

Schedule B Municipal Class Environmental Assessment Study Fletcher's Creek Slope Stabilization

Prepared for
Regional Municipality of Peel

Prepared by



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Appendices

Appendix A – Fluvial Geomorphological Report

Appendix B – Natural Science Report

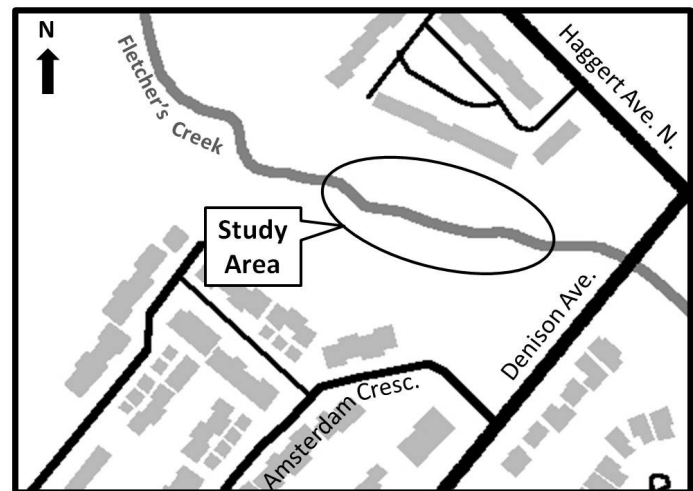
Appendix C – Public Consultation

Executive Summary

The Regional Municipality of Peel is undertaking a study to identify a preferred solution for addressing a small area of soil erosion on the bank of Fletcher's Creek, north of the Denison Avenue bridge, in Brampton, ON. The study area is outlined in the map below. In the study area, the area of erosion is located on the south bank of Fletcher's Creek, approximately 75 meters upstream from the Denison Avenue bridge. The soil erosion has exposed an existing, 450mm abandoned sanitary sewer pipe. As erosion continues, there will be an increasing threat of damage to an adjacent, active 1050mm sanitary sewer pipe, which could become exposed or susceptible to winter freezing or damage due to frost.

The study was conducted under Schedule B of the Municipal Class Environmental Assessment (Class EA) process in accordance with the Municipal Engineers' Association's Municipal Class Environmental Assessment document (September 2007, as amended in 2011).

Six different alternatives were evaluated to address the slope erosion. Of the six evaluated, three met a preliminary screening set of criteria and were carried forward for detailed evaluation. Upon completion of the evaluation, the preferred alternative selected involves the removal of the exposed pipe and the installation of a habitat feature on the bank that will protect it, and the active sanitary sewer, from further erosion.



The study area does not contain significant terrestrial habitat, however Fletcher's Creek is designated as habitat for the endangered Redside Dace fish, although the aquatic habitat quality in the vicinity of the exposed pipe is poor. The preferred alternative solution to the bank erosion will improve the aquatic habitat, while stabilizing the bank and slowing or halting future erosion, thus protecting the active sanitary sewer pipe.

The public and public review agencies were consulted during the study, and their comments and concerns were addressed with the preferred alternative solution.

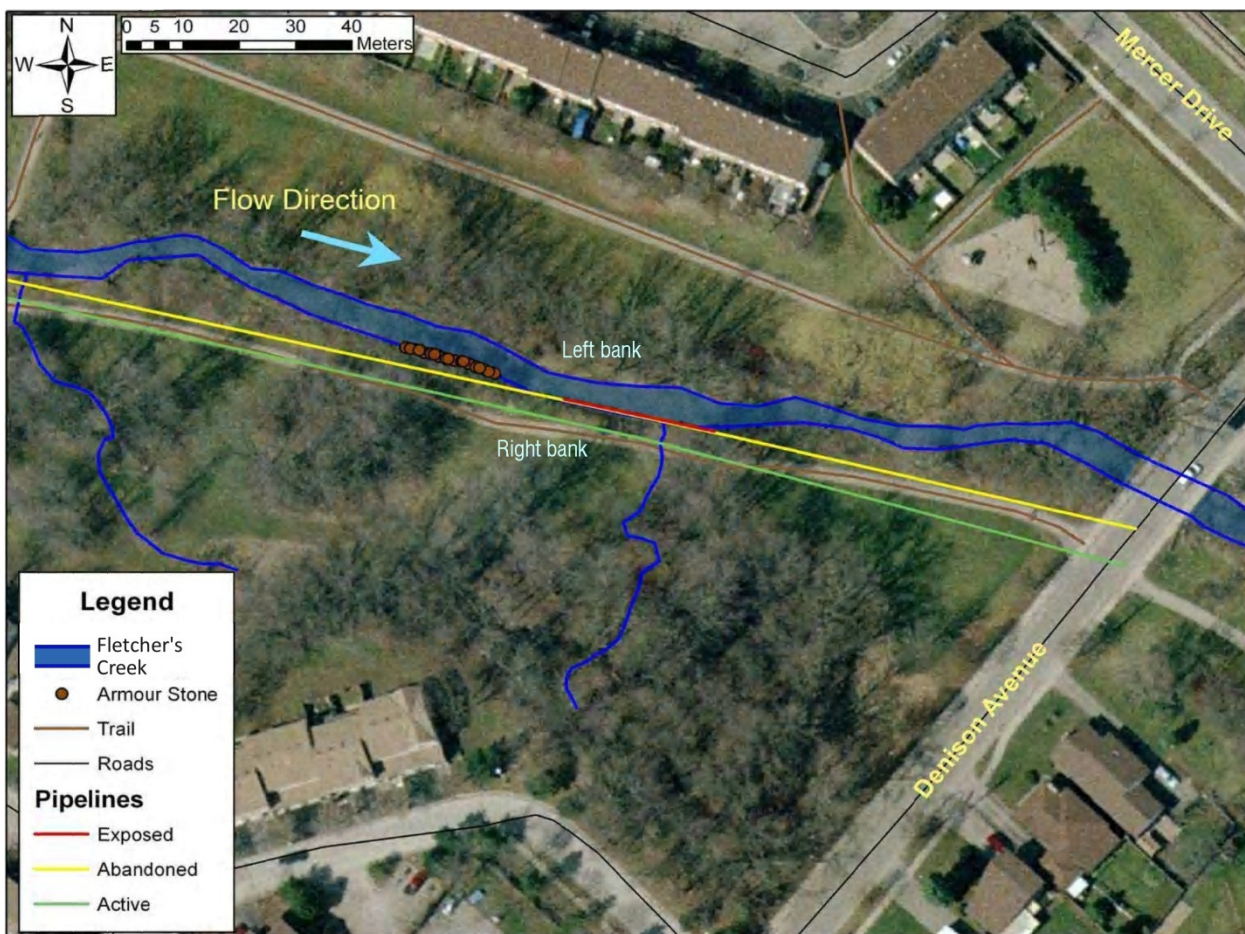
The Region of Peel plans to implement the preferred alternative solution in 2014.

1.Introduction and Background

1.1 Background

In 2010 the Region of Peel became aware of an area of exposed pipe on the bank of Fletcher's Creek, located north of Denison Ave, in the City of Brampton. Upon further investigation, it was discovered that this pipe is abandoned; however an active trunk sewer runs parallel to it. Parish Geomorphic Limited conducted an erosion assessment in order to determine the potential risks to the trunk sewer line (Parish, 2012). At the time of publishing the erosion assessment report, it was estimated that the active trunk sewer was only 1.9m from the south bank and would be at risk of freezing if the bank erodes another 0.1m. At the estimated migration rate of 0.69m/year, it was estimated that the active trunk sewer could become compromised in the short term.

Figure 1-1: Location of exposed pipe



In response to the imminent risk to an existing, active trunk sewer, located in the vicinity of a flowing watercourse in an urban area, the Region of Peel has initiated a municipal Class Environmental Assessment to address the stabilization of the slope on the bank of Fletcher's Creek, where the abandoned sewer pipe is exposed and an active sewer pipe is threatened. The location of the exposed pipe is shown in Figure 1-1, above.

1.2 Ontario's Environmental Assessment Act

Ontario's Environmental Assessment Act (EA Act) was passed in 1976 and first applied to municipalities in 1981. The EA Act requires the study, documentation, and examination of the environmental effects that could result from major projects or activities. The objective of the EA Act is to consider the possible effects of these projects early in the planning process—when concerns are most easily resolved—and to select a preferred alternative with the fewest environmental impacts.

The EA Act defines the environment very broadly as:

- Air, land, or water
- Plant and animal life, including humans
- The social, economic, and cultural conditions that influence the life of humans or a community
- Any building, structure, machine or other device or thing made by humans
- Any solid, liquid, gas, odour, heat, sound, vibration or radiation resulting directly or indirectly from human activities
- Any part or combination of the foregoing and the interrelationships between any two or more of them, in or of Ontario

The following two types of EA planning and approval processes are applied to projects to meet requirements of the EA Act:

- **Individual EAs (Part II of the EA Act):** Projects for which a Terms of Reference (TOR) and an individual EA are carried out and submitted to the Minister of the Environment (MOE) for review and approval
- **Class EAs:** Projects that are approved subject to compliance with an approved class EA process with respect to a class of undertakings. Provided that the appropriate Class EA approval process is followed, a proponent will comply with Section 13(3) a, Part II.1 of the EA Act

1.3 Municipal Class Environmental Assessment Process

All municipalities in Ontario are subject to provisions of the EA Act when undertaking public works projects. The MEA's *Municipal Class Environmental Assessment* (September 2007) document provides municipalities with a five-phase planning procedure approved under the EA Act to plan and undertake all municipal sewage, water, stormwater management, and transportation projects that occur frequently, are usually limited in scale, and have a predictable range of environmental impacts and applicable mitigation measures.

The EA planning process includes the following key components:

- Consultation early and throughout the process
- Reasonable range of alternatives
- Consideration of effects on the environment and ways to avoid/reduce impacts
- Systematic evaluation of alternatives
- Clear documentation
- Traceable decision making

Figure 1-2 illustrates the process followed in the planning and design of projects covered by a Municipal Class EA, including the Fletcher's Creek Trunk Sewer Capacity Class EA study. The figure incorporates steps summarized in the following sub-sections that are considered essential for compliance with the EA Act.

Phase 1

Identify the problem (deficiency) or opportunity.

Phase 2

Identify alternative solutions to the problem or opportunity by taking into consideration the existing environment and establish the preferred solution accounting for public and agency review and input. Document the planning process in a Municipal Class EA project file and make such documentation available for scrutiny by review agencies and the public.

