MAYFIELD WEST, PHASE 2 SECONDARY PLAN COMPREHENSIVE ENVIRONMENTAL IMPACT STUDY AND MANAGEMENT PLAN

PART A: EXISTING CONDITIONS AND CHARACTERIZATION

DRAFT REPORT

TOWN OF CALEDON

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1. INTRODUCTION

The Comprehensive EIS and Management Plan (Environmental Study) represents a central study, among others initiated by the Town of Caledon in support of the overall Secondary Plan for Mayfield West Phase 2 Study Area. The Environmental Study has been commissioned in order to address the predicted impacts from the proposed urban development within the Mayfield West Phase 2 Study Area, bound by Chinguacousy to the west, Hurontario to the east, Mayfield to the south, and Old School Road to the north, in the context of the physical, social and regulatory environments. The past, present and future impacts on the various land forms and resources will be documented and defined; this will then set the foundation for establishing the area's management strategies. The plan will ultimately provide clear implementation guidance on priorities, timing, proponency, process, monitoring and future study needs.

The Mayfield West Phase 2 Secondary Plan study area has several important characteristics which need to be considered in the study, including:

- ***Unique location in upper Etobicoke Creek and Fletcher's Creek, headwater represented by numerous small channels and swales of limited baseflow***
- ***Potential groundwater linkages to local wetlands and various reaches of Fletcher's Creek and Etobicoke Creek***
- ***Presence of headwater systems (terrestrial and aquatic) that are currently of reduced function in terms of natural cover and diversity of biota***
- ***An existing natural heritage system that is relatively well documented as being, highly fragmented, and apparently low-functioning due to a longstanding agricultural history***
- ***Existing development at the northwest corner of Mayfield and Hurontario***
- ***Proposed development south of Mayfield Road in the Mount Pleasant Community (Brampton)***
- ***Influence of the CPR railway and future Highway 10 interchange on drainage and terrestrial movement***

These characteristics lead to a series of potential physical and stakeholder-based issues, which will need to be addressed by the Comprehensive EIS and Management Plan, including:

- ***Need for land use development plans to manage impacts locally (i.e. through Low Impact Development and Best Management Practices)***
- ***Treatment of headwater swales in land use designs***
- ***Integration with transportation system planning for both Caledon and Brampton (Peel); plan for 400 Series Interchange for Highway 10***
- ***Watershed scale impact management related to water quality and quantity (surface and groundwater); need to consider downstream impacts in both Fletcher's Creek and Etobicoke Creek***
- ***Integration of the study area with the broader landscape in terms of features and functions, affecting lands in Caledon, Brampton and Halton Hills***

- ***Strategies to fit complementary land uses with existing natural features, to build on potential synergies between uses***
- ***Special treatment of Greenbelt Areas associated with Etobicoke Creek***
- ***Need to consider planning overland flow routes in Mayfield West area to be complementary to those established for the Mount Pleasant Community in Brampton***

The Agency-approved Work Plan for the overall study process has been developed to logically build on the data resources and information collected as part of the on-going North West Brampton Environmental studies, as well as the Etobicoke Creek Headwaters Subwatershed Plans, including TRCA's Terrestrial Natural Heritage System and CVC's Environmental Effectiveness Strategy Monitoring Plan. By embracing these holistic resources, the overall study has been able to focus in more detail on local specifics of the area resources.

The Environmental Study commenced in April 2008 when the project Start-up meeting was convened with the Technical Steering Committee. The balance of the support studies were initiated over 2008. This Report constitutes the Part A: Existing Conditions and Characterization for the study area. It summarizes the results of the field monitoring component of the Environmental Study, as well as provides results from the various assessments completed to-date, related to the environmental systems including: hydrogeology (groundwater), hydrology (surface water), hydraulics, water quality, stream morphology, fisheries, and terrestrial resources. The report findings will be used as a base from which the Secondary Plan will build from in terms of constraints and opportunities, along with information from the other companion studies.

2. BACKGROUND INFORMATION

Various sources of background information have been provided by the members of the Technical Steering Committee for use in the Environmental Study including Town of Caledon, Region of Peel, Toronto and Region Conservation Authority, and Credit Valley Conservation. As well, the various companion initiatives supporting the overall Secondary Planning Process have also over the course of the Secondary Plan required access to this information. The information received, as well as the source of the data, has been documented in an Information Tracking Chart prepared for this study; a copy of this chart is provided in Appendix 'A' of this report.

3. GOALS, OBJECTIVES AND TARGETS

Specific goals, objectives, and targets for the management plan will be developed, as part of the subsequent phases of the Environmental Study. These goals, objectives, and targets will be established consultatively with the Technical Steering Committee, based upon the integrated results of the Characterization of existing conditions, as well as the subsequent Impact Assessment. Appendix 'H' contains early policy and relevant documentation associated with Natural Heritage System goals, objectives, and targets.

4. BASELINE INVENTORY

4.1. Geotechnical

4.1.1. Importance/Purpose

It is important to understand the background geologic information, as well as to assess the existing conditions within the study area, in order to identify areas of significant erosion, over-steepening, and long-term movement of the top of bank. A detailed site inspection is necessary to properly assess slope stability, which is used to create constraint mapping for development purposes.

4.1.2. Background Information

The following reports and maps have been reviewed for background geological and physiological information.

- ***State of the Watershed Report: Etobicoke and Mimico Creek Watersheds. TRCA. 1998.***
- ***The Physiography of Southern Ontario, 3rd Edition. Ontario Geological Survey, Special Volume 2. Chapman, L.J. and D.F. Putnam. 1984.***
- ***Palaeozoic Geology, Brampton (1:50,000), Ontario Division of Mines, Map No. 2337. 1976.***
- ***Industrial Mineral Resources of the Brampton Area, Ontario Department of Mines, Industrial Mineral Report 23, Hewitt, D.F. 1969.***
- ***Brampton Area Drift Thickness Sheet (1:63,360), Ontario Department of Mines, Map No. 2179. 1969.***
- ***Brampton Area Industrial Mineral Resources Sheet (1:63,360), Ontario Department of Mines, Map No. 2176. 1969.***

The following geotechnical reports have also been reviewed for detailed stratigraphic information:

- ***Foundation Investigation & Design Report (Part 1: Factual Information), Etobicoke Creek Bridge, Highway 410 Extension – Phase III, prepared for the Ministry of Transportation Ontario, Terraprobe Ltd. 2007.***
- ***Foundation Investigation & Design Report (Part 1: Factual Information), Valleywood Boulevard Underpass Structure, Highway 410 Extension – Phase III, prepared for the Ministry of Transportation Ontario, Terraprobe Ltd. 2007.***

Several other geotechnical reports by Terraprobe Limited in the vicinity of the site have also been reviewed for general regional stratigraphic information. Ministry of the Environment water well records have also been reviewed for generalized stratigraphy in the area.

4.1.2.1 Physiography and Geology

The physiographic description of an area commonly includes summaries of topography, landform, drainage and the occurrence of surface soils types along with an overview of the depositional and erosion history that created the landform. Geologic descriptions commonly detail the overburden and bedrock composition and form below the surface as well as the relationship of the geology to the physiography of that area. Together these two descriptions are used to characterize the physical setting of a study area. Within the study area the physiography and geology are so very closely related that for the purposes of this study the physical setting overview is a synthesis of both overall characteristics.

The physiography and Quaternary geology of the general area is detailed in Chapman and Putnam (1984) and Hewitt (1969), respectively.

The site is generally bounded by Mayfield Road to the south, Old School Road to the north, Highway 10 to the east, and Chinguacousy Road to the west (Appendix 'B', Figure 1). This area lies within of the general physiographic region known as the South Slope, which lies between the Oak Ridges Moraine and the Peel Plain. The shape of the bedrock surface as well as the occurrence of the overburden units, which make up the above region, is a result of the repeated glacial advances and retreats which have occurred in Southern Ontario. The most recent glacial advance and retreat formed much of the land surface and geology present in the area today. This event is referred to as the Wisconsin Glaciation, and was accompanied by various meltwater lakes and channels. All of the Pleistocene deposits in the vicinity of Caledon and Brampton are associated with the advance and retreat of this ice sheet. By 27,000 years ago, the last major glaciation had begun advancing and by 20,000 years ago had reached its furthest point south in Ohio. All of southern Ontario was covered by glacial ice until about 14,000 years ago when a retreat of the ice fronts began, as one ice lobe occupied the Lake Ontario Basin and another occupied the Lake Simcoe Basin (Hewitt, 1969). Most of the study area is flat or has gently rolling topography except where Etobicoke Creek or tributaries of Fletcher's Creek have dissected the till plain. There is some fluting present in the bevelled till plain. The regional slope of the South Slope is toward the south to southeast. The direction of glacial movement has formed parallel topographic features which tend to control the surface drainage features. The topography varies from approximate Elevation 270 m (geodetic) in the north to Elevation 260 m (geodetic) in the south.

<u>Bedrock</u>

The Ontario Divisions of Mines Map No. 2337 (1976) indicates that the site and surrounding region is underlain by bedrock of the Queenston Formation. The Queenston Formation is of Upper Ordovician age and underlies much of the Caledon and Brampton area, stretching from the base of the Niagara Escarpment to Streetsville and east. The bedrock consists of dark red, hematitic shale interbedded with grey to green limestone and occasionally sandstone. The bedding of the Queenston Formation is typically flat and sub-horizontal. The Ontario Divisions of Mines Map No. 2179 (1969) indicates that the thickness of overburden soils (drift thickness) typically varies from about 10 to 20 m below existing grade (Appendix 'B', Figure 2). In the southern portion of the site around McLaughlin Road, the overburden thickness is shown to be less than 7.5 m, but in the south-eastern portion of the site near Mayfield Road and Highway 10 is shown to be up to 40 m below existing grade.

Surficial Overburden Soils

The Ontario Department of Mines Map No. 2176 (1969) indicates that the site and surrounding region overburden soils consist of clay or silt till, of the Wisconsinan glacial period (Appendix ‘B’, Figure 3). This large till plain is known as the Halton-Peel Till plain, which occupies the area east of the Niagara Escarpment and north of the Lake Iroquois shoreline. Although the glacial till can be quite thick in this area, it takes on the character of the underlying bedrock. For example, where it overlies the red Queenston Formation, the till is comprised of reddish brown to brick red clay and silt with abundant red shale inclusions. In some locations, the till is overlain by a thin veneer of clays or sands.

4.1.2.2 Previous Investigations

A review of previous geotechnical investigations in the vicinity of the study area was undertaken to understand detailed stratigraphy. Terraprobe (2007) completed geotechnical investigations for the proposed extension of Highway 410 from east of Heart Lake Road to Highway 10, north of Mayfield Road. The closest of these investigations to the study area included the proposed Valleywood Boulevard underpass structure, and the proposed bridge over Etobicoke Creek.

In general, a clayey silt glacial till deposit was encountered beneath a surficial topsoil layer. The clayey silt till extends to depths ranging from about 10 to 13 m below ground surface. The clayey silt glacial till is of low plasticity and has a typically very stiff to hard consistency. Below the clayey silt till is a deposit of sand and silt till. The sand and silt till has a compact to very dense (typically very dense) relative density and extends down to bedrock. The glacial tills have some interbeds of sands and silts of limited extent. In some locations, the sand and silt till is underlain by a deposit of cobbles and boulders at the bedrock interface. At Valleywood Boulevard, the boreholes extended to depths ranging from 12 to 26 m below existing grade and did not encounter bedrock. Further east, the boreholes for the Etobicoke Creek bridge extended to depths ranging from about 7 to 36 m below grade. In these boreholes, bedrock was encountered at depths of about 28 to 33 m below grade (Elevation 214 to 223 m). It should be noted, however, that the bedrock encountered at this site was grey shale and limestone of the Georgian Bay Formation, not of the red Queenston Formation. Piezometers installed in boreholes for these projects indicate that the groundwater table was consistently found around Elevation 247 to 250 m (geodetic).

Other boreholes by Terraprobe south east of Mayfield Road and Highway 10, and southeast of Mayfield Road and Chinguacousy Road also revealed surficial deposits of clayey silt till and sandy silt till. These investigations extended only to depths of about 5 to 11 m below existing grade. Boreholes advanced in the Valleywood subdivision also found hard clayey silt till to depths of 11 m. Other boreholes about 5 km north – northwest of Old School Road and Chinguacousy Road found very stiff to hard clayey silt till to a depth of 11 m below grade at that site.

Ontario Ministry of the Environment water well records also indicate the presence of clay till soils to significant depth across the site. Wells drilled close to the branches of Etobicoke Creek indicate the presence of sands and gravels, which are likely relatively young fluvial deposits. The deep wells across the site which encountered bedrock indicate that the bedrock is comprised of red shale or red limestone, which was encountered at depths ranging from about 15 to 37 m below existing grade.

4.1.2.3 Aerial Photographs

The vicinity of the study site has historically been used for agricultural purposes. Air photographs were examined for the site dating from 1956, 1979 and 1990, along with recent air photos. The photographs are included in Appendix 'B' as Figures 4, through 7.

The air photograph from 1956 shows that the land use and landforms of the study site were much the same then, as they are today. That is, the majority of the site is used for farming, with the northern portion of the site is incised by Etobicoke Creek. There do not appear to be any major changes in locations or meanders of the creek. The only exception is that in the 1990 air photograph, the branch of the creek crossing McLaughlin Road, about half way between Mayfield Road and Old School Road, appears to have a somewhat straightened path. There are no indications of long-term movement of the top of bank or of slope instability. A school seems to have been built just south of Etobicoke Creek, just west of Highway 10, sometime between 1979 and 1990. The air photograph for 1990 has the south east corner cut off, unfortunately. It is therefore not possible from air photographs to determine exactly when the Snelgrove subdivision at the northwest corner of Mayfield Road and Highway 10 was constructed, but to say that it was built after 1979.

4.1.3. Methods

4.1.3.1 Initial Characterization

A visual inspection of the table land and slope areas was conducted on October 14-17, and 28, 2008. General information pertaining to the existing slope features such as slope profile, slope drainage, water course features, vegetation cover, structures in the vicinity of the slope, erosion features and slope slide features, was obtained during this inspection. A brief summary of the results of the visual inspection is presented below. Photographs were taken during the inspection are included in Appendix 'B'. A mapping key plan, provided in Appendix 'B' as Figure 8, shows the overall locations of the detailed site inspection areas. Each of the individual Photograph and Features Plans are provided in Appendix 'B' as Figures 9A through 9G, and show the locations of the features discussed below. These were the only areas, based on the provided topographic mapping, that have any significant slopes which require inspection (i.e. there are no slopes that require inspection in the Fletcher's Creek area). Each of the Photograph and Features Plans will be discussed as a separate area of the creek.

Area A (ref. Photographs 1 to 3 in Appendix 'B')

This area of the mapping extends from Chinguacousy Road to about 600 m east of Chinguacousy Road, and is about 1.4 to 1.9 km south of Old School Road. In general, Etobicoke Creek runs from west to east through this area. The creek is 3 to 5 m wide in this area, with a flood plain varying from approximately 5 to 50 m. The flood plain has swampy to marshy vegetation. In general there is little observed toe erosion but for a few isolated areas of some minor undercutting and exposed roots (Photograph 3). The slopes vary in height from less than 1 m near Chinguacousy Road, to about 3 m at the eastern portion of the area, and are all 3H :1V or flatter. The slopes are all well vegetated.

Area B (ref. Photographs 4 to 6 in Appendix 'B')

This area of the mapping is situated between Chinguacousy Road and McLaughlin Road, and is about 1.2 to 1.7 km south of Old School Road. In general, Etobicoke Creek runs from west to east through this area. The creek is about 3 to 5 m wide in this area, with a flood plain varying from approximately 10 to 80 m. The flood plain has some marshy and / or grassy vegetation. In general there is little to no observed toe erosion throughout this area. The slopes vary in height from 2 to 3 m in the west to up to about 5 m at the eastern portion of the area, and vary from 2H : 1V to 3H :1V or flatter. The slopes are all well vegetated with grasses, trees, shrubs, saplings, etc.

Area C (ref. Photographs 7 to 11 in Appendix 'B')

This area of the mapping is situated from about 250 m west of McLaughlin Road to about 300 m east of the CN Railway Line (CNR), and is about 1.1 to 1.6 km south of Old School Road. In general, Etobicoke Creek runs from west to east through this area. The creek is about 2 to 7 m wide in this area, with a flood plain varying from approximately 0 to 50 m. The flood plain, where present, has marshy vegetation. In general there is little to no observed toe erosion throughout this area. The slopes vary in height from about 5 to 6 m across the area and are as steep as 2H : 1V in a few isolated areas, but are generally 3H :1V or flatter. The slopes are all well vegetated with grasses, trees, shrubs, saplings, etc.

Area D (ref. Photographs 12 to 17 in Appendix 'B')

This area of the mapping is situated from about 300 m east of the CN Railway Line (CNR) to Highway 10, and is about 1.0 to 1.5 km south of Old School Road. In general, this branch of Etobicoke Creek runs from west to east through this area. The creek is about 1 to 7 m wide in this area and meanders through the western portion of this area. The flood plain varies from approximately 0 to 50 m. The flood plain, where present, has marshy vegetation. In general there is little to no observed toe erosion throughout this area. The one observed exception is shown in Photograph 16, where some minor undercutting and erosion of the toe of the slope about 200 m west of Highway 10. The slopes vary in height from about 6 m in the west to about 10 m near Highway 10. In general the southern slope is steeper and higher than the northern slope. The southern slopes are as steep as 1.5H : 1V in a few isolated areas, but are generally 2H to 3H :1V, and in some areas are much flatter. The slopes are typically well vegetated with grasses, trees, shrubs, saplings, etc. There is a school with associated buildings, parking lots and track facilities on the tableland of the southern slope of this branch of the creek, near Highway 10. The creek runs east through a culvert beneath Highway 10.

Area E (ref. Photographs 18 to 27 in Appendix 'B')

This area of the mapping is situated from Highway 10 to about 400 m west of Highway 10, and is about 0.4 to 1.2 km south of Old School Road. In general, this branch of Etobicoke Creek runs from north to south through this area. The creek is about 2 to 7 m wide in this area. The flood plain varies from approximately 0 to 40 m. In general there is some minor toe erosion throughout this area, with several discrete locations of moderate erosion. One observed area of moderate erosion is located in the southern portion of this area, about 20 m west of Highway 10 on the eastern bank of the creek, near an access road from the table land down to the flood plain. In this area, there is undercutting and erosion of the toe that has exposed root systems and has bare areas (Photographs 18 to 20). Another similar area of erosion and undercutting occurs at the northern portion of the area on the west slope of the creek (Photographs 26 and 27). Other than these areas, the slopes are generally well vegetated with grasses, trees, shrubs, saplings, etc. The slopes vary in height from about 6 to 8 m across the area. Isolated sections of the slopes are as steep as 1H : 1V, but for the most part are generally 1.5H to 2H :1V, and in some areas are much flatter. There are several dwellings on the tableland near to Highway 10 in this area. The creek runs through beneath an access road through two culverts about 1 km south of Old School Road, and then through another large culvert beneath Highway 10.

Area F (ref. Photographs 28 to 41 in Appendix 'B')

This area of the mapping is situated from Highway 10 to about 700 m west of Highway 10, and from 0 to 350 m south of Old School Road. There are several branches of Etobicoke Creek through this area, but in general the creek runs from west and north to east and south. The creek is about less than 1 m to 7 m wide in this area. The flood plain varies from approximately 0 to 50 m. In general the southern slope throughout this area varies from 6 to 9 m in height and has an inclination of typically 1.5H : 1V, with some steep areas up to 1H : 1V, and a few gentle slopes of up to 4H : 1V. There is some erosion and undercutting of the slope toe in isolated areas, with a typical example shown in Photograph 28. There is also some indication of slope creep shown by some bent and fallen trees.

One branch of Etobicoke Creek, about 300 m west of Highway 10, runs underneath Old School Road from north to south. This branch of the creek has slopes typically inclined at about 1.5H : 1V and are about 8 m in height (Photographs 31 to 36). In this portion of the area, the slopes are experiencing localized toe erosion, and show evidence of slope creep. The slopes are vegetated with young to mature trees and spotty low-lying vegetation.

The other branch of Etobicoke Creek, about 700 m west of Highway 10 also runs underneath Old School Road from north to south. This branch of the creek has slopes typically inclined at about 1.5H : 1V on the western slope and about 2H : 1V on the eastern slope and is about 7 and 6 m in height, respectively (Photographs 38 to 40). In this portion of the area, the slopes are experiencing localized toe erosion, and show evidence of slope creep. The slopes are vegetated with young to mature trees, saplings, and some low-lying vegetation.

There are several dwellings on the tableland near Old School Road in this area.

Area G (ref. Photographs 42 to 45 in Appendix 'B')

This area of the mapping is situated from about 350 m east of CNR to McLaughlin Road, and is about 0 to 350 m south of Old School Road. In general, this branch of Etobicoke Creek runs from west to east through this area. The creek is less than 1 to at most 2 m wide in this area. The flood plain varies from approximately 0 to 15 m. In general there was little to no toe erosion observed throughout this area, with a few localized areas of exposed roots and bare areas. The slopes are generally well vegetated with grasses, young to mature trees, shrubs, saplings, and other low-lying vegetation. The slopes vary in height from about 3 to 5 m across the area. For the most part, the southern slopes are generally inclined at 2H :1V with some flatter areas. The northern slopes are generally inclined at 3H : 1V or flatter. There are several dwellings on the tableland near to Old School Road in this area.

4.1.3.2 Slope Stability Assessment

The geotechnical field investigation was conducted on February 9 to 12, 2009, and consisted of drilling and sampling a total of six (6) boreholes extending to depths of about from 9.6 to 30.5 m below existing ground surface. Four of the boreholes were located in the vicinity of the Etobicoke Creek slope crests in the northeast portion of the site (near Hurontario Road and Old School Road), one was advanced closer to Chinguacousy Road, and one was advanced in the Fletcher's Creek Watershed in the southwest portion of the site. The boreholes were staked in the field by the Terraprobe. Various utility locating agencies were contacted to clear the borehole locations of underground public utilities present on the site. The approximate locations of boreholes are shown in Appendix 'B'.

The borings were advanced by a specialist drilling contractor using a track mounted power auger drill rig. The borings were advanced using continuous flight hollow stem augers, and were sampled at 0.75 m to 1.5 m intervals with conventional 50 mm diameter split barrel samplers when the Standard Penetration Test (SPT) was carried out (ASTM D 1586). The field work (drilling, sampling, testing) was observed and recorded by Terraprobe engineering staff. All samples obtained during the investigation were sealed into plastic jars, and transported to Terraprobe's Brampton laboratory for detailed inspection and testing. All borehole samples were examined (tactile) in detail by the Terraprobe field technician, examined in the laboratory by a professional engineer, and classified according to visual and index properties. Laboratory testing consisted of water content determination on all samples; and sieve and hydrometer analysis and Atterberg Limits tests on several selected soil samples. The measured natural water contents for individual samples are plotted on the enclosed borehole logs at respective sampling depths, and the results of the sieve and hydrometer analysis as well as Atterberg Limits tests are appended with the borehole logs (ref. Appendix 'B').

Water levels were monitored in open boreholes upon completion of drilling. Monitoring wells (50 mm diameter) were installed in all of the boreholes to facilitate groundwater monitoring and sampling (by others). The results of ground water monitoring are summarized in Section 4.1.4.

The ground surface elevations at borehole locations were interpreted using the 0.25 m contour mapping provided to Terraprobe.

4.1.4. Interpretation

The results of the individual boreholes are summarized below and recorded on the accompanying Borehole Logs (ref. Appendix 'B'). This summary is intended to correlate this data to assist in the interpretation of the subsurface conditions at the site.

It should be noted that the soil conditions are confirmed at the borehole locations only and may vary between and beyond the boreholes. The boundaries between the various strata as shown on the logs are based on non-continuous sampling. These boundaries represent an inferred transition between the various strata, rather than a precise plane of geologic change.

In summary, the boreholes typically encountered a surficial topsoil layer underlain by weathered native glacial till soil. The weathered native till was underlain by undisturbed native glacial till soils which were in turn underlain by cohesionless sands and silts.

4.1.4.1 Fletcher's Creek Watershed

Borehole 6 was advanced in the southwest portion of the site, in the Fletcher's Creek watershed area. The borehole encountered 280 mm of topsoil overlying a deposit of clayey silt glacial till. The till is weathered and only stiff in the upper 0.5 m. As is typical of glacial till soils, the clayey silt till contains embedded sand and gravel, and is brown and moist. Measured moisture contents of the undisturbed native glacial till ranged from 13 percent to 17 percent by weight. The Standard Penetration Test results ('N' Values) from the undisturbed till varied from 10 to 21 blows per 300 mm of penetration, indicating a stiff to very stiff consistency. The clayey silt till extends to 9.1 m below grade (Elev. 251.9 m). A layer of cohesionless sandy silt was encountered within the clayey silt glacial till stratum, from 3.0 to 4.6 m below existing grade. The sandy silt contains trace gravel, and is compact, brown and wet.

Below the clayey silt glacial till the borehole encountered a deposit of cohesionless sandy silt glacial till. The till contains embedded gravel and some limestone fragments. The measured moisture content of the sample of sandy silt glacial till is 9 percent by weight. The Standard Penetration Test result ('N' Value) from the sandy silt till was 48 blows per 300 mm of penetration, indicating a dense state.

It must be noted that the glacial till deposits are likely to contain larger size particles (cobbles and boulders) that are not specifically identified in the boreholes. The size and distribution of such obstructions cannot be predicted with borings, because the borehole sample size is insufficient to secure representative samples for particles of this size. Provision should be made in excavation contracts to allocate risks associated with the time spent and equipment utilized to remove or penetrate such obstructions when encountered.

4.1.4.2 Etobicoke Creek Watershed

Boreholes 1 to 5 were advanced in the north and northeast portion of the site, in the Etobicoke Creek watershed area. The boreholes encountered 250 to 280 mm of topsoil overlying a deposit of clayey silt glacial till. The till is weathered and only firm to stiff in the upper 0.5 to 1 m. As is typical of glacial till soils, the clayey silt till contains embedded sand and gravel (and probably cobbles and boulder), and is brown and moist. Measured moisture contents of the undisturbed native glacial till ranged from 10 percent to 25 percent by weight (averaging about 18%). The Standard Penetration Test results (‘N’ Values) from the undisturbed till varied from 12 to 36 blows per 300 mm of penetration, indicating a very stiff to hard consistency. The clayey silt till extends to depths ranging from 1.1 to 7.0 m below grade, averaging about 6 m.

Below the clayey silt glacial till, each of the boreholes encountered deposits of cohesionless sands and silts at depths ranging from 1.1 to 7.0 m below grade (Elev. 252.2 to 263.2 m). The deposits vary from sand, to sandy silt, to silt. The deposits contain trace gravel and trace clay. The measured moisture contents of the samples of cohesionless sands and silts vary from 3 to 25 percent by weight. The deposits were typically wet below an average depth of about 7 m. The Standard Penetration Test results (‘N’ Values) from the sands and silts vary from 3 to greater than 50 blows per 300 mm of penetration, indicating a loose to very dense state. However, the low ‘N’ values found in Borehole 3 are likely disturbed values due to a higher water table, and not indicative of undisturbed in situ densities. Therefore, it can be reasonably assumed that the sands and silts are dense to very dense.

