. The RGA score for Reach C-9B is 0.32 indicating a channel in transition with evidence of aggradation being the dominant geomorphic factor influencing channel function. The RSAT score of 19 indicates that the channel is in poor health. Limiting factors are found in nearly all factor value categories including extensive deposition, lack of suitable instream habitat, water quality issues, riparian conditions, and biological indicators.

4.1.3 Reach C-10

Reach C-10 extends downstream from the Hadati Creek confluence to the confluence with the Eramosa River adjacent to the CP Rail bridge over the Eramosa at the confluence. Channel planform within the reach is typically straight, however the channel changes direction do to historical alteration of the Industrial Ponds and influences of the CP Rail line embankment. Downstream from the Hadati Creek confluence the channel branches into a north and south alignment, each flowing though one of the Industrial Ponds, forming an islands. A single channel connects the two ponds at the western property extent. At the outlet from the southern Industrial Pond, the reach follows a straight planform to the southeast before flowing along the CP Rail embankment until the Eramosa River confluence. Total reach length is approximately 450 m along the dominant flow path through the southern Industrial Pond. Bankfull channel dimensions were measured at 8.5 m wide and 1 m deep. Riparian corridor is comprised of a cedar forest with beaver activity present along the banks. A single beaver dam is located along the channel 150 m upstream from the Eramosa River confluence. Due to the beaver dam, as well as the Industrial Ponds, flow through this reach is slow and sediment accumulation along the bed is extensive. Unconsolidated silt and sand deposition along the bed ranges from 0.1 to 0.2 m throughout the reach. The RGA score for Reach C-10 is 0.32 indicating a channel in transition, with evidence of aggradation being the dominant geomorphic factor influencing channel function. The RSAT score of 24 indicates the channel reach in generally in moderate health, however major limiting factors include extensive deposition, lack of diverse instream habitat, water quality, and biological indicators.

4.1.4 Reach HC-1

Hadati Creek was walked for approximately 200 m upstream from the Clythe Creek Confluence. For the first 75 m upstream from Clythe Creek, Hadati Creek is partially channelized with the right bank lined with eroding cement cushions. Few trees are growing out of the banks, and have exposed, elevated roots. Bank heights are approximately 1.5 to 2.0 m tall and are near vertical. At several locations along the outer meander bends the cement cushions are undermined. Bankfull width was measured at approximately 3.0 m and bankfull depth at 1.0 m. Bankfull measurements were determined by the height of exposed tree roots and an inflection in the exposed soil profile. At Beaumont Crescent, the channel becomes briefly concrete lined as is flows through a box culvert. Upstream from Beaumont Crescent the channel is heavily entrenched within the roadside ditch with bank heights over 2.0 m and vertical. The exaggerated entrenchment of the channel upstream from Beaumont Crescent is likely a result of historical trenching. Approximately 120 m upstream from Beaumont Crescent, the main Hadati Creek Channel and a tributary converge. The RGA score for Reach HC-1 is 0.3 indicating a channel in transition, with evidence of degradation being the dominant geomorphic factor influencing channel function. The RSAT score of 22 indicates the channel reach in generally in moderate health; however, major limiting factors include lack of riparian corridor, lack of instream habitat, water quality, and biological indicators.

4.2 Detailed Channel Characterization

A geomorphic survey was conducted within reach C-9A, C-9B, and C-10 of the York Road study area in order to gain an understanding of the existing channel function and stability. Approximately 1.4 km of channel was surveyed from the upstream York Road reach break to the Eramosa River confluence.

The collection of more complete field data to also aids in defining current channel geometry and hydraulics. Detailed field data collection included the following tasks:

- measurement of bankfull channel geometries via cross-section surveys at nine locations
- characterization of bank parameters, such as height, angle, sediment composition, degree of vegetative cover, and other metrics
- identification of the median sediment size along the bed and a description of clast size distributions at the nine cross-section survey sites
- determination of local energy gradients through a survey of channel bottom and bankfull elevations, including top-of-riffle and bottom-of-riffle (where applicable), maximum depth, and any obstructions to flow

4.2.1 Bankfull Geometry

Bankfull geometry was recorded at nine cross-sections: five within Reach C-9A and four within Reach C-9B. **Table 4.4** contains a summary of the bankfull parameters, including mean values for all cross-section sites in the study reaches. **Figure 4.1** and **Figure 4.2** provide a typical channel cross-section for each reach and **Figure 4.3** depicts the overall longitudinal profile from York Road to the Eramosa River confluence. Cross-sections were not surveyed within Reach C-10.

The typical cross-section for Reach C-9A (**Figure 4.1**) 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 4.3**) shows that the gradient along through Reach C-9A from York Road to the historic stone arch bridge is low-moderate, with an average slope of 0.012 m/m.

The typical cross-section for Reach C-9B (**Figure 4.2**) 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.

TABLE 4.4 Channel Geometry Data for Clythe Creek

Cross-section Parameter	Minimum	Maximum	C-9A Average	Minimum	Maximum	C-9B Average
Bankfull Width (m)	3.04	4.0	**3.39**	9.03	11.08	**10.19**
Average Bankfull Depth (m)	0.29	0.42	**0.36**	0.31	0.53	**0.44**
Maximum Bankfull Depth (m)	0.44	0.75	**0.64**	0.61	0.96	**0.8**
Bankfull Width:Depth	9.02	11.59	**9.67**	19.61	28.77	**23.83**
Cross-sectional Area (m^2)	0.93	1.75	**1.51**	3.75	7.19	**6.0**
Wetted Perimeter (m)	3.4	4..73	**3.98**	9.21	11.43	**10.62**
Hydraulic Radius (m)	0.27	0.45	**0.38**	0.41	0.65	**0.56**

Bankfull width was determined in the field by identifying grade inflections that are associated with the start of the floodplain, as well as changes in vegetation growth and exposed roots. The bankfull elevation of the channel is typically associated with the point at which overbank flooding occurs if overtopped. Within the study reaches, water level was frequently observed at or near bankfull level. Oversaturated banks and hummocky terrain in close proximity to the channel indicates that the channel is frequently overtopped, that the channel is undersized, or that there are barriers preventing the downstream movement of water.

Width to depth ratio is defined as the ratio of the bankfull surface width to the average depth of the bankfull channel and is a ratio that helps to interpret prevailing energy distributions within a channel and the ability of various discharges to move sediment downstream through the reach. Channels with a high width to depth ratio, such as Reach C-9B, are characteristically wide and shallow. Deposition in channels with a high width to depth ratio is common, as the over-widened nature reduces the channels ability to transport sediment.

The presence of bedrock observed near the surface of the existing bed profile, as seen on the original York Road Reconstruction and Trunk Watermain engineering drawings (Guelph, 1988a and b) may have an influence on the overall gradient of the channel. Several bedrock inflections are recorded in the vicinity of significant instream structures, particularly near the historic stone arch bridge. The potential for bedrock outcropping being the basis for structure placement or that the structures were intentionally built on top of bedrock, could lead to further understanding of exiting conditions and downstream channel morphology. Within Reach C-9B, where the channel is dominated by aggradation processes, channel widening can then be associated with downstream adjustments to the degradation process and particularly changes in bed slope. The containment of flows within a degrading channel increases available energy and typically leads to erosion of one or both banks where the bed material is more resistant to erosion (i.e., bedrock material) than bank materials. Coupled with a sharp decrease in slope, there is expected to be a natural widening of the channel.

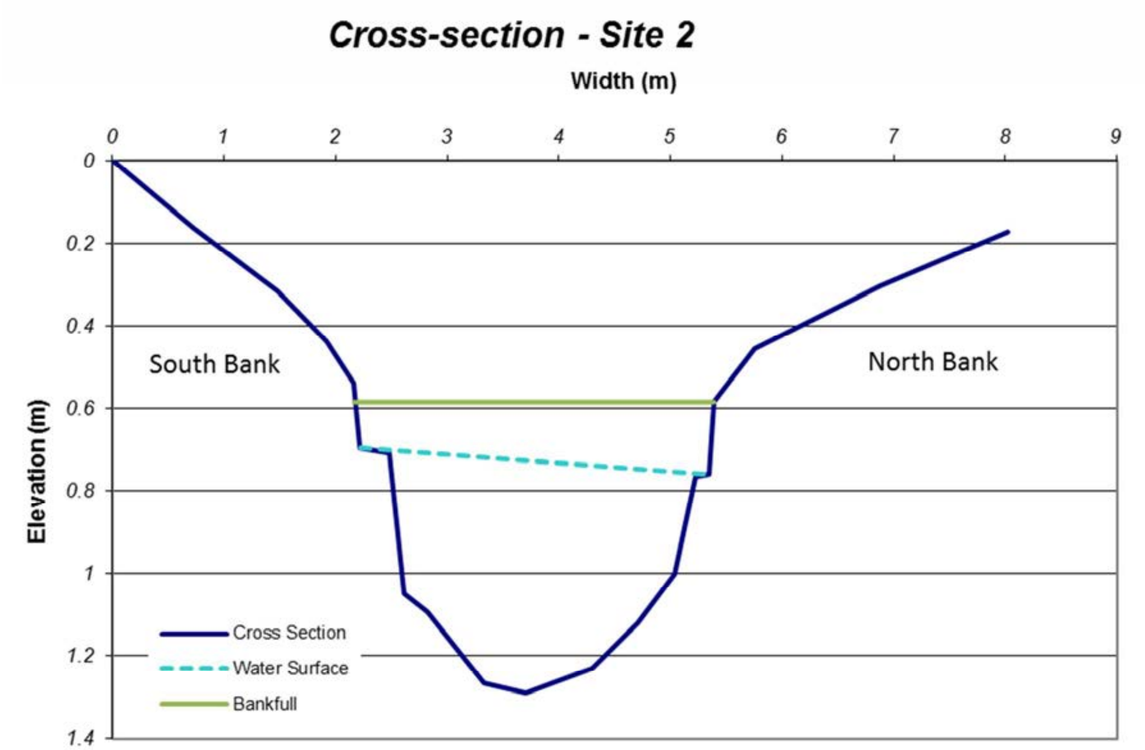

FIGURE 4.1 Typical Cross-Section within Reach C-9A

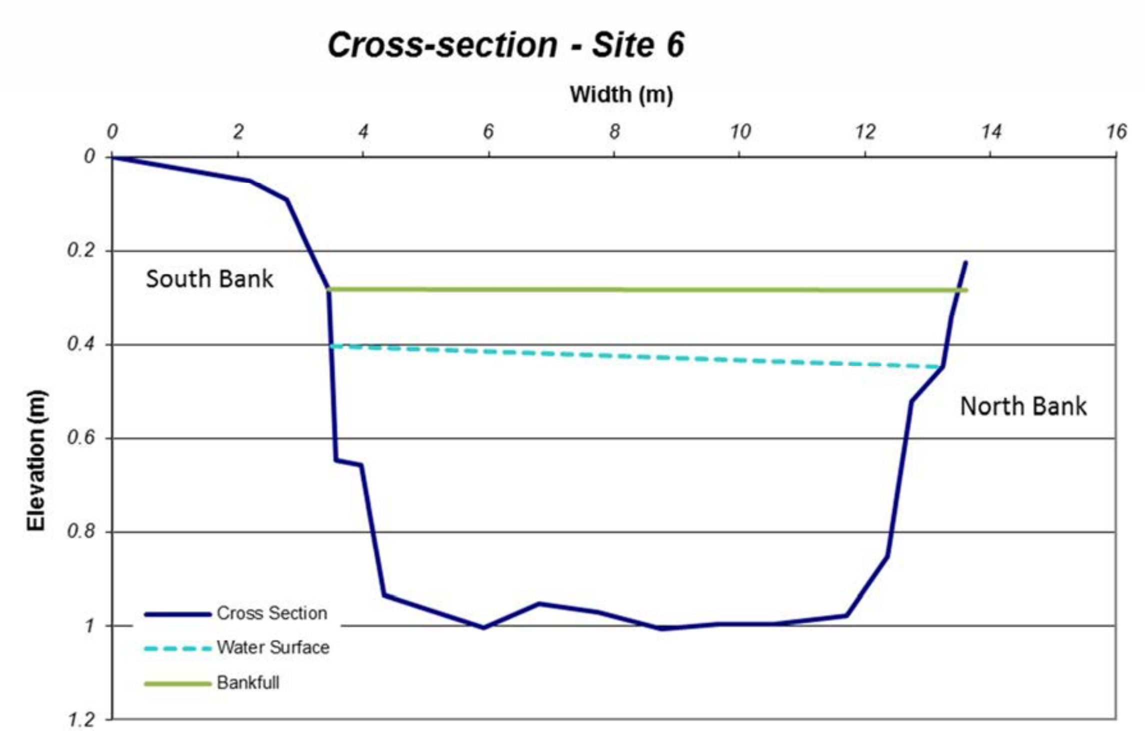

FIGURE 4.2 Typical Cross-Section within Reach C-9B

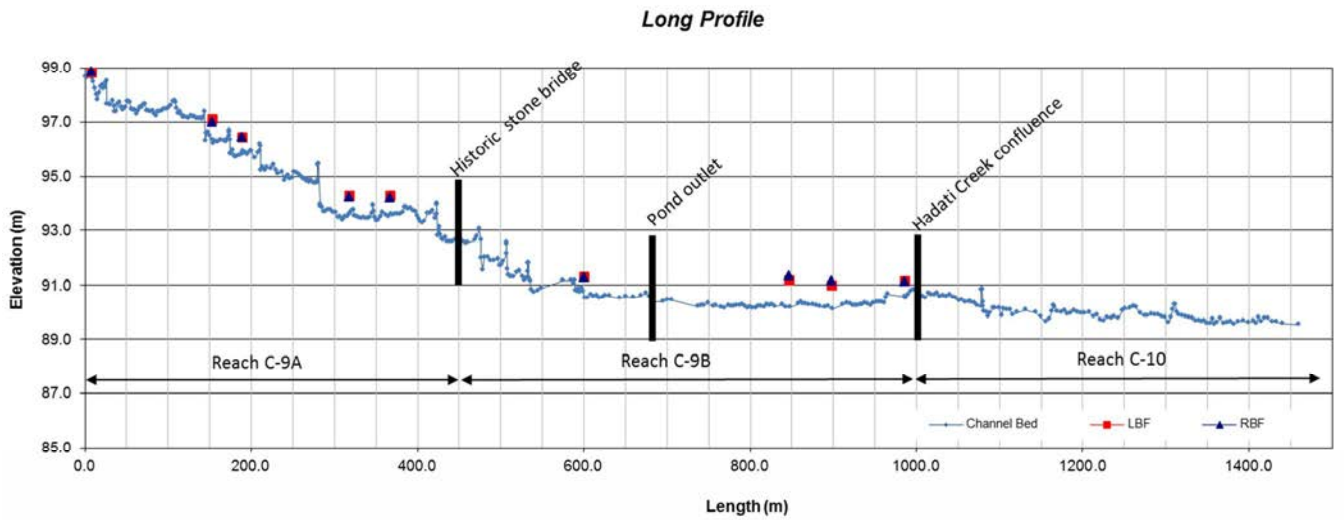

FIGURE 4.3 Long Profile Survey of Clythe Creek

4.2.2 Instream Structures

During the detailed field assessments, an inventory of all instream structures, bridges, and outlets was completed and information regarding location, type, drop height, and influences to the stream system were recorded.

In total, nine instream structures of a cultural heritage nature were observed as having direct contact with flow within Reach C-9A and seven structures within Reach C-9B, which are present within the first 125 m of the reach. Additionally, there are three pedestrian bridges that have limited cultural heritage value and a double CSP culvert crossing with no cultural heritage value within Reach C-9B. A detailed inventory of these structures and how they impact channel processes is included in Appendix B. These structures need to be considered when proposing recommended channel realignments through the study area.

5 CHANNEL REALIGNMENT - DESIGN OPTIONS

Due to the proposed widening of York Road it will be necessary to undertake channel realignments to accommodate proposed grading of the roadway. Several design options have been considered with the primary focus on optimizing channel dynamics, while considering grade controlling instream structures that have been installed along the channel and are considered to be features of cultural importance. It is important to consider several options with regards to channel realignment and how they will ultimately impact the form and function of the channel. Particularly within the lower reaches of the study area (i.e., Reaches C-9B and C-10) where Clythe Creek is considered to be in a state of reduced fluvial function associated with an over-widened channel and low gradient, there are opportunities to advance restoration options beyond minimum requirements for roadway grading.

5.1 Option 1 – Do Nothing

In order to accommodate the proposed widening of York Road adjacent to the study area, required channel works are proposed as Option 1 (**Appendix C**). For this option, little work will be done to the channel other than general maintenance required following road widening works. This option is considered consistent with recommendations made in the 2007 Class EA, in which all cultural heritage features will be maintained and creek works are minimized (NRSI, 2006).

For this option all cultural heritage feature will be maintained within the creek and no channel realignments will occur. As a result, the existing fish passage issues and impaired fluvial form and function of the channel will remain.

While this work would be recommended as interim until further improvements to the channel can be made, several aspects of the design have been included in order to enhance fish passage requirements.

Within Reach C-9A, local works will be required to restore the channel following a culvert extension or replacement at York Road. There will be no impact to cultural heritage features located within the channel. In order to maintain the features, a retaining wall will be constructed adjacent to features 9 and 10 in order to accommodate grading requirements of the road widening.

5.2 Option 2 - Improved Form and Function

Minimal channel works required for the proposed widening are not expected to improve in the overall function or habitat of Clythe Creek. Therefore, additional channel works are proposed. Option 2 (**Appendix C**) channel works would be considered the minimum required in order to improve channel function.

For Option 2, works within Reach C-9A will include an extensive channel realignment that will bring the creek well away from the York Road right-of-way and utilize more of the 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 slit 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 Reaches C-9B and C-10, significant grading work are proposed in order to narrow the channel and create a consistent bed profile. The outlet of the northern Reformatory Pond will also be narrowed in an effort to limit interactions between the pond and creek channel. The bed and bank grading will continue downstream to the existing flow splitter which will be removed.

5.3 Option 3 - Ultimate Channel Configuration

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 C**).

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 slit 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.

6 STREAM MORPHOLOGY CONCLUSIONS AND RECOMMENDATIONS

A geomorphic assessment has been completed to assist with the detailed design and restoration of Clythe Creek within the York Road study area. This assessment reviewed background information, which included past documents, aerial photos, and contour mapping. Watercourse reaches were identified along the study corridor using desktop analyses and were further assessed in the field. During the field investigation, indicators of active geomorphic processes were noted, channel dimensions were measures and a stability index was provided for each reach as required. Additional detailed geomorphic surveys were carried out along two tributaries within the study corridor in order to investigate possible bed degradation that could pose a hazard to proposed sanitary sewer infrastructure.

As a result of proposed widening of York Road, it is necessary to consider the impact these works will have on Clythe Creek which flows parallel to the roadway. As existing channel conditions are severely impaired, the opportunity exists to improve overall health and function of the creek. Following a review and analysis of existing conditions, three options for channel improvements have been made which correspond to the minimum amount of work required (consistent with the 2007 EA), as well as two additional options which will improve the fluvial form and function of the channel and fish passage.

7 REFERENCES

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APPENDIX A
Site Photographs

Matrix Solutions Inc.
May 5, 2016

1. Reach C-9A: Clythe Creek culvert inlet at York Road. Gabion protection along road embankment and rip rap placement along the channel banks. Channel approaches culvert at a 45 degree angle; rip rap protection limits bank scour at inlet.

Matrix Solutions Inc.
May 5, 2016

2. Reach C-9A: Substrate inside York Road culvert. Wetted channel width occupies the entire culvert width.

Matrix Solutions Inc.
May 5, 2016

3. Reach C-9A: Looking downstream from York Road culvert outlet.

Matrix Solutions Inc.
May 5, 2016

4. Reach C-9A: Typical cross section within the reach. Water level site near bankfull, banks are oversaturated and slumping causing hummocky terrain.

Matrix Solutions Inc.
May 5, 2016

5. Reach C-9A: Banks are typically lines with small boulders.

Matrix Solutions Inc.
May 5, 2016

6. Reach C-9A: Channel outflanks in-stream weir structure.

Matrix Solutions Inc.
May 5, 2016

7. Reach C-9A: Section of over widened channel upstream from weir where water is ponded. Sediment deposition occurs and cat tail growth observed.

Matrix Solutions Inc.
May 5, 2016

8. Reach C-9A: Channel is locally widened downstream from weir structure that spans approximately 2x bankfull width. Deposition and infill occurs to compensate.

Matrix Solutions Inc.
May 5, 2016

9. Reach C-9A: Tributary channel through ornamental grounds that confluences' with Clythe Creek.

Matrix Solutions Inc.
May 5, 2016

10. Reach C-9A: Minor debris upstream from wier.

Matrix Solutions Inc.
May 5, 2016

11. Reach C-9B: Looking upstream towards man-made island and main correctional facility entrance.

Matrix Solutions Inc.
May 5, 2016

12. Reach C-9B: CSP outlet and sediment deposition plume upstream from pedestrian bridge.

Matrix Solutions Inc.
May 5, 2016

13. Reach C-9B: Looking upstream along Clythe Creek adjacent to Jaycee Park.

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May 5, 2016

14. Reach C-9B: Looking downstream along Clythe Creek adjacent to Jaycee Park.

Matrix Solutions Inc.
May 5, 2016

15. Reach C-9B: Double CSP culvert at entrance to Jaycee Park.

Matrix Solutions Inc.
May 5, 2016

16. Reach C-10: Clythe Creek downstream from Hadati Creek confluence; flow is ponded upstream from flow splitter.

Matrix Solutions Inc.
May 5, 2016

17. Reach C-10: Flow splitter structure installed along Clythe Creek.

Matrix Solutions Inc.
May 5, 2016

18. Reach C-10: Beaver dam towards the downstream extent of the reach contributing to ponding water.

Matrix Solutions Inc.
May 5, 2016

19. Reach C-10: Channel flows adjacent to CNRL embankment at the Eramosa River confluence.

Matrix Solutions Inc.
May 5, 2016

20. Reach C-10: Confluence with the Eramosa.

Matrix Solutions Inc.
May 5, 2016

21. Reach HC-1: Looking downstream towards York Road culvert crossing.

Matrix Solutions Inc.
May 5, 2016

22. Reach HC-1: Looking upstream along Hadati Creek.

Matrix Solutions Inc.
May 5, 2016

23. Reach HC-1: Concrete cushion bank protection installed along the west bank is failing.

Matrix Solutions Inc.
May 5, 2016

24. Reach HC-1: Concrete block wall at channel bend is undermined.

Matrix Solutions Inc.
May 5, 2016

25. Reach HC-1: Channel immediately downstream form Beaumont Cres. Both banks are lines with concrete and shale bricks. Bank protection is undermined along meander bend.

Matrix Solutions Inc.
May 5, 2016

26. Reach HC-1: Looking upstream towards Beaumont Cres culvert crossing.

Matrix Solutions Inc.
May 5, 2016

27. Reach HC-1: Beaumont Cres culvert inlet.

Matrix Solutions Inc.
May 5, 2016

28. Reach HC-1: Looking upstream from Beaumont Cres crossing. Channel is lined with concrete for approximately 18 m.

Matrix Solutions Inc.
May 5, 2016

29. Reach HC-1: Channel occupies roadside ditch and has been historically altered.

Matrix Solutions Inc.
May 5, 2016

30. Reach HC-1: Culvert crossing at Industrial Ave. Channel has been buried for approximately 60 m upstream from Industrial Ave.

Matrix Solutions Inc.
May 5, 2016

31. Reach HC-1: Inlet 60 m upstream from Industrial Ave. Channel was dry at the time of field inspection.

Matrix Solutions Inc.
May 5, 2016

32. Reach HC-1: Elizabeth Street culvert crossing

Matrix Solutions Inc.
May 5, 2016

33. Reach HC-1: Upstream from Elizabeth Street the channel is confined through private property.

Matrix Solutions Inc.
May 5, 2016

34. Reach HC-1: Bedrock influence along the channel bed upstream from Suburban Ave.

APPENDIX B
Cultural Heritage Features

Matrix Solutions Inc.
May 5, 2016

1. Feature #1: Ashlar stone culvert (potential significance) north of York Road. Culvert is 25 m upstream from York Road and conveys Clythe Creek flow underneath the CNR line. The double box culvert has approximate dimensions of 1.2 m wide by 1.4 m high. Substrate is present along the bed of the culvert however, natural light does not penetrate and the upstream inlet is not visible.

City of Guelph
n/a

2. Feature #2: Reinforced concrete road bridge railing (potential significance) north of York Road. Railing has been reinforce with gabion and rip-rap.

Matrix Solutions Inc.
May 5, 2016

3. Feature #3: Fieldstone weir with steps and sentinel stones (listed, non-designated significant feature). Structure height is 0.5 m above water level with an additional 0.45 m scour pool (total height above bed 0.95 m). At the time of survey, flow depth over the structure was 0.08 m and 1.6 m wide. Backwatering upstream from the structure had a depth of 0.45 m. Channel has scoured out downstream from the weir, over-widening the channel to 4m

City of Guelph
n/a

4. Feature #4: Fieldstone garden wall with sentinels (listed, non-designated significant feature). Feature extends for 110 m south-east across the floodplain.

Matrix Solutions Inc.
May 5, 2016

5. Feature #5: Fieldstone weir with clay pipes (listed, non-designated significant feature). Two clay pipes are imbedded into concrete and fieldstone weir structure. The feature is 2m wide and has a total height of 1.1 m; 0.5 m above existing water level plus 0.6 m scour depth. Feature imposes a significant barrier to downstream flow movement and has trapped woody debris at its crest.

City of Guelph
n/a

6. Feature #6: Fieldstone steps (listed, non-designated significant feature). Feature is located on the floodplain north of Clythe Creek and south of York Road.

City of Guelph
n/a

7. Feature #7: Large boulder or bedrock outcrop (potential significance). Feature is located on the floodplain north of Clythe Creek and south of York Road.

Matrix Solutions Inc.
May 5, 2016

8. Feature #8: Fieldstone weir (listed, non-designated significant feature). This feature is made from fieldstone and concrete with decorated stones placed along the banks. The feature is 1m high; 0.55 m above existing water level plus 0.45 m scour pool. The upstream pool created by backwater is 0.4 m deep with a flow depth of 0.04 m over the crest of the feature. Width of the feature is 2m conforming to the bankfull channel.

Matrix Solutions Inc.
May 5, 2016

9. Feature #9: Fieldstone weir (listed, non-designated significant feature). This feature is located within a group of cedar trees and the feature and been outflanked to the south. Channel banks are lined with decorative stone and gabion baskets are in place along the road embankment to the north. The feature is 0.9 m high with a downstream scour pool

Matrix Solutions Inc.
May 5, 2016

10. Feature #10: Fieldstone weir (listed, non-designated significant feature). No in-stream structure is visible, however banks are lines with decorative stone. Bankfull width is 2m and wetted depth is 0.15 m.

Matrix Solutions Inc.
May 5, 2016

11. Feature #11: Fieldstone weir with steps and ashlar stone terrace wall (listed, non-designated significant feature). This feature is 4m wide and 1.4 m high from the channel bed to crest. Stone placement along the channel bed downstream from the feature limits scour. Decorative stone placement line the banks of the channel.

City of Guelph
n/a

12. Feature #12: Ashlar limestone wall (listed, non-designated significant feature). The feature is approximately 10m in length and extends south across the floodplain adjacent to Feature #11.

Matrix Solutions Inc.
May 5, 2016

13. Feature #13: Confluence of Clythe Creek and intermittent stream (potential significance). The intermittent stream flows through the southern floodplain and typically conveys groundwater flows. There is a small CSP culvert crossing immediately upstream from the confluence that allows for pedestrian crossing.

Matrix Solutions Inc.
May 5, 2016

14. Feature #14: Fieldstone weir with cut stone terrace wall (listed, non-designated significant feature). The crest of this feature is 1.5 m wide between the two main sentinel stones and is 1.45 m high from the base of the downstream scour pool. The backwater pool upstream from the feature is 0.55 m deep. Noticeable sedimentation is occurring behind the structure, with unconsolidated material measuring 10-15 cm.

City of Guelph
n/a

15. Feature #15: Fieldstone east entrance wall with sentinel stones (listed, non-designated significant feature). This feature is located to the north of the channel adjacent to York Road. The feature is 42 m long.

City of Guelph
n/a

16. Fieldstone west entrance wall with sentinel stones (listed, non-designated significant feature). This feature is located to the north of the channel adjacent to York Road. The feature is 50 m long.

Matrix Solutions Inc.
May 5, 2016

17. Feature #17: Stone and concrete road bridge (listed, non-designated significant feature). The bridge and wing-wall structure is approximately 14 m wide. The inlet to convey Clythe Creek is 4m wide and is considered to be undersized from a geomorphic perspective as the channel has widened and pooled on either side of the inlet.

Matrix Solutions Inc.
May 5, 2016

18. Feature #18: Fieldstone steps to the south of road bridge (listed, non-designated significant feature). The steps lead from the driveway entrance, down to Clythe Creek south of the bridge.

City of Guelph
n/a

19. Feature #19: Entrance sign, ashlar stone with jack arch (potential significance). The sign is located south of the creek channel and east of the main entrance drive way.

City of Guelph
n/a

20. Feature #20: Ashlar dry stone wall (listed, non-designated significant feature). The wall is 160 m long and runs parallel to the main entrance driveway south of the creek channel.

Google Earth
December 21, 2016

21. Feature #21: Willowbank Hall (listed, non-designated significant feature). The building structure is located to the south-west of the main entrance driveway and is a prominent landscape feature when visitors enter the property.

Matrix Solutions Inc.
May 5, 2016

22. Feature #22: Fieldstone weir (listed, non-designated significant feature). The feature is located 6m downstream from Feature #17, and is made from concrete with small boulders protruding which emphasizes the “rushing” waterfall effect. Structure width is 2.5 m along the crest and is 1.5 m height from the downstream bed elevation. The downstream water depth within the associated scour pool is 0.8 m.

Matrix Solutions Inc.
May 5, 2016

23. Feature #23: Fieldstone weir (listed, non-designated significant feature). This feature is located to the south of a man-made island downstream from the main entrance. The feature is 2m wide and is made out of concrete with small boulders protruding which emphasizes the "rushing" waterfall effect. Channel banks are lined with decorative stone and there is visual evidence of the structure detaching from the bank.

Matrix Solutions Inc.
May 5, 2016

24. Feature #24: Fieldstone weir (listed, non-designated significant feature). This feature is located to the north of a man-made island downstream from the main entrance. The feature is 2.1 m wide and is made out of concrete with small boulders protruding which emphasizes the "rushing" waterfall effect. Channel banks are lined with decorative stone. There are fracture lines present along the northern bank adjacent to the downstream stone wall. The structure is 0.7 m high, with the downstream bank heights/stone wall 1m high. Stone placement along the channel bed limits scour.

Matrix Solutions Inc.
May 5, 2016

25. Feature #25: Fieldstone weir (listed, non-designated significant feature). This feature is located downstream from the man-made island and 60m downstream from Feature #17 (main bridge). The feature is 5.5 m wide, however active flow width is only 4m over the crest. Height of the structure is 0.8 m from the downstream channel bed, with maximum scour depth of 0.5 m. Water depth upstream from the structure is 0.45 m, and the channel is heavily silted with deposition.

Matrix Solutions Inc.
May 5, 2016

26. Feature #26: Fieldstone weir (listed, non-designated significant feature). The feature height is 1m from the crest to the downstream channel bed, scour depth is 0.4 m. The feature is spanned by Feature #27 and decorative stone is places along the banks.

Matrix Solutions Inc.
May 5, 2016

27. Feature #27: Arched concrete and metal pedestrian bridge with stone abutments (potential significance). The bridge is 6.5 m long, and 2.5 m wide, the opening between footings allowing for channel flow is 3.5 m wide.

City of Guelph
n/a

28. Feature #28 and #29: Limestone pillars with wood board fencing leading to main entrance (potential significance). This feature runs parallel to York Road north of Clythe Creek, and extends for 630 m along the edge of the property.

City of Guelph
n/a

29. Feature #30: Limestone pillars (potential significance). This feature runs parallel to York Road north of Clythe Creek, and extends for 630 m along the edge of the property.

Matrix Solutions Inc.
May 5, 2016

30. Feature #31: metal and wooden pedestrian bridge (potential significance). The bridge is 7m long and 1.8 m wide, with a metal railing and concrete block footings. Water depth under the bridge is 0.65 m with 0.8 m freeboard between the water surface and the bridge deck. Minimum width of the outlet channel is 6.5 m indicating that the bridge is likely undersized.

City of Guelph
n/a

31. Feature #32: Metal and wood pedestrian bridge (potential significance). This pedestrian bridge leads from the south floodplain downstream from Feature #31 to a small island feature within Clythe Creek. The bridge is 9m long and 1.1 m wide sitting on concrete block footings. Wetted depth under the bridge is 0.28 m. Significant sedimentation has occurred within the vicinity of the bridge, with a depth of approximately 0.55 m of soft unconsolidated material present.

City of Guelph
n/a

32. Feature #33: Metal and wood pedestrian bridge (potential significance). The bridge spans Clythe Creek 120 m east of the driveway to Jacees Park. The Bridge is 7m long and 1.15 m wide, the deck sits 0.75 m above water level.

Matrix Solutions Inc.
May 5, 2016

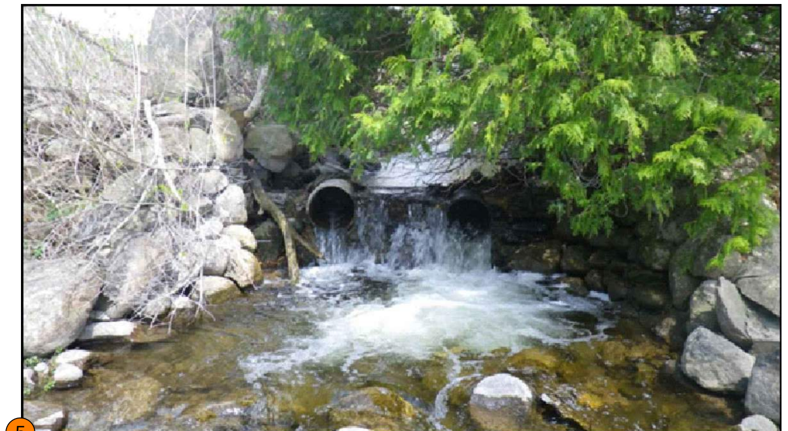
33. Feature #34: Confluence of Clythe Creek and Hadati Creek (potential significance). Hadati Creek flows south-east, crossing perpendicular to York Road through a concrete box culvert.

Matrix Solutions Inc.
May 5, 2016

34. Feature #35: Concrete and stone weir (potential significance). Total height of the feature is 0.7 m, with 0.35 m downstream water depth. The structure is 5.5 m wide and is constructed with concrete and decorative limestone blocks along the banks.

APPENDIX C
Clythe Creek Channel Alignment Options

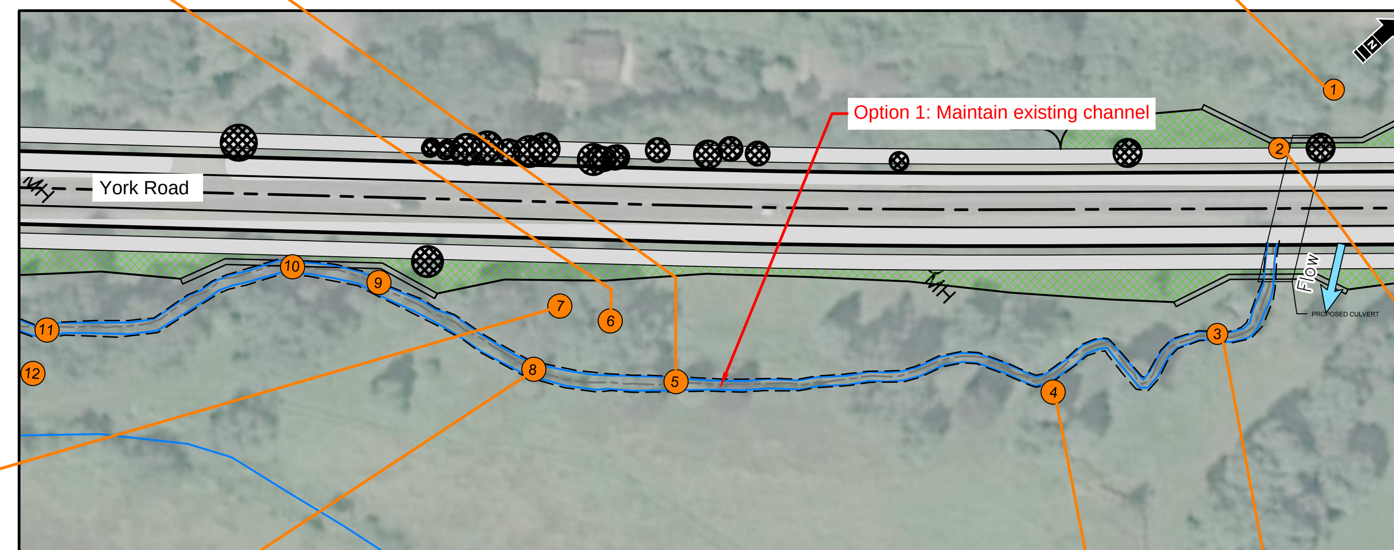
Feature #6: Fieldstone steps (listed, non-designated significant feature). No impact to feature anticipated.



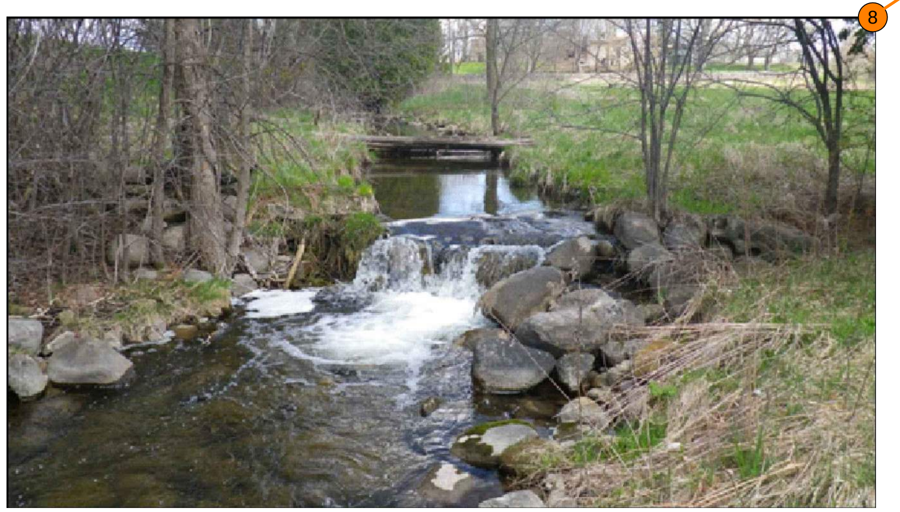
Feature #5: Fieldstone weir with clay pipes (listed, non-designated significant feature). No impact to feature anticipated.

Feature #1: Ashlar stone culvert (potential significance). No impact to feature anticipated.

Feature #7: Large boulder or bedrock outcrop (potential significance). No impact to feature anticipated.



Feature #2: Reinforced concrete road bridge railing (potential significance). Feature to be modified to accommodate road widening works.



Feature #8: Fieldstone weir (listed, non-designated significant feature). No impact to feature anticipated.

Feature #4: Fieldstone garden wall with sentinels (listed, non-designated significant feature). No impact to feature anticipated.

Feature #3: Fieldstone weir with steps and sentinel stones (listed, non-designated significant feature). No impact to feature anticipated.

1:1499.9989 Meters
15 0 15 30
Datum

Notes:
1. Refer to drawing 02 for photos of features 9, 10, 11 and 12.
2. For full plan and profile design information on Option 1, refer to drawings 06-08.

REVISION					
00	01 17 2017	Issued for client review	JH	JP	ED
No.	DATE	DESCRIPTION	BY	CHK.	DRN.

PARISH aquatic services
A Division of Matrix Solutions Inc.

AMEC Foster Wheeler
York Road Widening

York Road Improvements
Clythe Creek Option 1 - Reach C-9A
Cultural Heritage Feature Impacts

Date:	Project:	Technical:	Reviewer:	Drawn:
01 17 2017	22257 York Road	J. Henshaw	J. Parish	E. Drost

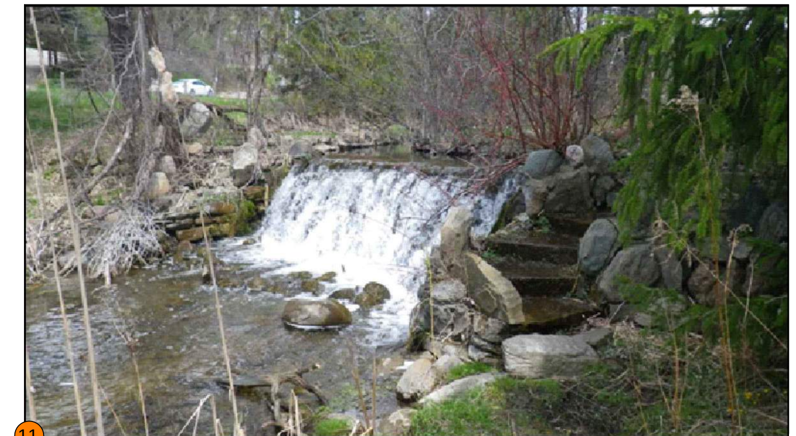
Figure 01

Plot 1:1 = Tabloid (L)
N:\PROJECTS\22257 - York Road Guelph\145912 - AMEC - York Road Environmental Design Study\03 Data\CAD\Matrix CAD\22257 York Road - CHF Figs- Option 1_01-09-2017.dwg - CHF 01 - Tuesday, January 17, 2017 10:44:50 PM - Eric Drost

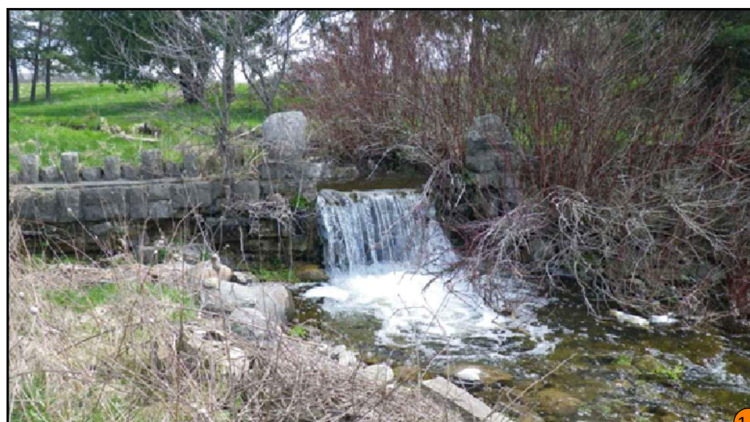
Plot 1:1 = Tabloid (L)

Feature #15: Fieldstone east entrance wall with sentinel stones (listed, non-designated significant feature)

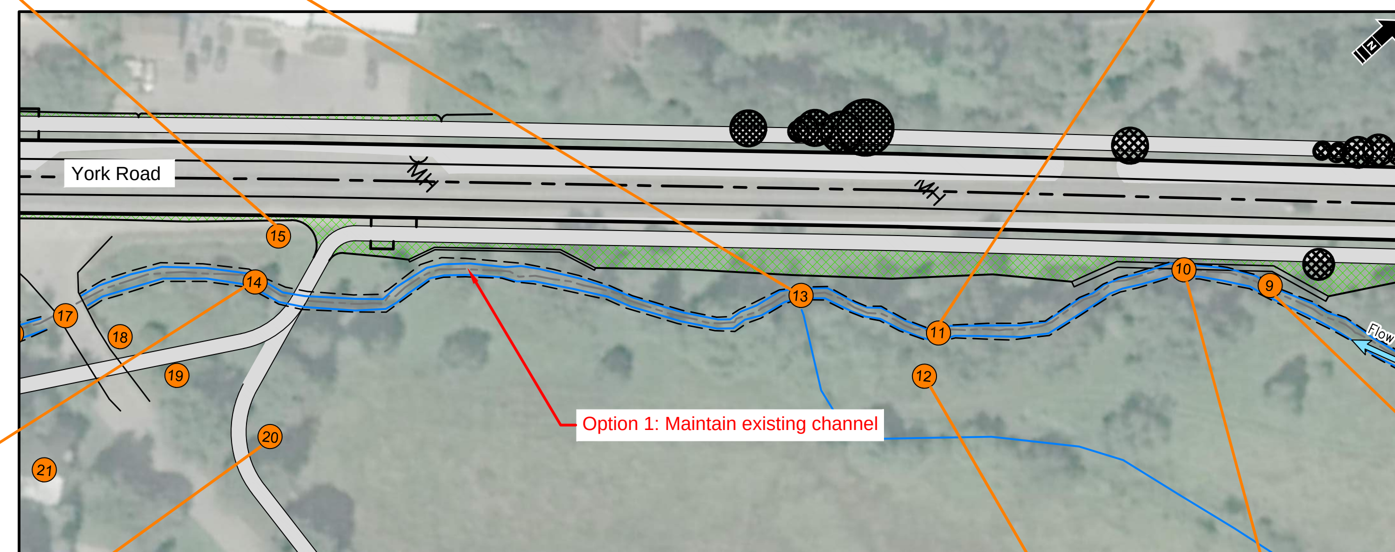
Feature #13: Confluence of Clythe Creek and intermittent stream (potential significance). No impact to feature anticipated.

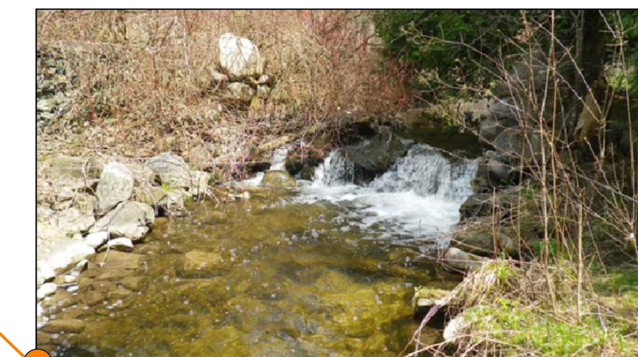


Feature #11: Fieldstone weir with steps and ashlar stone terrace wall (listed, non-designated significant feature). No impact to feature anticipated.



Feature #14: Fieldstone weir with cut stone terrace wall (listed, non-designated significant feature).





Feature #9: Fieldstone weir (listed, non-designated significant feature). No impact to feature anticipated. Retaining wall required to be built to protect/maintain feature from anticipated roadway grading limits.

Feature #20: Ashlar dry stone wall (listed, non-designated significant feature). No impact to feature anticipated.

Feature #12: Ashlar limestone wall (listed, non-designated significant feature). No impact to feature anticipated.

Feature #10: Fieldstone weir (listed, non-designated significant feature). Retaining wall required to be built to protect/maintain feature from anticipated roadway grading limits. Part of flagstone to be removed to accommodate retaining wall.

1:1500 Meters
15 0 15 30
Datum

Notes:
1. For full plan and profile design information on Option 1, refer to drawings 06-08.
2. Refer to drawing 03 for photos of features 17, 18,19 and 21.

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00	01 17 2017	Issued for client review	JH	JP	ED
No.	DATE	DESCRIPTION	BY	CHK.	DRN.

PARISH aquatic services
A Division of Matrix Solutions Inc.

AMEC Foster Wheeler
York Road Widening

York Road Improvements
Clythe Creek Option 1 - Reach C-9A
Cultural Heritage Feature Impacts

Date: 01 17 2017	Project: 22257 York Road	Technical: J. Henshaw	Reviewer: J. Parish	Drawn: E. Drost

Figure 02

N:\PROJECTS\22257 - York Road Guelph\145912 - AMEC - York Road Environmental Design Study\03 Data\CAD\Matrix CAD\22257 York Road - CHF Figs- Option 1_01-09-2017.dwg - CHF 02 - Tuesday, January 17, 2017 10:44:50 PM - Eric Drost

Plot 1:1 = Tabloid (L)

N:\PROJECTS\22257 - York Road Guelph\145912 - AMEC - York Road Environmental Design Study\03 Data\CAD\Matrix CAD\22257 York Road - CHF Figs- Option 1_01-09-2017.dwg - CHF 03 - Tuesday, January 17, 2017 10:44:50 PM - Eric Drost

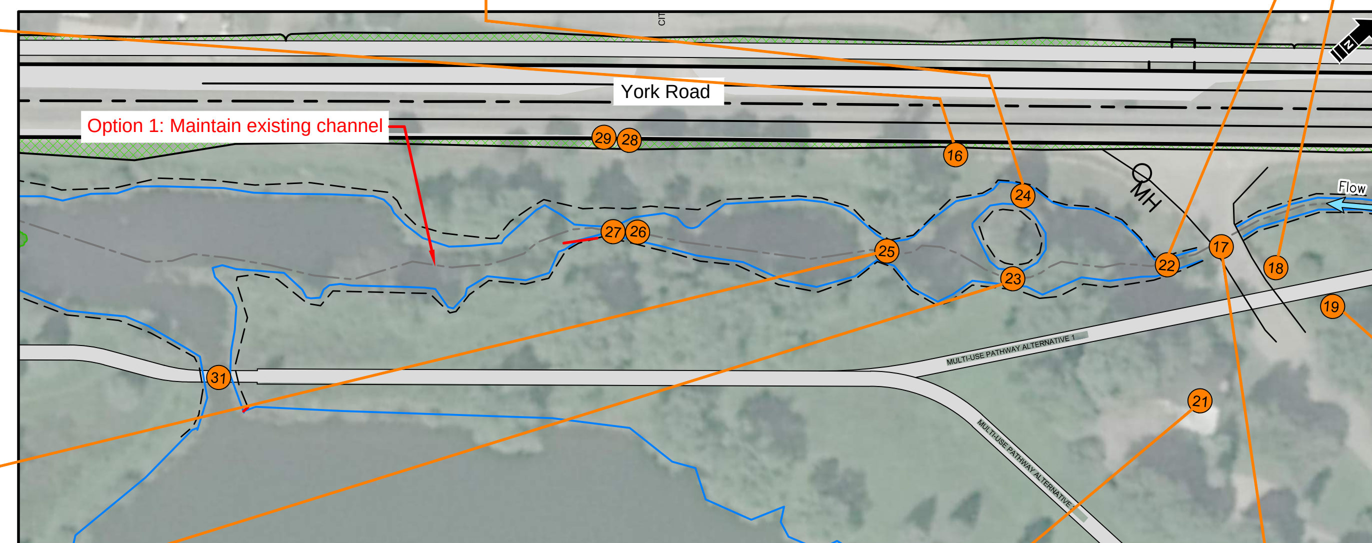

Feature #16: Fieldstone west entrance wall with sentinel stones (listed, non-designated significant feature). Potential for feature to be modified as a result of roadway grading requirements.


Feature #24: Fieldstone weir (listed, non-designated significant feature). No impact to feature anticipated.


Feature #22: Fieldstone weir (listed, non-designated significant feature). No impact to feature anticipated.


Feature #18: Fieldstone steps to the south of road bridge (listed, non-designated significant feature). No impact to feature anticipated. No impact to feature anticipated.


Feature #25: Fieldstone weir (listed, non-designated significant feature)



Feature #19: Entrance sign, ashlar stone with jack arch (potential significance). No impact to feature anticipated.


Feature #23: Fieldstone weir (listed, non-designated significant feature). No impact to feature anticipated.


Feature #21: Willowbank Hall (listed, non-designated significant feature). No impact to feature anticipated.


Feature #17: Stone and concrete road bridge (listed, non-designated significant feature). No impact to feature anticipated. No impact to feature anticipated.

1:1499.9988 Meters
15 0 15 30
Datum

Notes:

1. For full plan and profile design information on Option 1, refer to drawings 06-08.
2. Refer to drawing 04 for photos of features 26,27 and 31.

REVISION

No.	DATE	DESCRIPTION	BY	CHK.	DRN.
00	01 17 2017	Issued for client review	JH	JP	ED

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AMEC Foster Wheeler
York Road Widening

York Road Improvements
Clythe Creek Option 1 - Reach C-9B
Cultural Heritage Feature Impacts

Date:	Project:	Technical:	Reviewer:	Drawn:
01 17 2017	22257 York Road	J. Henshaw	J. Parish	E. Drost

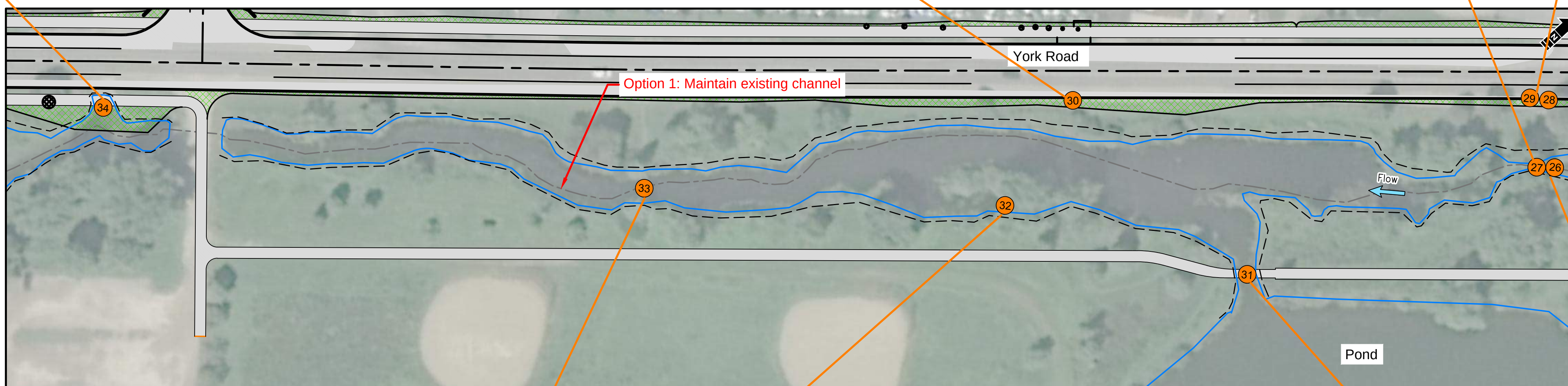
Figure 03

34 Feature #34 (not considered cultural heritage feature): Box culvert at confluence of Clythe Creek and Hadati Creek. Potential culvert extension to accommodate roadway grading requirement and CSP replacement.

30 Feature #30: Limestone pillars (potential significance). Potential for feature to be modified as a result of roadway grading requirements.

27 Feature #27: Arched concrete and metal pedestrian bridge with stone abutments (potential significance). No impact to feature anticipated.

28 28 Feature #28 and #29: Limestone pillars with wood board fencing leading to main entrance (potential significance). Potential for feature to be modified as a result of roadway grading requirements.



26 Feature #26: Fieldstone weir (listed, non-designated significant feature). No impact to feature anticipated.

33

Feature #33: Metal and wood pedestrian bridge (potential significance). No impact to feature anticipated.

32

Feature #32: Metal and wood pedestrian bridge (potential significance). No impact to feature anticipated.

31

Feature #31: metal and wooden pedestrian bridge (potential significance). Potential for feature to be modified to accommodate pedestrian traffic and multi-use pathway.

1:1499.9989 Meters
15 0 15 30
Datum

Notes:
1. For full plan and profile design information on Option 1, refer to drawings 06-08.

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00	01 17 2017	Issued for client review	JH	JP	ED
No.	DATE	DESCRIPTION	BY	CHK.	DRN.

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AMEC Foster Wheeler
York Road Widening

York Road Improvements
Clythe Creek Option 1 - Reach C-9B
Cultural Heritage Feature Impacts

Date:	Project:	Technical:	Reviewer:	Drawn:
01 17 2017	22257 York Road	J. Henshaw	J. Parish	E. Drost

Figure 04

35 Feature #35: Concrete and stone weir (potential significance). No impact to feature anticipated.

38

Feature #38: GJR railway bridge (potential significance). No impact to feature anticipated.

Notes:
1. For full plan and profile design information on Option 3, refer to drawings 06-08.

1:1500 Meters
15 0 15 30
Datum

REVISION					
00	01 17 2017	Issued for client review	JH	JP	ED
No.	DATE	DESCRIPTION	BY	CHK.	DRN.