Phase 3

For Schedule C projects, examine alternative methods of implementing the preferred solution based on the existing environment, public and government agency input, anticipated environmental effects, and methods of minimizing negative effects and maximizing positive effects.

Phase 4

For Schedule C projects, document in an Environmental Study Report (ESR) a summary of the rationale and the planning, design, and project consultation process and make such documentation available for scrutiny by review agencies and the public.

Phase 5

Complete contract drawings and documents, proceed to construction and operation and monitor construction for adherence to environmental provisions and commitments. Where special conditions dictate, also monitor the operation of the completed facilities.

1.3.1 Class EA Schedules

The MEA Municipal Class EA document also serves as a public statement of the decision making process followed by municipalities in planning and implementing infrastructure. Based on the September 2007 MEA Municipal Class EA document, projects are classified as either Schedule A, A+, B, or C projects. Each classification requires a different level of review to satisfy Municipal Class EA requirements and comply with the EA Act. The scale of and consultation requirements for each category of project are outlined below.

Schedule A

Schedule A projects are limited in scale, have minimal adverse effects and include the majority of municipal sewage, stormwater management and water operations, and maintenance activities. These projects are approved and may be implemented without following the Class EA planning process. Schedule A projects typically include normal or emergency operational maintenance activities where the environmental effects of these activities are usually minimal.

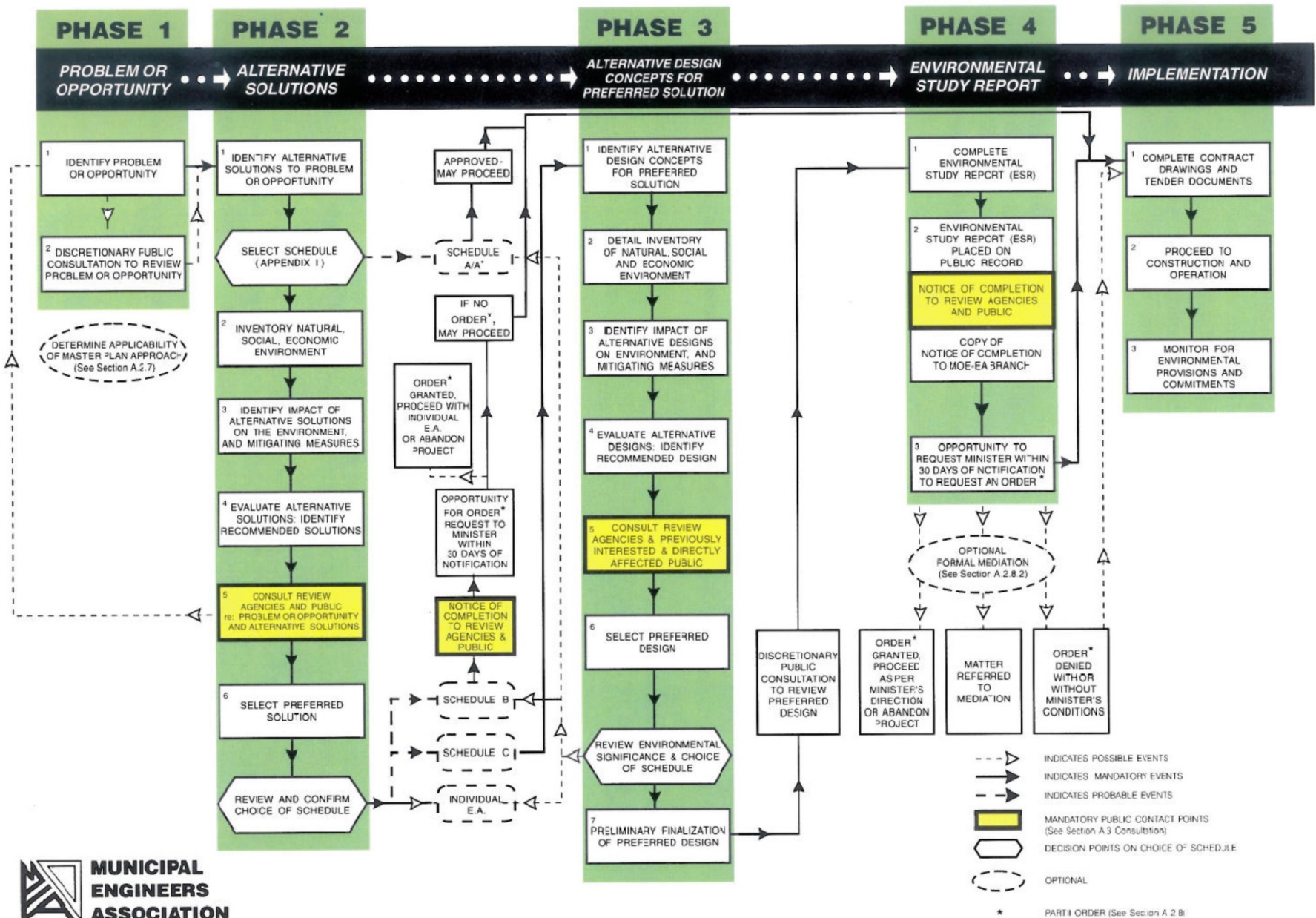
Examples of Schedule A projects include water main and trunk sewer extensions where all such facilities are located within the municipal road allowance or an existing utility corridor. As such, these projects are pre-approved and subsequently do not require any further planning and public consultation.

Figure 1-2: Overview of the Municipal Class Environmental Assessment Process

EXHIBIT A.2

MUNICIPAL CLASS EA PLANNING AND DESIGN PROCESS

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



Schedule A+

The purpose of this Schedule is to ensure some type of public notification for certain projects that are pre-approved under the Municipal Class EA. However, there would be no ability for the public to request a Part II Order. Examples of Schedule “A+” projects include modifications to a retention/detention facility for the purpose of stormwater quality control or installation of new standby power equipment where new equipment is located in an existing building or structure.

Schedule B

Schedule B projects have the potential for some adverse environmental effects. The proponent is required to undertake a screening process involving mandatory contact with directly affected public and relevant review agencies to ensure that they are aware of the project and that their concerns are addressed.

Schedule B projects require that Phases 1 and 2 of the Class EA planning process be followed and a project file report be prepared and submitted for review by the public. If there are no outstanding concerns raised by the public and/or review agencies, then the proponent may proceed to project implementation. However, if the screening process raises a concern that cannot be resolved, then the Part II Order procedure may be invoked. Alternatively, the proponent may voluntarily elect to plan the project as a Schedule C project.

Schedule B projects generally include improvements and expansions to existing facilities where there is the potential for some adverse environmental impacts. As a result, the proponent is required to proceed through a screening process including consultation with those who may be affected. Examples of Schedule B projects include activities such as the establishment of new sewage pumping stations and expanding a wastewater treatment plant to existing rated capacity where new land acquisition is required. As a result, the proponent is required to proceed through a screening process (Phases 1 and 2) including consultation with stakeholders and public who may be affected.

Schedule C

Schedule C projects have the potential to significantly affect the environment; therefore, these projects are subjected to the full planning and documentation procedures (Phases 1 to 4) that are specified in the Municipal Class EA document. An ESR must be prepared for Schedule C projects and submitted to the public for review. The Part II Order procedure may be invoked if concerns are raised that cannot be resolved.

An example of a Schedule C project is the siting or construction of a new wastewater treatment plant or expansion of an existing wastewater treatment plant beyond existing rated capacity, including an outfall to a receiving body of water.

The works for the Fletcher’s Creek slope stabilization project fall under a Schedule B project as specified in item 19 of Schedule B for Wastewater Management Projects. Item 19 - Works undertaken in a watercourse for the purposes of flood control or erosion control, includes the following activities:

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

As such, this project will follow the first two phases of the Class EA process, including one point of public contact, prior to commencing detailed design and project implementation.

1.4 Project Team

CH2M HILL Canada Limited has been retained by the Regional Municipality of Peel to complete the Class EA requirements for this project. The project team includes CH2M HILL staff and consultants. LGL Limited was retained to provide environmental commentary, and Parish Geomorphic was retained to provide geotechnical advice and peer review.

2 Problem Definition

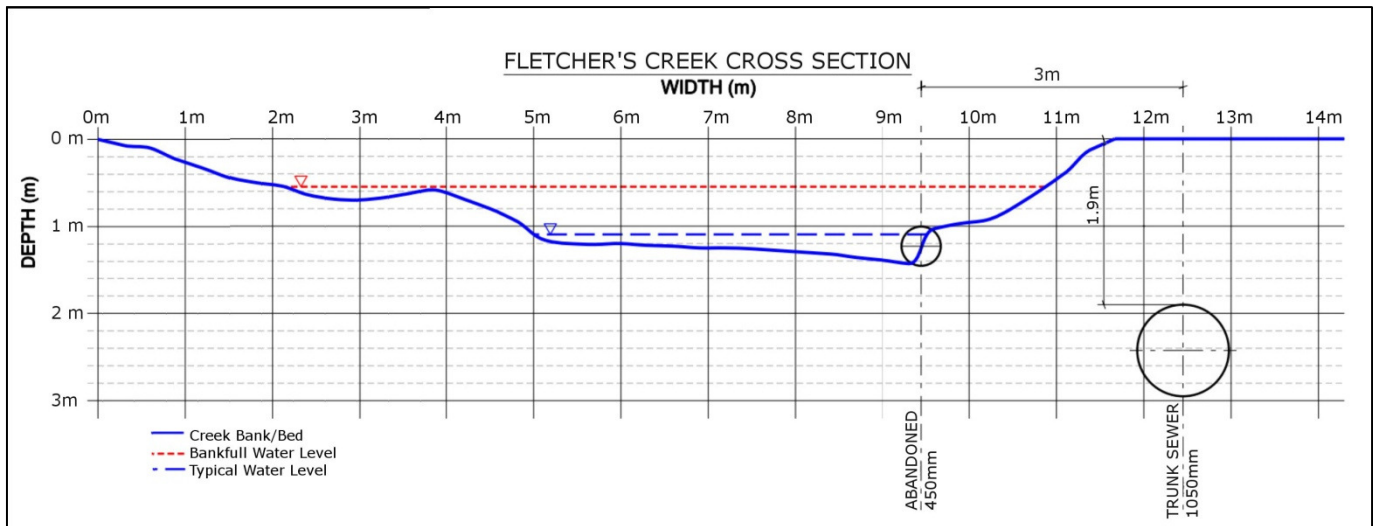
2.1 Purpose of Study

As a result of previous monitoring and investigation studies completed along Fletcher’s Creek, a section of exposed sewer pipe has been identified upstream of the Denison Avenue Bridge, in Brampton. Although the exposed sewer pipe is abandoned, and no longer conveys sewage, the Region of Peel has concerns that ongoing erosion along this section of the banks of Fletcher’s Creek will reduce the depth of cover of a functioning 1050 mm diameter trunk sewer running parallel to and within 3 m of the exposed pipeline (Figure 2-1). Reduced soil cover the active 1050mm diameter trunk sewer will make it susceptible to winter freezing or frost, and could result in breakage and the release of untreated sewage into Fletcher’s Creek or the surrounding environment.