4.1.4.3 Geotechnical Laboratory Test Results

The geotechnical laboratory testing consisted of water content determination on all samples, while a sieve and hydrometer analysis was carried out on selected native soil samples. The measured natural water contents for individual samples are plotted on the borehole logs at respective sampling depths. The results of the sieve and hydrometer (grain size) analysis are provided in Appendix ‘B’ and noted on the borehole logs at respective sampling depths. A summary of the Sieve and Hydrometer (grain size) analysis results are presented in Table 4.1.1 below:

Table 4.1.1. Sieve And Hydrometer (Grain Size) Analysis Results

Borehole No. Sample No.	Sampling Depth below Grade	Percentage				Description (MIT System)
		Gravel	Sand	Silt	Clay	
Borehole 1 Sample 3	1.5 m	9	18	39	34	CLAYEY SILT, some sand, trace gravel (GLACIAL TILL)
Borehole 6 Sample 7	4.6 m	6	27	47	20	CLAYEY SILT, sandy, trace gravel (GLACIAL TILL)
Borehole 2 Sample 7	4.6 m	1	34	68	2	SANDY SILT, trace clay, trace gravel
Borehole 3 Sample 8	7.6 m	0	19	75	6	SILT, some sand, trace clay
Borehole 4 Sample 22	29.0m	22	35	40	3	SILT and SAND, gravelly, trace clay
Borehole 5 Sample 9	9.1 m	7	30	56	7	SANDY SILT, trace gravel, trace clay (GLACIAL TILL)

Atterberg Limits Tests were also carried out on selected native soil samples. The results are shown on the borehole logs and are summarized in Table 4.1.2:

Table 4.1.2. Summary of Atterburg Limits Tests							
Borehole No. Sample No.	**Sampling Depth below Grade**	**Liquid Limit (WL)**	**Plastic Limit (WP)**	**Plasticity Index (IP)**	**Natural Water Content (WN)**	**Compressibil ity**	**Plasticit y**
Borehole 1 Sample 3	1.5 m	31.3	18.9	12.4	14.0	Slight or Low	Slightly Plastic
Borehole 6 Sample 7	4.6 m	20.4	13.1	7.3	13.0	Slight	Slightly Plastic

The result of the Atterberg Limits tests classify the samples of clayey silt glacial till as an inorganic clay of slightly plasticity and slight to low compressibility. Atterberg Limits test were also performed on samples from Boreholes 4 and 5 at depths of 29.0 and 9.1 m, respectively, and found that these samples were non-plastic.

4.1.4.4 Ground Water

Observations pertaining to the depth of unstabilized water levels and caving were made in the open boreholes immediately after completion of drilling, and are noted on the enclosed borehole logs. Monitoring wells (50 mm diameter) were installed in all boreholes upon completion of drilling. A second monitoring well (50 mm diameter) was installed next to Borehole 4 to allow for multi-level ground water monitoring (to be completed by others in this study). Details of the well installations are shown on the borehole logs in Appendix 'B'. Ground water level measurements were taken on April 23, 2009, approximately nine weeks following installation. This spring-time condition of ground water is assumed to represent a higher ground water condition than in other times of the year. A summary of ground water observations are provided in Table 4.1.3:

Table 4.1.3. Ground Water Observations				
Borehole No.	**Depth of Boring, m BG**	**Depth to Cave, m BG**	**Water level at the time of drilling, m BG**	**Water level in piezometers on April 23, 2009, m BG (Elev., m)**
1	9.6	6.7	6.4	6.2 (256.8)
2	9.6	8.8	8.8	8.6 (255.7)
3	9.6	5.5	5.2	2.1 (257.2)
4 (shallow)	30.5	open	9.8	3.1 (256.4)
4 (deep)	30.5	open	9.8	1.3 (258.2)
5	9.6	8.4	7.6	6.2 (252.1)
6	9.6	open	dry	2.2 (258.8)

BG = Below Grade

It should be noted that the ground water levels indicated above may fluctuate seasonally depending on the amount of precipitation and surface runoff. Long term monitoring of ground water levels was beyond the scope of this investigation, but is detailed by others.

Slope Stability Analysis

The following discussion and recommendations are based on the factual data obtained from the geotechnical investigation and site visits by Terraprobe in October 2008 and February 2009, and are intended for use of the Town of Caledon. Contractors bidding or providing services on projects in these areas should review the factual data and determine their own conclusions regarding construction methods and scheduling. A total of eleven (11) cross-sections were derived from the provided topographic information (0.25 m contours) for slope stability analyses. The locations of the selected slope cross-sections are presented in Appendix 'B', and the details of the slope profiles are shown on the slope stability analysis figures.

The slopes within the study area generally appeared to be stable, but for some isolated areas of toe erosion. The slope height and inclination for the plotted sections, as well as the inferred transition elevation between clayey silt glacial till and the underlying cohesionless sands and silts are summarized in Table 4.1.4:

Table 4.1.4. Summary of Slope Heights, Slope Inclination, and Inferred Transitioning

Section	Approximate Slope Height, m	Approximate Average Slope Inclination	Inferred Transition From Glacial Till to Sands and Silts, Elevation (m)
1	± 6	± 2.9 H : 1 V	± 252
2	± 10	± 2.5 H : 1 V	± 252
3	± 8	± 1.1 H : 1 V	± 252
4	± 9	± 2.0 H : 1 V	± 253
5	± 7	± 1.3 H : 1 V	± 254
6	± 10	± 1.4 H : 1 V (toe is steeper than 1H : 1V)	± 256
7	± 7	± 1.2 H : 1 V	± 257
8E	± 9	± 1.7 H : 1 V	± 258
8W	± 7	± 1.7 H : 1 V	± 258
9S	± 6	± 1.6 H : 1 V	± 263
9N	± 6	± 2.2 H : 1 V	± 263
10W	± 7	± 1.5 H : 1 V	± 260
11S	± 6	± 2.5 H : 1 V	± 263
11N	± 5	± 2.0 H : 1 V	± 263

A detailed engineering analysis of slope stability was carried out for the selected slope cross-sections utilizing the commercially available slope stability program SLIDE (version 5.035), developed by Rocscience Inc. The slope stability analyses were based on an effective stress limit equilibrium analysis for long term slope stability using Morgenstern-Price, Spencer, Bishop and Janbu methods. These methods of analysis allow the calculation of Factors of Safety for hypothetical or assumed failure surfaces through the slope. The analysis method is used to assess potential for movements of large masses of soil over a specific failure surface which is often curved or circular. The analysis involves dividing the sliding mass into many thin slices and calculating the forces on each slice. The normal and shear forces acting on the sides and base of each slice are calculated. It is an iterative process that converges on a solution.

For a specific failure surface, the Factor of Safety is defined as the ratio of the available soil strength resisting movement, divided by the gravitational forces tending to cause movement. The Factor of Safety of 1.0 represents a "limiting equilibrium" condition where the slope is at a point of pending failure since the soil resistance is equal to forces tending to cause movement.

It is usual to require a Factor of Safety greater than one (1) to ensure stability of the slope. The typical Factor of Safety used for engineering design of slopes for stability, ranges from about 1.3 to 1.5 for developments situated close to the slope crest. The most common design guidelines are based on a 1.5 minimum Factor of Safety.

The analysis was carried out by preparing a model of the slope geometry using subsurface conditions, and analyzing numerous potential failure surfaces through the slope in search of the minimum or critical Factor of Safety for site specific conditions. The pertinent data obtained from topographic and borehole information was input for the slope stability analysis. Many calculations were carried out to examine the Factors of Safety for varying depths for potential failure surfaces. A typical slope stability analysis is provided in Appendix ‘B’. Based on the borehole results, the average soil properties in Table 4.1.5 were utilized for the overburden soil strata in the slope stability analysis:

Table 4.1.5. Average Soil Properties of Overburden Soil

Stratum	**Unit Weight, □ (kN/m^3)**	**Angle of internal friction, φ’ (deg.)**	**Cohesion, c’ (kPa)**
Clayey Silt Glacial Till (typically hard)	21.5	30^o	10
Sandy Silt (typically dense)	21.0	36^o	0

The above soil strength parameters are based on the effective stress analysis for long-term slope stability. It is noted that the above soil parameters are conservative and actual site soils are likely stronger.

The results of the slope stability analysis for the existing slope condition are presented in Appendix ‘B’ and are summarized in Table 4.1.6:

Table 4.1.6. Slope Stability Analysis for the Existing Slope Condition

Section No.	**Average Slope Inclination**	**Factor of Safety for Potential Slope Slides (Existing Conditions)**	**Type of Slope Slide**
1	± 2.9 H : 1 V	2.2	Overall Slope Slide
2	± 2.5 H : 1 V	1.9	Overall Slope Slide
3	± 1.1 H : 1 V	1.5	Overall Slope Slide
4	± 2.0 H : 1 V	2.1	Overall Slope Slide
5	± 1.3 H : 1 V	1.5	Overall Slope Slide
6	± 1.4 H : 1 V (toe is steeper than 1H : 1V)	1.1	Overall Slope Slide
7	± 1.2 H : 1 V	1.4	Overall Slope Slide
8E	± 1.7 H : 1 V	1.6	Overall Slope Slide
8W	± 1.7 H : 1 V	2.1	Overall Slope Slide
9S	± 1.6 H : 1 V	1.6	Overall Slope Slide
9N	± 2.2 H : 1 V	1.8	Overall Slope Slide
10W	± 1.5 H : 1 V	1.6	Overall Slope Slide
11S	± 2.5 H : 1 V	2.4	Overall Slope Slide
11N	± 2.0 H : 1 V	1.9	Overall Slope Slide

The minimum factor of safety was determined for Section 6 at 1.1 for normal groundwater conditions (spring season condition) and is considered marginally stable. All other slopes had factors of safety of 1.4 or above, which are considered acceptable.

For residential developments, the MNR Policy Guidelines allow a minimum Factor of Safety of 1.3 to 1.5 for slope stability, as follows:

Table 4.1.7. MNR Policy Guidelines for Factor of Safety

TYPE	LAND-USES	DESIGN MINIMUM FACTOR OF SAFETY
A	PASSIVE: no buildings near slope; farm field, bush, forest, timberland, woods, wasteland, badlands, tundra	1.1
B	LIGHT: no habitable structures near slope; recreational parks, golf courses, buried small utilities, tile beds, barns, garages, swimming pools, sheds, satellite dishes, dog houses	1.20 to 1.30
C	ACTIVE: habitable or occupied structures near slopes; residential, commercial, and industrial buildings, retaining walls, storage/warehousing of non-hazardous substances	1.30 to 1.50
D	INFRASTRUCTURE and PUBLIC USE: public use structures and buildings (i.e. hospitals, schools, stadiums), cemeteries, bridges, high voltage power transmission lines, towers, storage/warehousing of hazardous materials, waste management areas	1.40 to 1.50

MNR and TRCA policy guidelines require a 1.5 minimum F.S. for slope stability for land development and planning. A minimum factor of safety of 1.5 is required for normal ground water condition and a minimum factor of safety of 1.3 is required for elevated, short term and infrequent ground water condition.

Further slope stability analyses were conducted for a hypothetical slope profile with a flatter inclination and similar sub-surface conditions, to result in a minimum factor of safety of 1.5 for Sections 6 and 7 (which had factors of safety of less than 1.5). This factor of safety conforms to the minimum safety factor requirement and is considered adequate and acceptable. The analysis suggests that the long term stable slope inclination for the for these slopes is 1.6 H : 1 V, or flatter.

Toe Erosion Analysis

In addition to a stability set-back, a toe erosion allowance is also recommended in areas where the watercourse/stream position is within 15 m of the slope toe. A guideline table (MNR) recommended for estimating the toe erosion allowance is presented in Table 4.1.8:

Table 4.1.8. Guideline Table – Toe Erosion Allowance

MINIMUM TOE EROSION ALLOWANCE - River within 15 m of Slope Toe *

Type of Material Native Soil Structure	Evidence of Active Erosion** or Bankfull Flow Velocity > Competent Flow Velocity***	No evidence of Active Erosion** or Flow Velocity << Competent Flow Velocity***		
		Bankfull Width		
		<5 m	5 - 30 m	> 30 m
1. Hard Rock (granite)	0 - 2 m	0 m	0 m	1 m
2. Soft Rock (shale, limestone) Cobbles, Boulders	2 - 5 m	0 m	1 m	2 m
3. Stiff/Hard Cohesive Soil (clays, clayey silt) Coarse Granular (gravels) Tills	5 - 8 m	1 m	2 m	4 m
4. Soft/Firm Cohesive Soil Fine Granular (sand, silt) Fill	8 - 15 m	1-2 m	5 m	7 m

* If a valley floor is > 15m width, still may require study or inclusion of a toe erosion allowance.

** Active Erosion is defined as: bank material is bare and exposed directly to stream flow under normal or flood flow conditions and, where undercutting, over steepening, slumping of a bank or high down stream sediment loading is occurring. An area may be exposed to river flow but may not display "active erosion" (i.e. is not bare or undercut) either as a result of well rooted vegetation or as a result of shifting of the channel or because flows are relatively low velocity. The toe erosion allowances presented in the right half of Table 2 are suggested for sites with this condition.

*** Competent Flow velocity; the flow velocity that the bed material in the stream can support without resulting in erosion or scour.
Consideration must also be given to potential future meandering of the watercourse channel.

Source: Ontario Ministry of Natural Resources (2002), "Technical Guide River & Stream Systems: Erosion Hazard Limit, pp38

The watercourse within the study area is located at distances varying from 0 to 50 m from the slope toe. Where present, the flood plain separating the slope toe and the watercourse is well vegetated. Over the majority of the site, there was no obvious evidence of active slope toe erosion within the study area. In isolated localized areas, such as at Sections 2, 3, 6, and 7, some evidence of toe erosion (undercutting, exposed roots, bare areas) was noted. The borehole data suggests that in general the site slopes comprise competent very stiff to hard undisturbed native clayey silt glacial till overlying cohesionless dense sands and silts. The sections indicate that the toes of all slopes are found in the sands and silts, with the exception of Section 1.

Therefore, based on the subsurface information and the guideline table, Table 4.1.9 summarizes the toe erosion allowances recommended in general across the site.

Table 4.1.9. Toe Erosion Allowances Recommended Across the Site

Soil at Slope Toe	Evidence of Active Toe Erosion	Recommended Toe Erosion Allowance (m)
Clayey Silt Till	No	1
Clayey Silt Till	Yes	5
Sands and Silts	No	2
Sands and Silts	Yes	8

Over the majority of the site, the flood plain width far exceeds the above recommended toe erosion setbacks, based on the MNR guidelines. However, for planning purposes, each site planned for development should be assessed with respect to toe erosion and with respect to slope stability. How these setbacks are applied to each section is detailed below in the Long Term Stable Slope Crest position section (4.1.5) of this report, below.

Long Term Stable Slope Crest Position

The application of the toe erosion allowance in addition to the stability setback component is known as the Long Term Stable Slope Crest (LTSSC). Figure 4 in Appendix ‘B’ indicates how this is determined. The toe erosion component for each section is shown in the table below based on the recommendations from section 4.1.5. Only Cross Sections 6 and 7 had factors of safety assessed at less than 1.5, the TRCA and MNR regulated value. The long term stable slope inclination was determined for these sections as 1.6 H : 1 V, and can also be applicable to all sections where the flood plain is less than the recommended toe erosion setback. The position of the LTSSC, shown as a setback from the existing slope crest is summarized for each section in Table 4.1.10.

Table 4.1.10. Long Term Stable Slope Crest Position

Section No.	Average Slope Inclination	Evidence of Active Erosion	Soil at Slope Toe	Toe Erosion Setback (m)	LTSSC Position Relative to Existing Slope Crest Position (m)
1	± 2.9 H : 1 V	No	Clayey Silt Till	1	0 (existing slope crest)
2	± 2.5 H : 1 V	Yes	Sands and Silts	8	0 (existing slope crest)
3	± 1.1 H : 1 V	Yes	Sands and Silts	8	12
4	± 2.0 H : 1 V	No	Sands and Silts	2	0 (existing slope crest)
5	± 1.3 H : 1 V	No	Sands and Silts	2	0 (existing slope crest)
6	± 1.4 H : 1 V (toe is steeper than 1H : 1V)	Yes	Sands and Silts	8	13
7	± 1.2 H : 1 V	Yes	Sands and Silts	8	7
8E	± 1.7 H : 1 V	No	Sands and Silts	2	0 (existing slope crest)
8W	± 1.7 H : 1 V	No	Sands and Silts	2	0 (existing slope crest)
9S	± 1.6 H : 1 V	No	Sands and Silts	2	0 (existing slope crest)
9N	± 2.2 H : 1 V	No	Sands and Silts	2	0 (existing slope crest)
10W	± 1.5 H : 1 V	No	Sands and Silts	2	0 (existing slope crest)
11S	± 2.5 H : 1 V	No	Sands and Silts	2	0 (existing slope crest)
11N	± 2.0 H : 1 V	No	Sands and Silts	2	0 (existing slope crest)

The analysis indicates that for the majority of the site, the LTSSC is coincident with the existing slope crest (also known as the top of bank). For Cross Sections 3, 6, and 7, the LTSSC is setback 12, 13, and 7 metres from the existing slope crest, respectively. The LTSSC in these areas is shown in Figures 5A and 5B in Appendix ‘B’.

Development Setback

In addition to the stability and erosion setbacks (comprising the LTSSC), a development setback (also known as an erosion access allowance) is typically required from the identified slope hazard area (long-term stable slope crest location) to take into account possible external conditions which could have an adverse effect on the existing natural condition of the slope, and to provide access to the slope in emergencies. This setback generally varies from 5 to 15 m depending upon the policies of individual authorities. The determination of the setback value depends on a number of factors including but not limited to, the watershed classification, type of development, site specific conditions and available access to the slope. The structures may be allowed to be located closer to the long-term stable slope crest but only if approved by the concerned conservation authority and a qualified geotechnical engineer. It is understood that the TRCA will require a development setback of 10 m beyond the LTSSC for the slopes in the Etobicoke Creek watershed.

4.1.5. Summary

The subsurface soil conditions of the valley slope and tableland are expected to consist of competent clayey silt glacial till of very stiff to hard (typically hard) consistency, overlying cohesionless, dense sands and silts. Based on the results of the slope stability analysis, the majority of the subject slopes across the site are stable and the existing slope crest position (top of bank) is considered to be the Long Term Stable Slope Crest (LTSSC). The only areas where the LTSSC is set back from the existing slope crest occur in the vicinity of Sections 3, 6, and 7, which are located in the section of Etobicoke Creek west of Hurontario Road, south of Old School Road and north of the school. The location of the long-term stable slope crest, where not coincident with the existing slope crest, is presented in Figures 5A and 5B in Appendix ‘B’.

4.2. Hydrogeology

4.2.1. Importance/Purpose

It is important to understand the inter-relationship between the hydrogeologic conditions, the use of groundwater for anthropogenic needs and the subwatershed ecosystem in order to assess and develop targets and controls for potential impacts from land use changes and to enhance the linkages where appropriate.

4.2.2. Background Information

The reports reviewed and incorporated into this study include:

- Etobicoke Creek Headwaters Subwatershed Study – Synthesis Report (September, 2008).
- Northwest Brampton Subwatershed Study (2007 Draft Characterization Report).

Te report titled “Private Water Well Issues and Alternative Water Supply in Pressure Zone 7” (KMK Consultants Ltd., 2001) was reviewed but no specific information could be extracted for use in the characterization portion of this study.

Portions of the Northwest Brampton Subwatershed Study relating to hydrogeology have been presented and re-edited for this study as the Mayfield West Phase 2 Study Area is either coincident or immediately adjacent to the Northwest Brampton study area and, as such, the general characteristics are considered similar.

In order to present a more convenient flow of technical material for the reader, this background information section includes graphical material updated for this study dealing with hydrogeological cross-sections, overburden thickness and bedrock topography.

This graphical material was generated using a well log database. The York, Peel, Durham, Toronto (YPDT) – Conservation Authorities Moraine Coalition (CAMC) Groundwater Study has undertaken a number of technical studies that include the Northwest Brampton Study Area. One key product of this study has been the development of the 'YPDT Database' that stores the geologic and hydrogeologic information from all study partners. The database is structured around the Ministry of the Environment (MOE) Water Well Information System (WWIS) which includes the location of all drilled wells and associated geology, well construction, water level, and well capacity information. Using information available from study partners, well locations have been assessed and assigned a quality code providing information on the confidence in the well location. Additionally geologic descriptions have been standardized using a rule-based method developed by the Geological Survey of Canada (GSC) (MOE, 2001) to aid in geologic interpretation and correlation between wells.

4.2.2.1 Study Area

The study area for the hydrogeological component extends beyond the Mayfield West Phase 2 Study Area. So as to place the groundwater flow system within a more regional context. The groundwater flow system and associated divides may not necessarily follow the local surface water divides and the FEFLOW modelling will be carried out on a more regional scale.

4.2.2.2 Geology

The IWA (Interim Waste Authority) Landfill Site Search Peel Region – Step 6 Hydrogeological Reports investigated, in substantial detail, the geology and hydrogeology of 3 candidate sites south of the Mayfield West study area including 2 sites at the north-western and south-western corner of Heritage Road and Wanless Road, and one site immediately south of Highway 7 between Mississauga Road and Creditview Road. These sites are expected to be in similar settings as the Mayfield West Phase 2 Study Area.

Surficial Deposits

The Surficial (Quaternary) Geology Map shown in Figure GW-1 (ref. Appendix 'C') shows the distribution of these units within the study area. Surficial geology differs from soil maps in that it represents the upper 2 m of material whereas the soils maps represent the material at surface. The Surficial Geology was mapped by Karrow (1991) at a scale of 1:50,000 within the study area. Outside the study area 1:100,000 scale provincial mapping (OGS, 2000) is used.

In the study area several glacial depositional processes resulted in various overburden deposits. As the glacier advanced the bedrock was eroded and "till" units were deposited. These consist of a mixture of materials; usually including a significant fine grained (silt and clay of the Halton Till) component as well as sand, gravel or larger stones. The texture and reddish brown colour of the Halton Till reflects in part the erosional material from the underlying Queenston shale during glaciation. As meltwater flowed away from the glacier (or temporary lakes) some stream channels were eroded and sand and gravel was left behind as older alluvium. Within glacial lakes silt and clay were laid down as lakebed material, known as (glacio)lacustrine deposits. The geological interpretation will be presented in more detail below.

Halton Till

The IWA studies provided extensive characterization of the overburden in support of assessing the potential for a landfill site. Where the overburden had sufficient thickness the overburden was subdivided into four stratigraphic units to establish a certain level of confidence in the hydrostratigraphic correlation for hydrogeologic impact assessment.

These units included:

Upper Till Unit – this correlates with the Halton Till. This unit is described as sandy silty clay to clayey silt with sand. Small amounts of gravel and cobbles were noted. The till was described as massive and generally weathered through its entire thickness (up to 5 m). Vertical fractures were noted extending beyond the base of the unit.

Middle Till Complex – up to 13 m of individual, poorly correlated massive till layers with interbeds of stratified silt to sand and gravel. The layers and interbeds, generally in the range of 0.1 to 3.3 m thick, are interpreted to be discontinuous but may extend tens to hundreds of metres. Weathering, to varying extents, occurs within the Middle Till.

Glaciolacustrine Deposits – layers of fine grained glaciolacustrine clayey silts and silty clays were encountered at the base of the Middle Till. Although these layers were generally less than 1 m, varved (rhythmically layered) sequences were found up to 8.4 m in thickness.

Lower Till Complex – this till is similar to the Middle Till but not as variable. Gravel was observed in all till samples and shale fragments were more common closer to the bedrock surface. Sand and gravel at the bedrock contact was common but not consistent.

The hydrostratigraphic units presented in the Etobicoke Creek Headwaters Subwatershed Study Synthesis Report include a unit referred to as the Oak Ridges unit or aquifer. Significant sand and gravel deposits occur in the southeast corner of the study area at depth below the till and adjacent to the northwest and northeast of the study area. These deposits likely reflect the Oak Ridges unit.

Geologic Interpretation

The geological interpretation presented in the IWA reports is excellent and is re-presented in the following:

The surficial deposits beneath the site, including the Upper Till Unit, Middle Till Complex, Lower Till Complex and Glaciolacustrine Deposits, are predominately ice-contact deposits associated with the last glaciation of the area. The depositional events beginning with the basal Lower Till Complex and proceeding to the Upper Till Unit are discussed below.

The Lower Till Complex represents basal deposition from an initial advance of glacial ice moving across the area likely in direct contact with the bedrock surface. The Lower Till Complex is overlain by glaciolacustrine deposits consisting of silt and laminated clay. The glaciolacustrine deposits drape over the underlying Lower Till Complex and the topography formed by the basal till likely influenced the deposition and thickness of the glaciolacustrine deposition. The deposition of the glaciolacustrine deposits is considered to reflect a retreat of the glacier associated with the Lower Till from the vicinity of the site. The retreat was also associated with the inundation of the area by a pro-glacial lake, likely confined between the Niagara Escarpment upland and the ice lobe that occupied Lake Ontario through-out much of the late Wisconsin period. The deposition of these deposits was likely quite laterally extensive and as such they provide significant stratigraphic marker horizons unless removed by subsequent glacial advances. These deposits are also locally associated with layers of stratified sands and gravels, deposited during periods when the glacial ice was more proximal to the site or when rates of melt water runoff and associated sedimentation increased.

The Middle Till Complex represents a period preceding the deposition of the Upper Till Unit. The complex was associated with highly variable deposition of relatively thin layers of till interbedded with glaciolacustrine clay, silt, sand, sand and gravel. This "Middle period" may represent successive advances and retreats of a glacier front over comparatively short periods of time. Alternatively, it may also represent the deposition of till as interfingered lobes of material originating as debris slides into a glaciolacustrine environment from either a stagnant or moving glacier front. Regardless, the highly interbedded nature of the deposits encountered within the Middle Till Complex, which represent the bulk of the soil beneath the site, reflects a very complicated and highly variable environment of depositions.

The clayey Upper Till Unit represents the last ice-contact glacial deposits underlying the site. This till correlates with the Halton Till recognized throughout the area (Karrow, 1987). The more `clayey' nature of the till may reflect incorporation of earlier glaciolacustrine deposits. The upper portion of the till may also be glaciolacustrine till deposited in a pro-glacial pond during the retreating stages of the Halton ice. No clear evidence of such was encountered during drilling, although Ontario Geological Survey mapping within the area (Karrow, 1987) has indicated the local occurrence of glaciolacustrine silts and clays overlying the till at the ground surface.

Overburden Thickness

A map of overburden thickness is depicted in the Figure GW-2 (ref. Appendix ‘C’). The map was created using the ground surface topography from the 5 m -digital elevation model (DEM) provided by CVC and the bedrock surface developed using water well records as described

above. The map of bedrock surface elevation was subtracted from the ground surface elevation map (DEM) to compute the thickness of unconsolidated material (overburden) that overlies bedrock. Overburden thicknesses vary from 10 to greater than 35 m.
Within the YPDT database the standardized geologic descriptions include material descriptions that include unconsolidated aquifer materials. These aquifer material names include:

1. gravel, gravelly sand
2. gravel, gravelly sand, with rhythmic/graded bedding
3. gravel, gravelly sand, topsoil
4. gravel, gravelly sand, with muck, peat, wood frags.
5. sand, silty sand
6. sand, silty sand, with rhythmic/graded bedding
7. sand, silty sand, topsoil
8. sand, silty sand, with muck, peat, wood frags.