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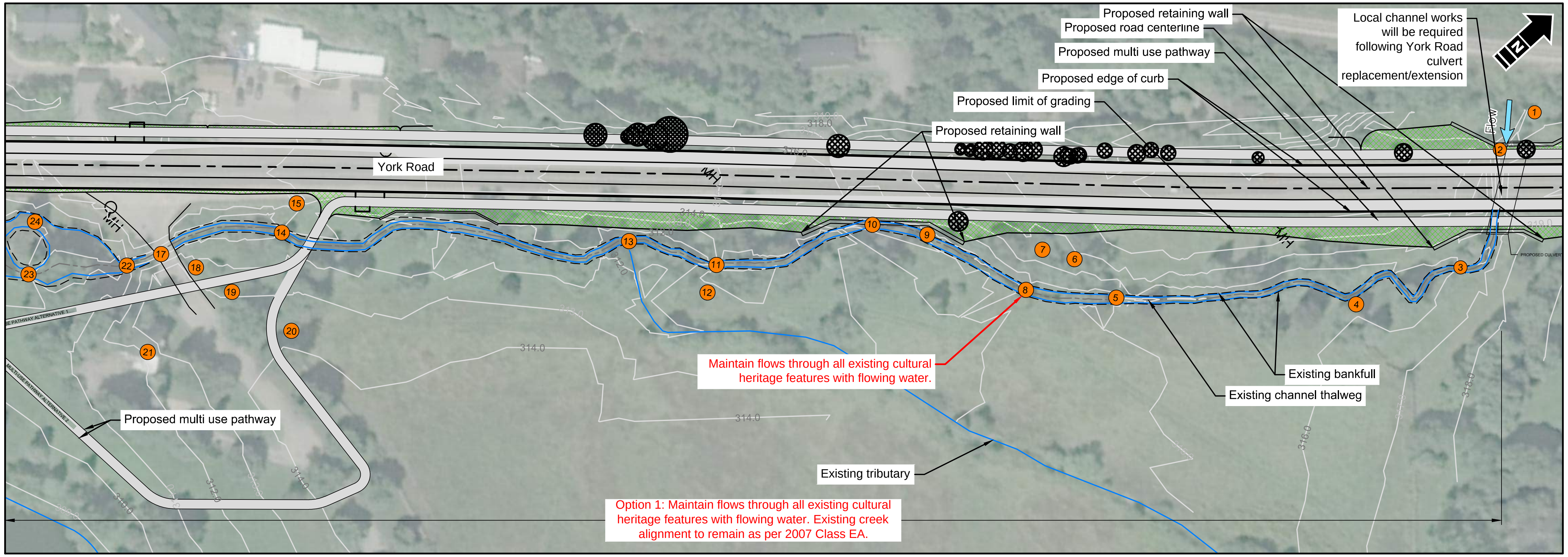
AMEC Foster Wheeler
York Road Widening

York Road Improvements
Clythe Creek Option 1 - Reach C-10
Cultural Heritage Feature Impacts

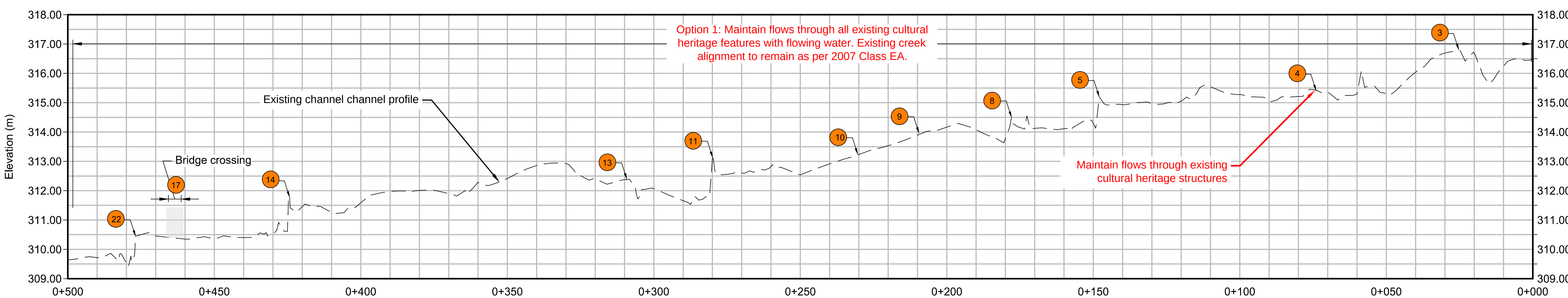
Date:	Project:	Technical:	Reviewer:	Drawn:
01 17 2017	22257 York Road	J. Henshaw	J. Parish	E. Drost

Figure
05



Legend	
	Surveyed channel thalweg
	Surveyed edge of water
	Surveyed bankfull
	Toe of road grading
	Fill/grading area
2	Cultural heritage feature/structure

Notes:
1. Channel survey completed by Matrix Solutions Inc. on May 2, 3, and 5, 2016.
2. Road and property survey completed by others.
3. Air imagery provided by others.
4. Features displayed are in UTM Nad 83 Zone 17 coordinate system.
5. Heritage feature location and information provided by others.
6. Bank treatments to be confirmed in detailed design.



Channel Profile
Horizontal Scale 1:1500
Vertical Scale 1:150

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No.	DATE	DESCRIPTION	BY	CHK.	DRN.
02	01 17 2017	Revised based on client comments	JH	JP	ED
01	12 09 2016	Revised based on client comments	JH	JP	ED
00	09 15 2016	Draft for client review	JH	JP	ED

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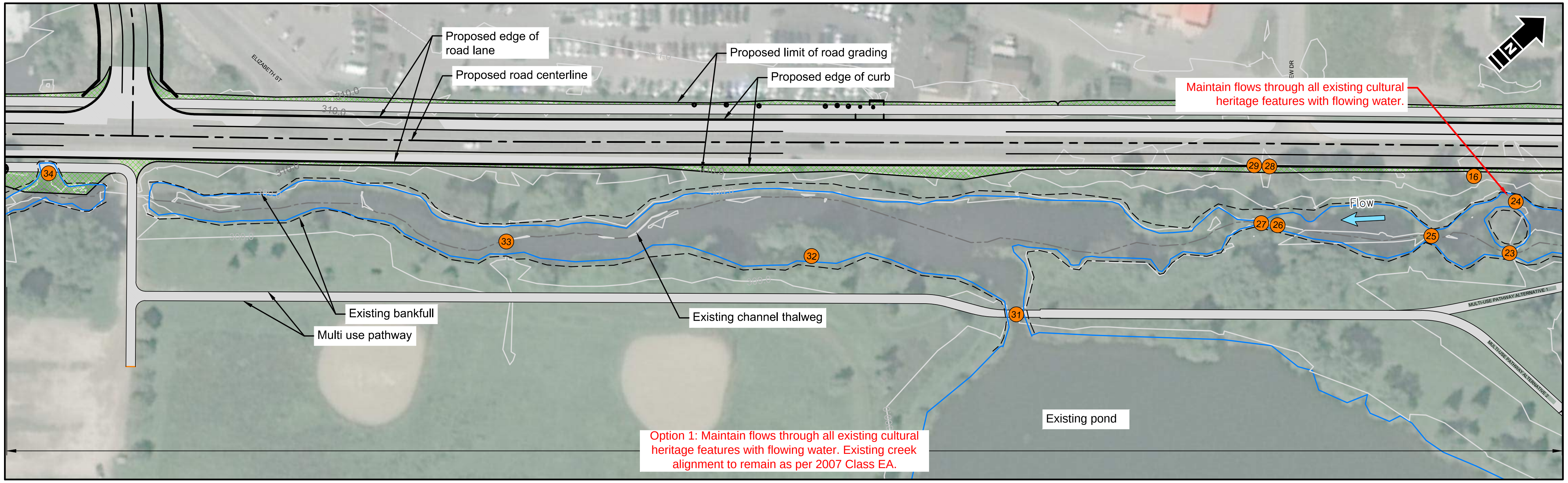
AMEC Foster Wheeler
York Road Widening

York Road Improvements
Clythe Creek - Option 1
Preliminary Plan and Profile 0+000-0+500m

Date:	Project:	Technical:	Reviewer:	Drawn:
01 17 2017	22257 York Road	J. Henshaw	J. Parish	E. Drost

Figure 06



Legend	
	Surveyed channel thalweg
	Surveyed edge of water
	Surveyed bankfull
	Toe of road grading
	Fill/grading area
2	Cultural heritage feature/structure

Notes:

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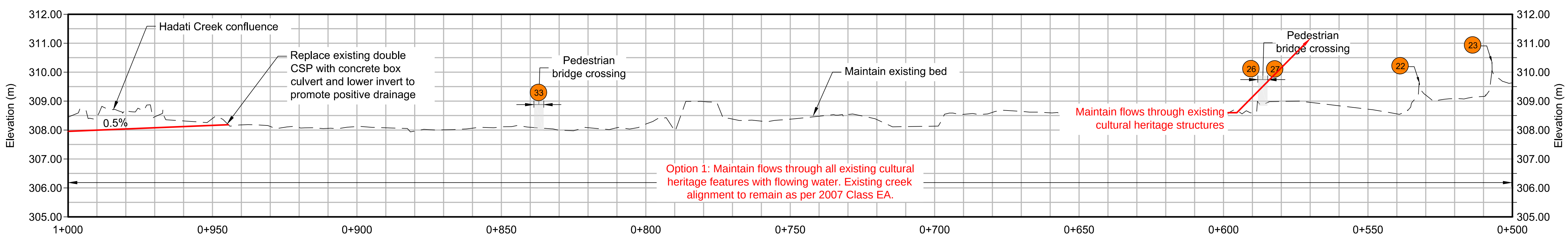
3. Air imagery provided by others.
4. Features displayed are in UTM Nad 83 Zone 17 coordinate system.
5. Heritage feature location and information provided by others.
6. Bank treatments to be confirmed in detailed design.

1:1499.9989 Meters
15 0 15 30
Datum



Channel Profile
Horizontal Scale 1:1500
Vertical Scale 1:150

REVISION					
02	01 17 2017	Revised based on client comments	JH	JP	ED
01	12 09 2016	Revised based on client comments	JH	JP	ED
00	09 15 2016	Draft for client review	JH	JP	ED
No.	DATE	DESCRIPTION	BY	CHK.	DRN.

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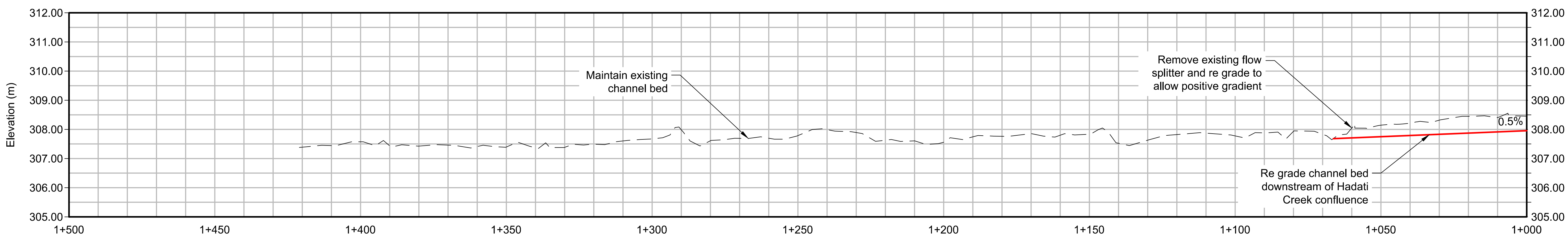
York Road Improvements
Clythe Creek - Option 1
Preliminary Plan and Profile 0+500-1+000m

Date: 01 17 2017 | Project: 22257 York Road | Technical: J. Henshaw | Reviewer: J. Parish | Drawn: E. Drost

Figure 07

Legend	
— · —	Surveyed channel thalweg
——	Surveyed edge of water
— —	Surveyed bankfull
——	Toe of road grading
	Fill/grading area
2	Cultural heritage feature/structure

Notes:
1. Channel survey completed by Matrix Solutions Inc. on May 2, 3, and 5, 2016.
2. Road and property survey completed by others.
3. Air imagery provided by others.
4. Features displayed are in UTM Nad 83 Zone 17 coordinate system.
5. Heritage feature location and information provided by others.
6. Bank treatments to be confirmed in detailed design.



Channel Profile
Horizontal Scale 1:1500
Vertical Scale 1:150

REVISION					
No.	DATE	DESCRIPTION	BY	CHK.	DRN.
02	01 17 2017	Revised based on client comments	JH	JP	ED
01	12 09 2016	Revised based on client comments	JH	JP	ED
00	09 15 2016	Draft for client review	JH	JP	ED

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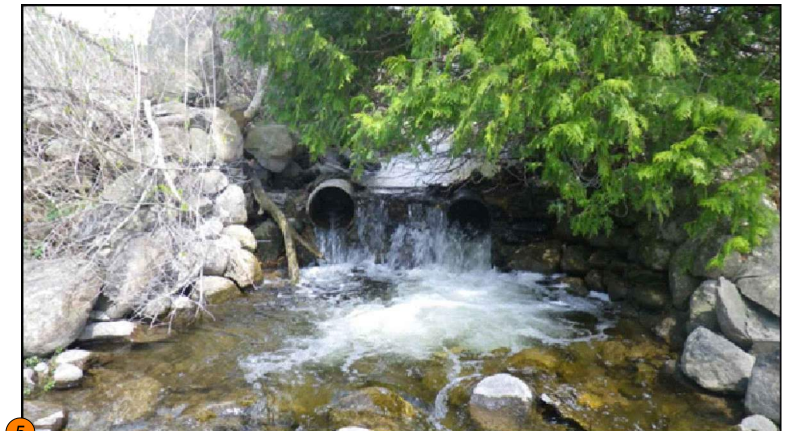
York Road Widening

York Road Improvements
Clythe Creek - Option 1
Preliminary Plan and Profile 1+000-1+500m

Date:	Project:	Technical:	Reviewer:	Drawn:
01 17 2017	22257 York Road	J. Henshaw	J. Parish	E. Drost

Figure 08

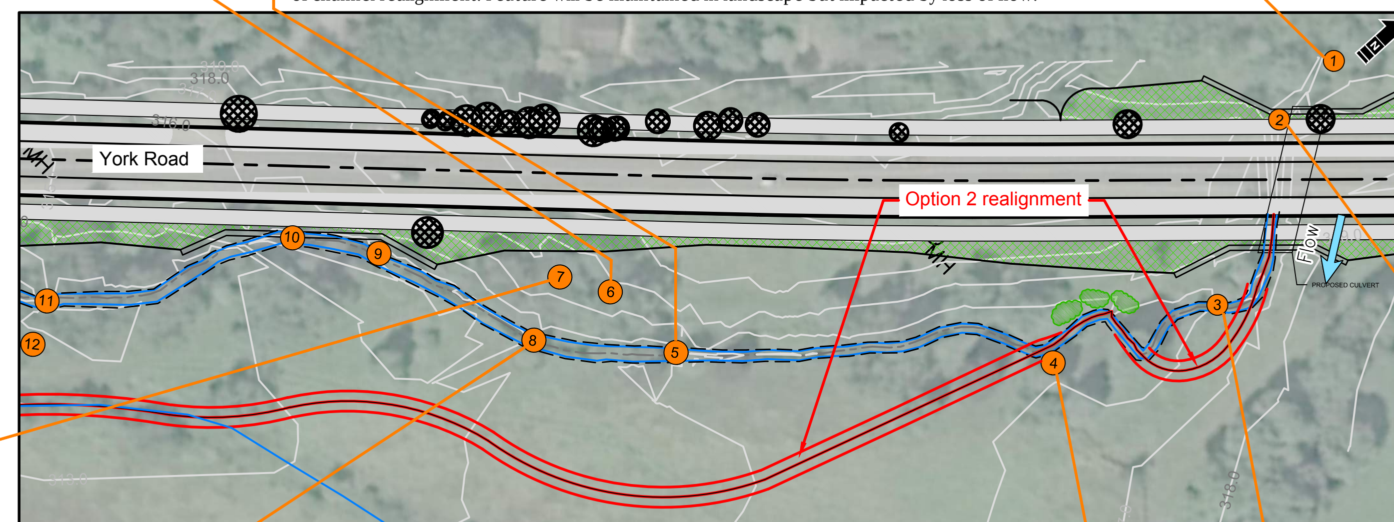
Feature #6: Fieldstone steps (listed, non-designated significant feature). No impact to feature anticipated.



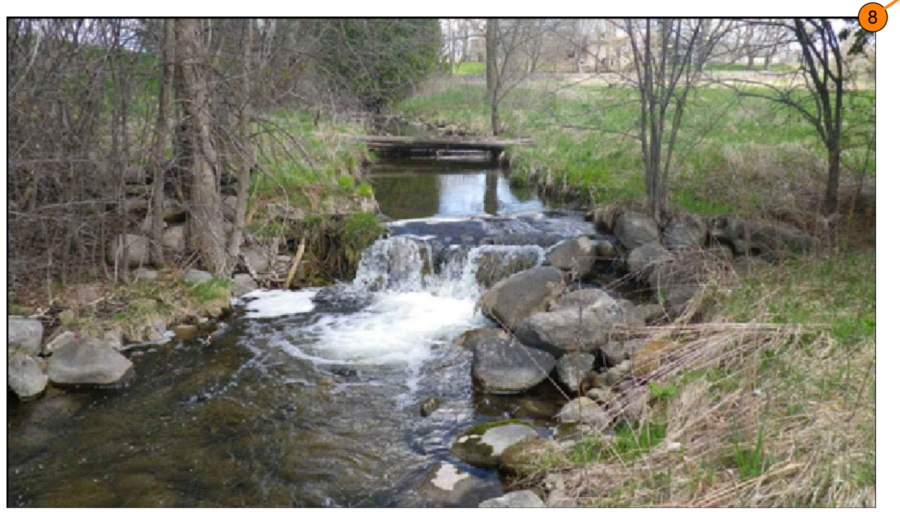
Feature #5: Fieldstone weir with clay pipes (listed, non-designated significant feature). No impact to feature anticipated. Feature is a substantial barrier to fish passage and limiting factor in overall channel function and health. Feature to be taken off-line/disconnected from active flow as a result of channel realignment. Feature will be maintained in landscape but impacted by loss of flow.

Feature #1: Ashlar stone culvert (potential significance). No impact to feature anticipated.

Feature #7: Large boulder or bedrock outcrop (potential significance). No impact to feature anticipated.



Feature #2: Reinforced concrete road bridge railing (potential significance). Feature to be modified to accommodate road widening works.



Feature #8: Fieldstone weir (listed, non-designated significant feature). No impact to feature anticipated. Feature is a substantial barrier to fish passage and limiting factor in overall channel function and health. Feature to be taken off-line/disconnected from active flow as a result of channel realignment. Feature will be maintained in landscape but will be impacted from loss of flow.

Feature #4: Fieldstone garden wall with sentinels (listed, non-designated significant feature). No impact to feature anticipated.

Feature #3: Fieldstone weir with steps and sentinel stones (listed, non-designated significant feature). Feature is a substantial barrier to fish passage and limiting factor in overall channel function and health. Feature to be taken off-line/disconnected from active flow as a result of channel realignment. Feature will be maintained in landscape but impacted by loss of flow.

1:1499.9989 Meters
15 0 15 30
Datum

Notes:
1. Refer to drawing 02 for photos of features 9, 10, 11 and 12.
2. For full plan and profile design information on Option 2, refer to drawings 06-08.

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York Road Widening

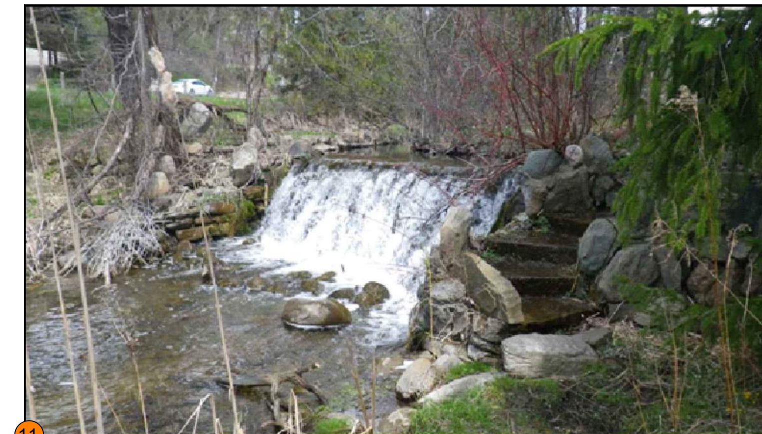
York Road Improvements
Clythe Creek Option 2 - Reach C-9A
Cultural Heritage Feature Impacts

Date:	Project:	Technical:	Reviewer:	Drawn:
01 17 2017	22257 York Road	J. Henshaw	J. Parish	E. Drost

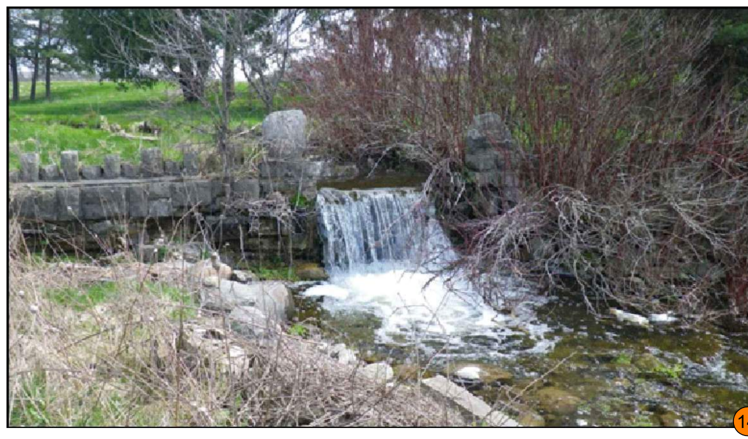
Figure 01

Feature #15: Fieldstone east entrance wall with sentinel stones (listed, non-designated significant feature). No impact to feature anticipated.

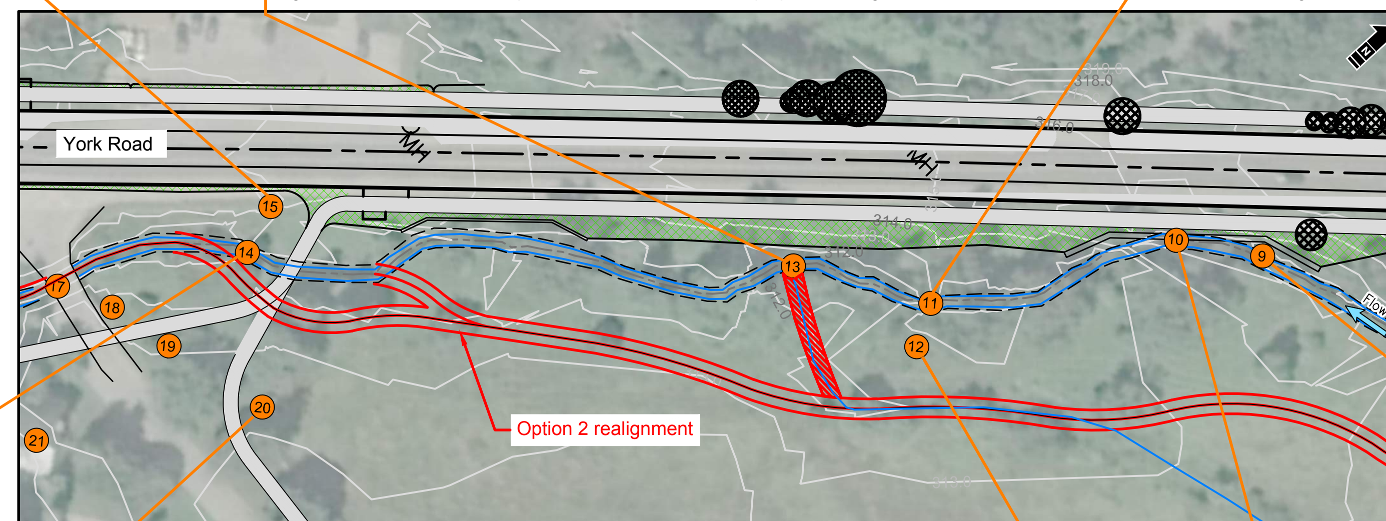
Feature #13: Confluence of Clythe Creek and intermittent stream (potential significance). Feature to be taken off-line/disconnected from active flow as a result of channel realignment. Tributary connection to Existing Clythe Creek will be filled. Existing groundwater draw to be incorporated and maintained within proposed re-alignment.

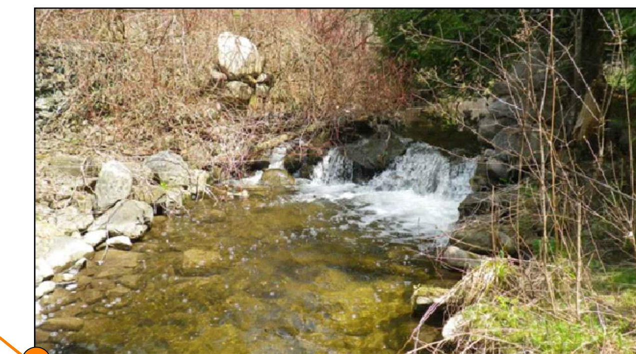


Feature #11: Fieldstone weir with steps and ashlar stone terrace wall (listed, non-designated significant feature). Feature is a substantial barrier to fish passage and limiting factor in overall channel function and health. Feature to be taken off-line/disconnected from active flow as a result of channel realignment. Feature will be maintained in landscape but will be impacted by loss of flow.



Feature #14: Fieldstone weir with cut stone terrace wall (listed, non-designated significant feature). Feature is a substantial barrier to fish passage and limiting factor in overall channel function and health. Feature to be taken off-line/disconnected from active flow as a result of channel realignment and maintained within landscape. Potential for overflow channel to reconnect feature during times of high-flow.





Feature #9: Fieldstone weir (listed, non-designated significant feature). No impact to feature anticipated. Feature is a substantial barrier to fish passage and limiting factor in overall channel function and health. Feature to be taken of-line as a result of channel realignment. Feature will be maintained in landscape but will be impacted by loss of flow.

Feature #20: Ashlar dry stone wall (listed, non-designated significant feature). No impact to feature anticipated.

Feature #12: Ashlar limestone wall (listed, non-designated significant feature). Part of feature impacted by proposed creek realignment.

Feature #10: Fieldstone weir (listed, non-designated significant feature). No impact to feature anticipated. Feature is a substantial barrier to fish passage and limiting factor in overall channel function and health. Feature to be taken off-line/disconnected from active flow as a result of channel realignment. Feature will be maintained in landscape but will be impacted by loss of flow.

1:1499.999 Meters
15 0 15 30
Datum

Notes:
1. For full plan and profile design information on Option 2, refer to drawings 06-08.
2. Refer to drawing 03 for photos of features 17, 18,19 and 21.

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No.	DATE	DESCRIPTION	BY	CHK.	DRN.

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York Road Improvements
Clythe Creek Option 2 - Reach C-9A
Cultural Heritage Feature Impacts

Date:	Project:	Technical:	Reviewer:	Drawn:
01 17 2017	22257 York Road	J. Henshaw	J. Parish	E. Drost

Figure 02

N:\PROJECTS\22257 - York Road Guelph\145912 - AMEC - York Road Environmental Design Study\03 Data\CAD\Matrix CAD\22257 York Road - CHF Figs- Option 2_01-09-2017.dwg - CHF 02 - Tuesday, January 17, 2017 10:14:05 PM - Eric Drost

Plot 1:1 = Tabloid (L)

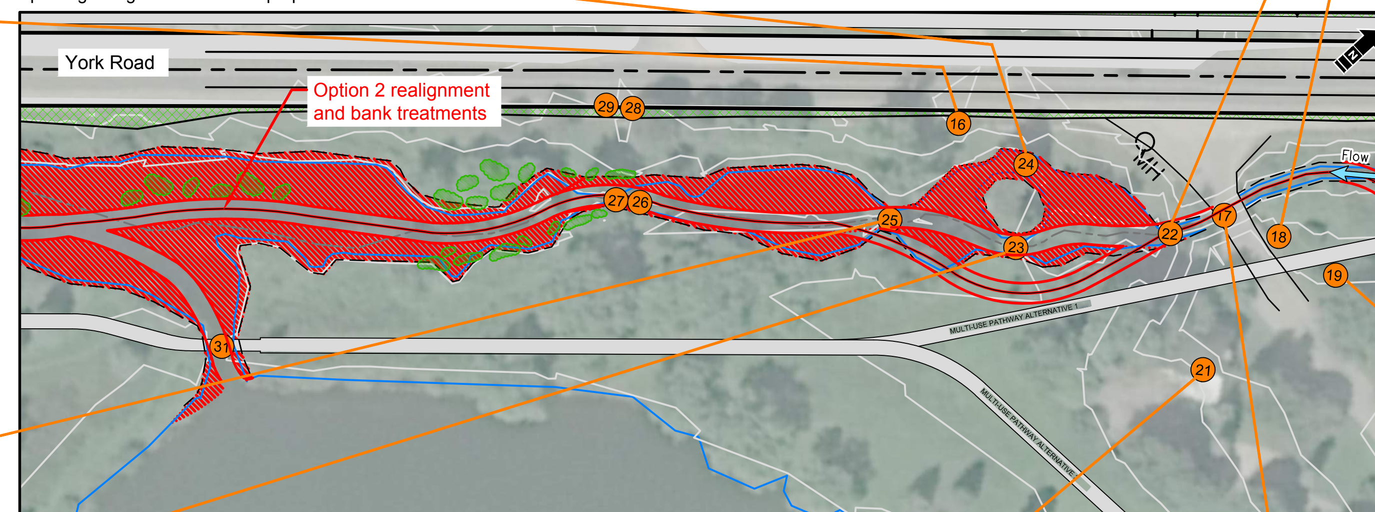
Feature #16: Fieldstone west entrance wall with sentinel stones (listed, non-designated significant feature). Potential for feature to be modified as a result of roadway grading requirements.

Feature #24: Fieldstone weir (listed, non-designated significant feature). Feature is a substantial barrier to fish passage and limiting factor in overall channel function and health. Feature to be taken off-line/disconnected from active flow as a result of proposed channel works. Potential for feature to be impacted as a result of required grading/fill as a result of proposed channel works.

Feature #22: Fieldstone weir (listed, non-designated significant feature). No impact to feature anticipated.

Feature #18: Fieldstone steps to the south of road bridge (listed, non-designated significant feature). No impact to feature anticipated. No impact to feature anticipated.

Feature #25: Fieldstone weir (listed, non-designated significant feature). Feature is a substantial barrier to fish passage and limiting factor in overall channel function and health. Feature will require modification or removal (confirmed during detailed design) as a result of channel works.



Feature #19: Entrance sign, ashlar stone with jack arch (potential significance). No impact to feature anticipated.

Feature #23: Fieldstone weir (listed, non-designated significant feature). Feature is a substantial barrier to fish passage and limiting factor in overall channel function and health. Feature will require modification or removal (confirmed during detailed design) as a result of channel works.

Feature #21: Willowbank Hall (listed, non-designated significant feature). No impact to feature anticipated.

Feature #17: Stone and concrete road bridge (listed, non-designated significant feature). No impact to feature anticipated, existing capacity dimensions to be maintained.

1:1499.9988 Meters
15 0 15 30
Datum

Notes:
1. For full plan and profile design information on Option 2, refer to drawings 06-08.
2. Refer to drawing 04 for photos of features 26,27 and 31.

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York Road Widening

York Road Improvements
Clythe Creek Option 2 - Reach C-9B
Cultural Heritage Feature Impacts

Date:	Project:	Technical:	Reviewer:	Drawn:
01 17 2017	22257 York Road	J. Henshaw	J. Parish	E. Drost

Figure 03

Plot 1:1 = Tabloid (L)

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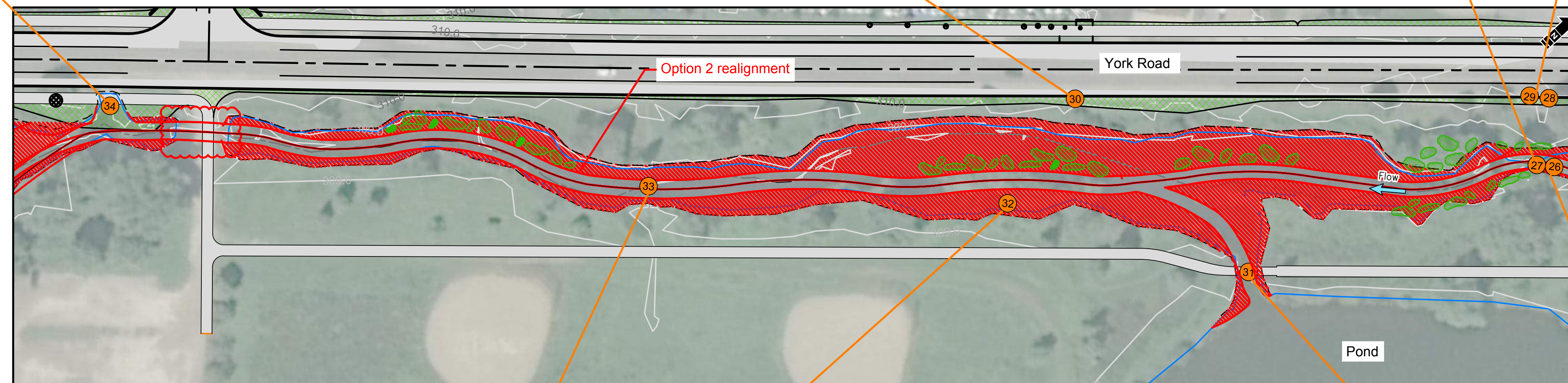
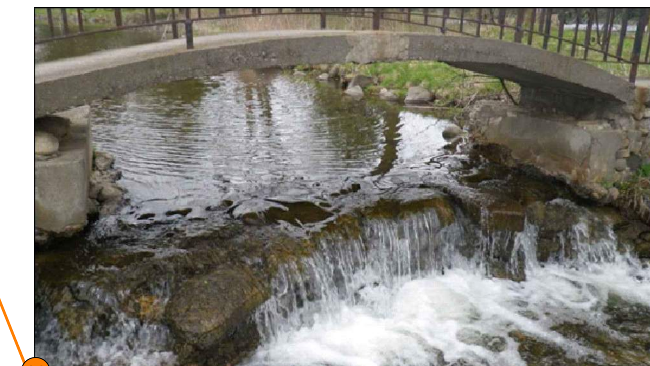
Feature #34 (not considered cultural heritage feature): Box culvert at confluence of Clythe Creek and Hadati Creek. Potential culvert extension to accommodate roadway grading requirement and CSP replacement.

Feature #30: Limestone pillars (potential significance). Potential for feature to be modified as a result of roadway grading requirements.

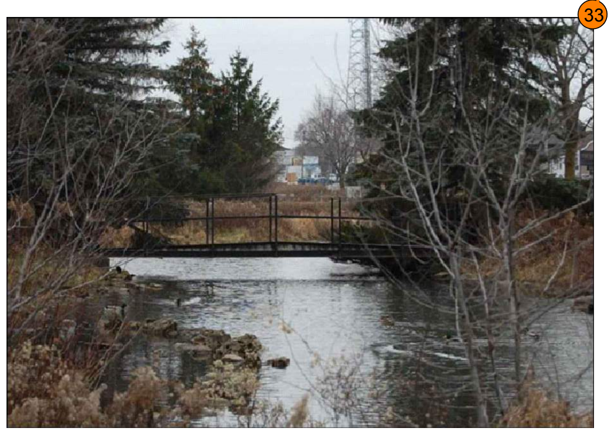
Feature #27: Arched concrete and metal pedestrian bridge with stone abutments (potential significance). Potential for feature to be modified to accommodate pedestrian traffic and multi-use pathway.

Feature #28 and #29: Limestone pillars with wood board fencing leading to main entrance (potential significance). Potential for feature to be modified as a result of roadway grading requirements.





Feature #26: Fieldstone weir (listed, non-designated significant feature). Feature is a substantial barrier to fish passage and limiting factor in overall channel function and health. Feature will require modification or removal (confirmed during detailed design) as a result of channel works.



Feature #33: Metal and wood pedestrian bridge (potential significance). No impact to feature anticipated. Potential for feature to be modified to accommodate pedestrian traffic and multi-use pathway.

Feature #32: Metal and wood pedestrian bridge (potential significance). Feature to be removed as a result of proposed channel works.

Feature #31: Metal and wooden pedestrian bridge (potential significance). Potential for feature to be modified to accommodate pedestrian traffic and multi-use pathway.

1:1499.9989 Meters
15 0 15 30
Datum

Notes:
1. For full plan and profile design information on Option 2, refer to drawings 06-08.

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York Road Widening

York Road Improvements
Clythe Creek Option 2 - Reach C-9B
Cultural Heritage Feature Impacts

Date:	Project:	Technical:	Reviewer:	Drawn:
01 17 2017	22257 York Road	J. Henshaw	J. Parish	E. Drost

Figure
04

Plot 1:1 = Tabloid (L)

N:\PROJECTS\22257 - York Road Guelph\145912 - AMEC - York Road Environmental Design Study\03 Data\CAD\Matrix CAD\22257 York Road - CHF Figs- Option 2_01-09-2017.dwg - CHF 04 - Tuesday, January 17, 2017 10:14:05 PM - Eric Drost

35 Feature #35: Concrete and stone weir (potential significance). Feature to be removed as a result of proposed channel works.

38 Feature #38: GJR railway bridge (potential significance). No impact to feature anticipated.

Notes:
1. For full plan and profile design information on Option 2, refer to drawings 06-08.

1:1500 Meters
15 0 15 30
Datum

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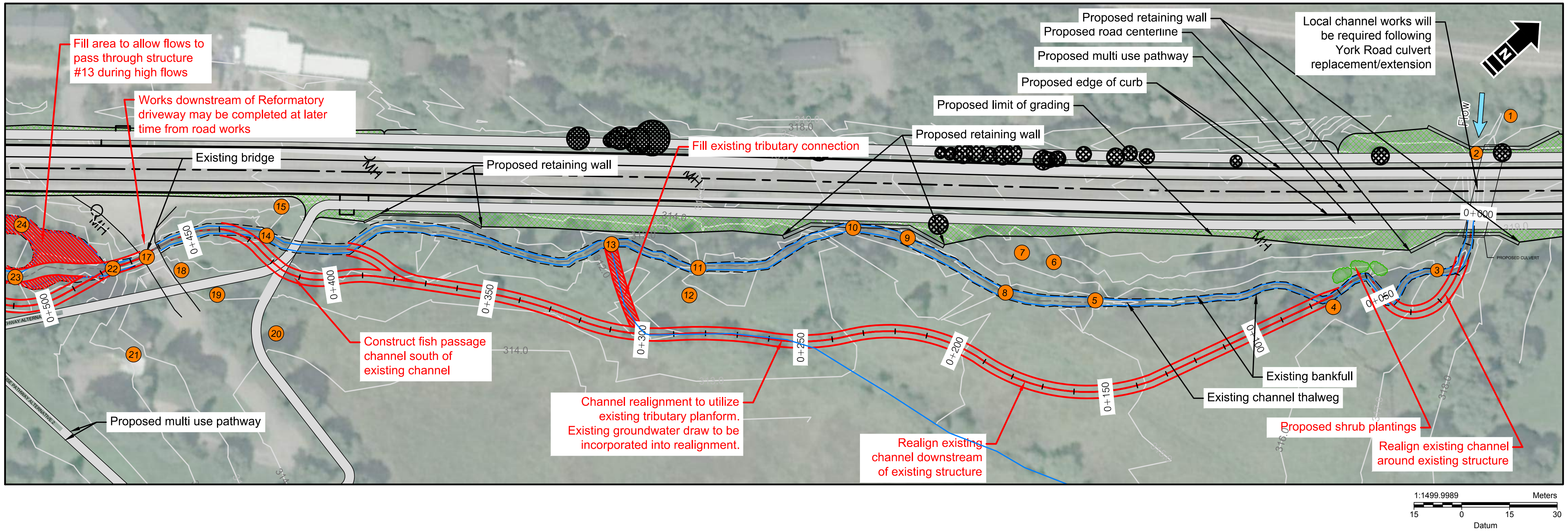
York Road Improvements
Clythe Creek Option 2 - Reach C-10
Cultural Heritage Feature Impacts

Date:	Project:	Technical:	Reviewer:	Drawn:
01 17 2017	22257 York Road	J. Henshaw	J. Parish	E. Drost

Figure 05



Legend

- Surveyed edge of water
- Surveyed bankfull
- Toe of road grading
- Proposed realignment
- Proposed fill/bank treatment
- Proposed shrubs and plantings
- Cultural heritage feature/structure

Notes:

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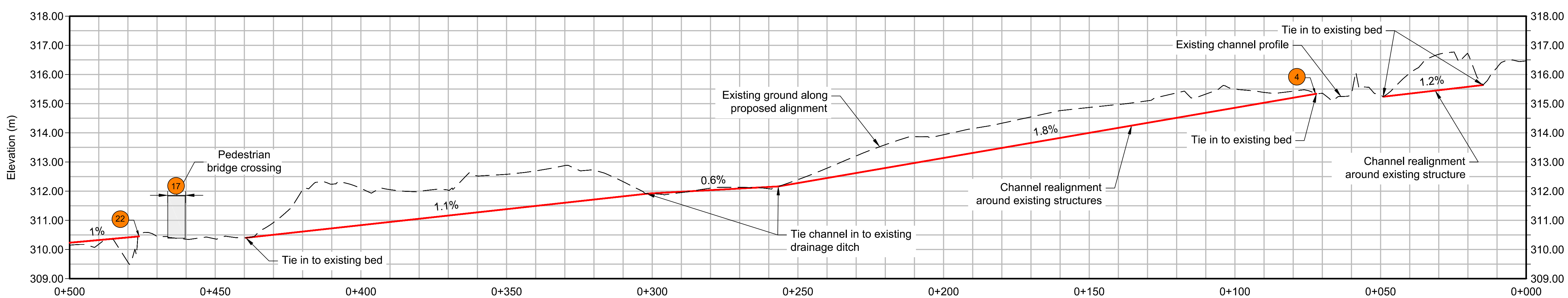
6. Bank treatments to be confirmed in detailed design.



Channel Profile
Horizontal Scale 1:1500
Vertical Scale 1:150

PARISH aquatic services
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AMEC Foster Wheeler
York Road Widening

York Road Improvements
Clythe Creek - Option 2
Preliminary Plan and Profile 0+000-0+500m

Date:	Project:	Technical:	Reviewer:	Drawn:
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Disclaimer: The information contained herein may be compiled from numerous third party materials that are subject to periodic change without prior notification. While every effort has been made by Matrix Solutions Inc. to ensure the accuracy of the information presented at the time of publication, Matrix Solutions Inc. assumes no liability for any errors, omissions, or inaccuracies in the third party material.

Figure 06

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No.	DATE	DESCRIPTION	BY	CHK.	DRN.
02	01 17 2017	Revised based on client comments	JH	JP	ED
01	12 09 2016	Revised based on client comments	JH	JP	ED
00	09 15 2016	Draft for client review	JH	JP	ED

Plot 1:1 = Tabloid (L)

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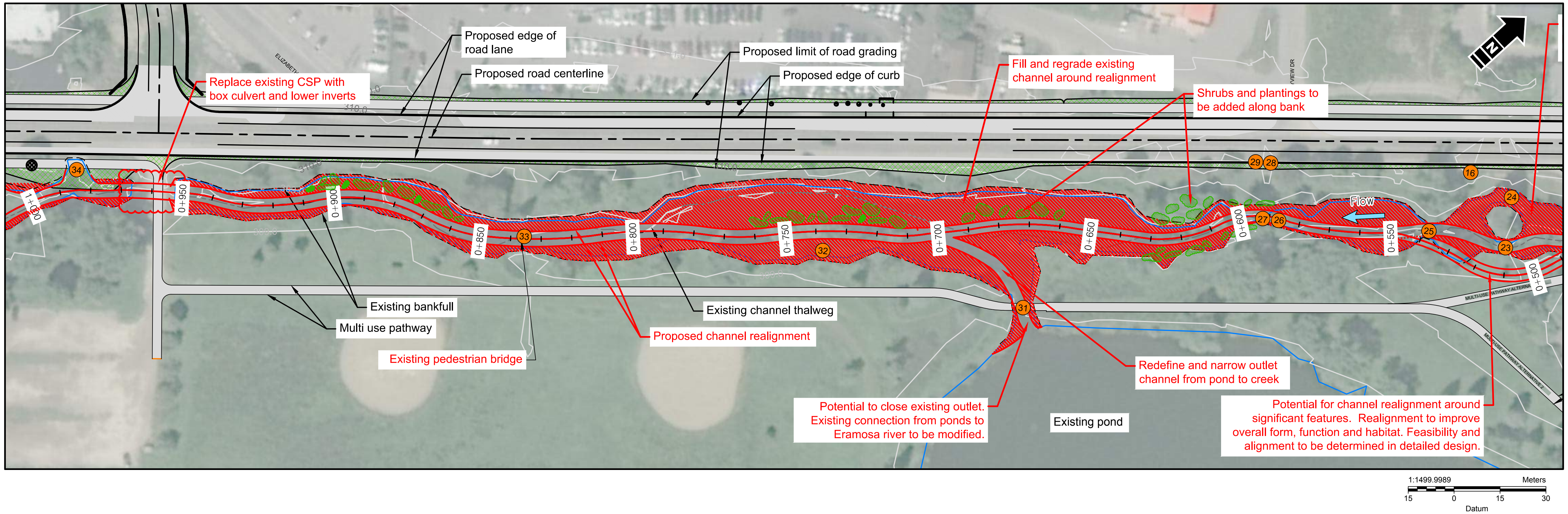

Legend	
	Surveyed edge of water
	Surveyed bankfull
	Toe of road grading
	Proposed realignment
	Proposed fill/bank treatment
	Proposed shrubs and plantings
2	Cultural heritage feature/structure

Notes:

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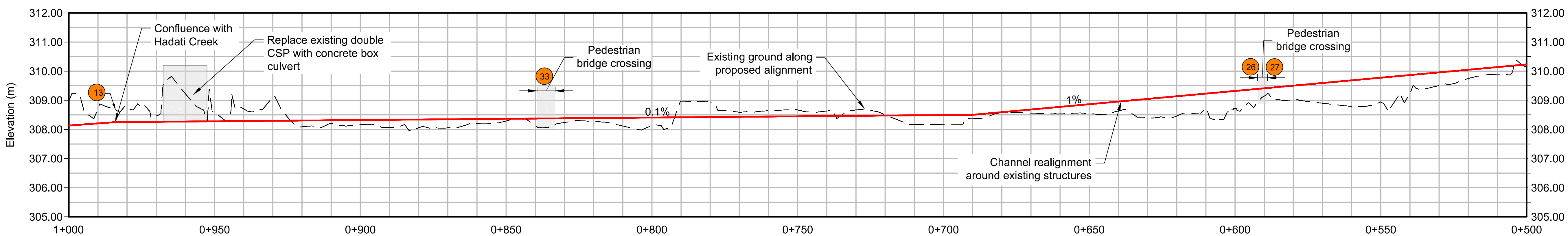

Channel Profile
Horizontal Scale 1:1500
Vertical Scale 1:150

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York Road Widening

York Road Improvements
Clythe Creek - Option 2
Preliminary Plan and Profile 0+500-1+000m

Date: 01 17 2017 | Project: 22257 York Road | Technical: J. Henshaw | Reviewer: J. Parish | Drawn: E. Drost

Figure 07

REVISION					
No.	DATE	DESCRIPTION	BY	CHK.	DRN.
02	01 17 2017	Revised based on client comments	JH	JP	ED
01	12 09 2016	Revised based on client comments	JH	JP	ED
00	09 15 2016	Draft for client review	JH	JP	ED

Plot 1:1 = Tabloid (L)
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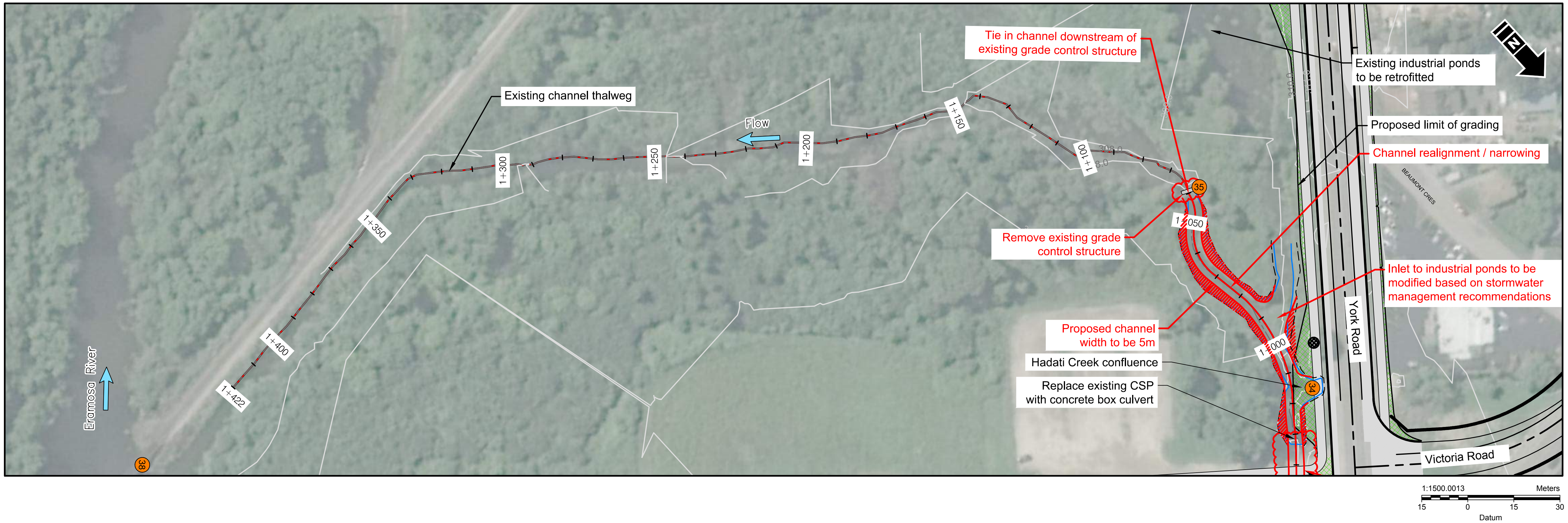

Legend	
	Surveyed edge of water
	Surveyed bankfull
	Toe of road grading
	Proposed realignment
	Proposed fill/bank treatment
2	Cultural heritage feature/structure

Notes:
1. Channel survey completed by Matrix Solutions Inc. on May 2, 3, and 5, 2016.
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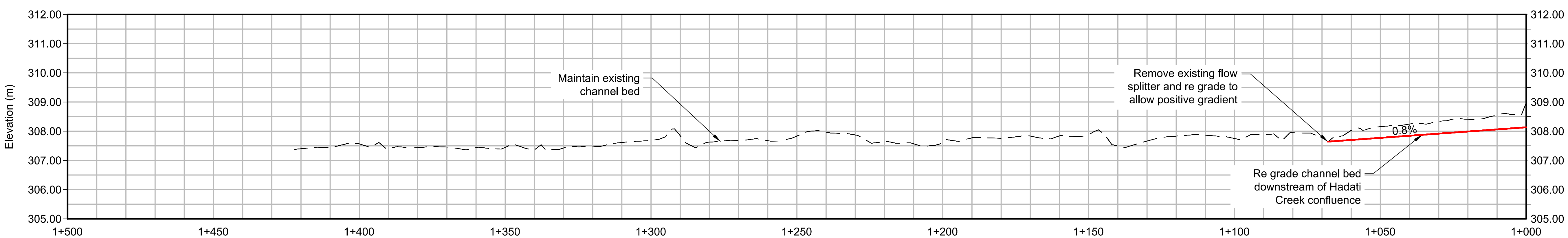
5. Heritage feature location and information provided by others.
6. Bank treatments to be confirmed in detailed design.



Channel Profile
Horizontal Scale 1:1500
Vertical Scale 1:150

REVISION					
No.	DATE	DESCRIPTION	BY	CHK.	DRN.
02	01 17 2017	Revised based on client comments	JH	JP	ED
01	12 09 2016	Revised based on client comments	JH	JP	ED
00	09 15 2016	Draft for client review	JH	JP	ED

PARISH aquatic services
A Division of Matrix Solutions Inc.

AMEC Foster Wheeler
York Road Widening

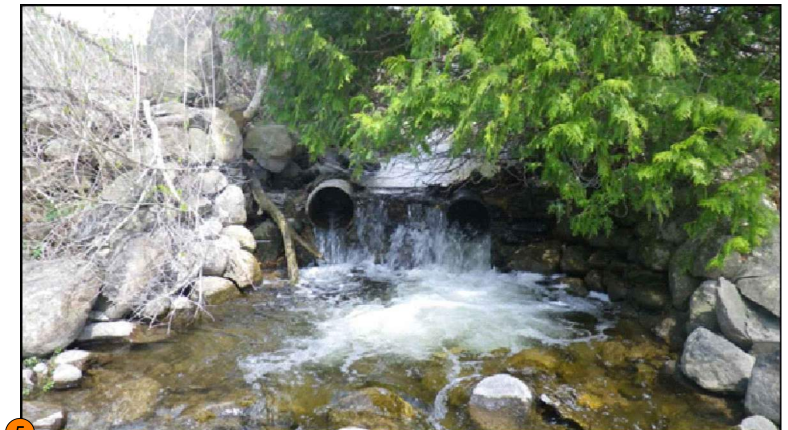
York Road Improvements
Clythe Creek - Option 2
Preliminary Plan and Profile 1+000-1+500m

Date: 01 17 2017 | Project: 22257 York Road | Technical: J. Henshaw | Reviewer: J. Parish | Drawn: E. Drost

Figure 08

Plot 1:1 = Tabloid (L)
N:\PROJECTS\22257 - York Road Guelph\145912 - AMEC - York Road Environmental Design Study\03 Data\CAD\Matrix CAD\22257 York Road - Concepts 1-3_01-17-2017.dwg - Option 2 (8) - Tuesday, January 17, 2017 10:12:13 PM - Eric Drost

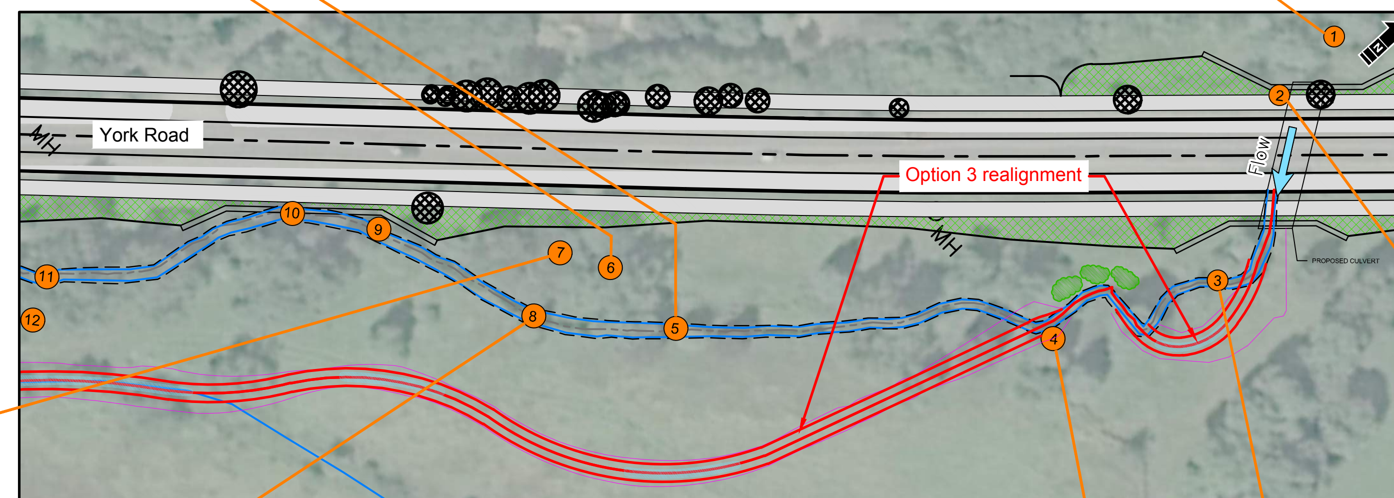
Feature #6: Fieldstone steps (listed, non-designated significant feature). Feature is located within the floodplain and will not be impacted by proposed channel works.



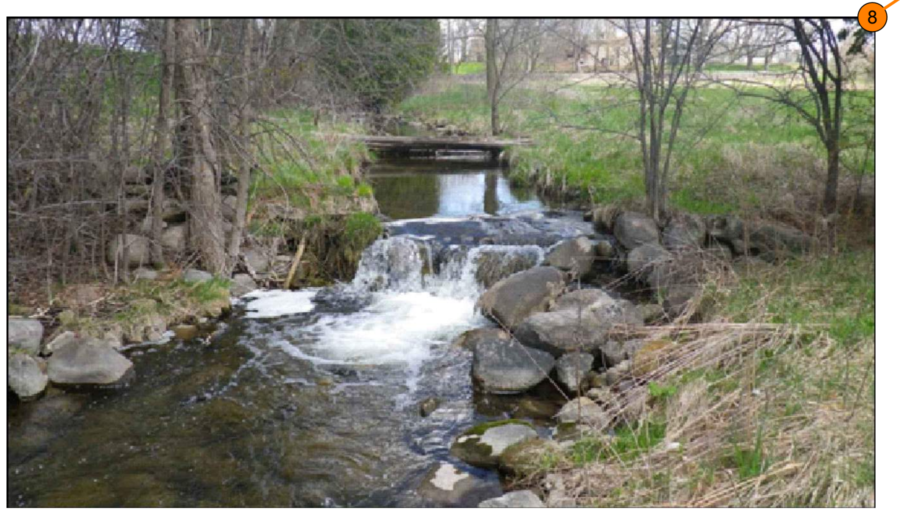
Feature #5: Fieldstone weir with clay pipes (listed, non-designated significant feature). Feature is a substantial barrier to fish passage and limiting factor in overall channel function and health. Feature to be taken off-line and disconnected from active flow as a result of channel realignment. Feature will be maintained in the landscape.

Feature #1: Ashlar stone culvert (potential significance). Channel works are not proposed upstream from York Road therefore the feature will not be impacted by proposed channel works.