This study examined the natural and social environment in the vicinity of the exposed pipe, and developed alternative solutions to address the risk of damage to the active trunk sewer that is caused by erosion on the south bank of Fletcher’s Creek, upstream of Denison Avenue. Each alternative has been evaluated based on its associated feasibility and costs, as well as impacts to the natural and social environment, and impact mitigation measures that can be feasibly implemented.

The preferred alternative selected most effectively and economically addresses the risk to infrastructure of localized bank erosion in Fletcher’s Creek, north of Denison Avenue, while minimizing and best mitigating negative environmental impacts.

Figure 2-1: Location of exposed, abandoned sewer pipe and active trunk sewer pipe in the vicinity of Fletcher’s Creek, approximately 75m upstream of Denison Avenue



2.2 Rationale for the Study

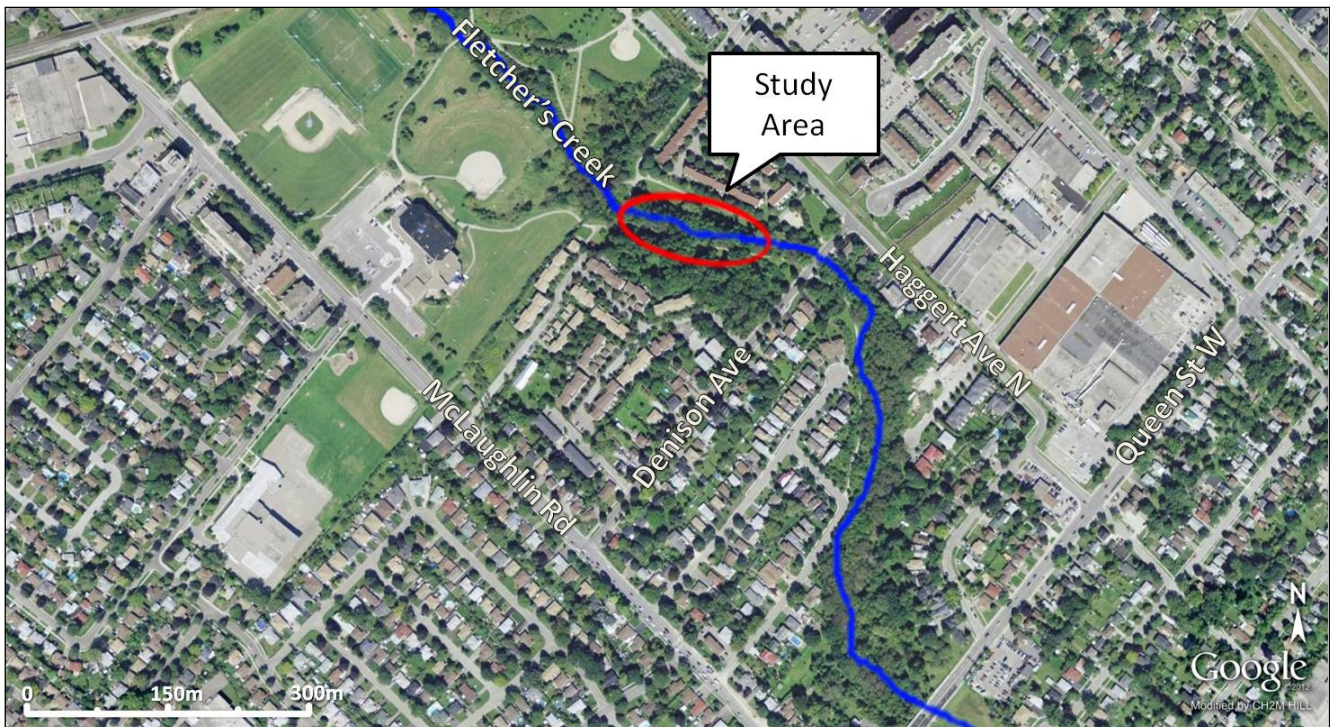
A number of sensitive features are located in the vicinity of the exposed pipe. These include the functioning 1050mm diameter active trunk sewer, a recreational walking trail along the top of the bank, the Fletcher’s Creek valley, and potential fish habitat. This study has developed a solution to the localized bank erosion that is currently putting these features at risk, with a focus on reducing the risks to the active trunk sanitary sewer.

Although erosion is a natural function of a flowing watercourse, due to the features at risk further erosion could result in immediate harm to the natural environment or human health.

2.3 Study Area

The study area includes valley features in the vicinity of the existing exposed sewer pipe, on the south bank of Fletcher’s Creek, north of Denison Avenue. The study area is characterized by a constrained, urban valley feature, surrounded by manicured parkland and a residential neighbourhood in the City of Brampton, Ontario (Figure 2-2). The study area is outlined in the map below. In the study area, the area of erosion is located on the south bank of Fletcher’s Creek, approximately 75 meters upstream from the Denison Avenue bridge.

Figure 2-2: Project Study Area



2.4 Problem Statement

Bank erosion in Fletcher’s creek, north of Denison Avenue in Brampton, Ontario, has exposed an abandoned sewer pipe and risks causing damage to an existing, active sewer pipe. This erosion needs to be stabilized in the immediate short term in order to protect the active sewer pipe and the surrounding ecosystem from damage. Consequently, the purpose of this study is to identify a preferred solution for addressing this small area of soil erosion on the south bank of Fletcher’s Creek, approximately 75m north of the Denison Avenue bridge, in Brampton, ON.

3 Existing Conditions

3.1 Existing Pipe Locations and Conditions

Within the study area, the 1050mm diameter Fletcher's Trunk Sewer is located parallel to Fletcher's Creek, and generally within 5 metres or less of the south bank of the creek. Adjacent to, and between the trunk sewer and the creek is an exposed, abandoned concrete sanitary sewer with a diameter of 450mm. The pipe is approximately 30 years old. Based on as-built record drawings, the approximate depth of pipe cover at the time of construction was 1.4 m. Since its construction, the pipe has become exposed as the watercourse has migrated south through the natural processes of stream morphology. At the time of field investigations a 26 metre length of this abandoned pipe was exposed. An existing culvert directs surface storm water drainage into Fletcher's Creek, over the exposed pipe. This may be contributing to the bank erosion in this location. A paved walking trail is located at the top of the stream bank, and can be seen in Figure 3- 1.

Although the abandoned pipe may be providing some stability at the toe of the slope, the main concern of the Region is that further erosion from overland flow and high stream flows during wet weather events, and natural erosion processes within the creek will result in damage to or breakage of the active trunk sewer.

Figure 3- 1: Photograph of exposed pipe in Fletcher's Creek, upstream of Denison Avenue, November, 2012



3.2 Fletcher's Creek Physical Environment

The study area is located around a short reach of Fletcher's Creek, which is a major tributary to the Credit River system. Located in the lower third of the Credit River watershed, the Fletchers Creek sub-watershed drains an area of 45 km² extending from Caledon to Brampton to Mississauga. Although the headwaters of Fletchers Creek are situated in a primarily agricultural area, north of Bovaird Drive, the majority of this permanent surface water system flows through increasingly urbanized land uses. It is estimated that the impervious cover within the

Fletcher's Creek subwatershed increased from approximately 17.2 % to 23.2% of the basin area between 1999 and 2003 (Gartner Lee Limited, 2006). As urban areas have grown and intensified throughout the subwatershed, the creek itself has been channelized and hardened in sections, re-routed or straightened in some areas, and cut off from its flood plain as urban development has encroached into the valley lands.

Within the study area Fletcher's Creek flows in a north-south direction, parallel to McLaughlin Road South. Multiple control structures, including gabion baskets and armourstone walls have been installed in the vicinity of the study area to regulate erosion and eliminate creek meandering. Within the study area, degradation is the prominent mode of adjustment (channel migration), as is evidenced by undermined gabion baskets, elevated storm outfalls, the exposed sewer pipe, and evidence of channel incision into the undisturbed clay overburden. The second most prominent mode of adjustment within the study area is channel widening, which is especially evident downstream of the study area at the inlet of the Denison Avenue bridge.

Fletcher's Creek is regulated by the Credit Valley Conservation Authority (CVC) under the *Development, Interference with Wetlands and Alterations to Shorelines and Watercourses Ontario Regulation 160/06*.

3.2.1 Geotechnical and Channel Conditions

Based on the Ontario Geological Survey (2007) the study area is located within the bevelled till plains of the Peel Plain physiographic region. The Credit River and its tributaries have cut deep valleys throughout this plain (Chapman and Putnam 1984). The soils located along the watercourses have been identified as variable with variable drainage and stoniness (Hoffman and Richards 1953). Based on the MOE water well records in the site area, the surface of the bedrock generally occurs at depths greater than 18 m. The typical stratigraphy present includes a 1.5 to 3.8 m thick fill overlying glacial till sand and sandy silt with trace of some clay and gravel. In the stream reach where the exposed pipe is located, the channel has a width of 6.0 to 7.0 m and a depth of 0.8 to 1.1 m. Bank height is 1.4 to 2.2 m. The bed substrate is comprised of fine sand to coarse sand, with silt and large cobbles in pools. Rip rap with large cobbles to small boulders are present in riffles.

Approximately 10m upstream of the exposed pipe the south bank has been hardened with approximately 17m of armourstone. The discontinuity of bank materials within the study area is causing an intensification of bank erosion between the exposed pipeline and armourstone upstream, and is influencing the direction of channel flow.

Two draw features within the study area, and several storm outlets in the vicinity of the study area discharge surface flows during wet weather events over the south bank. One of the draw features outlets directly over the exposed pipe, and may be partially responsible for the bank erosion and subsequent exposure of the abandoned sewer pipe.