The map of total sand and gravel thickness shown in Figure GW-3 (ref. Appendix 'C') was developed by querying the total thickness of unconsolidated aquifer materials listed above in each well in the study area. The thickness of sand and gravel at each well was then interpolated within the GIS to create a surface showing the variation in the sand and gravel thickness. The resulting map represents the total thickness of these materials and does not account for the fact that the sand and gravel units in a well may not be grouped together but could be separated by lower permeability clay or till units. A map of the sand and gravel thickness within the first 5 m of overburden is shown in Figure GW-3a (ref. Appendix 'C'). A comparison of the two maps shows the majority of the sand and gravel is deeper. The borehole log data forms the boreholes drilled for this project are incorporated into the sand and gravel maps.

Bedrock

The IWA geologic description and interpretation for the Queenston Shale bedrock is detailed and re-presented in the following. The Queenston shale is the surficial bedrock unit for the entire study area.

> ***The Queenston Formation shale is an Upper Ordovician age sequence that was deposited in a sub-aerial, marine-deltaic environment. The Queenston delta encroached westward from the ancient Appalachian Mountain source area into the marine water that occupied the area during ancient geological times. The surface of the delta was exposed to the atmosphere which accounts for the red, oxidized condition of the material. The bulk of the detrital material comprising the deposit is illitic clay and quartz mineral derived from mature weathering of the sedimentary source area. However, some marine material including calcite (calcium carbonate), gypsum (calcium sulphate) and traces of intergranular halite (sodium chloride) also occur within the shale.***
>
> ***The total depositional thickness of the Queenston Formation within the area was approximately 120 m based on records of deep petroleum exploration drilling in the adjacent Niagara Escarpment area near Milton. Subsequent erosion both previous to, and during the***

Pleistocene Epoch has removed the upper portion of the formation within the site area based on the geological mapping within the area (Bond and Telford, 1976).

The weathering profile that has developed within the bedrock surface may reflect both pre-glacial as well as post-glacial weathering. Portions of the pre-glacial weathered layer may have been removed by the glaciers considering the relatively soft nature of the material, accounting for the variability in the thickness of the weathered zone encountered in the boreholes.

The fracturing that occurs within the shale is largely due to both structural fracturing, such as the more vertical fractures, and weathering of bedding planes. Bedding planes associated with gypsiferous coatings are most susceptible to weathering due to circulating groundwater.

The bedrock topography is influenced by a number of factors including the lithology, weathering, glacial-fluvial erosion and direct glacial erosion. The bedrock topography is presented in Figure GW-4 (ref. Appendix 'C')**.** The bedrock topography was determined by interpolating bedrock surface elevations contained within the YPDT database. The surface was created using wells that intersected bedrock and overburden wells were used to constrain the minimum depth of the bedrock surface elsewhere. Bedrock thalwegs developed as part of the YPDT study mark the axes of the buried valleys interpreted to exist within the map area.

There is a strong correlation between areas of thick overburden (GW-2) and the bedrock surface particularly in the southeast portion of the study area.

Hydrogeological Cross-Sections

Five geologic cross-sections were created for the study area. The sections were developed by projecting the subsurface logs for local wells contained in the YDPT database along each cross-section line to enable interpretation of subsurface features. Wells were selected for projection onto each section by preferentially selecting high quality wells and deep wells which provide the most complete information on the subsurface. Wells were only excluded to avoid visual overlap of well logs on the sections. Once built the static water levels, screen or open well sections, surface water features and cross-section intersection points were annotated on the logs. The ground surface and bedrock topography surfaces were also displayed as continuous lines on the sections. The lithologic names and colours used to represent the geology reflect the standardized GSC_code names (MOE, 2001).

The cross-sections are presented in Appendix 'C'. The cross-sections reflect the stratigraphic description presented above and of particular note are the inclusions of more permeable discontinuous sand and gravel lenses and the bedrock topography. The cross-section for Hurontario Street shows the significant sand and gravel deposits that are can be seen on the Sand and Gravel Thickness map (GW-3). The cross-section also presents the static water levels in the well at the time of installation. A water table has been interpolated between the wells.

4.2.2.3 Hydrogeologic Setting

Hydraulic Conductivity

Water level response tests were carried out at all the IWA sites to determine the hydraulic conductivity of the various units. Although these numbers may vary across the study area they likely reflect the general and relative permeabilities of the various units. The hydraulic conductivity of the massive tills were on the order 3×10^{-6} cm/sec. The stratified units were interpreted to act as one hydraulic unit and with a representative hydraulic conductivity on the order of 5×10^{-5} cm/sec. The permeable surficial deposits at the bedrock contact, below the till, had an averaged hydraulic conductivity of 1×10^{-4} cm/sec. It is important to note that the water level response tests may not accurately represent the increased hydraulic connection within the fractured network of the till as borehole drilling may smear and disrupt the fracture network.

The shallow, highly fractured bedrock had a hydraulic conductivity of 1×10^{-3} cm/sec, the intermediate bedrock (within the top 10 m) had a representative hydraulic conductivity on the order of 4×10^{-5} cm/sec, and the deep bedrock (> 10 m) had a representative hydraulic conductivity of 1×10^{-6} cm/sec. The general trend with depth in the bedrock of decreasing hydraulic conductivity reflects the trend to less fracturing.

Groundwater Levels

The monitoring of groundwater levels at the three IWA sites showed seasonal trends of between 1-2 m, reflecting seasonal recharge. The site south of Highway 7 showed less of a seasonal trend which could be a result of the site being situated further down in the groundwater flow system. The water level trends within the surficial deposits and the bedrock were similar; this was interpreted to indicate a stronger degree of hydraulic connection between the surficial overburden and the bedrock. The vertical gradients between the overburden wells and the bedrock varied within and amongst the sites. There were minor upward gradients at a few wells, neutral gradients at the majority of wells and minor to strong downward gradients at a number of wells. The vertical hydraulic gradients within the bedrock were consistently downward.

Water levels in 17 wells within the Northwest Brampton Subwatershed Study area to the south showed variations of 1-3 m over a two year period. Water levels for 2008 show a rise that is commonly within the upper 2 m of ground surface. This likely reflects the greater amount of precipitation in 2008.

4.2.2.4 Groundwater Quality

Samples for groundwater quality were obtained for all the wells in the IWA study and detailed chemical analyses carried out. The interpretation of the groundwater was basically divided into 2 broad categories (1) over burden and (2) bedrock.

Overburden

The overburden water quality was further divided into the stratified unit (i.e. units described above, within the Middle Till) and the massive tills.

The water in the stratified unit is typically hard (up to 490 mg/L $CaCO_3$) and slightly alkaline with concentrations of Total Dissolved Solids (TDS) up to 810 mg/L. Major ions are calcium, magnesium, sodium and bicarbonate. There were minor concentrations of sulphate and sodium.

Water quality within the sand lenses in the basal till had relatively high concentrations of TDS, principally from sodium and chloride reflecting the mixing of more saline water from the underlying bedrock.

The water quality within the Upper and Middle Till units is similar to the water quality within the stratified unit. The Lower Till unit had relatively higher values for TDS, chloride, sodium and sulphate. Again this is interpreted to reflect mixing with more saline water within the upper bedrock. The level of mixing would depend on the consistency of upward gradients flux of fresher water horizontally or from above to the basal unit.

Bedrock

The water quality in the upper 6 m of bedrock demonstrated both saline and relatively fresh water. The difference likely reflects varying fluxes to the upper bedrock of fresh recharge water and the residence time of water within the bedrock. The upper fractured bedrock, although assumed to be continually fractured and hydraulically connected, may not be locally. This can result from local portions of the pre-glacial fractured bedrock being removed during the latest glaciation.

Again the dominant ions are calcium, sulphate, sodium and chloride. Bromide appears to be a tracer as well for the more saline waters. As we proceed deeper in the bedrock the water becomes more saline due mainly to a longer residence time (i.e. much slower moving water as the deeper bedrock is not as hydraulically connected). For the purpose of this study we are generally interested in the shallow bedrock.

Nitrate values appear in a number of overburden and bedrock samples including intermediate and deep bedrock, along with elevated ammonia. The nitrate values vary from non-detect to 21ppm and are generally higher in the shallow bedrock/overburden contact or within the more permeable stratified silt/sand/gravel unit.

4.2.2.5 Groundwater Use

Groundwater use in this context refers to anthropogenic use. Wells within the overburden are generally dug or bored and tend to be completed within the water bearing sand lenses. The drilled wells are completed within the shale or at the bedrock/overburden contact where the overburden contact is more permeable material.

The IWA water well survey carried out in 1993 at, and within 500 m of the 3 potential sites had 67 responses. There were only three concerns with water quantity and most responded that the quality of water was good (fresher zones noted above).

The Etobicoke Creek Headwaters Subwatershed Study presented that local farmers recently reporting declining water levels in their private wells. Specifics as to locations, depths of wells and whether there was a correlation to development or precipitation trends was not documented.

The MOE water wells and the Permits To Take Water (PTTW) are presented in Figure GW-5 (ref. Appendix 'C'). The Ministry of the Environment issues Permits to Take Water (PTTW) that allow the owner to withdraw a large volume of surface water and/or groundwater. These permits are contained within a database that identifies the location, source of water, maximum permitted volume and pumping rate, number of days of extraction, and expiry date of the permit. They are completed for both surface water and groundwater withdrawals that have a pumping rate of greater than 50,000 litres per day (LPD). CVC was provided a copy of the PTTW database by MOE in May 2005 and was updated to reflect known expired permits. The Etobicoke Creek Headwaters Subwatershed Study reported 39 minor groundwater takings within their study area with none greater than 50,000 L/day.

The specific capacities of the water wells, a reflection of the ability of the well to produce water, are generally provided on the MOE Water Well Database. Recorded capacities have been plotted for overburden wells (ref. Appendix 'C', Figure GW-6) and bedrock wells (ref. Appendix 'C', Figure GW-7). Low to moderate yields in the wells generally reflect the range of hydraulic conductivity values determined through the IWA field testing. Higher capacity wells in the overburden may indicate larger more extensive sand lenses. Higher well capacities in the bedrock likely reflect the shallow highly fractured rock.

As part of this study a water well survey will be carried out within the Mayfield West Phase 2 Study Area to document water use and water quantity and quality issues. This portion of the study is in progress and should be completed spring 2010.

4.2.3. Methods

4.2.3.1 Field

Groundwater Monitoring

In order to further characterize the hydrogeologic setting so as to provide a more detailed conceptual model to form the basis for the computer model, and to obtain more detailed data to provide for a preliminary sensitivity analysis (i.e. calibration) of the computer model, additional field data were and will continue to be collected. These data will be used to refine our understanding of potential groundwater flow pathways, groundwater discharge zones and to provide additional input into the groundwater balance and to calibrate the FEFLOW model.

Streamflow Measurement

Streamflow measurements were carried out at various locations during periods of baseflow in an attempt to quantify groundwater discharge within these reaches. Five rounds of more detailed baseflow monitoring have been carried out along with two additional sets at 4 select sites. In addition site reconnaissance of various reaches was carried out on four occasions to note potential groundwater discharge areas along streambanks or open water (winter survey).

Streamflow measurements were obtained using a combination of the area-velocity method, or direct measurement of flow.

The direct measurement of flow was carried out by allowing stream flow to be collected within a calibrated bucket for a measured period of time.

Where the area-velocity method was used a representative section with a regular streambed profile and laminar flow was selected in order to maximize the accuracy of the measurement. At each location the total width of the creek was measured and the section divided into representative intervals, where necessary, for which total stream depth and average velocity was measured. Velocity was measured at the surface as stream depths were limited. Measurements were recorded in the field and total streamflow was later calculated using a factor of 0.85 on the surface velocity to obtain a representative velocity.

Monitoring Well Installation and Water Levels

Monitoring wells were advanced at six locations within the study area with one site being a multilevel monitoring site. The boreholes were advanced using standard hollow-stem augers, soil samples were obtained using split-spoons. The monitoring wells will consist of nominal 51 mm diameter PVC pipe and slotted screens. Silica sand-packs and bentonite annular seals were installed as appropriate and in accordance with all applicable regulations. Locking protective casings were installed at each location. After completion each monitor will be developed by removing up to 5 to 10 bore-volumes of water, where possible, using a dedicated Waterra inertial pump.

Drivepoint piezometers were installed at 5 locations to depths of approximately 2 metres. Four locations were chosen to provide additional information on the seasonal high water levels. One valley location was chosen to investigate the potential for groundwater discharge. The piezometers consist of 25 mm iron pipe with 40 cm screened drivepoints.

Water Quality Sampling

Surface water samples were obtained as grab samples from approximately mid-stream (depth and width) in March 2009. Groundwater samples were collected at 4 borehole monitoring wells. The samples were analyzed for nitrogen species, metals, basic anions, alkalinity, conductivity and pH. Samples for enriched tritium were collected at to boreholes and 4 surface water sites. The groundwater and enriched tritium samples were collected on August 7, 2009.

4.2.3.2 Borehole Analysis

Borehole data analysis methodology was previously discussed in Section 4.2.2 to present the reader with a more complete geological picture and more complete background of the hydrogeologic setting. Additional analysis is presented below.

Water Level Maps

The map of shallow water levels (ref. Appendix ‘C’, Figure GW-8) representing the shallow equipotential surface (water table) was developed by interpolating static groundwater levels reported for each water well in the YPDT database that has a total borehole depth of 25 m or less (1122 wells). The 25 m depth interval was chosen as there were not sufficient numbers of wells in the upper 10 m to generate a water table map. The potential for downward gradients from the water table to 25 m is recognized as a limiting factor for the current water table map. The distribution of wells was sufficient to represent the character of the water table including the connection with surface water features. The contour interval for the map is 5 m. Known groundwater discharge points from the current study will be added to the database after the next round of refined baseflow measurements. (NOTE: The updated shallow water level map has not been prepared but a comparison of 2009 onsite water level data and reaches with permanent water tend to correlate well with the existing map.) Stream inverts will not be added as it was felt this would bias the potential groundwater discharge zones given the known lack of surface water. The shallow water level map shows groundwater flow from northwest to southeast with a potential convergence of flow in the vicinity of Etobicoke Creek at McLaughlin Road.

The map of deep water levels (ref. Appendix ‘C’, Figure GW-9) representing the deep groundwater equipotential surface was developed by interpolating static groundwater levels reported for each water well in the YPDT database that has a total borehole depth greater than 25 m (493 wells). The distribution of wells was sufficient to represent the character of the deep equipotential surface, but due to the fewer number of wells, as compared to the shallow water level map, the surface is more regional in nature. The contour interval for the map is 5 m. The deep water level map shows the same general flow from the northwest to the southeast with some convergence east oHwy 10 likely reflecting the influence of the lower bedrock surface.

Intrinsic Susceptibility Map

The Intrinsic Susceptibility Index (ISI) is an index value that estimates the susceptibility of a given aquifer to contamination at a given point. ISI values were calculated using the 3D geologic model developed as part of the CVC Water Budget Project, which defines the elevation of the each aquifer within the NW Brampton Study area. The approach used is defined in the Source Protection Guidance Module (MOE, 2006) for Aquifer Vulnerability.

ISI is calculated as calculated as the sum of the product of the thickness and hydraulic conductivity (as a K-factor – (- log of K in m/s) of each geologic unit overlying an aquifer. The resulting ISI values are then classed into one of three groups (high (<30), medium (30-80) or low (>80)). Therefore high numbers represent low aquifer susceptibility/vulnerability and low numbers represent areas of high aquifer susceptibility.

The ISI analysis was completed for the first aquifer encountered with depth. This first aquifer was identified through regional cross-section interpretation of geology as completed in the development of the CVC Water Budget Model. The first aquifer corresponds to the interpreted depth of ORM/Mackinaw sediments (older than Halton Till younger than Northern Till). The ISI map was developed using interpolated surfaces of the thickness and hydraulic conductivity of material overlying the aquifer and the water table elevation, to compute the ISI scores. Water table elevation from the regional groundwater model was used in the analysis. All wells within the YPDT database with Universal Transverse Mercator (UTM) reliability codes of 5 or less were used to create the maps for the analysis. For all wells determined to be screened within confined aquifers, the ISI value was calculated by summing the product of the thickness of each geological unit by its respective K-factors, presented below, from the ground surface to the top surface of the aquifer. Where the well is unconfined, or semi-confined, the ISI value was calculated to the water table surface as opposed to the top of the aquifer. If the water table was found to lie within 4 m of the top of the aquifer, the aquifer was considered to be partially saturated, and was classified as unconfined (MOE, 2006). The ISI values were then interpolated and classed into one of three groups (high (<30), medium (30-80) or low (>80)) to produce a map of intrinsic susceptibility. This approach is advantageous as it incorporates the understanding of lateral variability derived from development of the 3D geology using cross-section interpretations.

The K-factors used to calculate the ISI in this Study deviated slightly from those outlined in MOE (2001; see below). The MOE guidance module (MOE, 2006) states that the K-factors suggested are a general guide, and can be modified using professional judgment and local knowledge. In Northwest Brampton, weathering of fine-grained sediments such as the clay rich Halton Till, can reduce the degree of protection to the underlying aquifers. For this reason, weathered tills and clay-rich soils (defined as borehole segments that lie within 5 m of ground surface) were assigned a higher K-factor than their unweathered counterparts.

Table 4.2.1. K Factors Used in ISI Calculations

Lithology/ Geologic Material	Unweathered K Factor	Weathered K Factor
Gravel	1	1
Sand	2	3
Silt	4	4
Clay	6	5
Clay-rich till	6	5
Sand-rich till	5	4

[1]The K-factor is a dimensionless number related to the degree of protection offered by a given geologic material.

The ISI map is presented in Figure GW-10 (ref. Appendix ‘C’). The map shows a predominance of general ratings for susceptibility of medium to high whereas the Etobicoke Creek Headwaters

Subwatershed Study present values of low to medium. This will be looked at further particularly within the context of the methodologies used. Within a basic groundwater flow system context the high ratings seem too conservative.

The ISI mapping will be followed up and reassessed when land use impacts are modelled with FEFLOW.

4.2.4. Results

The locations for the spot baseflow measurements, borehole monitoring wells and drivepoint piezometers can be found in Appendix ‘C’. This map is currently draft. NOTE: Spot baseflow sites are now designated FE (Etobicoke) and FF (Fletchers). It is also noted for this draft that FF4 should be located to the north on the southern flank of Mayfield Road.

Borehole Logs and Groundwater Levels

Borehole logs (ref. Appendix ‘C’) for the six wells confirm the basic stratigraphy presented in the previous section indicated a predominant surficial clay/silt till with underlying units to10 m comprised of a mix of silt, clay and sand. The deep borehole at BH4 shows a more permeable sand unit below 21 m which likely correlates with the Oak Ridges unit and is consistent with the existing sand and gravel thickness map.

Photos of select monitoring locations can be found in Appendix ‘C’.

Water levels in the borehole monitoring wells (ref. Appendix ‘C’) were obtained on six occasions. BH1 and BH3 were monitored with a continuous recorder. Hydrographs are also presented in Appendix ‘C’. The borehole water levels show seasonal trends up to 1.5 metres. An upward gradient is consistently seen at BH4.

The upland drivepoint piezometers DP1-DP4 show seasonal trends and can be dry during low precipitation periods. The high water table in the upland areas appear to fall within the upper two metres of ground surface. DP5 adjacent to Etobicoke Creek shows a slight potential for seasonal or event upward gradients and groundwater discharge.

Hydraulic Conductivity Measurements

Slug tests to determine hydraulic conductivity were carried out at BH1, BH3, BH4D, BH5, and BH6. The analysis can be found in Appendix ‘C’. The results ranged from 2.0E-04 m/sec to 1.3E-08 m/sec.

Streamflow Measurements

Spot baseflow measurements carried out in detail on 5 occasions and at select sites on two occasions and the results can be found in Appendix ‘C’. Some results exhibit a relatively significant increase in baseflow between the tributaries entering the study area and the main branch (FE14) crossing Hurontario Street. The increase in baseflow was noted as 98 L/sec in May, 2008, 16 L/sec in August, 2008 and 66L/sec in March 2009. Additional flow measurements in the summer and early fall of 2009 show relatively lower flows with July and September showing flows on the order of 10 L/sec. Flow contributions upstream of FE10 may be influenced by tile drainage. The local drainage system mapping is provided in Appendix 'C'.

Various reaches were examined on November 2, 2008 and February 5, 2009, August 12, 2009 and October 22, 20009 for visual observations of groundwater discharge considering local seeps, stream temperature and/or open water during freeze over conditions. The site for DP5 was chosen based on consultation with Jim Dougan and was found to be consistently wet through the summer of 2009. As discussed above DP5 exhibited upward gradients.

Although seasonally high water table levels may account for an increase in groundwater discharge and surface flows it is expected that online storage and slow release depressional storage in the creek valley, in relation to snowmelt and timing on precipitation events, may be a greater contributor to the variation in flows. The low hydraulic conductivity of the surficial material isn't generally consistent with higher levels of groundwater derived flow. Groundwater recharge from more local adjacent areas within the creek valley may provide limited groundwater discharge

Water Quality

Surface water samples were obtained on March 24, 2009 at FE1, FE13, FE15, FE19, FE21 and FE22. The results indicate elevate hardness, TDS and sulphate reflecting the general chemistry of the till. Some of the elevated sodium and chloride values could reflect roadsalt. The elevated nitrates may reflect agricultural practices given the concentrations and the flow rate. The FE1 concentration of 6 ppm for nitrate may reflect the tile drainage discussed above.

The borehole water samples indicate the similar till chemistry described in previous sections although some of the values appear to be slightly lower. BH1 has elevated nitrates (5.42 ppm) indicating a nutrient source.

The enriched tritium samples will be assessed further but BH4d has a definitive signature of pre bomb water (i.e. 1953).

4.2.5. Conceptual Groundwater Flow

NOTE: All of the current field data have been incorporated into refining the base groundwater FEFLOW model. Calibration of the model is ongoing and is expected to modify the discussion on the conceptual groundwater flow system presented below particularly relating to the flow within the upper till unit.

Water from precipitation percolates or infiltrates into the ground until it reaches the water table. Areas where water moves downward from the water table are known as recharge areas. These areas are generally in areas of topographically high relief. Areas where groundwater moves upward to the water table are known as discharge areas. These generally occur in areas of topographically low relief, such as stream valleys. Groundwater that discharges to streams is the water that maintains the baseflow of the stream. Wetlands may be fed by groundwater discharge.

There are different types and rates of recharge and discharge. Water percolating into the ground at a specific location may discharge to a small stream a short distance away. This is local recharge and local discharge. Some water may recharge a certain area and discharge to a larger river basin a long way from the source of recharge. This is known as regional recharge and regional discharge.

Permeable geologic materials through which groundwater moves are known as aquifers. Aquifers are "water bearing" formations meaning that water can be easily extracted from these units. The less permeable units are known as aquitards, and although water can move through these units, it moves slowly and it is difficult to extract water from these units. How these aquifers are connected within a hydrogeologic setting is what controls much of the movement of groundwater.

A delineation of the flow system(s) in this way will identify where groundwater originates, where it discharges and the most prominent paths it travels between these points (e.g. the aquifer pathways or more permeable hydrostratigraphic units). Having done this, one can assess the relative sensitivity of the linkage from the groundwater system to the aquatic or terrestrial systems. Knowing the level of sensitivity of the receptor one can determine the impacts of particular types and scales of land uses or land use changes on the groundwater flow system and other linked ecosystem components. Best management practices can then be developed to prevent unacceptable impacts from occurring.

The detailed geological and hydrogeological background information presented Section 4.2.2 gives rise to the following major hydrogeologic units:

- The fractured shallow till
- The permeable discontinuous stratified units within the till
- Vertical fractures within the till where the till is sufficiently thin to develop fractures to the bedrock (approximately 6 m)
- The highly fractured upper bedrock (approximately the upper 5 m)
- The surficial organic sediments within the forested areas
- The glaciolacustrine surficial units

The general direction of horizontal groundwater flow within the shallow overburden/shale system (ref. Appendix ‘C’, Figure GW-8) trends towards the south-east with some preference to stream convergence. The orientation of the main reach, which is incised from McLaughlin Road to Hurontario Street, runs perpendicular to the direction of flow and this may be a source of significant groundwater discharge

The deeper groundwater flow (ref. Appendix 'C', Figure GW-9) shows similar but more subtle regional trends.

The horizontal component of groundwater flow, particularly within the overburden, will be weak due to the low permeability of the silt/clay sediments as discussed in Section 4.2.2.3. The upper fractured till is expected to transmit more significant quantities of water but on a more local scale. A significant amount of research has focused on the hydrogeology of fractured glacial tills. A literature review has been carried out for this study and documented the following hydrogeologic factors that relate to the till in the study area:

- Frequency and depth of fractures can depend on the clay/silt/sand content, average precipitation and temperature
- Fractures can occur up to 6 m but they are likely more prevalent with the upper 2-3 m (Upper Fractured Till)
- The lateral connection within the Upper Fractured Till can be relatively significant
- Horizontal flow patterns in the Upper Fractured Till will be controlled by local depressional topography and restricted by underlying more massive and less permeable till
- Vertical groundwater flow below the Upper Fractured Till is generally low unless more permeable, interconnected lenses exist
- Evapotranspiration will significantly reduce water levels in the Upper Fractured Till
- Lateral flow in the Upper Fractured Till reduces more quickly as the water levels drop due to less fracture with depth
- Gradients can be reversed within the underlying massive till (downward to upward) as water levels in the Upper Fractured Till lower thereby reducing recharge to depth

It is currently proposed that the Upper Fractured Till is a very active groundwater flow zone mainly due to the permeability contrast (2-3 orders of magnitude) between it and the underlying more massive till. It is currently interpreted that lateral flow in the Upper Fractured Till will be directed to the depressional features. Where water levels in the Upper Fractured Till are high enough and the depressional features are connected at surface, (i.e. a ridge/swale system) groundwater discharge and overland flow may occur. The extent and distance of overland flow will vary. This flow may be more dominant immediately following a precipitation event and may only last for a short period of time. It is more common for the water to exist as shallow ponding within these depressions or for the water table to be closer to ground surface within the depressional areas as the depth of the depressional features is on the order of the thickness of the Upper Fractured Till layer. This more common scenario would lead to greater evapotranspiration within the depressional features. In this setting although precipitation would infiltrate to the water table and be considered recharge, local shallow flow would deliver it to depressional areas where it could be considered groundwater discharge but would be lost to evapotranspiration and not manifest as overland flow. This conceptual flow is also evident in air photos as darker (i.e. wetter) areas.

Where the underlying till is massive both vertical and horizontal groundwater flow is restricted. The vertical hydraulic gradients are generally quite higher than the horizontal gradients. Some level of fracturing may occur in the more massive till as well as interconnected more permeable layers which may transmit more groundwater to depth.

Groundwater flow within the discontinuous sand lenses may also be significant on a local scale where these sand lenses intercept surface water features. It was presented in the IWA study the some of these sand lenses may be on the order of 100 m in areal extent. The existence of the sand lenses is evident in the cross-sections found in Appendix 'C' but the continuity can only be demonstrated through detailed monitoring well installation and pump tests. These lenses could provide discharge for extended periods of time during the drier season and also are the likely sources for the higher capacity overburden wells.

Groundwater flow, generally a more dominant horizontal flow, is expected to be greater in the upper fractured shale (and where they contact overlying permeable sand and gravel lenses) due to the contrast between the higher permeability of this unit and the lower permeability of the overlying silt/clay unit and the underlying more competent shale unit. This hydrogeologic unit is also considered to be the most continuous although there may be local areas that where the upper fractured shale was eroded from prior glacial activity.