Feature #7: Large boulder or bedrock outcrop (potential significance). Feature is located within the floodplain and will not be impacted by proposed channel works.



Feature #2: Reinforced concrete road bridge railing (potential significance). No impact to feature anticipated as a result of proposed channel works.



Feature #8: Fieldstone weir (listed, non-designated significant feature). Feature is a substantial barrier to fish passage and limiting factor in overall channel function and health. Feature to be taken off-line and disconnected from active flow as a result of channel realignment. Feature will be maintained in the landscape.

Feature #4: Fieldstone garden wall with sentinels (listed, non-designated significant feature). In order to maintain the feature, the existing channel planform will be utilized. As the feature is within the floodplain and will not be impacted by proposed channel works.

Feature #3: Fieldstone weir with steps and sentinel stones (listed, non-designated significant feature). Feature is a substantial barrier to fish passage and limiting factor in overall channel function and health. Feature to be taken off-line and disconnected from active flow as a result of channel realignment. Feature will be maintained in the landscape.

1:1499.9989 Meters
15 0 15 30
Datum

Notes:
1. Refer to drawing 02 for photos of features 9, 10, 11 and 12.
2. For full plan and profile design information on Option 3, refer to drawings 06-08.

REVISION

No.	DATE	DESCRIPTION	BY	CHK.	DRN.
01	03 08 2017	Revised based on client comments	JH	JP	ED
00	01 17 2017	Issued for client review	JH	JP	ED

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AMEC Foster Wheeler
York Road Widening

York Road Improvements
Clythe Creek Option 3 - Reach C-9A
Cultural Heritage Feature Impacts

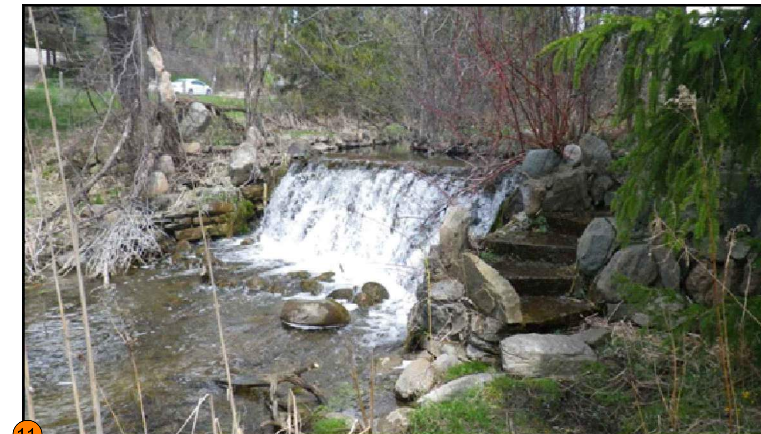
Date:	Project:	Technical:	Reviewer:	Drawn:
03 08 2017	22257 York Road	J. Henshaw	J. Parish	E. Drost

Figure 01

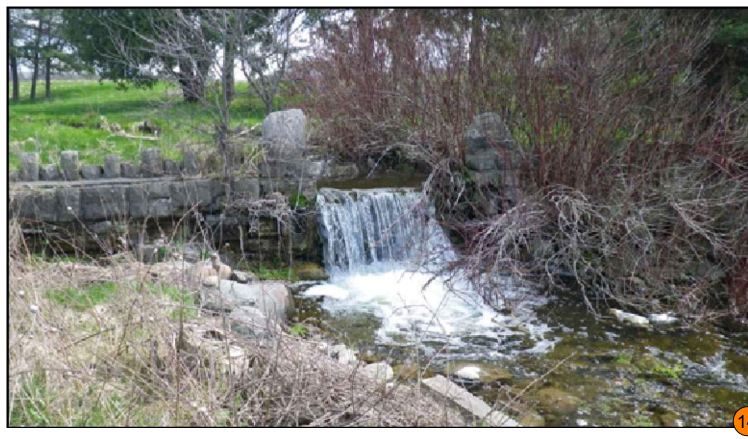
Plot 1:1 = Tabloid (L)

Feature #15: Fieldstone east entrance wall with sentinel stones (listed, non-designated significant feature). No impact to feature anticipated as a result of proposed channel works.

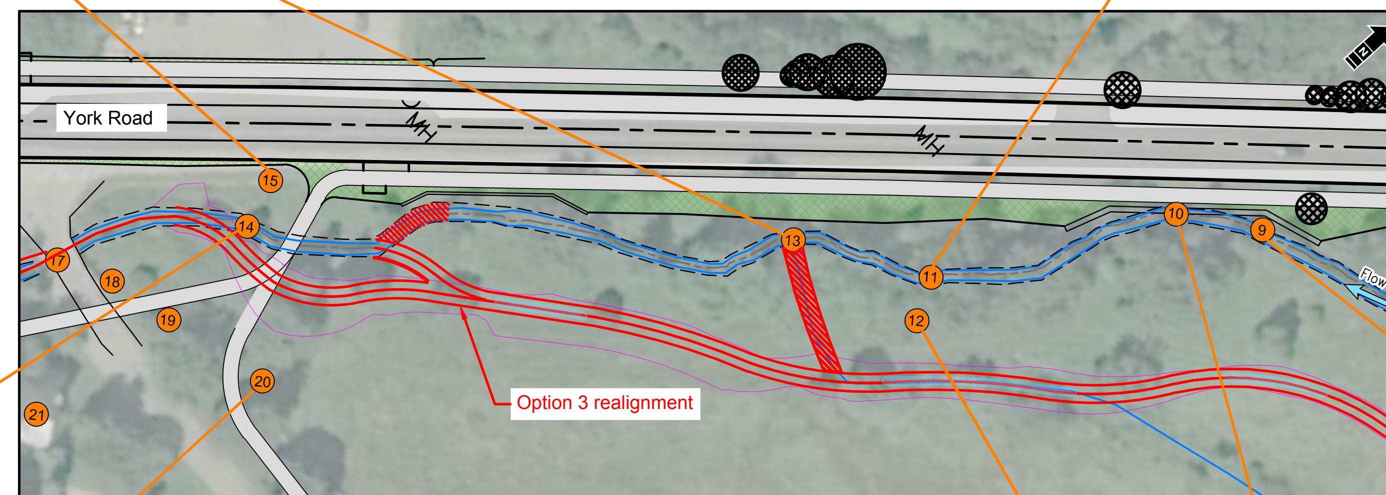
Feature #13: Confluence of Clythe Creek and intermittent stream (potential significance). Feature will be 'filled' and the floodplain restored to uniform elevation. The proposed channel alignment utilizes a local section of the intermittent streams planform, as a result existing groundwater draw will be maintained within proposed re-alignment.

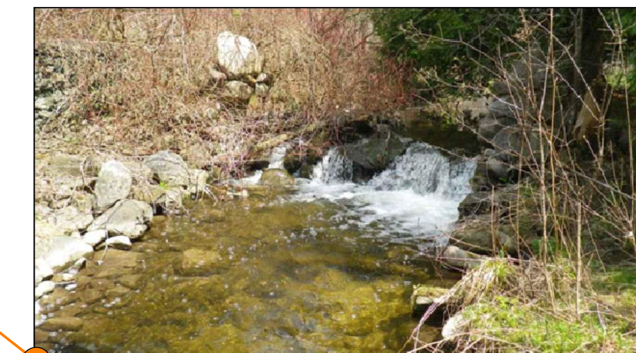


Feature #11: Fieldstone weir with steps and ashlar stone terrace wall (listed, non-designated significant feature). Feature is a substantial barrier to fish passage and limiting factor in overall channel function and health. Feature to be taken off-line and disconnected from active flow as a result of channel realignment. Feature will be maintained in the landscape.



Feature #14: Fieldstone weir with cut stone terrace wall (listed, non-designated significant feature). Feature is a substantial barrier to fish passage and limiting factor in overall channel function and health. Feature to be taken off-line and disconnected during low-flow stages. An overflow channel will be incorporated so that the feature will be reconnected during high-flow stages (i.e., flows greater than the 2yr discharge).





Feature #9: Fieldstone weir (listed, non-designated significant feature). Feature is a substantial barrier to fish passage and limiting factor in overall channel function and health. Feature to be taken of-line and disconnected from active flow as a result of channel realignment. A retaining wall will be installed in order for the feature to be maintained in the landscape.

Feature #20: Ashlar dry stone wall (listed, non-designated significant feature). Feature is located within the floodplain and will not be impacted by proposed channel works.

Feature #12: Ashlar limestone wall (listed, non-designated significant feature). Feature is located within the floodplain and will not be impacted by proposed channel works.

Feature #10: Fieldstone weir (listed, non-designated significant feature). Feature is a substantial barrier to fish passage and limiting factor in overall channel function and health. Feature to be taken of-line and disconnected from active flow as a result of channel realignment. A retaining wall will be installed in order for the feature to be maintained in the landscape.

1:1499.999 Meters
15 0 15 30
Datum

Notes:
1. For full plan and profile design information on Option 3, refer to drawings 06-08.
2. Refer to drawing 03 for photos of features 17, 18,19 and 21.

REVISION					
01	03 08 2017	Revised based on client comments	JH	JP	ED
00	01 17 2017	Issued for client review	JH	JP	ED
No.	DATE	DESCRIPTION	BY	CHK.	DRN.

PARISH aquatic services
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AMEC Foster Wheeler
York Road Widening

York Road Improvements
Clythe Creek Option 3 - Reach C-9A
Cultural Heritage Feature Impacts

Date:	Project:	Technical:	Reviewer:	Drawn:
03 08 2017	22257 York Road	J. Henshaw	J. Parish	E. Drost

Figure 02

N:\PROJECTS\22257 - York Road Guelph\145912 - AMEC - York Road Environmental Design Study\03 Data\CAD\Matrix CAD\22257 York Road - CHF Figs- Option 3_01-09-2017.dwg - CHF 02 - Wednesday, March 08, 2017 2:32:04 PM - Eric Drost

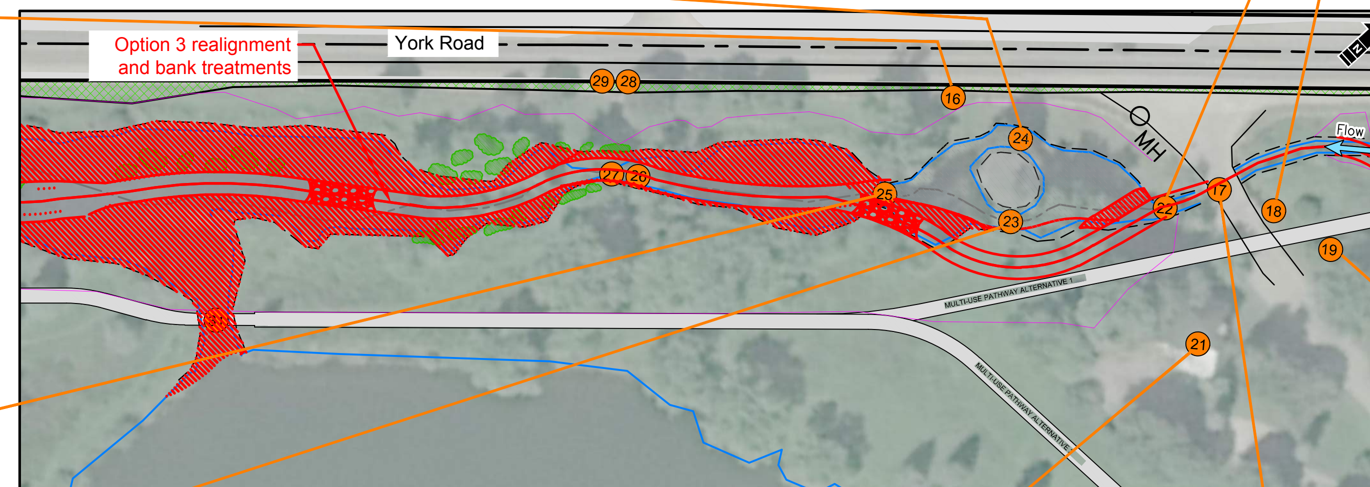
Feature #16: Fieldstone west entrance wall with sentinel stones (listed, non-designated significant feature). No impact to feature anticipated as a result of proposed channel works.

Feature #24: Fieldstone weir (listed, non-designated significant feature). Feature is a substantial barrier to fish passage and limiting factor in overall channel function and health. Feature to be taken off-line and disconnected during low-flow stages as a result of proposed channel realignment. An overflow channel will be incorporated so that the feature will be reconnected during high-flow stages (i.e., flows greater than the 2yr discharge).

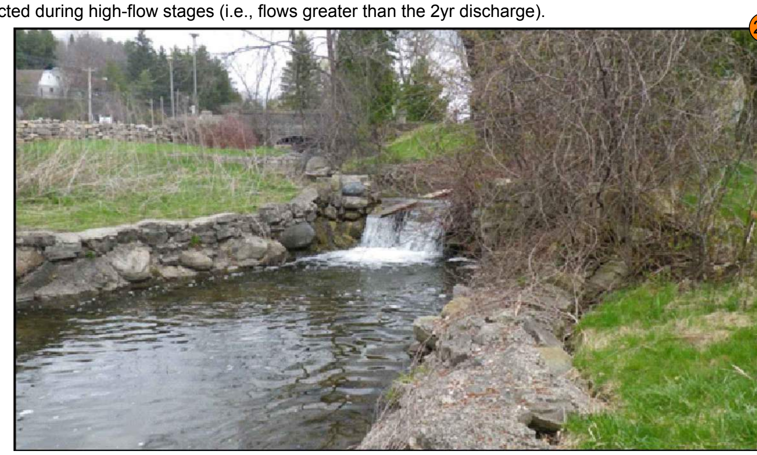
Feature #22: Fieldstone weir (listed, non-designated significant feature). Feature will require modification as a result of proposed channel realignment. Proposed channel realignment will require a "tie-in" location immediately downstream from Feature 17. Full extent of proposed modification to be confirmed during detailed design.

Feature #18: Fieldstone steps to the south of road bridge (listed, non-designated significant feature). Feature is located within the floodplain and will not be impacted by proposed channel works.

Feature #25: Fieldstone weir (listed, non-designated significant feature). Feature is a substantial barrier to fish passage and limiting factor in overall channel function and health. Feature to be taken off-line and disconnected during low-flow stages as a result of proposed channel realignment. An overflow channel will be incorporated so that the feature will be reconnected during high-flow stages (i.e., flows greater than the 2yr discharge).



Feature #19: Entrance sign, ashlar stone with jack arch (potential significance). Feature is located within the floodplain and will not be impacted by proposed channel works.



Feature #23: Fieldstone weir (listed, non-designated significant feature). Feature is a substantial barrier to fish passage and limiting factor in overall channel function and health. Feature to be taken off-line and disconnected during low-flow stages as a result of proposed channel realignment. An overflow channel will be incorporated so that the feature will be reconnected during high-flow stages (i.e., flows greater than the 2yr discharge).

Feature #21: Willowbank Hall (listed, non-designated significant feature). Feature is located within the floodplain and will not be impacted by proposed channel works.

Feature #17: Stone and concrete road bridge (listed, non-designated significant feature). No impact to feature anticipated as a result of proposed channel works, existing capacity dimensions to be maintained.

1:1499.9988 Meters
15 0 15 30
Datum

Notes:

1. For full plan and profile design information on Option 3, refer to drawings 06-08.
2. Refer to drawing 04 for photos of features 26,27 and 31.

REVISION					
01	03 08 2017	Revised based on client comments	JH	JP	ED
00	01 17 2017	Issued for client review	JH	JP	ED
No.	DATE	DESCRIPTION	BY	CHK.	DRN.

PARISH aquatic services
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AMEC Foster Wheeler
York Road Widening

York Road Improvements
Clythe Creek Option 3 - Reach C-9B
Cultural Heritage Feature Impacts

Date: 03 08 2017	Project: 22257 York Road	Technical: J. Henshaw	Reviewer: J. Parish	Drawn: E. Drost

Figure 03

Plot 1:1 = Tabloid (L)

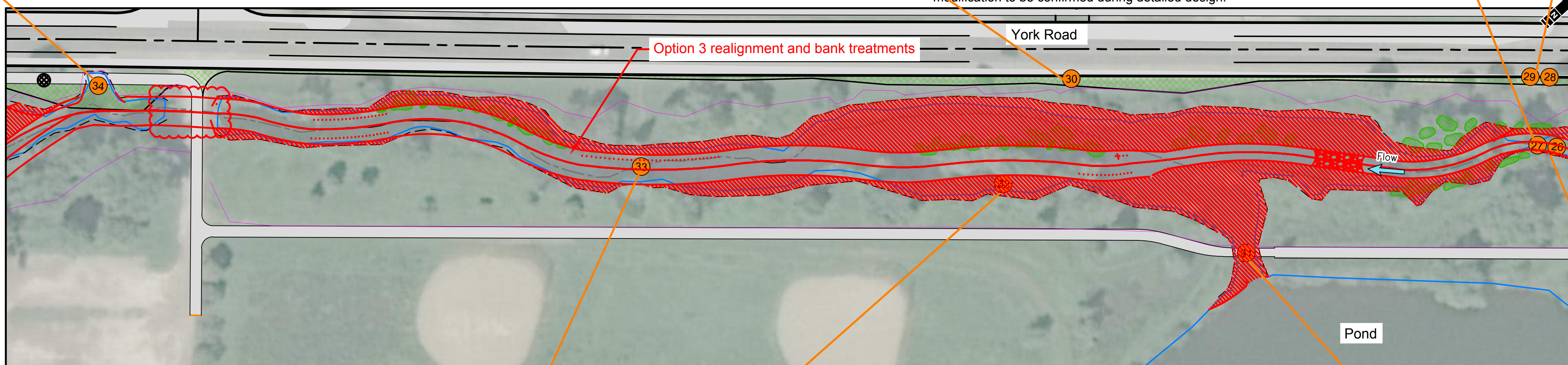
N:\PROJECTS\22257 - York Road Guelph\145912 - AMEC - York Road Environmental Design Study\03 Data\CAD\Matrix CAD\22257 York Road - CHF Figs- Option 3_01-09-2017.dwg - CHF 04 - Wednesday, March 08, 2017 2:32:04 PM - Eric Drost

34 Feature #34: Confluence of Clythe Creek and Hadati Creek (potential significance). Potential impact to culvert outlet to accommodate roadway grading requirement and CSP replacement.

30 Feature #30: Limestone pillars (potential significance). No impact to feature anticipated as a result of proposed channel works.

27 Feature #27: Arched concrete and metal pedestrian bridge with stone abutments (potential significance). Potential for feature abutments to be modified as a result of proposed channel works. The proposed channel will require a "tie-in" location in the vicinity of the abutments both upstream and downstream. Full extent of proposed modification to be confirmed during detailed design.

28 28 Feature #28 and #29: Limestone pillars with wood board fencing leading to main entrance (potential significance). No impact to feature anticipated as a result of proposed channel works.



26 Feature #26: Fieldstone weir (listed, non-designated significant feature). Feature is a substantial barrier to fish passage and limiting factor in overall channel function and health. As a result of proposed channel works it is anticipated that the feature will be backwatered, decreasing or eliminating the existing fish passage barrier.

33

Feature #33: Metal and wood pedestrian bridge (potential significance). Potential for feature to be modified or removed as a result of proposed channel works.

32

Feature #32: Metal and wood pedestrian bridge (potential significance). Feature is likely to be modified or removed as a result of proposed channel works.

31

Feature #31: Metal and wooden pedestrian bridge (potential significance). Feature is likely to be modified or removed as a result of proposed channel works.

1:1499.9989 Meters
15 0 15 30
Datum

Notes:
1. For full plan and profile design information on Option 3, refer to drawings 06-08.

REVISION					
01	03 08 2017	Revised based on client comments	JH	JP	ED
00	01 17 2017	Issued for client review	JH	JP	ED
No.	DATE	DESCRIPTION	BY	CHK.	DRN.

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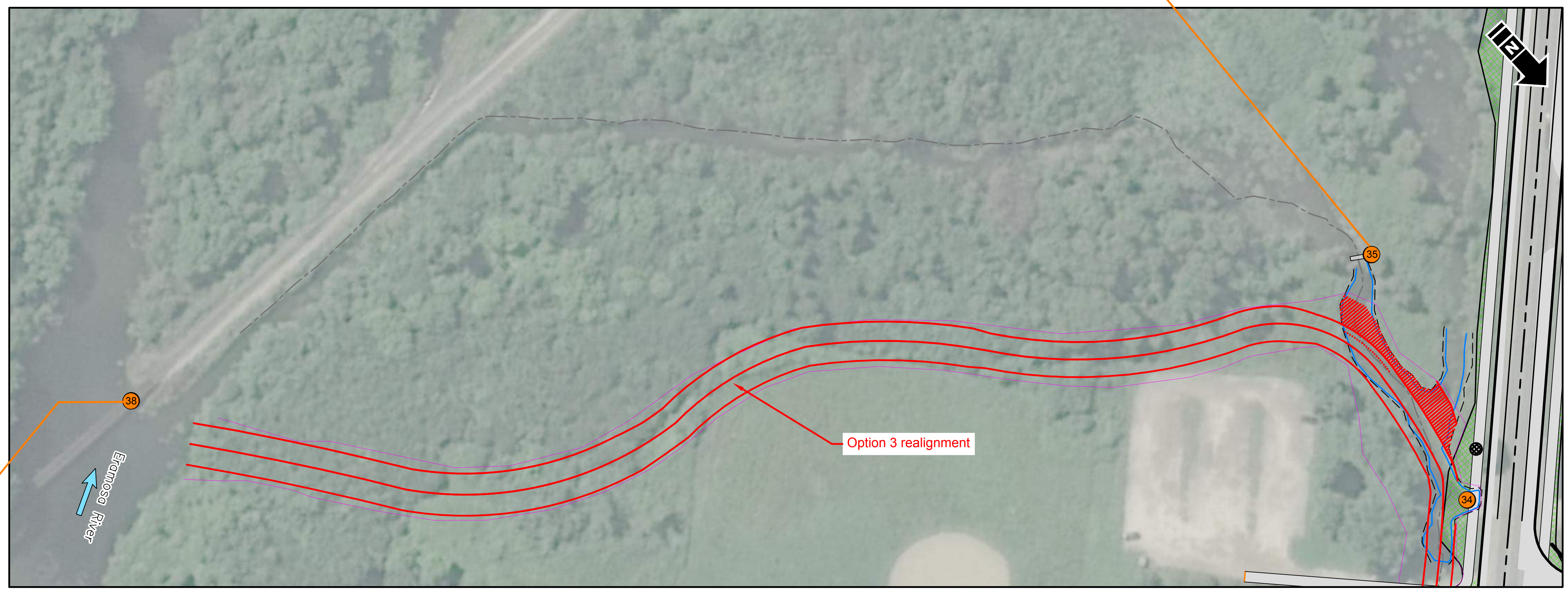
AMEC Foster Wheeler
York Road Widening

York Road Improvements
Clythe Creek Option 3 - Reach C-9B
Cultural Heritage Feature Impacts

Date:	Project:	Technical:	Reviewer:	Drawn:
03 08 2017	22257 York Road	J. Henshaw	J. Parish	E. Drost

Figure 04

35 Feature #35: Concrete and stone weir (potential significance). Feature to be taken off-line and disconnected during low-flow stages. An allowance for overflow capabilities will be incorporated so that the feature will be reconnected during high-flow stages (i.e., flows greater than the 2yr discharge).



38

Feature #38: GJR railway bridge (potential significance). No impact to feature anticipated.

Notes:
1. For full plan and profile design information on Option 3, refer to drawings 06-08.

1:1500 Meters
15 0 15 30
Datum

REVISION					
01	03 08 2017	Revised based on client comments	JH	JP	ED
00	01 17 2017	Issued for client review	JH	JP	ED
No.	DATE	DESCRIPTION	BY	CHK.	DRN.

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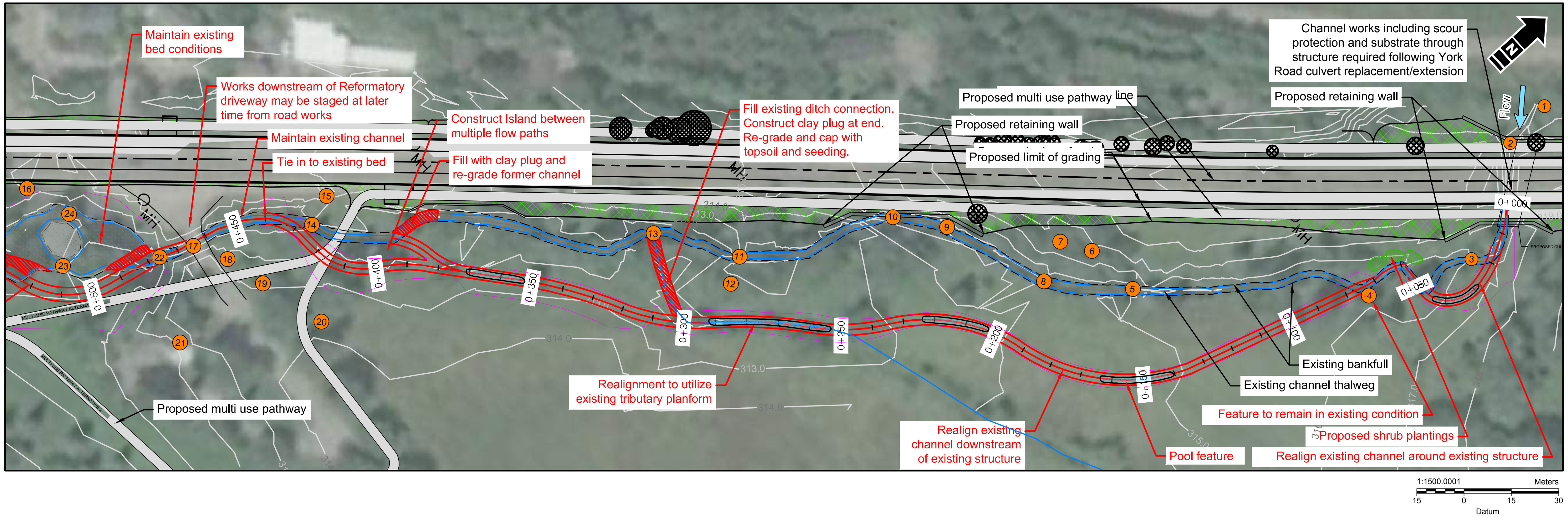
AMEC Foster Wheeler
York Road Widening

York Road Improvements
Clythe Creek Option 3 - Reach C-10
Cultural Heritage Feature Impacts

Date:	Project:	Technical:	Reviewer:	Drawn:
03 08 2017	22257 York Road	J. Henshaw	J. Parish	E. Drost

Figure
05

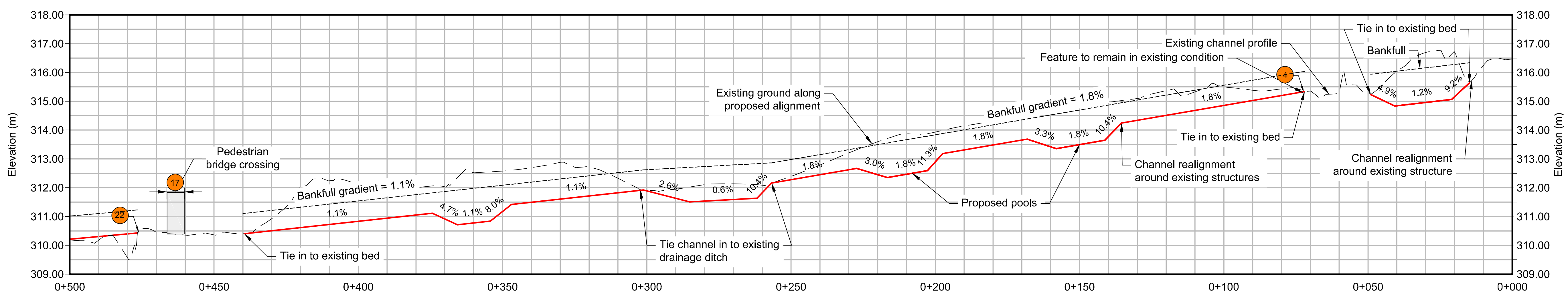


Legend

	Surveyed edge of water
	Surveyed bankfull
	Toe of road grading
	Proposed realignment
	Proposed fill/bank treatment
	Proposed shrubs and plantings
2	Cultural heritage feature/structure
	Maintain existing bed
	Proposed pool
	Approximate grading limit

Notes:

1. Channel survey completed by Matrix Solutions Inc. on May 2, 3, and 5, 2016.
2. Road and property survey completed by others.
3. Air imagery provided by others.
4. Features displayed are in UTM Nad 83 Zone 17 coordinate system.
5. Heritage feature location and information provided by others.
6. Bank treatments to be confirmed in detailed design.



Channel Profile
Horizontal Scale 1:1500
Vertical Scale 1:150

No.	DATE	DESCRIPTION	BY	CHK.	DRN.
03	03 08 2017	Revised based on client comments	JH	JP	ED
02	01 17 2017	Revised based on client comments	JH	JP	ED
01	12 09 2016	Revised based on client comments	JH	JP	ED
00	09 15 2016	Draft for client review	JH	JP	ED

REVISION

PARISH aquatic services
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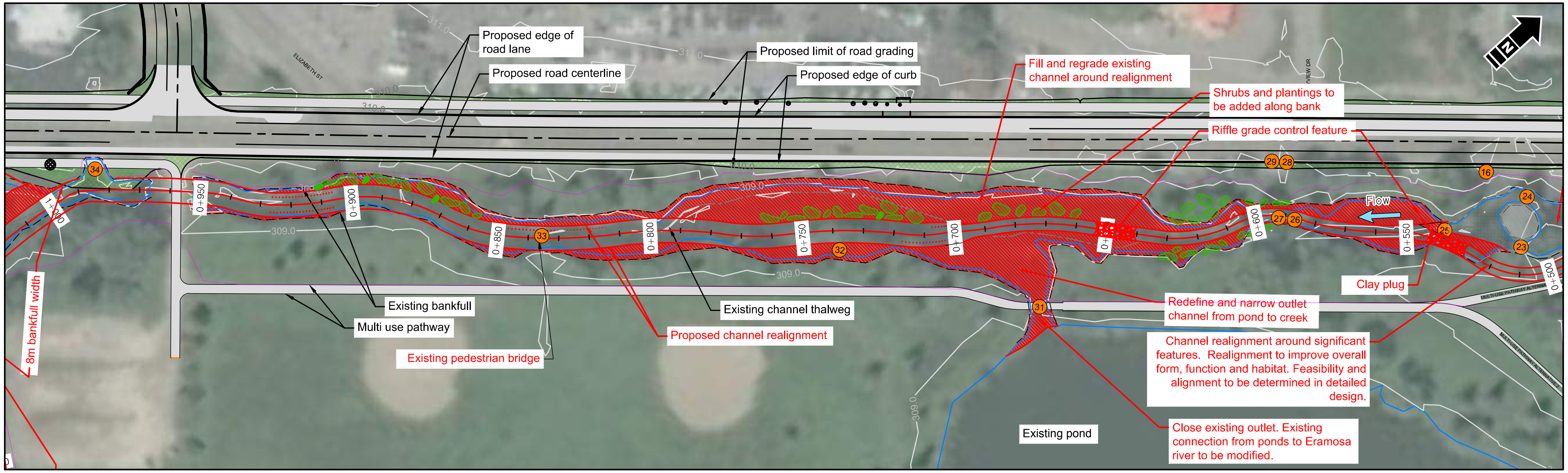
AMEC Foster Wheeler
York Road Widening

York Road Improvements
Clythe Creek - Option 3
Preliminary Plan and Profile 0+000-0+500m

Date: 03 08 2017 | Project: 22257 York Road | Technical: J. Henshaw | Reviewer: J. Parish | Drawn: E. Drost

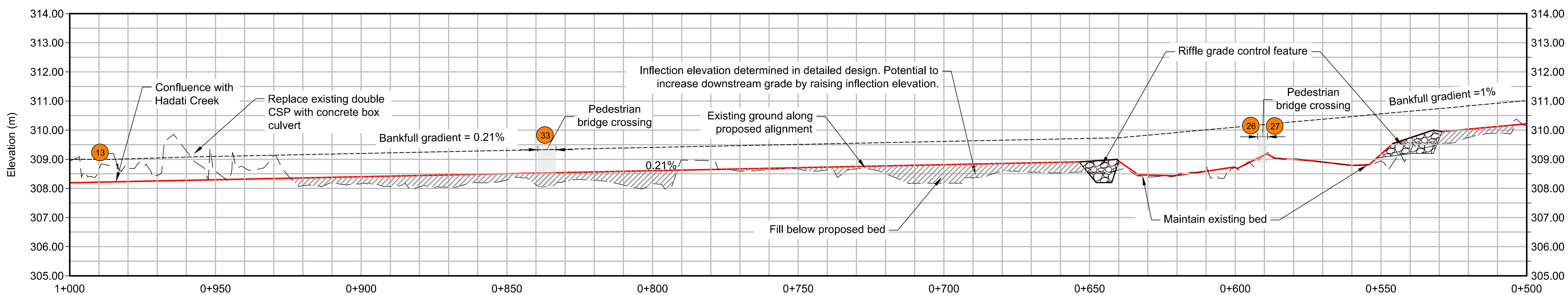
Figure 06



Legend	
	Surveyed edge of water
	Surveyed bankfull
	Toe of road grading
	Proposed realignment
	Proposed fill/bank treatment
	Proposed shrubs and plantings
2	Cultural heritage feature/structure
	Maintain existing conditions
	Approximate grading limit

Notes:

1. Channel survey completed by Matrix Solutions Inc. on May 2, 3, and 5, 2016.
2. Road and property survey completed by others.
3. Air imagery provided by others.
4. Features displayed are in UTM Nad 83 Zone 17 coordinate system.
5. Heritage feature location and information provided by others.
6. Bank treatments to be confirmed in detailed design.



Channel Profile

Horizontal Scale 1:1500
Vertical Scale 1:150

REVISION					
03	03 08 2017	Revised based on client comments	JH	JP	ED
02	01 17 2017	Revised based on client comments	JH	JP	ED
01	12 09 2016	Revised based on client comments	JH	JP	ED
00	09 15 2016	Draft for client review	JH	JP	ED
No.	DATE	DESCRIPTION	BY	CHK.	DRN.

PARISH aquatic services
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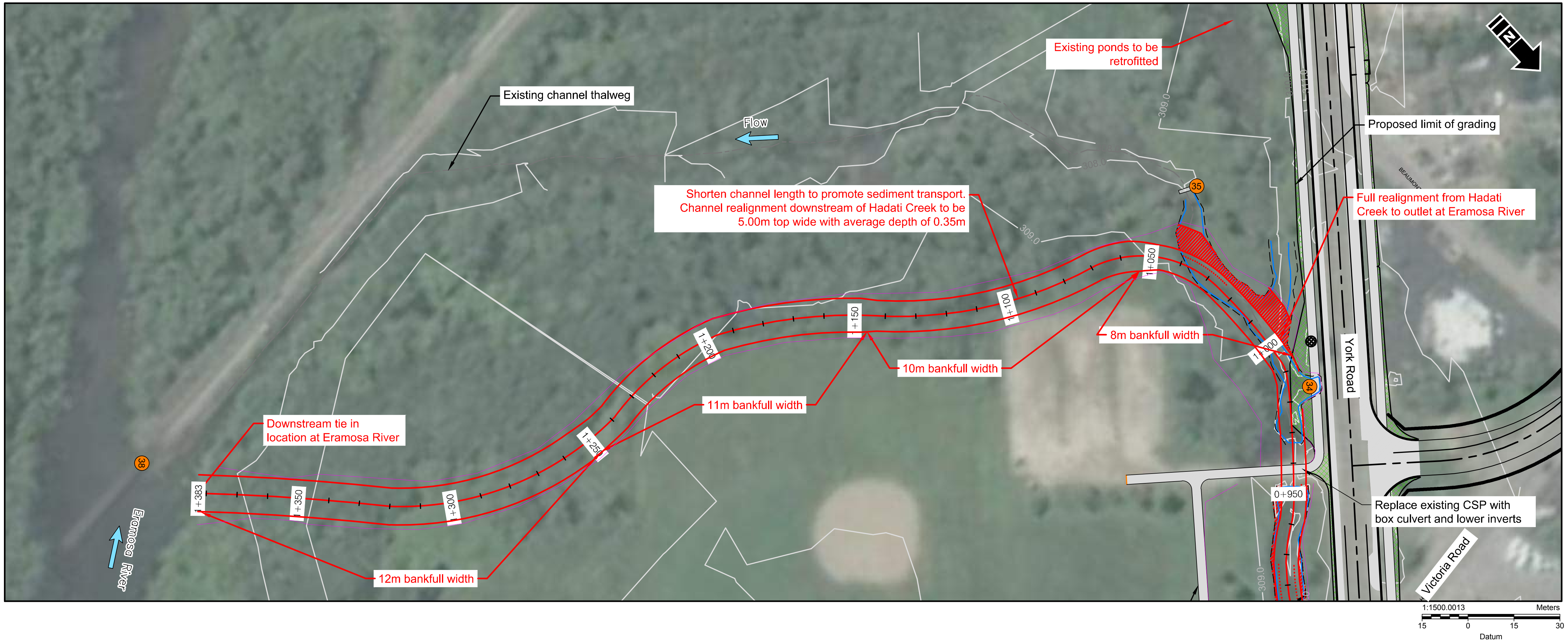
AMEC Foster Wheeler
York Road Widening

York Road Improvements
Clythe Creek - Option 3
Preliminary Plan and Profile 0+500-1+000m

Date: 03 08 2017 | Project: 22257 York Road | Technical: J. Henshaw | Reviewer: J. Parish | Drawn: E. Drost

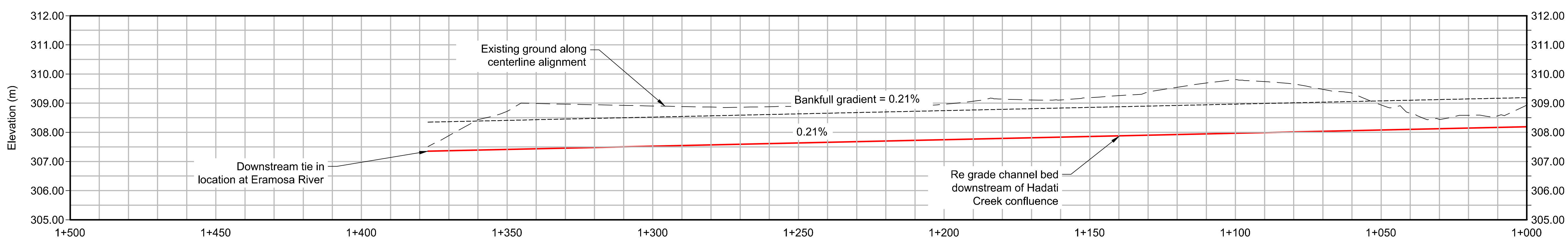
Figure 07

N:\PROJECTS\22257 - York Road Guelph\145912 - AMEC - York Road Environmental Design Study\03 Data\CAD\Matrix CAD\22257 York Road - Concepts 1-3_03-07-2017.dwg - Option 3 (08) - Wednesday, March 08, 2017 3:13:40 PM - Eric Drost
Plot 1:1 = Tabloid (L)



Legend	
	Surveyed edge of water
	Surveyed bankfull
	Toe of road grading
	Proposed realignment
	Proposed fill/bank treatment
2	Cultural heritage feature/structure
	Approximate grading limit

Notes:
1. Channel survey completed by Matrix Solutions Inc. on May 2, 3, and 5, 2016.
2. Road and property survey completed by others.
3. Air imagery provided by others.
4. Features displayed are in UTM Nad 83 Zone 17 coordinate system.
5. Heritage feature location and information provided by others.
6. Bank treatments to be confirmed in detailed design.



Channel Profile
Horizontal Scale 1:1500
Vertical Scale 1:150

REVISION					
No.	DATE	DESCRIPTION	BY	CHK.	DRN.
03	03 08 2017	Revised based on client comments	JH	JP	ED
02	01 17 2017	Revised based on client comments	JH	JP	ED
01	12 09 2016	Revised based on client comments	JH	JP	ED
00	09 15 2016	Draft for client review	JH	JP	ED

PARISH aquatic services
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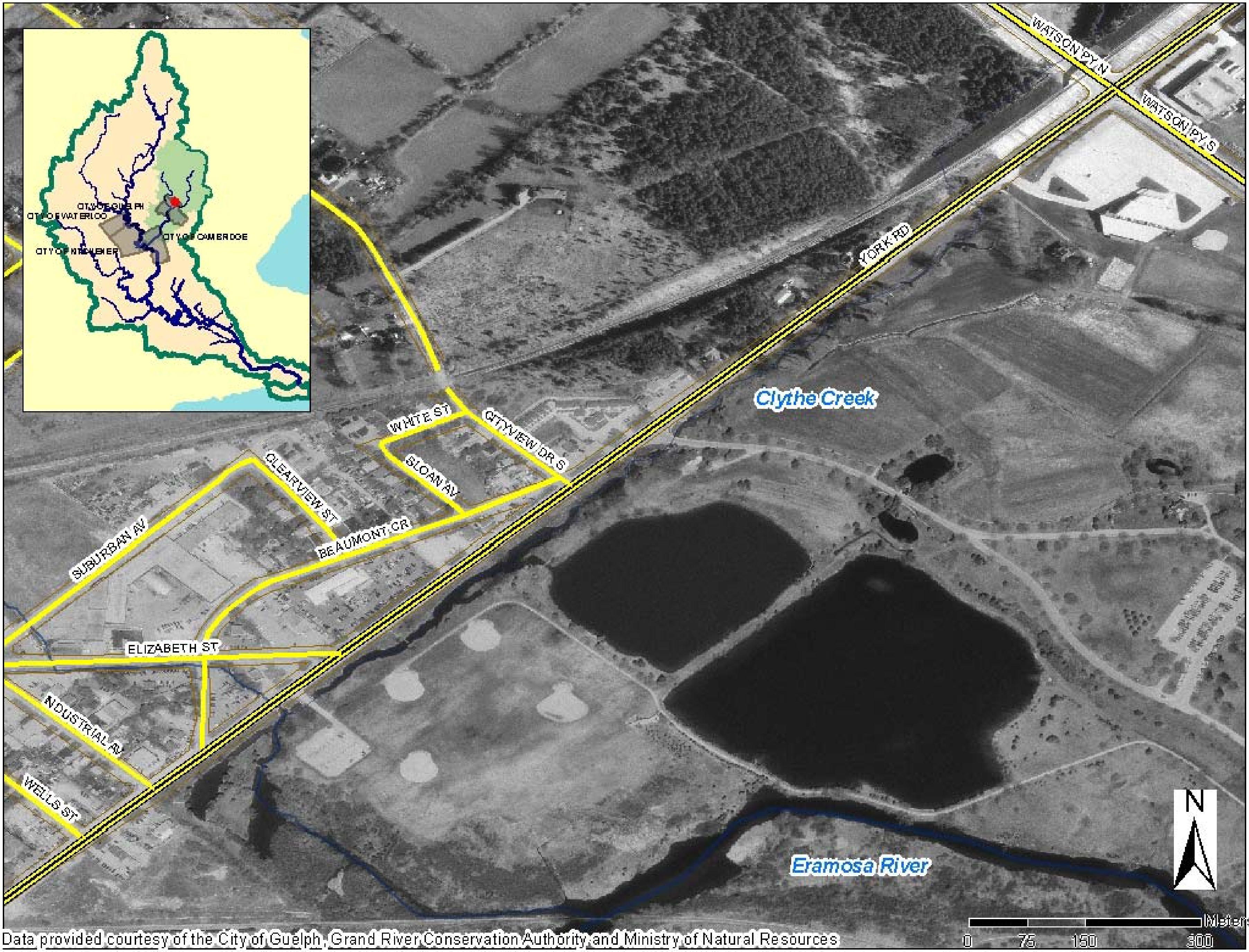
AMEC Foster Wheeler
York Road Widening

York Road Improvements
Clythe Creek - Option 3
Preliminary Plan and Profile 1+000-1+500m

Date:	Project:	Technical:	Reviewer:	Drawn:
03 08 2017	22257 York Road	J. Henshaw	J. Parish	E. Drost

Figure 08


Assessment of
Clythe Creek Remediation
Alternatives, Guelph, ON
UW 4th year Engineering Students
November 23, 2007



WATSON PY N
WATSON PY S
YORK RD
Clythe Creek
WHITE ST
CITYVIEW DR S
SLOAN AV
CLEARVIEW ST
BEAUMONT CR
SUBURBAN AV
ELIZABETH ST
INDUSTRIAL AV
WELLS ST
Eramosa River
N
Meters
0
75
150
300
Data provided courtesy of the City of Guelph, Grand River Conservation Authority and Ministry of Natural Resources

Project Objectives

- Accommodate for the widening of York Road
- Improve cold water aquatic life habitat
- Improve the stream thermal regime

Project Scope

- Assess the current state of the study area
- Determine alternative solutions for remediation
- Present final detailed design for the preferred alternative

Current Site Conditions

- Only crude base flow estimate available (17.7 L/s)
- No average or peak discharge values available
- Creek classified as cool water stream
- Stream is located in sensitive groundwater recharge/discharge area
- Land currently classified as institutional; proposed use as greenlands

Hydrology

- Three method were used to estimate stream discharge
  - Rational Method
  - Regional Analysis
  - SCS Triangular Method

	2 Year	**20 Year**	**25 Year**	**50 Year**	**100 Year**
Rational Method					
tc = 4 hrs	14.06	-	26.21	29.21	32.20
tc = 6 hrs	10.16	-	18.02	19.99	21.93
Regional Analysis					
Region 7	3.76	8.85	-	-	11.81
Region 8	3.05	6.00	-	-	7.93
SCS Triangular Method					
D = 4hr	0.1044		2.89	4.02	5.28
D = 6hr	0.0942		2.60	3.63	4.77

All flows are in m^3/s

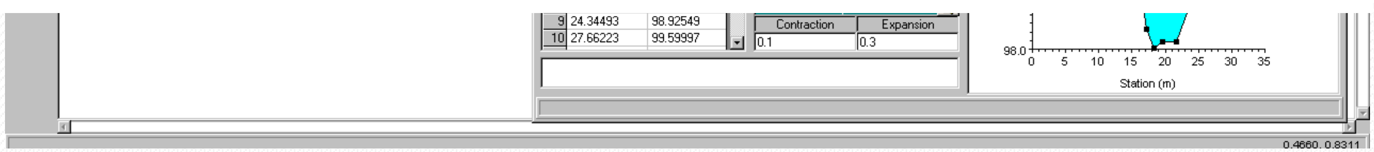
Problems/Issues

- Rational Method: assumes small watershed area and uniform rainfall
- Regional Analysis: study area near boundary of two regions
- SCS Triangular Method: assumes uniform rainfall

- Recharge/discharge play significant role in the study reach
- Wetlands and storm detention ponds upstream

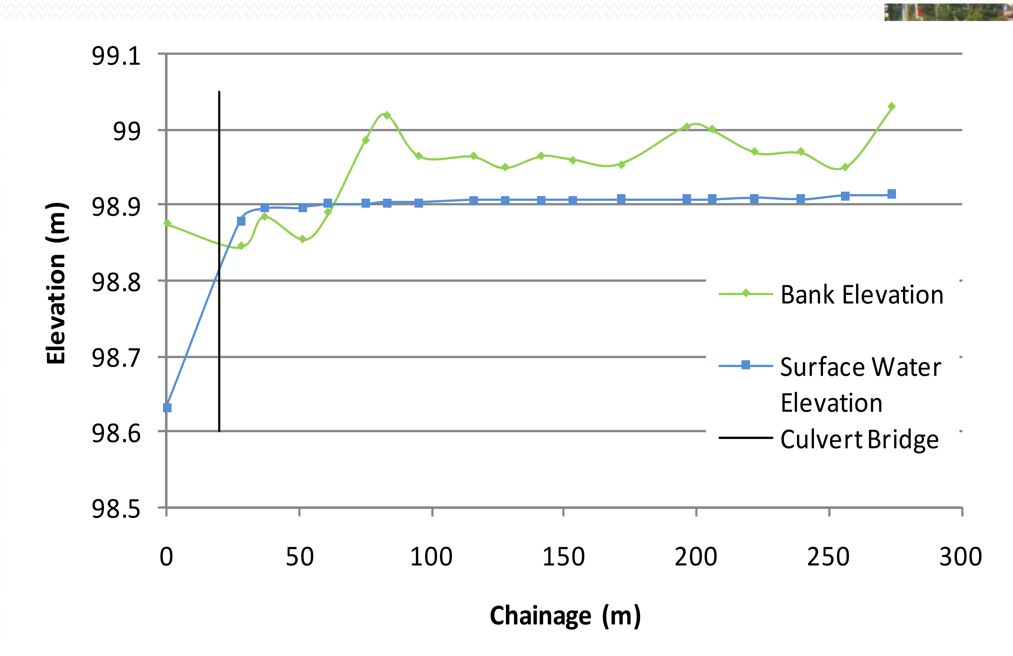
HEC- RAS Model Creation

- Current site conditions modeled using topographical survey data
- 84 cross sections, 10 weirs, 2 vehicle bridges, and 3 pedestrian bridges over a stream length of 1 km
- Created to identify:
  - bank-full discharge
  - low flow water elevations and water velocity
  - Basis for creating future designs
- Base flow and bank-full discharge scenarios run



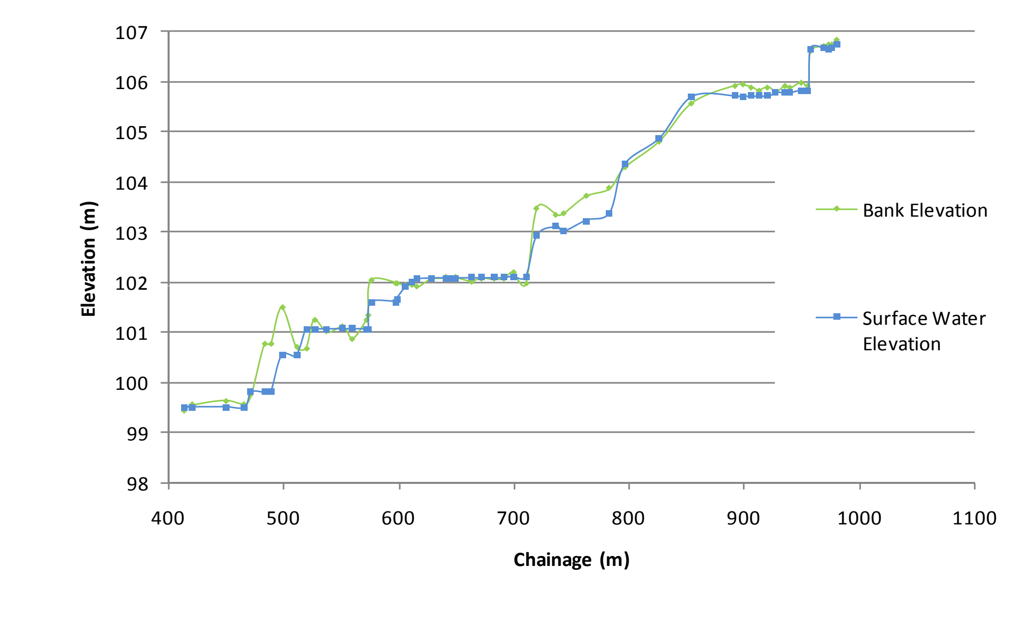
Bank-Full Conditions

- Lower reach max discharge = 1.3m³/s

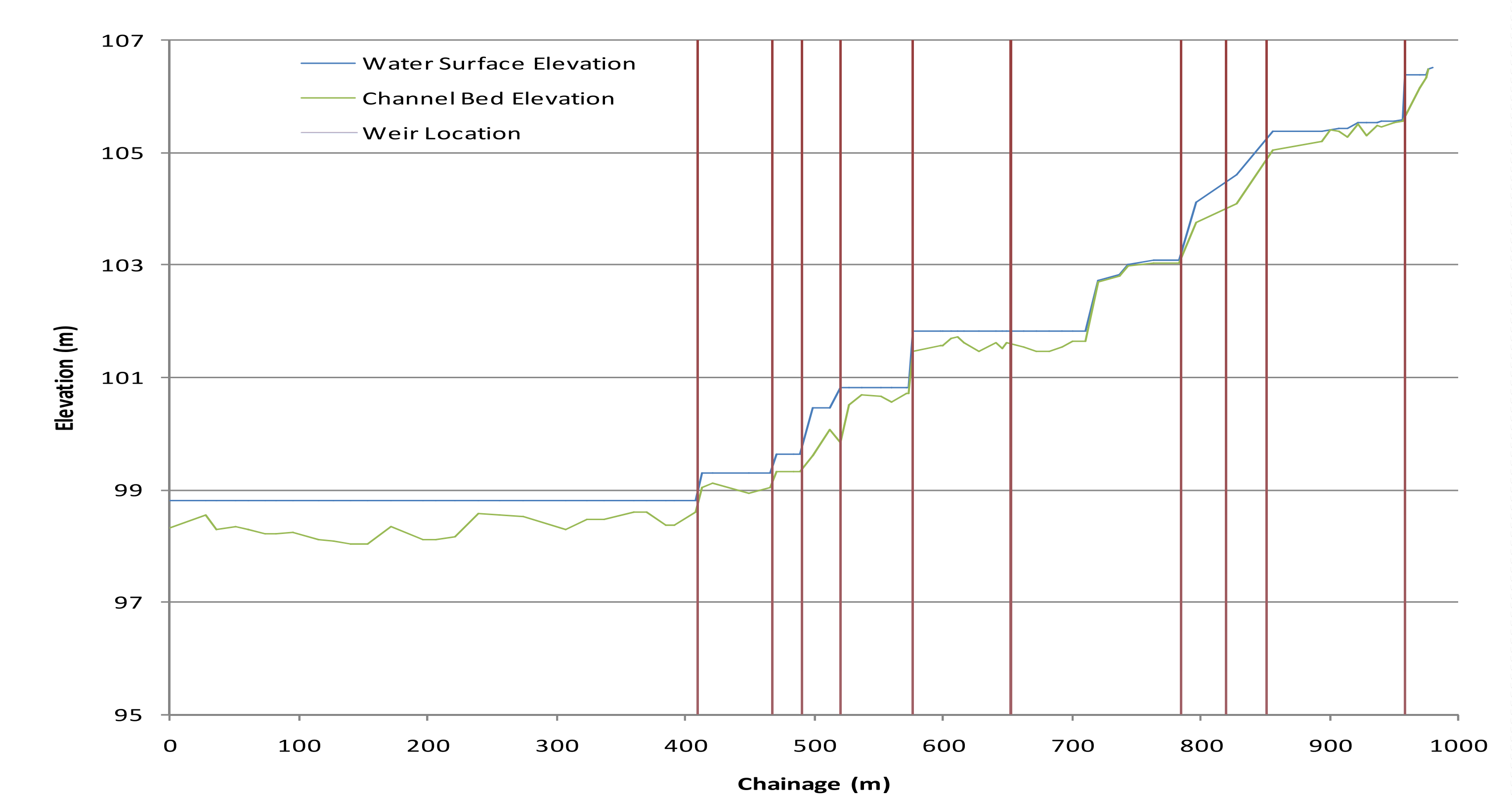


Bank-Full Conditions

- Upper reach max discharge = 0.6 m^3/s



Base Flow Conditions



- Water velocities during base flow approximately 0.005m/s

Current Site Conditions Water Quality

- Nitrates, phosphates, DO – below PWQO
- Temperature satisfies cold water habitat conditions (might not in the summer)
- pH of the downstream is high (9.2)
- BOD generally increases from upstream to downstream

Alternatives

1. Do not change the current alignment of Clythe Creek
2. Construct a concrete channel parallel to York Rd to accommodate the water currently flowing through Clythe Creek
3. Realign sections of the creek which interfere with the scheduled road construction
4. Realign all or the majority of Clythe Creek running thought the Site

- Map and explain alternatives more

Regulatory Compliance

1. May or may not satisfy Canada Fisheries Act (CFA)
2. It does not satisfy CFA (destruction of fish habitat)
3. Satisfies the regulations
4. Satisfies the regulations

Thermal Regime and Aquatic Habitat Impacts

1. Ditch-like stream would not help to lower temperatures and will decrease the quality of habitat
2. Concrete channel would destroy the fish habitat
3. Partially re-naturalized stream would benefit the aquatic organisms and improve thermal regime
4. Completely re-naturalized stream would provide the largest environmental benefits

Social Impact

- 1: The stream would loose its aesthetic attractiveness
- 3 and 4: Re-naturalization of the creek would keep the area aesthetically pleasing and add to the educational value in the community

Costs

	Initial Costs	Maintenance	Present Worth
Alternative 1	$9,300	$1700	**$11,000**
Alternative 3	$112,500	0	**$112,500**
Alternative 4	$166,500	0	**$166,500**

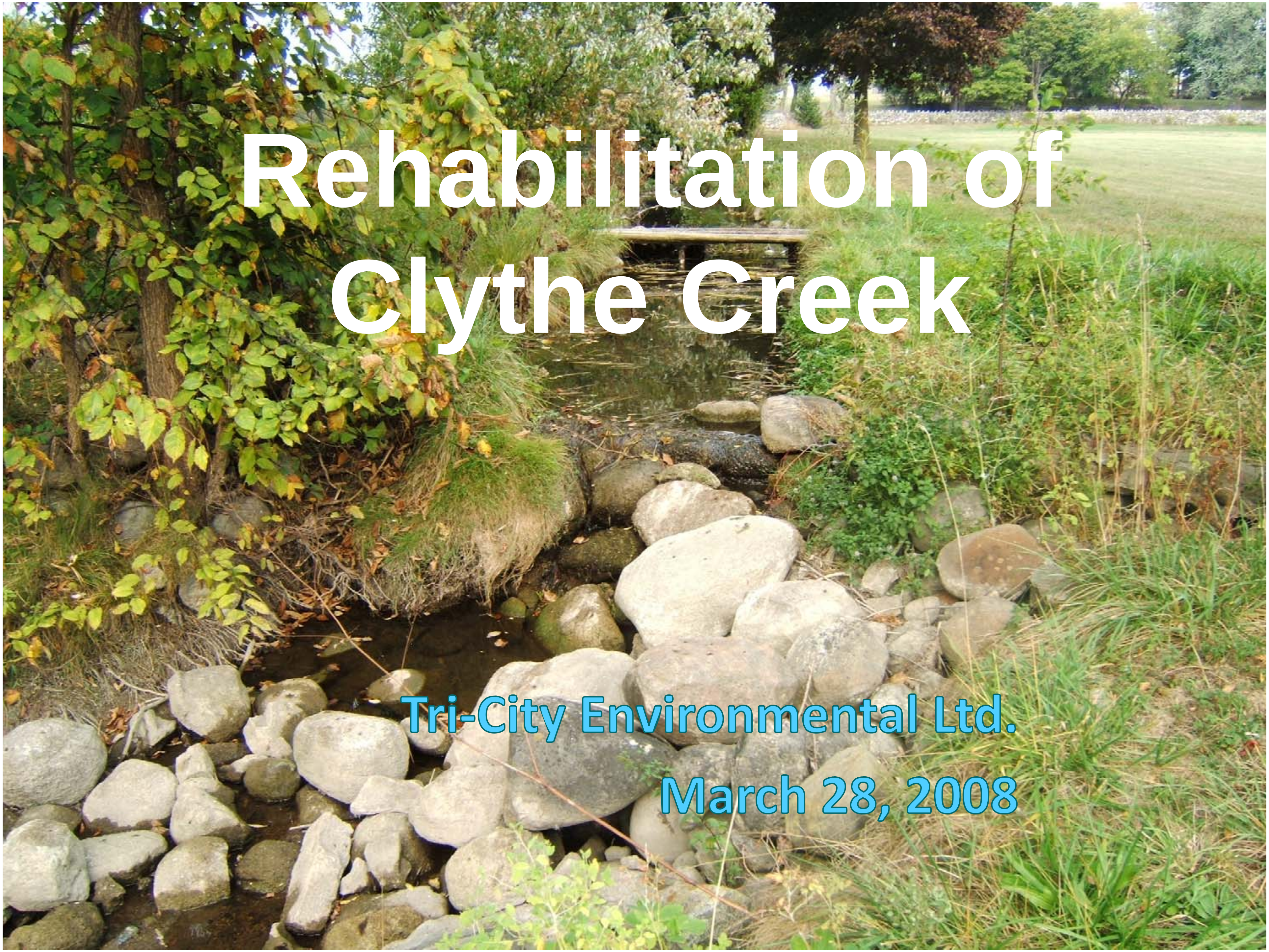
Preferred Alternative

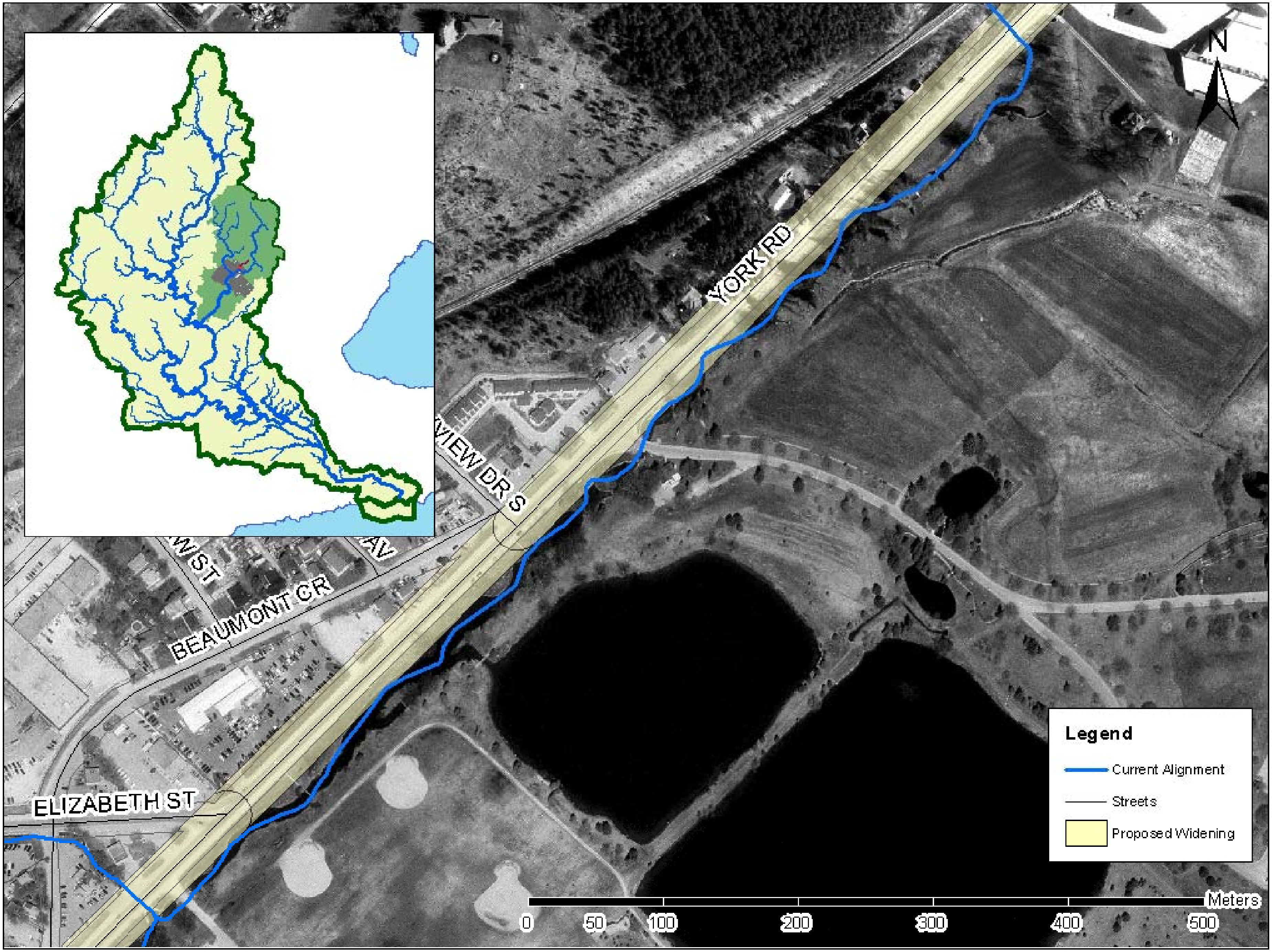
- Alternative 4 - Complete re-naturalization of the study reach

Recommendations

- Research remediation tools
- Use HEC-RAS model to design the new channel against erosion
- Investigate the cause of high pH
- Analyze temperature data (to be obtained from Trout Unlimited)

Questions?