3.2.3 Geomorphic Conditions and Scour Analysis

A Fluvial Geomorphic Erosion Assessment was completed by Parish Geomorphic in March 2012 to assess the potential risk of further erosion on the south bank of Fletcher's Creek upstream of the Denison Avenue Bridge. The erosion rates for the opposite (north) bank of ranged between 0.029 m/year and 0.193 m/year, and between 0.024 m/year and 0.112 m/year for the south bank containing the exposed pipeline. The average erosion rate at the section of the exposed pipe is 0.069 m/year in a south-southwest direction. The stream reach within the study area is in a transitional/stressed condition. Degradation was the prominent mode of channel adjustment as observed through evidence of undermined gabion baskets, elevated storm outfalls, the exposed pipeline, and evidence of channel incision into the undisturbed clay overburden. The watercourse within the study area is in a

moderate state of stream health mainly due to the effects of urbanization along this section of Fletcher's Creek. Based on a detailed geomorphological assessment, it appears that Fletcher's Creek is developing a meandering thalweg pattern in the vicinity of the exposed pipeline. The complete "Fluvial Geomorphologic Erosion Assessment at Denison Avenue" report is provided in Appendix A.

3.3 Fletcher's Creek Natural Environment

The stream reach where the study area is located is highly urbanized. Bank vegetation consists of scrub forest with maple, willow and grasses. Fallen or leaning trees with exposed tree roots are common along the stream bank. A review of the Ministry of Natural Resource's (MNR) Natural Heritage Information Centre (NHIC) database as well as the Regional Municipality of Peel and the City of Brampton Official Plans was undertaken to identify significant natural areas within the study area boundary. There are no Areas of Natural and Scientific Interest (ANSI), Environmentally Significant Areas (ESA), or Provincially Significant Wetlands (PSW) located within the study area. Details of the natural environment in the vicinity of the study area were provided by LGL in a 2012 report, reproduced in Appendix B.

3.3.1 Aquatic Habitat

The Credit River Fisheries Management Plan (CRFMP) has identified this section of Fletcher's Creek as a small warm water community, dominated by species such as creek chub (*Semotilus atromaculatus*) and blacknose dace (*Rhinichthys atratulus*) (LGL, 2012). The construction timing window in which in-water works are typically allowed for warmwater communities is July 1 to March 31. This type of community is typical of clay till plains with few silt/sand/gravel components (LGL, 2012).

Species at Risk (Aquatic)

The NHIC database has identified this stretch of Fletchers Creek as Recovery Redside Dace (*Clinostomus elongatus*) Habitat. Redside Dace is designated as endangered by the MNR and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Based on historical fish records cited above, this species has been identified downstream of the study area as recently as 2000. Redside Dace can be found in coldwater headwaters in North America, and according to Fisheries and Oceans Canada (2010), are found in "pools and slow-flowing areas of small headwater streams with a moderate to high gradient. Overhanging grasses and shrubs, as well as undercut banks, are an important part of their habitat, as are instream boulders and large woody debris."

The Ministry of Natural Resources (MNR), through correspondence regarding the Fletcher's Creek Trunk Sewer Project just south of the study area, have indicated this stretch of Fletcher's Creek is considered recovery habitat for Redside Dace. This habitat is defined as the watercourse as well as the meander belt width, plus 30m on either side of the watercourse. As such, any activities within or in the vicinity of this stretch of Fletcher's Creek are regulated under the Endangered Species Act, 2007 (ESA), and may require a permit under section 17(c) of the ESA.

A field assessment of the habitat in November, 2012, found that the stream morphology in the vicinity of the exposed pipe consists of mainly pools and runs with a few small riffles. Substrates were mainly cobble covered in silt. Banks were devoid of vegetation due to the flashy nature of the watercourse, making the banks prone to erosion. The riparian vegetation on the right bank, at the exposed pipe, is very narrow and a manicured lawn is present on the south/west side of the walking path. The assessment found minimal bank vegetation, a homogenous substrate, and the likelihood of high turbidity during wet weather events. The aquatic habitat in this stretch of Fletchers Creek is poorly suited for supporting Redside Dace, which is a species that prefers cool clear water, pools with overhanging vegetation and coarse substrate (LGL, 2012).

3.3.2 Terrestrial Habitat

Natural vegetation within the study area is restricted to deciduous forest/swamp, upland meadows and manicured lawns within the floodplain of Fletcher's Creek. Parks and paved walking paths occur throughout the floodplain. This reach of Fletcher's Creek is an altered, urban watercourse located within a semi-natural wood lot and managed park land. The stream is shaded by a mixture of native and invasive plant species which grow along the banks of the creek. Deciduous forested areas contain a well developed and established understorey and ground cover. The MNR has not recorded any natural heritage features in the vicinity of the study area. The MNR NHIC Database indicated that there were no provincially or federally rare vegetation communities identified within the study area. No species listed as at risk under the provincial Endangered Species Act (2007), or the federal Species at Risk Act (2002), or having local significance were found within the study area.

A total of forty six species were recorded within the study area. Fifteen 15 species, or 33% of the recorded flora are considered introduced and non-native to Ontario. Introduced species were found throughout the floodplain mainly within the cultural communities and disturbed portions of the forests.

Species at Risk (Vegetation)

There are no provincially or federally rare vegetation communities identified within the study area according to the NHIC database. A field assessment done in November, 2012 found no instances of listed terrestrial species within or in the vicinity of the study area.

Wildlife and Wildlife Habitat

The study area is comprised mostly of anthropogenic land uses (i.e. residential/institutional). Background information was reviewed to understand the composition of wildlife species and habitat within the study area. These urbanized areas usually support minimal habitat diversity. The MNR NHIC Database does not indicate records of locally, provincially or federally rare wildlife species within the study area. A November, 2012 field assessment found no instances of listed wildlife within the study area. The Ontario Breeding Bird Atlas was searched for bird species in the study area, and most species recorded in the Atlas were relatively common in the area. A record of a Rusty Blackbird (*Euphagus carolinus*) was noted in the Atlas in the vicinity of the study area. This is a species of Special Concern provincially and federally. The habitat for this species is boreal forest, and not found within our study area. The bird recorded may have been misidentified, or passing through the area.

The MNR NHIC Database does not indicate records of locally, provincially or federally rare wildlife species within the study area.

3.4 Water Quantity in the Fletchers Creek Subwatershed

As the watershed has become increasingly urbanized, the porosity of ground surfaces has been reduced, resulting in greater overland flow of storm water during wet weather events. As less storm water percolates into the soil, and more of it travels over paved surfaces, or is directed through storm drainage into Fletchers Creek and its tributaries, the flashier the Creek becomes. A decrease in base flow and an increase in storm flow have resulted in higher energy flows that have scoured away the banks of Fletchers Creek in multiple locations. To address the scouring, and subsequent widening and movement of the creek bed, various governments over time have constructed localized control structures along the banks of the creek that are less susceptible to the erosive forces of storm flows. These control structures vary in size, material, and construction methods, but most are either gabion baskets or armourstone walls placed along one or both banks of the creek in short sections. While many of these structures are protecting existing infrastructure or improved properties, because they are not natural, and

therefore not flexible, the discontinuity of bank materials has resulted in an increased rate of erosion where the stream bank is unprotected.

According to the Interim Watershed Characterization Report for the Credit River Watershed (CVC, 2007), Fletcher's Creek has a decreased ability to assimilate impacts from point and non-point sources, resulting in negative impacts to surface water quality. This is partially due to the urbanized nature of the watershed, and the imperviousness of the land that drains to the creek. The report (ibid.) notes elevated levels of Total Phosphorus, Chlorides, E. Coli bacteria, Iron, Zinc, and suspended solids in Fletcher's Creek. This urban tributary of the Credit River generally ranks as fair to poor in terms of water quality, and the degraded macroinvertebrate community within Fletcher's Creek may be "attributed to impacts associated with urbanization such as contaminated surface runoff, a loss of groundwater upwellings and a loss of important habitat features including riparian cover" (CVC, 2007, pp. 59-60).

3.5 Socio-Cultural Environment

A review of local and region official plans was conducted for the study area. The study area is located in the City of Brampton, in the Regional Municipality of Peel.

3.5.1 Official Plan Review, Regional Municipality of Peel

Based on Schedule A of the Region of Peel Official Plan (2005), the study area is not located within a 'Core Area' of the Greenlands System. Schedule D indicates that the study area is located within the 'Urban System.'

3.5.2 Official Plan Review, City of Brampton

Based on the City of Brampton's Official Plan (2006), the study area is located partially within a residential use area and partially within the Brampton Central Area. The Fletcher's Creek corridor within the study area has been designated as Community Park Lands, as well as Valleyland/Watercourse Corridor, which are open space designations (Figure 3- 2). Provincially Significant Wetlands (PSWs), Environmentally Significant Areas (ESAs) or Areas of Natural and Scientific Interest (ANSIs) have not been identified within the study area.

To the west of Fletcher's Creek is a residential area under the Northwood Park Secondary Plan, and to the east is Brampton's downtown central area. The Central Area is a zone of higher density and mixed-use development which has commercial and industrial establishments.

3.5.3 Greenbelt Plan Review

Based on a review of detailed mapping, the study area is not located within the Greenbelt Plan area.

3.5.4 Other Applicable Legislation and Policy

Navigable Waters Protection Act

Fletcher's Creek is considered to be a navigable water, according to the Navigable Waters Protection Act, 1985. As such, there may be a requirement to obtain permission for works within the watercourse from Transport Canada prior to commencing construction. Works affecting only creek banks or not obstructing navigation may fit within the definition of a Minor Work, as outlined in the Minor Works and Waters Order (Navigable Waters Protection Act), 2009. Slope stabilization measures, including the placement of rip-rap, tree branches or trunks, or other

Figure 3- 2: Brampton Official Plan, 2012 Land Use Designations



materials on the slope or bank of a watercourse are typically considered to be Minor Works. If it is determined that the preferred solution fits within this definition, no permissions or approvals will be required from Transport Canada for the construction of the proposed works. Further consultation with Transport Canada at the detailed design stage will determine permitting and approvals requirements.

Region of Peel Stormwater Management

Although the Region of Peel takes responsibility for stormwater generated only on Regional Roads, the Region does have policies for the handling, treatment, and reduction of storm water flows. Through such implements as the Region of Peel Water Efficiency Plan measures to encourage property owners to reduce irrigations needs, and Peel Official Plan policies to encourage lower tier municipalities to wisely manage storm flows, the Region of Peel takes a proactive approach to water management, including the management of storm water.