Some major questions concerning the hydraulic connection of vertical flow in the till arise. Basic Darcy fluxes calculated in the IWA study don't allow for a significant flow to the bedrock or to recharge the more permeable stratified layers within the till, yet domestic wells don't appear to have quantity problems and water trends in the shallow bedrock correlate with trends in the till. The extent of vertical fracturing and interconnection of inter-fingered permeable units within the till may account for the apparent inconsistency.

The organic sediments within the forested areas could provide significant storage of water on a local scale which could provide local recharge to the upper fractured till or could drain slowly to local reaches.

The pockets of surficial glaciolacustrine clays may behave differently with respect to storage and retention of groundwater (greater disconnected pore space) and may correlate to local wetlands or give rise to geotechnical issues.

Infiltration rates are governed to a large extent by the surficial geology and associated permeability. Other factors include vegetative cover, topography, spatial and temporal distribution of precipitation events and temperature. A long term variation in frequency of the low intensity events may affect the overall recharge.

The surficial geology within the study area consists predominantly of the Halton Till. The silt to clayey silt nature of this till gives it a relatively low permeability. Hydraulic conductivities determined in the Fletcher's Creek study were in the range 3×10^{-5} to 5×10^{-7} cm/sec. In the Fletchers Creek study infiltration rates were approximated by correlating to a baseflow range of 50-150 mm year over the basin. The Shale Resources Review reported an average bulk hydraulic conductivity for the till as 1×10^{-4} cm/sec and an infiltration rate of 80-100 mm/year. An estimated infiltration rate of 50mm/year was reported by Funk (1979) for a watershed underlain by the Halton Till. A stormwater management study carried out within a subcatchment area in the upper reaches of the Red Hill Creek estimated an infiltration rate of 150-200 mm/year in a highly fractured Halton Till directly connected to highly fractured bedrock (Guther, Scheckenberger, Blackport, 1997). The Credit Valley Subwatershed Study & Servicing Plan (Final Draft) used potential infiltration rates of 100-150 mm/year for the Halton Till. Subsequent hydrological modelling provided infiltration rates in the range 80-100 mm/year upon calibration. IWA recharge rates were proposed to be on the order of 80 – 160 mm/year. EBNFLO, 2004 presents recharge rates of 117-168 mm/year the Etobicoke Headwaters area but it is presented in the Etobicoke Creek Headwaters Subwatershed Study that these values may be too high. Values presented for the West Humber subwatershed, located on the Peel Plain, were estimated to be on the order of 50-100 mm/year and detailed groundwater modelling for the Northwest Brampton Subwatershed Study presented values from 20-100 mm/year.

4.3. Hydrology and Hydraulics

4.3.1. Importance/Purpose

The 2008 Field Monitoring Program for rainfall and streamflow has been conducted to provide an understanding of the current hydrologic conditions within the area of interest, specifically pertaining to the watercourses and open water features. In accordance with the Approved Work Plan for this study, the rainfall monitoring and flow monitoring have been conducted to determine the dry weather and wet weather conditions specifically within the portion of the study area which lies within the Etobicoke Creek Watershed. Understanding the existing system's response to rainfall is important to develop a balanced management strategy for this area under future land use conditions.

4.3.2. Background Information

The following background information has been reviewed, specifically pertaining to the hydrologic/hydraulic components of this study:

- Etobicoke Creek Hydrology Update Final Draft Study Report (Totten Sims Hubicki, March 2007).
- Functional Servicing and Stormwater Management Report (C.F. Crozier & Associates Inc., February 2005).
- Northwest Brampton Urban Area Subwatershed Characterization and Integration (Philips Engineering Ltd., December 2007)
- Northwest Brampton Urban Area Subwatershed Impact Assessment (Philips Engineering Ltd., May 2009 Draft)
- 2008 LiDAR mapping for Mayfield West Study Area
- Topographic mapping (OBM) for lands upstream of Mayfield West Study Area within the Town of Caledon
- Visual OTTHYMO hydrologic models for Etobicoke Creek Watershed
- HSP-F hydrologic model for the Fletcher's Creek Subwatershed
- Regulatory Limit for Etobicoke Creek
- Base-mapping information (roads, lotting, watercourses)

4.3.3. Methods

4.3.3.1 Hydrology Field Methods

The detailed scope of work for the Rainfall and Water Quantity (Streamflow) Field Sampling Component of the Program was presented to the Technical Steering Committee in April 2008, and consisted of the installation of one rainfall gauge and two streamflow gauges for data collection. As indicated during that meeting, the final siting of the gauges was conducted on April 7, 2008 with TRCA staff in order to determine the most suitable locations for the installation of the gauges. The gauges were installed at the following locations (ref. Drawing 1):

- One rainfall gauge was installed on the roof of the private school along Hurontario for rainfall data collection.
- One streamflow gauge was installed along the tributary west of Hurontario, upstream of the confluence with the Etobicoke Creek (ref. site Q1).
- One streamflow gauge was installed along the tributary on the east side of the culvert along Chinguacousy, south of Old School Road (ref. site Q2).

Streamflow monitoring has been completed using Flo-Tote II™ streamflow gauges. The streamflow gauges were installed on April 24, 2008, and the rainfall gauge was installed on May 5, 2008 following coordination and discussion with the administrative staff at the private school, the gauges were subsequently removed December 4, 2009.

Theoretical rating curves (i.e. depth-discharge relationships) have been developed at each of the gauge locations in order to convert the continuous depth data to continuous flow data (i.e. hydrographs) for the monitoring period. Cross-section geometry has been generated based upon field measures at the monitoring sites, as well as available topographic mapping. Roughness coefficients (Mannings) have been established based upon the observed field conditions and calibrated values obtained from monitoring programs under similar field conditions. The calibrated rating curves have been used in order to generate continuous observed streamflow data (i.e. hydrographs) based upon the continuous observed depths recorded at the gauges.

Total Station Survey has been completed at hydraulic structures (i.e. bridges and culverts) within the Mayfield West Phase 2 lands in order to obtain the geometry of the various hydraulic structures, as well as the upstream and downstream inverts relative to the centerline profile of the roadway. Hydraulic structures which have been identified within the study area are presented on Drawing 2.

4.3.3.2 Hydrology Analytic Methods

Hydrologic analyses for the Mayfield West area within the Fletcher's Creek Subwatershed have been completed using the currently approved HSP-F hydrologic model for the Subwatershed. That model, developed originally for the Northwest Brampton Subwatershed Study, has been refined within the limits of the Mayfield West Phase 2 Study Area, based upon the LiDAR mapping for the area.

Hydrologic analyses for the Etobicoke Creek Watershed have been completed most recently for the March 2007 Hydrology Update (ref. Totten Sims Hubicki, March 2007). The analyses completed under that study have applied the Visual OTTHYMO methodology and have used theoretical design events in order to define return period flows within the watershed. The Approved Work Plan for the current study requires that continuous simulation be completed for the hydrologic analyses, primarily to develop more refined analyses for the erosion assessment component of this project. As such, the Visual OTTHYMO model is considered unsuited for application in this project. Although the currently approved Work Plan recommended that the updated QUALHYMO hydrologic model being developed in conjunction with TRCA be applied for this study, the final development of that model has not progressed beyond the Beta testing stage; hence, the HSP-F methodology has been applied for the Etobicoke Creek Watershed, to the downstream limit of the Study Area.

The following provides a summary of the hydrologic conditions within the Fletcher's Creek Subwatershed and the Etobicoke Creek Watershed.

Soils

Soils data within the Fletcher's Creek Subwatershed and the Etobicoke Creek Watershed have been provided by CVC and TRCA in the form of GIS database (.dbf) and graphical (.shp) files, two of which pertain to the surficial soils within the Study Area. The SCS classifications of the surficial soils also include the specific soil types. The information provided in these databases is consistent with the information in the Ontario Ministry of Agriculture, Food, and Rural Affairs (OMAFRA) soils database.

The surficial soils within the Caledon Study Area are primarily Chinguacousy clay loam, which is classified as SCS Soil Type 'C' (i.e. exhibits moderate to low infiltration rates), with small pockets of Jeddo Clay Loam which is classified as SCS Soil Type 'D' (i.e. exhibits low infiltration rates).

Slopes

Slopes for Mayfield West Phase 2 Study Area have been characterized using the LiDAR mapping provided for this study. Slopes within the Fletcher's Creek Subwatershed have been characterized as typically low, with only the creek and valley features downstream of the study area having slopes that are steeper. By comparison, the slopes within the Etobicoke Creek Watershed portion of the Study Area tend to be steeper, with the steepest slopes located along the watercourses through the area.

4.3.4. Results

Results of the continuous streamflow and rainfall monitoring data are summarized in Appendix 'D'. The suite of rainfall and flow data has been screened in order to identify "significant" storm events which occurred during the 2008 monitoring season, based upon total rainfall volume, average and maximum intensity, and observed runoff response. The results of this assessment are summarized in Table 4.3.1.

Table 4.3.1. Significant Precipitation Events 2008 Season

Event	Date	Total Event Precipitation (mm)	Duration (hours)	Average Intensity (mm/hr)	Peak Intensity[1] (mm/hr)	Inter-event Time[2]	Comments
1	28-June	27.8	6	4.6	79.2	5 days	22 mm of total rainfall occurred during peak 35 minute period
2	20-July	45.4	10	4.6	28.8	3.5 hours	5 mm event occurred on July 19th . Prior to that, 7 day inter-event period.
3	23-July	19.2	4.5	4.3	26.4	7 hours	4.8 mm event occurred in the morning. 9.2 mm event on the 22nd, other events on the 20th and 19th as above.
4	9-August	28.4	9.25	3.1	52.8	22.5 hours	17.4 mm event occurred on the 8th. 11.2 mm event occurred on the 7th, which contained sudden burst with 79.2 mm/hr intensity.
5	10-August	15.8	1.5	11.2	48.0	7.75 hours	Intense event that followed August 9th event. 11.6 mm of total rainfall occurred during peak 20 minute period.

1 Based on available 5 minute rainfall data
2 Time between last recorded rainfall and start of rainfall event in question

The results of this assessment indicate that the storm events which occurred during 2008 were characterized by relatively short durations and high volumes and intensities.

The rainfall data collected during 2008 has been further reviewed in order to determine the observed monthly rainfall volumes. This information has been compared with the average monthly rainfall volumes observed at the Pearson Airport gauge in order to characterize the meteorological conditions as either representative or atypical. The results of this assessment are presented in Table 4.3.2.

Table 4.3.2. Monthly Precipitation Summary

MONTH	Total Monthly Precipitation (mm)		Comments
	PEL Observed	Pearson*	
May 2008[1]	22.0 (59.4)	72.4	82% of average rainfall (when missing days are accounted for)
June 2008	110.6	74.2	149% of average rainfall
July 2008	130.4	74.4	175% of average rainfall
Aug 2008[2]	102.0 (110.2)	79.6	138% of average rainfall (when missing days are accounted for)
Oct 2008	26.8 (29.0)	63.4	46% of average rainfall (when missing days are accounted for)
* Historical 30 Year Average Data Recorded for Pearson Airport Rain Gauge (1971-2000)			

1 PEL Observed data is missing from May 1st to 5th. 37.4 mm of rainfall recorded at Pearson during this period.
2 PEL Observed data is missing from August 25th to end of month. 8.2 mm of rainfall recorded at Pearson during this period.

The results in Table 4.3.2 indicate that the rainfall which occurred during May 2008 was relatively comparable to the average monthly volumes for that month, however the rainfall during June, July, and August 2008 was significantly greater than the average monthly values. The data collected during 2008 was considered suitable for model calibration, due to the abundance of data and conditions under which the events occurred; on this basis, the data collected for 2008 has been advanced for application in the hydrologic model development.

The TRCA operates rainfall gauges in the vicinity of the Study Area. The locations of the TRCA rainfall gauges, in relation to the Philips rainfall gauge which has been installed for this monitoring program, are provided in Drawing 1 (ref. Appendix 'D'). As the information in Drawing 1 indicates, the TRCA gauge at the Sue Granger Farm lies within the headwaters of the drainage area to Gauge Q1. Rainfall data has been provided by TRCA for the gauges in the vicinity of the Study Area, in order to validate the calibration storm events listed in Table 4.3.1; the results of this assessment are presented in Table 4.3.3.

Table 4.3.3. Comparison Of Rainfall Data For Calibration Events

Event	Data Source	Duration (hours)	Volume (mm)	Peak Intensity (mm/hr)
June 28, 2008	PEL	1.5	15.4	36
	TRCA Heart Lake	2.2	17.6	44.4
	TRCA Laidlaw	2.2	21.2	62.4
	TRCA Caledon PS	1.8	13.2	62.4
	TRCA Sue Grange Farm	2.1	15	38.4
July 20, 2008	PEL	10	45.4	19.2
	TRCA Heart Lake	10.2	44.8	28.8
	TRCA Laidlaw	9.3	44.6	38.4
	TRCA Caledon PS	8.5	23.6	19.2
	TRCA Sue Grange Farm	10.1	40.6	50.4
July 23, 2008	PEL	4.2	19.2	13.6
	TRCA Heart Lake	4.4	16.9	12
	TRCA Laidlaw	5.2	26.8	43.2
	TRCA Caledon PS	6.2	19.6	43.2
	TRCA Sue Grange Farm	6.2	11.2	40.8
August 9, 2008	PEL	9	28.4	25.6
	TRCA Heart Lake	9.2	37.4	40.8
	TRCA Laidlaw	8.8	28.8	26.4
	TRCA Caledon PS	6.7	23.6	50.4
	TRCA Sue Grange Farm	7.9	28.8	50.4
August 10, 2008	PEL	1.2	15.8	27.2
	TRCA Heart Lake	1.7	1.1	1.2
	TRCA Laidlaw	0.3	1.2	4.8
	TRCA Caledon PS	0.4	1.6	4.8
	TRCA Sue Grange Farm	3.8	7	9.6

Calibration

The streamflow and rainfall data which has been collected for the events listed in Table 4.3.1 has been used in order to calibrate the HSP-F hydrologic model for the Etobicoke Creek Watershed within the limits of the Study Area; the subcatchment boundary plan is presented in Drawing 3. The sensor for streamflow Gauge Q2, which is located at the west limit of the Mayfield West Study Area, was found to be frequently obstructed with debris during the course of the monitoring program, and frequently recorded oscillating water surface elevations, which were inconsistent with observed conditions (i.e. water depths at the gauge). Following the completion of the monitoring program, it was discovered that the sensor on the probe had malfunctioned; it was therefore concluded that the data recorded at Gauge Q2 was considered less reliable for application in the model development. As such, the data collected at Gauge Q1 has principally been applied for the model calibration. Given the homogeneous conditions which prevail throughout the Study Area (i.e. land use, soils, slopes), the parameter adjustments which have been applied for the calibration of the drainage areas to Gauge Q1 have been applied for the balance of the Study Area. The results of the model calibration are provided in Appendix 'D' and are summarized in Table 4.3.4.

Table 4.3.4. Statistical Summary Of Model Calibration

Statistical Indicator	Calibration Indicator	
	Instantaneous Peak Flow	Daily Flow
Sample Population	7 Events	81
Slope of Trendline Through Origin	1.03	0.90
R^2	0.85	0.93

As the calibration results indicate, the calibrated HSP-F hydrologic model for the drainage area to Gauge Q1 satisfactorily reproduces the observed peak flows for the calibration events, the runoff volumes observed for the monitoring program, and the baseflow conditions which occur between storm events. As such, the HSP-F model for the Study Area within the Etobicoke Creek Watershed is considered sufficiently calibrated for the determination of frequency flows, and for the erosion analyses based upon continuous simulation and duration analyses.

Frequency Analysis

A 40 year continuous simulation has been completed using the HSP-F hydrologic models for the Fletcher's Creek Subwatershed and the Etobicoke Creek Watershed, and frequency analyses have been completed using the Consolidated Frequency Analysis (CFA) software based upon the simulated annual maximum flow rates. As per the Ministry of Natural Resources guidelines for conducting frequency analysis, the Coefficient of Skew has been checked to determine which distribution is the most appropriate. The Log Pearson Type III Distribution has been applied for the Fletcher's Creek Subwatershed, consistent with the methodology which has been previously applied for the North West Brampton Subwatershed Study; the Log Pearson Type III Distribution has also been applied for the Etobicoke Creek Watershed, based upon the negative coefficient of skew, and the observed "fit" of the distribution to the data. As well, the Regional Storm (Hurricane Hazel) has been simulated as a discrete storm event, and the peak flow rate obtained at key locations throughout the Study Area. The results of this assessment are summarized in Table 4.3.5.

Table 4.3.5. Peak Flows For Existing Land Use Conditions(m^3/s)									
Node	Frequency (years)								
	1.05	1.25	2	5	10	20	50	100	Regional
Etobicoke Creek									
2.350	3.11	5.43	9.04	14.3	17.7	21.0	25.2	28.2	209
2.360	1.61	2.76	4.56	7.20	8.99	10.7	12.9	14.5	113
2.363	0.95	1.61	2.67	4.30	5.46	6.61	8.16	9.36	67.8
2.370	1.556	2.76	4.60	7.24	8.97	10.6	12.6	14.1	108
2.380	0.24	0.51	0.94	1.51	1.86	2.15	2.48	2.69	22
2.390	0.62	1.05	1.75	2.85	3.65	4.46	5.56	6.42	45.7
2.400	0.34	0.57	0.95	1.55	1.98	2.42	3.01	3.48	25.1
2.410	0.29	0.50	0.83	1.34	1.70	2.06	2.53	2.89	19.9
2.420	0..058	0.10	0.18	0.34	0.47	0.61	0.83	1.02	5.29
2.430	0.23	0.40	0.67	1.08	1.35	1.60	1.93	2.18	15.2
2.470	1.48	2.58	4.30	6.75	8.38	9.90	11.8	13.2	99
2.480	0.45	0.76	1.26	2.05	2.63	3.21	4.01	4.64	33.9
2.490	1.00	1.78	2.97	4.63	5.69	6.66	7.85	8.70	66.3
2.500	0.16	0.30	0.53	0.90	1.17	1.43	1.78	2.05	14.8
2.510	0.04	0.07	0.12	0.22	0.30	0.38	0.50	0.60	3.51
2.520	0.13	0.22	0.37	0.62	0.81	1.00	1.27	1.49	10
2.530	0.25	0.43	0.72	1.17	1.48	1.79	2.21	2.53	18.6
2.540	0.39	0.67	1.12	1.83	2.34	2.86	3.55	4.09	27.6
2.550	0.10	0.19	0.35	0.62	0.83	1.03	1.32	1.55	8.94
2.560	0.21	0.43	0.78	1.27	1.57	1.83	2.14	2.35	18.3
Fletcher's Creek									
5.580	0.042	0.065	0.12	0.23	0.36	0.53	0.85	1.18	1.94
5.611	0.10	0.16	0.27	0.55	0.84	1.24	1.99	2.79	4.88
5.860	0.023	0.035	0.062	0.12	0.19	0.28	0.45	0.63	1.1
5.870	0.047	0.072	0.12	0.25	0.38	0.57	0.91	1.28	2.24
5.790	0.061	0.093	0.16	0.32	0.49	0.73	1.17	1.65	2.92
5.800	0.11	0.17	0.3	0.61	0.93	1.38	2.22	3.11	5.28
5.880	0.13	0.2	0.35	0.71	1.08	1.59	2.56	3.59	6.31
5.741	0.024	0.036	0.063	0.13	0.19	0.29	0.46	0.64	1.13
5.750	0.060	0.091	0.16	0.32	0.49	0.72	1.16	1.63	2.83

A further review and validation of the simulated frequency flows will be completed as part of the Impact Assessment phase of this study. Nevertheless, the results above are considered sufficient to provide an initial characterization of the hydrology within the Study Area.

Erosion Analyses

The results of the continuous simulation have been used in conjunction with the critical flow rates provided from the fluvial geomorphological assessment in order to identify the erosion sensitive zones within the within the Etobicoke Creek Watershed and within the Fletcher's Creek Subwatershed (ref. Section 4.4.4). Specifically, duration analyses have been completed based upon the results of the continuous simulation in order to determine the number of hours and percent of time within the 40 year continuous simulation during which the flow rates would be above the erosion threshold. The sites for the erosion assessment within the Etobicoke

Creek Watershed and the Fletcher's Creek Subwatershed are presented in Figure 4.4.1 of this report. The results of the duration analyses are presented in Table 4.3.6.

Table 4.3.6. Duration Analyses For Erosion Sites

Erosion Assessment Site	Q_{crit} (m^3/s)	Time with Flow Above Q_{crit}	
		Hours	Percent of Total
Etobicoke Creek Watershed			
R1	2.15	4290	1.2
R2	0.68	20796	2.3
R5	0.56	9427	5.9
R8	1.16	3758	2.7
R25	1.64	114	0.0
Fletcher's Creek Subwatershed			
R3	0.06	3401	1.0

As indicated previously, the further review and validation of the hydrologic model for the Etobicoke Creek will be completed as part of the Impact Assessment phase of this study based upon the updated hydrogeological characterization data, in order to reflect the resident recharge conditions within the study area; once the development of the hydrologic model is completed, the duration analyses and erosion assessment will be updated as required. As per the study Terms of Reference, the threshold stream stability criteria established through the geomorphologic assessment will be applied in conjunction with the duration analyses to assess the effectiveness of flow modulation and shear stress improvements considered as part of future tasks. Nevertheless, the results of the above assessment are considered sufficient to characterize the sensitivity of the geomorphological assessment sites to erosion.

Hydraulic Assessment

The information collected from the hydraulic structure inventory has been used in order to summarize the structures within the study area. The results are presented in Table 4.3.7.

Table 4.3.7. Hydraulic Structure Inventory

Crossing Number	Location	Crossing Type	Size of Opening (span x rise) (mm)	Upstream Invert (m)	Downstream Invert (m)
1	Chinguacousy Rd., 1,350m north of Mayfield Rd.	Conc. Open Footing	4500 x 1860	255.42	255.40
2	Chinguacousy Rd., 1,080m south of Old School Rd.	Conc. Open Footing	3600 x 920	257.73	257.60
3	Chinguacousy Rd., 750m South of Old School Rd.	Conc. Open Footing	2900 x 930	260.47	260.32
4	Chinguacousy Rd., 460m South of Old School Rd.	Conc. Open Footing	3500 x 930	262.52	262.49
5	Old School Rd., 130m East of Chinguacousy Rd.	Conc. Open Footing	1500 x 1200	265.95	265.91
6	Old School Rd., 340m East of Chinguacousy Rd.	Conc. Open Footing	1500 x 1200	265.99	265.81
7	Old School Rd., 890m East of Chinguacousy Rd.	C.S.P	600 Diam.	268.00	267.82
8	Old School Rd., 85m West of McLaughlin Rd.	Conc. Box	2400 x 1200	264.66	264.01
9	Old School Rd., 900m East of McLaughlin Rd.	Conc. Box	1840 x 2460	257.21	256.86
10	Old School Rd., 360m West of Hurontario Rd.	C.S.P	1800 Diam.	255.71	255.45
11	McLaughlin Rd., 1,250m South of Old School Rd.	Conc. Open Footing	9140 x 3200	249.73	249.72
12	McLaughlin Rd., 850m South of Old School Rd.	C.S.P.	1100 Diam.	260.71	260.26
13	McLaughlin Rd., 80m South of Old School Rd.	Conc. Box	2400 x 1200	251.86	251.69
14	Hurontario Rd., 530m South of Old School Rd.	Conc. Open Footing	3050 x 1900	252.34	251.43
EI C8	McLaughlin Road, 140m South of Mayfield Road	Conc. Open Footing	1500 x 1200	N/A	N/A
EI C9	Mayfield Road 15m West of McLaughlin Road	C.S.P.	750 diameter	N/A	N/A
EI C10	Mayfield Road 100m West of McLaughlin Road	C.S.P.	750 diameter	N/A	N/A
EI C11	Mayfield Road 190m West of McLaughlin Road	C.S.P.	675 diameter	N/A	N/A
EI C12	Mayfield Road 320m East of Chinguacousy Road	C.S.P.	750 diameter	N/A	N/A
EI C13	Mayfield Road 280m East of Chinguacousy Road	C.S.P.	750 diameter	N/A	N/A
EI C14	Mayfield Road 150m East of Chinguacousy Road	C.S.P.	750 diameter	N/A	N/A
EI C15	Mayfield Road 60m East of Chinguacousy Road	C.S.P.	750 diameter	N/A	N/A

A HEC-RAS hydraulic model has been developed through the study area within the Etobicoke Creek Watershed in order to establish the Regulatory floodplain; a HEC-RAS model for the regulated watercourses within the Fletcher's Creek, which lie downstream of the Study Area, has been previously developed as part of the Subwatershed Study for the Northwest Brampton Urban Area. The cross-section geometry data has been obtained from the 2008 LiDAR mapping provided for this study and the geometry of the openings through the hydraulic structures has been simulated based upon the results of the hydraulic structure inventory. The Regulatory (Regional Storm) Event flow rates which have been obtained from the hydrologic analysis have been incorporated into the HEC-RAS model in order to generate the Regulatory

(Regional Storm) floodplain for the Etobicoke Creek. Consistent with current practice, as well as the 2001 Hazard Guidelines from the Ministry of Natural Resources, this analysis has been applied only for those reaches with contributing drainage areas greater than 125 ha. In the absence of a currently approved hydraulic model for the reach downstream of the study area, the boundary condition for the hydraulic analyses has been specified as normal depth, based upon the channel gradient. The HEC-RAS cross-section location plan and the Regulatory floodplain are presented in Drawing 4, and the HEC-RAS model is provided in Appendix ‘D’.

4.3.5. Interpretation

The results of the erosion assessment indicate that the greatest duration of flows above the critical flow rate occurs at erosion site of the Main Branch of the Etobicoke Creek at the Study Area outlet at Highway 10 (reference Site R2). As such, this site represents the most erosion sensitive site, and the “target” site for the provision of erosion controls related to future development scenarios.

The results of the erosion assessment for the reach within the limits of the Fletcher’s Creek Subwatershed indicate that, for the 40 year continuous simulation, the flow rates exceeded the erosion threshold 1.0 % of the time. However, duration analyses completed for the Draft Impact Assessment for the Northwest Brampton Urban Area indicate that, under existing land use conditions, flow rates at key nodes within the Fletcher’s Creek Subwatershed, and downstream of the Mayfield West Study Area, exceeded the erosion threshold 1.7 % of the time or more. Therefore, the erosion control warrants for the portion of the Mayfield West Study Area which is located within the Fletcher’s Creek Subwatershed will be determined based upon the targets established at key nodes located further downstream within the Fletcher’s Creek Subwatershed.

The results of the floodline mapping indicate that the Regulatory floodplain for the Etobicoke Creek lies within the well-defined valley system (i.e. does not breach the valley onto the table lands). During the next phase of this study, the results of this assessment will be compiled with the slope stability assessment and the fluvial geomorphologic assessment in order to determine the Regulatory Limit for the Etobicoke Creek. The hydraulic analyses will be refined based upon information from TRCA, in order to incorporate the tailwater condition (i.e. boundary condition) at the Study Area outlet, based upon the approved floodplain mapping for the Etobicoke Creek Watershed. In addition, pending further consultation with CVC, hydraulic analyses will be completed for reaches within the Fletcher’s Creek Subwatershed, which are deemed to warrant the definition of a hazard limit for future land use planning.