Rehabilitation of
Clythe Creek
Tri-City Environmental Ltd.
March 28, 2008



YORK RD
VIEW DR S
BEAUMONT CR
ELIZABETH ST
W ST
AV
N
Legend
Current Alignment
Streets
Proposed Widening
Meters
0
50
100
200
300
400
500

Project Objectives

- Accommodate for the widening of York Road
- Increase stream velocity
- Improve the stream thermal regime
- Improve aquatic life habitat
- Maintain parkland athletics

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Phase I

- Background site assessment
- Modeling of existing conditions
- Selection of preferred alternative
  - Complete realignment of the study reach

Phase II Scope

- Determine channel geometry and alignment
- Compare the current and proposed channel alignments
- Propose a construction schedule
- Prepare a cost estimation

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Design Parameters

- Split channel into upstream and downstream separated by the arch bridge
- Design bankull flow of 2 m^3/s (Tr=1.25 yr)
- Class C stream (Rosgen Classification)
  - defines ranges for width to depth ratio and sinuosity

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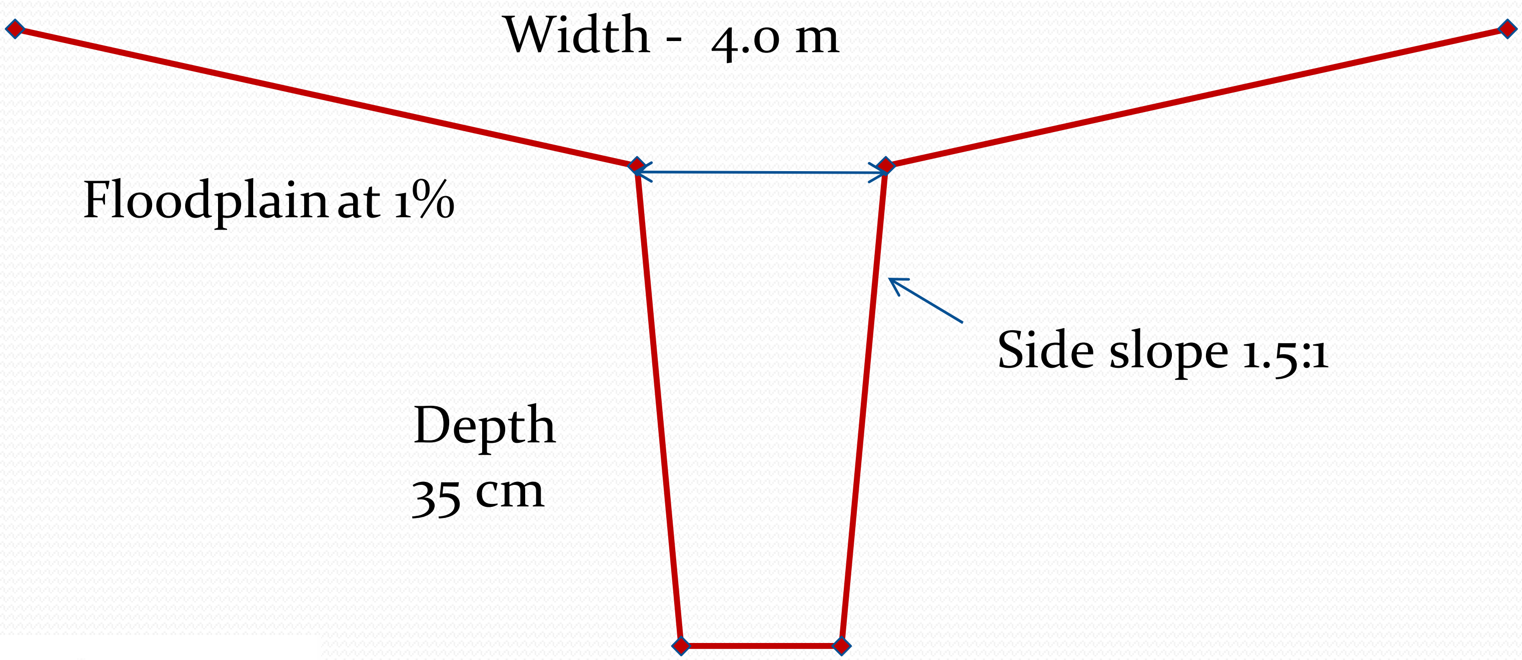
Proposed Alignment
Cross Sectional Geometry (at Riffles)



Proposed Alignment
Meander Geometry

- Regional morphological relationships used to calculated amplitude, wavelength, and radius of curvature
- Radius of curvature/bankfull width >2.5 indicates lateral stream stability
- Target sinuosity for Upstream: 1.25; Downstream: 1.1
- Non-uniform meander pattern to create more natural look

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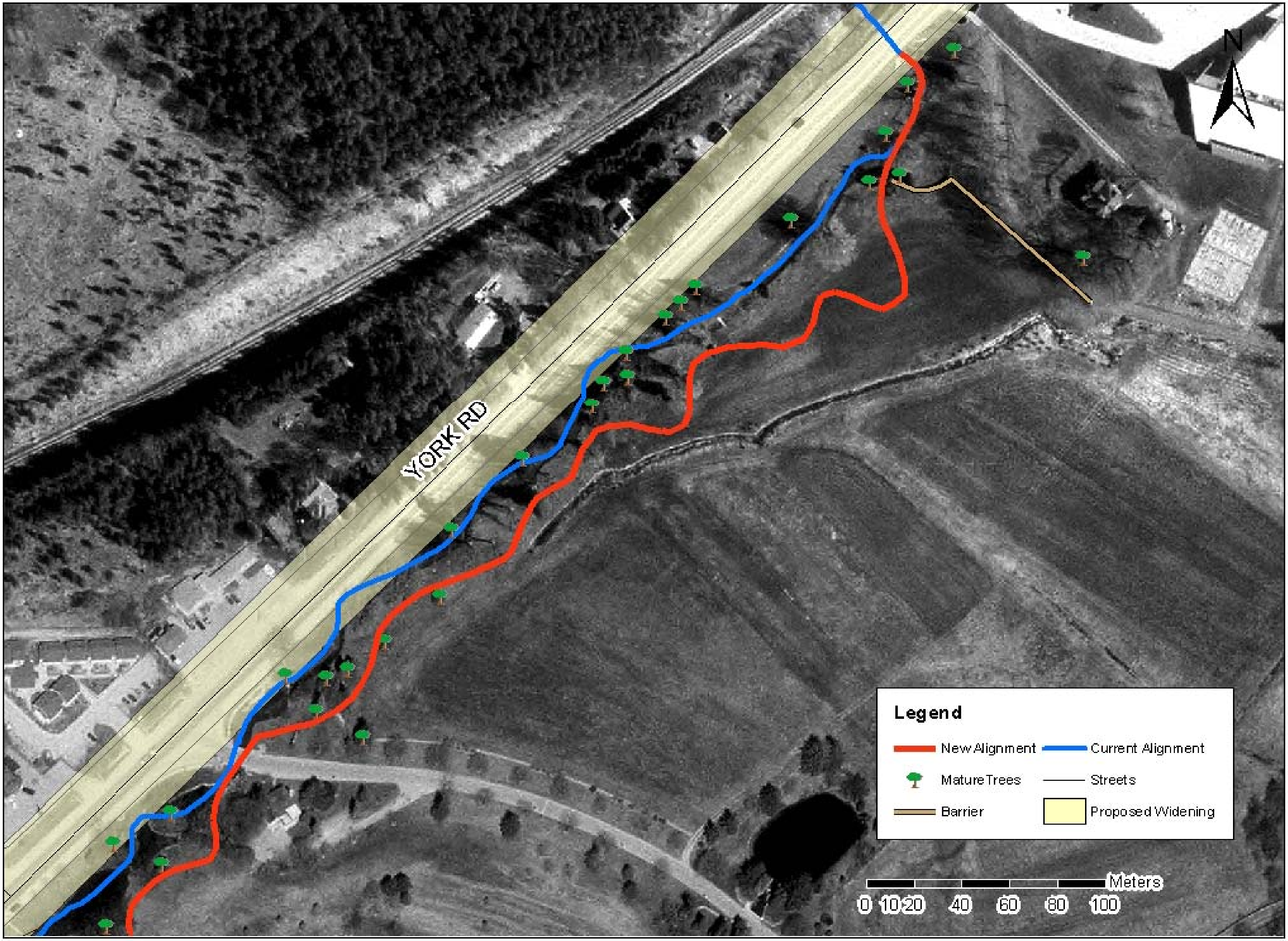
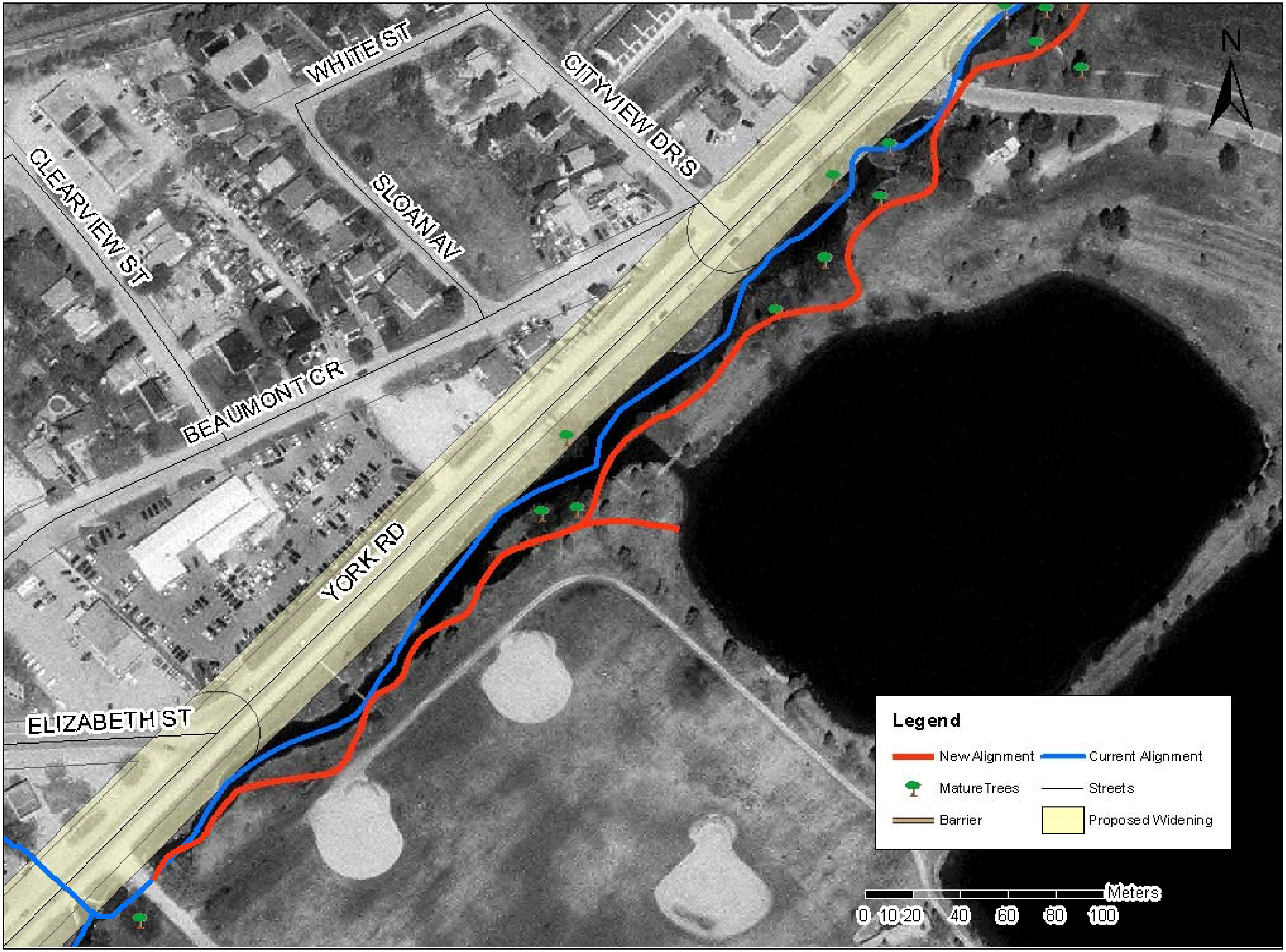
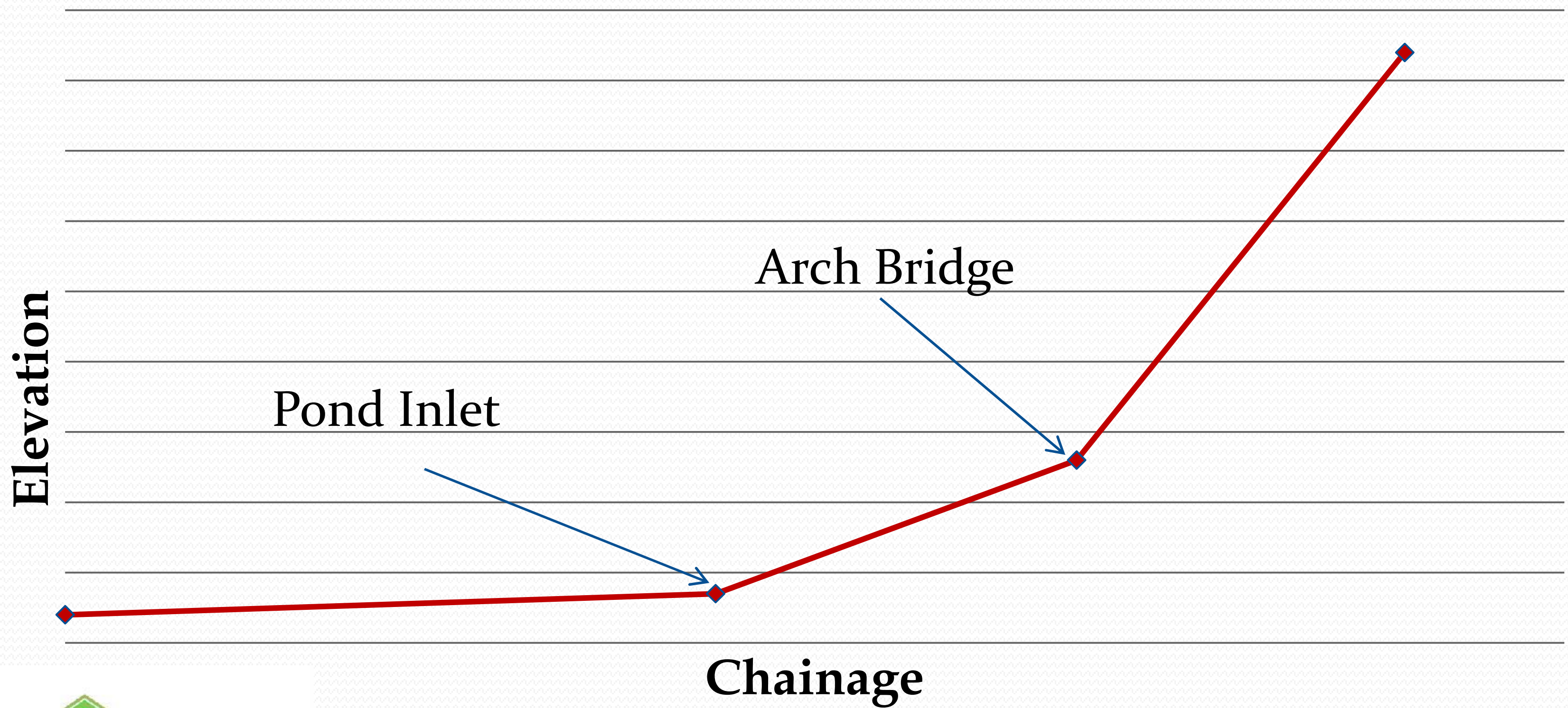

YORK RD
N
Legend
New Alignment
Current Alignment
Mature Trees
Streets
Barrier
Proposed Widening
Meters
0 10 20 40 60 80 100


WHITE ST
CITYVIEW DR S
CLEARVIEW ST
SLOAN AV
BEAUMONT CR
YORK RD
ELIZABETH ST
N
Legend
New Alignment
Current Alignment
Mature Trees
Streets
Barrier
Proposed Widening
Meters
0 10 20 40 60 80 100

Proposed Alignment

Channel Slope



Vegetation and Buffer Strips

- Vegetated zones along the creek – 5 meters wide
- Benefits
  - Bank stabilization
  - Shading (reducing thermal pollution)
  - Cover (better habitat for fish)
  - Geese deterrence (reducing organic loading)
- Used the list of Ontario native species to pick a variety of species with different salt and moisture tolerance

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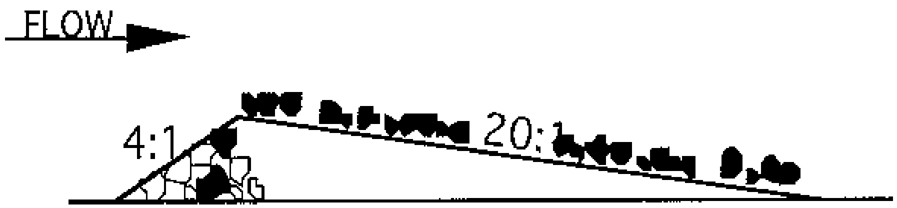
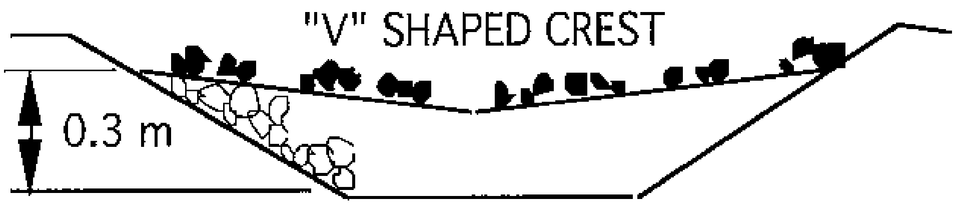
In-Stream Structures
Constructed Riffles

- Material size
  - US: 60 mm
  - DS: 18 mm

- 23 riffles to be constructed





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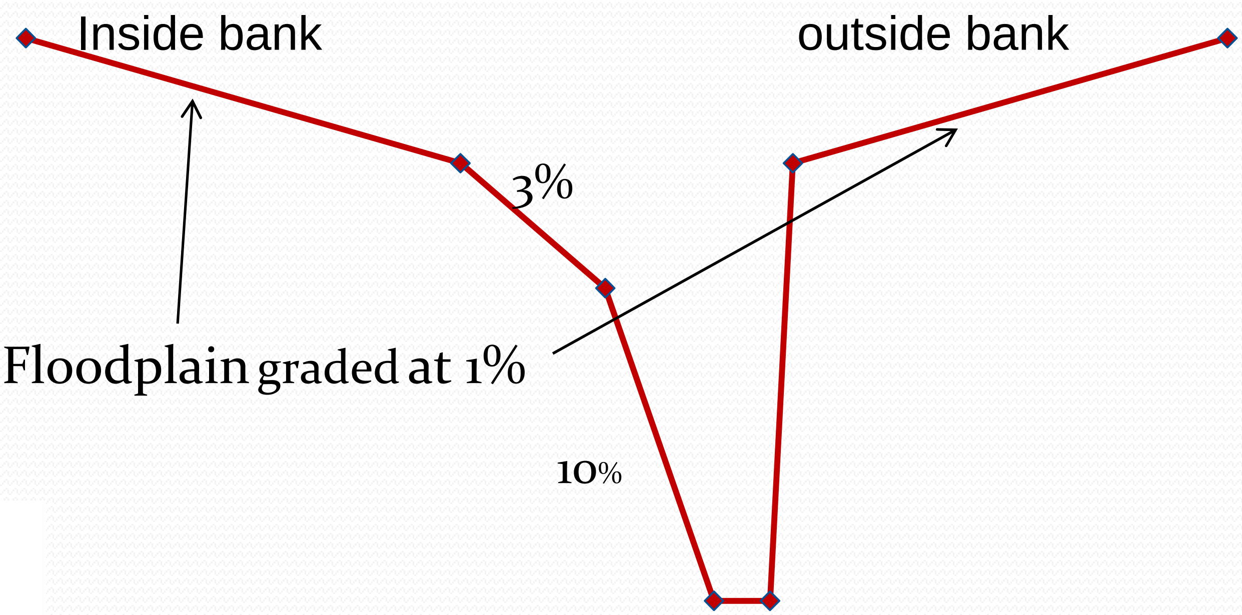
In-Stream Structures

Point Bars

- Total of 19 point bars



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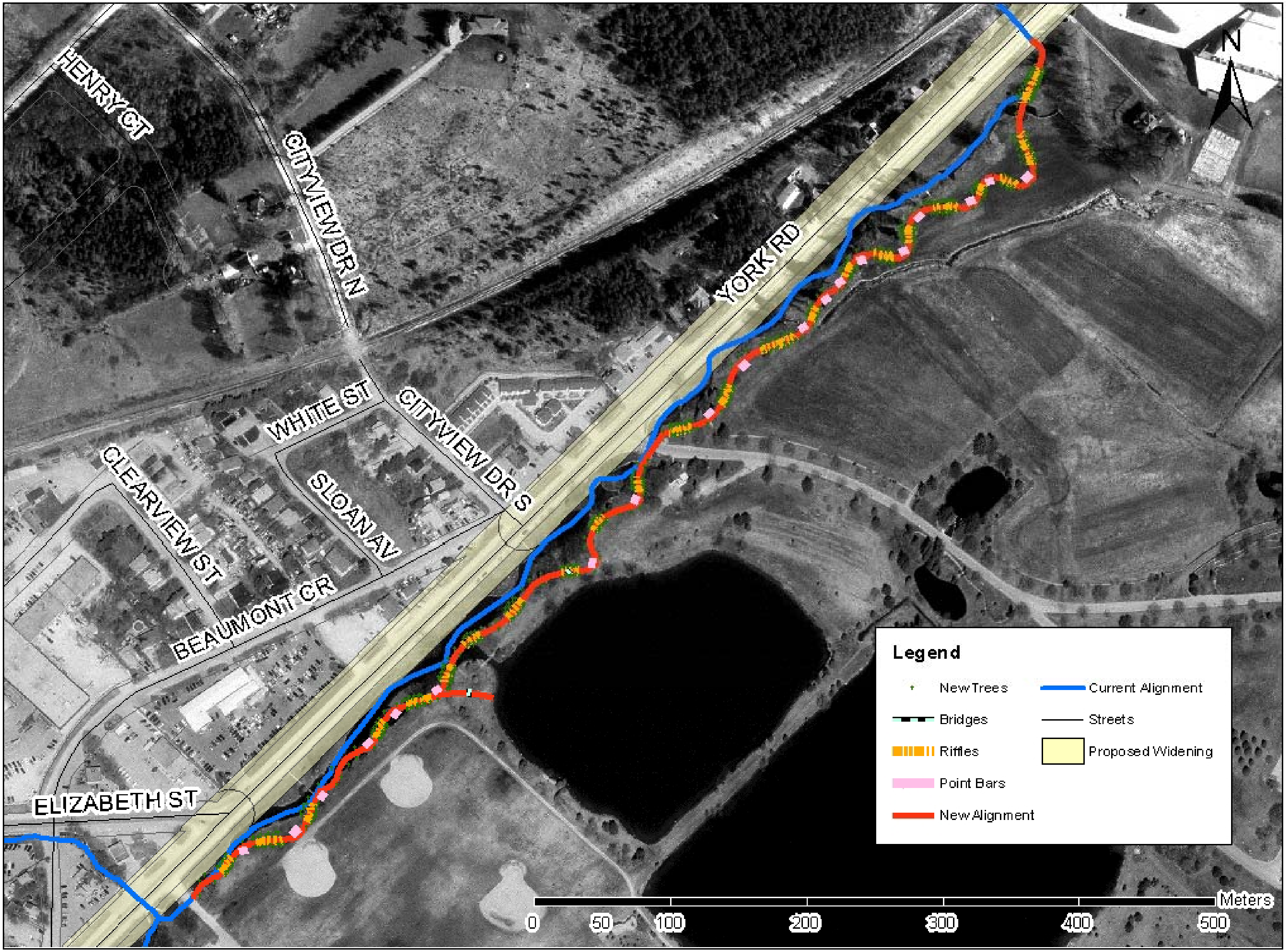
HENRY CT
CITYVIEW DR N
YORK RD
WHITE ST
CITYVIEW DR S
CLEARVIEW ST
SLOAN AV
BEAUMONT CR
ELIZABETH ST
N
Legend
New Trees
Bridges
Riffles
Point Bars
New Alignment
Current Alignment
Streets
Proposed Widening
0
50
100
200
300
400
500
Meters

Evaluation of Project Objectives

HEC-RAS Analysis

- 80 cross sections and an arch vehicle bridge
- Flow elevations were determined for the 1.25, 2, 20, and 100 year flows
- Velocities and elevations compared to current alignment model
  - New alignment results in increased velocities and similar surface water elevations

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Evaluation of Project Objectives

Temperature & Fish Habitat

- Increased velocities
  - Cooler stream temperatures
- Vegetation
  - Reduce thermal loading
  - Create fish habitat
- Riffles
  - Create zones of varied flow, preferred by fish

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Evaluation of Project Objectives

Aesthetics

- Clythe Creek runs through existing parkland
- Loss of waterfall structures, mixed opinion
- Re-vegetation will result in park like appearence
- Variation in stream alignment gives less “engineered” appearance

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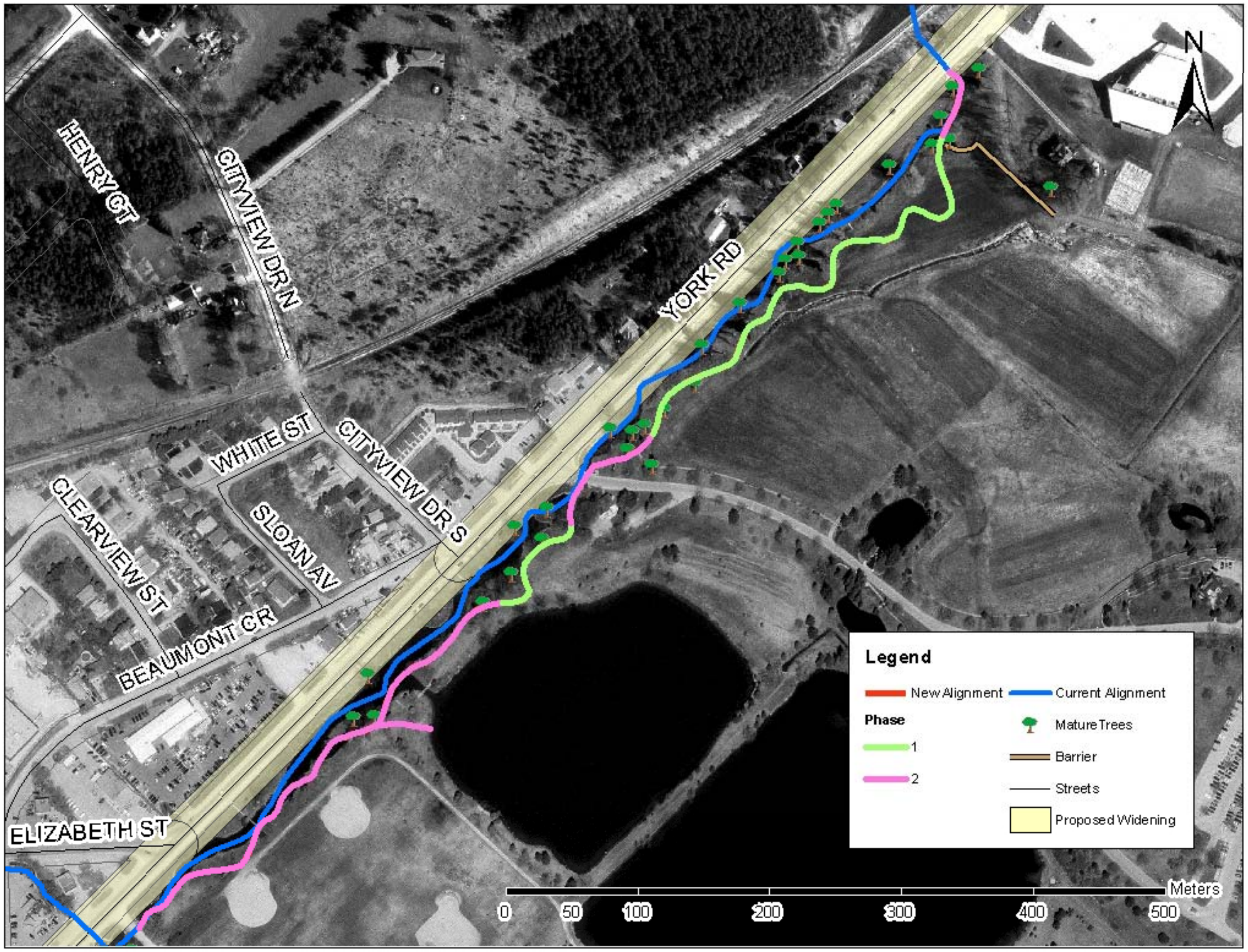
Construction Schedule



Cost Estimation

Current Stream	Maintenance
Backfill Current Cross Section	*Creek Features*
Removal of in-stream structures	*Monitoring buffer vegetation*

New Stream	Miscellaneous Construction
Construction of new channel alignment	*Safety*
Regrade new floodplain`	
Buffer Strips	
Creek Features	

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Cost Estimation (Continued)

Cost Summary Table

Phase I	**$113,900**
New Stream	
Miscellaneous Construction	
Phase II	**$134,800**
Current Stream	
New Stream	
Phase III	**$7,790**
Maintenance	
Subtotal (2006 dollars) =	$256,490
Inflation rate* =	3.33%
Total Costs =	**<u>$274,000</u>**

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Questions

APPENDIX A-2
Natural Environmental Report

Environmental Input to the EA for the Widening of York Road, Victoria Road to the East City Limit, Guelph, Ontario

Prepared for:
The City of Guelph, Ontario
c/o: Totten Sims Hubicki Associates
72 Victoria Street South
Kitchener, Ontario
N2G 4Y9

Project No. 658

Date: September 2006

NATURAL RESOURCE SOLUTIONS INC.
Aquatic, Terrestrial and Wetland Biologists

Natural Resource Solutions Inc.
Aquatic, Terrestrial and Wetland Biologists

Memo

Project No. 658

To: Ernst Heinrichs – Totten Sims Hubicki Associates

CC:

From: Dave Green

Date: September 25, 2006

Re: Environmental Input to York Road Widening - Guelph

The City of Guelph has proposed to widen York Road/Provincial Highway 7 in the section from Victoria Road eastward to the city limit. Natural Resource Solutions Inc. has provided the following information on the existing natural environment features within the project boundary as well as an assessment of impact for the preliminary design provided by TSH on September 13, 2006. Please refer to Drawings 5.1 to 5.4 in the main report by TSH for the preliminary design. A tree survey has also been completed for the York Road corridor. Information on the tree survey will be provided to TSH under a separate cover. Please refer to Figure 1, Key Map, for the location of the study area.

Methods

Information on the aquatic habitats was obtained by review of available background information and assessment of habitat in the field. Background information was obtained from the Ministry of Natural Resources Guelph District Office on June 8, 2006.

The aquatic habitat in the vicinity of York Road was assessed by an aquatic biologist from NRSI during two site visits, which occurred on June 5, 2006 and June 8, 2006.

A tree survey was carried out by a certified arborist from NRSI on June 5, June 16, and June 19, 2006

Figure 1

Environmental Input for the Widening of York Road, Guelph, Ontario

Key Map

September 26, 2006
Project NRSI-0658
NAD83 - UTM Zone 17
1:45,000 at 8.5 x 11

Natural Resource Solutions Inc.
Aquatic, Terrestrial and Wetland Biologists

Layers:
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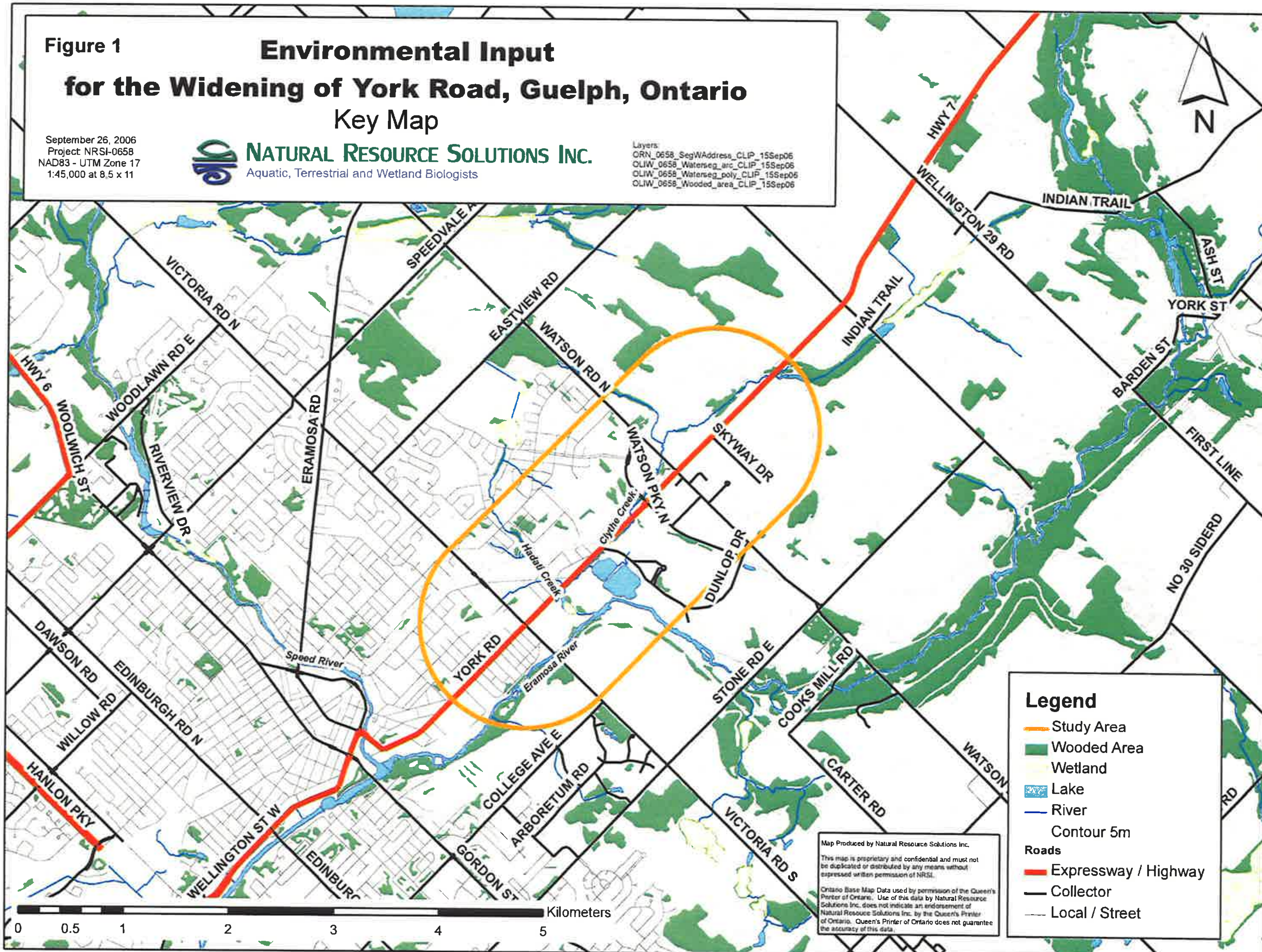

Map Produced by Natural Resource Solutions Inc.

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NRSI_0658_YorkRd_keymap_fig1_45k_26Sep08

EXISTING CONDITIONS

Aquatic Habitat – Clythe Creek

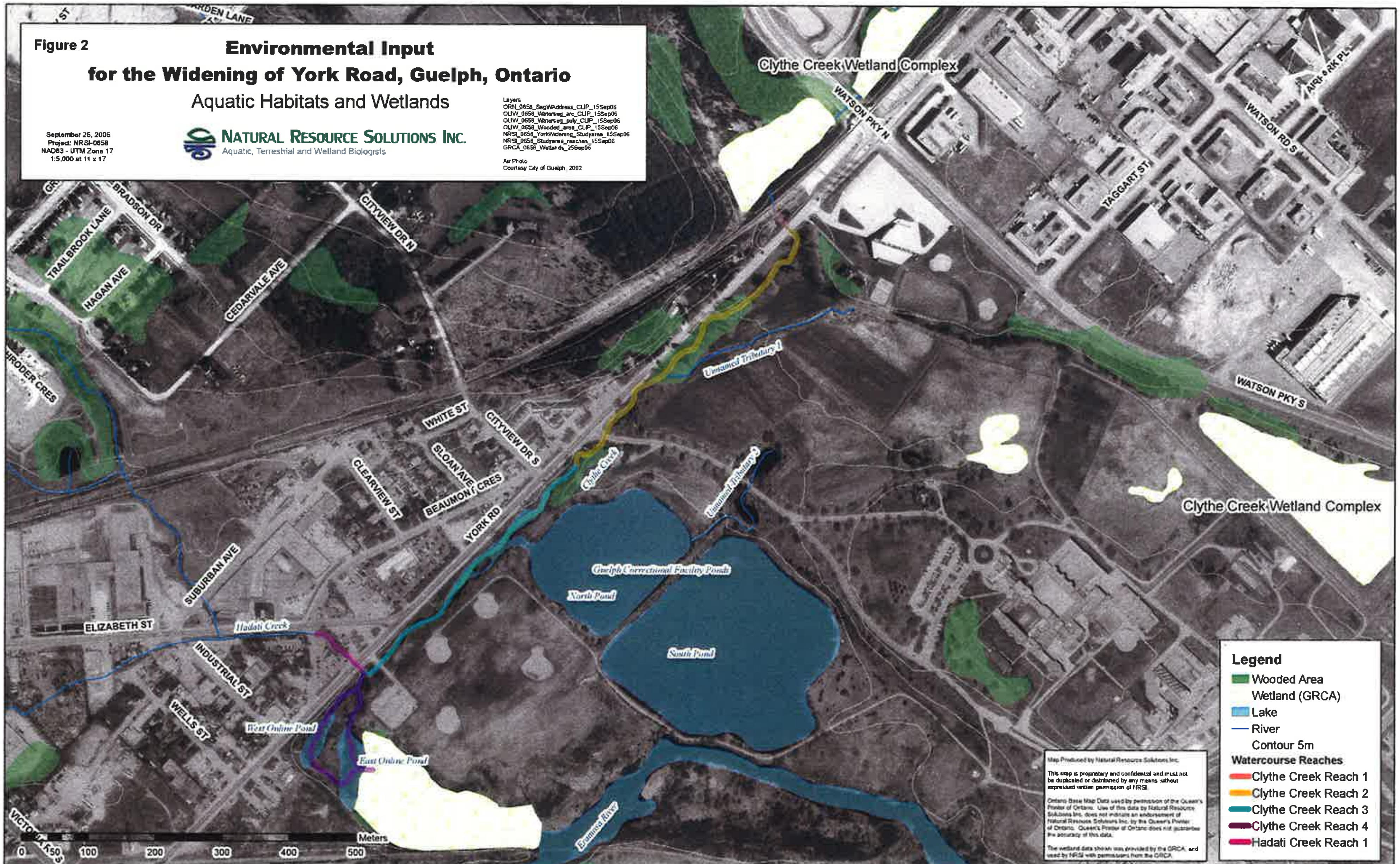
According to the Grand River Conservation Authority (GRCA), Clythe Creek is a coolwater stream (GRCA 2006). It originates in a lowland cedar swamp located approximately 6km upstream of its outlet to the Eramosa River, and the water is cold and clear in the upstream area near the swamp (Ecologistics et al 1998). The swamp is part of the Clythe Creek Provincially Significant Wetland (PSW) Complex. There are additional groundwater inputs to Clythe Creek between Watson Road and York Road (Ecologistics et al 1998). This section of the creek flows through another wetland in the Clythe Creek PSW Complex.

There are also 2 tributary streams that originate east of Clythe Creek (see Figure 2). One enters directly into Clythe Creek upstream of the ponds at the Guelph Correctional Centre (Unnamed Tributary 1), and the other flows into the south pond (Unnamed Tributary 2). Art Timmerman of the MNR indicated that both of these tributaries have cold water temperatures (MNR, 2006). The tributary that enters directly into Clythe Creek is currently providing a cooling influence. A survey by the MNR on August 30, 1994 found water temperatures at 2 locations in the tributary to be 11.6°C and 10.8°C while the air temperature was 19.7°C. In contrast, the other tributary flows into the south pond and does not have a meaningful cooling influence on Clythe Creek. Hadati Creek joins Clythe Creek from the north near Elizabeth Street, and is another coldwater tributary. It is described in detail in Section 3.3.

Within the study area, there are numerous weirs and dams on Clythe Creek that create barriers to fish movement (See Photo 1, Appendix I)

Clythe Creek – Reach 1

This short section of Clythe Creek is situated between the York Road crossing and a railway crossing (Figure 2). The vegetation on both sides of the creek is primarily long grasses along with other herbaceous plants and occasional shrubs. There are also several trees, including cedars, maples, and other deciduous species. The trees and shrubs create a canopy that provides approximately 70% shade to this reach.



NRSI_0658_YorkRd_Reaches_Fig2_5k_26Sep08

The bank vegetation is composed of grasses, other herbaceous plants, and shrubs. The high vegetation density affords good bank stability. Bank-full width ranged from approximately 3.1 to 3.5m. The channel substrate is dominated by coarse materials, consisting of approximately 10% boulder, 60% cobble, 10% pebble, 10% gravel, and 10% sand. Cover for fish includes pools (at the York Road culvert), boulders, and cobble. Most of this section is considered riffle habitat (See Photo 2, Appendix I).

On June 5, 2006, the measured wetted widths varied between 2.4 and 3.0m. Water depths ranged from 9 to 19cm. Water quality parameters were measured at 1:55pm. The water temperature was 18.8°C, and the air temperature was 25°C. The dissolved oxygen was 9.3ppm, or 99.8% saturation (at 18.8°C). The pH was 7.96, and the conductivity was 716µs/cm.

Clythe Creek – Reach 2

This reach of Clythe Creek is between the York Road crossing and the Ponds at the Guelph Correctional Centre (Figure 2). The lands surrounding this reach have a gently rolling topography. The vegetation in the riparian zone is manicured grass with some open-grown trees, including coniferous trees and willow trees (see Photo 3, Appendix I). Although the grass was mowed right up to the top-of-bank, the bank vegetation also included some trees, shrubs, and longer grass creating a high vegetation density on the banks.

Channel substrate in this reach is approximately 30% boulder, 20% cobble, 20% silt, 10%sand, 10% gravel, and 10% muck. Aquatic habitat features and cover include pools, riffles, backwater, undercut banks, woody debris, several types of aquatic vegetation, boulders, and cobble.

During site visits on June 5 and June 8, 2006, the measured wetted widths of the channel were as narrow as 1.8m in narrow sections of the channel, and up to 3.5m in wider locations. Measured depths at various locations along the middle of the channel varied between 8 and 72cm. The macrohabitats consisted mostly of runs, occasional pools, and a few riffles. Maximum pool depth was 72cm, and many runs were deeper than 30cm. The water temperature taken in the middle of this reach was 19.7°C at 3:40pm while the air temperature was 26°C. At the same location, dissolved oxygen was 9.5ppm (103.5% saturation at 26°C), pH was 7.99, and conductivity was 709μs/cm. Many small fish were observed.

Clythe Creek – Reach 3

This reach lies between the ponds at the Guelph Correctional Centre (Figure 2) and Hadati Creek. The lands surrounding this reach are relatively flat, and include baseball diamonds. The vegetation is dominated by manicured grass to the top-of-bank of Clythe Creek. Trees are distributed somewhat randomly in the vicinity of the creek. The vegetation density on the banks of Clythe Creek has been compromised due to feeding by the large numbers of geese that inhabit this area. This has contributed to bank instability, and boulders that were placed along the banks for aesthetic purposes are no longer integrated with the bank.

The bank height ranges from approximately 0.1 to 0.3m, and the bank-full channel width varies between 7 and 12m. This widened section of Clythe Creek has some meandering form, but intensive modifications have left it with a low gradient. As a result, the water becomes ponded during low flow (see Photo 4, Appendix I). The substrate reflects the depositional nature of the slow, diffused flows. It is approximately 50% silt, 30% boulder, and 20% muck.

On June 8, 2006, the water temperature in Clythe Creek immediately upstream of the Hadati Creek outlet was 23.5°C at 3:45pm while the air temperature was 24°C. The pH was 8.39, and the conductivity was 686μs/cm. Fish from the families Cyprinidae and Centrachidae (*Lepomis* sp.) were observed in this reach.

Clythe Creek – Reach 4

This reach lies between the outlet of Hadati Creek and the downstream limit of two online ponds (Figure 2) The flow diverges downstream of the Hadati Creek outlet to flow into the two ponds, which are located side-by-side (see Photo 5, Appendix I). The east online pond is at a lower elevation and is the larger of the two. The land on the east side of this pond is wooded. The land in between the two ponds and west of the ponds is manicured grass with occasional trees. Boulders were used as a landscaping feature along the banks, and there is abundant aquatic vegetation throughout both ponds.

The portion of flow that enters directly into the east pond passes over a weir and into a plunge pool at the upstream end of the pond. The west pond receives flow directly and as a result the water is at a higher elevation than that of the east pond. The flow leaves the pond through a channel that connects to the downstream end of the east pond. There is a pedestrian crossing over this channel that uses a corrugated steel pipe (CSP) to convey flow. A weir situated in this outlet channel keeps the west pond at its higher elevation.

On June 8, 2006, the water was relatively shallow (approximately 0.3m deep) throughout most of the area of the ponds. Water temperature was measured where the flow from the upper (west) pond joins the lower (east) pond. At 2:45pm, the water temperature was 23.5°C and the air temperature was 24°C. The pH at this location was 7.80 and the conductivity was 812µs/cm. The dissolved oxygen level was 9.3ppm, indicating supersaturated conditions (approximately 110% at 23.5°C). This was likely a result of the prolific growth of aquatic plants (see Photo 6, Appendix I). Fish from the families Centrarchidae (*Lepomis* sp.) and Cyprinidae were observed in the ponds.

Aquatic Habitat – Ponds at the Guelph Correctional Centre

The ponds at the Guelph Correctional Centre consist of two large ponds to the south of York Road and Clythe Creek (Figure 2). The north pond is closer to Clythe Creek, and is connected via a short channel approximately 10m long and 3 to 4m wide (see Photo 7, Appendix I). The flow of water moves slowly out of the pond as it joins the slow-moving water of this widened section of Clythe Creek. The south pond is not directly connected to Clythe Creek.

These constructed ponds are known to provide habitat for a variety of game fish and are used as a popular urban fishery (see Photo 8, Appendix I). Manicured grass surrounds much of their shorelines, and various trees and shrubs line the banks in some locations. The two ponds are separated by a narrow strip of land, and the south pond has a higher water level than the north pond (see Photo 9, Appendix I). The south pond is contained by a berm between it and the Eramosa River along its south shoreline. A formal trail has been established along the top of the berm on the south side.

Some water from the south pond seeps into the north pond. One location in particular was observed where the surface of the water in the north pond was turbulent due to flows entering from the south pond. Other less obvious seeps may also be present. As a result, this seepage flows through the north pond and subsequently into Clythe Creek. Therefore, there is a hydraulic connection between the south pond and Clythe Creek.

While this provides an input of flow, the potential for a cooling influence is lost as the water from the tributary entering the south pond is subject to warming while passing through the ponds. Furthermore, most of the flow leaves the south pond through a 45cm diameter CSP leading directly to the Eramosa River, which causes a large portion of the input from the tributary to be diverted directly to the Eramosa River instead of to Clythe Creek.

Aquatic Habitat – Hadati Creek

According to the GRCA, Hadati Creek is considered a coldwater stream (GRCA 2006). According to MNR, Guelph District file information, the gradient is higher upstream of Elizabeth Street, the substrate is primarily bedrock, and the stream is narrower than it is near the outlet to Clythe Creek (MNR 2001). A western tributary discharges to the main branch east of the Elizabeth Street/Industrial Street intersection. Upstream of Suburban Avenue, "...there is a bedrock shelf which probably prevents the upstream migration of fish (MNR 2001)."

Hadati Creek – Reach 1

Reach 1 of Hadati Creek is between Elizabeth Street and its outlet to Clythe Creek (Figure 2). Here, Hadati Creek passes between parking lots of the commercial lands that line York Road. The corridor is extremely narrow, with no more than one or two metres of vegetation on either side of the creek. The creek passes through a large box culvert under York Road. On the downstream side, grasses in the roadside ditch surround the short length of channel between the road and the outlet to Clythe Creek.

The channel in Reach 1 is approximately 3m wide, and is very entrenched. The bank height ranges from approximately 1.9 to 2.2m, and bank slopes are nearly vertical. Most of the banks are hardened with a concrete bag wall (see Photo 10, Appendix I). Elsewhere, vegetation consists of grasses and other herbaceous plants that provide a moderate vegetation density for bank stability. Some minor bank scour is occurring on the west bank immediately upstream of the York Road culvert, likely resulting from flow patterns at the culvert inlet. The varied channel substrate is the most important habitat feature. It consists of approximately 30% cobble, 20% pebble, 10% gravel, 20% sand, and 20% silt. A 2001 MNR report shows that the substrate downstream of Elizabeth Street is "...composed on fractured bedrock and bedrock (MNR 2001)." The difference in observations occurred either because of different observation locations, or because material from upstream of the site has been deposited in this reach since 2001.

On June 8, 2006, the measured wetted widths in Reach 1 were approximately 2.7 to 2.9m between York Road and Elizabeth Street. Measured water depths ranged from 8 to 20cm. Several water quality parameters were measured at 3:05pm approximately 5m upstream of the York Road culvert. At this time the air temperature was 23°C, the water temperature was 21.9°C, the pH was 8.27, and the conductivity was 989µs/cm. Many small fish were observed on the upstream side of York Road.