3.6 Location and Surrounding Land Uses

3.6.1 Residential

Residential townhome developments are located to the west and to the east of the study area. Private dwellings are separated from the valley lands by fences, however both residential developments have pedestrian access to the paved trails that run along both banks of the creek.

3.6.2 Recreational Amenity

A park trail system maintained by the City of Brampton extends along both banks of the creek upstream of Denison Avenue. The trail continues upstream to a pedestrian bridge that crosses Fletcher’s Creek near Chris Gibson Park which is a recreational sports complex. In the vicinity of the exposed pipe the paved trail running along the southern bank of the creek is located at the ridge line of the top of the valley slope. The embankment down to the watercourse is steep here, and further erosion of the creek bank could result in slope failure. As a result, this trail represents a potential hazard in the vicinity of the exposed pipe.

3.6.3 Creek Access

The exposed section of pipe is located upstream of Denison Avenue, a two-lane, local road that can be accessed from the arterial McLaughlin Road North, and from the arterial Queen Street West, via Park Street. Paved trails run along both sides of the creek north of Denison Avenue.

3.7 Archaeological Conditions

The Stage 1 archaeological assessment field review, conducted for the Fletcher's Creek Trunk Sewer Capacity Class EA in 2010, for the Fletcher's Creek corridor from Steeles Avenue West to Denison Avenue north of Queen Street, indicated that numerous historical homesteads, structures, and the historic village of Brampton were formerly located within these boundaries. It was determined that there is high potential for locating historical remains within undisturbed portions of the corridor area based on this background research. The presence of Fletcher's Creek – a primary water source, also increases the potential for the location and recovery of Aboriginal archaeological resources within this corridor. Although the study area for the Fletcher's Creek Slope Stabilization EA is not encompassed within the study area for the Fletcher's Creek Trunk Sewer Capacity Class EA, it is adjacent to it, and it has therefore been assumed that a Stage I and Stage II Archaeological Assessment will be completed by a qualified archaeologist during the detailed design phase of the works, and the results of the assessments must be and the results reported to the Ministry of Tourism and Culture prior to commencing any works that will disturb soils within the study area.

4 Identification of Alternative Solutions

4.1 Alternative Solutions

Phase 2 is the identification of alternative solutions. Several potential solutions have been identified in response to the Problem Statement to address the area of soil erosion on the south bank of Fletcher's Creek. Each alternative solution is based on the findings from the fluvial geomorphic erosion assessment, and takes a different approach to managing the erosion that is putting the active sewer pipe at risk. The "do nothing" alternative has also been examined as a baseline scenario, against which the other solutions can be compared. The alternative solutions are listed below and described in detail in the subsections that follow.

1. Do Nothing"
2. Long-term management
 - a) Stormwater management / floodplain reconnection
 - b) Reduce discontinuity caused by in-stream structures by removing them
 - c) Reduce discontinuity caused by in-stream structures by extending them
3. Site-specific
 - a) Protect over pipe and re-grade opposite bank to maintain stream capacity
 - b) Remove pipe and protect south slope

4.2 Descriptions of Alternative Solutions

This section provides a detailed description of the proposed alternative solutions.

4.2.1 Alternative 1: Do Nothing

Do nothing, although not a solution to the Problem Statement, is an alternative that will be assessed to identify the impacts of no activity to stabilize the south bank of Fletcher's Creek. This alternative involves not intervening in any way to reduce erosion to or increase the protection of the south bank of Fletcher's Creek in the vicinity of the exposed pipe. This alternative will be examined as a baseline scenario and will be a comparator for the other alternative solutions.

4.2.2 Long-Term Management

The "Long-term Management" alternatives aim to address the root cause of widening and degradation occurring within the Fletcher's Creek subwatershed by taking action throughout the watershed.

Three long-term management options are proposed to meet the ultimate goal of a stable watercourse that is adjusted to the higher, flashier flows of the urbanized subwatershed.

Alternative 2A: Stormwater management / floodplain reconnection

The first long-term management alternative entails the management of storm water flows throughout the subwatershed before they reach the creek, and the reconnection of the creek to its flood plain. This two-pronged approach could address the erosion concerns in the study area by reducing the flashiness in the creek (by slowing the speed with which storm water is allowed to enter the watercourse during and after wet weather events), and by allowing high flows, once they reach the creek, to overtop the creek banks, and flood the surrounding area, thereby dissipating the energy associated with higher flow events. A multitude of technologies are available for managing stormwater by retrofitting the existing urban environment in such a way that slows the flow rate of water towards the receiving body of water. These can include such elements as rain gardens, pervious pavement, stormwater management ponds, green roofs, porous pipes, and other elements of low impact design. The Region of Peel currently encourages all lower tier municipalities, through its Official Plan policies, to implement policies and programs to attenuate and treat stormwater or maintain pre-construction storm flow patterns.

Where wet weather events are so large that storm flows are not fully attenuated by the on-land management elements described above, the reconnection of the creek to its flood plain can help to dissipate energy by allowing

the water to flood low-lying land adjacent to the creek. Currently high flows are kept within the creek by high, often steep banks, designed to direct water as quickly as possible through Fletchers Creek and into the Credit River, which has a higher capacity than the creek. Reconnection would require large-scale earth-moving and landscaping to lower the gradient of the creek bank in some locations, and to create spillways where high flows would be directed into low-lying floodplains. Property acquisition may be required to accomplish this, and significant re-grading in some locations will also be necessary. This alternative aims to reduce the velocity of flows through the entire creek, reducing overall erosion in addition to the localized erosion that is currently threatening the infrastructure upstream of Denison Avenue.

Alternative 2B: Reduce discontinuity of in-stream structures by removing them

As the Fletchers Creek subwatershed urbanized, control structures were placed along the banks of the creek in various locations along its length an effort to address localized erosion and channel migration, or in some cases, to realign the channel to permit development. These control structures include gabion baskets, armourstone walls, rip-rap, and concrete channels. Although these measures protect the banks from further erosion where they are placed, they often have the perverse effect of increasing the rate of erosion downstream, and sometimes upstream or on the opposite bank from where they are located. By removing all of the control structures along the length of the creek, and allowing the natural erosion and deposition processes to run their course, a new equilibrium could be reached over time. This renaturalization of the creek would require the removal of some or all of the infrastructure and other development from the meander belt of the creek. This option is unlikely to reduce the erosion in the vicinity of the exposed pipe, however, it will require the removal of the active trunk sewer pipe from the creek's meander belt, resulting in the elimination of risk to the pipe associated with further erosion. This would represent a significant undertaking on the part of the Region.

Alternative 2C: Reduce discontinuity of in-stream structures by extending them

As noted above, the discontinuity of bank materials in Fletchers Creek has resulted in an increased rate of erosion in some instances. In the study area, it appears as though the rip-rap placed on the south bank upstream from the exposed pipe may have played a role in the rate of erosion of the south bank. If removing all of the structures from the creek is not feasible, extending them along the entire length of the creek will also protect the banks from further erosion or channel migration. This would involve the construction of new structures such as armourstone walls to connect the existing structures, and likely the retrofitting of existing structures in order to ensure that they are properly keyed into the bank, and to repair any failing structures, such as older gabion baskets. This would have the effect of hardening the entire length of the creek, and would greatly reduce the likelihood of any future channel migration or an increase in cross sectional area. Through careful planning and design, habitat features could also be built into banks and the creek bed to create riffles and pools, and spawning grounds for target fish populations.

4.2.3 Site-Specific Management

The "Site -specific Management" alternatives address only the immediate concerns caused by localized bank erosion in the vicinity of the exposed pipeline by protecting the active sanitary sewer from bank erosion and reductions in cover.

Alternative 3A: Protect over pipe/rebuild bank and re-grade opposite bank to maintain stream capacity

This alternative involves rebuilding the eroded bank of the creek by placing fill that is specially designed to stabilize the bank (typically a granular material on top of a geotextile fabric, covered with topsoil) on top of the native bank material above and below the exposed pipe, as well as over the exposed pipe. Stabilizing plantings can be incorporated into the design, improving terrestrial habitat function on this poorly-vegetated slope. Rebuilding the slope would increase the depth of cover over the active sewer pipe, however it would also result in a reduction in channel capacity. In order to compensate for the loss in capacity, the same volume of fill will have to be removed from the opposite bank for at least the same length as the north bank reconstruction. The re-grading of both banks will establish a more stable cross section while maintaining channel capacity in this reach. Both banks will require re-vegetation, which may improve habitat function and riparian stability.

Alternative 3B: Remove pipe and install slope revetment

This alternative involves the removal of the section of abandoned pipe that has become exposed and covering over the bank with a protective angular stone slope revetment where the pipe has been removed and upstream of the removed pipe to the existing rip-rap. This intervention can be combined with re-vegetation of the poorly-vegetated south bank, which will improve riparian habitat and stability, and will involve minimal in-water works. Vegetation plantings will include native, non-invasive tree and shrub species that are tolerant of periodic flooding conditions.

5 Evaluation of Alternatives

5.1 Method for Evaluation

The alternative solutions have undergone a two-part evaluation. The first part involved screening the alternatives for basic pass/fail criteria. Alternatives that met all pass/fail criteria were carried forward for a more detailed evaluation, and ranked against each other using a matrix evaluation method. Under each criterion, alternative solutions were ranked as most preferred to least preferred. Detailed evaluation criteria were categorized under four areas (technical, natural, social, and cost considerations), consistent with the Municipal Class Environmental Assessment. Based on the results of the evaluation, a preferred alternative solution was selected.

5.2 Screening of Alternatives

As noted in Section 1, at the time of completion of the Geomorphological Assessment, in March, 2012, it was identified that, based on the rate of erosion within the study area, the active sewer pipe would be at risk of damage in the short term. This time frame suggests that a solution to address slope erosion within the study area must be implemented within a year. Therefore all six alternative solutions were screened using a pass/fail method for the following two criteria:

Addresses the Problem Statement – The alternative will address the problem statement if it results in halting or reversing the bank erosion in Fletcher’s creek, north of Denison Avenue in Brampton, Ontario, that has caused the exposure of an abandoned sewer pipe and is placing an active sewer pipe at risk of damage

Meets the Time Frame Requirements – The alternative will meet the time frame requirements if it can address the problem statement within a year.