4.4. Fluvial Geomorphology

4.4.1. Importance/Purpose

In order to assess the potential impacts of the proposed development on the streams within the Mayfield West lands in the Town of Caledon, a detailed fluvial geomorphic study was undertaken. The study inventories and characterizes the local channel systems. It also includes a specific focus on headwater channels, since the southern portion of the study area draining into Fletcher's Creek is comprised of a headwater drainage network. The morphology of the headwater portion of a drainage network provides an indication of the hydrological and sedimentological behaviour of the overall system. The following report describes the investigative methods used and the findings of the fieldwork undertaken within the 2008 field season.

4.4.2. Background Information

Prior to the geomorphic assessment, a background review was conducted to reveal any relevant information that could be considered applicable to this specific study. The following reports were reviewed as part of this investigation:

- Parish Geomorphic Ltd. 2002. ***Regional Monitoring Program – Fluvial Geomorphology Component Etobicoke Creek, Mimico Creek, and Humber River Watersheds*** (Submitted to: Toronto and Region Conservation Authority)
- Parish Geomorphic Ltd. 2003. ***Bankfull Characteristics and Regional Thresholds for TRCA Regional Monitoring Program Detailed Sites*** (Submitted to: TRCA)

The aforementioned reports allowed for the location of long-term monitoring sites within the Mayfield West Study Area and subsequent data analysis. One site was established through these previous studies within the Mayfield West Study Area (Reach MEC-R5).

4.4.3. Methods

Reach Delineation

Reaches are lengths of channel, typically 200 m – 2 km in length, that are relatively homogeneous with respect to sinuosity, gradient, geology, physical setting (e.g., relation to valley walls), and surrounding land use/cover. When any of these key variables change in the downstream direction, the channel will adjust, thus establishing new equilibrium conditions. Given the continuous nature of controlling and modifying factors along a reach, it is anticipated that channel form, function and process within a reach are consistent. Figure 4.4.1 illustrates the reaches identified for the portions of Fletcher's Creek and Etobicoke Creek Subwatersheds that are within the Mayfield West Study Area. References within this report refer to the reaches using this referencing system.

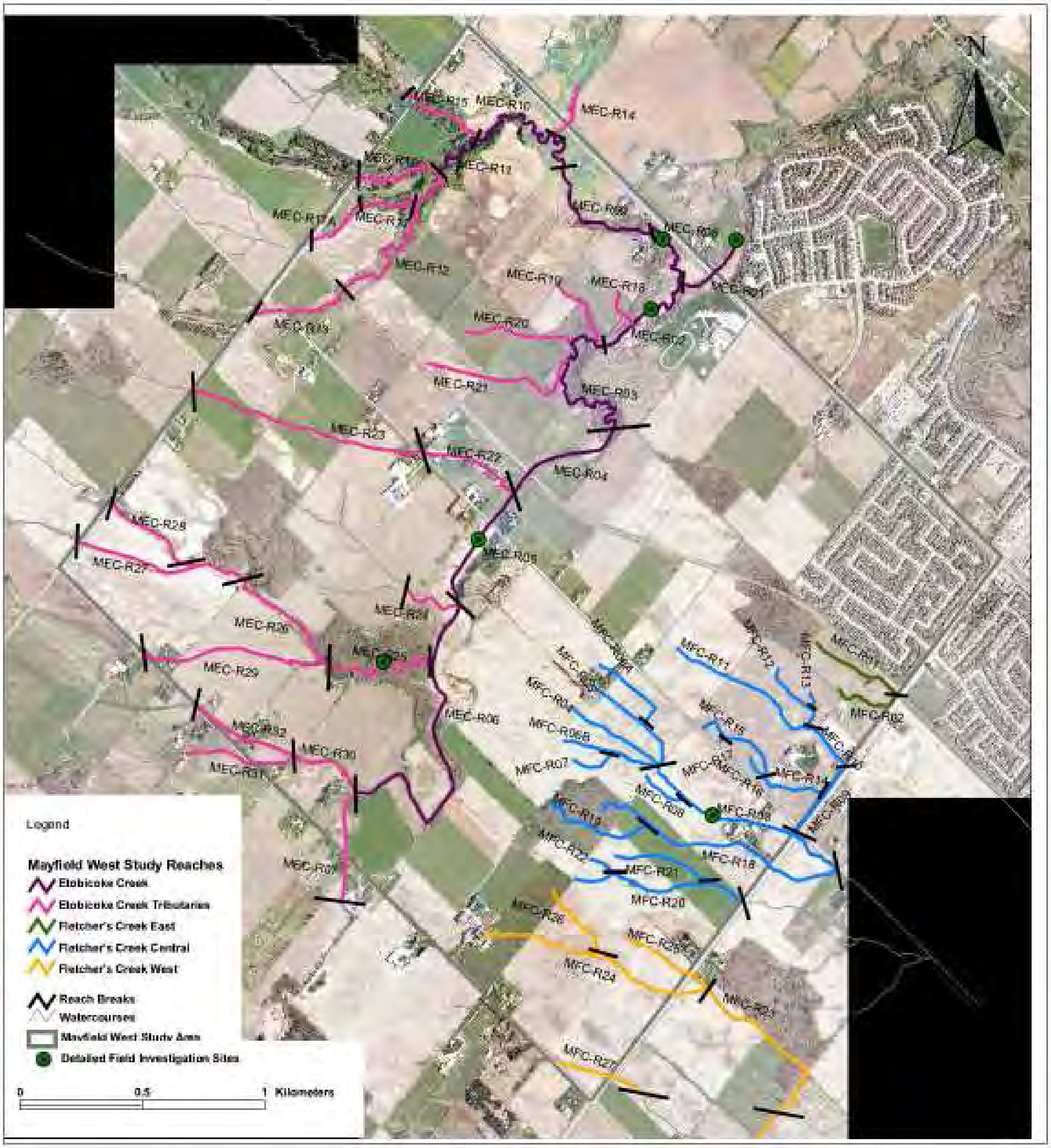


Figure 4.4.1: Mayfield West – Study reach delineation and location of detailed field investigation sites

Rapid Assessments

Rapid assessment work was undertaken throughout the study area in July and August 2008. While rapid geomorphic and stream assessments were completed for defined channel reaches, qualitative observations were also recorded for undefined channels within the study area. The rapid assessment work consisted of walking each reach in its entirety, documenting areas of active erosion and recording basic channel dimensions. For the purposes of this study two different channel assessment techniques were applied; the Rapid Geomorphic Assessment (RGA) and the Rapid Stream Assessment Technique (RSAT).

Rapid Geomorphic Assessment (RGA)

Reach stability was quantified with an RGA, which documents observed indicators of channel erosion and deposition (MOE, 1999). Observations are quantified using an index that identifies channel sensitivity with respect to aggradation, degradation, channel widening and planimetric adjustment. The index produces values that indicate whether the channel is “in regime” or stable (<0.20), “in transition” (0.21-0.40) or “in adjustment” (e.g. incising, widening and/or aggrading) (>0.41).

Rapid Stream Assessment Technique (RSAT)

The RSAT provides a broader view of the system by also considering the ecological functioning of the stream (Galli, 1996). This includes observations of channel stability, scour/deposition, instream habitat, water quality, riparian conditions and biological indicators such as the abundance of benthic invertebrates. Each indicator was ranked numerically, a lower value indicates poorer stream health and a higher value represents a rich, healthy stream. The RSAT score ranks the channel as maintaining a low (<20), moderate (20-35) or high (>35) degree of stream health. Also included in the RSAT are general observations of channel dimensions, such as bankfull widths and depths, substrate size, bank heights, vegetation cover, channel hardening and other disturbances.

The rapid assessment methods describe above fulfill the requirements of the updated ***Evaluation, Classification and Management of Headwater Drainage Features: Interim Guidelines*** (CVC & TRCA, March 2009) which includes consideration of the following:

- Channel gradient
- Channel planform
- Substrate materials
- Bank materials
- Bank height & width
- Channel stability
- Morphology – e.g. presence of pool-riffle sequences
- Presence of channelization and/or bank stability works

According to these guidelines a summary of the rapid assessment findings is presented in a Evaluation, Classification and Management Table, which describes the hydrological, ecological and geomorphological characteristics of each of the study reaches and helps to identify linkages between these characteristics.
As part of the rapid assessments, photographs illustrating the typical characteristics of the study reaches were also taken and are presented alongside the Evaluation, Classification and Management Table to provide visualisation of reach characteristics.

Detailed Field Investigation

To gain further insight into geomorphic processes occurring within the Mayfield West Study Area, detailed field sites were established in August 2008 along Reaches MEC-R1, MEC-R2, MEC-R8, MEC-R25 and MFC-R3 (see Figure 4.4.1). The locations of these sites were selected to provide appropriate representation of the watersheds, both spatially and morphologically. At each of the detailed sites, cross-sections were measured at ten locations, including pools, riffles and transitional areas. In general, the field approach follows the CVC monitoring protocol. At each transect, bankfull widths and depths, entrenchment, as well as low flow dimensions were recorded. Substrate was sampled using a modified Wolman pebble count. Sub-pavement was also characterized at each cross-section. Bank assessments included measurements of heights, angle, bank composition, in-situ shear strength, vegetation and rooting depths.

These 10 cross-sections were placed over a minimum of two meander wavelengths and included one monitoring transect located at the top of bank; this involved installing permanent pins in order to permit re-measurement. Erosion pins were also installed at each site to enable monitoring of rates of migration. A level survey of the site extending upstream and downstream of the 10 cross-section locations was also conducted. The survey included bankfull elevations, maximum pool depths, top and bottom of riffles and any obstruction to flow and provided measures of energy gradient, inter-pool gradient and riffle gradient. This field assessment will enable the quantification of channel processes and functions such as linkages to floodplains which occur at the cross-section and reach scale. The collected data will also be suitable for detailed analyses of sediment transport, channel thresholds and stability.

Monitoring

Subsequent to the detailed fieldwork, a monitoring program was undertaken in October 2008 to assess the degree of change occurring within the Mayfield West Study Area. Monitoring work provides frequent, ‘low-tech’ observations which, especially after higher flow events, enhance our understanding of a river system. Monitoring also enables direct measurements of channel change, such as bank erosion and bed scour, which can be linked to the historic assessment and provide a clearer picture of channel dynamics. This entailed repeat cross-sectional levelling survey at the detailed field investigation sites where erosion pins had been established. In addition, the modified Wolman pebble count was repeated at each control cross-section to provide an indication of substrate gradation and quantify changes overtime.

In addition to monitoring the five detailed field sites established as part of this study, an existing monitoring site established in 2001 as part of the TRCA Regional Monitoring Program within Reach MEC-R5 was also re-visited in October 2008.

Meander Belt Width

For the purposes of this study, meander belt widths were developed from a geomorphological perspective on a broad scale and, as such, should be subject to refinement during the EIR/EIS stage. This would also determine whether the meander belt width represents the constraining parameter for watercourse extent relative to the regional floodline or ecological considerations. It should be noted that geomorphic corridors were only designated for those reaches displaying defined bed and banks. A meander belt width defines the area that a watercourse currently occupies or can be expected to occupy in the future. Meander belt width delineation is commonly used as a planning tool in order to protect private property and structures from erosion due to fluvial action or geotechnical instability (PARISH Geomorphic Ltd., 2001). Within a subwatershed context, studies require the general identification of meander belt widths to facilitate the planning process.

For unconfined channels, limits of the meander belt are defined by parallel lines drawn tangential to the outside bends of the laterally extreme meanders of the planform for each reach. For confined channels, the meander belt width is generally defined by parallel lines drawn parallel to the central valley trend of the reach. The meander belt width does not refer to the bottom of valley width. A channel was considered confined if it displayed a well-defined valley based on the detailed contour mapping provided for the study area. Because the belt width has distinct, linear boundaries, instances can occur where the belt width captures the majority of the river valley but may extend into the valley in isolated areas as the valley undulates back and forth while maintaining a consistent center line trend. In the majority of cases, the meander belt width for a channel is smaller than the flood plain for unconfined systems. When alterations to the flood plain occur (e.g. filling), the flood plain becomes smaller and the meander belt width can become the constraining parameter for watercourse extent. In order to delineate the geomorphic corridor, a 10% factor of safety was applied to either side of the belt width. This factor of safety was applied in lieu of calculating 100-year erosion rates and was deemed appropriate given the broad-level nature of the study. In addition to the factor of safety, a 7.5 m setback was applied to either side of the belt width which includes a 6 m erosion access allowance as recommended by Provincial Policy Statement 3.1, but also provides an access allowance for any future maintenance requirements.

4.4.4. Results

Reach Delineation

The study area is bordered by Chinguacousy Road to the West, Old School Road to the North, Hurontario Street to the east and Mayfield Road to the south. Basic physical characteristics of the identified reaches are presented in Table 4.4.1**.** The Fletcher's Creek watershed area is characterized by historically modified headwater drainage features (as indicated by the low sinuosities) with minimal gradient, characteristic of the Peel Plain geological conditions. In contrast, the main branches of Etobicoke Creek within the northeast quadrant of the study area have retained a more natural, meandering planform. These reaches have also retained, to a large degree, a vegetated stream corridor which supports these systems.

Rapid Assessments

The results of the rapid assessment work indicate that the drainage characteristics of the Mayfield West lands are typical of headwater systems within Southern Ontario, with the majority of drainage features characterized as swales (i.e., features lacking a defined bed and banks) (Figure 4.4.2 and Table 4.4.1). The exceptions to this generalization were the two main branches of Etobicoke Creek which flowed within the study area, in addition to selected higher order streams accumulating flows from the upstream swale features. In general, the low order streams, or historically modified and straightened higher order streams were found to be stable or 'in regime', while the downstream sections of Etobicoke Creek which had retained a more natural planform exhibited some evidence of stress, primarily in the form of aggradation and widening.

A photographic record illustrating characteristic geomorphic conditions observed within each reach is provided in Appendix 'E' alongside the Evaluation, Classification and Management Table, which also summarises the findings of the rapid assessments. Two reaches, MEC-R22 and MRC-R31 could not be assessed due to land access issues.

Table 4.4.1. Reach Characteristics and Rapid Assessment Results for Mayfield West Study Area.

Reach	Length (m)	Sinuosity	Gradient (%)	RGA Score	RGA Condition	RSAT Score	RSAT Condition
Etobicoke Creek							
MEC-R01	336	1.00	< 0.10	0.00	IN REGIME	27.5	MODERATE
MEC-R02	486	1.09	0.10	0.34	TRANSITIONAL	22.0	MODERATE
MEC-R03	916	1.37	0.16	0.34	TRANSITIONAL	22.0	MODERATE
MEC-R04	533	1.02	0.09	0.00	IN REGIME	21.0	MODERATE
MEC-R05	545	1.01	0.09	0.00	IN REGIME	27.0	MODERATE
MEC-R06	1445	1.01	0.10	0.23	TRANSITIONAL	25.0	MODERATE
MEC-R07	458	1.00	0.65	0.06	IN REGIME	19.0	LOW
MEC-R08	346	1.07	0.14	0.00	IN REGIME	27.5	MODERATE
MEC-R09	580	1.07	0.17	0.23	TRANSITIONAL	27.5	MODERATE
MEC-R10	835	1.35	0.24	0.15	IN REGIME	28.5	MODERATE
MEC-R11	259	1.16	0.58	0.14	IN REGIME	28.5	MODERATE
MEC-R12	891	1.31	0.56	0.00	IN REGIME	25.5	MODERATE
MEC-R13	437	1.09	0.57	0.00	IN REGIME	26.0	MODERATE
MEC-R14	294	1.14	0.34	0.00	IN REGIME	26.0	MODERATE
MEC-R15	404	1.18	0.49	0.07	IN REGIME	25.5	MODERATE
MEC-R16	433	1.26	0.35	0.06	IN REGIME	28.0	MODERATE
MEC-R17	303	1.19	1.32	0.00	IN REGIME	25.5	MODERATE
MEC-R17A	273	1.05	1.65	0.00	IN REGIME	25.5	MODERATE
MEC-R18	177	1.03	3.94	--	SWALE	--	SWALE
MEC-R19	326	1.03	2.30	--	SWALE	--	SWALE
MEC-R20	461	1.02	1.84	--	SWALE	--	SWALE
MEC-R21	713	1.00	1.05	--	SWALE	--	SWALE
MEC-R22	432	1.05	1.16	0.00	NOT ASSESSED	0.0	NOT ASSESSED
MEC-R23	1008	1.02	0.64	--	SWALE	--	SWALE
MEC-R24	265	1.02	1.32	--	SWALE	--	SWALE
MEC-R25	627	1.16	0.48	0.20	IN REGIME	25.5	MODERATE
MEC-R26	502	1.00	0.60	--	SWALE	--	SWALE
MEC-R27	745	1.03	0.87	--	SWALE	--	SWALE
MEC-R28	466	1.03	1.29	--	SWALE	--	SWALE
MEC-R29	792	1.04	0.69	--	SWALE	--	SWALE
MEC-R30	338	1.01	1.18	0.06	IN REGIME	24.5	MODERATE
MEC-R31	481	1.01	0.42	0.00	NOT ASSESSED	0.0	NOT ASSESSED
MEC-R32	461	1.03	0.65	0.04	IN REGIME	18.0	LOW

Table 4.4.1. Reach Characteristics and Rapid Assessment Results for Mayfield West Study Area.

Reach	Length (m)	Sinuosity	Gradient (%)	RGA Score	RGA Condition	RSAT Score	RSAT Condition
Fletcher's Creek							
MFC-R01	414	1.02	0.60	--	SWALE	--	SWALE
MFC-R02	301	1.07	0.67	--	SWALE	--	SWALE
MFC-R03	906	1.03	0.50	0.10	IN REGIME	22.5	MODERATE
MFC-R04	437	1.02	0.57	--	SWALE	--	SWALE
MFC-R05	440	1.03	0.57	--	SWALE	--	SWALE
MFC-R06A	385	1.00	0.52	--	SWALE	--	SWALE
MFC-R06B	410	1.01	0.61	--	SWALE	--	SWALE
MFC-R07	201	1.02	0.75	--	SWALE	--	SWALE
MFC-R08	208	1.01	0.48	--	SWALE	--	SWALE
MFC-R09	356	1.06	0.14	--	SWALE	--	SWALE
MFC-R10	214	1.01	0.47	--	SWALE	--	SWALE
MFC-R11	686	1.01	0.36	--	SWALE	--	SWALE
MFC-R12	330	1.01	1.06	--	SWALE	--	SWALE
MFC-R13	76	1.00	0.66	--	SWALE	--	SWALE
MFC-R14	302	1.06	0.50	--	SWALE	--	SWALE
MFC-R15	406	1.04	0.37	--	SWALE	--	SWALE
MFC-R16	105	1.00	0.95	--	SWALE	--	SWALE
MFC-R17	31	1.23	1.62	--	SWALE	--	SWALE
MFC-R18	1102	1.02	0.68	--	SWALE	--	SWALE
MFC-R19	506	1.10	0.49	--	SWALE	--	SWALE
MFC-R20	748	1.02	0.47	--	SWALE	--	SWALE
MFC-R21	429	1.02	0.58	--	SWALE	--	SWALE
MFC-R22	122	1.05	1.23	--	SWALE	--	SWALE
MFC-R23	769	1.00	0.00	--	SWALE	--	SWALE
MFC-R24	1006	1.04	0.65	--	SWALE	--	SWALE
MFC-R25	407	1.03	0.37	--	SWALE	--	SWALE
MFC-R26	355	1.04	0.70	--	SWALE	--	SWALE
MFC-R27	510	1.34	0.39	--	SWALE	--	SWALE

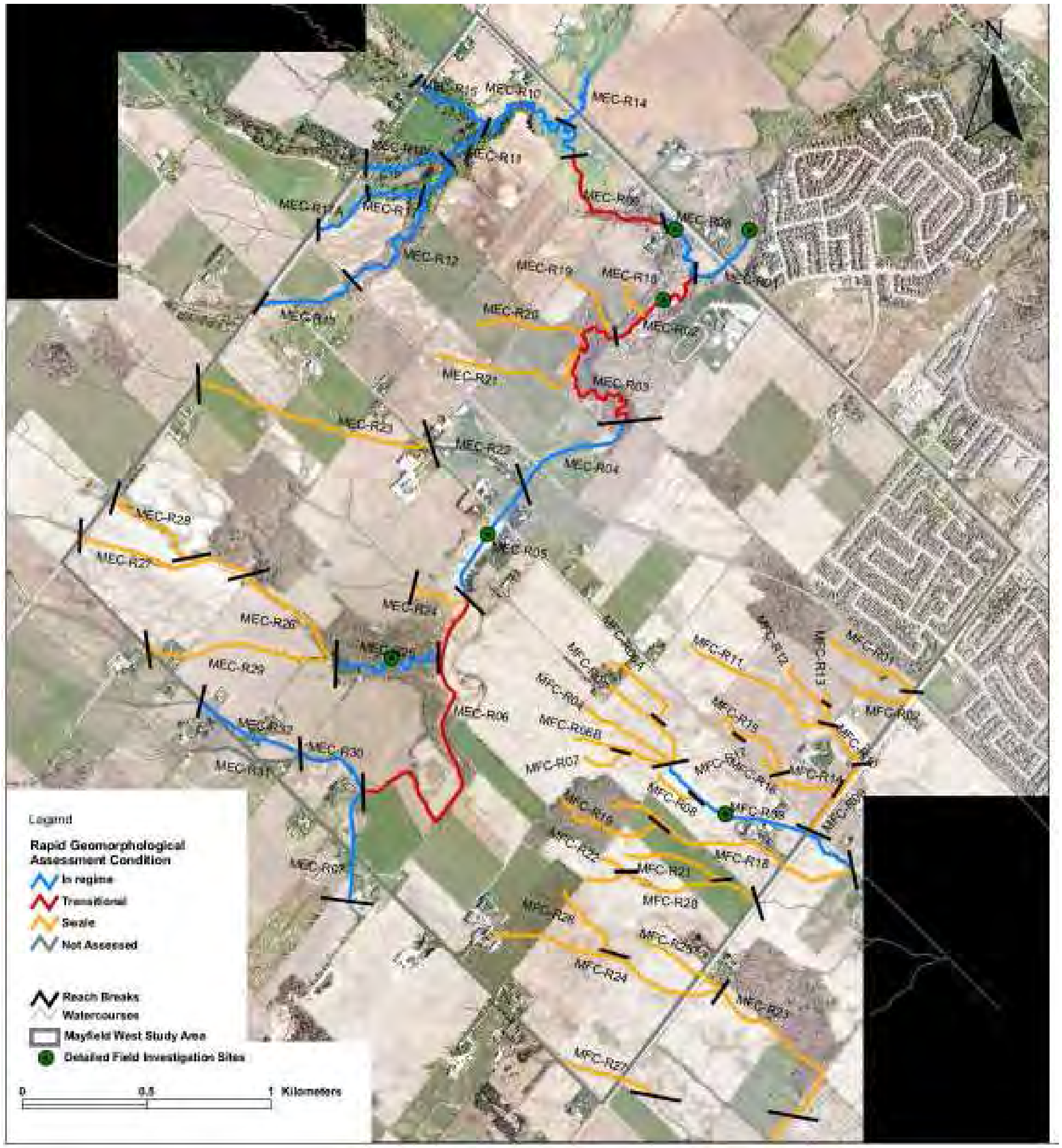


Figure 4.4.2: Rapid assessment results for reaches within the Mayfield West Study Area

Detailed Field Investigation

The results of the field assessment indicate that the landscape of the Mayfield West Study Area is dominated by two distinct geomorphic zones: the Etobicoke Creek valley lands and the headwaters of Etobicoke Creek and Fletchers Creek. The main branches of Etobicoke Creek were characterized by permanently flowing channels situated within a relatively defined valley setting. The remaining portions of the study area, meanwhile, are typical of headwater systems with numerous undefined drainage features carrying surface runoff downstream to the main branches of Etobicoke Mile and Fletchers Creek. These features display moderate gradients and fine boundary materials characteristic of the underlying Peel Plain.

Results of the detailed geomorphic field work are summarized in Table 4.4.2, with a detailed account of geomorphic parameters for each site provided in Appendix 'E'. Pebble count and bank material characterization are both indicative of the underlying Peel Plain parent materials, generally dominated by clay, silts and very fine sands. Average bankfull dimensions, meanwhile, were typical of a headwater environment, with larger depths and widths restricted to the main sections of Etobicoke Creek.

Table 4.4.2. Channel Characteristics for the Detailed Geomorphic Field Sites.

Parameter	MEC-R1	MEC-R2	MEC-R5	MEC-R8	MEC-R25	MFC-R3
Bankfull Width (m)	7.1	5.8	6.9	5.2	4.9	2.2
Bankfull Depth (m)	0.60	0.54	0.45	0.79	0.51	0.12
Average Bankfull Gradient (%)	0.23	0.14	0.04	0.07	0.36	0.51
Bed Material D_{50} (cm)	1.11	0.30	0.16	0.58	0.36	0.016
Bed Material D_{84} (cm)	6.61	1.78	0.80	2.7	1.5	0.29
Bank Materials	Ms/fs/si	Ms/fs/cl	Ms/fs/cl	Ms/fs/si	Ms/cl/si	Cl/si/vfs

Monitoring

Monitoring of the six detailed field sites established as part of this study was conducted in the fall of 2008. Results of the monitoring are presented in Appendix 'E', which indicates that the average absolute percent change in cross-sectional area over the monitoring period ranged from 0.69-3.38%, with the exception of the Fletchers Creek headwater site MFC-R3 which displayed a percent change of 23.6% within the monitoring period. In some cases (MEC-R8, MEC-R5) this adjustment was in the form of aggradation, while others (MEC-R1, MEC-R2, MEC-R25, MEC-R3) the trend was towards erosion through a combination of incision and widening. All of the data presented, however, are well within the range of natural rates of geomorphic adjustment and error associated with repeated measurements. The larger degree of change in MFC-R3 is not unexpected, given its sediment production role as a headwater drainage feature. Moreover, the short time frame between the site establishment and monitoring provides only a seasonal snapshot of channel processes. A longer monitoring period is required to determine whether the changes observed are indicative of long-term processes.

In general, erosion pin results confirm the findings of the cross-sectional monitoring, although outliers exist in the form of MEC-R2 and MEC-R25. An overall range in absolute erosion rates of 0.55-22.2 cm/yr was observed within the study area. The trend was evenly distributed between aggradation and erosion. No doubt, the wet weather conditions of the summer and fall months of 2008 contributed to the rate of changed observed within these sites.

In 2001, PARISH Geomorphic Ltd. was retained by the TRCA to establish a total of fifteen long-term monitoring sites throughout the Etobicoke Creek and Mimico Creek watersheds. Each site included the measurement of ten bankfull cross-sections, substrate (Wolman pebble count) and bank characterization, as well as a longitudinal profile of the channel bed morphology and bankfull stage. One of these sites (MEC-R5) was located within the Mayfield West Phase 2 lands (Figure 4.4.3). Within this site, a monitoring station including five erosion pins, control cross-section and bed chain were installed. Starting in 2004, the TRCA assumed responsibility for repeated measurement of each of the monitoring sites and maintaining the database; monitoring was undertaken in 2004 and 2007. In 2008, PARISH Geomorphic Ltd. began the process of collating and analyzing the data collected for each of the monitoring sites. Ultimately, this information took the form of regional curves that could be used to extract trends in channel stability and hydraulic geometry at the watershed scale.