FISH COMMUNITY

Rare Fish Species

Records of greenside darter in the vicinity of the study area were found on the Natural Heritage Information Centre (NHIC) website using the geographic query function (NHIC 2006). There was one "element occurrence" square (1km by 1km) that included part of the study area. Observations were made at that location in 1991. They were also found during sampling by the University of Guelph in the Guelph Correctional Facility Ponds in 2005 (see Section 3.4.4 of this report). The greenside darter *(Etheostoma blennioides)* has an S-rank (subnational rank) of S4, which means it is apparently secure. Nevertheless, at the present time it remains listed as a species of "special concern" by both the MNR for Ontario and COSEWIC for Canada (NHIC 2006; Pers. Comm. with Donald Kirk, MNR 2006b).

According to the *Ontario Freshwater Fishes Life History Database (OFFLHD)*, greenside darters prefer "algae-covered rocky riffles of creeks and small to medium rivers with clear water and moderate to fast current" (Eakins 2005). Their preferred water temperature is 25.4°C. As phytophils, greenside darters deposit their eggs on vegetation and woody debris (Eakins 2005).

Brook Trout and Brown Trout

According to a MNR map of brook trout distributions (MNR Unknown Date), brook trout were known to inhabit Clythe Creek in 1952 (Figure 3). According to Art Timmerman (MNR 2006a), there are currently no brook trout but there are mottled sculpin *(Cottus bairdi)* which also require cool water temperatures. However, the Speed Valley chapter of Trout Unlimited is conducting a monitoring program throughout the Clythe Creek watershed to determine the suitability of the habitat for brook trout. Temperature monitoring is ongoing in 2006 and electrofishing will be conducted throughout Clythe Creek to determine if any populations are present (D'Amelio, 2006). In addition, brook trout and brown trout are known to inhabit the Eramosa River (Ecologistics Ltd. et al 1998).

Figure 3

Environmental Input for the Widening of York Road, Guelph, Ontario

Fish Record Locations

September 26, 2006
Project: NRSI-0658
NAD83 - UTM Zone 17
1:45,000 at 8.5 x 11

NATURAL RESOURCE SOLUTIONS INC.
Aquatic, Terrestrial and Wetland Biologists

Layers:
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OLIW_0658_Waterseg_arc_CLIP_15Sep06
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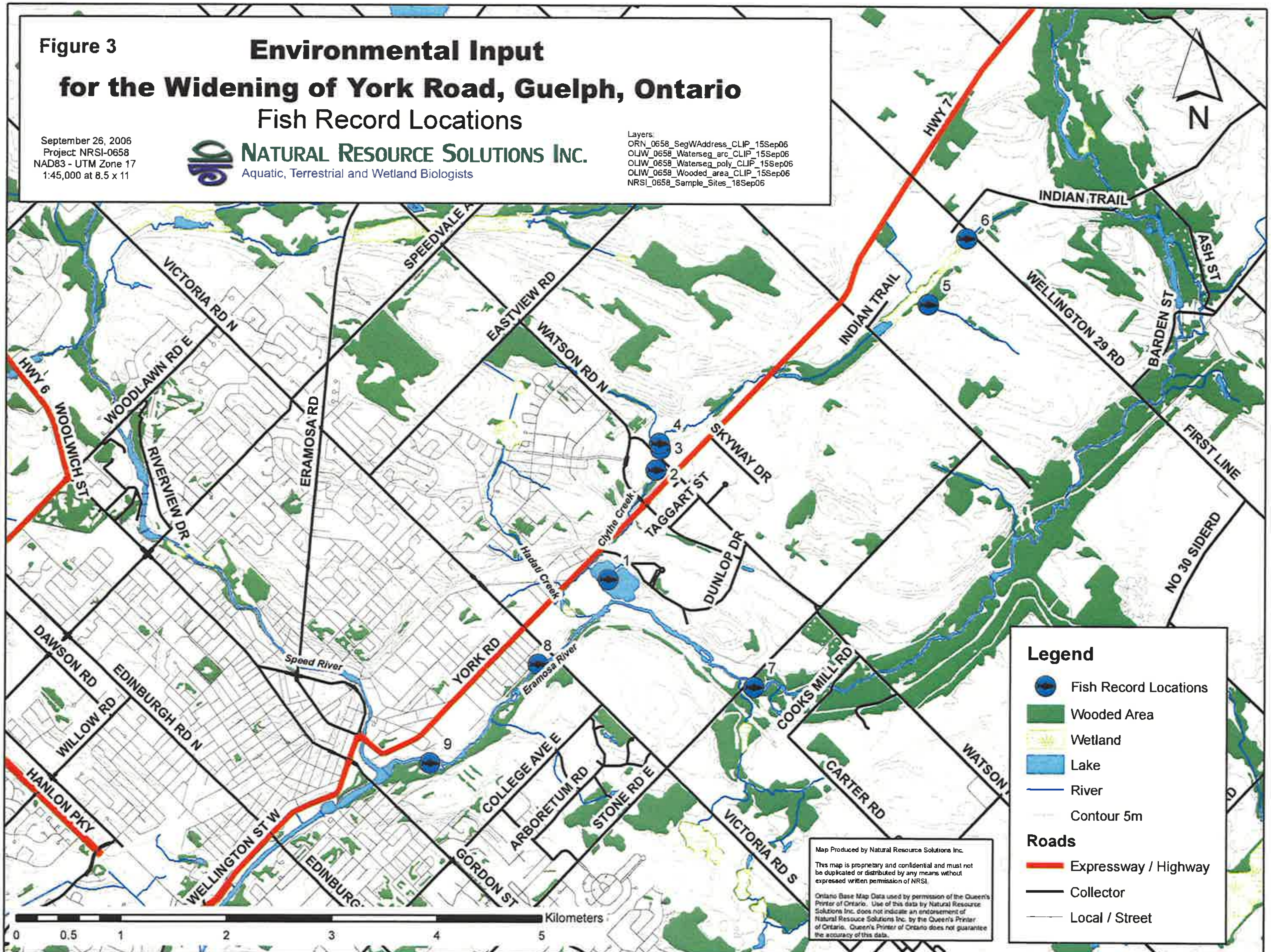
NRSI_0658_Sample_Sites_18Sep06



Map Produced by Natural Resource Solutions Inc.

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NRSI_0658_YorkRd_samplingsites_fig3_45k_26Sep08

Urban Fishery at the Guelph Correctional Centre Ponds

A report by Art Timmerman indicates information from anglers that the ponds at the Guelph Correctional Centre "...contain excellent populations of pike, smallmouth bass, crappie, bullheads and sunfish. Yellow perch and largemouth bass have also been caught in these ponds (MNR 2001)."

Other Fish Records

Unnamed Tributary 1, which enters Clythe Creek upstream of the ponds at the Guelph Correctional Centre, is known to contain fish near the outlet (Figure 2). A survey by the MNR on August 30, 1994 indicated that unidentified minnows were observed in the lower 10m of the tributary (MNR 1994).

The sampling results for a number of fish collection records from the MNR Guelph District Office files are given in Table 1. Descriptions are given below for the various sources of information for this list of fish species. Available specific fish sampling locations are shown on Figure 3.

In 2005, the University of Guelph sampled several watercourses in southern Ontario, including the Eramosa River. Sampling in the Eramosa River watershed occurred in the ponds at the Guelph Correctional Centre (Record Location 1, Figure 3).

In 2001, Fisheries and Oceans Canada (DFO) conducted fish sampling at a variety of locations with the purpose of monitoring culvert installations. This included Clythe Creek upstream of the York Road corridor, between York Road and Watson Road (see Record Location 2, Figure 3).

In 1998, a subwatershed study was conducted for the Clythe Creek subwatershed (Ecologistics et al 1998). The report included a list of species for the entire subwatershed.

In 1990, the GRCA conducted exploratory electrofishing at 4 sites on Clythe Creek upstream of Watson Road (see Record Locations 3, 4, 5, and 6, Figure 3).

In 1981, Gregory Humphreys (affiliation not noted) conducted sampling under scientific permit at various locations in the Grand River and Thames River Drainage. One site was located on the Eramosa River at the "Guelph Correctional Centre (bridge)".

In 1972, the GRCA published a report called "Water Quality Survey of the Speed and Eramosa Rivers." The report includes results of fish sampling for 13 sites, 3 of which are on the Eramosa River in relatively close proximity to the outlet of Clythe Creek (see Record Locations 7, 8, and 9).

Table 1. Fish Species Known from the Clythe Creek Subwatershed, and the Eramosa River near the Clythe Creek Outlet

Common Name	Scientific Name	Provincial Rank (S-Rank)	University of Guelph, Correctional Centre Ponds (2005)	DFO, Clythe Cr. between York Rd. and Watson Rd. (2001)	Ecologistics et al, Clythe Creek Subwatershed (1998)	GRCA, Clythe Cr. Upstream of Watson Rd. (1990)	Gregory Humphreys Eramosa River at Correctional Centre (1981)	GRCA Water Quality Survey, Eramosa River (1972)
Cyprinidae								
creek chub	*Semotilus atromaculatus*	S5	X		X	X		X
hornyhead chub	*Nocomis biguttatus*	S4						X
common shiner	*Luxilus cornutus*	S5			X	X		X
blacknose shiner	*Notropis heterolepis*	S5			X			
northern redbelly dace	*Phoxinus eos*	S5			X	X		
finescale dace	*Phoxinus neogaeus*	S5			X	X		
bluntnose minnow	*Pimephales notatus*	S5	X	X				X
fathead minnow	*Pimephales promelas*	S5			X	X		
blacknose dace	*Rhinichthys atratulus*	S5			X	X		
longnose dace	*Rhinichthys cataractae*	S5						X
Percidae								
greenside darter	*Etheostoma blennioides*	S4	X					
fantail darter	*Etheostoma flabellare*	S4	X	X	X			
barred fantail*								X
rainbow darter	*Etheostoma caeruleum*	S4	X					X
johnny darter	*Etheostoma nigrum*	S5	X				X	X
blackside darter	*Percina maculata*	S4					X	X
Centrarchidae								
smallmouth bass	*Micropteris dolomieu*	S5						X
largemouth bass	*Micropteris salmoides*	S5						X
pumpkinseed	*Leponis gibbosus*	S5						X
rock bass	*Ambloplites rupestris*	S5						X
Catostomidae								
white sucker	*Catostomus commersoni*	S5			X	X		X
northern hog sucker	*Hypentelium nigricans*	S4			X			X
Other Families								
brook stickleback	*Culaea inconstans*	S5		X	X	X	X	
brown bullhead	*Ameiurus nebulosus*	S5		X				
central mudminnow	*Umbra limi*	S5		X	X	X		
mottled sculpin	*Cottus bairdi*	S5			X	X		X
brook trout	*Salvelinus fontinalis*	S5			X			

*The "barred fantail" is most likely the fantail darter *(Etheostoma flabellare)*

OPPORTUNITIES AND CONSTRAINTS

The aquatic habitat in the section of Clythe Creek along the south side of York Road is heavily impacted by numerous weirs, straightening, widening, and ongoing maintenance of manicured grass along its length. There is also ongoing impact by large goose populations that are contributing to bank erosion. As such, there are many opportunities to improve the condition of the creek.

Factors to consider in the design process include the current use of the area as an urban angling opportunity, the use of the habitat by many warmwater species of fish, the limited space or buffer between York Road and Clythe Creek, and the opportunity to restore this portion of the creek so it continues to provide coolwater or coldwater fish habitat.

Grand River Fisheries Management Plan

Opportunities and constraints can also be identified in the Grand River Fisheries Management Plan, which was completed in September 1998 by the Ontario Ministry of Natural Resources and the Grand River Conservation Authority. The management plan identifies Clythe Creek as a mixed water tributary to the Speed River. The fish community objectives for mixed water tributaries are to achieve 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 (MNR & GRCA 1998)." Based on these objectives, the planning and design of any work affecting a mixed water tributary such as Clythe Creek should investigate the possibility of improving the habitat for a coldwater fish community.

Furthermore, the management plan identifies issues that exist for the Speed River's mixed water tributaries. Of relevance to the York Road widening project are the following:

1. water quality/quantity impacts from:
    a. nutrient and sediment inputs;
    b. riparian zone destruction and increased water temperatures; and
    c. stormwater discharge.
2. fish habitat impacts from:

    a. conflict between land use activities and use of flood plains as productive fish habitat;
    b. dams and impoundments on fish migration, downstream movements of stream bedload, water quality, and possibly increased water temperatures;
    c. loss of natural habitat due to channelization and stream bank hardening (urban encroachment); and
    d. perched culverts on fish movements.
3. fish population/community concerns:
    a. significant reduction in brook trout populations; and
    b. potentially incompatible fish species and/or communities (e.g. Eramosa River).

Finally, the Grand River Fisheries Management Plan identifies management strategies for the mixed water tributaries to the Speed River. From those listed in the management plan, the following strategies are relevant to this project:

1. Communication/Education/Partnerships:
    a. work with owners of dams and impoundments to eliminate or reduce the impacts of these features on downstream fish populations and fish habitat, and
    b. encourage tributary restoration program.
2. Data Collection/Assessment:
    a. assess habitat conditions and recommend candidates for rehabilitation,
    b. assess impacts of online ponds and develop strategies to mitigate such impacts (e.g. Eramosa River),
    c. assess value of ponds/dams to local communities and municipalities (consider removal of barriers if ponds are of little value),
    d. assess the social and economic benefits associated with the fish resource,
3. Habitat Management/Rehabilitation:
    a. rehabilitate fish habitat with the objective of extending the coldwater attributes downstream in each system,
    b. determine rehabilitation needs and prepare rehabilitation plans (instream and riparian zones),
    c. improve water quality, establish stable flows and restore riparian vegetation,
    d. consider modifications to/removal of existing barriers to fish passage,
    e. rehabilitate degraded habitat to restore functional system, and
    f. protect groundwater and riparian zones to maintain water quality/quantity.
4. Fish Population Management:
    a. use of structures (e.g. dams) for partitioning incompatible fish species/communities (e.g., Eramosa River).

IMPACT ASSESSMENT AND MITIGATION MEASURES

For details of the preliminary design provided to NRSI for the assessment of natural environment impacts, please refer to Drawings 5.1 to 5.4 in the main report by TSH.

Direct Impacts

The proposed road widening will cause a direct impact to Clythe Creek in 2 locations (described below). The impacts will result from the proposed additional traffic lanes and associated fill placement to create stable slopes along the south side of York Road.

Clythe Creek Culvert Extension or Replacement

The extension or replacement of the culvert for Clythe Creek (at chainage 13 + 280) may result in a Harmful Alteration, Disruption, or Destruction (HADD) of fish habitat, and will be subject to approval under the federal *Fisheries Act.* . It is possible that operational statements for culvert replacements and extensions prepared by DFO as part of the new risk management framework may allow the work to proceed without a full Authorization assuming that the criteria provided in the operational statement are met. The existing concrete headwall and stormwater pipe outlet adjacent to the south side of the culvert may also need to be modified in conjunction with the culvert replacement. In addition to direct impacts within the wetted area of the creek, attention must be given to fill placement adjacent to the creek as there are steep slopes in the vicinity of the crossing and a significant amount of fill may be required

Clythe Creek Channel Relocation

Mid-way between the Clythe Creek/York Road crossing and the main driveway to the Guelph Correctional Facility, the channel will need to be relocated to accommodate the widening of York Road. The section that would be impacted lies between chainage 13 + 055 and 13 + 135. In order to construct and a new section of channel that is stable and kept well away from the road, the channel realignment will affect at a minimum, approximately 90m of existing channel length. This will result in a HADD of fish habitat that will require mitigation and/or compensation. To compensate for the loss of existing habitat, a new channel that retains the same (or greater) channel length and area of habitat should suffice. It is recommended that the proposed channel realignment extend between the rock weirs located upstream and downstream of the area directly impacted by the York Road widening. This would result in reconstruction of approximately 135m of channel but would remove two barriers to fish movement and connect a larger section of Clythe Creek with the reaches upstream of York Road. Regardless of the specific design requirements, an authorization under the federal *Fisheries Act* will be required.

Indirect Impacts

Erosion and Sedimentation Potential Near Aquatic Habitats

The disturbance to the vegetation on lands immediately adjacent to Clythe Creek will cause indirect impact to the aquatic habitat due to elimination of existing vegetation and potential for sediment entering the water. Potential indirect impact will occur to some extent along the entire distance where Clythe Creek flows parallel to York Road. The impacts will need to be mitigated using erosion and sediment control measures, and the standard mitigation measures and operational constraints outlined in Section 5.4 of this report. It is strongly advised that the sediment and erosion control planning specifically address the areas where there is limited space between the proposed construction and Clythe Creek. Standard mitigation measures may not be sufficient in areas where there is less than 3.0m between the active construction of road slopes and the creek. Stockpiling and other construction practices should also be developed specifically for these pinch points along the York Road corridor.

Disturbance to soils on the north side of York Road also have potential to impact Clythe Creek. The ditch along the north side of York Road, and cross-drainage culverts that convey flow underneath York Road have potential to transport sediment across the road and into the creek. As such, the standard mitigation measures and operational constraints apply to all culvert inlets along York Road east of Victoria Street. A known 600mm diameter culvert crossing is found at chainage 12 + 950. Hadati Creek also flows under York Road from the north side, and must be protected from indirect impact by standard mitigation measures. Any other existing culverts will need to be identified in the detailed design, and standard mitigation measures will apply to them as well.

In some locations, grading will require slopes to be greater than 3:1 to allow a 1.5m or greater separation between fill placement and the top-of-bank of a creek. This separation will provide marginally sufficient space to install of erosion and sediment control fencing. In these locations of steeper slopes and close proximity of fill placement, stabilization techniques such as erosion matting and seeding must occur immediately after grading is finished. This applies at the following locations:

- On the northeast side of the Clythe Creek crossing (at chainage 13 + 290),
- west of the Clythe Creek crossing from chainage 13 + 260 to 13 + 280,
- from chainage 13 + 010 to 13 + 030,
- from chainage 12 + 940 to 12 + 980, and
- from chainage 12 + 880 to 12 +900.

Lastly, the crossing of Hadati Creek does not require replacement of the culvert. However, the widening of York Road and the realignment of Elizabeth Street will involve construction adjacent to Hadati Creek. Standard mitigation measures and operational constraints will apply to these construction activities.

Adjacent Vegetated Lands

The widening of the road will result in a reduction of the amount of vegetated land surface adjacent to Clythe Creek. The existing vegetated land along the north side of the creek includes manicured grass, and trees. The trees provide shade over the creek in some places, and the manicured grass has some limited benefit to the creek. The root mass stabilizes the soil, and the grass dissipates the energy of surface water runoff from the road as it flows overland to the creek. The loss of some of these functions will be considered a minor indirect impact.

The extent of this indirect impact can be described by comparing the distance between Clythe Creek and York Road before and after the widening. West of the outlet of Unnamed Tributary 1 (at chainage 13 + 000), there is currently a range of between 8 to 20m of land between Clythe Creek and the edge of the shoulder of York Road. In this section, the widening will bring the edge of the road at a minimum, approximately 2m closer to the creek, resulting in 6 to 18m of vegetated land. The preliminary design details provided to NRSI when compared to field investigations suggest there will be some sections that will have an even closer proximity to the creek

East of the outlet of Unnamed Tributary 1, there is currently a range of approximately 18 to 28m of land between Clythe Creek and the edge of the shoulder of York Road. In this section, the widening of York Road will bring the edge of the pavement approximately 6m closer to Clythe Creek. This will result in 12 to 22m of vegetated land between the creek and the road. Where Clythe Creek is to be relocated, it is anticipated that the resulting distance to the road will be similar to the rest of this section.

There is an opportunity to mitigate the loss of vegetated land adjacent to Clythe Creek by planting natural vegetation alongside the creek. Naturally vegetated lands adjacent to a watercourse have the following benefits:

- Vegetation provides shade over the watercourse to prevent water temperatures from rising due to solar energy inputs,
- Roots of larger and more varied vegetation improve stability of soils on the banks and adjacent land,
- The vegetation provides inputs of detritus that provides nutrients for aquatic organisms,
- The vegetation is a source of large woody material that provides important aquatic habitat structure,
- Abundant shrubs and trees along the creek deter geese and reduce their impacts to the creek banks,
- Floodplains are more effective for temporary floodwater storage, and
- The natural vegetation filters overland water runoff.

Stormwater Management

Currently, stormwater management details have not been presented in the provided information. Therefore it has been assumed that the increased amount of surface area of the road will increase the amount of stormwater that runs off the road in the direction of Clythe Creek. This will result in greater capacity to convey traffic-related contaminants in the direction of Clythe Creek. This impact should be mitigated on the south side of the road by installing native herbaceous plants, shrubs and trees to create a functional filter or buffer strip between Clythe Creek and York Road. A filter strip will enhance the capacity of the land between Clythe Creek and York Road to filter stormwater runoff. This will also serve as mitigation for the loss of adjacent vegetated land, which reduces the ability of the existing vegetation to filter stormwater runoff. This measure is consistent with management strategies 3a, 3c, 3e, and 3f of the Grand River Fisheries Management Plan (see paraphrased excerpts in this report).

To mitigate the increased stormwater runoff from the north side of the road, it is an option to install oil-grit separators to control the quality of the stormwater.

The number and locations of culverts that convey flow from the north side of York Road to the south side will not change. New culverts will replace the existing pipes, and the outlet locations will only change as a result of the required increased length to accommodate the wider road. As a result, no long-term impact is anticipated from changes in flow paths to the creek. In some cases, the replacement or extension of these culverts will increase the sedimentation potential and require active construction within close proximity to Clythe Creek.

SPECIAL CONSIDERATIONS FOR FISH COMMUNITIES

Populations of rare fish species are considered more sensitive because impacts can affect the viability of a species. The greenside darter, with an S-Rank of S4, and a status of Special Concern, is not expected to become extinct in the near future, and there is hope that it will recover. However, there is concern about the population of this fish species, which calls for diligent application of the mitigation measures and operational constraints recommended in this report. This diligence should be sufficient to ensure that the construction activities do not impact the aquatic habitat in the study area in any way that would be detrimental to a greenside darter population.

The interest by Trout Unlimited Canada in the brook trout potential of Clythe Creek confirms that it has potential to provide a valuable resource. This gives further reason to be diligent in applying the recommended mitigation measures and operational constraints.

Standard Mitigation Measures and Operational Constraints

During construction, standard mitigation measures and operational constraints will apply to protect the aquatic habitats against erosion and sedimentation, and other risks such as fuel and lubricants from equipment. They are as follows:

1. Sediment and erosion control measures should be installed and maintained throughout the construction period. Disturbed soils should be stabilized immediately with suitable plantings/seed/mat.
2. Stockpile and staging areas should be well removed from the watercourse and contained by appropriate sediment and erosion controls.
3. Dewatering of any excavations, pits or chambers must be done in a controlled manner so as not to discharge turbid water to watercourses or other aquatic features. Dewatering operations shall be directed to areas above ground and could include containment areas constructed with silt fence/strawbales and/or filter bag on existing vegetation. Where necessary, other techniques such as defractionation tanks or chemical flocculants shall be used. Suitable containment areas must be identified prior to any work commencing.

4. Where waterflow is to be pumped, screening shall be provided so as to prevent entry or damage fish at the intake, and discharge shall be directed so as to avoid erosion of the watercourse bed and banks at the water outlet. Water flow downstream must be maintained with a minimal amount of turbidity both from pumps and from associated construction activities.
5. For instream works, the area of disturbance within the channel and on the streambanks must be kept to a minimum. Heavy equipment traffic will be restricted to established travel pathways.
6. All timing restrictions, such as fisheries timing windows assigned by the MNR, must be adhered to.
7. Refueling activities should be conducted in an environmentally responsible manner. This includes a keeping the fueling operations 30 m setback from the waters edge, unless otherwise directed by the Environmental Monitor/Contract Administrator. Spill kits and sorbant material should be available on the fuel or service vehicles.
8. Any spills resulting from refueling operations, hydraulic leaks, maintenance etc. must be reported immediately to the Contact Administrator or Environmental Monitor who will then notify the Spills Action Centre if required.
9. Weather conditions should be monitored to adequately prepare the site for rain events.
10. Environmental monitoring must be conducted throughout the construction period. Post-construction monitoring should also be carried out to ensure that plantings become established and soils remain stabilized.

RECOMMENDATIONS

Based on the findings of this report, we make the following recommendations.

1. All mitigation measure provided in this report should be implemented.
2. Standard mitigation measures and operational constraints provided in this report should be employed as applicable throughout the construction period.
3. The section of channel to be realigned should be constructed using Natural Channel Design principles.
4. A *Fisheries Act* authorization will be required for the channel realignment, and possibly the culvert extension/replacement at the crossing of York Road and Clythe Creek.
5. Native herbaceous plants, shrubs and trees should be installed to create a filter strip between Clythe Creek and York Road, and to enhance the aquatic habitat in Clythe Creek. This will serve as mitigation for the loss of adjacent vegetated land and increased volume of stormwater runoff that will result from the road widening.

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Photo 1 – Clythe Creek, example of the many weirs in the study area

Photo 2 – Clythe Creek, Reach 1, looking downstream

Photo 3 – Clythe Creek, Reach 2, looking upstream toward York Road crossing

Photo 4 – Clythe Creek, Reach 3, looking upstream

Photo 5 – Clythe Creek, Reach 4, looking downstream toward Hadati Cr. outlet and ponds

Photo 6 – Clythe Creek, Reach 4, abundant aquatic plants in the online ponds

Photo 7 – Connection between the north pond and Reach 3 of Clythe Creek

Photo 8 – Fisherman at Guelph Correctional Facility Ponds, looking south from Clythe Cr.

Photo 9 – South Pond, looking southwest

Photo 10 – Hadati Creek, Reach 1, looking upstream

October 26, 2006

Mr. Ernst Heinrichs
Totten Sims Hubicki Associates
72 Victoria Street South
Kitchener, Ontario
N2G 4Y9

Dear Mr. Heinrichs:

Re: Tree Management Plan –York Road, City of Guelph.

Natural Resource Solutions Inc. was retained to prepare a tree management plan consistent with the City of Guelph Tree Management Guidelines for the lands adjacent to a length of York Road, Guelph, Ontario. This work was undertaken as part of a Class Environmental Assessment for the proposed widening of a section of York Road. The original study area included both sides of York Road from Skyway Drive in the east to the western limit of York Road just west of Wyndham Street. It included Wyndham Street from York Road to Wellington Road. The initial assessment work was completed for this study area as depicted in the base survey provided by Totten Sims Hubicki Associates (TSH). Since that time, the study area has been reduced and consists of York Road from Victoria Street in the west to Skyway Drive in the east. This report only addresses this smaller study area, however the appended tree table shows all trees.

A Certified Arborist from Natural Resource Solutions Inc. visited the site on June 5, 16 and 19, 2006 to map and describe the trees in the proximity of the proposed undertakings. The following is a description of our findings.

A base survey was used to locate each of the surveyed trees. The attached copy of the plan shows the numbers and locations of the trees that were assessed. For each tree evaluated, species, diameter at breast height (dbh), crown radius and condition were recorded. Notes were also made on significant defects and other features of interest.

A table summarizing this information is appended to this letter. Those trees in the table that do not appear on the preliminary drawings are located on York Road west of Victoria Road and are not impacted by the recommended improvements.

Analysis of Potential Impacts to Trees

The preliminary design provided by TSH on September 13, 2006 was compared to the locations and characteristics of the trees within the study area. Trees were assessed individually using field measurements, a scale and the preliminary drawing. Please refer to Drawings 5.5 to 5.12 in the main report by TSH for the preliminary design.

A total of 204 trees comprising 20 species were evaluated within the smaller study area. No rare tree species were found in this area. The condition of the trees ranged from poor to good; some snags (standing dead trees) were also documented. Common defects in the trees with poor health included trunk wounds, weak forks, dead branches and past evidence of 'topping'. The trunk sizes ranged from less than 10cm dbh to 168cm dbh. The crown radii ranged from 1.5m to 12m.

The preliminary design proposes to widen York Road. This widening will require the removal of the trees within the construction footprint as well as those with significant portions of root zones extending into this construction area. This was assessed by comparing the actual tree crown radii to the proposed grading. Recommendations are provided below to minimize impacts to the trees to be retained.

Summary

The proposed widening of York Road between Skyway Drive and Victoria Street will result in the loss of 44 trees. An additional number of trees (2) were identified for removal due to their potential hazard condition and/or their poor condition. This included trees that will lose significant (> 25%) portions of their root systems. It should be noted however, that all trees have an inherent risk and warrant care and arboricultural management. A number of the trees to be retained along the construction edge may require some arboricultural attention. In a number of locations, limbs and roots were noted to overlap with the proposed road extension. These overlaps are not anticipated to result in significant impact to the retained trees if appropriate tree protection and care is implemented.

Tree protection measures should be installed prior to any clearing or other work. This will include but not be limited to the installation of tree protection and silt fencing along the proposed construction limit, inspection of the proposed fencing location before installation and after / before cutting, and installation of appropriate signage to mark the tree protection zones. As well, limbs and roots that are impacted by construction should be pruned and treated following standard arboricultural practices. Storage of materials and equipment must not occur within the dripline of trees to be retained.

Yours sincerely,
Natural Resource Solutions Inc.

Brett Woodman, M.E.S.
Certified Arborist / Terrestrial Biologist

TREE INVENTORY

Tree Number	Species	*Scientific Name*	dbh (cm)	Crown Radius (m)	Condition	Comments	Retain / Remove	Reason for action taken
1	Norway Maple	*Acer platanoides*	16	8	Good		retain	outside construction footprint
2	Norway Maple	*Acer platanoides*	60	7	Fair	frost cracks present	remove	in construction footprint
3	Norway Maple	*Acer platanoides*	75	7	Fair	forks with included bark	retain	outside construction footprint
4	Austrian Pine	*Pinus nigra*	27	5	Good		retain	outside construction footprint
5	Austrian Pine	*Pinus nigra*	17	4	Good		retain	outside construction footprint
6	Austrian Pine	*Pinus nigra*	26	5	Good		retain	outside construction footprint
7	Maple	*Acer sp.*	18	8	Poor	multi-stemmed clump; crown dieback; frost cracks	retain	outside construction footprint
8	Norway Maple	*Acer platanoides*	30	4	Good		retain	outside construction footprint
9	Austrian Pine	*Pinus nigra*	33	4	Fair	structure poor	retain	outside construction footprint
10	Austrian Pine	*Pinus nigra*	23	3.5	Good		retain	outside construction footprint
11	Scott's Pine	*Pinus sylvestris*	29	3.5	Good		retain	outside construction footprint
12	Norway Maple	*Acer platanoides*	27	4	Fair	some bark damage	retain	outside construction footprint
13	Austrian Pine	*Pinus nigra*	20	3.5	Good		retain	outside construction footprint
14	Austrian Pine	*Pinus nigra*	24	3.5	Good		retain	outside construction footprint
15	Honey Locust	*Gleditsi triacanthos var. inermis*	27	5	Fair	some crown dieback	retain	outside construction footprint
16	Honey Locust	*Gleditsi triacanthos var. inermis*	24	5	Fair	some crown dieback	retain	outside construction footprint
17	Norway Maple	*Acer platanoides*	26	4	Good		retain	outside construction footprint
18	Blue Spruce	*Picea pungens*	27	3	Good		retain	outside construction footprint
19	White Spruce	*Picea glauca*	26	2	Good		retain	outside construction footprint
20	Blue Spruce	*Picea pungens*	27	3	Good		retain	outside construction footprint
21	Blue Spruce	*Picea pungens*	20	3	Good		retain	outside construction footprint
22	Norway Maple	*Acer platanoides*	27	4	Fair	some crown dieback	retain	outside construction footprint
23	Blue Spruce	*Picea pungens*	31	4	Good		retain	outside construction footprint
24	Honey Locust	*Gleditsi triacanthos var. inermis*	30	5.5	Fair		retain	outside construction footprint
25	White Spruce	*Picea glauca*	20	3	Fair	some crown dieback	retain	outside construction footprint
26	Blue Spruce	*Picea pungens*	14	2.5	Good		retain	outside construction footprint
27	European Buckthorn	*Rhamnus cathartica*	10	3	Good		remove	in construction footprint
28	Scott's Pine	*Pinus sylvestris*	21	2.5	Good		retain	outside construction footprint
29	Norway Maple	*Acer platanoides*	31	3.5	Good	2 stems	retain	in construction footprint
30	Sugar Maple	*Acer saccharum*	24	4.5	Fair	epicormic branching	remove	in construction footprint
31	Norway Maple	*Acer platanoides*	45	5.5	Good	forking (< or = 30%)	remove	in construction footprint
32	Silver Maple	*Acer saccharinum*	65	7	Fair	some crown dieback	remove	in construction footprint
33	Norway Maple	*Acer platanoides*	70	7	Good	imbedded wire	remove	in construction footprint
34	Silver Maple	*Acer saccharinum*	80	9	Fair		remove	in construction footprint
35	Silver Maple	*Acer saccharinum*	64	9	Good		remove	in construction footprint
36	Silver Maple	*Acer saccharinum*	80	8	Fair	forking (< or = 30%)	remove	significant root loss
37	Norway Maple	*Acer platanoides*	10	1.5	Good		retain	outside construction footprint
38	Silver Maple	*Acer saccharinum*	64	8	Fair		remove	significant root loss
39	White Cedar	*Thuja occidentalis*	43	1	Fair	topped; significant bark damage;	retain	outside construction footprint
40	Norway Maple	*Acer platanoides*	10	0.5	Fair		retain	outside construction footprint
41	White Cedar	*Thuja occidentalis*	75	4	Good	forking (< or = 30%)	retain	outside construction footprint
42	White Elm	*Ulmus americana*	26	4.5	Good	forking (< or = 30%)	retain	outside construction footprint
43	White Cedar	*Thuja occidentalis*	30	2.5	Poor	crown dieback	retain	outside construction footprint

Tree Number	Species	Scientific Name	dbh (cm)	Crown Radius (m)	Condition	Comments	Retain / Remove	Reason for action taken
44	Norway Maple	*Acer platanoides*	10	1	Fair	significant bark damage	retain	outside construction footprint
45	Little-leaved Linden	*Tilia cordata*	16	2.5	Good		retain	outside construction footprint
46	Little-leaved Linden	*Tilia cordata*	15	2	Good		retain	outside construction footprint
47	White Spruce	*Picea glauca*	19	2	Good		retain	outside construction footprint
48	White Spruce	*Picea glauca*	19	2	Good		retain	outside construction footprint
49	Honey Locust	*Gleditsi triacanthos var. inermis*	15	4.5	Fair		retain	outside construction footprint
50	Austrian Pine	*Pinus nigra*	20	2.5	Good		retain	outside construction footprint
51	Austrian Pine	*Pinus nigra*	21	2.5	Good		retain	outside construction footprint
52	Austrian Pine	*Pinus nigra*	19	2	Fair		retain	outside construction footprint
53	White Spruce	*Picea glauca*	17	2	Good		retain	outside construction footprint
54	Blue Spruce	*Picea pungens*	17	1.5	Good		retain	outside construction footprint
55	Norway Maple	*Acer platanoides*	17	3	Good		retain	outside construction footprint
56	White Spruce	*Picea glauca*	17	1	Good		retain	outside construction footprint
57	Blue Spruce	*Picea pungens*	16	1.5	Good		retain	outside construction footprint
58	Silver Maple	*Acer saccharinum*	59	7	Poor	crown dieback	remove	in construction footprint
59	Silver Maple	*Acer saccharinum*	67	8	Fair-Poor	cavities	remove	in construction footprint
60	Silver Maple	*Acer saccharinum*	64	7	Poor	crown dieback	remove	in construction footprint
61	Silver Maple	*Acer saccharinum*	64	8	Fair		remove	in construction footprint
62	Silver Maple	*Acer saccharinum*	62	8	Fair	some crown dieback	remove	significant root loss
63	Norway Maple	*Acer platanoides*	65	7	Fair	forking (< or = 30%); 15" leaner	remove	significant root loss
64	White Elm	*Ulmus americana*	15	3	Good	forking (< or = 30%)	retain	outside construction footprint
65	White Cedar	*Thuja occidentalis*	41	3	Good		retain	outside construction footprint
66	White Elm	*Ulmus americana*	36	7	Good	forking (< or = 30%)	remove	fill and grading in root zone
67	White Spruce	*Picea glauca*	42	3	Good		retain	outside construction footprint
68	Norway Maple	*Acer platanoides*	13	2.5	Good	2 stems	retain	outside construction footprint
69	White Cedar	*Thuja occidentalis*	15	15	Good	multi-stemmed clump	retain	outside construction footprint
70	White Elm	*Ulmus americana*			Snag		remove	existing hazard
71	Silver Maple	*Acer saccharinum*	22	4	Good	forking (< or =30%)	retain	outside construction footprint
72	Silver Maple	*Acer saccharinum*	23	4	Fair	significant bark damage	retain	outside construction footprint
73	European Buckthorn	*Rhamnus cathartica*	19	7	Good	forking (< or = 30%)	retain	outside construction footprint
74	White Cedar	*Thuja occidentalis*	36	5.5	Good	forking (< or = 30%)	retain	outside construction footprint
75	White Elm	*Ulmus americana*	21	3	Fair	major crook in trunk stem	retain	outside construction footprint
76	Blue Spruce	*Picea pungens*	31	3	Good		retain	outside construction footprint
77	White Elm	*Ulmus americana*	18	6	Good	multi-stemmed clump	retain	outside construction footprint
78	White Elm	*Ulmus americana*	18	5	Fair-Poor	multi-stemmed clump; primary fungal disease presen	retain	outside construction footprint
79	White Elm	*Ulmus americana*	44	9	Good		remove	significant root loss
80	Apple	*Malus sp*	30	5.5	Fair		retain	outside construction footprint
81	European Buckthorn	*Rhamnus cathartica*	11	3.5	Fair	poor structure	retain	outside construction footprint
82	White Cedar	*Thuja occidentalis*	13	1	Good		retain	outside construction footprint
83	White Cedar	*Thuja occidentalis*	17	2	Fair	under hydro-pruned	retain	outside construction footprint
84	White Cedar	*Thuja occidentalis*	16	2	Fair	under hydro-pruned	retain	outside construction footprint
85	White Cedar	*Thuja occidentalis*	15	1.5	Fair	under hydro-pruned	retain	outside construction footprint
86	White Cedar	*Thuja occidentalis*	12	1.5	Fair	under hydro-pruned	retain	outside construction footprint
87	White Cedar	*Thuja occidentalis*	19	2	Fair	by hydro - pruned	retain	outside construction footprint
88	White Cedar	*Thuja occidentalis*	12	1.5	Fair	by hydro - pruned	retain	outside construction footprint

Tree Number	Species	Scientific Name	dbh (cm)	Crown Radius (m)	Condition	Comments	Retain / Remove	Reason for action taken
89	White Cedar	*Thuja occidentalis*	24	2.5	Fair	by hydro - pruned	retain	outside construction footprint
90	White Cedar	*Thuja occidentalis*	16	3	Fair	2 stems; by hydro	retain	outside construction footprint
91	White Cedar	*Thuja occidentalis*	13/10	1	Good	2 stems	retain	outside construction footprint
92	White Cedar	*Thuja occidentalis*	22	1	Fair	2 stems; topped by hydro	retain	outside construction footprint
93	White Cedar	*Thuja occidentalis*	11	1	Fair	in hydro lines	retain	outside construction footprint
94	White Cedar	*Thuja occidentalis*	49	3	Good		retain	outside construction footprint
95	White Cedar	*Thuja occidentalis*	24	2	Good		retain	outside construction footprint
96	White Cedar	*Thuja occidentalis*	41	2.5	Poor	significant bark damage	retain	outside construction footprint
97	White Elm	*Ulmus americana*	22	3	Good	forking (< or = 30%)	retain	outside construction footprint
98	White Elm	*Ulmus americana*	14	3.5	Good	forking (< or = 30%)	retain	outside construction footprint
99	White Elm	*Ulmus americana*	10	1.5	Good	forking (< or = 30%)	retain	outside construction footprint
100	White Elm	*Ulmus americana*	11	1.5	Good	directly under hydro	retain	outside construction footprint
101	White Elm	*Ulmus americana*	28	1.5	Good		retain	outside construction footprint
102	White Elm	*Ulmus americana*	18	2	Good		retain	outside construction footprint
103	White Cedar	*Thuja occidentalis*	35	3.5	Poor	multi-stemmed clump; significant bark damage	retain	outside construction footprint
104	White Elm	*Ulmus americana*	12	1.5	Good		retain	outside construction footprint
105	White Elm	*Ulmus americana*	13	1.5	Good		retain	outside construction footprint
106	White Elm	*Ulmus americana*	19	1.5	Good		retain	outside construction footprint
107	White Elm	*Ulmus americana*	12	1	Good		retain	outside construction footprint
108	White Elm	*Ulmus americana*	12	1	Good		retain	outside construction footprint
109	White Elm	*Ulmus americana*	25	2	Good		retain	outside construction footprint
110	White Elm	*Ulmus americana*	16	1.5	Good	2 stems	retain	outside construction footprint
111	Pear	*Pyrus communis*	41	4	Good		retain	outside construction footprint
112	White Cedar	*Thuja occidentalis*	27	2.5	Fair	multi-stemmed clump; 1 stem top broken	retain	outside construction footprint
113	White Cedar	*Thuja occidentalis*	35	2.5	Poor	2 stems= snag @ 2.5m	retain	outside construction footprint
114	Blue Spruce	*Picea pungens*	24	1.5	Good		retain	outside construction footprint
115	Blue Spruce	*Picea pungens*	19	1.5	Good		retain	outside construction footprint
116	White Cedar	*Thuja occidentalis*	45	2	Poor	originally 4 stems now 1 remaining; bark damage	retain	outside construction footprint
117	Norway Spruce	*Picea abies*	45	3	Good		retain	outside construction footprint
118	European Buckthorn	*Rhamnus cathartica*	11	2.5	Good	multi-stemmed clump	retain	outside construction footprint
119	Norway Spruce	*Picea abies*	55	3.5	Good		retain	outside construction footprint
120	Norway Spruce	*Picea abies*	44	3	Good		retain	outside construction footprint
121	White Cedar	*Thuja occidentalis*	10	1	Good		retain	outside construction footprint
122	Norway Spruce	*Picea abies*	45	3.5	Good		retain	outside construction footprint
123	Norway Spruce	*Picea abies*	21	2	Good		retain	outside construction footprint
124	Norway Spruce	*Picea abies*	39	3	Good		retain	outside construction footprint
125	European Buckthorn	*Rhamnus cathartica*	15	3.5	Poor		remove	outside construction footprint
126	Norway Spruce	*Picea abies*	33	3	Good		retain	outside construction footprint
127	Manitoba Maple	*Acer negundo*	29	4.5	Poor		remove	outside construction footprint
128	Norway Spruce	*Picea abies*	39	4	Good		retain	outside construction footprint
129	Norway Spruce	*Picea abies*	28	3.5	Good		retain	outside construction footprint
130	White Elm	*Ulmus americana*	27	4	Fair	forking (< or = 30%)	retain	outside construction footprint
131	Norway Spruce	*Picea abies*	20	3.5	Good		retain	outside construction footprint
132	Norway Spruce	*Picea abies*	30	3.5	Good		retain	outside construction footprint
133	White Elm	*Ulmus americana*	11	2	Good		retain	outside construction footprint

Tree Number	Species	Scientific Name	dbh (cm)	Crown Radius (m)	Condition	Comments	Retain / Remove	Reason for action taken
134	White Elm	*Ulmus americana*	54	3	Fair	forking (< or = 30%); canopy sparce	retain	outside construction footprint
135	Serviceberry	*Amelanchier*	19	1.5	Good		retain	outside construction footprint
136	Red Oak	*Quercus rubra*	20	4.5	Good		retain	outside construction footprint
137	Red Oak	*Quercus rubra*	17	4	Good	forking (< or = 30%)	retain	outside construction footprint
138	Red Oak	*Quercus rubra*	21	5	Fair	evidence of past biological infestation	retain	outside construction footprint
139	Red Oak	*Quercus rubra*	25	8	Good		retain	outside construction footprint
140	Red Oak	*Quercus rubra*	20	4	Good		retain	outside construction footprint
141	Red Oak	*Quercus rubra*	12	2	Good		retain	outside construction footprint
142	Siberian Elm	*Ulmus pumila*	20	3	Good	2 stems		
143	Siberian Elm	*Ulmus pumila*	12	2	Good			
144	Little-leaved Linden	*Tilia cordata*	37	5	Good	multi-stemmed clump		
145	Sugar Maple	*Acer saccharum*	59	6	Fair	imbedded wire		
146	Sugar Maple	*Acer saccharum*	65	9	Fair	cavities		
147	Norway Maple	*Acer platanoides*	37	4.5	Fair	directly under hydro;V-pruned		
148	Siberian Elm	*Ulmus pumila*	65	7.5	Poor			
149	Sugar Maple	*Acer saccharum*	55	4.5	Poor			
150	Norway Maple	*Acer platanoides*	28	3	Poor	poor structure; V-pruned		
151	Norway Maple	*Acer platanoides*	27	2	Poor	under hydro		
152	Norway Maple	*Acer platanoides*	14	1	Good			
153	Norway Maple	*Acer platanoides*	30	4	Good			
154	Norway Maple	*Acer platanoides*	62	5.5	Good			
155	Norway Maple	*Acer platanoides*	68	5	Fair	structure fair		
156	Silver Maple	*Acer saccharinum*	64	8	Fair	forking (< or = 30%); some canopy dieback		
157	White Elm	*Ulmus americana*	51	7	Fair-Poor	some canopy dieback		
158	Crab Apple	*Malus baccata*	25	4	Good			
159	Black Locust	*Robinia pseudoacacia*	24	3	Good			
160	Norway Maple	*Acer platanoides*	62	5	Fair	fair structure		
161	Crab Apple	*Malus baccata*	27	3	Good			
162	Norway Maple	*Acer platanoides*	44	5	Good			
163	Magnolia	*Magnoliaceae*	12	3.5	Good			
164	Silver Maple	*Acer saccharinum*	54	7	Fair-Good			
165	Honey Locust	*Gleditsi triacanthos var. inermis*	34	5	Good			
166	Red Ash	*Fraxinus pennsylvanica*	39	5	Good			
167	Honey Locust	*Gleditsi triacanthos var. inermis*	28	5	Good			
168	Honey Locust	*Gleditsi triacanthos var. inermis*	27	5	Fair	forking (< or = 30%); some canopy dieback		
169	White Cedar	*Thuja occidentalis*	15	1	Good	2 stems		
170	Siberian Elm	*Ulmus pumila*	15	3.5	Good	multi-stemmed clump		
171	Red Cedar	*Juniperus virginiana*	15	1	Good			
172	Honey Locust	*Gleditsi triacanthos var. inermis*	60	8	Poor	significant bark damage; cavities		
173	Sugar Maple	*Acer saccharum*	14	2.5	Fair	sparse canopy		
174	Japanese Horsechest	*Aescalus sp*	55	4	Fair	some dieback		
175	Norway Spruce	*Picea abies*	34	4	Poor	90% dead		
176	Silver Maple	*Acer saccharinum*	60	9	Fair			
177	Honey Locust	*Gleditsi triacanthos var. inermis*	35	5	Fair	sparse canopy		
178	Silver Maple	*Acer saccharinum*	107	9	Poor	crown dieback		

Tree Number	Species	Scientific Name	dbh (cm)	Crown Radius (m)	Condition	Comments	Retain / Remove	Reason for action taken
179	Silver Maple	*Acer saccharinum*	34	6.5	Poor	crown dieback		
180	Silver Maple	*Acer saccharinum*	62	8	Good			
181	Silver Maple	*Acer saccharinum*	40	7	Good			
182	Silver Maple	*Acer saccharinum*	140	10	Fair	some canopy dieback		
183	Blue Spruce	*Picea pungens*	26	1	Fair	topped		
184	Silver Maple	*Acer saccharinum*	59	6	Good			
185	Silver Maple	*Acer saccharinum*	108	10	Good			
186	Norway Maple	*Acer platanoides*	21	4	Good			
187	White Elm	*Ulmus americana*	38	5	Fair			
188	White Elm	*Ulmus americana*	27	4	Poor			
189	White Cedar	*Thuja occidentalis*	15	1	Good			
190	Silver Maple	*Acer saccharinum*	80	8	Poor	crown dieback		
191	Crab Apple	*Malus baccata*	24	6	Good	3 stems		
192	Honey Locust	*Gleditsi triacanthos var. inermis*	28	5	Good			
193	Silver Maple	*Acer saccharinum*	61	8	Good			
194	Silver Maple	*Acer saccharinum*	89	8	Good			
195	Sugar Maple	*Acer saccharum*	66	6.5	Good			
196	Silver Maple	*Acer saccharinum*	88	8	Good			
197	White Birch	*Betula papyrifera*	20	3	Good	3 stems		
198	White Spruce	*Picea glauca*	22	2.5	Good			
199	Silver Maple	*Acer saccharinum*	119	10	Good			
200	Norway Maple	*Acer platanoides*	31	4	Good			
201	Norway Maple	*Acer platanoides*	37	5	Good			
202	Silver Maple	*Acer saccharinum*	101	9	Good			
203	Norway Maple	*Acer platanoides*	70	9	Good			
204	Norway Maple	*Acer platanoides*	64	8	Good			
205	Norway Maple	*Acer platanoides*	40	7	Fair	15 degree leaner		
206	Silver Maple	*Acer saccharinum*	59	8	Good			
207	Norway Maple	*Acer platanoides*	26	7	Good			
208	Silver Maple	*Acer saccharinum*	67	7	Fair	some canopy dieback		
209	Norway Maple	*Acer platanoides*	39	6	Good			
210	Silver Maple	*Acer saccharinum*	93	9.5	Good			
211	Silver Maple	*Acer saccharinum*	69	8	Good			
212	Norway Maple	*Acer platanoides*	33	5	Good			
213	Norway Maple	*Acer platanoides*	39	6	Good			
214	Cottonwood	*Populus sp*	28	4.5	Poor	60% dead		
215	Cottonwood	*Populus sp*	39	7	Fair	2-stem; leaner; some crown dieback		
216	Cottonwood	*Populus sp*	94	7	Fair			
217	Silver Maple	*Acer saccharinum*	109	7	Fair-Poor	crown dieback		
218	Silver Maple	*Acer saccharinum*	104	11	Good			
219	Silver Maple	*Acer saccharinum*	103	10	Good			
220	Silver Maple	*Acer saccharinum*	61	9	Good			
221	Silver Maple	*Acer saccharinum*	63	6.5	Good			
222	Silver Maple	*Acer saccharinum*	60	7.5	Good			
223	Silver Maple	*Acer saccharinum*	64	8	Good			

Tree Number	Species	Scientific Name	dbh (cm)	Crown Radius (m)	Condition	Comments	Retain / Remove	Reason for action taken
224	Silver Maple	*Acer saccharinum*	87	8	Good			
225	Silver Maple	*Acer saccharinum*	91	10	Good			
226	Silver Maple	*Acer saccharinum*	99	8	Good			
227	Silver Maple	*Acer saccharinum*	94	7	Good			
228	Silver Maple	*Acer saccharinum*	130	9.5	Fair			
229	Silver Maple	*Acer saccharinum*	102	9.5	Good			
230	Silver Maple	*Acer saccharinum*	96	7	Good			
231	Silver Maple	*Acer saccharinum*	100	7	Good			
232	Silver Maple	*Acer saccharinum*	87	6	Good			
233	Silver Maple	*Acer saccharinum*	88	9	Fair			
234	Silver Maple	*Acer saccharinum*	73	9	Good			
235	Silver Maple	*Acer saccharinum*	79	8.5	Good			
236	Silver Maple	*Acer saccharinum*	84	8	Poor	crown dieback		
237	Silver Maple	*Acer saccharinum*	50	5.5	Good			
238	Silver Maple	*Acer saccharinum*	57	7	Good			
239	Silver Maple	*Acer saccharinum*	66	6.5	Good			
240	Norway Maple	*Acer platanoides*	39.5	3	Good			
241	Silver Maple	*Acer saccharinum*	23	2.5	Poor			
242	Silver Maple	*Acer saccharinum*	24	3	Fair	some crown dieback		
243	Silver Maple	*Acer saccharinum*	42	4.5	Good			
244	Silver Maple	*Acer saccharinum*	58	7	Good			
245	Norway Maple	*Acer platanoides*	67	7	Poor	hydro- Pruned-V		
246	Norway Maple	*Acer platanoides*	60	7	Poor	hydro- Pruned-V		
247	Norway Maple	*Acer platanoides*	24	4.5	Poor	crown damaged		
248	Honey Locust	*Gleditsi triacanthos var. inermis*	27	3.5	Good			
249	Honey Locust	*Gleditsi triacanthos var. inermis*	24	2.5	Good			
250	Honey Locust	*Gleditsi triacanthos var. inermis*	19.5	2.5	Good			
251	Honey Locust	*Gleditsi triacanthos var. inermis*	22.5	3.5	Good			
252	Honey Locust	*Gleditsi triacanthos var. inermis*	21	2	Good			
253	Crab Apple	*Malus baccata*	16.5	2.5	Good			
254	Crab Apple	*Malus baccata*	15	1	Good			
255	Honey Locust	*Gleditsi triacanthos var. inermis*	29	4	Good			
256	Honey Locust	*Gleditsi triacanthos var. inermis*	34	4.5	Good			
257	Crab Apple	*Malus baccata*	21	4	Good			
258	Honey Locust	*Gleditsi triacanthos var. inermis*	30	7	Good			
259	Honey Locust	*Gleditsi triacanthos var. inermis*	31	6	Good			
260	Crab Apple	*Malus baccata*	20.5	2.5	Good			
261	Norway Maple	*Acer platanoides*	34	5.5	Good			
262	Silver Maple	*Acer saccharinum*	16.5	2.5	Poor	crown dieback		
263	Blue Spruce	*Picea pungens*	24	1.5	Good			
264	Red Ash	*Fraxinus pennsylvanica*	19	3.5	Good			
265	Red Ash	*Fraxinus pennsylvanica*	36	5.2	Fair			
266	Honey Locust	*Gleditsi triacanthos var. inermis*	26	4.5	Good			
267	Blue Spruce	*Picea pungens*	22	1.5	Good			
268	Manitoba Maple	*Acer negundo*	37.5	6.5	Good			

Tree Number	Species	Scientific Name	dbh (cm)	Crown Radius (m)	Condition	Comments	Retain / Remove	Reason for action taken
269	Crab Apple	*Malus baccata*	25	3	Good			
270	Red Ash	*Fraxinus pennsylvanica*	26	6.5	Good			
271	Ornamental Cherry	*Prunus sp.*	12	1.5	Good			
272	Norway Maple	*Acer platanoides*	22	3	Good			
273	Silver Maple	*Acer saccharinum*	54	10	Poor	frost crack		
274	Crab Apple	*Malus baccata*	34.5	3.5	Good			
275	Crab Apple	*Malus baccata*	22.5	4.5	Good			
276	Honey Locust	*Gleditsi triacanthos var. inermis*	39.5	6.5	Good			
277	Honey Locust	*Gleditsi triacanthos var. inermis*	47	6.5	Good			
278	Norway Maple	*Acer platanoides*	23	7.5	Fair			
279	Norway Maple	*Acer platanoides*	52	7	Good			
280	Little-leaved Linden	*Tilia cordata*	57	8.5	Good			
281	Little-leaved Linden	*Tilia cordata*	79	5	Good			
282	Norway Maple	*Acer platanoides*	25	3	Good			
283	Norway Maple	*Acer platanoides*	56	6.5	Good			
284	Norway Maple	*Acer platanoides*	43	8	Good			
285	Crab Apple	*Malus baccata*	13	2	Good			
286	Norway Maple	*Acer platanoides*	12	0.5	Good			
287	Norway Maple	*Acer platanoides*	58.5	9	Good			
288	Norway Maple	*Acer platanoides*	34	7.5	Good			
289	Norway Maple	*Acer platanoides*	29	3	Good			
290	White Spruce	*Picea glauca*	27	2	Good			
291	Silver Maple	*Acer saccharinum*	66	8	Good			
292	Silver Maple	*Acer saccharinum*	63	9	Good			
293	Silver Maple	*Acer saccharinum*	54	10.5	Poor	broken crown (mechanical)		
294	Norway Maple	*Acer platanoides*	36	7	Fair			
295	Siberian Elm	*Ulmus pumila*	18	2	Fair	multi-stemmed clump		
296	Siberian Elm	*Ulmus pumila*	41	6.5	Fair	2 stems		
297	Norway Maple	*Acer platanoides*	30	5	Fair			
298	Norway Maple	*Acer platanoides*	33	6	Good			
299	Norway Maple	*Acer platanoides*	11.5	4	Good			
300	Siberian Elm	*Ulmus pumila*	13	1.5	Good	multi-stemmed clump		
301	Siberian Elm	*Ulmus pumila*	19.5	3.5	Good	multi-stemmed clump		
302	Siberian Elm	*Ulmus pumila*	22	3.5	Good	multi-stemmed clump	retain	outside construction footprint
303	Siberian Elm	*Ulmus pumila*	18.5	3.5	Good	multi-stemmed clump	retain	outside construction footprint
304	Siberian Elm	*Ulmus pumila*	21	3.5	Good		remove	in construction footprint
305	Siberian Elm	*Ulmus pumila*	13.5	2.5	Good		remove	in construction footprint
306	Norway Maple	*Acer platanoides*	25.5	4	Good		retain	outside construction footprint
307	Norway Maple	*Acer platanoides*	25.5	4	Good		retain	outside construction footprint
308	Norway Maple	*Acer platanoides*	24.5	4	Good		retain	outside construction footprint
309	Norway Maple	*Acer platanoides*	31	5	Good		retain	outside construction footprint
310	White Cedar	*Thuja occidentalis*	24.5	2.5	Good	multi-stemmed clump	retain	outside construction footprint
311	White Cedar	*Thuja occidentalis*	24.5	3	Good	multi-stemmed clump	retain	outside construction footprint
312	White Cedar	*Thuja occidentalis*	15.5	2	Good	multi-stemmed clump	retain	outside construction footprint
313	White Cedar	*Thuja occidentalis*	16	1.5	Poor	multi-stemmed clump; crown dieback; frost cracks	retain	outside construction footprint

Tree Number	Species	Scientific Name	dbh (cm)	Crown Radius (m)	Condition	Comments	Retain / Remove	Reason for action taken
314	White Cedar	*Thuja occidentalis*	12.5	0.5	Poor	clump; crown dieback	retain	outside construction footprint
315	White Cedar	*Thuja occidentalis*	28	3	Good	multi-stemmed clump	retain	outside construction footprint
316	White Cedar	*Thuja occidentalis*	28	4	Good	multi-stemmed clump	retain	outside construction footprint
317	European Buckthorn	*Rhamnus cathartica*	21	4	Good		retain	outside construction footprint
318	White Cedar	*Thuja occidentalis*	24	2	Poor		retain	outside construction footprint
319	Norway Maple	*Acer platanoides*	32	4.5	Good		remove	in construction footprint
320	Silver Maple	*Acer saccharinum*	26	6	Fair	sparse canopy	retain	outside construction footprint
321	Silver Maple	*Acer saccharinum*	14.5	3.5	Fair	sparse canopy	retain	outside construction footprint
322	Norway Maple	*Acer platanoides*	32	8	Poor		retain	outside construction footprint
323	Norway Maple	*Acer platanoides*	29	5	Fair		retain	outside construction footprint
324	Norway Maple	*Acer platanoides*	29	4.5	Poor		retain	outside construction footprint
325	Norway Maple	*Acer platanoides*	32	5	Good		retain	outside construction footprint
326	Blue Spruce	*Picea pungens*	28	3	Good		retain	outside construction footprint
327	Blue Spruce	*Picea pungens*	26	2	Fair		retain	outside construction footprint
328	Silver Maple	*Acer saccharinum*	61	11	Fair	some dieback	retain	outside construction footprint
329	Silver Maple	*Acer saccharinum*	10	3	fair		retain	outside construction footprint
330	Silver Maple	*Acer saccharinum*	14.5	3.5	Fair		retain	outside construction footprint
331	Norway Maple	*Acer platanoides*	19	4	Poor		remove	in construction footprint
332	White Elm	*Ulmus americana*	81	13	Poor	clump; crown dieback (90% dead)	remove	significant root loss
333	Norway Maple	*Acer platanoides*	26.5	5	Good		remove	in construction footprint
334	Silver Maple	*Acer saccharinum*	2	4	Good		retain	outside construction footprint
335	Silver Maple	*Acer saccharinum*	22.5	6	Good		retain	outside construction footprint
336	Silver Maple	*Acer saccharinum*	26	5	Good		retain	outside construction footprint
337	Norway Maple	*Acer platanoides*	16.5	5	Poor	significant bark damage	remove	in construction footprint
338	Norway Maple	*Acer platanoides*	20.5	5	Poor	crown dieback;significant bark damage	remove	in construction footprint
339	Norway Maple	*Acer platanoides*	31	5	Good		remove	in construction footprint
340	Norway Maple	*Acer platanoides*	23	4	Fair		remove	in construction footprint
341	Norway Maple	*Acer platanoides*	33	5	Good		remove	in construction footprint
342	Norway Maple	*Acer platanoides*	34	6.5	Good		remove	in construction footprint
343	White Cedar	*Thuja occidentalis*	24.5	1.5	Poor		remove	significant root loss
344	White Cedar	*Thuja occidentalis*	32	2.5	Poor		remove	significant root loss
345	Silver Maple	*Acer saccharinum*	99	12	Fair	some crown dieback	remove	significant root loss
346	White Cedar	*Thuja occidentalis*	24.5	2.5	Fair		retain	outside construction footprint
347	Silver Maple	*Acer saccharinum*	12	3	Good		retain	outside construction footprint
348	White Cedar	*Thuja occidentalis*	28	3	Poor		retain	outside construction footprint
349	White Cedar	*Thuja occidentalis*	32	3	Poor		retain	outside construction footprint
350	Red Pine	*Pinus resinosa*	74	9	Fair		remove	in construction footprint
351	White Cedar	*Thuja occidentalis*	10	1	Good	multi-stemmed clump	remove	fill and grading in root zone
352	Red Pine	*Pinus resinosa*	60.5	10	Fair		remove	fill and grading in root zone
353	White Spruce	*Picea glauca*	38	3	Fair	some crown dieback	remove	fill and grading in root zone
354	White Cedar	*Thuja occidentalis*	28	2.5	Fair		remove	in construction footprint
355	White Cedar	*Thuja occidentalis*	48	4	Good		remove	fill and grading in root zone
356	White Cedar	*Thuja occidentalis*	17	1	Good	multi-stemmed clump	remove	in construction footprint
357	White Elm	*Ulmus americana*	13	3	Good	multi-stemmed clump	retain	outside construction footprint
358	White Elm	*Ulmus americana*	12	1.5	Poor		retain	outside construction footprint

Tree Number	Species	*Scientific Name*	dbh (cm)	Crown Radius (m)	Condition	Comments	Retain / Remove	Reason for action taken
359	White Elm	*Ulmus americana*	11	2	Good		remove	fill and grading in root zone
360	White Elm	*Ulmus americana*	11.5	4	Fair	multi-stemmed clump	retain	outside construction footprint
361	Crack Willow	*Salix fragilis*	168	10	Poor	crown dieback	remove	fill and grading in root zone
362	Silver Maple	*Acer saccharinum*	59	8	Good		retain	outside construction footprint
363	Blue Spruce	*Picea pungens*	4	3	Good		remove	fill and grading in root zone
364	White Elm	*Ulmus americana*	14	2.5	Good		retain	outside construction footprint
365	Silver Maple	*Acer saccharinum*	67	10	Fair	some crown dieback	retain	outside construction footprint
366	White Elm	*Ulmus americana*	145	5	Good			
367	Manitoba Maple	*Acer negundo*	18	4	Good			
368	Manitoba Maple	*Acer negundo*	19	4	Good			
369	Manitoba Maple	*Acer negundo*	40	4	Good			
370	Manitoba Maple	*Acer negundo*	18.5	3	Good			
371	Manitoba Maple	*Acer negundo*	42	6	Good			
372	Manitoba Maple	*Acer negundo*	48	7	Good			
373	Crab Apple	*Malus baccata*	37	3.5	Poor	crown dieback		
374	Blue Spruce	*Picea pungens*	35.5	3	Good			
375	Blue Spruce	*Picea pungens*	36	3	Good			
376	White Spruce	*Picea glauca*	46	5	Good			
377	Manitoba Maple	*Acer negundo*	23	5	Good	multi-stemmed clump		
378	Manitoba Maple	*Acer negundo*	37	5	Good			
379	Manitoba Maple	*Acer negundo*	40	5	Good			
380	Manitoba Maple	*Acer negundo*	46	5	Good			
381	Red Ash	*Fraxinus pennsylvanica*	10.5	1	Good			
382	Red Ash	*Fraxinus pennsylvanica*	18	3	Good			
383	Bur Oak	*Quercus macrocarpa*	11	2	Good			
384	Honey Locust	*Gleditsi triacanthos var. inermis*	36	7	Good			
385	Norway Maple	*Acer platanoides*	38.5	4	Good			
386	Norway Maple	*Acer platanoides*	21.5	4	Good			

From: Arun.Hindupur@guelph.ca
Sent: December-01-15 10:33 AM
To: Senior, Matt; Chipps, Steve
Subject: FW: York Road Environmental Design Study
Attachments: Clythe Creek.jpg

From: McKenna, Tara (MNRF) [mailto:Tara.McKenna@ontario.ca]
Sent: December 1, 2015 10:22 AM
To: Arun Hindupur
Cc: Thompson, Melinda (MNRF); Timmerman, Art (MNRF)
Subject: RE: York Road Environmental Design Study

Hi Arun,

The previous figure provided by Art Timmerman was his interpretation of where the weirs appear to be from the aerial imagery. We do not have a shape file associated with that information.