The results of the screening are outlined in Table 5-1, below. The three alternatives that received a pass on both screening criteria were carried forward for detailed evaluation. In detailed evaluation, alternatives were ranked against each other for their impacts on aquatic habitat, terrestrial habitat, flood storage capacity, stormwater management, sensitive/listed species, visual amenity, and recreational amenity. In addition, alternatives were also evaluated for their ease of implementation, cost, risk of cost escalation, risks to public health, ability to meet City of Brampton and other governmental policy/legislation, and construction-related disturbance.

Evaluation criteria reflect all components of the natural, social, cultural and technical environment, as well as cost and feasibility criteria, as required by the Environmental Assessment Act. Each element of the detailed evaluation assessed the impacts of alternatives in terms of the potential changes from the existing conditions as described in Section 3 of this report. Based on the assessments done for the detailed evaluation, each alternative was ranked as the most preferred, less preferred, or the least preferred alternative for each criteria. Upon completion of the evaluation, the alternative with the highest preference was selected as the preferred alternative overall. The results of the detailed evaluation are outlined in Table 5 2, on the following page.

Table 5-1: Screening of Alternatives

Alternative Solutions	Pass/Fail Criteria		Carry Forward?
	Addresses the problem statement	Meets the time frame requirements	
1. Do Nothing	Fail: Does not result in protection of active sewer pipe north of Denison Avenue	N/A	No.

Table 5-1: Screening of Alternatives

Alternative Solutions	Pass/Fail Criteria		Carry Forward?
	Addresses the problem statement	Meets the time frame requirements	
2A. Stormwater Management/ Floodplain Reconnection	Pass: The Region currently encourages stormwater management through existing policies and plans. Floodplain reconnection could result in a stabilized, more resilient channel, if properly designed and holistically managed could have lower channel migration and therefore reduce the risks to the active sewer pipe north of Denison Avenue.	Fail: Although there are ongoing programs and policies to improve stormwater management throughout the Region of Peel, the time required to acquire the property necessary to reconnect the channel to its floodplain, in addition to the time required to complete the extensive grading works required to allow flood flows to overtop the creek banks in a safe and controlled manner, would far exceed the current time frame limitations on this project.	No.
2B. Remove Control Structures	Fail: Naturalization (removal of control structures), as a part of a much larger watershed management program will allow the channel to continue to meander within its flood plain, likely increasing in sinuosity. Should the channel migration continue to follow past trends, this would result in further exposure of the abandoned pipe and possible exposure of the active sewer pipe as well.	Fail: The time required to remove all control structures within the subwatershed would far exceed the current time frame limitations on this project.	No.
2C. Extend Control Structures Throughout Sub-Watershed	Pass: Hardening of the entire length of the Creek will protect the active sewer pipe north of Denison Avenue, in addition to other infrastructure along its banks.	Pass: If the focus on control structure extension began in the vicinity of the exposed pipe, the pipe could be protected within the time limitations as a part of the larger project, extending over a number of years.	Yes.
3A. Rebuild Bank/ Re-grade Opposite Bank	Pass: Stabilizing and rebuilding the steam bank over the exposed pipe will protect the active sewer pipe behind it, increasing the depth of cover over the pipe.	Pass: The rebuilding/regrading works could easily be completed within a matter of weeks.	Yes.
3B. Remove Pipe and Install Slope Revetment	Pass: Bank stabilization will reduce the risk of further erosion and protect the active sewer pipe north of Denison Avenue.	Pass: Bank stabilization works could easily be completed within a week.	Yes.

Based on the pass/fail methodology for screening, three alternatives were carried forward for detailed evaluation. They are Alternatives 2C Reduce discontinuity caused by in-stream structures by extending them, 3A Protect over pipe/rebuild bank and re-grade opposite bank to maintain stream capacity, and 3B Remove pipe and Install Slope Revetment.

5.3 Detailed Evaluation

The three alternatives that received a pass on both screening criteria were carried forward for detailed evaluation. In detailed evaluation, alternatives were ranked against each other for their impacts on aquatic habitat, terrestrial habitat, flood storage capacity, stormwater management, sensitive/listed species, visual amenity, and recreational amenity. In addition, alternatives were also evaluated for their ease of implementation, cost, risk of cost escalation, risks to public health, ability to meet City of Brampton and other governmental policy/legislation, and construction-related disturbance.

Evaluation criteria reflect all components of the natural, social, cultural and technical environment, as well as cost and feasibility criteria, as required by the Environmental Assessment Act. Each element of the detailed evaluation assessed the impacts of alternatives in terms of the potential changes from the existing conditions as described in Section 3 of this report. Based on the assessments done for the detailed evaluation, each alternative was ranked as the most preferred, less preferred, or the least preferred alternative for each criteria, as depicted in the graphic below. Upon completion of the evaluation, the alternative with the highest preference was selected as the preferred alternative overall. The results of the detailed evaluation are outlined in Table 5-2, on the following page.

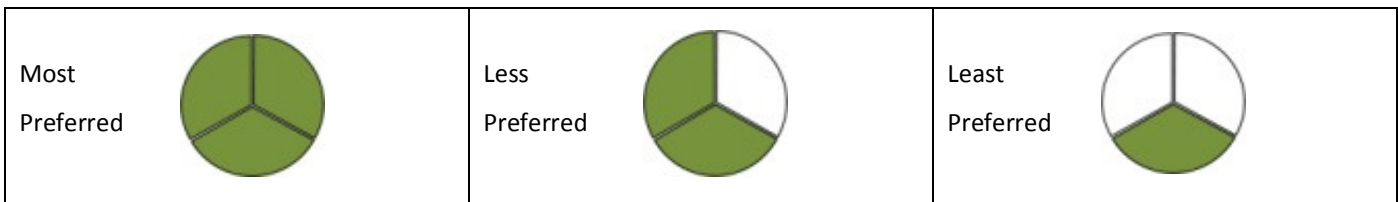


Table 5-2: Detailed Evaluation of Alternatives



















Evaluation Criteria	Alternative Solution		
	2C. Extend Control Structures	3A. Rebuild Bank/ Regrade Opposite Bank	3B. Remove Pipe and Install Slope Revetment
Natural Environment			
Impacts on aquatic habitat	 <p>Extensive shoreline works and some in-water works will result in large-scale habitat disruption, some of which may be permanent.</p>	 <p>Minor habitat disruption due to small-scale in-water works can be mitigated. Due to the current poor condition of aquatic habitat, this represents an opportunity for habitat improvement.</p>	 <p>Very minor habitat disruption due to no, or minimal in-water works.</p>
Impacts on terrestrial habitat	 <p>Extensive shoreline works will require vegetation removal along the length of the watercourse, in some cases including vegetation removal outside of the valley corridor to facilitate access to the creek banks for equipment and machinery.</p>	 <p>Minor vegetation disruption at south bank access point, and minor vegetation disruption at north bank access point.</p>	 <p>Minor vegetation disruption at south bank access point.</p>
Impacts on flood storage capacity	 <p>Although structures can be designed to ensure no loss in channel capacity, hardening of all surfaces reduces ability of channel to respond to flood events.</p>	 <p>Maintains channel capacity, however results in slight alteration to flow patterns as channel is slightly re-routed.</p>	 <p>Maintains channel capacity and current flow patterns.</p>
Impacts on stormwater runoff from the site	 <p>Bank hardening along the length of the watercourse results in very localized overland flow of stormwater along the length of the creek.</p>	 <p>Stormwater retention/attenuation improved through plantings and grading works.</p>	 <p>Stormwater flow unchanged.</p>
Impacts on sensitive/listed species	 <p>Redside Dace and Butternut are listed within Fletcher's Creek corridor, and are likely to be impacted by construction works.</p>	 <p>This reach of the stream is designated as Recovery Redside Dace habitat, however the quality of the aquatic habitat is poor. The proposed works can be designed such that habitat is improved along this reach.</p>	 <p>Some disruption to aquatic habitat may occur, however the quality of the aquatic habitat is poor.</p>
Impacts to slope and shoreline hazards	 <p>Reduces risks of bank erosion and slope failure along entire length of creek.</p>	 <p>May not slow the process of erosion; new fill may continue to erode after it has been placed over the bank.</p>	 <p>Reduces erosion along south bank only, maintaining existing risks of slope failure.</p>

Table 5-2: Detailed Evaluation of Alternatives




























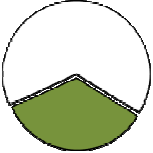

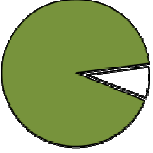
Evaluation Criteria	Alternative Solution		
	2C. Extend Control Structures	3A. Rebuild Bank/ Regrade Opposite Bank	3B. Remove Pipe and Install Slope Revetment
Social/Cultural Environment			
Impacts on visual amenity	 <p>Although bank hardening may have the effect of appearing to “clean up” the banks of the creek, it may take some time for vegetation to fill in, and the creek will appear less naturalized.</p>	 <p>Vegetation on the regraded north bank may take a few seasons to fill in.</p>	 <p>No impact after construction complete.</p>
Impacts on recreational amenity	 <p>Many trails and creekside recreational areas will have restricted access during construction activities.</p>	 <p>Two trail closures (on north and south bank) will occur during construction.</p>	 <p>One trail closure will occur during construction.</p>
Noise/dust generated from construction activities	 <p>Multiple sources of noise and dust will require mitigation during construction activities.</p>	 <p>Two sources of noise/dust will require mitigation during construction activities.</p>	 <p>One source of noise/dust will require mitigation during construction activities.</p>
Impacts on Archaeological resources	 <p>Multiple sites of possible impacts to archaeological resources.</p>	 <p>Two sites of possible impacts to archaeological resources.</p>	 <p>One site of possible impacts to archaeological resources.³</p>
Impacts on Aboriginal communities	 <p>Potential for impacts to Aboriginal communities due to scope of project.</p>	 <p>Low potential for impacts to Aboriginal communities due to scope of project.</p>	 <p>Low potential for impacts to Aboriginal communities due to scope of project.</p>
Technical			
Ease of implementation	 <p>Large-scale, long-term regrading and bank hardening works will require watershed-wide coordination.</p>	 <p>Can be constructed quickly with mini excavator at north bank and small bobcat at south bank.</p>	 <p>Can be constructed quickly with small bobcat or by hand at south bank.</p>
Access to construction sites	 <p>Access to multiple locations along creek may require temporary easements from municipal or private property owners.</p>	 <p>Two access points within park can be obtained from City of Brampton.</p>	 <p>One access point within park can be obtained from City of Brampton.</p>
Cost			
Cost of implementation	 <p>Very high cost for extensive regrading and restoration along entire creek.</p>	 <p>Low cost for regrading and restoration on both sides of the creek.</p>	 <p>Very low cost for restoration on south side of creek.</p>