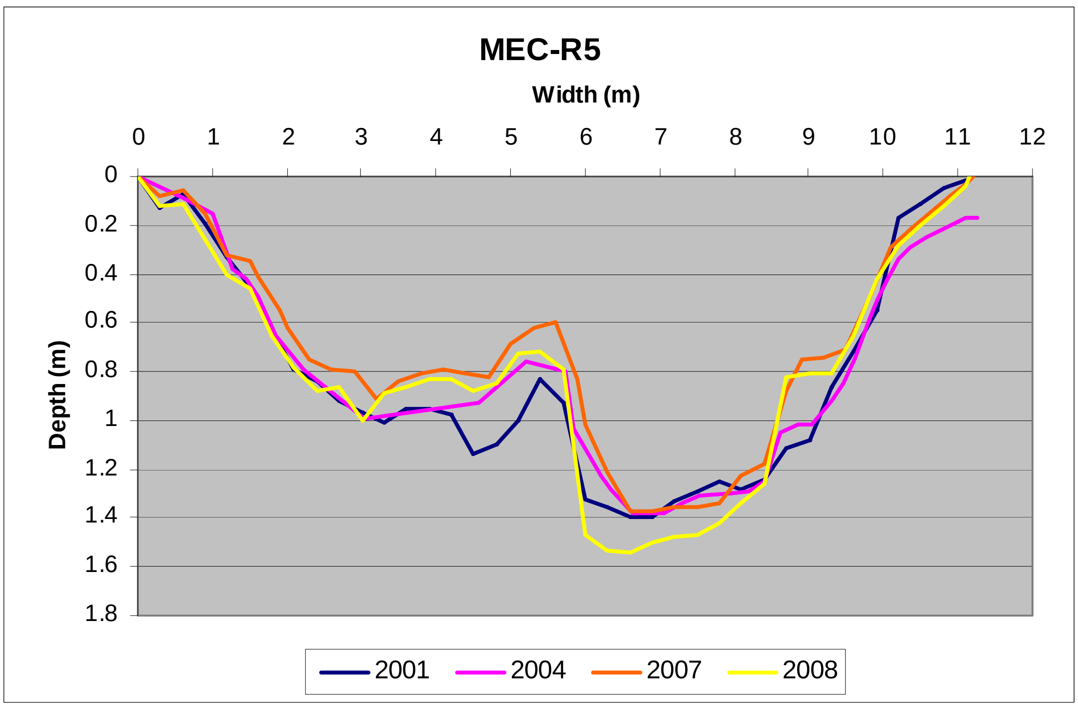


Figure 4.4.3: Cross-sectional monitoring results from 2001-2008 for Site MEC-R5.

Results of the long-term cross-sectional monitoring data for MEC-R5 indicated an overall decrease in cross-sectional area of 2.25%, indicating a trend towards aggradation. Within the cross-section itself, however, a pattern has clearly emerged with respect to localized aggradation (bar formation) in combination with incision along the thalweg (deepest portion of the channel). This would indicate that, over time, a well-defined low flow channel has formed within the overall bankfull cross-section.

'Appendix E' provides results of the regional curve trend analysis. Monitoring sites located within the Mayfield West Phase 2 lands are highlighted within each plot. In generally, findings indicated that the Mayfield West sites fell within or below the regional watershed average. The only plots where any sites were identified as being above the regional average was with respect to average and maximum bankfull depth. These values then influenced the results pertaining to bankfull velocity. It is likely that the agricultural nature of the Mayfield Phase 2 lands, in addition to underlying geology, represent the greatest influence on channel form and function. Narrower channel dimensions, as well as lower flows and stream power values are indicative of a portion of the watershed that has yet to experience the intense urbanization and associated stormwater contributions that are characteristic of the remaining portions of the Etobicoke Creek watershed. The disparity with respect to channel depths likely reflects a combination of active maintenance of these features to facilitate drainage of surrounding lands, as well as the downstream influence of contact with underlying bedrock that has slowed incision rates within downstream reaches.

Meander Belt Width

Figure 4.4.4 illustrates meander belt widths delineated on a reach basis using digital mapping for the study area. Table 4.4.4 indicates not only the meander belt width for each reach within the study area, but also any additional setbacks that are associated with the erosion and access as required by relevant provincial policy considerations. Meander belt widths and corridor widths have been identified for those drainage features with defined bed and banks.

Table 4.4.4. Mayfield West Corridor Widths on a Reach Basis

REACH	BELT WIDTH (m)	20% FACTOR OF SAFETY (m)	15 m SETBACK	CORRIDOR WIDTH (m)
Etobicoke Creek				
MEC-R01	60.0	12.0	15.0	87.0
MEC-R02	50.0	10.0	15.0	75.0
MEC-R03	55.0	11.0	15.0	81.0
MEC-R04	50.0	10.0	15.0	75.0
MEC-R05	50.0	10.0	15.0	75.0
MEC-R06	50.0	10.0	15.0	75.0
MEC-R07	30.0	6.0	15.0	51.0
MEC-R08	50.0	10.0	15.0	75.0
MEC-R09	30.0	6.0	15.0	51.0
MEC-R10	40.0	8.0	15.0	63.0
MEC-R11	40.0	8.0	15.0	63.0
MEC-R12	55.0	11.0	15.0	81.0
MEC-R13	20.0	4.0	15.0	39.0
MEC-R14	30.0	6.0	15.0	51.0
MEC-R15	25.0	5.0	15.0	45.0
MEC-R16	25.0	5.0	15.0	45.0
MEC-R17	25.0	5.0	15.0	45.0
MEC-R17A	15.0	3.0	15.0	33.0
MEC-R22	15.0	3.0	15.0	33.0
MEC-R25	22.0	4.4	15.0	41.4
MEC-R30	15.0	3.0	15.0	33.0
MEC-R31	15.0	3.0	15.0	33.0
MEC-R32	15.0	3.0	15.0	33.0
Fletcher's Creek				
MFC-R03	18.0	3.6	15.0	36.6

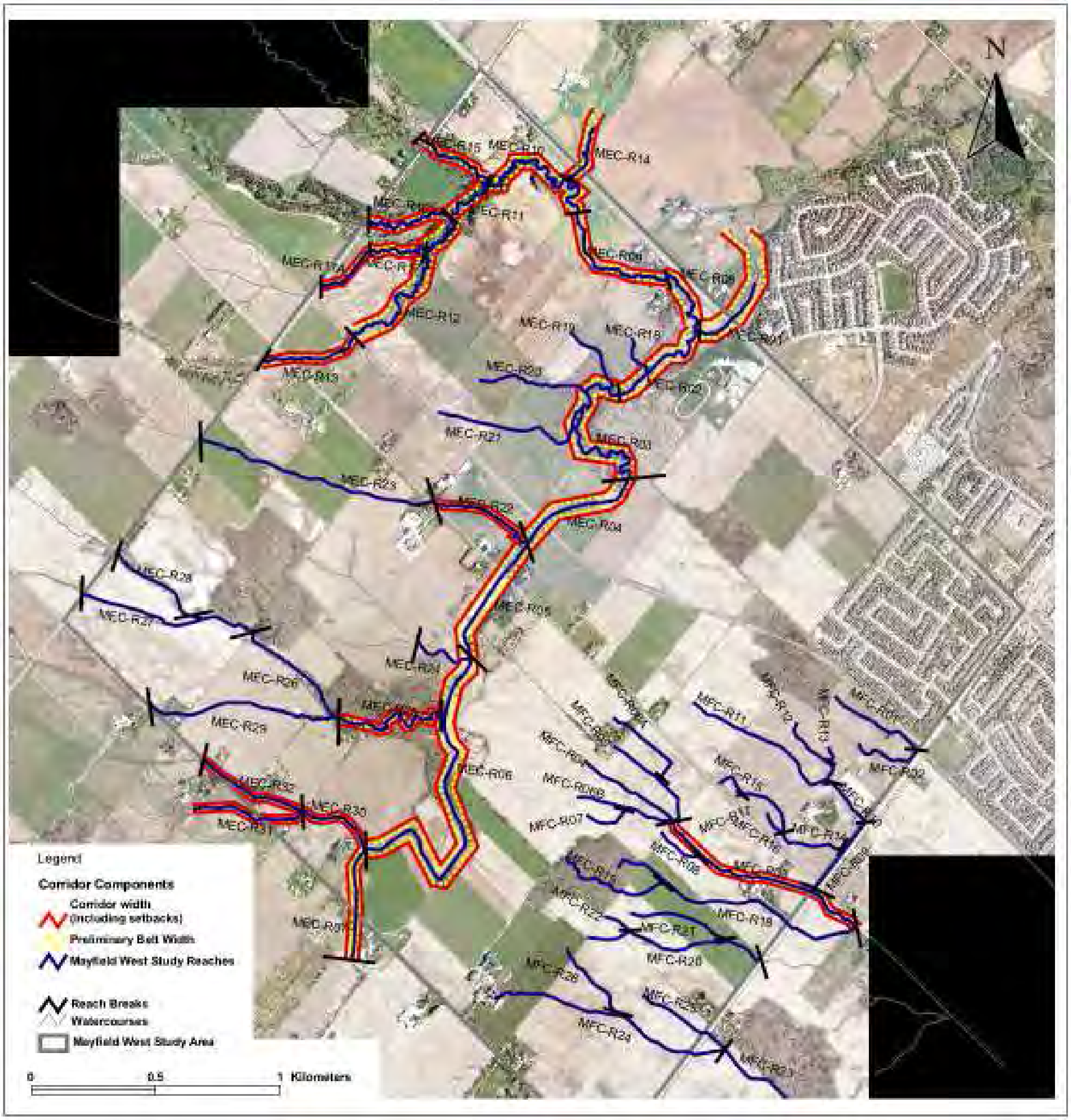


Figure 4.4.4: Meander belt width and corridor delineation for Mayfield West Study Area

Erosion Thresholds

While it is acknowledged that water quality and water quantity are integral components of any proposed stormwater management strategy, so too is erosion control. Stormwater flows need to be controlled and released in such a manner that existing channel erosion or aggradation is not exacerbated by the land use change. This is accomplished through the incorporation of erosion thresholds within the stormwater management approach. For the purposes of this project, erosion thresholds were determined based on the following steps:

1. The most sensitive (or less stable) reach within representative portions of the study area were identified through the Rapid Field Assessment work.
2. Detailed field work was then completed along each of these reaches to a suitable level of resolution to be representative of field conditions and permit a range of hydraulic analyses to be completed.
3. The erosion thresholds were then selected through the application of a suite of analytical techniques including, but not limited to, substrate and bank shear stress and permissible velocity. The actual threshold value was selected based, in part, on technical experience as well as being representative of the field conditions.

Table 4.4.5 presents the erosion thresholds quantified for the study area. In all cases, a comparison between the critical and bankfull discharge indicates that the bed is likely fully mobilized around bankfull flows. This implies that sediment can be entrained below bankfull flows and that any increase in discharge within these systems may lead to increased sediment transport and would likely exacerbate natural rates of channel erosion.

Table 4.4.5. Flow Characteristics Estimated for the Detailed Geomorphic Field Sites.

Parameter	MEC-R1	MEC-R2	MEC-R5	MEC-R8	MEC-R25	MFC-R3
Average Bankfull Width (m)*	8.04	5.92	6.94	4.97	4.77	2.08
Average Bankfull Depth (m)*	0.68	0.70	0.45	0.83	0.55	0.12
Manning's 'n'**	0.028	0.029	0.025	0.03	0.03	0.025
Bankfull Discharge (m^3/s)	6.60	5.18	1.59	3.33	3.82	0.21
Average Bankfull Velocity (m/s)	1.04	0.92	0.41	0.65	1.23	0.63
Maximum Bankfull Velocity (m/s)	1.40	1.38	0.59	0.94	1.69	1.04
Average Shear Velocity (m/s)	0.10	0.09	0.04	0.06	0.13	0.08
Stream Power (W/m)	103.5	71.2	5.45	19.6	131.0	10.3
Maximum Shear Stress (N/m^2)	14.8	14.4	2.41	7.03	26.2	11.0
Critical Discharge (m^3/s)	2.15	0.68	0.56	1.16	1.64	0.06
Critical Velocity (m/s)	0.90	0.72	0.41	0.63	1.13	0.74

* Based on selected, representative cross-sections ** Based on visual estimate

4.4.5. Preliminary Constraint Rankings

The role of the stream corridors is multipurpose from a geomorphic standpoint. It not only provides flow and sediment storage during high flow events, it also acts as a filter to prevent sediment and particulate inputs from surface runoff from embedding coarse substrates within the streams. The maintenance of riparian vegetation within the stream corridor acts to stabilize banks and also provides inputs of organic materials and debris which aid in creating a diverse morphology. The meander belt width incorporated into the corridor allows the channel to migrate naturally within its floodplain without the loss of property or structural integrity. In order to establish preliminary constraint ratings on a reach basis for the Mayfield West Phase 2 lands, the following categorization system was established based upon geomorphic form and function:

1. High Geomorphic Classification: these reaches have a defined channel that displays a well-defined morphology and/or valley system (i.e., form and function) that would be difficult to replicate in a post-development scenario.

2. Medium Geomorphic Classification: these reaches have a defined channel and may or may not have a well-defined morphology (i.e., function and limited form). Typically, these reaches have been heavily modified by historic land use practices and would benefit from rehabilitation. Management options for these reaches include the following:

3. Low Geomorphic Classification: these reaches are undefined (swale) ephemeral systems which convey flow and sediment to downstream reaches (i.e., function only). These reaches could be replicated through stormwater management practices in a post-development scenario.

Figure 4.4.5 illustrates the preliminary geomorphic constraint rankings developed for the Mayfield West Phase 2 lands on a reach basis.

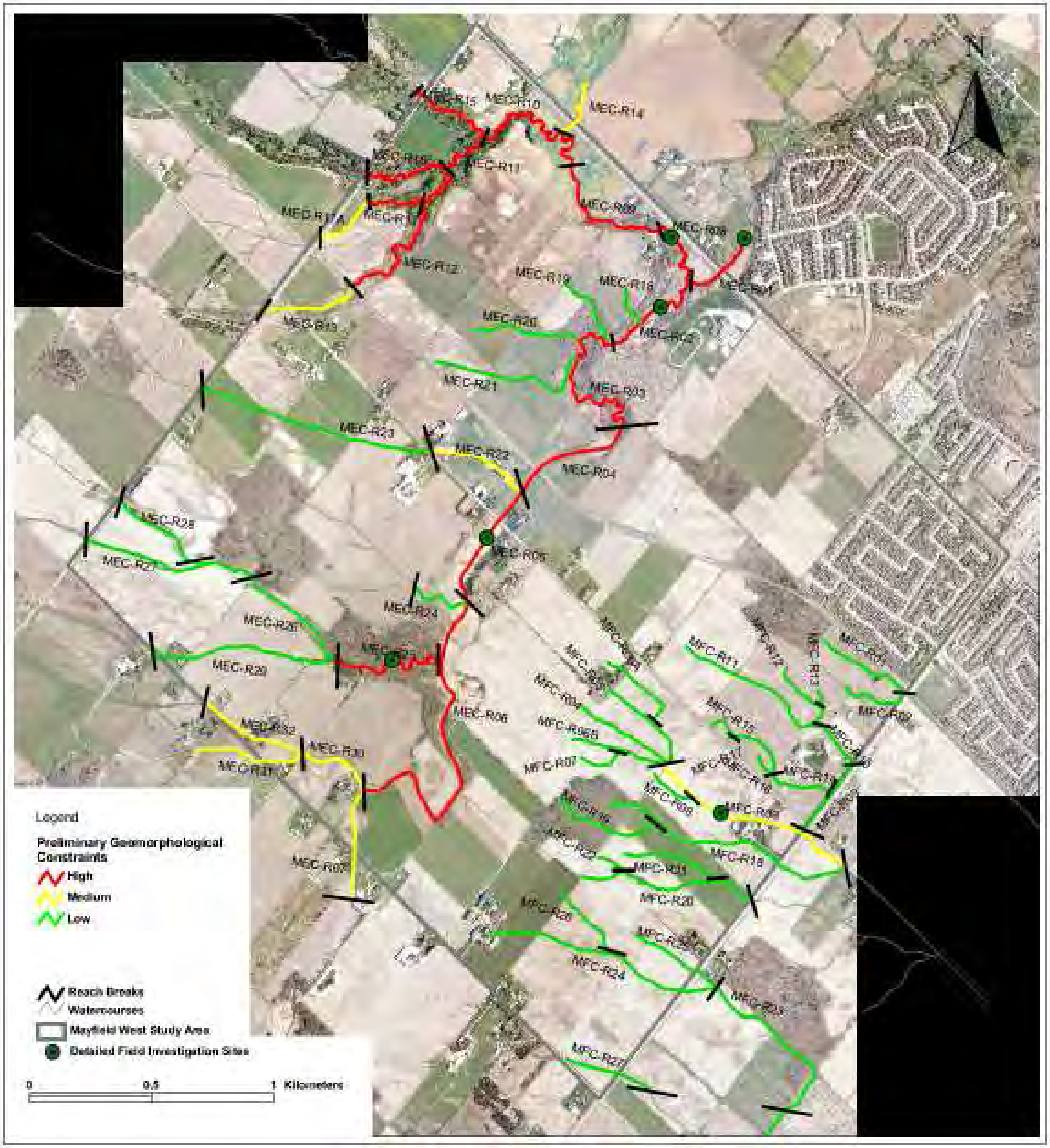


Figure 4.4.5: Preliminary geomorphic constraint rankings for Mayfield West

4.4.6. Interpretation

In essence, there is a dichotomy of form and process between the small, low order tributaries of Etobicoke and Fletchers Creeks and the main branches of Etobicoke Creek within the study area. Within the smaller, lower order tributaries, the overall trend is towards stable systems which have been heavily modified in association with historic agricultural land use practices. Portions of the main branches of Etobicoke Creek, meanwhile, have maintained some form of vegetative corridor in addition to a natural meandering planform. These reaches tend to exhibit some evidence of geomorphic adjustment in the form of aggradation and widening. The fine nature of the bed and bank materials documented within the study area is indicative of the underlying surficial geology. These fine materials drive the erosion thresholds quantified for the study area which indicate mobilization of the bed below the bankfull or effective discharge event.

4.5. Surface Water Quality

4.5.1. Importance/Purpose

Surface water quality monitoring has been implemented in order to characterize existing surface water chemistry, as well as to complement the benthic invertebrate communities sampling (i.e. provide baseline data) in watercourses that may be impacted by development. A good understanding of the existing system water quality is important to allow for an assessment of future impacts in relation to what can and cannot be sustained in the present aquatic environment.

4.5.2. Background Information

Surface water quality data within the Fletcher's Creek Subwatershed has been previously obtained as part of the ongoing Effectiveness Monitoring Program being conducted by CVC, and more recently as part of the Northwest Brampton Urban Development Area Phase 1 Characterization and Integration Draft Report (Philips Engineering Ltd., December 2007), based upon monitoring completed during 2006; relevant excerpts from that report are provided in Appendix 'I'. All water quality monitoring sites within the Fletcher's Creek Subwatershed lie downstream of the current study area. Nevertheless, the results presented in the Characterization Draft Report indicate that the water chemistry for the lands north of Wanless, which includes the lands north of Mayfield, is generally consistent with literature values reported for the same land use conditions.

Surface water quality monitoring within the Etobicoke Creek Watershed has been conducted by TRCA. It has been requested that TRCA provide that data for review as part of the current study; once the information is received, the baseline characterization will be revised as required.

4.5.3. Methods

The protocol for the monitoring program consisted of obtaining grab samples at three locations (ref. Drawing 1) during storm events which generated a runoff response, as well as during dry weather periods where stream flows were representative of baseflow/low flow conditions.

The grab samples were delivered to Maxxam Labs for analysis in order to characterize the existing water chemistry within the study area. As per the approved Field Monitoring Work Plan, the grab samples have been analyzed for the following water quality indicators:

- Total Metals
- Escherichia Coli (E.Coli)
- Total Suspended Solids (TSS)
- Biochemical Oxygen Demand (BOD_5)
- Chloride (Cl^-)
- Ammonia Nitrogen (NH_3 – N)
- Total Phosphorus
- Total Kjeldahl Nitrogen (TKN)
- Nitrate and Nitrite (NO_3 – N and NO_2 – N)
- Alkalinity and Hardness
- Conductivity

Wet weather sampling for the 2008 monitoring program has been completed during the following storm events:

- May 31, 2008
- June 13, 2008
- July 23, 2008
- August 7, 2008
- September 30, 2008

Dry weather sampling for the 2008 monitoring program has been completed during low flow periods on the following dates:

- June 17, 2008
- July 15, 2008
- October 31, 2008

4.5.4. Results

The full suite of results for the water quality monitoring are provided in Appendix ‘F’. The mean and median concentrations of select representative water quality indicators are presented in Tables 4.5.1 through 4.5.6 for the wet weather and dry weather monitoring at each of the monitoring sites.

Table 4.5.1. Summary of Wet Weather Water Quality Monitoring Results for Site Q1 (mg/L unless otherwise noted)

Contaminant	Total Number of Samples	Number of Samples Above MDL	Range	Mean	Median
BOD/CBOD	5	1	<2 - 2	<2	<2
E.coli (#/100mL)	5	5	80 – 7500	452	300
TKN	5	5	0.8 – 1.2	0.96	0.90
Total P	5	5	0.035 – 0.11	0.08	0.09
TSS	5	2	<10 – 54	<33	<33
Copper (µg/L)	5	5	2 – 3	2.2	2.0
Zinc (µg/L)	5	2	<5 – 5	<5	<5
Lead (µg/L)	5	1	<0.5 – 0.8	<0.8	<0.8
Nitrate+Nitrite	5	5	0.3 – 0.5	0.4	0.4

Table 4.5.2. Summary of Wet Weather Water Quality Monitoring Results for Site Q2 (mg/L unless otherwise noted)

Contaminant	Total Number of Samples	Number of Samples Above MDL	Range	Mean	Median
BOD/CBOD	2	1	<2 – 3	<3	<3
E.coli (#/100mL)	2	2	50 – 890	210	210
TKN	2	2	2.5 – 2.6	2.55	2.55
Total P	2	2	0.17 – 0.26	0.22	0.22
TSS	2	2	36 – 94	65	65
Copper (µg/L)	2	2	3 – 4	3.5	3.5
Zinc (µg/L)	2	0	<5 - <5	<5	<5
Lead (µg/L)	2	1	<0.5 – 0.5	<0.5	<0.5
Nitrate+Nitrite	2	2	0.1 – 2.2	1.15	1.15

Table 4.5.3. Summary of Wet Weather Water Quality Monitoring Results for Site Q3 (mg/L unless otherwise noted)

Contaminant	Total Number of Samples	Number of Samples Above MDL	Range	Mean	Median
BOD/CBOD	5	1	<2 – 2	<2	<2
E.coli (#/100mL)	5	5	180 – 2800	494	490
TKN	5	5	0.7 – 1.7	1.04	0.90
Total P	5	5	0.036 – 0.13	0.07	0.07
TSS	5	2	<10 – 28	<19	<19
Copper (µg/L)	5	5	2 – 4	2.6	2.0
Zinc (µg/L)	5	2	<5 – 11	<8.5	<8.5
Lead (µg/L)	5	1	<0.5 – 0.7	<0.7	<0.7
Nitrate+Nitrite	5	5	0.1 – 4	1.34	0.30

Table 4.5.4. Summary of Dry Weather Water Quality Monitoring Results for Site Q1 (mg/L unless otherwise noted)

Contaminant	Total Number of Samples	Number of Samples Above MDL	Range	Mean	Median
BOD/CBOD	3	2	2 – 3	2.50	2.50
E.coli (#/100mL)	3	2	<10 – 630	<95.9	<140
TKN	3	2	0.6 – 0.9	0.80	0.90
Total P	3	2	0.023 – 0.1	0.06	0.06
TSS	3	2	<10 – 13	<11.67	<12.0
Copper (µg/L)	3	2	<1 – 2	<1.67	<2
Zinc (µg/L)	3	0	<5	<5	<5
Lead (µg/L)	3	0	<0.5	<0.5	<0.5
Nitrate+Nitrite	3	2	<0.1 – 1	<0.53	<0.5

Table 4.5.5. Summary of Dry Weather Water Quality Monitoring Results for Site Q2 (mg/L unless otherwise noted)					
Contaminant	**Total Number of Samples**	**Number of Samples Above MDL**	**Range**	**Mean**	**Median**
BOD/CBOD	2	1	3 – 5	5.00	5.00
E.coli (#/100mL)	2	2	<10 – 100	<31.62	<31.62
TKN	2	1	1.2 – 2.4	1.80	1.80
Total P	2	1	0.075 – 0.14	0.11	0.11
TSS	2	1	<10 – 11	<10.5	<10.5
Copper (μg/L)	2	2	2 – 3	2.50	2.50
Zinc (μg/L)	2	0	<5	<5	<5
Lead (μg/L)	2	0	<0.5	<0.5	<0.5
Nitrate+Nitrite	2	1	<0.1 – 2.7	<1.4	<1.4

Table 4.5.6. Summary of Dry Weather Water Quality Monitoring Results for Site Q3 (mg/L unless otherwise noted)					
Contaminant	**Total Number of Samples**	**Number of Samples Above MDL**	**Range**	**Mean**	**Median**
BOD/CBOD	3	3	3 – 4	3.33	3.00
E.coli (#/100mL)	3	3	60 – 1200	221	150
TKN	3	3	1 – 1.2	1.07	1.00
Total P	3	3	0.079 – 0.098	0.09	0.10
TSS	3	3	26 – 43	33.00	30.00
Copper (μg/L)	3	3	2 – 3	2.67	3.00
Zinc (μg/L)	3	1	<5 – 9	<6.3	<5
Lead (μg/L)	3	1	<0.5 – 1.1	<0.7	<0.5
Nitrate+Nitrite	3	3	0.2 – 3.9	1.67	0.90

The mean and median concentrations observed for each of the monitoring sites have been compared with literature values and results of monitoring programs for similar land use and soils within the contributing drainage areas in order to determine whether or not the results are considered representative and consistent with anticipated conditions. The results of this analysis are presented in Tables 4.5.7 through 4.5.9.