I have attached an additional figure with this email, and the green dots represent locations where fish and/or fish habitat information has been collected in the past. The consultant or yourself can make arrangements with Art (copied on this email) to look at the data in more detail in our office at 1 Stone Road West in Guelph.

Art informed me that the Speed River chapter of Trout Unlimited Canada has also collected a lot of data from the area recently and we recommend that you consult with them to request that information.

Kind regards,

Tara

Tara McKenna, M.Pl.
District Planner
Ministry of Natural Resources and Forestry, Guelph District
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Guelph ON, N1G 4Y2
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email: tara.mckenna@ontario.ca

From: Arun.Hindupur@guelph.ca [mailto:Arun.Hindupur@guelph.ca]
Sent: November-30-15 12:57 PM
To: Thompson, Melinda (MNRF); McKenna, Tara (MNRF)
Cc: steve.chipps@amecfw.com; matt.senior@amecfw.com
Subject: RE: York Road Environmental Design Study

Hi Melinda,

Thanks for the information you had previously sent. In discussions with the GRCA, it appears they have a copy of a 2001 Inspection report from Guelph MNRF on various reaches of the Clythe Creek. Would you happen to provide us with a copy of that report as well?

Also, the attached figure which was previously sent by MNRF appears to show weirs/fish barriers. Would you be able to provide this information in shapefile format?

Thanks,
Arun

From: Thompson, Melinda (MNRF) [mailto:Melinda.Thompson@ontario.ca]
Sent: November 25, 2015 1:51 PM
To: Arun Hindupur; McKenna, Tara (MNRF)
Cc: steve.chipps@amecfw.com; matt.senior@amecfw.com
Subject: RE: York Road Environmental Design Study

Please see the attached.

Melinda

MELINDA J. THOMPSON ❀ ❀ ❀ ❀ ❀

MANAGEMENT BIOLOGIST | ONTARIO MINISTRY of NATURAL RESOURCES and FORESTRY | GUELPH DISTRICT OFFICE
1 Stone Road West, Guelph, Ontario, N1G 4Y2 | ☎ 519.826.6543 | melinda.thompson@ontario.ca

Learn more about Ontario's Species at Risk

From: Arun.Hindupur@guelph.ca [mailto:Arun.Hindupur@guelph.ca]
Sent: November 25, 2015 1:49 PM
To: McKenna, Tara (MNRF)
Cc: Thompson, Melinda (MNRF); steve.chipps@amecfw.com; matt.senior@amecfw.com
Subject: RE: York Road Environmental Design Study

Thanks Tara. That would be great.

From: McKenna, Tara (MNRF) [mailto:Tara.McKenna@ontario.ca]
Sent: November 25, 2015 1:17 PM
To: Arun Hindupur
Cc: Thompson, Melinda (MNRF)
Subject: RE: York Road Environmental Design Study

Hi Arun,

MNRF staff received a similar information request for this project from Dougan and Associates, and a response was provided to them this morning. If you would like, we can send you a copy of the letter.

Regards,

Tara

Tara McKenna, M.Pl.
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From: Arun.Hindupur@guelph.ca [mailto:Arun.Hindupur@guelph.ca]
Sent: November-25-15 9:30 AM
To: McKenna, Tara (MNRF)
Cc: steve.chipps@amecfw.com; matt.senior@amecfw.com
Subject: RE: York Road Environmental Design Study

Hi Tara,

In addition to the jpg file you provided, would you happen to have any more information which may be relevant to this study area? Was something along the lines of ecological mapping for the area or perhaps field monitoring, including temperature data collection or electrofishing?

Thanks,
Arun

From: Arun Hindupur
Sent: November 10, 2015 8:49 AM
To: 'McKenna, Tara (MNRF)'
Cc: Chipps, Steve (steve.chipps@amecfw.com); Senior, Matt (matt.senior@amecfw.com)
Subject: RE: York Road Environmental Design Study

Hi Tara,

Thanks for your comments. The project team will take them into consideration and be in touch if there are any additional questions.

Regards,
Arun

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From: McKenna, Tara (MNRF) [mailto:Tara.McKenna@ontario.ca]
Sent: November 9, 2015 4:13 PM
To: Arun Hindupur
Cc: Timmerman, Art (MNRF); Whalen, Rose (MNRF)
Subject: RE: York Road Environmental Design Study

Hi Arun,

MNRF staff have reviewed the York Road Class Environmental Assessment Report and Terms of Reference for the environmental design study. Please find MNRF comments below:

- Where the dam/weir decommissioning or partial decommissioning is being proposed, Lands and Rivers Improvement Act (LRIA) approval may be required. MNRF staff require more detailed information on the proposal to provide specific direction in this regard.
- The relocation or channelization of the creek does not require LRIA approval as this is the jurisdiction of the Grand River Conservation Authority for approvals at this location.
- The following bullet points come directly from the Grand River Fisheries management plan:
    - "The *fish community objective* for Clythe Creek is a coldwater fish community in areas where geological and biophysical characteristics are present and habitat exists or has been rehabilitated." (Pg. 78)
    - "Management Strategies for Clythe Creek include: work with owners of dams and impoundments to eliminate or reduce the impacts of these features on downstream fish populations and fish habitat, consider modifications to remove existing barriers to fish passage, rehabilitate degraded habitat to restore functional system" (Pg. 78-79)

  MNRF staff recommend incorporating these objectives and management strategies into the relocation design for Clythe Creek.
- Based on information in the Terms of Reference, MNRF staff have marked on the attached map the approximate location of the 135m stretch of the Clythe Creek which is recommended to be relocated for the proposed road widening.
    - MNRF staff note that there appears to be 3 weirs within the 135m stretch of creek to be relocated, whereas only 2 weirs are proposed to be removed for the relocation of the creek. MNRF would appreciate clarification on whether or not the 3rd weir is being considered for removal to improve fish passage.
    - Also within this stretch of Clythe Creek is a tributary that enters from the east (see attached map). This tributary discharges cold water to the creek, and MNRF recommends that this tributary be considered in the relocation design for Clythe Creek.
    - Downstream (to the southwest) of this reach all the way to Hadati Creek, Clythe Creek appears to be just as close to the existing York Road as the creek is within the 135m stretch. Will this downstream area be impacted by the proposed widening of York Road? This section contains additional weirs that not only impact fish movement in the creek but they also impound the creek, causing widening which in turn elevates the water temperature of the creek.
        - Within this downstream reach there is a lack of riparian vegetation, and as such, MNRF staff recommend considering opportunities for riparian planting in this area to improve fish habitat.

Should you have any questions or require any clarification on the above comments, please do not hesitate to contact me.

Kind regards,

Tara

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email: tara.mckenna@ontario.ca

From: Arun.Hindupur@guelph.ca [mailto:Arun.Hindupur@guelph.ca]
Sent: October-28-15 9:52 AM
To: McKenna, Tara (MNRF)
Cc: steve.chipps@amecfw.com; matt.senior@amecfw.com
Subject: RE: York Road Environmental Design Study

Hi Tara,

The main objective of the current study is to determine a creek design/realignment in order to accommodate the widening of York Rd. from 2 to 4 lanes. We are aware of the weir structures along different reaches of the creek and that they pose a barrier to fish passage. However, these weir features have cultural heritage significance so it's not necessarily as simple as removing them completely. The ultimate creek/channel design as to balance hydrology and hydraulic considerations as well as natural heritage features (groundwater/surface water interactions, fish passage, etc.) and cultural heritage aspects (weirs).

Nothing has been proposed as of yet as we have just started the study. The project team is planning on engaging all affected stakeholders (GRCA, MOECC, Infrastructure Ontario, etc.) including the MNRF at the beginning of the study in order to determine what considerations should be taken into account when considering a new channel design/realignment. Once that information is provided, the project team will evaluate various design alternatives and ask the impacted stakeholders to provide input in order to inform the preferred final design.

Please feel free to contact me if you have any questions.

Thanks,
Arun

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From: McKenna, Tara (MNRF) [mailto:Tara.McKenna@ontario.ca]
Sent: October 27, 2015 4:26 PM
To: Arun Hindupur
Subject: RE: York Road Environmental Design Study

Hi Arun,

I have a some areas for clarification based on the information you sent me previously. On page 16 of the EA report, Section 5.7 notes the removal of two weirs which are a barrier to fish passage. Is the proposal still to remove only the 2 weirs? It is MNRF's understanding that there are 10+ weirs along Clythe Creek in this area, and staff would appreciate a better understanding of the number and location of the weirs proposed in the relocation of the creek.

Would you be able to send any preliminary figures, maps, or images of the potential relocation options for Clythe Creek? This would help give MNRF staff a better understanding of the works proposed, and potential impacts to the creek.

How will the flow of the creek be controlled with the removal of the weirs?

Looking forward to your response. Thank you kindly,

Tara

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email: tara.mckenna@ontario.ca

From: Arun.Hindupur@guelph.ca [mailto:Arun.Hindupur@guelph.ca]
Sent: October-21-15 1:28 PM
To: McKenna, Tara (MNRF)
Subject: RE: York Road Environmental Design Study

Hi Tara,

Hope all is well. We will be having a project meeting next Friday morning here at the City with our consultants. If you're available Friday afternoon, perhaps we can come to your office and discuss any of the MNRF's concerns with respect to this study?

Thanks,
Arun

From: Arun Hindupur
Sent: October 19, 2015 11:13 AM
To: 'tara.mckenna@ontario.ca'
Cc: Chipps, Steve (steve.chipps@amecfw.com); Senior, Matt (matt.senior@amecfw.com)
Subject: York Road Environmental Design Study

Hi Tara,

Further to our discussion, please see attached original 2007 York Rd. EA. Once, you've had a chance to review, it would be good to have a chat with yourself and our consulting team (cc'd on this email) to discuss any considerations from the MNRs perspective.

Please feel free to contact me if you have any questions.

Thanks,
Arun

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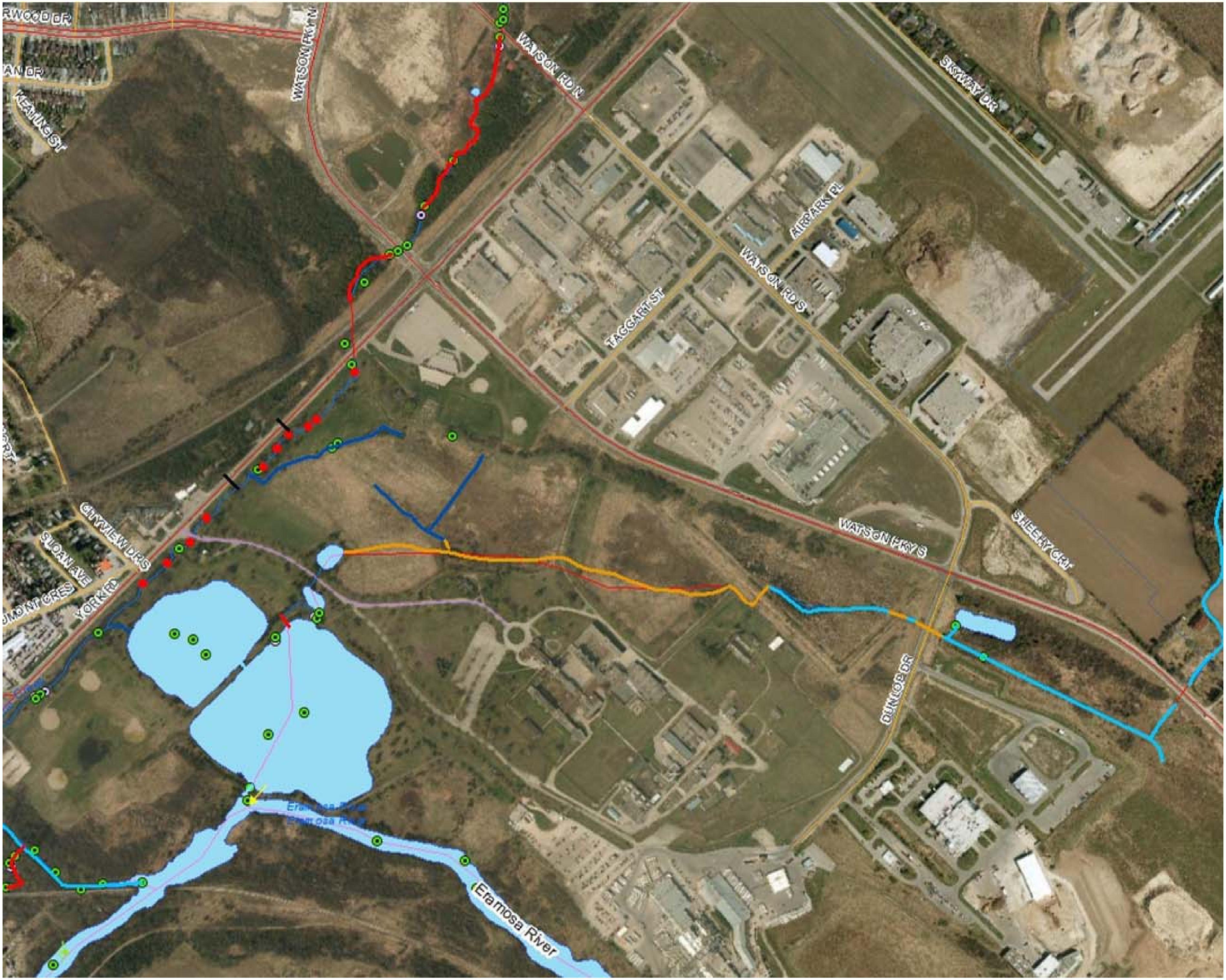

WATSON PKY N
WATSON RD N
SKYWAY DR
KEATING ST
AIRPARK PL
WATSON RD S
TAGGART ST
CITYVIEW DR S
SLOAN AVE
YORK RD
WATSON PKY S
SHEEHY CRT
DUNLOP DR
Eramosa River
Eramosa River
Eramosa River

Appendix H-1: Vascular Plant Species List from Available Background Resources.

Natural Heritage Information Centre (NHIC) Biodiversity Explorer query (NHIC 2015)	City of Guelph Municipal List of Species at Risk (SAR) (City of Guelph 2015)	Wellington Upper Tier SAR List (OMNRF 2013)	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)	Guelph Correctional Centre Natural Heritage Assessment (Natural Resources Solutions Inc., 2013)	Scientific Name	Common Name	GRANK	COSEWIC	SARO STATUS	SRANK	City of Guelph	Wellington County	Native Status
		X					*Arnoglossum plantagineum*	Tuberous Indian-plantain	G4G5	SC	SC	S3			N
				X			*Asplenium platyneuron*	Ebony Spleenwort	G5			S4	LS	R1	N
				X			*Asplenium trichomanes*	Maidenhair Spleenwort	G5			S5	LS	R2	N
				X			*Botrychium simplex*	Least Moonwort	GNR			SU	LS	R1/R2	N
H				X			*Carex careyana*	Carey's Sedge	G4G5			S2		R1	N
				X			*Carex pallescens*	Pale Sedge	G5			S5	LS		N
		X					*Castanea dentata*	American Chestnut	G4	E	END	S2		R1	N
						P	*Celtis occidentalis*	Common Hackberry	G5			S4	LS		N
				H			*Epilobium strictum*	Downy Willowherb	G5?			S5	LS	R1	N
				X			*Equisetum pratense*	Meadow Horsetail	G5			S5	LS	R1	N
						P	*Euonymus atropurpureus*	Eastern Burning Bush	G5			S3		R1	N
					X		*Gentiana rubricaulis*	Closed Gentian	G4?			S4	LS	R1	N
	X	X		H		X	*Juglans cinerea*	Butternut	G4	E	END	S3?			N
					X		*Lobelia kalmii*	Kalm's Lobelia	G5			S5	LS		N
				H			*Lycopodium clavatum*	Running Clubmoss	G5			S5	LS		N
		X					*Panax quinquefolius*	American Ginseng	G3G4	E	END	S2		R2	N
				X			*Pellaea atropurpurea*	Purple-stemmed Cliffbrake	G5			S3		R1	N
		X					*Potamogeton hillii*	Hill's Pondweed	G3	SC	SC	S2		R2	N
				H			*Pyrola chlorantha*	Green-flowered Pyrola	G5			S4S5	LS	R1	N
				H			*Ribes hirtellum*	Smooth Gooseberry	G5			S5	LS	R1	N
				X			*Solidago arguta*	Cut-leaved Goldenrod	G5			S4	LS	R1	N
			X				*Vaccinium corymbosum*	Highbush Blueberry	G5			S4	LS	R1	N

X: Species was recorded in the document.

H: Species was recorded in the document but is considered historic

P: Species was recorded in the document and is known to be planted.

Appendix H-1: Vascular Plant Species List from Available Background Resources.

Parameter	Source	Legend
G Rank	NHIC (Natural Heritage Information Centre). 2011. Ontario Vascular Plant Species List. Biodiversity Explorer Online Database. Ontario Ministry of Natural Resources.	G1 critically imperiled on a global scale; G2 imperiled on a global scale; G3 vulnerable on a global scale; G4 apparently secure on a global scale; G5 secure on a global scale. (http://www.natureserve.org/explorer/ranking.htm)
COSEWIC	NHIC (Natural Heritage Information Centre). 2011. Ontario Vascular Plant Species List. Biodiversity Explorer Online Database. Ontario Ministry of Natural Resources.	NAR Not At Risk, a wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances; SC Special Concern, a wildlife species that may become threatened or endangered because of a combination of biological characteristics and identified threats; T Threatened, a wildlife species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction; E Endangered, a wildlife species facing imminent extirpation or extinction; XT Extirpated, a wildlife species that no longer exists in the wild in Canada, but exists elsewhere; X Extinct, a wildlife species that no longer exists.
SARO Status	NHIC (Natural Heritage Information Centre). 2011. Ontario Vascular Plant Species List. Biodiversity Explorer Online Database. Ontario Ministry of Natural Resources.	NAR Not At Risk; SC Special Concern; THR Threatened; END Endangered; EXP Extirpated; END-R Endangered (Regulated)
S Rank	NHIC (Natural Heritage Information Centre). 2011. Ontario Vascular Plant Species List. Biodiversity Explorer Online Database. Ontario Ministry of Natural Resources.	SX Presumed Extirpated; SH Possibly Extirpated (Historical); S1 Critically Imperiled; S2Imperiled; S3 Vulnerable; S4 Apparently Secure; S5 Secure; SNR Unranked; SU Unrankable (conflicting information about status or trends); SNA Not Applicable (A conservation status rank is not applicable because the species is not a suitable target for conservation activities.); S#S# Range Rank (used to indicate any range of uncertainty about the status of the species or community). S? Not Ranked Yet; or if following a ranking, Rank Uncertain (e.g. S3?).
City of Guelph	City of Guelph. 2012. Locally Significant Species List, Significant Plant List. Official Plan Amendment # 42.	LS Locally Significant in the City of Guelph but not including species with higher level rarity status (COSEWIC, COSSARO, G1-G3, S1-S3)
Wellington County	Frank, R. and A. Anderson. 2009. The Flora of Wellington County. Wellington County Historical Society, Fergus Ontario. 145 pp.	Defined by the number of survey sites where the species was found. R1 1-3 sites; R2 4-6 sites; R3 6-10 sites.
Native Status	NHIC (Natural Heritage Information Centre). 2009. Ontario Vascular Plant Species List. Biodiversity Explorer Online Database. Ontario Ministry of Natural Resources.	N native; I introduced

Appendix I-1 - Species at Risk (SAR) Screening

SPECIES	SAR Designation	Status in City of Guelph (to September 29, 2015)	Key Habitats Used By Species	Status at York Road Environmental Design site and adjacent lands (within 120 metres)
AMPHIBIANS				
Jefferson Salamander (*Ambystoma jeffersonianum*)	Endangered	Known to Occur	Inhabits deciduous and mixed deciduous forests with suitable breeding areas which generally consist of ephemeral (temporary) bodies of water that are fed by spring runoff, groundwater, or springs.	**No suitable habitat present on site or on adjacent lands.**
BIRDS				
Bald Eagle (*Haliaeetus leucocephalus*)	Special Concern	Known to Occur		**No suitable breeding habitat present on site or on adjacent lands; may overwinter along stretches of the adjacent Eramosa River. Not detected during 2016 field investigations.**
Bank Swallow (*Riparia riparia*)	Threatened (federal only)	Known to Occur	Low areas along rivers, streams, coasts or reservoirs; nest in natural bluffs and eroding streamside banks, also sand and gravel quarries and road cuts	**No suitable habitat present on site or on adjacent lands. Not detected during 2016 breeding bird surveys.**
Barn Swallow (*Hirundo rustica*)	Threatened	Known to Occur	Prefers farmland, lake/river shorelines, wooded clearings, urban populated areas, rocky cliffs, and wetlands. They nest inside or outside buildings; under bridges and in road culverts; on rock faces and in caves, etc.	**Present at site foraging over open areas, such as the main ponds, the baseball fields on the west side, and fields at the east side. No nesting structures are present on site although they exist in adjacent areas.**
Bobolink (*Dolichonyx oryzivorus*)	Threatened	Known to Occur	Generally prefers open grasslands and hay fields. In migration and in winter uses freshwater marshes and grasslands.	**No suitable habitat present on site or on adjacent lands. Not detected during 2016 breeding bird surveys.**
Canada Warbler (*Wilsonia canadensis*)	Threatened (federal) / Special Concern (provincial)	Suspected to Occur	Generally prefers wet coniferous, deciduous and mixed forest types, with a dense shrub layer. Nests on the ground, on logs or hummocks, and uses dense shrub layer to conceal the nest.	**No suitable habitat present on site or on adjacent lands. Not detected during 2016 breeding bird surveys.**
Chimney Swift (*Chaetura pelagica*)	Threatened	Known to Occur	Historically found in deciduous and coniferous, usually wet forest types, all with a well developed, dense shrub layer; now most are found in urban areas in large uncapped chimneys.	**Seen foraging over main ponds. Not nesting on-site or in adjacent lands as no suitable chimneys available or large (50+ cm dbh) cavity trees.**
Common Nighthawk (*Chordeiles minor*)	Threatened (federal) / Special Concern (provincial)	Known to Occur	Generally prefers open, vegetation-free habitats, including dunes, beaches, recently harvested forests, burnt-over areas, logged areas, rocky outcrops, rocky barrens, grasslands, pastures, peat bogs, marshes, lakeshores, and river banks. This species also inhabits mixed and coniferous forests. Can also be found in urban areas (nests on flat roof-tops).	**No suitable habitat present on site or on adjacent lands.**
Eastern Meadowlark (*Sturnella Magna*)	Threatened	Known to Occur	Generally prefers grassy pastures, meadows and hay fields. Nests are always on the ground and usually hidden in or under grass clumps.	**One pair present in field at east side of site; see report for details.**
Eastern Wood-Pewee (*Contopus virens*)	Special Concern (federal only)	Known to Occur	Found in deciduous, mixed woods, or pine plantations; also found in mature woodlands, urban shade trees, roadsides, and orchards; usually found in clearings and forest edges.	**Suitable habitat present on site and on adjacent lands. Not detected during 2016 breeding bird surveys.**
Golden-winged Warbler (*Vermivora chrysoptera*)	Special Concern	Known to Occur	Generally prefers areas of early successional vegetation, found primarily on field edges, hydro or utility right-of-ways, or recently logged areas.	**No suitable habitat present on site or on adjacent lands. Not detected during 2016 breeding bird surveys.**
Red-Headed Woodpecker (*Melanerpes erythrocephalus*)	Threatened (federal) / Special Concern (provincial)	Known to Occur	Generally prefers open oak and beech forests, grasslands, forest edges, orchards, pastures, riparian forests, roadsides, urban parks, golf courses, cemeteries, as well as along beaver ponds and brooks.	**No suitable habitat present on site or on adjacent lands. Not detected during 2016 breeding bird surveys.**

Wood Thrush ***(Hylocichla mustelina)***	Special Concern (federal only)	Known to Occur	Breeds in mature deciduous and mixed forests, most commonly those with American beech, sweet gum, red maple, black gum, eastern hemlock, flowering dogwood, American hornbeam, oaks, or pines; nests less successfully in fragmented forests and suburban parks with enough large trees for a territory; ideal habitat includes trees over 50 feet tall, a moderate understory of saplings/shrubs, an open floor with moist soil and decaying leaf litter, and water nearby.	**No suitable habitat present on site or on adjacent lands. Not detected during 2016 breeding bird surveys.**
Yellow-breasted Chat ***(Icteria virens)***	Endangered	Historically Known to Occur	Generally prefers dense thickets around wood edges, riparian areas, and in overgrown clearings.	**No suitable habitat present on site or on adjacent lands. Not detected during 2016 breeding bird surveys.**
INSECTS				
Monarch ***(Danaus plexippus)***	Special Concern	Known to Occur	Exist primarily wherever milkweed and wildflowers exist, such as abandoned farmland, along roadsides, and other open spaces.	**May occur during migration in non-significant numbers; may breed as Common Milkweed is present in some open areas.**
Rusty-patched Bumble Bee ***(Bombus affinis)***	Endangered	Known to Occur	Generally inhabits a range of diverse habitats including mixed farmlands, sand dunes, marshes, urban and wooded areas. It usually nests underground in abandoned rodent burrows.	**No suitable habitat present on site or on adjacent lands.**
West Virginia White ***(Pieris virginiensis)***	Special Concern	Known to Occur	Generally prefer moist, deciduous woodlands; the larvae feed only on the leaves of the two-leaved toothwort (Cardamine diphylla), which is a small, spring-blooming plant of the forest floor.	**No suitable habitat present on site or in adjacent lands.**
MAMMALS				
Eastern Small-footed Myotis ***(Myotis leibii)***	Endangered	Known to Occur	Overwintering habitat: caves and mines that remain above 0 degrees Celsuis; Maternal roosts: primarily under loose rocks on exposed rock outcrops, crevices and cliffs, and occasionally in buildings, under bridges and highway overpasses, and under tree bark.	**No overwintering habitat on site; no suitable buildings available for roosting are on site although some are present in adjacent areas. Some potential cavity trees available on site although none of these will be negatively impacted by the proposed works.**
Little Brown Myotis ***(Myotis lucifugus)***	Endangered	Known to Occur	Overwintering habitat: caves and mines that remain above 0 C; Maternal roosts: Often associated with buildings (attics, barns, etc.). Occasionally found in trees (25-44 cm dbh).	**No overwintering habitat on site; no suitable buildings available for roosting are on site although some are present in adjacent areas. Some potential cavity trees available on site although none of these will be negatively impacted by the proposed works.**
Northern Myotis ***(Myotis septentrionalis)***	Endangered	Known to Occur	Overwintering habitat: caves and mines that remain above 0 C; Maternal roosts: often asssociated with cavities of large diameter trees (25-44 cm dbh). Occasionally found in structures (attics, barns, etc.)	**No overwintering habitat on site; no suitable buildings available for roosting are on site although some are present in adjacent areas. Some potential cavity trees available on site although none of these will be negatively impacted by the proposed works.**
REPTILES				
Blanding's Turtle ***(Emydonidea blandingii)***	Threatened	Known to Occur	Generally occurs in freshwater lakes, permanent or temporary pools, slow-flowing streams, marshes and swamps. Prefers shallow water that is rich in nutrients, organic soil and dense vegetation. Adults are generally found in open or partially vegetated sites, and juveniles prefer areas that contain thick aquatic vegetation including sphagnum, water lilies and algae. They dig their nest in a variety of loose substrates, including sand, organic soil, gravel and cobblestone. Overwintering occurs in permanent pools that average about one metre in depth, or in slow-flowing streams.	**No records from area in NHIC and MNRF databases. None were observed during extensive basking turtle surveys undertaken in 2016. Character of main ponds and adjacent Eramosa River generally unsuitable for species.**
Eastern Ribbonsnake ***(Thamnophis sauritus)***	Special Concern	Known to Occur	Generally occurs along the edges of shallow ponds, streams, marshes, swamps, or bogs bordered by dense vegetation that provides cover. Abundant exposure to sunlight is also required, and adjacent upland areas may be used for nesting.	**Potential habitat occurs on site and in adjacent areas, although upland areas not present. None found during extensive snake surveys undertaken in 2016. Record from April 25, 1990 in NHIC database.**
Milksnake ***(Lampropeltis triangulum)***	Special Concern (pre 2016)	Known to Occur	Generally occurs in rural areas, where it is most frequently reported in and around buildings, especially old structures. It is also found in a wide variety of habitats, from prairies, pastures, and hayfields, to rocky hillsides and a wide variety of forest types. They must also be in proximity to water, and suitable locations for basking and egg-laying.	**Marginal habitat available on site, although it lacks old buildings for foraging as well as rocky hillsides and extensive uplands. None were detected during extensive snake surveys undertaken in 2016. Record from vicinity in the MNRF database; record from September 28, 1978 in NHIC database. No longer considered a SAR (as of June 15, 2016).**

Northern Map Turtle (Graptemys geographica)	Special Concern	Historically Known to Occur	Found in large rivers and lakes with slow-moving currents and soft bottoms	**Record from July 1924 in NHIC database is considered historic in nature. MNRF does not list this species in their current database for the City of Guelph (the species is considered locally extirpated).**
Snapping Turtle *(Chelydra serpentina)*	Special Concern	Known to Occur	Generally inhabit shallow waters where they can hide under the soft mud and leaf litter. Nesting sites usually occur on gravely or sandy areas along streams. Snapping Turtles often take advantage of man-made structures for nest sites, including roads (especially gravel shoulders), dams and aggregate pits.	**Observed in main pond in 2016, and undoubtedly occurs elsewhere. No suitable nesting sites (i.e., areas of sand and gravel with a southerly aspect in proximity to water). Overwintering habitat occurs in main ponds and potentially along adjacent Eramosa River. Record from vicinity in MNRF database.**
Vascular Plants				
Butternut (*Juglans cinerea*)	Endangered	Known to Occur	Generally grows in rich, moist, and well-drained soils often found along streams. It may also be found on well-drained gravel sites, especially those made up of limestone. It is also found, though seldomly, on dry, rocky and sterile soils. In Ontario, the Butternut generally grows alone or in small groups in deciduous forests as well as in hedgerows.	**Potential habitat occurs on site and in adjacent lands; none detected during 2016 field investigations.**

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							1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
Acer negundo	Manitoba Maple	G5	S5			N				X	X		X	X		X	X			X					X	X
Acer platanoides	Norway Maple	GNR	SNA			I	X	X	X	X	X	X	X			X	X		X	X				X		X
Acer saccharinum	Silver Maple	G5	S5			N						X	X			X	X			X	X				X	X
Acer saccharum	Sugar Maple	G5	S5			N	X	X	X	X							X								X	
Acer x freemanii	(Acer rubrum X Acer saccharinum)	GNA	SNA			I			X								X						X			
Achillea millefolium	Common Yarrow	G5	SNA			N			X			X	X				X		X	X	X		X	X	X	X
Agrostis gigantea	Redtop	G4G5	SNA			I						X								X						
Agrostis stolonifera	Creeping Bentgrass	G5	SNA			N			X						X			X	X		X	X	X	X		
Alisma triviale	Northern Water-plantain	G5	S5			N			X																	
Alliaria petiolata	Garlic Mustard	GNR	SNA			I		X	X				X			X	X			X		X				X
Alnus glutinosa	European Alder	GNR	SNA			I			X													X				
Amaranthus powellii ssp. powellii	Powell's Amaranth	G5T5	SNA			I																			X	
Ambrosia artemisiifolia	Annual Ragweed	G5	S5		X	N								X			X		X							
Amelanchier arborea	Downy Serviceberry	G5	S5		X	N					X															
Amelanchier sp	Serviceberry Species									X																X
Anemone canadensis	Canada Anemone	G5	S5		X	N						X		X			X	X	X		X					
Angelica atropurpurea	Great Angelica	G5	S5		X	N							X				X			X	X					X
Apocynum androsaemifolium	Spreading Dogbane	G5	S5		X	N																			X	
Apocynum sp	Dogbane Species																							X		
Arctium lappa	Greater Burdock	GNR	SNA			I			X																	
Arctium minus	Common Burdock	GNR	SNA			I		X				X													X	X
Asclepias incarnata	Swamp Milkweed	G5	S5		X	N								X					X				X		X	
Asclepias syriaca	Common Milkweed	G5	S5		X	N						X		X			X						X		X	X
Aster sp	Aster Species								X													X				
Betula papyrifera	Paper Birch	G5	S5		X	N																			X	
Bidens connata	Purple-stemmed Beggarticks	G5	S4?											X												X
Bidens sp	Beggar's Ticks Species								X															X		
Bromus inermis	Awnless Brome	G5TNR	SNA			I			X	X		X	X				X			X	X		X		X	X
Calla palustris	Wild Calla	G5	S5		X	N			X													X				
Capsella bursa-pastoris	Common Shepherd's Purse	GNR	SNA			I																			X	
Carex bebbii	Bebb's Sedge	G5	S5		X	N			X			X					X	X	X		X					
Carex blanda	Woodland Sedge	G5?	S5		X	N											X									
Carex comosa	Bristly Sedge	G5	S5		X	N																	X			
Carex crawei	Crawe's Sedge	G5	S4			N															X					

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Carex eburnea	Ebony Sedge	G5	S5		X	N																			X	
Carex flava	Yellow Sedge	G5	S5		X	N			X	X		X					X									
Carex hystericina	Porcupine Sedge	G5	S5		X	N			X	X																
Carex lacustris	Lake-bank Sedge	G5	S5		X	N							X	X									X		X	
Carex retrorsa	Retrorse Sedge	G5	S5		X	N												X								
Carex sp	Sedge Species											X		X							X					X
Carex spicata	Spiked Sedge	GNR	SNA			I											X									
Carex stipata	Awl-fruited Sedge	G5	S5		X	N			X								X									
Carex stricta	Tussock Sedge	G5	S5		X	N			X					X								X				
Carex sychnocephala	Many-headed Sedge	G4	S4	LS		N												X								
Carex utriculata	Bladder Sedge	G5	S5		X	N												X								
Carex vulpinoidea	Fox Sedge	G5	S5		X	N			X	X							X	X	X				X			
Cerastium sp	Chickweed Species									X							X									
Chelidonium majus	Greater Celadine	GNR	SNA			I						X														
Chelone glabra	White Turtlehead	G5	S5		X	N			X				X				X			X					X	X
Chenopodium album	White Goosefoot	G5	SNA			I													X						X	
Cichorium intybus	Chicory	GNR	SNA			I			X														X		X	
Cicuta bulbifera	Bulb-bearing Water-hemlock	G5	S5		X	N			X					X								X				
Cicuta maculata var. maculata	Spotted Water-hemlock	G5T5	S5		X	N			X													X				
Circaea canadensis	Broad-leaved Enchanter's Nightshade	G5T5	S5		X	N					X		X													
Cirsium arvense	Canada Thistle	GNR	SNA			I			X	X		X					X				X	X	X		X	X
Cirsium vulgare	Bull Thistle	GNR	SNA			I						X											X		X	X
Clematis virginiana	Virginia Virgin's-bower	G5	S5		X	N						X		X							X				X	
Convolvulus arvensis	Field Bindweed	GNR	SNA			I				X																
Cornus alternifolia	Alternate-leaved Dogwood	G5	S5		X	N																		X		
Cornus amomum	Silky Dogwood	G5	S5		X	N																		X		
Cornus stolonifera	Red-osier Dogwood	G5	S5			N			X	X		X	X	X	X	X	X		X	X		X	X	X	X	X
Crataegus punctata	Dotted Hawthorn	G5	S5		X	N					X															
Cynanchum sp	Swallow-wort Species																X									
Cyperus sp	Umbrella Sedge Species											X														
Dactylis glomerata	Orchard Grass	GNR	SNA			I	X	X	X	X		X	X									X			X	X
Daucus carota	Wild Carrot	GNR	SNA			I		X	X			X					X					X	X	X	X	X
Dipsacus fullonum	Fuller's Teasel	GNR	SNA			I																			X	
Dryopteris marginalis	Marginal Wood Fern	G5	S5		X	N																			X	
Echinochloa crus-galli	Large Barnyard Grass	GNR	SNA			I																			X	
Echinocystis lobata	Wild Mock-cucumber	G5	S5		X	N						X	X	X		X	X			X	X				X	X

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Echium plantagineum	Viperine	GNR	SNA			I						X														X
Echium vulgare	Common Viper's-bugloss	GNR	SNA			I						X													X	
Eleocharis sp	Spikerush Species								X	X							X	X								
Elymus virginicus var. virginicus	Virginia Wildrye	G5T5	S5		X	N								X											X	
Epilobium hirsutum	Hairy Willowherb	GNR	SNA			I			X																	
Epilobium parviflorum	Small-flowered Willowherb	GNR	SNA			I												X	X				X	X		
Epilobium sp	Willow-herb Species								X													X				
Equisetum arvense	Field Horsetail	G5	S5		X	N			X			X					X					X		X		
Equisetum variegatum	Variegated Horsetail	G5	S5	LS		N													X							
Erigeron annuus	Annual Fleabane	G5	S5		X	N			X			X														
Erigeron canadensis	Canada Horseweed	G5	S5		X	N																			X	
Erigeron philadelphicus	Philadelphia Fleabane	G5	S5		X	N			X								X									
Erucastrum gallicum	Common Dogmustard	G5	SNA			I																			X	
Erysimum cheiranthoides	Wormseed Wallflower	G5	SNA			I															X				X	
Euonymus europaeus	European Euonymus	GNR	SNA			I																			X	
Eupatorium perfoliatum	Common Boneset	G5	S5		X	N			X										X	X			X			
Euphorbia sp	Spurge Species																				X					
Euthamia graminifolia	Grass-leaved Goldenrod	G5	S5		X	N													X					X		
Eutrochium maculatum var. maculatum	Spotted Joe Pye Weed	G5T5	S5		X	I			X				X	X			X		X	X	X				X	X
Fallopia convolvulus	Black Bindweed	GNR	SNA			I								X												
Fallopia japonica	Japanese Knotweed	GNR	SNA			I								X												
Festuca rubra ssp. rubra	Red Fescue	G5T5	SNA			I													X							
Fragaria sp	Strawberry Species								X													X				
Fragaria vesca	Woodland Strawberry	G5	S5		X	N															X					X
Fragaria virginiana	Wild Strawberry	G5	S5		X	N	X		X	X		X					X						X		X	
Frangula alnus	Glossy Buckthorn	GNR	SNA			I			X	X		X	X	X		X	X		X	X			X		X	X
Fraxinus americana	White Ash	G5	S4		X	N						X													X	
Fraxinus pennsylvanica	Green Ash	G5	S4		X	N																	X	X	X	
Galium asprellum	Rough Bedstraw	G5	S5		X	N								X												
Galium mollugo	Smooth Bedstraw	GNR	SNA			I			X													X				
Galium palustre	Marsh Bedstraw	G5	S5		X	N			X	X							X		X		X					X
Galium sp	Bedstraw Species								X												X					
Geum aleppicum	Yellow Avens	G5	S5		X	N			X				X				X			X	X	X				X
Geum canadense	White Avens	G5	S5		X	N											X									
Geum laciniatum	Rough Avens	G5	S4	LS	SR	N			X								X									
Geum sp	Avens Species										X	X	X	X			X			X					X	X

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Glechoma hederacea	Ground Ivy	GNR	SNA			I			X													X	X			
Glyceria grandis	Tall Mannagrass	G5	S4S5		X	N			X																	
Glyceria striata	Fowl Mannagrass	G5	S5		X	N			X										X							
Hemerocallis fulva	Orange Daylily	GNA	SNA			I						X														
Heracleum maximum	Cow-parsnip	G5	S5		X	N						X														
Hesperis matronalis	Dame's Rocket	G4G5	SNA			I							X													
Hypericum perforatum	Common St. John's-wort	GNR	SNA			I	X					X											X			
Impatiens capensis	Spotted Jewelweed	G5	S5		X	N			X	X							X				X		X	X		
Impatiens sp	Jewel-weed Species															X										X
Inula helenium	Elecampane	GNR	SNA			I											X									
Iris versicolor	Harlequin Blue Flag	G5	S5		X	N			X														X			
Jacobaea vulgaris	Tansy Ragwort	GNR	SNA			I																	X			
Juglans nigra	Black Walnut	G5	S4		X	N			X																	
Juncus articulatus	Jointed Rush	G5	S5		X	N													X							
Juncus dudleyi	Dudley's Rush	G5	S5		X	N			X								X						X			
Juncus effusus	Soft Rush	G5	S5			N			X														X			
Juncus tenuis	Path Rush	G5	S5		X	N																	X		X	
Juniperus communis	Ground Juniper	G5	S5			N				X																
Juniperus virginiana	Eastern Red Cedar	G5	S5		X	N		X																	X	
Larix laricina	American Larch	G5	S5		X	N																			X	
Leonurus cardiaca	Common Motherwort	GNR	SNA			I		X				X		X											X	X
Lepidium densiflorum	Dense-flowered Peppergrass	G5	SNA			I																			X	
Leucanthemum vulgare	Oxeye Daisy	GNR	SNA			I			X														X			
Ligustrum vulgare	European Privet	GNR	SNA			I							X				X			X						X
Linaria vulgaris	Butter-and-eggs	GNR	SNA			I													X		X				X	
Liriodendron tulipifera	Tulip Tree	G5	S4			N				X																
Lonicera tatarica	Tartarian Honeysuckle	GNR	SNA			I		X	X		X		X	X			X			X		X		X	X	X
Lotus corniculatus	Garden Bird's-foot Trefoil	GNR	SNA			I			X								X								X	
Lycopodium sp	Clubmoss Species																X			X	X					X
Lycopus americanus	American Water-horehound	G5	S5		X	N																			X	
Lycopus uniflorus	Northern Water-horehound	G5	S5		X	N			X					X												
Lysimachia thyrsiflora	Water Loosestrife	G5	S5		X	N							X													
Lythrum salicaria	Purple Loosestrife	G5	SNA			I			X					X			X		X				X			
Malus sp	Apple Species								X													X				
Matteuccia struthiopteris	Ostrich Fern	G5	S5		X	N							X			X	X			X					X	X

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Medicago lupulina	Black Medic	GNR	SNA			I	X		X			X					X									
Medicago sativa	Alfalfa	GNR	SNA			I			X																	
Melilotus albus	White Sweet-clover	G5	SNA			I						X														
Melilotus sp	Sweet Clover Species																								X	
Mentha arvensis	Field Mint	G5	S5			N			X								X	X	X				X	X		
Mentha spicata	Spearmint	GNR	SNA			I												X								
Mentha x piperita	(Mentha aquatica X Mentha spicata)	GNA	SNA			I			X	X								X					X	X		
Muhlenbergia frondosa	Wirestem Muhly	G5	S4		X	N								X							X					
Myosotis scorpioides	True Forget-me-not	G5	SNA			I			X									X								
Myosotis sp	Forget-me-not Species									X													X	X		
Myriophyllum spicatum	Eurasian Water-milfoil	GNR	SNA			I																	X	X		
Nasturtium microphyllum	Small-leaved Watercress	GNR	SNA			I																			X	
Nasturtium officinale	Watercress	GNR	SNA			I			X			X										X				X
Nepeta cataria	Catnip	GNR	SNA			I																			X	
Nuphar sp	Pond-lily Species																						X			
Nymphaea odorata ssp. odorata	Fragrant Water-lily	G5T5	S5?		X	N											X									
Oenothera biennis	Common Evening Primrose	G5	S5		X	N		X	X	X		X	X	X			X			X	X	X	X	X	X	X
Onoclea sensibilis	Sensitive Fern	G5	S5		X	N			X																	
Origanum vulgare	Wild Marjoram	GNR	SNA			I																	X			
Ostrya virginiana	Eastern Hop-hornbeam	G5	S5		X	N																			X	
Oxalis sp	Wood Sorrel Species																							X		
Panicum capillare	Common Panicgrass	G5	S5		X	N																			X	
Parthenocissus inserta	Thicket Creeper	G5	S5		X	N			X																	
Persicaria lapathifolia	Pale Smartweed	G5	S5		X	N								X				X								
Persicaria maculosa	Spotted Lady's-thumb	G3G 5	SNA			I												X								
Phalaris arundinacea	Reed Canary Grass	G5	S5		X	N			X			X		X			X		X	X	X	X		X	X	X
Phleum pratense	Common Timothy	GNR	SNA			I						X														
Phragmites australis ssp. australis	European Reed	G5T5	SNA			I													X		X					X
Picea abies	Norway Spruce	G5	SNA			I			X	X		X	X				X			X			X		X	X
Picea glauca	White Spruce	G5	S5		X	N			X	X	X	X	X				X			X					X	X
Picea pungens	Blue Spruce	G5	SNA			I			X			X	X				X			X			X	X		X
Pinus banksiana	Jack Pine	G5	S5			N																			X	
Pinus nigra	Black Pine	GNR	SNA			I			X		X		X				X			X						X
Pinus resinosa	Red Pine	G5	S5		X	N				X			X			X	X			X					X	X
Pinus strobus	Eastern White Pine	G5	S5		X	N			X	X															X	X

Scientific Name (NHIC 2016)	Common Name (NHIC 2016)	GRANK	SRANK	City of Guelph (2012)	Wellington Status (2004)	Native Status	Polygon ID																		Stantec (2006)	NRSI (2012)
							1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
Pinus sylvestris	Scotch Pine	GNR	SNA			I			X	X	X														X	X
Plantago lanceolata	English Plantain	G5	SNA			I	X	X		X							X						X	X	X	
Plantago major	Common Plantain	G5	S5			N				X		X							X						X	X
Poa pratensis ssp. pratensis	Kentucky Bluegrass	G5T5	S5			N			X	X							X		X			X				
Poa sp	Bluegrass Species													X							X					X
Polygonatum pubescens	Hairy Solomon's Seal	G5	S5		R	N								X					X							
Polygonatum sp	Solomon's Seal Species											X														
Polygonum sp	Smartweed Species																X									
Populus balsamifera	Balsam Poplar	G5	S5		X	N													X							
Populus grandidentata	Large-tooth Aspen	G5	S5		X	N																			X	
Populus tremuloides	Trembling Aspen	G5	S5		X	N																			X	
Potamogeton crispus	Curly-leaved Pondweed	G5	SNA			I																		X		
Potentilla anserina ssp. anserina	Common Silverweed	GNR	S5			N				X													X			
Potentilla norvegica	Norwegian Cinquefoil	G5	S5			N													X							
Potentilla recta	Sulphur Cinquefoil	GNR	SNA			I																			X	
Prunus serotina	Wild Black Cherry	G5	S5		X	N				X	X															X
Prunus virginiana	Choke Cherry	G5	S5		X	N			X		X	X	X				X			X	X	X	X	X		X
Quercus macrocarpa	Bur Oak	G5	S5		X	N																			X	
Ranunculus acris	Tall Buttercup	G5	SNA			I				X																
Ranunculus recurvatus	Hooked Buttercup	G5	S5			N															X					X
Ranunculus repens	Creeping Buttercup	GNR	SNA			I							X				X			X						X
Ranunculus sp	Buttercup Species													X												
Rhamnus cathartica	Common Buckthorn	GNR	SNA			I		X	X	X	X	X	X	X		X	X		X	X		X	X	X	X	X
Rhus typhina	Staghorn Sumac	G5	S5			N						X													X	
Ribes americanum	Wild Black Currant	G5	S5		X	N							X													
Ribes sp	Currant Species													X												
Robinia pseudoacacia	Black Locust	G5	SNA			I							X				X			X					X	X
Rosa rugosa	Rugosa Rose	GNR	SNA			I				X																
Rubus idaeus ssp. idaeus	Common Red Raspberry	G5T5	SNA			I					X	X	X	X			X			X	X					X
Rubus occidentalis	Black Raspberry	G5	S5		X	N			X					X								X				
Rudbeckia hirta var. hirta	Black-eyed Susan	G5T4 T5	SU					X																		
Rumex crispus	Curly Dock	GNR	SNA			I		X	X														X			
Sagittaria latifolia	Broad-leaved Arrowhead	G5	S5		X	N			X								X						X			
Salix alba	White Willow	G5	SNA			I														X				X		
Salix amygdaloides	Peach-leaved Willow	G5	S5		X	N													X							

Scientific Name (NHIC 2016)	Common Name (NHIC 2016)	GRANK	SRANK	City of Guelph (2012)	Wellington Status (2004)	Native Status	Polygon ID																		Stantec (2006)	NRSI (2012)
							1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
Salix discolor	Pussy Willow	G5	S5		X	N								X												
Salix eriocephala	Heart-leaved Willow	G5	S5		X	N			X					X								X				
Salix humilis	Prairie Willow	G5	S5		X	N								X												
Salix interior	Sandbar Willow	GNR	S5		X	N			X																	
Salix petiolaris	Meadow Willow	G5	S5		X	N								X												
Salix purpurea	Basket Willow	G5	SNA			I																			X	
Salix sp	Willow Species															X										
Salix x fragilis	(Salix alba X Salix euxina)	GNR	SNA			I			X			X	X	X		X	X		X	X					X	X
Sambucus canadensis	Common Elderberry	G5T5	S5		X	N								X												X
Schedonorus arundinaceus	Tall Fescue	GNR	SNA			I			X																	
Schoenoplectus tabernaemontani	Soft-stemmed Bulrush	G5	S5		X	N																	X			
Scirpus atrovirens	Dark-green Bulrush	G5?	S5		X	N			X			X		X			X		X	X			X			
Scirpus sp	Bulrush Species																X									
Scutellaria galericulata	Hooded Skullcap	G5	S5		X	N													X							
Senecio vulgaris	Common Ragwort	GNR	SNA			I																			X	
Setaria pumila	Yellow Foxtail	GNR	SNA			I																			X	
Silene latifolia	White Campion	GNR	SNA			I				X														X		
Silene vulgaris	Maiden's Tears	GNR	SNA			I																			X	
Solanum dulcamara	Climbing Nightshade	GNR	SNA			I			X																	
Solidago altissima ssp. altissima	Eastern Late Goldenrod	GNR	S5			N		X	X			X	X	X	X		X			X	X	X		X	X	X
Solidago canadensis var. canadensis	Canada Goldenrod	G5T5	S5		X	N						X	X							X	X		X	X		X
Solidago flexicaulis	Zigzag Goldenrod	G5	S5		X	N																			X	
Solidago gigantea	Smooth Goldenrod	G5	S5		X	N													X							
Solidago nemoralis ssp. nemoralis	Gray-stemmed Goldenrod	G5T5	S5		X	N																			X	
Solidago rugosa var. rugosa	Northern Rough-leaved Goldenrod	G5T5	S5		X	N													X							
Solidago sp	Goldenrod Species								X	X	X		X			X	X			X				X		X
Sonchus arvensis ssp. arvensis	Field Sow-thistle	GNR TNR	SNA			I						X					X						X	X		
Sorbus aucuparia	European Mountain-ash	G5	SNA			I					X															
Sorbus decora	Northern Mountain-ash	G4G 5	S5		X	N				X																
Sorbus sp	Mountain-ash Species																							X		
Stellaria graminea	Grass-leaved Starwort	GNR	SNA			I											X									
Stellaria media	Common Chickweed	GNR	SNA			I																			X	
Symphoricarpos albus var. albus	Common Snowberry	G5T5	S5		X	N				X																
Symphyotrichum ericoides var. ericoides	White Heath Aster	G5T5	S5			N															X					X

Scientific Name (NHIC 2016)	Common Name (NHIC 2016)	GRANK	SRANK	City of Guelph (2012)	Wellington Status (2004)	Native Status	Polygon ID																		Stantec (2006)	NRSI (2012)
							1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
Symphyotrichum lanceolatum ssp. lanceolatum	Panicled Aster	G5T5	S5			N			X						X	X		X	X	X	X		X	X		X
Symphyotrichum lateriflorum	Starved Aster	G5	S5			N														X	X					X
Symphyotrichum novae-angliae	New England Aster	G5	S5		X	N				X		X	X				X			X	X					X
Symphyotrichum puniceum	Swamp Aster	G5	S5		X	N			X					X				X	X							
Symphytum officinale	Common Comfrey	GNR	SNA			I			X													X				
Syringa vulgaris	Common Lilac	GNR	SNA			I				X	X													X	X	X
Tanacetum vulgare	Common Tansy	GNR	SNA			I																			X	
Taraxacum ceratophorum	Horned Dandelion	G5T5	S5			N			X																	
Taraxacum officinale	Common Dandelion	G5	SNA			I	X	X	X		X	X										X			X	
Thalictrum dioicum	Early Meadow-rue	G5	S5		X	N			X													X				
Thalictrum pubescens	Tall Meadow-rue	G5	S5		X	N			X											X	X					
Thalictrum sp	Meadowrue Species											X	X													
Thlaspi arvense	Field Penny-cress	GNR	SNA			I																			X	
Thuja occidentalis	Eastern White Cedar	G5	S5		X	N		X	X	X	X	X	X	X		X	X			X			X	X	X	X
Tilia americana	American Basswood	G5	S5		X	N																			X	
Toxicodendron radicans	Climbing Poison Ivy	G5	S5			N											X									
Tragopogon pratensis	Meadow Goat's-beard	GNR	SNA			I			X																X	
Trifolium pratense	Red Clover	GNR	SNA			I																			X	
Tussilago farfara	Colt's-foot	GNR	SNA			I			X													X		X		
Typha angustifolia	Narrow-leaved Cattail	G5	SNA		X	I						X		X								X		X	X	X
Typha latifolia	Broad-leaved Cattail	G5	S5		X	N			X					X			X		X	X						X
Typha x glauca	(Typha angustifolia X Typha latifolia)	GNA	SNA		X	I			X																	
Ulmus americana	American Elm	G5?	S5		X	N			X		X	X					X								X	
Ulmus pumila	Siberian Elm	GNR	SNA			I																		X		
Ulmus thomasii	Rock Elm	G5	S4?		X	N																			X	
Urtica dioica ssp. dioica	European Stinging Nettle	G5T5 ?	SNA			I				X		X	X	X		X	X		X	X	X					X
Urtica dioica ssp. gracilis	Slender Stinging Nettle	G5T5	S5		X	N				X											X					X
Verbascum thapsus	Common Mullein	GNR	SNA			I			X			X	X				X			X		X			X	X
Verbena hastata	Blue Vervain	G5	S5		X	N						X	X	X			X			X	X		X		X	X
Verbena urticifolia	White Vervain	G5	S5		X	N							X					X							X	
Veronica officinalis	Common Speedwell	G5	SNA			I																			X	
Viburnum lantana	Wayfaring-tree	GNR	SNA			I					X	X												X		
Viburnum lentago	Nannyberry	G5	S5		X	N					X			X											X	
Viburnum opulus ssp. opulus	Cranberry Viburnum	GNR	SNA			I											X									
Viburnum opulus ssp. trilobum	Highbush Cranberry	GNR	S5		X	N																			X	

Scientific Name (NHIC 2016)	Common Name (NHIC 2016)	GRANK	SRANK	City of Guelph (2012)	Wellington Status (2004)	Native Status	Polygon ID																		Stantec (2006)	NRSI (2012)
							1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
Vicia cracca	Tufted Vetch	GNR	SNA			I						X							X	X	X		X		X	
Viola cucullata	Marsh Blue Violet	G4G5	S5		X	N						X														
Viola sp	Violet Species													X					X							
Vitis riparia	Riverbank Grape	G5	S5		X	N			X							X					X		X		X	X
Zanthoxylum americanum	Northern Prickley Ash	G5	S5		X	N																			X	

Global Conservation Status *(GRank)*

Global Conservation Status: *NatureServe Explorer* provides conservation status, taxonomy, distribution, and life history information for more than 70,000 plants, animals, and ecological communities and systems in the United States and Canada Natureserve (2014).