Table 5-2: Detailed Evaluation of Alternatives

Evaluation Criteria	Alternative Solution		
	2C. Extend Control Structures	3A. Rebuild Bank/ Regrade Opposite Bank	3B. Remove Pipe and Install Slope Revetment
Risk of cost escalation	 <p>High risks of large cost escalation due to scope of project.</p>	 <p>Moderate risks of minor cost escalation depending on outcome of archaeological and environmental testing at north and south bank during detailed design.</p>	 <p>Low risks of minor cost escalation depending on outcome of archaeological and environmental testing at south bank during detailed design.</p>
Summary			

5.4 Confirmation of the Preferred Alternative Solution

Based on this evaluation, the most preferred alternative is Alternative 3B Remove pipe and install slope revetment. Based on the minimal disturbance to aquatic and terrestrial habitat, long-term improvement to terrestrial and aquatic habitat, minimal disruption of access to recreational amenity, ease of implementation, and low cost, this alternative was selected as the most preferred alternative. Alternative 3B entails removing the exposed section of the abandoned sewer pipe, and protecting over the eroded bank with a bioengineered live rock revetment to reduce or halt further erosion. This can be accomplished using mostly hand tools and a small bobcat. This alternative will result in a marked improvement to the terrestrial and aquatic habitat as a result of the plantings that will be incorporated into the bank protection features, and the reduction in erosion and sedimentation in the water column. The aquatic habitat will be protected during construction with a silt curtain. An estimated cost breakdown for these elements is provided in the following section.

6 Preferred Alternative Solution

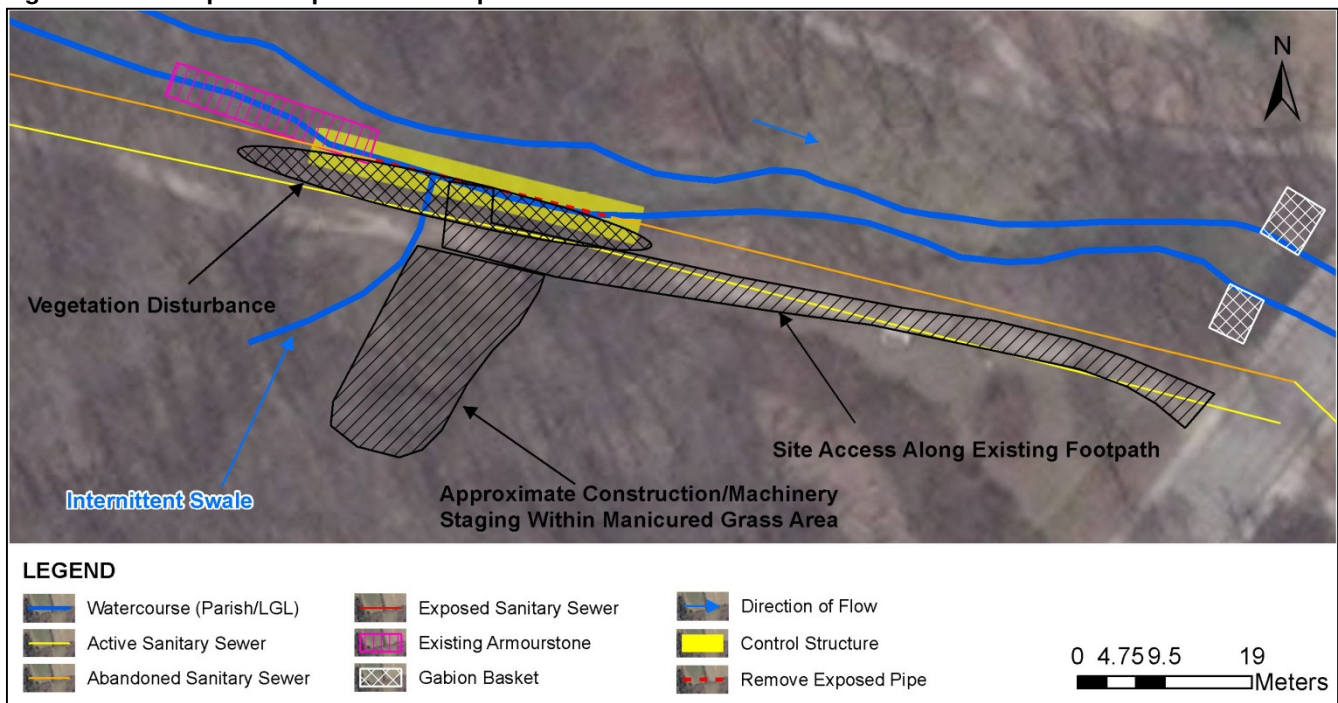
Based on the detailed evaluation of alternatives, it has been determined that the preferred alternative is to cut out the exposed section of the abandoned sewer pipe, and protect over the eroded bank to reduce or halt further erosion. This solution to the bank erosion is detailed below.

6.1 Conceptual Design of Preferred Alternative

6.1.1 Concrete Pipe Removal

The removal of the concrete pipe can be done primarily with hand tools and a small bobcat. The entire exposed section of pipe will be removed, as shown conceptually in Figure 6-1. There should be no need to remove more than just the exposed pipe unless the soil at either end is poorly consolidated. If this is the case, the pipe removal may include slightly more than the currently exposed section to reduce further bank erosion.

Figure 6-1: Conceptual scope of work for preferred alternative 3B

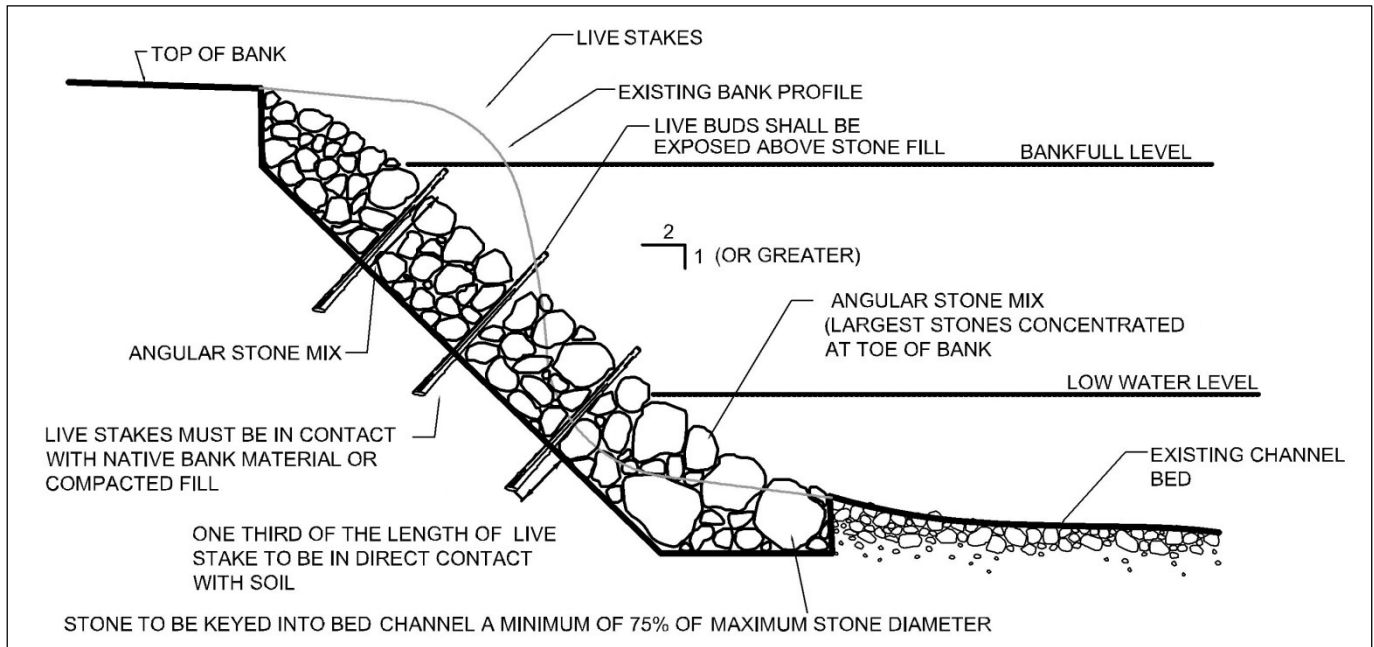


6.1.2 Bank Restoration

Once the exposed pipe has been removed, the bank will be protected by installing a bioengineered live rock revetment over the area of pipe removal, from the toe of the slope up to at least the 5-year flood level. To keep the soil beneath the revetment from washing out during wet weather events and times of high creek flow, granular material will be placed between the native soil and the new installation. This may require some minor excavation to create a stable slope pitch and to properly key the bank protection into the slope. It is anticipated that some native soil removal will be required, however this will be minor, and will be done by hand or with a mini excavator. The installation of the revetment can also be done by hand or with small machinery such as a bobcat.

Large angular stone will be placed on the bank starting at the downstream end of the exposed pipe removal, and will extend upstream to the existing angular stone, a length of approximately 60 metres. An example design details of this type of installation is shown below, in Figure 6-2.

Figure 6-2: Example cross section of a live rock revetment installation to protect a creek bank from erosion and create aquatic and terrestrial habitat



6.1.3 Vegetation

Although the vegetation currently on the slope above the exposed pipe is sparse, there are some small shrubs and tree species present that may need to be removed in order to install the revetment. There is very little understory on the bank, and as such, access to the site and the restoration works will not result in any major vegetation removal. Two trees are currently located in the vicinity of the exposed pipe. Both are leaning into the creek and their roots are pulling away the soil as they lean, exacerbating slope instability. The revetment will require the removal of these two hazardous trees to stabilize the bank and create a clearing to allow the new plantings access to sunlight. The new vegetation planted on the bank will improve the aquatic habitat functions of the watercourse by providing shade and stabilizing the revetment.

6.2 Costs and Schedule

It is anticipated that the MNR will apply the Redside Dace timing window to the construction works of June 15 to August 15. Therefore the works will be completed during the summer months, when they will cause the fewest impacts to potential Redside Dace habitat, and those impacts will be most easily mitigated.

An opinion of probable cost has been provided for the pipe removal, bank protection, and site restoration, as outlined in Table 6-1, below. This conceptual estimate includes a 15% contingency. The selected contractor will confirm or refine this estimate.