Table 4.5.7. Comparison of Wet Weather Event Mean Concentrations for Site Q1 with Literature Values from Water Quality Models (mg/L unless otherwise noted)					
Contaminant	**2008 Field Monitoring Results**			**Water Quality Models**	
	Range	**Mean**	**Median**	**TWWF (City of Toronto, 2002)**	**RHCWP (City of Hamilton, 1996)**
BOD/CBOD	<2 - 2	<2	<2		2
E.coli (#/100mL)	80 – 7500	452	300	100,000	
TKN	0.8 – 1.2	0.96	0.90	1.0	2.8
Total P	0.035 – 0.11	0.08	0.09	0.2	0.5
TSS	<10 – 54	<33	<33	100	400
Copper (μg/L)	2 – 3	2.2	2.0	8	5
Zinc (μg/L)	<5 – 5	<5	<5	18	10
Lead (μg/L)	<0.5 – 0.8	<0.8	<0.8	4	
Nitrate+Nitrite	0.3 – 0.5	0.4	0.4	2.5	

Table 4.5.8. Comparison of Wet Weather Event Mean Concentrations for Site Q2 with Literature Values from Water Quality Models (mg/L unless otherwise noted)

Contaminant	2008 Field Monitoring Results			Water Quality Models	
	Range	Mean	Median	TWWF (City of Toronto, 2002)	RHCWP (City of Hamilton, 1996)
BOD/CBOD	<2 – 3	<3	<3		2
E.coli (#/100mL)	50 – 890	210	210	100,000	
TKN	2.5 – 2.6	2.55	2.55	1.0	2.8
Total P	0.17 – 0.26	0.22	0.22	0.2	0.5
TSS	36 – 94	65	65	100	400
Copper (μg/L)	3 – 4	3.5	3.5	8	5
Zinc (μg/L)	<5 - <5	<5	<5	18	10
Lead (μg/L)	<0.5 – 0.5	<0.5	<0.5	4	
Nitrate+Nitrite	0.1 – 2.2	1.15	1.15	2.5	

Table 4.5.9. Comparison of Wet Weather Event Mean Concentrations for Site Q3 with Literature Values from Water Quality Models (mg/L unless otherwise noted)

Contaminant	2008 Field Monitoring Results			Water Quality Models	
	Range	Mean	Median	TWWF (City of Toronto, 2002)	RHCWP (City of Hamilton, 1996)
BOD/CBOD	<2 – 2	<2	<2		2
E.coli (#/100mL)	180 – 2800	494	490	100,000	
TKN	0.7 – 1.7	1.04	0.90	1.0	2.8
Total P	0.036 – 0.13	0.07	0.07	0.2	0.5
TSS	<10 – 28	<19	<19	100	400
Copper (μg/L)	2 – 4	2.6	2.0	8	5
Zinc (μg/L)	<5 – 11	<8.5	<8.5	18	10
Lead (μg/L)	<0.5 – 0.7	<0.7	<0.7	4	
Nitrate+Nitrite	0.1 – 4	1.34	0.30	2.5	

Mass balance modelling for the Etobicoke Creek and the Fletcher's Creek have been completed for select contaminants. The mass balance modelling has applied the methodology originally developed for the Toronto Wet Weather Flow Study (City of Toronto, 2002) and subsequently applied in the Credit River Water Management Strategy Update (CVC, June 2006). Under this approach, mass loadings from various land uses have been determined based upon the product of the Event Mean Concentration for the contaminant of interest for a given land use, the unitary runoff volume of annual runoff for the given land use and soil type, and area of the given land use and soil type within the overall Study Area. The Event Mean Concentrations by land use, for the various parameters analyzed are summarized in Table 4.5.10.

Table 4.5.10. Event Mean Concentration by Contaminant and Land Use (mg/l unless otherwise noted)						
Land use	**Contaminant**					
	Total P	**TKN**	**Copper**	**Zinc**	**E.Coli (#/100 ml)**	**TSS**
Residential	0.36	1.92	0.025	0.123	25,000	91
Commercial	0.25	0.71	0.022	0.127	5,000	70
Industrial	0.30	1.06	0.027	0.220	1,138	67
Educational/Institutional	0.36	1.92	0.025	0.123	8,360	63
Open Space	0.12	0.97	0.016	0.098	4,100	70
City Parks	0.36	1.92	0.025	0.123	10,000	63
Golf/Cemetary	0.70	3.30	0.025	0.123	4,100	63
Agricultural	0.20	1.00	0.008	0.018	100,000	100
Highway	0.39	2.00	0.052	0.302	3,070	331

The mass balance analyses have been completed in order to determine the average annual mass loadings to the receiving watercourse (i.e. the Etobicoke Creek or the Fletcher's Creek) from the Study Area and any external lands upstream (where applicable). The results of this assessment are presented in Table 4.5.11.

TABLE 4.5.11. Mass Balance Summary for Existing Conditions (kg unless otherwise noted)		
Contaminant	**Fletcher's Creek**	**Etobicoke Creek**
TKN	0.69	15
Total P	0.15	2.8
Copper	0.01	0.15
Zinc	0.02	0.57
TSS	65	1487
E. Coli (Counts)	616,100	11,699,800

4.5.5. Interpretation

The results of the water quality assessment indicate relatively little difference in contaminant concentrations between wet weather and dry weather events. The results also indicate that, in general, contaminant concentrations at all monitoring locations were less than values reported elsewhere. The lower concentrations are considered attributable to a dilution effect which occurred during the 2008 monitoring season as a result of the abundance of rainfall.

A review of the results has indicated no significant seasonal variations in contaminant concentrations. Again, this is considered attributable to the abundance of rain which occurred during the spring and summer of 2008.

The results in Table 4.5.10 will be used in the subsequent phases of this study in order to determine the anticipated impacts to surface water quality, associated with proposed land use changes within the Study Area, as well as to evaluate the anticipated effectiveness of various stormwater management strategies.

4.6. Aquatic Ecosystem

4.6.1. Importance/Purpose

The fish and benthic invertebrate communities are key biological components of the aquatic ecosystems. Many fish species feed on benthic invertebrates during some portion of their life history, and therefore the fish community can effect the benthic invertebrate community, and ***vice versa***. Both groups have intrinsic value as natural heritage components and, because their communities are strongly influenced by the physical and chemical conditions of the habitats that they occupy, they are valuable indicators of ecosystem health. Fish and benthic invertebrates also create important linkages between the terrestrial and aquatic communities. Aquatic insects, most of which are flying insects during their adult phase, can be an important source of food for insectivorous birds and fish are food for piscivorous birds such as the kingfisher (***Ceryle alcyon***) and great blue heron (***Ardea herodias)***. Some fish species (i.e. rainbow trout, ***Oncorhynchus mykiss***) are sought recreationally while for others, such as redside dace (***Clinostomus elongatus***), their rarity conveys additional importance. Many non-game fish species are harvested and sold as bait.

4.6.2. Background Information

Etobicoke Creek

Background documents that were examined include:

- Toronto and Region Conservation Authority. 1998. State of the Watershed Report: Etobicoke and Mimico Creek Watersheds
- Toronto and Region Conservation Authority. 2006. Etobicoke Creek GTAA Living City Study the Aquatic Ecosystem
- CH2MHILL and Toronto and Region Conservation Authority. 2008. Etobicoke Creek Headwaters Subwatershed Study Synthesis Report

The latter document synthesizes or incorporates most of the information contained in the earlier documents. Additional information with respect to fish and invertebrate collections were provided by TRCA. Aquatic species at risk distribution maps were consulted for CVC and TRCA jurisdictions (http://conservation-ontario.on.ca/projects/DFO/find/southwestern.html).

The fish sampling data provided by TRCA are presented in Table 4.6.1 and the sampling locations are shown in Figure 4.6.1. The sampling locations include two sites that are part of the TRCA Regional Watershed Monitoring Program (ECO13WM and ECO14WM), where fish are sampled every three years and benthic invertebrates are sampled annually.

Table 4.6.1 Fish Collection Results From Previous Sampling within the Etobicoke Creek Portion of the Study Area. Numbers Indicate Number of Individuals Captured. P Indicates Species was Present. Sampling Sites are shown in Figure 4.6.1. Data Provided by TRCA.								
Site	4		5		6	7		9
Date	7/1/1946	8/1/1996	7/1/1946	8/1/1996	9/5/1996	9/4/1985	9/5/1996	8/6/1996
blackchin shiner							3	
blacknose dace	P	13		20	34			2
blacknose shiner						11		
bluntnose minnow	P					7		
brook stickleback	P	2	P	35			183	4
brown bullhead						2		
central mudminnow								
common shiner	P				9	8	2	23
creek chub	P	22	P	27	28	16	57	
fantail darter	P							
fathead minnow			P			4	21	
golden shiner			P			23		4
johnny darter	P	8		1	2	1		
longnose dace		1						
minnow family								
northern redbelly dace			P				58	
pearl dace	P					1	11	
pumpkinseed								
rock bass					3	9		
spottail shiner								
white sucker	P	1			43	5	4	
Grand Total		47		83	119	87	339	33
Number of species	9	6	5	4	6	11	8	4

Table 4.6.1 (Con't). Fish Collection Results From Previous Sampling within the Etobicoke Creek Portion of the Study Area. Numbers Indicate Number of Individuals Captured. P Indicates Species was Present. Sampling Sites are shown in Figure 4.6.1. Data Provided by TRCA.

Site	21		62	EC013WM			EC014WM			
Date	7/1/1946	9/4/1985	7/1/1946	8/21/2001	6/29/2004	7/30/2007	8/22/2001	6/29/2004	8/14/2007	8/21/2007
blackchin shiner										
blacknose dace	P	3		72	25	32	1			
blacknose shiner		86		1		1			8	
bluntnose minnow		70			41	20	55	6	124	44
brook stickleback	P	4	P		10		51	391		
brown bullhead								1		5
central mudminnow							3	3	3	4
common shiner		61			27	10			1	5
creek chub		127		48	54	81	61	27	13	15
fantail darter				1	5	5				
fathead minnow		27		3	21	5	7	43	91	48
golden shiner		19		32			1	1	1	
johnny darter		28		22	38	29		13	15	3
longnose dace										
minnow family				3				3		
northern redbelly dace							26	9	1	
pearl dace							1	5	1	
pumpkinseed				1		2	5	3	2	5
rock bass		13		8	2	7		3	5	7
spottail shiner				71						
white sucker		22		66	70	45	7	9	41	28
Grand Total		460		328	293	237	218	517		
Number of species	2	11	1	12	10	11	11	14	13	10

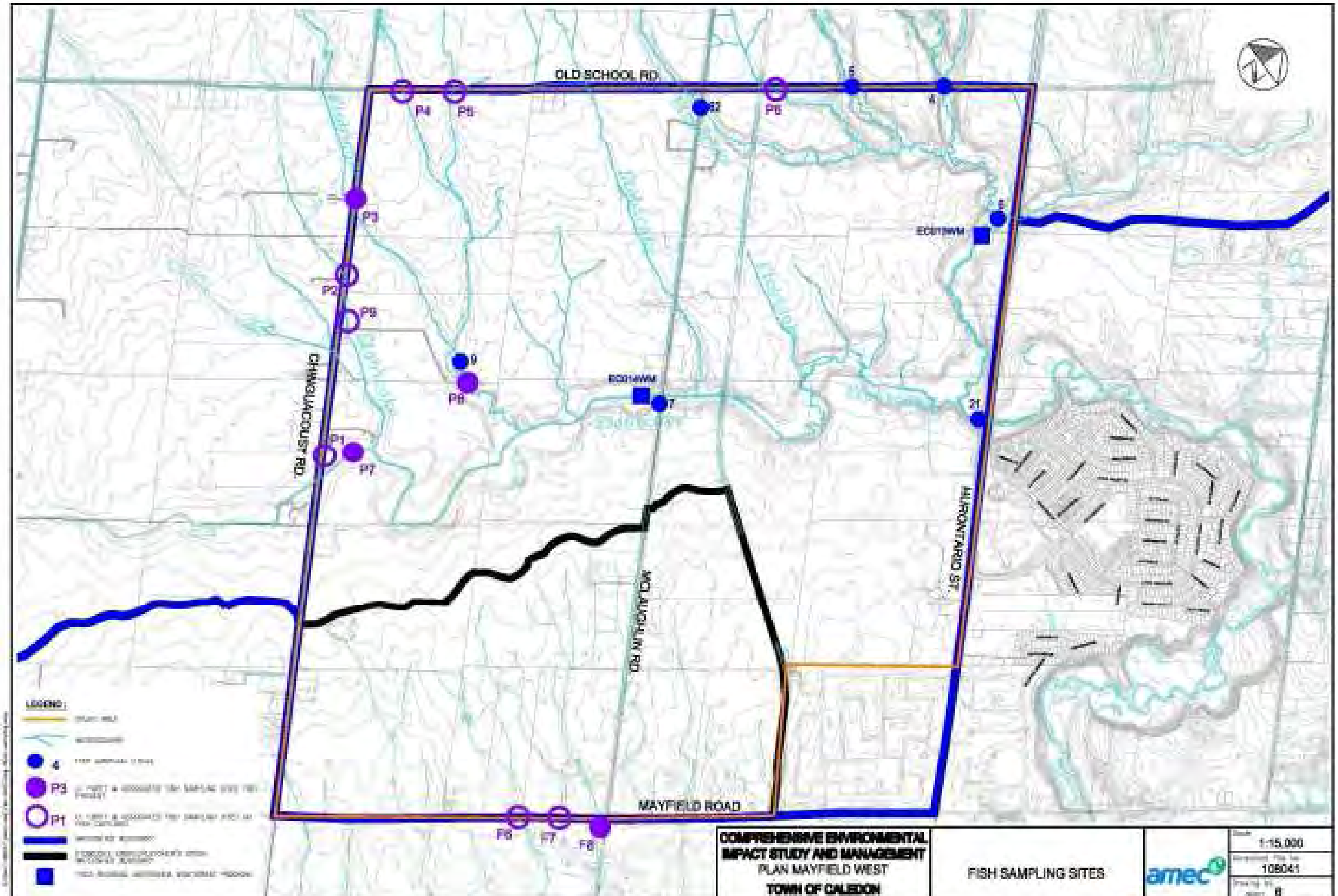


Figure4.6.1. Fish Sampling Locations: Benthic invertebrates have also been sampled at the TRCA Regional Watershed Monitoring Program sites.

A total of twenty fish species have been captured within the study area. The main branch of Etobicoke Creek (e.g. site ECO14WM) contains a diverse fish community, including blacknose shiner (***Notropis heterodon***), northern redbelly dace (***Phoxinus eos***), pearl dace (***Margariscus margarita***) and central mudminnow (***Umbra limi***), all of which TRCA have identified as species of conservation concern because of their sensitivity to habitat alteration, chemical pollution, siltation, and increased flow velocities (TRCA, 2004, cited in CH2MHILL and TRCA, 2008). The branch of Etobicoke Creek that enters the study area from east of Hurontario Street (sites ECO13WM and 6) also contains a diverse fish community, including blacknose shiner and fantail darter (***Etheostoma flabellare***). The latter, which has also been identified by TRCA as a species of conservation concern for the reasons listed above (TRCA, 2004, cited in CH2MHILL and TRCA, 2008), was also captured in one of the smaller tributaries to this branch (Site 4) in 1946. The fish IBI score is “Good” for the two TRCA monitoring sites (ECO13WM and ECO14WM) within study area, based on the 2001 data (TRCA, 2006).

According to the Etobicoke Creek Headwaters Subwatershed Study Synthesis Report (CH2MHILL and Toronto and Region Conservation Authority. 2008), and the sampling results provided by TRCA (ref. Table 4.6.1), no trout or sculpins, which require cold water temperatures (Coker et al, 2001), have been captured in the Etobicoke Creek watershed in the immediate vicinity of the study area. There are no known aquatic species at risk in, or in close proximity to, the Etobicoke Creek portion of the study area (http://conservation-ontario.on.ca/projects/DFO/find/southwestern.html. February 9, 2010).

Redside dace were historically (pre-1950’s) present in the Etobicoke Creek watershed, although they have never been captured in the Headwaters Subwatershed (TRCA, 2006). The Committee on the Status of Endangered Wildlife in Canada concluded that redside dace have probably been extirpated from the Etobicoke Creek watershed, based on the fact that none have been captured by more recent sampling (COSEWIC, 2007; also cited in Redside Dace Recovery Team, 2009). Notwithstanding the COSEWIC conclusion, the most recent Draft Redside Dace Recovery Strategy (Redside Dace Recovery Team, 2009) indicates that there is an “immediate need to assess” Etobicoke Creek (among others) “to identify if populations are extant, their area of occupancy and relative abundance.”

A “possible redside dace X creek chub (***Semotilus atromaculatus***) hybrid” captured in the watershed has been referred to in some reports (TRCA 2006, TRCA and CH2MHILL, 2008). A leading taxonomic expert on Ontario fishes who has examined this specimen, and who is a member of the redside dace recovery team and a co-author of the 2007 COSEWIC update report, has recommended that speculation regarding this specimen be ignored. It is a very unusual looking juvenile cyprinid, resembling a creek chub, but with small scales, and there is no basis for concluding that it is a redside dace hybrid (E. Holm, Assistant Curator, Ichthyology, Royal Ontario Museum, personal communication with C. Portt, November 23, 2008).

Using the thermal regime category definitions from TRCA (Table 4.6.2), the 3rd and 4th order watercourses within the study area are categorized as intermediate riverine warm water and the 1st and 2nd order watercourses are categorized as small riverine warm water (TRCA, 2008). The target species for riverine warm water habitats in the Etobicoke Creek headwaters subwatershed are the fantail (***Etheostoma flabellare***) and rainbow darter(***Etheostoma caeruleum***), as well as the blacknose and blackchin shiner (***Notropis heterolepis***, ***N***. ***heterodon***) and the central mudminnow (***Umbra limi***; TRCA, 2008). Fantail darters have been reported from only the eastern portion of the study area. Rainbow darter have not been captured within the study area (Table 4.6.1), and it is thought that rainbow darter are probably extirpated from the watershed (TRCA, 2006). Blackchin shiner have only been reported from one location, on one occasion, within the study area (Site 6, 9/5/1996; Table 4.6.1)), while blacknose shiner are more widely distributed (Table 4.6.1). Evidently, the fish community in the main branch at McLaughlin Road (sites 7 and ECO14WM, Figure 4.6.1), where pearl dace (***Semotilus margarita***), northern redbelly dace (***Phoxinus eos***) and central mudminnow have been captured regularly, is quite different from the fish community in the eastern part of the study area (sites ECO-13WM, 6, 21; Figure 4.6.1), where they have not (Table 4.6.1).

Table 4.6.2. Aquatic Habitat Thermal Regime Category Definitions (After TRCA, 2006)

Category	Mean baseflow ($m^3/s/km^2$)	Drainage Area (km^2)	Stream order	Temperature	Fish community
Small riverine cold water	High	Less than 10	1st and 2nd, sometimes 3rd	Stable	sculpin historically present
Small riverine warm water	Low	Less than 10	1st and 2nd	Fluctuates	cyprinids, johnny and fantail darters
Intermediate riverine warm water	Low	10 - 200	3rd, 4th, and 5th	Fluctuates	cyprinids, johnny and fantail darters

Benthic Invertebrates

TRCA has collected benthic invertebrate samples annually at the two monitoring sites within the study area, ECO13WM and ECO14WM (Figure 4.6.1), and has calculated summary metrics, based on identification to the family level from those data. From 2004 through 2008 the samples have been collected and processed according to the Ontario Stream Assessment Protocol (OSAP), which requires that 100+ individuals be sorted and identified from each sample. The 2001 through 2003 samples were larger. In order to create more comparable data among years, a ‘sample’ of 100 individuals has been randomly selected from the original, larger dataset for 2001 through 2003 and used to calculate the summary metrics (A. Wallace, TRCA, personal communication, February 8, 2010).

The most commonly used summary metrics are presented in Tables 4.6.3 and 4.6.4. The relationship between the Family Biotic Index (FBI) and water quality, as proposed by Hilsenhoff (1988), is as follows: 0.00 – 3.75 Excellent; 3.75 – 4.25 very good; 4.26 – 5.00 good; 5.01 – 5.75 fair; 5.76 – 6.50 fairly poor; 6.51 – 7.25 poor; 7.26 – 10.00 very poor. The FBI values at Site ECO13WM indicate that water quality was fairly poor (6 years) or poor (one year). At site ECO14WM, the FBI scores indicated water quality was “fairly poor” (4 years), “poor” (1 year) or “very poor” (1 year). Shannon diversity (Shannon and Weaver, 1949) was in the moderately polluted range (3 – 1) for all years at both sites. There were very few EPT (Ephmeroptera, Plecoptera, Trichoptera) taxa present. Many EPT taxa are considered sensitive to habitat quality, and therefore a greater number of those taxa is often considered to indicate better water quality.

Caution must be exercised in the interpretation of benthic invertebrate indices, as the relationship between a given index, the benthic invertebrate community from which it is derived, and the habitat that supports that benthic community is often not as simple as a numeric score could imply. The FBI, for example, is intended to give an indication of general organic pollution and is based on the tolerance of families of benthic invertebrates to low dissolved oxygen concentrations (Hilsenhoff, 1988). Consequently, other factors that can affect dissolved oxygen concentrations such as volume of flow, water temperature and stream gradient, can also affect the FBI score, and these can, and do, vary naturally among streams. Discriminating between the influences of multiple factors is a complex and difficult task, and it is possible for metrics to indicate impairment when, in fact, natural conditions are determining the benthic community.

Table 4.6.3. Invertebrate Indices for 2001 – 2008 for Monitoring Site ECO13WM (Ref Figure 4.6.1; Source: TRCA 2009).

Metric	EC013WM - 01	EC013WM - 02	EC013WM - 03	EC013WM - 04	EC013WM - 05	EC013WM - 06	EC013WM - 07	EC013WM-08
% Ephemeroptera	2	8	12	1	0	Inadequate sample	0	0
% Plecoptera	0	0	0	0	0		0	0
% Trichoptera	1	2	0	2	0		0	1
% EPT	3	10	12	3	0		0	1
% Insecta	69	72	67	84	88		72	73
% Gastropoda	3	2	4	1	2		5	6
% Oligochaeta	6	9	4	3	0		13	8
FBI	6.45	6.17	6.30	5.97	5.95		6.68	6.48
% Chironomidae	36	33	21	46	65		63	56
# Families	11	15	17	18	10		11	13
# Ephemeroptera Families	1	2	3	1	0		0	0
# Plecoptera Families	0	0	0	0	0		0	0
# Trichoptera Families	1	2	0	2	0		0	1
Shannon's_H	1.80	2.15	2.29	2.02	1.29		1.44	1.68
Simpson's D	0.78	0.83	0.87	0.76	0.55		0.59	0.67
Evenness_	0.55	0.57	0.58	0.42	0.36		0.35	0.41

Table 4.6.4. Invertebrate Indices for 2001 – 2008 for Monitoring Site ECO14WM (Ref Figure 4.6.1; Source: TRCA 2009).

Metric	EC014WM - 01	EC014WM - 02	EC014WM - 03	EC014WM - 04	EC014WM - 05	EC014WM - 06	EC014WM - 07	EC014WM-08
% Ephemeroptera	4	Inadequate sample	1	0	0	0	5	1
% Plecoptera	0		0	0	0	0	0	0
% Trichoptera	0		0	0	0	0	0	0
% EPT	4		1	0	0	0	5	1
% Insecta	41		53	79	65	54	60	72
% Gastropoda	2		25	0	12	20	0	4
% Oligochaeta	38		1	0	12	19	16	9
FBI	7.57		6.46	5.92	6.30	6.77	6.89	6.39
% Chironomidae	5		25	68	37	46	33	50
# Families	15		14	7	8	11	12	16
# Ephemeroptera Families	2		1	0	0	0	1	1
# Plecoptera Families	0		0	0	0	0	0	0
# Trichoptera Families	0		0	0	0	0	0	0
Shannon's_H	1.99		2.18	1.05	1.72	1.66	2.04	1.89
Simpson's D	0.79		0.86	0.49	0.78	0.72	0.82	0.73
Evenness_	0.49		0.63	0.41	0.69	0.48	0.64	0.41

Fletcher's Creek

Background documents that were examined include:

- Credit Valley Conservation Report, Ontario Department of Planning and Development, 1956
- Credit River Fisheries Management Plan. Volume 1: Credit Valley Conservation and Ontario Ministry of Natural Resources, 2002
- Fletchers Creek Subwatershed Study, Paragon Engineering et al, 1996
- Environmental Implementation Report and Sanitary Sewer and Water Servicing Study for the Fletcher's Meadow Secondary Planning Area, Marshall Macklin Monoghan, 1997
- North West Brampton Phase 2 Urban Expansion Area Environmental Open Space Study, Dougan and Associates and others, 2005

The study area contains portions of the headwaters of what are referred to as the East Tributary and the Centre Tributary of Fletcher's Creek that lie upstream from Mayfield Road. The Credit Valley Conservation Report (Department of Planning and Development, 1956) classified watercourses based on their flow characteristics (permanent flow, dries to standing pools, or dries up completely during most summers). Fletchers Creek was classified as "permanent flow warm" from the Credit River upstream to just past Derry Road. From there to just south of Highway 7 (Bovaird Drive) it was classified as "dries to standing pools" and everything from that point upstream was classified as "dries up completely (in most summers)".The report did not show any watercourses in the Fletcher's Creek watershed extending upstream as far as Mayfield Road.

The existing fish communities in the Fletcher's Creek watershed are characterized in the Credit River Fisheries Management Plan (Volume 1; Credit Valley Conservation and Ontario Ministry of Natural Resources, 2002). The lower reaches of Fletchers Creek support a cool/warm fish community. This community includes seasonal use by rainbow trout (***Oncorhynchus mykiss***) and salmon (***Oncorhynchus*** spp). Redside dace are also present within this habitat type. Most of the main branch of Fletchers Creek and the main tributaries, upstream as far as approximately Wanless Road, contain what is termed warmwater fish community dominated by cyprinids (minnows). The headwater tributaries upstream of approximately Wanless Road have no fish community classification assigned.

The Credit River Fisheries Management Plan (Credit Valley Conservation and Ontario Ministry of Natural Resources, 2002) also identifies fish community management zones, which are based on the fish communities that are present and on actual or potential habitat conditions. The lower reaches of Fletchers Creek, near its confluence with the Credit River, is designated a mixed warm/cool fish community management zone. The remainder of Fletchers Creek is designated a small warmwater community management area or, in the case of the smaller headwaters, is unclassified.

The Fletchers Creek Subwatershed Study (Paragon Engineering et al, 1996) indicated that the Fletcher's Creek headwaters are intermittent and that permanent flow occurs from approximately Highway 7 downstream. Fisheries investigations focused on the permanently flowing reaches, with five locations electrofished between Highway 7 and Highway 401. Three common fish species, white sucker (***Catostomus commersonii***), creek chub and blacknose dace, were present at all five locations, and they were the only species present at Highway 7. The largest number of species, seven, was captured upstream of McLaughlin Road, where redside dace and brassy minnow (***Hybognathus hankinsoni***), which tend to be associated with groundwater discharge in southern Ontario, were present. No aquatic resources were identified north of Wanless Drive.

The Environmental Implementation Report and Sanitary Sewer and Water Servicing Study for the Fletcher's Meadow Secondary Planning Area (Marshall Macklin Monoghan, 1997) indicated that fish were observed in the Centre Tributary north of the Wanless Road culvert and identified this tributary as Type 2 fish habitat. The East Tributary was considered to provide fish habitat upstream as far as the McLaughlin Road crossing. The lower reaches were designated Type 1 habitat based on the presence of redside dace downstream.

The North West Brampton Phase 2 Urban Expansion Area Environmental Open Space Study (Dougan and Associates and others, 2005) examined the flow and general habitat conditions in the headwaters of Fletchers Creek, north of Wanless Drive and east of McLaughlin Road, in September of 2003. All of the Fletcher's Creek headwaters within that area were dry at that time. Those observations were consistent with the conditions reported in the Fletchers Creek Subwatershed Study (Paragon Engineering et al, 1996) which reported only secondary intermittent streams and swales in that area. No biological sampling was undertaken within the Fletchers Creek watershed during the North West Brampton Phase 2 Urban Expansion Area Environmental Open Space Study, as all of the surface drainage features were dry, and there were no records of previous biological sampling within this portion of the Fletcher's Creek watershed on file with Credit Valley Conservation at the time. (ref. Bob Morris, personal communication, in Dougan and Associates and others, 2005).