Global conservation status assessments (G-Ranks) generally are carried out by NatureServe scientists (including biologists in state and provincial member programs), with input from other experts. These assessments are widely used throughout the conservation community and are regarded as highly credible by scientists, government agencies and private-sector organizations. Status assessments are based on the best available information and consider a variety of factors such as species abundance, distribution, population trends and threats. (Documentation of the methods for developing these assessments is available at www.natureserve.org/explorer/ranking.htm).

G1 **Critically Imperiled**—At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.

G2 **Imperiled**—At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.

G3 **Vulnerable**—At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.

G4 **Apparently Secure**—Uncommon but not rare; some cause for long-term concern due to declines or other factors.

G5 **Secure**—Common; widespread and abundant.

G#G# **Range Rank**—A numeric range rank (e.g., G2G3) is used to indicate the range of uncertainty in the status of a species or community. Ranges cannot skip more than one rank (e.g., GU should be used rather than G1G4).

GU **Unrankable**—-Currently unrankable due to lack of information or due to substantially conflicting information about status or trends. Whenever possible, the most likely rank is assigned and the question mark qualifier is added (e.g., G2?) to express uncertainty, or a range rank (e.g., G2G3) is used to delineate the limits (range) of uncertainty.

GNR **Unranked**—Global rank not yet assessed.

GNA **Not Applicable**—A conservation status rank is not applicable because the species is not a suitable target for conservation activities.

? **Inexact Numeric Rank**—Denotes inexact numeric rank (e.g., G2?)

Q **Questionable taxonomy**—Taxonomic distinctiveness of this entity at the current level is questionable; resolution of this uncertainty may result in change from a species to a subspecies or hybrid, or the inclusion of this taxon in another taxon, with the resulting taxon having a lower-priority conservation priority.

C **Captive or Cultivated Only**—At present extant only in captivity or cultivation, or as a reintroduced population not yet established.

T# **Infraspecific Taxon** (trinomial)—The status of infraspecific taxa (subspecies or varieties) are indicated by a "T-rank" following the species' global rank. Rules for assigning T-ranks follow the same principles outlined above for global conservation status ranks. For example, the global rank of a critically imperiled subspecies of an otherwise widespread and common species would be G5T1. A T-rank cannot imply the subspecies or variety is more abundant than the species as a whole-for example, a G1T2 cannot occur. A vertebrate animal population, such as those listed as distinct population segments under under the U.S. Endangered Species Act, may be considered an infraspecific taxon and assigned a T-rank; in such cases a Q is used after the T-rank to denote the taxon's informal taxonomic status.

HYB **Hybrid** – Applied by Dougan & Associates to individuals of hybrid origin.

Provincial rarity ranks (i.e. Subnational or "SRanks") are evaluated & assigned by the (Ontario) Natural Heritage Information Centre (NHIC, 2014)

Provincial (or Subnational) ranks are used by the Natural Heritage Information Centre to set protection priorities for rare species and natural communities. These ranks are not legal designations. Provincial ranks are assigned in a manner similar to that described for global ranks, but consider only those factors within the political boundaries of Ontario. By comparing the global and provincial ranks, the status, rarity, and the urgency of conservation needs can be ascertained. The NHIC evaluates provincial ranks on a continual basis and produces updated lists at least annually

SX **Presumed Extirpated**—Species or community is believed to be extirpated from the nation or state/province. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered.

SH **Possibly Extirpated (Histor.ical)**—Species or community occurred historically in the nation or state/province, and there is some possibility that it may be rediscovered. Its presence may not have been verified in the past 20-40 years. A species or community could become NH or SH without such a 20-40 year delay if the only known occurrences in a nation or state/province were destroyed or if it had been extensively and unsuccessfully looked for. The NH or SH rank is reserved for species or communities for which some effort has been made to relocate occurrences, rather than simply using this status for all elements not known from verified extant occurrences.

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

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

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

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

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

SNR **Unranked**—Nation or state/province conservation status not yet assessed.

SU **Unrankable**—Currently unrankable due to lack of information or due to substantially conflicting information about status or trends.

SNA **Not Applicable** —A conservation status rank is not applicable because the species is not a suitable target for conservation activities.

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

Regional Conservation Status

Native Status (Newmaster et al. 1998; Oldham et al. 1995)

"N" = Plant is considered native to this region.

"I" = Plant has been introduced from another region.

Local Conservation Status

City of Guelph (2012)

R-A Included based on "rare" status (i.e., occurrence at between 1 and 10 natural sites in the County) in the Flora of Wellington County;

R-B Added as a plant record from post-1990 environmental studies within Guelph with global and/or provincial significance. (Anderson and Frank 2004, unpublished) and subsequent revisions by A. Anderson over 2005-2008;

R-C Added based on records provided by Mike Oldham (NHIC) for Wellington County in 2005, verification of records in OAC herbarium (Jan. - Feb. 2008) and supplementary review by Mike Oldham Dec. 2007 - Feb. 2008. R-D New record for Wellington County, assumed significant (observed during field work conducted by Dougan & Associates 2005-2006).

Wellington County 2009

Defined by the number of survey sites where the species was found.

R1 1-3 sites; **R2** 4-6 sites; **R3** 6-10 sites.

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Appendix H-4 - Tree Inventory Data Table

Tree Tag #	Scientific Name	Common Name	DBH1 [1] (cm)	DBH2	DBH3	DBH4	DBH5	DBH6	Crown Reserve [2] (m)	Height [3] (m)	Structural Condition [4]	Biological Health [5]	Preservation Priority [6]	Native Status [7]	Tree Action [8]	Compensation Required [9]	NAD83 UTM Zone 17N X Coordinate	Y Coordinate	Comments
1687	Acer negundo	Manitoba Maple	15	12	10				03-05	03-05	Low	High	Low	Introduced	Preserve	N/A	562973.9623	4822662.4481	overgrew dead cedar
1688	Thuja occidentalis	White Cedar	19	19	10				03-05	05-10	Medium	High	Medium	Native	Injure	Yes	562969.3361	4822659.4857	overgrew and replaced dead cedar
1689	Thuja occidentalis	White Cedar	15	15	12	10			03-05	05-10	Medium	High	Medium	Native	Preserve	N/A	562972.8552	4822657.2643	multi-stemmed clump
1690	Thuja occidentalis	Eastern White Cedar	20	20	20	15	12		03-05	05-10	Medium	Medium	Medium	Native	Preserve	N/A	562982.0564	4822653.5729	supressed and leaning
1691	Acer platanoides	Norway Maple	30						05-10	10-15	Medium	Medium	Low	Introduced	Preserve	N/A	562978.4742	4822653.0938	supressed
1692	Acer platanoides	Norway Maple	33						10-15	10-15	High	High	Medium	Introduced	Preserve	N/A	562976.6431	4822658.2247	
1693	Acer platanoides	Norway Maple	35						05-10	10-15	Medium	High	Medium	Introduced	Preserve	N/A	562982.1672	4822659.4770	
1694	Acer platanoides	Norway Maple	42						10-15	10-15	Medium	High	Medium	Introduced	Injure	Yes	562979.3442	4822665.1020	
1695	Thuja occidentalis	White Cedar	35	30					05-10	05-10	Medium	High	Medium	Native	Preserve	N/A	562985.9943	4822665.7171	leaning, forked low
1696	Thuja occidentalis	White Cedar	30	25	20	10			03-05	05-10	Medium	Medium	Medium	Native	Preserve	N/A	562984.8243	4822664.6210	multi-stemmed clump
1697	Thuja occidentalis	White Cedar	35	20	10	15			05-10	05-10	Low	High	Low	Native	Injure	Yes	562993.9825	4822684.3643	leaning over creek
1698	Thuja occidentalis	White Cedar	35	20					03-05	05-10	Low	Low	Low	Native	Preserve	N/A	562996.0715	4822687.7805	leaning over creek
1699	Rhamnus cathartica	European Buckthorn	15	20	12	10			03-05	03-05	Low	Low	Low	Introduced	Preserve	N/A	563013.7724	4822705.7081	dead limbs
1700	Acer negundo	Manitoba Maple	10						03-05	03-05	Low	Medium	Low	Introduced	Remove	Yes	563012.6490	4822711.4505	leaning over
1701	Acer saccharinum	Silver Maple	59						10-15	05-10	Medium	High	Medium	Native	Remove	Yes	563822.9950	4823534.3615	limb removed
1702	Acer saccharinum	Silver Maple	72						05-10	05-10	Medium	High	High	Native	Remove	Yes	563812.6110	4823523.7275	cavities
1703	Acer saccharinum	Silver Maple	73						05-10	10-15	Low	Medium	Low	Native	Remove	Yes	563801.9880	4823512.8015	crown dieback, rotting crotch, cut limbs
1704	Acer saccharinum	Silver Maple	73						05-10	10-15	Medium	High	High	Native	Remove	Yes	563791.8820	4823502.5955	broken branch , poor form
1705	Acer saccharinum	Silver Maple	67						05-10	10-15	Low	High	Medium	Native	Remove	Yes	563781.6080	4823491.4835	broken branch , potential rot in bole, uneven crown
1706	Acer platanoides	Norway Maple	65						05-10	10-15	Low	Medium	Low	Introduced	Remove	Yes	563770.9520	4823480.4735	cracked healing, large cavity, leaning
1707	Acer platanoides	Norway Maple	48						10-15	10-15	Low	Medium	Low	Introduced	Preserve	N/A	563745.3567	4823433.0478	crack, cavity, crown dieback
1708	Picea glauca	White Spruce	50						05-10	10-15	High	Medium	High	Native	Preserve	N/A	563736.3161	4823423.7938	dead tip
1709	Acer platanoides	Norway Maple	14						03-05	05-10	Medium	High	Medium	Introduced	Preserve	N/A	563717.6047	4823419.3962	rooted in rocks - unstable
1710	Acer platanoides	Norway Maple	17	18					05-10	05-10	Medium	High	Medium	Introduced	Injure	Yes	563721.9186	4823417.1266	2 stems
1711	Thuja occidentalis	White Cedar	25	11	13	7			03-05	05-10	Medium	High	High	Native	Preserve	N/A	563720.8214	4823413.0427	multistem - 4
1712	Acer saccharinum	Silver Maple	20	7	6				03-05	05-10	Medium	High	Medium	Native	Injure	Yes	563707.4977	4823404.9686	callused crack
1713	Acer saccharinum	Silver Maple	40						05-10	10-15	Medium	High	High	Native	Injure	Yes	563694.9574	4823380.3635	leaning slightly
1714	Acer saccharinum	Silver Maple	40						05-10	10-15	Medium	High	High	Native	Preserve	N/A	563687.9430	4823374.7441	wound healed over
1715	Picea pungens	Blue Spruce	45						05-10	10-15	Medium	High	High		Preserve	N/A	563670.0810	4823355.8406	leaning
1716	Acer saccharinum	Silver Maple	82						10-15	15-20	Medium	High	High	Native	Preserve	N/A	563643.4693	4823322.0997	minor dieback , poor form
1717	Ulmus americana	White Elm	17						05-10	10-15	Medium	High	High	Native	Preserve	N/A	563636.3160	4823327.9566	rooted into rocks, old shoots from base
1718	Picea pungens	Blue Spruce	45						05-10	10-15	High	High	High		Injure	Yes	563630.3375	4823328.5877	
1719	Acer saccharinum	Silver Maple	70						05-10	10-15	Low	Low	Low	Native	Preserve	N/A	563627.9392	4823321.1057	extensive dieback and decay
1720	Salix fragilis	Crack Willow	146						10-15	15-20	Low	Low	Low	Introduced	Preserve	N/A	563625.7434	4823315.5968	crown dieback, broken branchs, measured below split so smaller
1721	Thuja occidentalis	Eastern White Cedar	17						03-05	05-10	Medium	High	Medium	Native	Remove	Yes	563619.4221	4823323.3086	rooted into boulder
1722	Thuja occidentalis	White Cedar	49	28	25				05-10	10-15	Medium	High	Medium	Native	Injure	Yes	563616.9922	4823313.9633	multi-stemmed clump
1723	Ulmus americana	White Elm	14						03-05	05-10	Medium	Low	Low	Native	Preserve	N/A	563615.7751	4823307.6840	supressed, insect damage, dieback
1724	Thuja occidentalis	White Cedar	32						03-05	05-10	Low	Medium	Low	Native	Remove	Yes	563602.1838	4823308.6674	rotting cavity at base
1725	Ulmus americana	American Elm	10						01-03	05-10	Medium	High	Medium	Native	Remove	Yes	563591.3475	4823297.0080	growing from rocks
1726	Picea glauca	White Spruce	38						05-10	10-15	Medium	High	Medium	Native	Injure	Yes	563575.9532	4823277.3626	leaning slightly , no dieback
1726	Ulmus americana	American Elm	15	12					03-05	05-10	Medium	High	Medium	Native	Injure	Yes	563578.7045	4823285.3109	growing from rocks
1728	Pinus resinosa	Red Pine	67						05-10	10-15	Low	Medium	Low	Native	Injure	Yes	563559.3723	4823256.1359	pinunig? ticket creeper choking out
1729	Thuja occidentalis	White Cedar	17	16	14	12			03-05	05-10	Medium	High	Medium	Native	Preserve	N/A	563551.0467	4823248.8616	multi-stemmed clump,
1730	Pinus resinosa	Red Pine	62						05-10	05-10	Low	Low	Low	Native	Remove	Yes	563528.4002	4823234.0141	likely pinunig, dieback and dead limbs
1731	Acer saccharinum	Silver Maple	34						05-10	05-10	Low	Medium	Low	Native	Remove	Yes	563510.7350	4823211.2858	likely acer x freemanii, epicormic shoots , leaning
1732	Acer x freemanii	Hybrid Maple	26	10	7				03-05	05-10	High	High	High	Introduced	Preserve	N/A	563475.3098	4823171.7049	poor form but healthy
1733	Juniperus virginiana	Eastern Red Cedar	21						03-05	05-10	High	High	High	Native	Preserve	N/A	563459.2635	4823127.4567	
1734	Juniperus virginiana	Eastern Red Cedar	22						03-05	05-10	Medium	Medium	Medium	Native	Preserve	N/A	563464.2437	4823134.6385	minor dieback
1735	Picea pungens	Blue Spruce	32						03-05	15-20	High	Medium	Medium	Introduced	Remove	Yes	563473.0378	4823142.9099	dieback
1736	Picea abies	Norway Spruce	45						05-10	10-15	High	High	High	Introduced	Remove	Yes	563462.6929	4823148.7254	
1737	Picea abies	Norway Spruce	65						05-10	15-20	Medium	High	Medium	Introduced	Remove	Yes	563474.9610	4823152.1181	cavity at base
1738	Picea pungens	Blue Spruce	43						03-05	15-20	High	High	High	Introduced	Remove	Yes	563480.0159	4823158.9932	
1739	Thuja occidentalis	Eastern White Cedar	37	32	30	30	25		05-10	10-15	Medium	High	Medium	Native	Remove	Yes	563481.2015	4823155.4574	
1740	Pinus sylvestris	Scotch Pine	25						03-05	05-10	Medium	Medium	Low	Introduced	Remove	Yes	563496.2109	4823168.3592	
1741	Pinus sylvestris	Scotch Pine	25						03-05	05-10	Medium	Medium	Low	Introduced	Preserve	N/A	563499.1949	4823169.1282	
1742	Pinus sylvestris	Scotch Pine	34						05-10	05-10	Low	Low	Low	Introduced	Remove	Yes	563497.1945	4823169.9655	dieback
1743	Thuja occidentalis	Eastern White Cedar	15	13	7	7	7	7	05-10	05-10	Low	Medium	Low	Native	Preserve	N/A	563486.8368	4823181.0005	broken multistem
1744	Salix fragilis	Crack Willow	200						15-20	15-20	Low	Medium	Low	Introduced	Injure	Yes	563506.9012	4823190.9290	poor form, broken branches, crotch decay
1745	Pinus sylvestris	Scotch Pine	34						03-05	05-10	Medium	Medium	Medium	Introduced	Remove	Yes	563522.1996	4823190.4445	
1746	Acer saccharinum	Silver Maple	33						03-05	05-10	High	High	High	Native	Preserve	N/A	563520.2420	4823203.1380	
1747	Acer saccharinum	Silver Maple	19						03-05	05-10	Medium	High	High	Native	Preserve	N/A	563525.5181	4823207.1674	leaning
1748	Acer saccharinum	Silver Maple							15-20	15-20	Medium	High	High	Native	Preserve	N/A	563534.2358	4823215.1342	poor form but no decay
1749	Acer saccharinum	Silver Maple							10-15	15-20	Medium	Medium	Medium	Native	Preserve	N/A	563541.5353	4823214.2557	dieback , cut limb but no decay
1750	Acer saccharinum	Silver Maple	13						03-05	05-10	Medium	High	High	Native	Preserve	N/A	563537.5579	4823226.8732	wound on lower bole callusing
1751	Acer saccharinum	Silver Maple	88						15-20	15-20	Low	Medium	Low	Native	Preserve	N/A	563552.3770	4823230.9536	crown dieback , poor form
1752	Picea abies	Norway Spruce	48						05-10	15-20	High	High	High	Introduced	Preserve	N/A	563562.2303	4823239.0951	
1753	Picea glauca	White Spruce	30						03-05	05-10	High	High	High	Native	Remove	Yes	563560.5142	4823212.6556	
1754	Acer platanoides	Norway Maple	13	11	6				03-05	05-10	Low	High	Low	Introduced	Remove	Yes	563567.5243	4823218.7064	

Appendix H-4 - Tree Inventory Data Table

Tree Tag #	Scientific Name	Common Name	DBH1 [1] (cm)	DBH2	DBH3	DBH4	DBH5	DBH6	Crown Reserve [2] (m)	Height [3] (m)	Structural Condition [4]	Biological Health [5]	Preservation Priority [6]	Native Status [7]	Tree Action [8]	Compensation Required [9]	NAD83 UTM Zone 17N X Coordinate	Y Coordinate	Comments
1755	Acer platanoides	Norway Maple	12	10	9				03-05	05-10	Low	Medium	Low	Introduced	Remove	Yes	563566.6241	4823218.2915	
1756	Acer platanoides	Norway Maple	17	16					03-05	05-10	Low	Medium	Low	Introduced	Remove	Yes	563566.3163	4823218.4981	
1757	Acer platanoides	Norway Maple	11						01-03	05-10	Medium	Medium	Low	Introduced	Remove	Yes	563565.9015	4823219.0274	suppressed
1758	Acer platanoides	Norway Maple	11						03-05	05-10	Low	Low	Low	Introduced	Remove	Yes	563565.1889	4823217.5867	
1759	Acer platanoides	Norway Maple	10						01-03	05-10	Medium	Medium	Low	Introduced	Remove	Yes	563566.7251	4823219.1628	suppressed
1760	Acer platanoides	Norway Maple	13	10	6				03-05	05-10	Low	Low	Low	Introduced	Remove	Yes	563569.6538	4823221.0447	
1761	Acer platanoides	Norway Maple	16	13	11	10			03-05	05-10	Low	Medium	Low	Introduced	Remove	Yes	563571.6062	4823222.7444	
1762	Acer negundo	Manitoba Maple	22	25					03-05	05-10	Low	High	Low	Introduced	Remove	Yes	563583.4214	4823234.6835	
1763	Picea abies	Norway Spruce	24						03-05	10-15	High	High	High	Introduced	Remove	Yes	563591.5741	4823239.9815	
1764	Picea abies	Norway Spruce	30						03-05	10-15	High	High	High	Introduced	Remove	Yes	563592.6899	4823240.7427	
1765	Picea abies	Norway Spruce	20						03-05	10-15	High	High	High	Introduced	Remove	Yes	563593.6079	4823241.2978	
1766	Picea abies	Norway Spruce	33						03-05	10-15	High	High	High	Introduced	Preserve	N/A	563596.1458	4823240.5294	
1767	Picea abies	Norway Spruce	30						03-05	05-10	High	High	High	Introduced	Preserve	N/A	563597.5470	4823241.0895	
1768	Acer saccharinum	Silver Maple	121						15-20	15-20	Medium	Medium	Medium	Native	Preserve	N/A	563567.0234	4823245.5253	dieback , poor form
1769	Salix fragilis	Crack Willow	39	120					10-15	15-20	Low	Low	Low	Introduced	Preserve	N/A	563582.4800	4823259.7036	falling apart, dead limbs
1770	Acer saccharinum	Silver Maple	47						05-10	10-15	Medium	High	Medium	Native	Remove	Yes	563603.0563	4823258.5818	poor form, some wounds healng
1771	Pinus strobus	Eastern White Pine	34						03-05	10-15	Low	Low	Low	Native	Preserve	N/A	563591.2484	4823267.8957	almost dead
1772	Thuja occidentalis	Eastern White Cedar	25						03-05	05-10	High	High	High	Native	Preserve	N/A	563580.6962	4823271.6301	
1773	Thuja occidentalis	Eastern White Cedar	17	11	9	8			03-05	05-10	Medium	High	High	Native	Preserve	N/A	563584.7281	4823267.2157	
1774	Thuja occidentalis	Eastern White Cedar	34						03-05	10-15	Medium	High	High	Native	Preserve	N/A	563585.8337	4823278.3555	
1775	Thuja occidentalis	Eastern White Cedar	32	31					05-10	10-15	Medium	High	High	Native	Preserve	N/A	563591.6857	4823275.7822	
1776	Thuja occidentalis	Eastern White Cedar	27	24	20				05-10	10-15	Medium	High	High	Native	Preserve	N/A	563588.0669	4823280.6722	
1777	Acer saccharinum	Silver Maple	94						10-15	15-20	Low	Low	Low	Native	Preserve	N/A	563589.4733	4823284.7608	large cavity. good wildlife tree, extensive dieback
1778	Thuja occidentalis	Eastern White Cedar	32	35	22	19			05-10	10-15	Medium	High	High	Native	Preserve	N/A	563591.7809	4823285.3763	
1779	Thuja occidentalis	Eastern White Cedar	34	38	32	30	28	17	05-10	10-15	Low	High	Medium	Native	Preserve	N/A	563597.3516	4823282.2977	large burl, cracked but healing
1780	Thuja occidentalis	Eastern White Cedar	34	25					05-10	10-15	Medium	High	High	Native	Preserve	N/A	563597.6361	4823293.4038	
1781	Thuja occidentalis	Eastern White Cedar	34	40					05-10	05-10	Medium	High	Medium	Native	Preserve	N/A	563605.8300	4823297.4940	leaning over creek
1782	Thuja occidentalis	Eastern White Cedar	34	29					05-10	10-15	Medium	High	Medium	Native	Preserve	N/A	563604.7720	4823294.9408	cracked but healing
1783	Thuja occidentalis	Eastern White Cedar	68						05-10	10-15	Medium	High	High	Native	Preserve	N/A	563614.5197	4823282.9233	geocache
1784	Thuja occidentalis	Eastern White Cedar	43						03-05	10-15	Medium	High	High	Native	Preserve	N/A	563632.1060	4823302.2487	leaning
1785	Salix fragilis	Crack Willow	11						03-05	05-10	Medium	High	Low	Introduced	Preserve	N/A	563640.9832	4823313.0896	over creek
1786	Acer platanoides	Norway Maple	39						05-10	05-10	Medium	High	Medium	Introduced	Preserve	N/A	563651.2130	4823318.2456	crimson, crooked trunk
1787	Thuja occidentalis	Eastern White Cedar	20	20	18	18	17	17	05-10	10-15	Medium	High	High	Native	Preserve	N/A	563655.4666	4823326.1820	over creek
1788	Acer platanoides	Norway Maple	40						05-10	10-15	Medium	High	Medium	Introduced	Preserve	N/A	563662.4587	4823331.2762	crimson, crackedhealing
1789	Salix fragilis	Crack Willow	200						10-15	15-20	Low	Medium	Low	Introduced	Preserve	N/A	563683.6789	4823352.2176	minor dieback , broken limbs
1790	Acer saccharinum	Silver Maple	36						05-10	10-15	Medium	High	High	Native	Remove	Yes	563693.8720	4823352.1065	
1791	Acer platanoides	Norway Maple	43						05-10	05-10	Medium	High	Medium	Introduced	Remove	Yes	563695.8812	4823364.2742	crimson
1792	Thuja occidentalis	Eastern White Cedar	60						03-05	10-15	Low	High	Medium	Native	Remove	Yes	563703.1745	4823372.3902	big crack
1793	Acer saccharinum	Silver Maple	38						05-10	10-15	Medium	High	High	Native	Preserve	N/A	563709.3974	4823367.3970	
1794	Thuja occidentalis	Eastern White Cedar	40						03-05	10-15	Medium	High	Medium	Native	Preserve	N/A	563708.9263	4823377.0113	cracked
1795	Picea pungens	Blue Spruce	60						05-10	10-15	High	High	High	Introduced	Preserve	N/A	563716.6701	4823377.2835	
1796	Malus sp	Apple Species	24						03-05	05-10	Low	Medium	Low	Genus	Preserve	N/A	563717.5278	4823387.4371	dead limb, rotting
1797	Acer platanoides	Norway Maple	51	15	12				10-15	10-15	Medium	High	Medium	Introduced	Remove	Yes	563716.5813	4823390.1456	leaning , cracked
1798	Acer platanoides	Norway Maple	57						10-15	10-15	Medium	High	Medium	Introduced	Preserve	N/A	563750.4191	4823401.1209	girdling roots, old crack
1799	Acer platanoides	Norway Maple	47						10-15	10-15	Low	Medium	Low	Introduced	Preserve	N/A	563747.0611	4823408.8004	crown dieback
1800	Acer platanoides	Norway Maple	62						05-10	10-15	Low	Medium	Low	Introduced	Preserve	N/A	563746.7801	4823416.8876	large crack, dieback
1801	Acer platanoides	Norway Maple	62						05-10	10-15	Low	Medium	Low	Introduced	Preserve	N/A	563745.8113	4823425.3641	dieback, decay, cracked
1802	Acer saccharinum	Silver Maple	66						10-15	10-15	Medium	High	High	Native	Preserve	N/A	563468.4653	4823122.4220	
1803	Liriodendron tulipifera	Tulip Tree	38						05-10	05-10	Medium	High	High	Native	Remove	Yes	563445.0795	4823110.1395	
1804	Ulmus americana	American Elm	16						03-05	05-10	Medium	Low	Low	Native	Preserve	N/A	563430.0634	4823117.1238	
1805	Acer platanoides	Norway Maple	59						05-10	03-05	Low	Medium	Low	Introduced	Remove	Yes	563402.5307	4823097.0672	topped
1806	Thuja occidentalis	Eastern White Cedar	32	28					03-05	05-10	Medium	High	Medium	Native	Remove	Yes	563389.8391	4823081.7717	probably tree 346 from the previous NRSI survey
1807	Acer saccharinum	Silver Maple	109						10-15	15-20	Low	Medium	Low	Native	Remove	Yes	563381.1365	4823078.9259	broken leader , rotting , poor form, dieback ; probably tree 345 from previous NRSI study
1808	Acer platanoides	Norway Maple	41						05-10	05-10	High	Medium	Medium	Introduced	Injure	Yes	563361.5565	4823068.3440	probably tree 342 from the previous NRSI survey
1809	Acer platanoides	Norway Maple	40						05-10	05-10	Medium	Medium	Medium	Introduced	Injure	Yes	563356.6094	4823064.0186	minor dieback ; probably tree 341 from the previous NRSI survey
1810	Acer saccharinum	Silver Maple	28						05-10	10-15	Medium	Medium	Medium	Native	Injure	Yes	563351.9701	4823058.0064	minor dieback , crack; potentially tree 340 from NRSI survey but NRSI had species list as Silver Maple
1811	Acer platanoides	Norway Maple	46						05-10	10-15	High	High	High	Introduced	Injure	Yes	563347.1917	4823054.6370	probably tree 339 from previous NRSI survey
1812	Acer platanoides	Norway Maple	29						05-10	05-10	Low	Medium	Low	Introduced	Injure	Yes	563331.9291	4823037.5192	dieback , healed crack; probably Tree 388 from previous NRSI survey
1813	Acer platanoides	Norway Maple	22						03-05	05-10	Medium	Medium	Medium	Introduced	Injure	Yes	563325.6744	4823032.1802	minor dieback ; probably tree 337 from previous NRSI survey
1814	Acer saccharinum	Silver Maple	49						05-10	10-15	High	High	High	Native	Remove	Yes	563333.7216	4823022.7946	Identifed as tree 336 in previous NRSI survey.
1815	Acer saccharinum	Silver Maple	38	32					05-10	10-15	Medium	Medium	Medium	Native	Remove	Yes	563329.7618	4823021.2363	moderate dieback in crown ; Identifed as tree 335 in previous NRSI survey.
1816	Acer saccharinum	Silver Maple	34	26					05-10	10-15	Medium	Medium	Medium	Native	Remove	Yes	563324.8277	4823011.9753	crown dieback
1817	Acer platanoides	Norway Maple	35						03-05	05-10	High	Medium	Medium	Introduced	Injure	Yes	563310.7349	4823015.9774	minor dieback
1818	Acer platanoides	Norway Maple	26						03-05	05-10	Medium	Medium	Low	Introduced	Remove	Yes	563236.2122	4822940.3561	dieback

Appendix H-4 - Tree Inventory Data Table

Tree Tag #	Scientific Name	Common Name	DBH1 [1] (cm)	DBH2	DBH3	DBH4	DBH5	DBH6	Crown Reserve [2] (m)	Height [3] (m)	Structural Condition [4]	Biological Health [5]	Preservation Priority [6]	Native Status [7]	Tree Action [8]	Compensation Required [9]	NAD83 UTM Zone 17N X Coordinate	Y Coordinate	Comments
1819	Acer saccharinum	Silver Maple	47						05-10	05-10	Medium	Medium	Medium	Native	Remove	Yes	563209.7541	4822905.8035	dieback
1820	Acer saccharinum	Silver Maple	45						05-10	05-10	Medium	Medium	Medium	Native	Remove	Yes	563197.3529	4822890.0943	epicormic shoots
1821	Acer saccharinum	Silver Maple	67						10-15	10-15	Low	Medium	Low	Native	Remove	Yes	563192.2734	4822878.1606	broken limbs , cracked , large cavity
1822	Picea pungens	Blue Spruce	32						03-05	10-15	High	High	High		Remove	Yes	563183.7015	4822875.9544	
1823	Picea pungens	Blue Spruce	40						03-05	10-15	Medium	High	Medium		Remove	Yes	563181.8616	4822862.6471	lean over creek
1824	Acer platanoides	Norway Maple	23						03-05	05-10	Low	Low	Low	Introduced	Remove	Yes	563176.1946	4822858.8306	cavity, leaning, epicormic shoots
1825	Acer platanoides	Norway Maple	38						05-10	05-10	High	Medium	Medium	Introduced	Remove	Yes	563172.1456	4822860.3478	minor dieback
1826	Acer platanoides	Norway Maple	29						03-05	05-10	Low	Low	Low	Introduced	Remove	Yes	563172.4982	4822855.7159	cracked, extensive dieback
1827	Acer platanoides	Norway Maple	40						05-10	05-10	Medium	Medium	Low	Introduced	Remove	Yes	563166.7072	4822855.6318	open wound, dieback
1828	Acer saccharinum	Silver Maple	31						05-10	05-10	Low	Low	Low	Native	Remove	Yes	563124.3733	4822820.3635	beaver damage and dieback
1829	Acer saccharinum	Silver Maple	36						05-10	05-10	Medium	Low	Low	Native	Remove	Yes	563113.0478	4822806.2261	dieback and wounds
1830	Acer platanoides	Norway Maple	35						05-10	05-10	Medium	High	Medium	Introduced	Remove	Yes	563058.9030	4822761.0525	cracked
1831	Acer saccharinum	Silver Maple	125						10-15	15-20	Medium	High	High	Native	Preserve	N/A	563097.1606	4822758.8756	
1832	Acer saccharinum	Silver Maple	123						10-15	15-20	Low	Medium	Low	Native	Remove	Yes	563078.7661	4822740.9106	half of tree broken off
1833	Acer saccharinum	Silver Maple	50						05-10	10-15	Low	Medium	Low	Native	Preserve	N/A	563078.8025	4822720.1933	broken, split bole
1834	Acer saccharinum	Silver Maple	50						05-10	10-15	Medium	High	High	Native	Preserve	N/A	563093.3624	4822734.7288	leaning
1835	Acer saccharinum	Silver Maple	51						05-10	10-15	Medium	High	High	Native	Preserve	N/A	563100.4628	4822745.1241	leaning slightly
1836	Acer platanoides	Norway Maple	25						03-05	05-10	Low	Low	Low	Introduced	Remove	Yes	563132.4442	4822789.3962	
1837	Acer platanoides	Norway Maple	24						03-05	05-10	Medium	Low	Low	Introduced	Remove	Yes	563133.0866	4822795.3445	
1838	Acer platanoides	Norway Maple	26						03-05	05-10	Low	Medium	Low	Introduced	Remove	Yes	563139.5212	4822801.0078	dieback , cracked healing
1839	Picea abies	Norway Spruce	20						03-05	05-10	High	High	High	Introduced	Remove	Yes	563140.8414	4822817.6488	
1840	Picea abies	Norway Spruce	25						03-05	05-10	High	High	High	Introduced	Remove	Yes	563143.4145	4822817.9019	
1841	Picea abies	Norway Spruce	18						03-05	05-10	High	High	High	Introduced	Remove	Yes	563141.2621	4822819.5942	
1842	Picea pungens	Blue Spruce	10	13	20				03-05	05-10	Medium	High	High	Introduced	Remove	Yes	563154.4716	4822810.4363	fallen tree that resprouted
1843	Picea pungens	Blue Spruce	18						01-03	05-10	Medium	High	Medium	Introduced	Remove	Yes	563173.3080	4822835.4385	leaning
1844	Picea abies	Norway Spruce	20						01-03	05-10	Medium	High	Medium	Introduced	Remove	Yes	563172.2537	4822832.0166	leaning
1845	Acer negundo	Manitoba Maple	14						03-05	05-10	Medium	High	Medium	Introduced	Remove	Yes	563182.8064	4822838.1419	
1846	Picea abies	Norway Spruce	17						03-05	05-10	Medium	High	Medium	Introduced	Remove	Yes	563184.8657	4822837.2592	
1847	Picea pungens	Blue Spruce	45						03-05	05-10	High	High	High	Introduced	Remove	Yes	563190.9958	4822855.1377	
1848	Acer saccharinum	Silver Maple	36						05-10	05-10	Low	Low	Low	Native	Remove	Yes	563204.8715	4822858.3019	
1849	Thuja occidentalis	Eastern White Cedar	26	30	23	18			03-05	05-10	Low	Medium	Low	Native	Remove	Yes	563224.4243	4822884.9911	fallen over
1850	Acer saccharinum	Silver Maple	73						10-15	15-20	High	High	High	Native	Remove	Yes	563237.8559	4822897.5194	
1851	Acer saccharinum	Silver Maple	110						15-20	15-20	Low	Medium	Medium	Native	Remove	Yes	563266.2309	4822928.2342	
1852	Picea glauca	White Spruce	35						03-05	10-15	High	Medium	Medium	Native	Remove	Yes	563273.4678	4822926.7560	some dieback on lower crown
1853	Thuja occidentalis	Eastern White Cedar	18						01-03	05-10	Low	Low	Low	Native	Remove	Yes	563283.0081	4822943.9484	dieback
1854	Thuja occidentalis	Eastern White Cedar	23	18					03-05	05-10	Medium	High	Medium	Native	Remove	Yes	563286.0349	4822933.7810	
1855	Thuja occidentalis	Eastern White Cedar	30	20	22	15			03-05	05-10	Medium	High	High	Native	Preserve	N/A	563288.1816	4822929.8029	
1856	Picea pungens	Blue Spruce	50						03-05	10-15	High	High	High	Introduced	Remove	Yes	563289.9840	4822938.6377	
1857	Picea pungens	Blue Spruce	40	30					03-05	10-15	High	Medium	Medium	Introduced	Preserve	N/A	563306.2175	4822942.3261	
1858	Picea abies	Norway Spruce	35						03-05	05-10	Medium	Low	Low	Introduced	Remove	Yes	563301.9722	4822954.7117	
1859	Picea abies	Norway Spruce	35						03-05	05-10	Medium	Low	Low	Introduced	Injure	Yes	563323.4734	4822965.0625	dieback
1860	Picea pungens	Blue Spruce	45						03-05	10-15	Medium	Low	Low	Introduced	Remove	Yes	563317.6314	4822983.7788	
1861	Acer saccharinum	Silver Maple							05-10	10-15	Low	Low	Low	Native	Remove	Yes	563329.4340	4822994.7347	decayed, broken
1862	Picea pungens	Blue Spruce	35						03-05	05-10	Medium	Medium	Medium	Introduced	Remove	Yes	563337.0250	4823002.8805	overgrown, dieback
1863	Acer saccharinum	Silver Maple	67						05-10	10-15	Medium	Medium	Medium	Native	Injure	Yes	563359.3656	4822999.3240	dieback
1864	Pinus sylvestris	Scotch Pine	30						03-05	15-20	Medium	Medium	Low	Introduced	Remove	Yes	563354.1335	4823015.7424	small cracks, broken limbs
1865	Pinus sylvestris	Scotch Pine	30						03-05	15-20	Medium	Medium	Low	Introduced	Remove	Yes	563356.0543	4823017.8038	small cracks, broken limbs
1866	Acer saccharinum	Silver Maple	115						10-15	15-20	Medium	High	High	Native	Remove	Yes	563358.3492	4823020.1020	minor dieback , poor form
1867	Acer saccharinum	Silver Maple	81						10-15	10-15	Medium	High	Medium	Native	Remove	Yes	563352.4424	4823033.5735	cavity and decay
1868	Acer saccharinum	Silver Maple	110						10-15	15-20	Medium	High	Medium	Native	Remove	Yes	563372.8473	4823033.7790	included bark split
1869	Acer saccharinum	Silver Maple	95						10-15	15-20	High	High	High	Native	Remove	Yes	563380.2072	4823035.2334	
1870	Thuja occidentalis	Eastern White Cedar	20	18					03-05	05-10	Medium	High	Medium	Native	Remove	Yes	563378.5853	4823040.1736	supressed
1871	Acer saccharinum	Silver Maple	135						10-15	15-20	Low	Medium	Medium	Native	Remove	Yes	563383.2764	4823049.0024	poor form, split
1872	Thuja occidentalis	Eastern White Cedar	32						03-05	05-10	High	Medium	Medium	Native	Remove	Yes	563383.0721	4823051.4031	cracked healing
1873	Thuja occidentalis	Eastern White Cedar	23	14					03-05	03-05	Medium	Medium	Low	Native	Remove	Yes	563381.0194	4823051.5526	suppressed, rotting base
1874	Acer saccharinum	Silver Maple	25						05-10	05-10	Medium	Medium	Medium	Native	Remove	Yes	563389.8163	4823058.7342	epicormic shoots
1875	Acer saccharinum	Silver Maple	105						10-15	15-20	Low	Medium	Medium	Native	Remove	Yes	563402.1819	4823065.8105	decay, poor form
1876	Thuja occidentalis	Eastern White Cedar	33	35	16				03-05	05-10	Medium	High	Medium	Native	Remove	Yes	563404.8502	4823069.5949	
1877	Thuja occidentalis	Eastern White Cedar	23	28					03-05	10-15	Medium	Medium	Medium	Native	Remove	Yes	563401.8799	4823071.3898	
1878	Thuja occidentalis	Eastern White Cedar	17	13					03-05	05-10	Medium	Medium	Medium	Native	Remove	Yes	563417.7185	4823087.9712	callused wounds , leaning over , supressed
1879	Thuja occidentalis	Eastern White Cedar	14						01-03	03-05	Low	Medium	Low	Native	Remove	Yes	563417.3696	4823088.6119	callused wounds , leaning over , supressed
1880	Thuja occidentalis	Eastern White Cedar	13						01-03	03-05	High	High	High	Native	Remove	Yes	563420.4848	4823088.4496	suppressed , leaning over slightly
1881	Thuja occidentalis	Eastern White Cedar	11						01-03	03-05	Medium	High	Medium	Native	Remove	Yes	563420.7191	4823088.7175	suppressed , leaning
1882	Thuja occidentalis	Eastern White Cedar	16						01-03	03-05	Low	Low	Low	Native	Remove	Yes	563420.3984	4823086.3639	suppressed , leaning
1883	Thuja occidentalis	Eastern White Cedar	16	14					03-05	05-10	Medium	High	Medium	Native	Remove	Yes	563421.0928	4823085.6256	suppressed , leaning
1884	Thuja occidentalis	Eastern White Cedar	16						01-03	05-10	Low	Low	Low	Native	Remove	Yes	563427.4147	4823083.0728	bark mostly gone, but callused
1885	Thuja occidentalis	Eastern White Cedar	14						01-03	05-10	Low	Medium	Low	Native	Remove	Yes	563429.4010	4823083.1829	
1886	Thuja occidentalis	Eastern White Cedar	11						01-03	03-05	Medium	Medium	Medium	Native	Remove	Yes	563425.5007	4823085.1538	suppressed , leaning
1887	Thuja occidentalis	Eastern White Cedar	11						01-03	03-05	Medium	Low	Low	Native	Remove	Yes	563426.1388	4823085.5649	suppressed , leaning
1888	Thuja occidentalis	Eastern White Cedar	13						01-03	05-10	Low	Medium	Low	Native	Remove	Yes	563422.9414	4823085.7484	suppressed , leaning

Tree Tag #	Scientific Name	Common Name	DBH1 [1] (cm)	DBH2	DBH3	DBH4	DBH5	DBH6	Crown Reserve [2] (m)	Height [3] (m)	Structural Condition [4]	Biological Health [5]	Preservation Priority [6]	Native Status [7]	Tree Action [8]	Compensation Required [9]	NAD83 UTM Zone 17N X Coordinate	Y Coordinate	Comments
1889	Thuja occidentalis	Eastern White Cedar	19						01-03	05-10	Low	Medium	Low	Native	Remove	Yes	563429.4847	4823081.4314	minor dieback , leaning over
1890	Thuja occidentalis	Eastern White Cedar	26						01-03	03-05	Low	Medium	Low	Native	Remove	Yes	563430.1324	4823080.0301	1 broken limbs
1891	Acer platanoides	Norway Maple	132						10-15	15-20	Medium	High	Medium	Introduced	Remove	Yes	563435.7548	4823087.6466	overall healthy tree but spreading form and cracked codomjnant stems may fail
1892	Acer saccharinum	Silver Maple	100	100					10-15	15-20	Low	Medium	Low	Native	Remove	Yes	563429.6037	4823087.5224	2nd stem broken and recently fallen, decay and included bark in fork, other limb may fail
1893	Prunus virginiana	Choke Cherry	12	10					01-03	03-05	Low	Low	Low	Native	Remove	Yes	563428.2216	4823091.3996	Decay and large wound
1894	Acer saccharinum	Silver Maple	140						10-15	15-20	Low	Medium	Low	Native	Remove	Yes	563419.7388	4823089.5750	forked above 2m, broken limbs , 2 lateral limbs are main concern, minor dieback in crown
1895	Picea abies	Norway Spruce	55		22				05-10	15-20	High	High	High	Introduced	Preserve	N/A	563444.3072	4823097.7137	
1896	Sorbus decora	Northern Mountain-ash	27	23	22				05-10	10-15	Medium	Medium	Low	Native	Preserve	N/A	563445.0023	4823102.9035	spreading , suppressed , epicormic shoots - see photos to confrim species
1897	Juniperus communis	Ground Juniper	13						03-05	01-03	Low	0	Low	Native	Preserve	N/A	563447.4755	4823105.8497	spreading
1898	Thuja occidentalis	Eastern White Cedar	26	19					03-05	05-10	Medium	High	Medium	Native	Preserve	N/A	563437.7992	4823115.5716	
1899	Juniperus communis	Ground Juniper	12						03-05	01-03	Medium	High	Medium	Native	Preserve	N/A	563449.7349	4823106.5089	spreading , pruned
1900	Thuja occidentalis	Eastern White Cedar	27						03-05	05-10	Low	Medium	Low	Native	Preserve	N/A	563032.5983	4822728.6638	Tree number 318 in previous NRSI survey.
332	Ulmus americana	White Elm	81						26					Native	N/A		563272.9117	4822970.9858	Tree not present. Removed since previous NRSI survey.
343	Thuja occidentalis	White Cedar	24						3					Native	N/A		563375.3264	4823076.3021	Tree not present. Removed since previous NRSI survey.
344	Thuja occidentalis	White Cedar	32						5					Native	N/A		563376.6087	4823077.1895	Tree not present. Removed since previous NRSI survey.
348	Thuja occidentalis	White Cedar	28											Native	N/A		563517.5017	4823214.3147	dead
349	Thuja occidentalis	White Cedar	32						6					Native	N/A		563530.0140	4823225.4592	dead
355	Thuja occidentalis	White Cedar	48											Native	N/A		563609.6207	4823311.2965	Tree not present. Removed since previous NRSI survey.
357	Ulmus americana	White Elm	13						6					Native	N/A		563625.4857	4823312.4179	dead
358	Ulmus americana	White Elm	12						3					Native	N/A		563621.9067	4823311.6855	dead
360	Ulmus americana	White Elm	12						8					Native	N/A		563628.2240	4823309.7201	dead
366	Ulmus americana	White Elm	145						10					Native	N/A		563632.3933	4823310.9801	dead

Tree Assessment Criteria

1 DBH (cm): Diameter at breast height, 1.4 m above ground, measured in centimetres.

2 Crown Reserve (m): Crown diameter (tree's canopy) measured at intervals of 1, 3, 5, 7.5, 10, 15 metres

3 Height (m): Height of tree from ground to top of crown.

4 Structural Condition: Related to defects in a tree's structure, (i.e., lean, codominant trunks).
High - No structural defects, well-developed crown.
Medium - Presence of minor structural defects.
Low - Presence of major structural defects including drastic leans and imminent branch and/or trunk failure.

5 Biological Health: Related to presence and extent of disease/disease symptoms and the vigour of the tree.
High - No diseases/disease symptoms present, and moderate to high vigour.
Medium - Presence of minor diseases/disease symptoms, and/or moderate vigour.
Low - Presence of major diseases/disease symptoms, (i.e., extensive crown dieback), and/or severely poor vigour.

6. Preservation Priority: A rating of each tree's projected survival related to existing conditions.
High - High to moderate biological health, and well developed crown. Well suited as a shade tree or screen planting. Will survive existing conditions indefinitely.
Medium - One or more moderate to severe defects in biological health and/or structural condition. Marginally suited as a shade tree or screen planting. Can survive at least 3 - 5 years under existing conditions.
This category also includes stock planted within past 2 years that is not yet established.
Low - Low biological health and/or severely damaged/defective structural condition, and/or unsuitable for urban uses. If biologically defective, survival for more than 1-3 years under existing conditions is unlikely.

7 Native Status:
Native – Native to Ontario
Introduced – Not native to Ontario
Genus - Unable to identify species level due to lack of key characteristics at the time of survey.
Source: NHIC (Natural Heritage Information Centre). 2009. Ontario Vascular Plant Species List. Biodiversity Explorer Online Database. Ontario Ministry of Natural Resources.

8. Tree Action:
Preserve - Trees that have a dripline that is substantially outside the limits of disturbance (less than 30% of the crown reserve will be impacted) and having moderate to high Preservation Priority. Protection of the entire root zone of the tree is desirable.
Injure - Impacts due to grading and/or construction may encroach into more than 30% of crown reserve and cause significant damage within the root zone; preserve and protect with fencing as far as possible from the tree trunk; monitor during and following construction.
Remove - Any tree for which at least 30% of the dripline is within the limits of disturbance, has low biological health, and/or severe structural defects, and is not likely to survive more than 1-3 years, and/or will not survive proposed development.
N/A - Not applicable. During the 2016 D&A arborist assessment the tree was either dead or not present, removed since NRSI survey.

9. Compensation Required:
Yes; 1:1 ratio or $500 per tree removed - Yes, compensation is required for this tree removal. A 1:1 ratio is required as per City of Guelph Tree By-Law (2010) 19058.
No - Species is exempted from compensation due to being an invasive exotic as per City of Guelph Tree By-Law (2010) 19058.

Appendix I-1: Wildlife Species List from Available Background Resources.

Natural Resources Solutions Inc. (2013)	Stantec (2006)	NHIC (2015)	OMNRF (Guelph District) SAR Records (2015)	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 – Wildlife SAR (2015)	Clythe Creek Subwatershed Overview (Ecologistics Ltd. and Blackport and Associates,1998)	Common Name	Scientific Name	COSEWIC (2013)	OMNR F (2014)	GRANK (Nature Serve, 2014)	Srank (OMNRF , 2013 Update)	BCR 13 Priority Landbir d Sp. (OPIF, 2008)	Wellingto n County (D&A 2009) (*i.e.* local rarity only)	Area Sensitivity (OMNR, 2000)
Insects:																		
		1								Painted Skimmer	*Libellula semifasciata*	---	---	G5	S2	n/a	X	n/a
							1			Common Sootywing	*Pholisora catullus*	---	---	G5	S3	n/a	X	n/a
							1			Little Glassywing	*Pompeius verna*	---	---	G5	S4	n/a	X	n/a
							1			Delaware Skipper	*Anatrytone logan*	---	---	G5	S4	n/a	X	n/a
							1			Dion Skipper	*Euphyes dion*	---	---	G4	S3	n/a	X	n/a
							1			Black Dash	*Euphyes conspicua*	---	---	G4	S3	n/a	X	n/a
							1			Giant Swallowtail	*Papilio cresphontes*	---	---	G5	S3	n/a	X	n/a
							1	1		West Virginia White	*Pieris virginiensis*	---	SC	G3G4	S3	n/a	X	n/a
1										Cabbage White	*Pieris rapae*	---	---	G5	SNA	n/a		n/a
							1			Hickory Hairstreak	*Satyrium caryaevorum*	---	---	G4	S3	n/a	X	n/a
1										Mourning Cloak	*Nymphalis antiopa*	---	---	G5	S5	n/a		n/a
1										Red Admiral	*Vanessa atalanta*	---	---	G5	S5	n/a		n/a
1							1	1		Monarch	*Danaus plexippus*	SC	SC	G5	S2N,S4B	n/a	X	n/a
Amphibians:																		
						1				Mudpuppy	*Necturus maculosus*	NAR	NAR	G5	S4	n/a	X	---
						1				Red-spotted Newt	*Notophthalmus viridescens viridescens*	---	---	G5T5	S5	n/a	X	---
						1		1	1	Jefferson Salamander	*Ambystoma jeffersonianum*	END	END	G4	S2	n/a	X	---
						1				Blue-spotted Salamander	*Ambystoma laterale*	---	---	G5	S4	n/a	X	---
						1				Four-toed Salamander	*Hemidactylium scutatum*	NAR	NAR	G5	S4	n/a	X	---
						1				Western Chorus Frog (Great Lakes/St. Lawrence - Canadian Shield Pop.)	*Pseudacris triseriata*	THR	NAR	G5	S3	n/a	X	---
						1				American Bullfrog	*Lithobates catesbeianus*	---	---	G5	S4	n/a	X	AS
						1				Pickerel Frog	*Lithobates palustris*	NAR	NAR	G5	S4	n/a	X	---
Reptiles:																		
			1			1		1		Snapping Turtle	*Chelydra serpentina*	SC	SC	G5	S3	n/a		---
						1		1		Blanding's Turtle	*Emydoidea blandingii*	THR	THR	G4	S3	n/a	X	---
		1				1				Northern Map Turtle	*Graptemys geographica*	SC	SC	G5	S3	n/a	X	AS
		1	1			1		1		Eastern Milksnake	*Lampropeltis t. triangulum*	SC	SC	G5	S3	n/a	X	---
						1				Smooth Greensnake	*Opheodrys vernalis*	---	---	G5	S4	n/a	X	---
						1				Northern Watersnake	*Nerodia sipedon sipedon*	NAR	NAR	G5T5	S5	n/a	X	---
						1				DeKay's Brownsnake	*Storeria dekayi*	NAR	NAR	G5	S5	n/a	X	---
						1				Northern Red-bellied Snake	*Storeria o. occipitomaculata*	---	---	G5	S5	n/a	X	---
		1				1		1		Northern Ribbonsnake	*Thamnophis sauritus septentrionalis*	SC	SC	G5	S3	n/a	X	---
Birds:																		
									1	Northern Bobwhite	*Colinus virginianus*	END	END	G5	S1	PLS	X	---
				1					1	Least Bittern	*Ixobrychus exilis*	THR	THR	G5	S4B	---	X	AS
				1				1		Bald Eagle	*Haliaeetus leucocephalus*	NAR	SC	G4	S2N,S4B	PLS	X	AS
									1	Red-shouldered Hawk	*Buteo lineatus*	NAR	NAR	G5	S4B	PLS	X	AS
				1				1		Common Nighthawk	*Chordeiles minor*	THR	SC	G5	S4B	---	X	---
				1				1		Chimney Swift	*Chaetura pelagica*	THR	THR	G5	S4B,S4N	PLS		---

Appendix I-1: Wildlife Species List from Available Background Resources.