Table 6-1: Fletcher's Creek Slope Stabilization - Opinion of Probable Cost

Work Element	Probable Cost
Site mobilization	\$5,500.00
Erosion/sediment and other temporary controls	\$8,000.00
Removals	\$6,664.00
Slope protection works	\$76,834.00
Restoration	tbd
Total cost	\$96,998.00
Total with 15% contingency	\$111,547.70

7 Environmental Impacts and Mitigation Measures

7.1 Potential Impacts and Mitigation Measures During Construction

7.1.1 Trucks and Traffic Impacts

Due to the small size of this project, it is not anticipated that there will be any noticeable increase in truck traffic in the vicinity of the proposed works. Truck access and parking will be arranged during the detailed design phase.

7.1.2 Noise

Since the proposed works are minor in nature, will be implemented by hand or with small machinery, and are located within an area that is adequately set back from residences, and within a valley feature (below existing residences), construction activities are expected to produce minimal noise. Although the construction activities may result in some minor noise, it will be completed during normal working hours, and is not expected to cause undue disturbance to local businesses or residents, due to adequate separation distances.

7.1.3 Park Access

Access to the parkland to the south of the creek will be maintained during construction activities. However, where equipment and materials are being stored, a temporary enclosure may be erected to protect the public safety.

7.1.4 Excavation and Construction Impacts

The slope within the study area is quite steep. Minor excavation works may temporarily increase the steepness of the slope, and it is important that the stability of the slope is maintained throughout construction works. No works will occur during wet weather events or during times of high stream flow. Additional measures to maintain slope stability during construction works may be determined during the detailed design phase.

7.1.5 Air Quality

The nature of the construction activity is expected to have no adverse impacts on local odour or air quality.

7.1.6 Aquatic Habitat

Parts of the proposed works will occur within the watercourse. To mitigate against the release of sediment into the water column during construction works, a silt curtain will be placed in the watercourse, around the working area, to capture any suspended solids that may be stirred up by the construction works. This sediment control measure will be inspected regularly for proper installation and operation. Detailed erosion and sediment control measures will be developed as part of the detailed design phase, in consultation with the CVC.

7.1.7 Terrestrial Habitat

The terrestrial habitat within the study area is currently in poor condition, with very little vegetated understory along the stream banks, and anthropogenic conditions present upland of the bank. Small machinery and hand equipment will be used to remove the abandoned pipe and install the bank protection measures, and as such the access area and equipment and machinery lay-down areas can avoid disrupting the vegetation community along the creek.

7.1.8 Species at Risk

This reach of Fletcher's Creek has been identified by the Ministry of Natural Resources as Redside Dace recovery habitat. Although the study area has been characterized by the CVC as a warm water fish habitat, meaning that Redside Dace are unlikely to occupy this reach, its potential as an area of fish passage means that the proposed works may result in an impact to potential future Redside Dace habitat. As such, the project team is discussing mitigation measures with the MNR, which will be implemented in accordance with the Endangered Species Act. These measures will be determined during the detailed design phase, and will likely include adherence to a construction timing window and the inclusion of erosion and sediment control measures in the final design.

7.2 Potential Impacts and Mitigation Measures During Operation

7.2.1 Flooding and Erosion Control

The removal of the abandoned pipe and the placement of rip-rap over the bank will be implemented in such a manner as to cause no loss of stream flow capacity and no loss of flood capacity. The exact quantities of soil to be removed from, and of material to be placed on the stream bank will be determined at the detailed design phase. As no changes are proposed to stream flow capacity or flood capacity, no mitigation measures are required.

The bank stabilization measure will result in a reduced rate of erosion from the south bank of Fletcher's Creek within the current vicinity of the exposed pipe. Erosion and sediment deposition are natural processes that occur in flowing watercourses. The slowing of the erosion of the south bank does represent a slowing of the channel's natural migration within its meander belt. As the channel migration is currently putting existing infrastructure at risk, in this instance, the natural channel migration is considered to be undesirable, and as such, the proposed works represent an improvement over existing conditions.

7.2.2 Terrestrial and Aquatic Habitat

The bank protection measures will require the removal of some small shrub and tree species. As no terrestrial species at risk are present in the study area, any vegetation removals would be subject to standard replacement ratios, and replacement vegetation will be provided in accordance with CVC requirements.

Although the installation of the live rock revetment on the bank of the creek will result in a change to the aquatic habitat feature, it is anticipated that this change will be a positive one. Currently the creek bed in the vicinity of the exposed pipe is composed of mainly cobble covered in silt. The installation of the revetment on the creek bank down to the toe of the slope will create riffles that serve an important habitat function for aquatic species, while the new vegetation will be more appropriate to the riparian environment and will provide cover for fish and invertebrates. Habitat improvement options will be further investigated during the detailed design phase.

The quality of the water flowing through the immediate vicinity of the bank protection measures will likely change slightly upon completion of the works; however this change is anticipated to represent an improvement in water quality. The reduced erosion from the bank during wet weather events will mean that fewer suspended solids are washed into the creek, resulting in lower turbidity levels. The riffles created by the revetment may also increase the amount of dissolved oxygen within the water column. Given the current, degraded nature of the watercourse within the study area, both of the above changes are considered to be desirable.

8 Public and Agency Consultation

Consultation with the public, with government review agencies, and with First Nations and Métis communities is an important part of the Municipal Class EA process. The Municipal Engineers Association’s Municipal Class EA document outlines consultation requirements for each project schedule. The document also states that the level of consultation and consultation methods shall be appropriate to the scope and potential impacts of the proposed project.

8.1 Public Consultation

Because this project falls under a Schedule B class Environmental Assessment, the Environmental Assessment Act requires consultation with the public on matters that may affect the environment. According to the Schedule B Municipal Class EA process followed for this study, proponents must also contact relevant agencies and affected members of the public, who must be given an opportunity to comment on or ask questions about the study, solution alternatives, and preferred solution.

A notice of commencement was published in local newspapers on September 26, 2012, and was also mailed directly to the Government Review Team (GRT), as outlined by the Ministry of the Environment (MOE). This notice can be found in Appendix C. Additional parties/agencies that may have an interest in the outcome of this project were included in the list of project contacts, including local utility companies. Contact details for consulting staff and the proponent were included on this notice.

8.1.1 Agency Consultation

Based on the interest shown in the EA as a result of the Notice of Commencement, a list of stakeholder agencies was drafted and preliminary consultation was conducted with these agencies. Agencies in this list were the City of Brampton, the Credit Valley Conservation Authority, and the Ministry of Natural Resources. Consultation with these three agencies provided useful information on natural habitat, recreational uses, and natural hazard concerns found within the study area. These issues were all accounted for in the selection of a preferred alternative solution for this Class EA.

An Information Bulletin was sent to all agencies on the MOE GRT contact list, as well as all local utilities. The Information Bulletin outlines information regarding the problem, the solution rationale, and contact details for questions or comments. The Information Bulletin is reproduced in Appendix C. Agency comments and questions in response to the Information Bulletin, along with the Region’s response to these comments and questions are reproduced in Appendix C. A summary of the comments received from agencies is shown in Table 8-1, below.

Table 8-1: Summary of comments received from public agencies and stakeholders, and responses from the Region of Peel

Agency	Agency Comment	Region Response
Ministry of Environment	The Ministry requested that the project examine impacts and mitigation measures for ecosystem protection and restoration, surface water, groundwater, air quality, dust and noise, contaminated soils, mitigation and monitoring, Class EA process, aboriginal consultation. Additional permits may be required from the MOE or other government agencies.	The Region has received advice from the Ministry of Natural Resources and the Credit Valley Conservation Authority on the protection and restoration of the ecosystem, surface water, and groundwater, mitigation measures will be put in place to minimize impacts on air quality and noise, soil contamination will be examined during detailed design, the Class EA process has been followed for a Schedule B Municipal Class EA, and interested aboriginal communities have been consulted. Permits will be investigated during detailed design.
Ministry of Natural Resources	This area is Redside Dace habitat. Please include a link to the MNR’s website with Redside Dace habitat and protection information in project documentation.	The preferred alternative solution will improve Redside Dace habitat. Appropriate construction timing windows will be imposed to minimize disruption to fish habitat. Interested parties are directed to learn more about

Table 8-1: Summary of comments received from public agencies and stakeholders, and responses from the Region of Peel

Agency	Agency Comment	Region Response
		Redside Dace habitat at http://www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/287136.html
Utilities	MTS Allstream, Hydro One Brampton, and Enbridge do not have utilities in the study area.	Noted.
Transport Canada	The proposed works may require a Minor Works and Waters Permit from Transport Canada	Noted. We will contact Transport Canada during detailed design to further examine permit requirements.
City of Brampton	There is an existing storm sewer outlet into Fletcher's Creek in the vicinity of the proposed works that will need to be addressed during detailed design.	Noted.
Ministry of Tourism, Culture, and Sport	Please be aware that all archaeological assessments must be completed, reviewed by an Archaeology Review Officer and the recommendations accepted prior to detail design.	The project team will commence an Archaeological Assessment upon completion of the Class EA study, and will submit the findings of this assessment to the MTCS when it is complete.

On February 19, 2013, a stakeholder roundtable meeting was held with the Region of Peel and their consultants, the City of Brampton, the CVC, and the MNR, to discuss and address project questions and concerns. The minutes of this meeting are copied in Appendix C.

8.1.2 Public Consultation

The Information Bulletin was also sent to all residents in the vicinity of the study area. The Information Bulletin sent to residents included a comment request sheet, with space for questions or comments on the study process or preferred alternative, along with a return address to which comments or questions could be returned, and a self-addressed, stamped envelope for residents to return the comment sheet to the Region of Peel within two weeks of receiving it.

One comment sheet was returned to the Region of Peel. The respondent noted dissatisfaction with debris and trash accumulating in the watercourse and requested that the works do not result in reduced access to the watercourse for area wildlife. The respondent indicated support for the preferred alternative solution.

8.2 Notice of Completion

The Notice of Completion was published in local newspapers, and is reproduced in Appendix C.

9 Next Steps

Upon completion of the 30-day review period, the Region of Peel will commence detailed design of the preferred alternative, and obtain all required permits and approvals for the final design details. Approvals requirements include a permit from the Credit Valley Conservation Authority, sign-off from the Ministry of Natural Resources, parks access permission from the City of Brampton, and any utility locates necessary. The Region plans to start construction in the summer of 2013.