Natural Resources Solutions Inc. (2013)	Stantec (2006)	NHIC (2015)	OMNRF (Guelph District) SAR Records (2015)	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 – Wildlife SAR (2015)	Clythe Creek Subwatershed Overview (Ecologistics Ltd. and Blackport and Associates,1998)	**Common Name**	**Scientific Name**	**COSEWIC** (2013)	**OMNRF** (2014)	**GRANK** (Nature Serve, 2014)	**Srank** (OMNRF, 2013 Update)	**BCR 13 Priority Landbird Sp.** (OPIF, 2008)	**Wellington County** (D&A 2009) (*i.e.* local rarity only)	**Area Sensitivity** (OMNR, 2000)
1										Belted Kingfisher	*Megaceryle alcyon*	---	---	G5	S4B	PLS		---
				1				1		Red-headed Woodpecker	*Melanerpes erythrocephalus*	THR	SC	G5	S4B	PLS	X	---
				1				1		Eastern Wood-Pewee	*Contopus virens*	SC	SC	G5	S4B	PLS		---
1										Eastern Kingbird	*Tyrannus tyrannus*	---	---	G5	S4B	PLS		---
				1				1		Bank Swallow	*Riparia riparia*	THR	THR	G5	S4B	PLS		---
				1				1		Barn Swallow	*Hirundo rustica*	THR	THR	G5	S4B	---		---
				1				1		Wood Thrush	*Hylocichla mustelina*	THR	SC	G5	S4B	PLS		---
								1		Golden-winged Warbler	*Vermivora chrysoptera*	THR	SC	G4	S4B	PLS	X	---
1										American Redstart	*Setophaga ruticilla*	---	---	G5	S5B	---		AS
								1		Canada Warbler	*Cardellina canadensis*	THR	SC	G5	S4B	PLS	X	AS
				1				1		Yellow-breasted Chat	*Icteria virens*	END	END	G5	S2B	PLS	X	---
				1						Grasshopper Sparrow	*Ammodramus savannarum*	SC	---	G5	S4B	PLS	X	AS
									1	Henslow's Sparrow	*Ammodramus henslowii*	END	END	G4	SHB	PLS	X	AS
1	1									Dark-eyed Junco	*Junco hyemalis*	---	---	G5	S5B	---	X	---
	1									Northern Cardinal	*Cardinalis cardinalis*	---	---	G5	S5	---		---
				1				1		Bobolink	*Dolichonyx oryzivorus*	THR	THR	G5	S4B	PLS		AS
				1				1		Eastern Meadowlark	*Sturnella magna*	THR	THR	G5	S4B	PLS		AS
Mammals:																		
					1				1	Smoky Shrew	*Sorex fumeus*	---	---	G5	S5	n/a		---
					1					Water Shrew	*Sorex palustris*	---	---	G5	S5	n/a	X	---
					1					Hairy-tailed Mole	*Parascalops breweri*	---	---	G5	S4	n/a	X	---
					1					Star-nosed Mole	*Condylura cristata*	---	---	G5	S5	n/a		---
					1			1		Small-footed Bat	*Myotis leibii*	---	END	G3	S2S3	n/a	X	---
					1			1		Little Brown Myotis	*Myotis lucifugus*	END	END	G5	S4	n/a		---
					1			1		Northern Myotis	*Myotis septentrionalis*	END	END	G4	S3	n/a	X	---
					1					Silver-haired Bat	*Lasionycteris noctivagans*	---	---	G5	S4	n/a		---
					1					Red Bat	*Lasiurus borealis*	---	---	G5	S4	n/a		---
					1					Hoary Bat	*Lasiurus cinereus*	---	---	G5	S4	n/a		---
					1					Snowshoe Hare	*Lepus americanus*	---	---	G5	S5	n/a	X	---
					1					Northern Flying Squirrel	*Glaucomys sabrinus*	---	---	G5	S5	n/a	X	AS
					1					Southern Flying Squirrel	*Glaucomys volans*	SC	NAR	G5	S4	n/a	X	AS
					1					Deer Mouse	*Peromyscus maniculatus*	---	---	G5	S5	n/a		---
					1					Woodland Vole	*Microtus pinetorum*	SC	SC	G5	S3?	n/a	X	---
					1					Woodland Jumping Mouse	*Napaeozapus insignis*	---	---	G5	S5	n/a	X	---
					1					Long-tailed Weasel	*Mustela frenata*	---	---	G5	S4	n/a	X	---

LEGEND:

COSEWIC: THR - Threatened; SC - Special Concern; NAR - assessed and deemed to be not at risk; --- = not assessed as population secure
OMNRF: THR - Threatened; SC - Special Concern; NAR - assessed and deemed to be not at risk; --- = not assessed as population secure
Global Granks: G3 - vulnerable; G4 - apparently secure; G5 - secure;
Provincial Sranks: S3 - vulnerable; S4 - apparently secure; S5 - secure; SNA - non-native exotic; B –breeding; N -; SH - Possibly Extirpated (Historical)

OPIF: PLS - Priority Landbird Species
Wellington County: X - rare
Area Sensitivity: AS = Area Sensitive species

Appendix I-2: Screening for Known/Candidate SWH at York Road Environmental Design site – using Ecoregion 6E Criteria Schedule (Final version: OMNRF, January 2015)

Significant Wildlife Habitat (SWH) Type	ELC Categories indicated for SWH Type	SWH present on site or within 120 m?	Rationale (Habitat Presence or Absence)	Additional field studies required?
	Seasonal Concentration Areas of Animals			
Waterfowl Stopover and Staging Areas (Terrestrial)	CUM1; CUT1; plus evidence of spring (Mar – May) flooding; does not include AGR	No	No suitable habitats were detected on site or in adjacent lands during field visits.	No
Waterfowl Stopover and Staging Areas (Aquatic)	MAS1; MAS2; MAS3; SAS1; SAM1; SAF1; SWD1; SWD2; SWD3; SWD4; SWD5; SWD6; SWD7	No	Habitat available in two main ponds and adjacent Eramosa River; however, indicator species diversity and numbers unlikely to exceed significance thresholds.	No
Shorebird Migratory Stopover Area	BB01; BB02; BBS1; BBS3; BBT1; BBT2; SDO1; SDS2; SDT1; MAM1; MAM2; MAM3; MAM4; MAM5	No	No suitable habitats were detected on site or in adjacent lands during field visits.	No
Raptor Wintering Area	One of FOD, FOM, FOC and one of CUM, CUT, CUS, CUW (20+ ha); least disturbed sites 15+ ha with adjacent woodlands; BAEA: FOD, FOM, FOC, SWD or SWC on shoreline areas adjacent to large rivers or adjacent to lakes with open water	No	Open areas have suitable wintering habitats for raptors; however, they do not meet size thresholds for both open areas and adjacent woodlands. Bald Eagle may winter along adjacent Eramosa River but would not be present at the site as the main ponds would freeze in winter.	No
Bat Hibernacula	BBBA/TRBA only; CCR1; CCR2; CCA1; CCA2; does not include buildings	No	No suitable habitats were found on site or in adjacent lands.	No
Bat Maternity Colonies	BBBA/SHBA only; all FOD, FOM, SWD, SWM; 10+ ha AND 25+ cm dbh	No	No FOD or FOM habitats of greater than 10 hectares are present on site or in adjacent lands.	No
Bat Migratory Stopover Area	No specific ELC types	No	No landforms present to concentrate migrant bats although they may move along the Eramosa River; note that MNRF has not yet determined thresholds/criteria for this category.	No
Turtle Wintering Areas	SNTU/PATU: SW, MA, OA, SA; FEO and BOO; NMTU: open water areas (e.g. deeper rivers, streams) and lakes with current can also be used as over-wintering habitat.	Candidate	Open waters of the two main ponds and the adjacent Eramosa River could serve as over-wintering habitat for Painted Turtle and Snapping Turtle (both confirmed from the site).	No

Appendix I-2: Screening for Known/Candidate SWH at York Road Environmental Design site – using Ecoregion 6E Criteria Schedule (Final version: OMNRF, January 2015)

Significant Wildlife Habitat (SWH) Type	ELC Categories indicated for SWH Type	SWH present on site or within 120 m?	Rationale (Habitat Presence or Absence)	Additional field studies required?
Reptile Hibernaculum	Snakes: any ecosite except very wet ones; talus, rock barren, crevice, cave, and alvar site may be directly related; FLSK: FOD, FOM and FOC1/FOC3	No	No suitable habitats were detected on site or in adjacent lands during field visits.	No
Colonially - Nesting Bird Breeding Habitat (Bank and Cliff)	CUM1, CUS1, BLS1, CLO1, CLT1; CUT1; BLO1; BLT1; CLS1	No	No suitable habitats were detected on site or in adjacent lands during field visits.	No
Colonially - Nesting Bird Breeding Habitat (Tree/Shrubs)	SWM2; SWM3; SWM5; SWM6; SWD1; SWD2; SWD3; SWD4; SWD5; SWD6; SWD7; FET1	No	No suitable habitats were detected on site or in adjacent lands during field visits.	No
Colonially - Nesting Bird Breeding Habitat (Ground)	MAM1 – 6; MAS1 – 3; CUM; CUS; CUT	No	No suitable habitats were detected on site or in adjacent lands during field visits.	No
Migratory Butterfly Stopover Areas	Field: CUM, CUS, CUT; Forest: FOC, FOD, FOM, CUT; 10+ ha, within 5 km of Lake Ontario	No	No combination of field and forest of sufficient size found within site and adjacent lands; site not within 5 km of Lake Ontario.	No
Landbird Migratory Stopover Areas	FOC, FOM, FOD, SWC, SWM, SWD; 10+ ha, within 5 km of Lake Ontario	No	No woodlands greater than 10 ha within site or adjacent lands; site not within 5 km of Lake Ontario.	No
Deer Yarding Areas	FOM, FOC, SWM, SWC; CUP2, CUP3, FOD3, CUT; identified by MNRF	No	No suitable habitats were detected on site or in adjacent lands during field visits. None have been identified in area by MNRF.	No
Deer Winter Congregation Areas	FOC; FOM; FOD; SWC; SWM; SWD; typically 100+ ha; identified by MNRF	No	No suitable habitats were detected on site or in adjacent lands during field visits. None have been identified in area by MNRF.	No
Rare Vegetation Communities				
Cliffs and Talus Slopes	TAO; TAS; TAT; CLO; CLS; CLT	No	None identified on site or in adjacent lands.	No
Sand Barren	SBO1; SBS1; SBT1	No	None identified on site or in adjacent lands.	No
Alvar	ALO1; ALS1; ALT1; FOC1; FOC2; CUM2; CUS2; CUT2-1; CUW2; 0.5+ ha	No	None identified on site or in adjacent lands.	No
Old Growth Forest	FOD; FOC; FOM; SWC; SWD; SWM; 30+ ha with 10+ ha IF (100m buffer)	No	None identified on site or in adjacent lands.	No
Savannah	TPS1; TPS2; TPW1; TPW2; CUS2	No	None identified on site or in adjacent lands.	No
Tallgrass Prairie	TPO1; TPO2	No	None identified on site or in adjacent lands.	No

Appendix I-2: Screening for Known/Candidate SWH at York Road Environmental Design site – using Ecoregion 6E Criteria Schedule (Final version: OMNRF, January 2015)

Significant Wildlife Habitat (SWH) Type	ELC Categories indicated for SWH Type	SWH present on site or within 120 m?	Rationale (Habitat Presence or Absence)	Additional field studies required?
Other Rare Vegetation Communities	S1, S2, or S3 vegetation communities	No	None identified on site or in adjacent lands.	No
	Specialized Habitat for Wildlife			
Waterfowl Nesting Area	MAS1; MAS2; MAS3; SAS1; SAM1; SAF1; MAM1; MAM2; MAM3; MAM4; MAM5; MAM6; SWT1; SWT2; SWD1; SWD2; SWD3; SWD4	No	Potential habitat found within site; no nesting waterfowl were detected during 2016 breeding bird surveys. If present, the number and diversity of indicator species not likely to exceed significance thresholds.	No
Bald Eagle and Osprey Nesting, Foraging, and Perching Habitat	FOD; FOM; FOC; SWD; SWM; SWC; adjacent to riparian areas (rivers, lakes, ponds and wetlands)	No	No suitable habitats were detected on site or in adjacent lands during field visits; likely habitat along Eramosa River. No Bald Eagles or Ospreys or their nests were detected during the breeding bird surveys in 2016.	No
Woodland Raptor Nesting Habitat	All forested ELC ecosites; also SWC, SWM, SWD, CUP3; 30+ ha with 10+ ha IF (200m buffer)	No	No forest sites of adequate size for breeding woodland raptors are located within the sites or their adjacent lands.	No
Turtle Nesting Areas	MAM1; MAM2; MAM3; MAM4; MAM5; MAM6; SAS1; SAM1; SAF1; BOO1; FEO1	Candidate	Potential nesting areas occur along the Eramosa River and in open areas with sand and gravel. No suitable habitat was observed along Clythe Creek.	No
Seeps and Springs	Any forested ecosite within headwater area of stream	No	None identified on sites or in adjacent lands during field investigations.	No
Amphibian Breeding Habitat (Woodland)	FOC; FOM; FOD; SWC; SWM; SWD	No	No suitable habitats were detected on sites or in adjacent lands during field visits.	No
Amphibian Breeding Habitat (Wetlands)	SW, MA, FE, BO, OA, SA; typically 120+ from woodlands (except AMBU)	No	The two main ponds serve as breeding habitat for several common and widespread amphibian species; however, the number and diversity detected during the 2016 nocturnal amphibian surveys did not meet significance thresholds.	No
Woodland Area-Sensitive Bird Breeding Habitat	FOC, FOM, FOD, SWC, SWM, SWD; mature (60+ years), 30+ ha; IF 200+ m from edge	No	No large enough woodlands (30+ ha) with interior forest (greater than 200 m from edge) and 60+ years old are present on sites or in adjacent lands.	No
	Habitats for Species of Conservation Concern (not including END or THR species)			

Appendix I-2: Screening for Known/Candidate SWH at York Road Environmental Design site – using Ecoregion 6E Criteria Schedule (Final version: OMNRF, January 2015)

Significant Wildlife Habitat (SWH) Type	ELC Categories indicated for SWH Type	SWH present on site or within 120 m?	Rationale (Habitat Presence or Absence)	Additional field studies required?
Marsh Breeding Bird Habitat	MAM1; MAM2; MAM3; MAM4; MAM5; MAM6; SAS1; SAM1; SAF1; FEO1; BOO1; GRHE – all SW, MA, CUM1 sites	No	No suitable habitats were detected on site or in adjacent lands during field visits. No indicator species were detected during 2016 breeding bird surveys.	No
Open Country Bird Breeding Habitat	CUM1; CUM2; 30+ ha; not Class 1 or 2 AGR or actively used for farming in last 5 years	No	No CUM1 or CUM2 habitat of greater than 30 hectares in size found in study area or adjacent lands. No indicator species were found during BBS in 2016.	No
Shrub/Early Successional Bird Breeding Habitat	CUT1; CUT2; CUS1; CUS2; CUW1; CUW2; 10+ ha; not Class 1 or 2 AGR or actively used for farming in last 5 years	No	No suitable ELC categories of sufficient size exist within the study area and adjacent lands; only one indicator species (Willow Flycatcher) found during BBS in 2016.	No
Terrestrial Crayfish	MAM1; MAM2; MAM3; MAM4; MAM5; MAM6; MAS1; MAS2; MAS3; SWT; SWD; SWM; CUM1 with inclusions of above MAM or swamp ecosites can be used by crayfish	No	No suitable habitats were detected on site or in adjacent lands during field visits	No
Special Concern and Rare Wildlife Species	SC and S1, S2, S3, and SH species	Candidate	Only one Special Concern species was found during the 2016 field investigations: Snapping Turtle. No S1 to S3 species of fauna were observed in 2016. Monarch (SC) may occur in non-significant numbers during migration and may also breed as Common Milkweed is present. No suitable habitat exists for other SC species known from the City of Hamilton (e.g., Common Nighthawk, Eastern Wood-Pewee, Canada Warbler).	No
	Animal Movement Corridors			
Amphibian Movement Corridors	All ecosites associated with water	Candidate	Small numbers of amphibians were detected in the two main ponds in 2016; amphibian movement would not be to the north as no habitat exists in that direction. Eramosa River, immediately to the south, likely serves as an amphibian movement corridor.	No
Deer Movement Corridors	All forested ecosites; Stratum II Deer Wintering Areas have potential to contain corridors.	No	Such corridors are within Stratum II yarding areas, typically following riparian zones, woodlots, and ravines/ridges, and are unbroken by roads and	No

Appendix I-2: Screening for Known/Candidate SWH at York Road Environmental Design site – using Ecoregion 6E Criteria Schedule (Final version: OMNRF, January 2015)

Significant Wildlife Habitat (SWH) Type	ELC Categories indicated for SWH Type	SWH present on site or within 120 m?	Rationale (Habitat Presence or Absence)	Additional field studies required?
			residential areas. Therefore, no deer movement corridors occur on the sites or in adjacent lands.	

Common Name	Scientific Name	Conservation Status						Covered by MBCA (1994) (Government of Canada 1994)	Area Sensitivity (OMNR, 2000)	Breeding Evidence (OBBA 2001)	Notes
		National	Provincial			Local					
		COSEWIC Designation (COSEWIC 2015)	OMNRF Designation (OMNRF 2016)	Srank (NHIC 2016)	Checklist of Ontario Butterflies (Jones 2012)	Regional Municipality of Waterloo Herpetofauna, Mammals & Birds - (RMW 1985a,b; 1996	Wellington County (local rarity only) (D&A 2009)				
Butterflies:											
Least Skipper	*Ancyloxypha numitor*	---	---	S5	C, L, Re			n/a	n/a	n/a	
European Skipper	*Thymelicus lineola*	---	---	SNA	C, Re			n/a	n/a	n/a	
Tawny-edged Skipper	*Polites themistocles*	---	---	S5	C, Re			n/a	n/a	n/a	
Eastern Tiger Swallowtail	*Papilio glaucus*	---	---	S5	C, Re			n/a	n/a	n/a	
Black Swallowtail	*Papilio polyxenes*	---	---	S5	C, Re			n/a	n/a	n/a	
Cabbage White	*Pieris rapae*	---	---	SNA	C, E, Re			n/a	n/a	n/a	
Spring Azure	*Celastrina lucia*	---	---	S5	C, Re			n/a	n/a	n/a	
Pearl Crescent	*Phyciodes tharos*	---	---	S4	C, Re			n/a	n/a	n/a	
Mourning Cloak	*Nymphalis antiopa*	---	---	S5	C, Re			n/a	n/a	n/a	
Painted Lady	*Vanessa cardui*	---	---	S5	R-C, BI			n/a	n/a	n/a	
Red Admiral	*Vanessa atalanta*	---	---	S5	U-C, BI			n/a	n/a	n/a	
Common Ringlet	*Coenonympha tullia*	---	---	S5	C, Re			n/a	n/a	n/a	
Monarch	*Danaus plexippus*	SC	SC	S2	C, BI		X	n/a	n/a	n/a	Two seen in northeast field on June 17 only; Common Milkweed is present in this area so potentially breeding.
Amphibians:											
American Toad	*Anaxyrus americanus*	---	---	S5	n/a			n/a	n/a	n/a	Recorded in small numbers (1 to 3) from survey station 2 on April 21 and May 9
Spring Peeper	*Pseudacris crucifer*	---	---	S5	n/a			n/a	n/a	n/a	Recorded in small numbers (two or less) from survey station 2 on April 21 and May 9 and survey station 3 on May 9
Northern Leopard Frog	*Lithobates pipiens*	---	---	S5	n/a			n/a	n/a	n/a	Observed in small numbers during diurnal surveys
Green Frog	*Lithobates clamitans*	---	---	S5	n/a			n/a	n/a	n/a	Recorded in small numbers in four areas outside of the three survey stations on June 21 only
Reptiles:											
Midland Painted Turtle	*Chrysemys picta marginata*	---	---	S4	n/a			n/a	n/a	n/a	
Snapping Turtle	*Chelydra serpentina*	SC	SC	S3	n/a			n/a	n/a	n/a	One seen on June 17 in small easternmost pond; carapace approximately 15 cm.
Pond Slider	*Trachemys scripta*	---	---	SNA	n/a			n/a	n/a	n/a	
Eastern Gartersnake	*Thamnophis sirtalis sirtalis*	---	---	S5	n/a			n/a	n/a	n/a	
Birds:											
Canada Goose	*Branta canadensis*	---	---		n/a			Y	---	PROBABLE	
Mute Swan	*Cygnus olor*	---	---	SNA	n/a			Y	---	POSSIBLE	
Mallard	*Anas platyrhynchos*	---	---	S5	n/a			Y	---	PROBABLE	
Ring-necked Duck	*Aythya collaris*	---	---	S5	n/a	p	X	Y	---	M	One female seen on May 20 only.
Great Blue Heron	*Ardea herodias*	---	---	S4	n/a	U	X	Y	---	X	Seen flying over site only; no colonies detected.
Green Heron	*Butorides virescens*	---	---	S4	n/a	U		Y	---	X	Seen flying ove site only.
Turkey Vulture	*Cathartes aura*	---	---	S5	n/a	U	X	N	---	X	Seen flying over site only.
Osprey	*Pandion haliaetus*	---	---	S5	n/a	p	X	N	---	X	Seen foraging over both main ponds; no evidence of nest on-site but is likely nesting locally.
Sharp-shinned Hawk	*Accipiter striatus*	NAR	NAR	S5	n/a	R		N	AS	M	One bird seen on May 3 was migrating over site.
Red-tailed Hawk	*Buteo jamaicensis*	NAR	NAR	S5	n/a			N	---	PROBABLE	One pair present.
Killdeer	*Charadrius vociferus*	---	---	S5	n/a			Y	---	PROBABLE	

Common Name	Scientific Name	Conservation Status						Covered by MBCA (1994) (Government of Canada 1994)	Area Sensitivity (OMNR, 2000)	Breeding Evidence (OBBA 2001)	Notes
		National	Provincial			Local					
		COSEWIC Designation (COSEWIC 2015)	OMNRF Designation (OMNRF 2016)	Srank (NHIC 2016)	Checklist of Ontario Butterflies (Jones 2012)	Regional Municipality of Waterloo Herpetofauna, Mammals & Birds - (RMW 1985a,b; 1996	Wellington County (local rarity only) (D&A 2009)				
Spotted Sandpiper	*Actitis macularius*	---	---	S5	n/a			Y	---	PROBABLE	
American Woodcock	*Scolopax minor*	---	---	S5	n/a			Y	---	POSSIBLE	Detected during nocturnal amphibian survey.
Herring Gull	*Larus argentatus*	---	---	S5	n/a		X	Y	---	X	Seen flying over site only; no colonies detected.
Rock Pigeon	*Patagioena livia*	---	---	SNA	n/a			N	---	X	
Mourning Dove	*Zenaida macroura*	---	---	S5	n/a			Y	---	PROBABLE	
Chimney Swift	*Chaetura pelagica*	THR	THR	S4	n/a			Y	---	POSSIBLE	Up to three birds seen foraging over the main ponds on May 20, June 3, and June 17; no suitable nesting sites (e.g. chimneys) detected but are present locally.
Belted Kingfisher	*Megaceryle alcyon*	---	---	S4	n/a	U		Y	---	PROBABLE	One pair present along Eramosa River and creek.
Downy Woodpecker	*Picoides pubescens*	---	---	S5	n/a			Y	---	POSSIBLE	
Northern Flicker	*Colaptes auratus*	---	---	S4	n/a			Y	---	PROBABLE	
Willow Flycatcher	*Empidonax traillii*	---	---	S5	n/a	U		Y	---	PROBABLE	
Great Crested Flycatcher	*Myiarchus crinitus*	---	---	S4	n/a			Y	---	POSSIBLE	
Eastern Kingbird	*Tyrannus tyrannus*	---	---	S4	n/a			Y	---	PROBABLE	Three pairs present.
Warbling Vireo	*Vireo gilvus*	---	---	S5	n/a	U		Y	---	PROBABLE	
Blue Jay	*Cyanocitta cristata*	---	---	S5	n/a			N	---	PROBABLE	
American Crow	*Corvus brachyrhynchos*	---	---	S5	n/a			N	---	PROBABLE	
Tree Swallow	*Tachycineta bicolor*	---	---	S4	n/a			Y	---	PROBABLE	
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	---	---	S4	n/a			Y	---	PROBABLE	
Barn Swallow	*Hirundo rustica*	THR	THR	S4	n/a			Y	---	PROBABLE	Up to eight birds seen foraging over baseball fields and northeast fields; no suitable structures for nesting are present on site but they are available locally.
Black-capped Chickadee	*Poecile atricapillus*	---	---	S5	n/a			Y	---	PROBABLE	
House Wren	*Troglodytes aedon*	---	---	S5	n/a			Y	---	PROBABLE	
American Robin	*Turdus migratorius*	---	---	S5	n/a			Y	---	CONFIRMED	Fledged young observed.
Gray Catbird	*Dumetella carolinensis*	---	---	S4	n/a			Y	---	PROBABLE	
European Starling	*Sturnus vulgaris*	---	---	SNA	n/a			N	---	CONFIRMED	Fledged young observed.
Cedar Waxwing	*Bombycilla cedrorum*	---	---	S5	n/a			Y	---	PROBABLE	
Common Yellowthroat	*Geothlypis trichas*	---	---	S5	n/a			Y	---	PROBABLE	
Yellow Warbler	*Setophaga petechia*	---	---	S5	n/a			Y	---	PROBABLE	
Chipping Sparrow	*Spizella passerina*	---	---	S5	n/a			Y	---	PROBABLE	
Savannah Sparrow	*Passerculus sandwichensis*	---	---	S4	n/a			Y	AS	PROBABLE	Two pairs present along south end of baseball fields.
Song Sparrow	*Melospiza melodia*	---	---	S5	n/a			Y	---	CONFIRMED	Fledged young observed.
Swamp Sparrow	*Melospiza georgiana*	---	---	S5	n/a	U		Y	---	PROBABLE	
Northern Cardinal	*Cardinalis cardinalis*	---	---	S5	n/a			Y	---	CONFIRMED	Fledged young observed.
Indigo Bunting	*Passerina cyanea*	---	---	S4	n/a			Y	---	PROBABLE	
Red-winged Blackbird	*Agelaius phoeniceus*	---	---	S4	n/a			N	---	PROBABLE	
Eastern Meadowlark	*Sturnella magna*	THR	THR	S4	n/a			Y	AS	PROBABLE	One pair present on both breeding bird surveys in northeast field.
Common Grackle	*Quiscalus quiscula*	---	---	S5	n/a			N	---	CONFIRMED	Fledged young observed.
Brown-headed Cowbird	*Molothrus ater*	---	---	S4	n/a			N	---	CONFIRMED	Fledged young observed.
Baltimore Oriole	*Icterus galbula*	---	---	S4	n/a			Y	---	PROBABLE	
American Goldfinch	*Spinus tristis*	---	---	S5	n/a			Y	---	PROBABLE	

Common Name	Scientific Name	Conservation Status						Covered by MBCA (1994) (Government of Canada 1994)	Area Sensitivity (OMNR, 2000)	Breeding Evidence (OBBA 2001)	Notes
		National	Provincial			Local					
		COSEWIC Designation (COSEWIC 2015)	OMNRF Designation (OMNRF 2016)	Srank (NHIC 2016)	Checklist of Ontario Butterflies (Jones 2012)	Regional Municipality of Waterloo Herpetofauna, Mammals & Birds - (RMW 1985a,b; 1996	Wellington County (local rarity only) (D&A 2009)				
House Sparrow	*Passer domesticus*	---	---	SNA	n/a			N	---	PROBABLE	
Mammals:											
Gray Squirrel	*Sciurus carolinensis*	---	---	S5	n/a			n/a	n/a	n/a	
Beaver	*Castor canadensis*	---	---	S5	n/a			n/a	n/a	n/a	
Raccoon	*Procyon lotor*	---	---	S5	n/a			n/a	n/a	n/a	

WEATHER AND SURVEY TIMES:

Nocturnal amphibian survey 1 - April 21, 2016; 20:44 – 21:18; Cloudy, calm, 11 – 14 °C

Snake & turtle survey 1 - May 3, 2016; 10:00 - 15:00; clear to partly cloudy, calm, 9 - 14 °C

Nocturnal amphibian survey 2 - May 9, 2016; 21:13 – 21:45; Partly cloudy, calm, 9 – 11 °C

Snake & turtle survey 2 - May 20, 2016; 10:30 - 15:30; partly cloudy, light north winds, 17 - 20 °C

Breeding bird survey (BBS) 1 - June 3, 2016; 06:15 - 09:45; clear, calm, 16 - 19 °C

Breeding bird survey (BBS) 2 - June 17, 2016; 06:30 - 10:00; clear, calm, 17 - 20 °C

Nocturnal amphibian survey 3 - June 21, 2016; 21:47 – 22:16; Partly cloudy, calm, 21 °C

LEGEND:

COSEWIC: THR - Threatened; SC - Special Concern; NAR - assessed and deemed to be not at risk; --- = not assessed as population secure

OMNRF: THR - Threatened; SC - Special Concern; NAR - assessed and deemed to be not at risk; --- = not assessed as population secure

Provincial Sranks: S2 - imperiled; S3 - vulnerable; S4 - apparently secure; S5 - secure; SNA - non-native exotic

Area Sensitivity: AS = Area Sensitive species

OBBA 2001: X - species observed flying over site only and not considered a potential breeder; M - migrant only (not breeding)

Jones 20102 - C - common; L - local; R - rare; Re - resident; E - exotic (non-native, introduced); BI - migrant (does not winter)

RMW 1985/1996 - U - uncommon; R - rare; p - probable

D&A 2009: X - rare

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RMW (Regional Municipality of Waterloo). 1985a. Appendix 3: Reptiles and Amphibians in Environmentally Sensitive Policy Areas Technical Appendix. Approved by Council: 1986.

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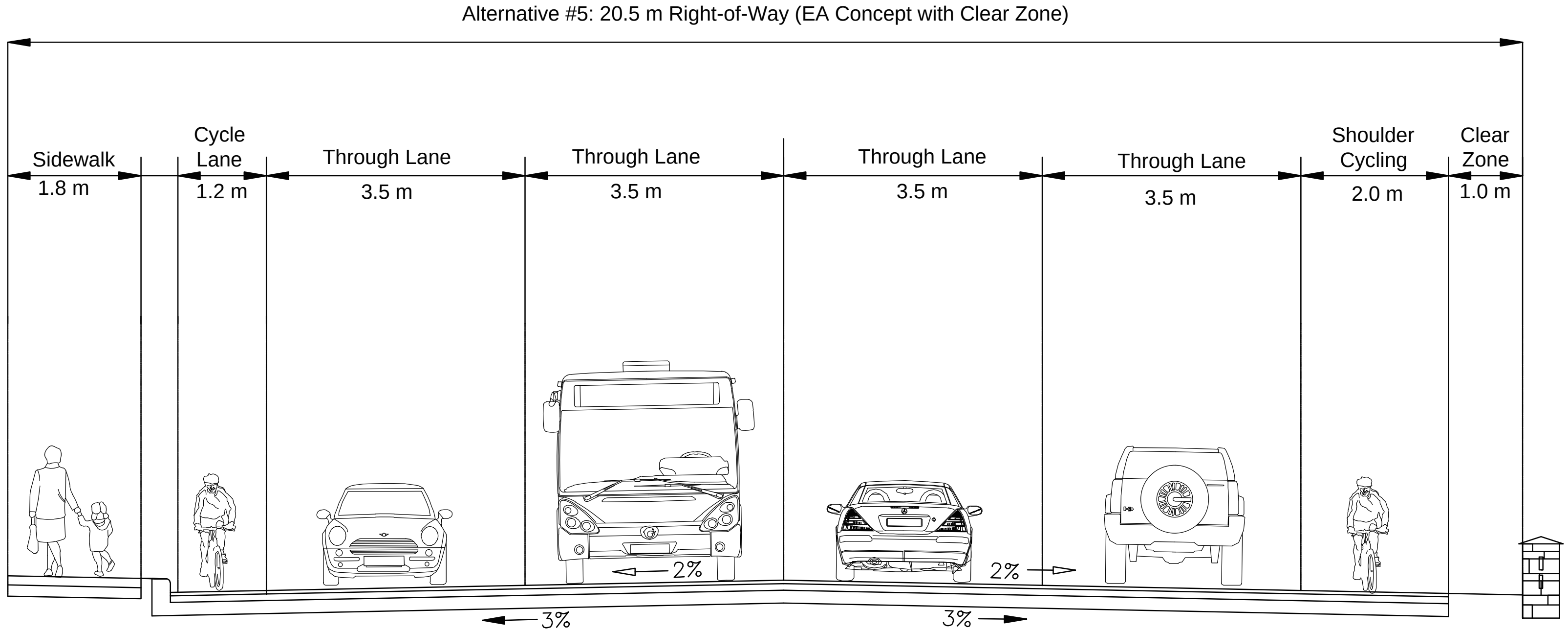
York Road Cross-Section Alternatives

25-Aug-16

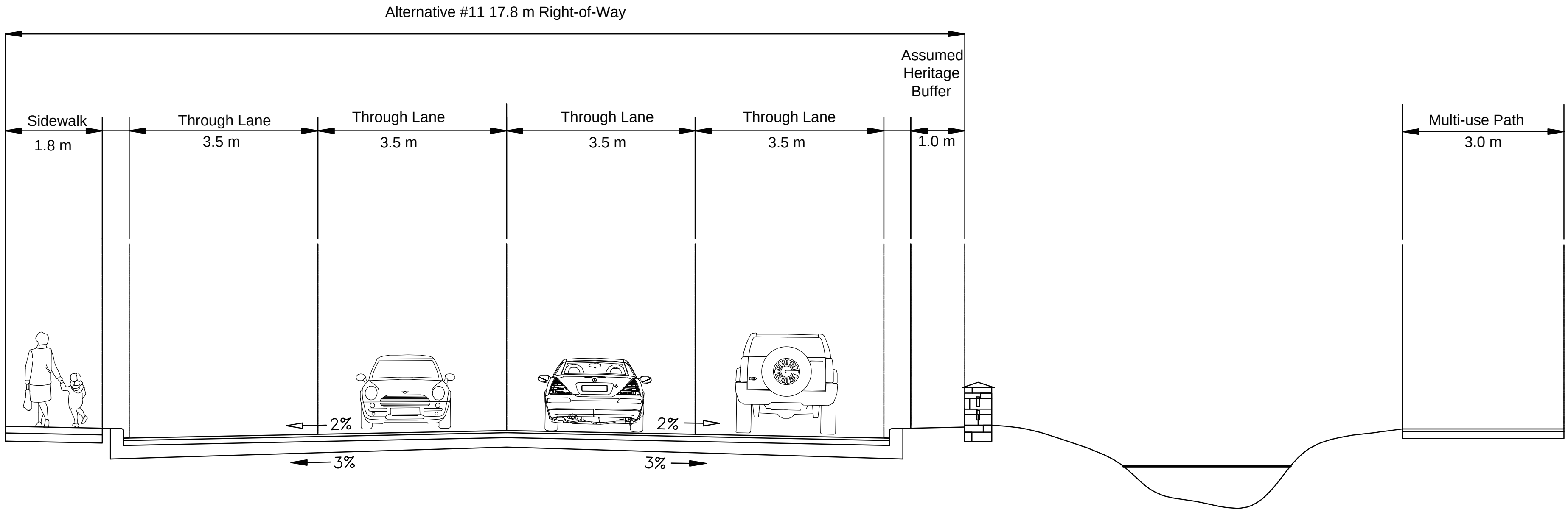
Alt #	General Description	Inside Lane Width (m)	Outside Lane Width (m)	Cycle Lane Width (m)		Sidewalk Width (m)		Multi-Use Pathway (m)		Curb Width (m)		Boulevard Width (m)		Shoulder Width, Incl. Clear Zone (m)		Heritage Buffer (m)	Total Width
				North Side	South Side	North Side	South Side	North Side	South Side	North Side	South Side	North Side	South Side	North Side	South Side		
1	Sidewalks and Cycle Lanes on Both Sides	3.5	4.0	1.5	1.5	1.5	1.5			0.5	0.5	1.0	1.0				24.00
2		3.5	3.5	1.5	1.5	1.5	1.5			0.5	0.5	1.0	1.0				23.00
3		3.5	4.0	1.5	1.5	1.8	1.8			0.5	0.5						22.60
4		3.5	3.5	1.5	1.5	1.8	1.8			0.5	0.5						21.60
5		3.5	3.5	1.2		1.8				0.5					3.0		20.50
6	Sidewalks Only, with and without Shared Use Lanes	3.5	4.3			1.5	1.5			0.5	0.5	1.0	1.0				21.60
7		3.5	4.3			1.8	1.8			0.5	0.5						20.20
8		3.5	3.5			1.5	1.5			0.5	0.5	1.0	1.0				20.00
9		3.5	3.5			1.8	1.8			0.5	0.5						18.60
10		3.5	3.5			1.5				0.5	0.5	1.0			0.5		18.00
11		3.5	3.5			1.8				0.5	0.5				0.5	0.5	17.80
12		3.5	3.5			1.5				0.5		1.0			3.0		20.00
13		3.5	3.5			1.8				0.5					3.0		19.30
14	Sidewalk on North Side, Cycle Lanes on Both Sides	3.5	3.5	1.5	1.5	1.5				0.5		1.0			1.5	1.0	22.50
15		3.5	3.5	1.5	1.5	1.8				0.5					1.5	1.0	21.80
16		3.5	3.5	1.5	1.5	1.5				0.5	0.5	1.0			0.5	0.5	21.50
17		3.5	3.5	1.5	1.5	1.8				0.5	0.5				0.5	0.5	20.80
18	Multi-Use on Both Sides, With Boulevards	3.5	4.3					3.0	3.0	0.5	0.5	1.0	1.0			1.0	25.60
19		3.5	4.0					3.0	3.0	0.5	0.5	1.0	1.0			1.0	25.00
20		3.5	3.5					3.0	3.0	0.5	0.5	1.0	1.0			1.0	24.00
21	Multi-Use on Both Sides, Without Boulevards	3.5	4.3					3.0	3.0	0.5	0.5					1.0	23.60
22		3.5	4.0					3.0	3.0	0.5	0.5					1.0	23.00
23		3.5	3.5					3.0	3.0	0.5	0.5					1.0	22.00
24	Sidewalk and Shared-Use Lane on North Side, Multi-Use on South Side	3.5	4.3/3.5			1.5			3.0	0.5	0.5	1.0	1.0			1.0	23.20
25		3.5	4.3/3.5			1.5			3.0	0.5	0.5	1.0				1.0	22.20
26		3.5	4.3/3.5			1.8			3.0	0.5	0.5					1.0	21.50
27	Sidewalk on North Side, Multi-Use on South Side	3.5	3.5			1.5			3.0	0.5	0.5	1.0				1.0	21.50
28		3.5	3.5			1.8			3.0	0.5	0.5		1.0			1.0	21.80
29		3.5	3.5			1.8			3.0	0.5	0.5					1.0	20.80

Notes:

- Profile will need to be reviewed in all instances to ensure roadway surface can be properly drained
- Storm sewer system will be required



CITY OF Guelph ENGINEERING SERVICES	YORK ROAD TYPICAL SECTION - ALTERNATIVE #5 20.5m RIGHT OF WAY	DATE DRAWN : 2016/08/25	DRAWN BY : BS
		SCALE : N.T.S.	DRAWING No. : -



CITY OF Guelph

ENGINEERING SERVICES

YORK ROAD

TYPICAL SECTION - ALTERNATIVE #11
17.8m RIGHT OF WAY

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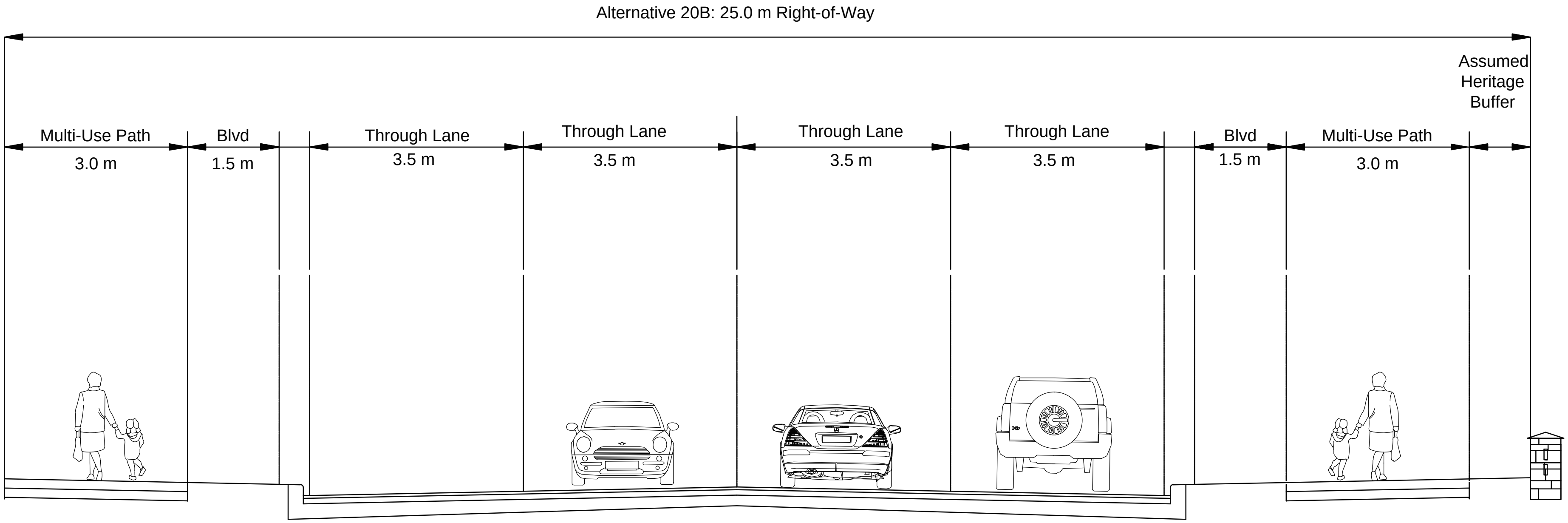
SCALE : N.T.S.	DRAWING No. : -



CITY OF Guelph ENGINEERING SERVICES	YORK ROAD TYPICAL SECTION - ALTERNATIVE #20B 25.0m RIGHT OF WAY	DATE DRAWN : 2016/08/25	DRAWN BY : BS
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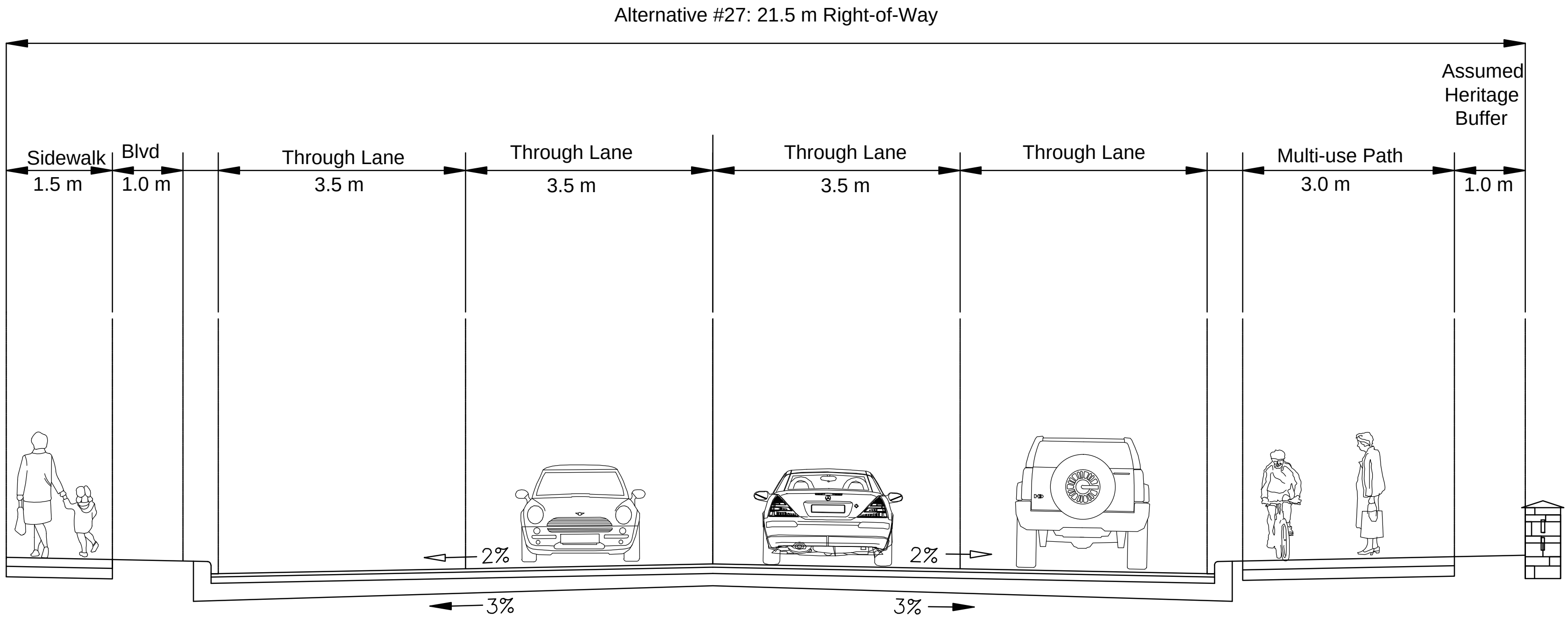

CITY OF Guelph ENGINEERING SERVICES	YORK ROAD TYPICAL SECTION - ALTERNATIVE #27 21.5m RIGHT OF WAY	DATE DRAWN : 2016/08/25	DRAWN BY : BS
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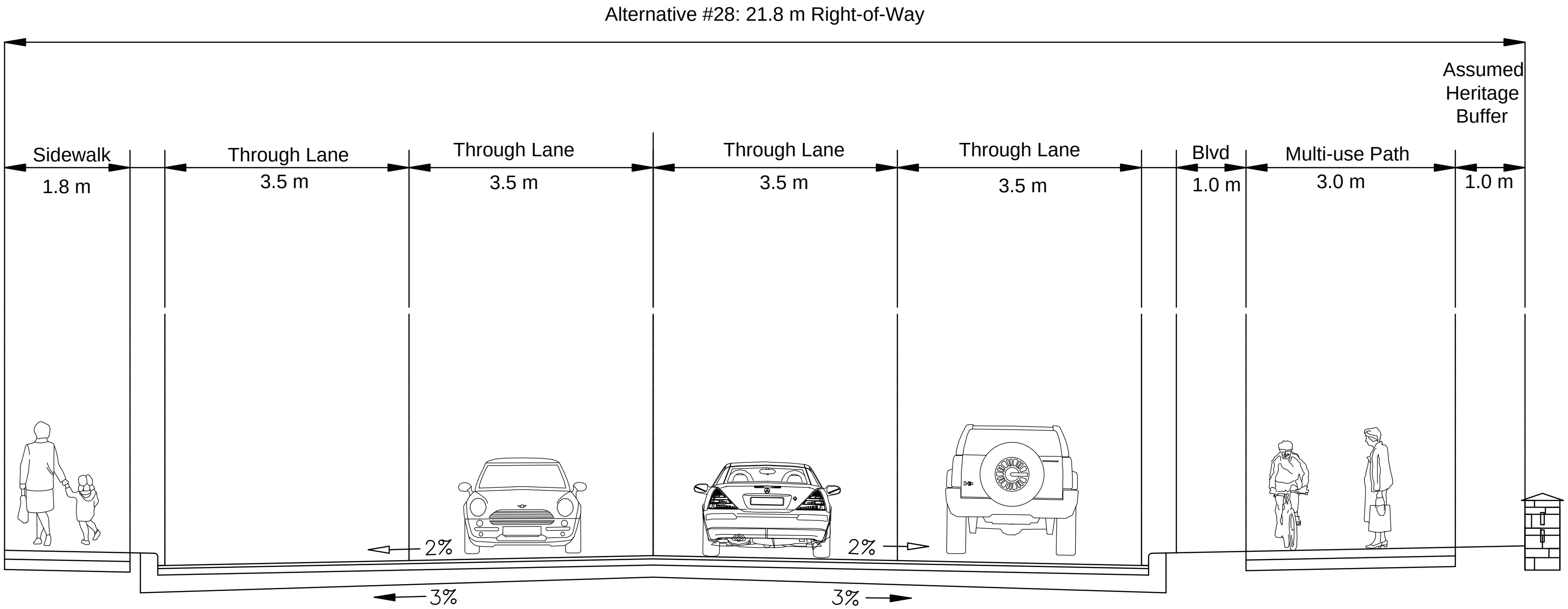
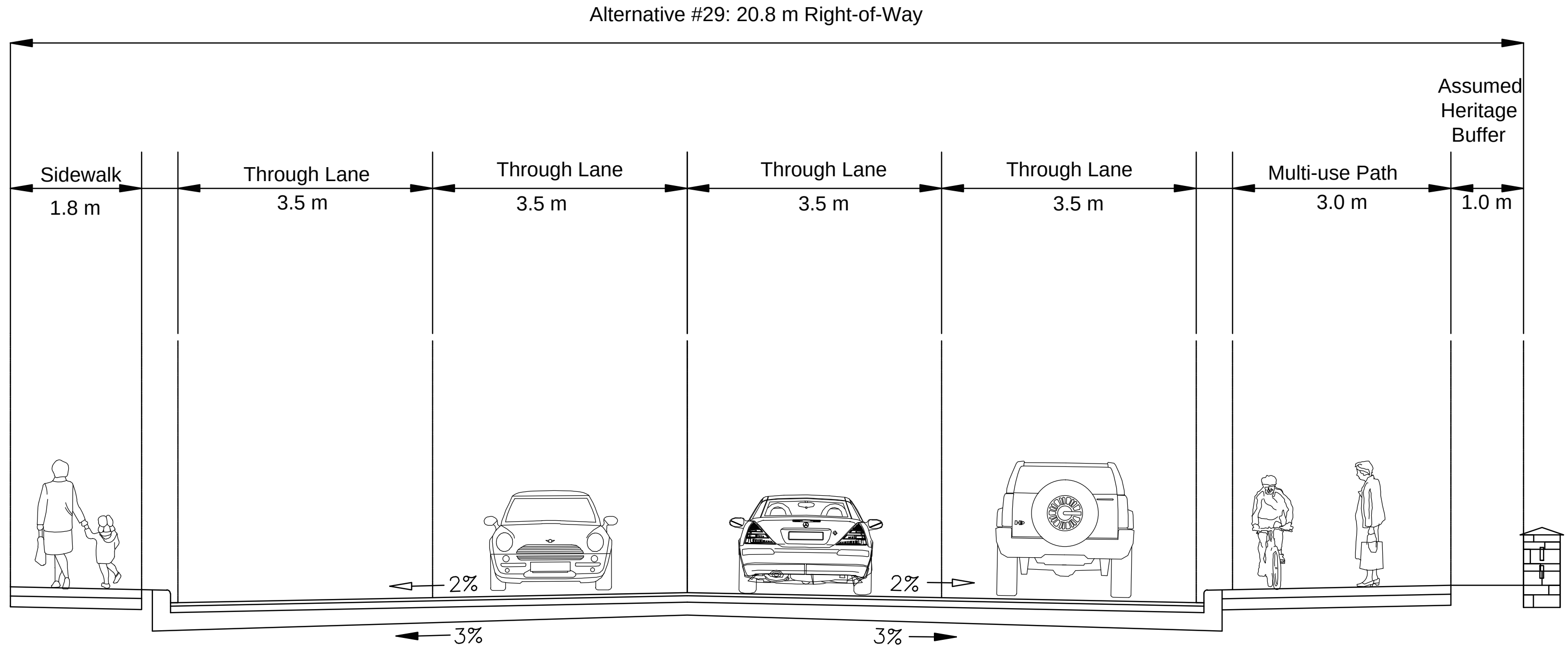


CITY OF Guelph
ENGINEERING SERVICES

YORK ROAD

TYPICAL SECTION - ALTERNATIVE #28
21.8m RIGHT OF WAY

DATE DRAWN :	DRAWN BY :
2016/08/25	BS
SCALE :	DRAWING No. :
N.T.S.	-



CITY OF Guelph ENGINEERING SERVICES	YORK ROAD TYPICAL SECTION - ALTERNATIVE #29 20.8m RIGHT OF WAY	DATE DRAWN : 2016/08/25	DRAWN BY : BS
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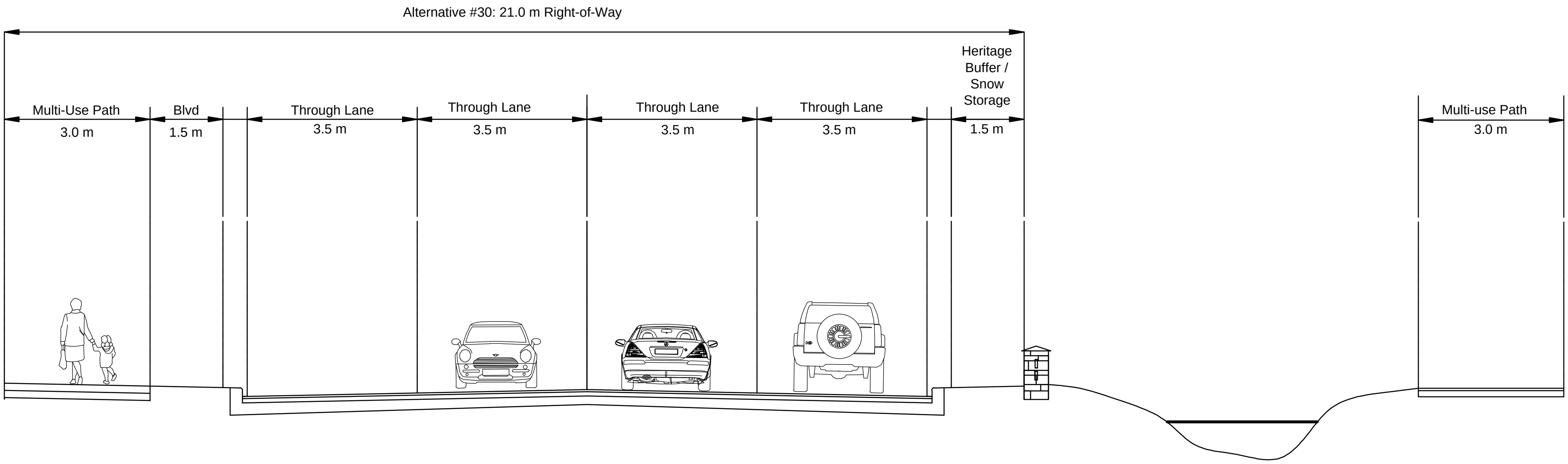

CITY OF Guelph

ENGINEERING SERVICES

YORK ROAD

TYPICAL SECTION - ALTERNATIVE #30

21.0m RIGHT OF WAY

DATE DRAWN : 2016/08/25	DRAWN BY : BS
SCALE : N.T.S.	DRAWING No. : -