The Fletcher's Creek headwater drainage features that lie between Chinguacousy Road and McLaughlin Road were examined by C. Portt in April of 2005, 2006 and 2007 and flow status was assessed (Table 4.6.5 and Figure 4.6.2). All but the three most easterly drainage features were dry when examined in 2005 and 2006 (Table 4.6.5). These three drainage features were the only ones that still held water when they were re-examined on May 11, 2005, and June 1, 2007, and therefore were the only locations where fish were sampled, by electrofishing, on those dates. No fish were captured at sites F6 and F7 (Table 4.6.6, Figure 4.6.1) on either of those occasions, but one blacknose dace (***Rhinichthys atratulus***) was captured at Site F8 in 2005 and one pumpkinseed (***Lepomis gibbosus***) was captured at the same location in 2007 (Table 4.6.6, Figure 4.6.1). The habitat at all three of these sites was limited to standing water at the time they were electrofish in both years (Table 4.6.6).

Table 4.6.5. Flow Conditions Observed in Fletcher's Creek Headwater Drainage Features in Spring 2005, 2006 And 2007 by C. Portt, Accompanied on April 30, 2007, by R. Morris, Cvc. See Figure 4.6.2 for Locations						
	April 19, 2005		April 20-21, 2006		April 30, 2007	
Location	Up	Down	Up	Down	Up	Down
536	dry	dry	dry	dry	dry	tiled
537	dry	dry	dry	dry	dry	pools
538	dry	dry	dry	dry	dry	dry
539	dry	dry	dry	dry	dry	dry
540	dry	pools	dry	pools	dry	pools
541	dry	pools	dry	pools		flow
542	dry	pools	flow	flow	flow	flow

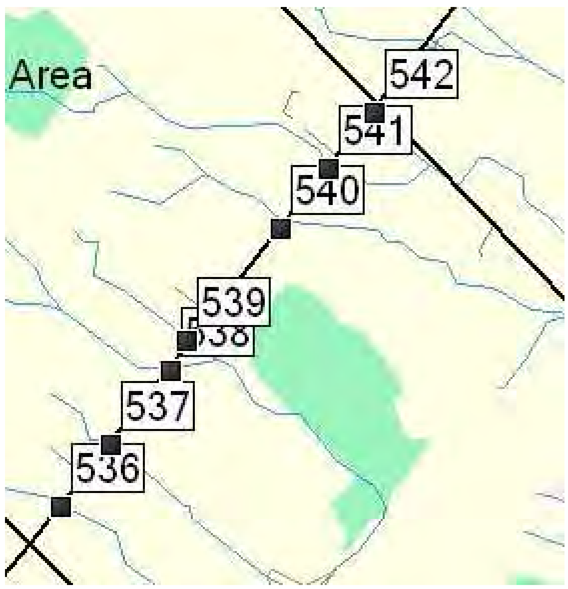


Figure 4.6.2. Locations where flow was assessed in Fletcher's Creek headwater drainage features along Mayfield Driver between Chinguacousy Road and McLaughlin Road in April of 2005, 2006 and 2007 (ref. Table 4.6.5)

Table 4.6.6. Electrofishing Catches and Habitat Descriptions for Fletcher's Creek Headwaters Sampled in 2005 and 2007. Locations are Shown on Figure 4.6.1 (And 4.6.2).				
Site	Date	Catch	Electro-seconds	Comments
6 (540)	5/11/2005	no catch	43	approx. 4 m long by 0.5 m deep puddle, up to 20 cm deep
6 (540)	6/1/2007	no catch	na	pool at culvert on south side,
7 (541)	5/11/2005	no catch	95	pool at downstream end of culvert approx 5 m long and 2 m wide - 25 cm max depth
7 (541)	6/1/2007	no catch	na	pool at culvert on south side
8 (542)	5/11/2005	1 blacknose dace	69	no surface flow, but standing pools
8 (542)	6/1/2007	1 pumpkinseed	44	only small amount of standing water at culvert

To the best of our knowledge, no benthic invertebrate sampling has been conducted in the Fletcher's Creek headwater drainage features in the vicinity of the study area, presumably because they go dry most summers.

4.6.3. Methods

Field investigations relevant to aquatic ecosystems were conducted by a number of disciplines including hydrogeology, hydrology, fluvial geomorphology, and terrestrial ecology, and are described in those respective sections. This section describes the field investigations directly related to fish and fish habitat. The field investigations were undertaken to address what were considered gaps in the existing data, where additional information would be useful in the secondary planning process. The presence of water is key for fish use, and watercourses where water is permanently present, either standing or flowing, were considered, based on the available background information, likely to provide permanent fish habitat. Therefore, field investigations focussed on fish use of intermittent or ephemeral watercourses.

Flow status (significant flow, trickle, standing water, dry) was determined at 19 road crossings on April 18 and June 11, 2008, and the sites were photographed on each occasion. The culvert at each crossing was also assessed to determine if it was a barrier to upstream fish migration. On June 11, 2008, screening level electrofishing was conducted (C. Portt, J.Reid) at seven locations where water was present but, based on observed conditions, it was thought that flow was likely either intermittent or ephemeral (P1 though P6, and at, approximately, TRCA site 62, Figure 4.6.1). One additional location was similarly examined on November 23, 2009 (P9, Figure 4.6.1; C. Portt, A. Bauer). A single pass was made through each site with a backpack electrofisher (Halltech Model HT2000B). All fish captured were identified to species in the field, enumerated and released. The length of watercourse electrofished was measured to the nearest metre and the number of electroseconds and flow condition were recorded. One additional reconnaissance level collection was made, using a dipnet from shore, in the pond at sampling location 9 (Figure 4.6.1).

Single pass electrofishing was conducted at four locations where flow appeared to be permanent, but either there were no fish data since 1996 (TRCA sites 4 and 5, Figure 4.6.1; sampled October 14, 2008 by C. Portt and J. Reid) or no fish data at all (Sites P7 and P8, Figure 4.6.1; sampled November 23, 2009 by C. Portt and A. Bauer). At each site, a single pass was made through a representative reach with a backpack electrofisher (Halltech Model HT2000B), without blocking nets, in accordance with the Ontario Stream Assessment Protocol (Version 7, Stanfield, 2007). The length of each site was measured to the nearest 0.1 m and wetted channel width was determined at ten approximately equidistant locations through the reach. At sites P7 and P8 depth was measured to the nearest 0.01 m at six approximately equidistant points along each transect across the channel width was measured. At sites P7 and P8 depth was not measured. At each site the proportion of the substrate composed of various materials was visually estimated. All fish captured were identified to species in the field, enumerated, weighed to the nearest gram (bulk weight), and released.

Ice cover and flow status were examined at a number of road crossings on March 4, 2009, as lack of ice cover can indicate substantial (relative to total flow) groundwater inputs. All watercourses were ice-covered.

The drainage features in the study area were classified according to the interim guidelines for the evaluation, classification and management of headwater drainage features (ref. CVC and TRCA, March 2009, Evaluation, Classification and Management of Headwater Drainage Features: Interim Guidelines). The classes of headwater drainage features (CVC and TRCA, March 2009) are as follows:

1. Permanent - Provides direct habitat onsite (e.g. feeding, breeding, migration and/or refuge habitat) as a result of year round groundwater discharge and/or permanent standing surface water within a storage feature (i.e. ponds, wetlands). Habitat may be either existing or potential (i.e. isolated by a barrier). Permanent habitat includes critical fish habitat (i.e. habitat that is limited in supply, essential to the fish life cycle, and generally habitat that is not easily duplicated or created). Hydrogeological studies and/or water balance calculations may be required to confirm groundwater contributions, as appropriate, with regard to the scale of the development application(s).

2. Seasonal - Provides limited direct habitat onsite (e.g. feeding, breeding, migration and/or refuge habitat), as a result of seasonally high groundwater discharge or seasonally extended contributions from wetlands or other surface storage areas that support intermittent flow conditions, or rarely ephemeral flow conditions. Occasionally, limited permanent refuge habitat may be identified within seasonal habitat reaches.

3. Contributing - Provides indirect (contributing) habitat to downstream reaches – functions generally increase with flow and/or as flows move downstream with increasing length of channel or channel density (e.g. extent of contributing area). There are two types of contributing habitat:
i. Complex contributing habitat – generally as a result of intermittent (or less commonly ephemeral) surface flows, can have marginal sorting of substrates – generally well vegetated features that influence flow conveyance, attenuation, storage, infiltration, water quality, sediment, food (invertebrates) and organic matter/nutrients (i.e. there are two types of nutrients, e.g. dissolved nutrients, and course/fine matter that can be used as cover). Generally, two types: a) defined features with natural bank vegetation consisting of forest, scrubland/thicket or meadow (as defined in OSAP or ELC); or
b) poorly defined features (swales) typically distinguished by hydrophilic vegetation
ii. Simple contributing habitat – generally as a result of ephemeral (or less commonly intermittent) surface flows – generally not well-vegetated features that influence flow conveyance, attenuation, storage, infiltration, water quality and sediment transport. Generally two types: a) defined features characterized by crop cultivation, mowing or no vegetation; or b) poorly defined features (swales) may contain terrestrial vegetation.

4***. Not Fish Habitat*** - The pre-screened drainage feature has been field verified to confirm that no features and/or functions associated with headwater drainage features is present – generally characterized by no definition or flow, no groundwater seepage or wetland functions, and evidence of cultivation, furrowing, presence of a seasonal crop, lack of natural vegetation, and fine textured soils (i.e. clay and/or silt).

5. ***Recharge Zone*** – Coarse-textured soils described as sand and/or gravel have been confirmed through field verification; majority of potential flow will be infiltrated. These features may have ill-defined channels as a relict of past flows; however the key function is groundwater recharge and maintenance of downstream aquatic functions via groundwater connections to streams. No direct fish habitat or indirect contributions through surface flow conveyance, allochthonous or sediment transport provided.

The watercourses in the Etobicoke Creek portion of the study area were classified based on the background data and field observations. The headwater drainage feature classifications were applied on a reach by reach basis to the reaches delineated by the fluvial geomorphological assessment. In some cases, ephemeral watercourses that drain to Etobicoke Creek may simple contributing habitat on the table lands and complex contributing habitat in the valley. The transition points have not been delineated, but it is assumed that this would be accomplished in the field, based on slope or vegetation. This delineation may be made redundant by green belt boundaries or hazard land delineations. Drainage features that were shown on base mapping but not deemed to be present based on the fluvial geomorphological assessment (i.e. are not designated as reaches in Figure 4.1.1) are considered not fish habitat, subject to verification.

Flow status was determined based on the observations of the fisheries investigator (C. Portt), spot base flow measurements and supporting observations collected by the hydrogeologists, previous spot base flow observations provided by TRCA, and the fluvial geomorphology rapid assessments. The presence or absence of fish, fish species richness, and the range of sizes/ages present also aided in distinguishing between permanent, seasonal and contributing fish habitat. The potential upstream extent of fish presence, where fish were not found to be present, was based on the application of professional judgement (C. Portt), given the habitat characteristics and proximity to permanent fish habitat. The influence of riparian vegetation on the aquatic classification was assessed based on the observations of the fisheries investigator (C. Portt), the information collected during the fluvial geomorphology rapid assessments, and the ELC mapping of vegetation types.

The headwater drainage features in the Fletcher's Creek portion of the study area that is west of McLaughlin Road were classified according to an earlier, but very similar, version of the headwater drainage feature classification system, and were verified at that time through a site visit by C. Portt and R. Morris of CVC, during the North West Brampton Urban Development Area characterization (Philips Engineering Ltd. 2007). These were not revisited. The classification of watercourses in the Fletcher's Creek watershed east of McLaughlin Road are based on field observations in the manner outlined for the Etobicoke Creek drainage features.

4.6.4. Results

The results of reconnaissance level fish sampling are presented in Table 4.6.7. No fish were captured at six of the locations and fathead minnows were captured at the other two. These catch results are consistent with the ephemeral or intermittent flows that occur at these sampling locations. Fathead minnows can survive in isolated pools and are apparently 'pioneer' fish species, in that they are not infrequently found in reaches that are dry for much of the year.

Table 4.6.7. Length Of Watercourse Sampled, Electroseconds, Flow Status and Catch at Locations where Reconnaissance Fish Sampling as Conducted (See Figure 4.6.1 for Sampling Locations)

Site	**P1**	**P2**	**P3**	**P4**	**P5**	**62**	**P6**	**P9**	**9**
Date	11/06/08	11/06/08	11/06/08	11/06/08	11/06/08	11/06/08	11/06/08	23/11/09	23/11/09
station length (m)	115	65	65	50	20	25	85	34	na
electroseconds	399	338	447	265	88	136	168	104	dipnet
flow status	flowing	flowing	flowing	flowing	isolated pools	standing water	puddles	standing water	pond
fathead minnow	no catch	no catch	6	no catch	no catch	12	no catch	no catch	yoy abundan t

Site P1 was in the roadside ditch along Chinguacousy Road, where flow originates from a field tile on the south-west side of the road. No fish were captured, but this ditch was never observed to be completely dry by C. Portt.

Sites P2 and P9 are on the same tributary, which was flowing when electrofished at P2 in June of 2008 and had standing water in some reaches when electrofished in November of 2009. It was considered somewhat surprising that fathead minnow were not present in this watercourse, given the duration of flow and proximity to the main branch of Etobicoke Creek. After the November 2009 electrofishing, a drop structure directing flow to a buried tile was located along this watercourse, at approximately the upstream boundary of reach MEC-R30. The tile and drop structure would prevent fish from moving upstream into these reaches except, perhaps, at very high flows.

Fathead minnow were captured at P3, where there was some flow on June 11, 2008, in a small, moderately defined channel. No fish were captured at either P4 or P5, which are branches of the same tributary. There was a small amount of flow in a the broad, heavily vegetated, swale at P4, but only standing water in the vicinity of the road culvert at P5 on June 11, 2008.

There was no flow at Site 62 on June 11, 2008. The concrete box culvert beneath Old School Road was completely dry. This culvert is perched by 10 to 20 cm, depending upon water levels, and would be a barrier to upstream fish migration under most, if not all, flows. There is a lesser drop at the downstream end of the culvert beneath McLaughlin Road, but it too is a barrier to upstream fish migration at low flows. There is a permanent online pond at Site 62, between McLaughlin Road and Old School Road, which would permanently support fish and was probably the source of the fathead minnows that were captured there.

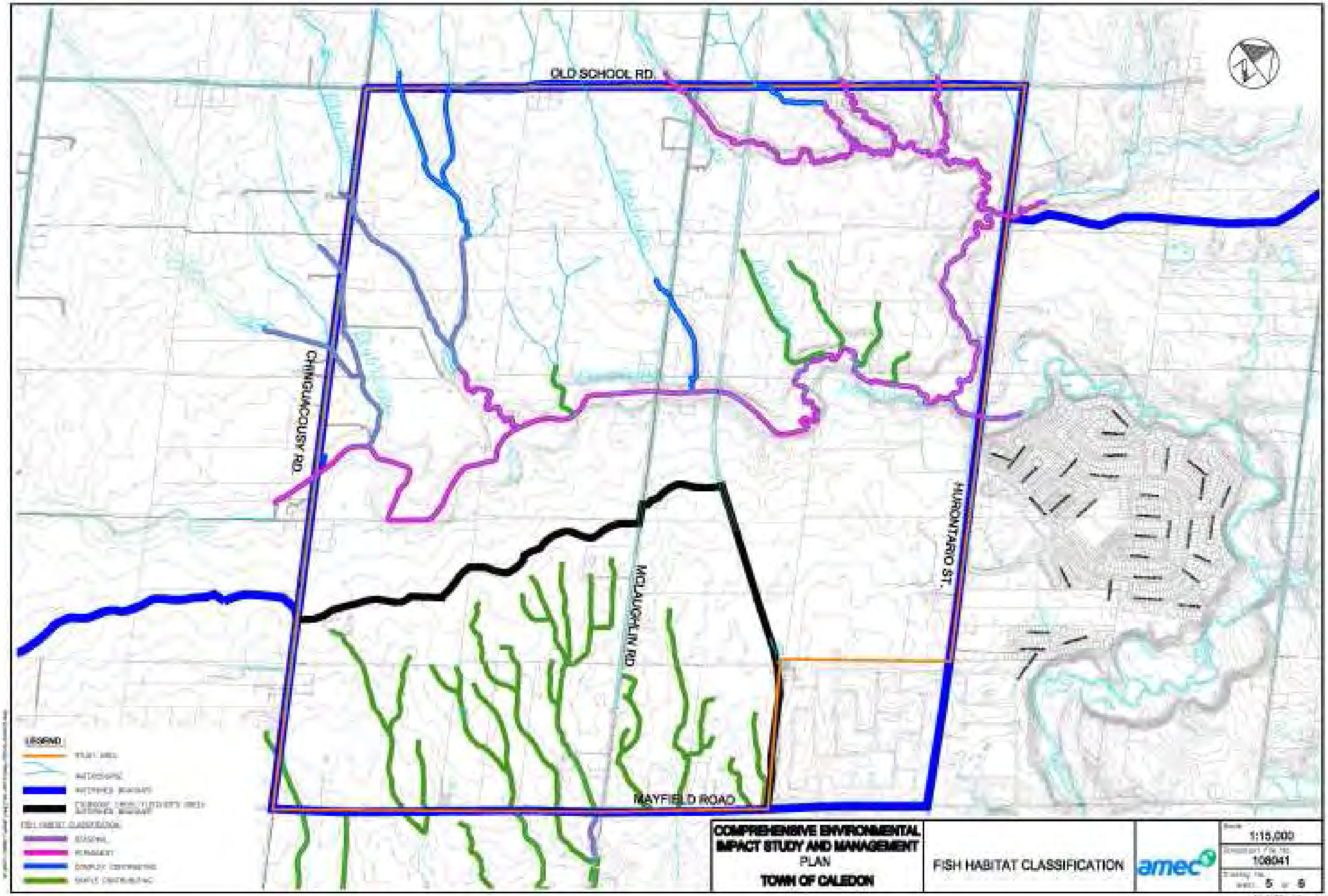
There was no flow in the watercourse at P6 on June 11, 2008, only isolated puddles. This watercourse is well defined downstream of Old School Road as it descends into the deeper valley, but fish utilization is probably severely limited by flow and access.

Large schools of fathead minnows were visible in the large, permanent, offline pond at Site 9, where they were captured by dip netting along the edges.

The sampling effort, habitat characteristics and catches at the flowing sites where electrofishing was conducted are presented in Table 4.6.8. Comparison of 2008 catches and the historical catches (Table 4.6.1) suggest little change has occurred, in terms of the dominant species, since 1996. The watercourse at Site 5 is smaller, and fewer fish species were captured there than at Site 4, where fantail darter and johnny darter were present. Five fish species were present at Site P7 on the main branch of the creek, and seven were present in the tributary at Site P8. This tributary was located in a woods, and had a considerable amount of gravel substrate, similar to Site 5.

Table 4.6.8. Site Dimensions, Habitat Characteristics, Sampling Effort and Number and Biomass (Grams, in Parentheses) of Each Fish Species Captured at Sites where Screening Level Electrofishing was Conducted. See Figure 4.6.1 for Sampling Locations.

Site	4	5	P7	P8
Date	10/14/2008	10/14/2008	11/23/2009	11/23/2009
Length (m)	47	54.5	64	60
Mean width (m)	2.7	1.3	5.6	3.4
Mean depth (m)	0.21	0.08		
% cobble	0	27	0	5
% gravel	22	36	10	30
% sand	14	1	15	10
% silt	0	0	75	30
% clay	64	36	0	25
electroseconds	2080	1131	1813	1524
electroseconds per m^2	16	16	5.0	7.4
blacknose dace	13	35	3	26
brook stickleback	2	33	5	20
common shiner				1
creek chub	30	64	15	69
fantail darter	1			
johnny darter	6		11	2
pumpkinseed				1
rock bass	3			
white sucker	2	1	6	28
Grand Total	57	133	40	147
Number of species	7	4	5	7


OLD SCHOOL RD.
CHINGUACOUSY RD.
MCLAUGHLIN RD.
HURONTARIO ST.
MAYFIELD ROAD
LEGEND
COMPREHENSIVE ENVIRONMENTAL IMPACT STUDY AND MANAGEMENT PLAN
TOWN OF CALEDON
FISH HABITAT CLASSIFICATION
amec
1:15,000
108041
5 of 6

Some of the benthic invertebrate indices (i.e. HBI) indicate “fairly poor” conditions at monitoring locations in Etobicoke Creek. It is thought, however, that the benthic community may reflect the natural condition for these watercourses, rather than an impaired state.

4.6.5 Interpretation

The drainage divide between the Fletcher’s Creek and Etobicoke Creek watersheds bisects the study area, with the south-easterly portion being in the headwaters of the Fletcher’s Creek watershed. The Fletcher’s Creek headwaters within the study area are primarily poorly defined drainage features with ephemeral or, at most, intermittent flow. Cultivation occurs through many of these features. Because most of these streams go dry they do not support fish directly, but colonizing species, such as fathead minnow (***Pimephales promelas***) and brook stickleback (***Culaea inconstans***), may occasionally be present, and these tolerant species can survive in isolated pools as long as standing water remains present. The one exception is the watercourse that crosses Mayfield Road just west of McLaughlin Road. There, low numbers of fish were present just downstream of Mayfield Road on both occasions when it was sampled.

The main branch of Etobicoke Creek is a permanent stream that flows through the study area in a north-easterly direction in a well-defined valley. The main branch has been designated a municipal drain through most of the study area and the designated portion appears to have been straightened or ditched in the past. The valley lands were, and some portions continue to be, used for pasture and livestock continue to have access to some reaches of the watercourse. Livestock access typically reduces channel complexity, decreases depth and increases width through trampling of the bed and banks.

Etobicoke Creek receives tile drains in a number of locations. Although some small patches of watercress have been observed, there does not appear to be a major influx of groundwater along the main branch within the study area. Winter observations suggest that groundwater contributions to the main branch are greater further to the west.

The main branch of Etobicoke Creek contains a relatively diverse fish community, including blacknose shiner, northern redbelly dace, pearl dace and central mudminnow, which TRCA have identified as species of conservation concern because of their sensitivity to habitat alteration, chemical pollution, siltation, and increased flow velocities (TRCA, 2004, cited in CH2MHILL and TRCA, 2008). The Etobicoke Creek tributaries in the north-east portion of the study area (reaches MEC-R08 through MEC-R11, and MEC-R15) probably all support fantail darter, which is also considered a species of conservation concern by TRCA. In the permanent watercourses, the fish community appears to differ between the east part of the study area, where darters are present, to the central part of the study area where northern redbelly dace, pearl dace and central mudminnow occur. This shift in species composition is probably a reflection of physical habitat, and perhaps water temperature, differences.

Some of the intermittent tributaries in the Etobicoke Creek watershed have been shown to, or are expected to, contain tolerant fish species (i.e. fathead minnow) on a seasonal basis. Many of the smaller watercourses are intermittent or ephemeral and do not appear to contain fish, but, to varying degrees, they contribute flow, sediment and organic matter to downstream habitats. Delineation of where the transitions from “not fish habitat” to “simple contributing habitat” to “complex contributing habitat” occur will be discussed, where necessary, during a field visit with agency staff.

4.7. Terrestrial

4.7.1. Importance/Purpose

Terrestrial ecosystems encompass upland and wetland vegetation of natural and/or cultural origin, providing habitat for wildlife which may utilize features on a transitory, seasonal or permanent basis. Terrestrial ecosystems provide intrinsic functions or services in terms of photosynthesis, storage and processing for carbon, minerals and nutrients as well as the hydrologic cycle. The above- and below-ground structure provided by vegetation interacts with air and water to promote conservative management and cycling of water and soil resources, manage a more stable microclimate, and in the process helps to sustain other reliant biota such as wildlife species, fish and invertebrates. The vertical and horizontal structure of vegetation systems, in conjunction with physical attributes of soil and water, is potentially capable of sustaining many species and populations of plants and animals as habitat structure evolves in extent, age and complexity over decades and longer periods. At watershed and larger scales these services are integral to sustaining the fundamental hydrologic and chemical cycles.

The purpose of this terrestrial characterization is to document and refine understanding of existing conditions in the Mayfield West Secondary Plan Study Area in terms of vegetative cover, flora and fauna, and ecosystem functions. The Mayfield West Secondary Plan Study Area includes lands located within the headwaters of the Fletcher’s Creek Subwatershed (Credit Valley Conservation jurisdiction) and also within the headwaters of Etobicoke Creek (Toronto and Region Conservation Authority jurisdiction). The headwaters area is also included in the ongoing North West Brampton Urban Development Area Huttonville and Fletcher’s Creeks Subwatershed Study. The understanding of the broader landscape in the vicinity is the subject of an ongoing Landscape Scale Analysis (LSA) study being conducted by Dougan & Associates on behalf of CVC and the City of Brampton as a parallel study to the North West Brampton Urban Development Area Subwatershed Study, to help inform decisions on future urban development including configuration of a sustainable Natural Heritage System as required under Provincial, Regional and City policies. The LSA study area extends 2.5 km beyond the limits of the Fletcher’s / Huttonville subwatersheds, and therefore encompasses the Mayfield West study area.

The terrestrial field studies undertaken in the Study Area were initiated in the spring of 2008 to provide a suite of seasonal data. All relevant properties were accessed for a series of vegetation and wildlife surveys, with support from Town of Caledon staff who contacted the affected landowners. The scope of 2008 terrestrial studies included seasonal observations of wildlife, botanical surveys, and Ecological Land Classification (ELC) mapping to document and refine understanding of existing conditions and ecosystem functions. The 2008 data supplements wildlife and vegetation data collected in the headwater areas of the Fletcher's and Huttonville Creeks in 2006 and 2007 as part of the North West Brampton SWS. Thus, all summary tables of Terrestrial vegetation and wildlife results include the relevant NWB data (for further reference, the summary tables included in the original NWB characterization report may be found in Appendix I). The terrestrial observations form a baseline of data and will ultimately contribute to development of an adaptive monitoring program in the Comprehensive EIS in response to the finalization of a Secondary Plan for the area, which is the subject of a separate study. The understanding of the natural system, in the context of the broader landscape beyond the study area boundary, will help inform decisions on future development including configuration of a sustainable Natural Heritage System for the Study Area as required under Provincial, Regional and Town policies.

4.7.2. Background Information

4.7.2.1 Data Sources

The following information and data have been accessed in the preparation of this report.

- 2007 Orthophoto (provided by Town)
- Cadman et al (2007) Ontario Breeding Bird Atlas
- Candevcon 1997 & 1999. Northwest Sandalwood Secondary Plan and EIR CVC (2003) ELC Mapping
- Dobbyn (1994) Atlas of the Mammals of Ontario
- Dougan & Associates (2007) North West Brampton Landscape Scale Analysis (Draft August 2007)
- Dougan & Associates. 2005. Northwest Brampton Environmental Open Space Study
- Greenbelt Boundary (provided by Town)
- Greenbelt Plan (2005)
- Greenbelt Plan Technical Papers 1-3 (MMAH Draft October 2008)
- Kaiser (2000) Vascular Plant Flora of the Region of Peel and the Credit Watershed
- MMAH (2005) Provincial Policy Statement
- MNR (2007) Ontario Herpetological Atlas
- MNR (2007) Fletcher's Creek Headwaters Wetland Complex Mapping and Data
- MNR (2008) Natural Heritage Information Centre (data queries for insects, lepidoptera, amphibians, reptiles, mammals, birds 2008)
- MNR (2008) Significant Species Data Query
- MNR (2008) Species at Risk in Ontario
- MNR (2009) Caledon Wetland Mapping
- Ontario Partners in Flight (2008) Ontario Landbird Conservation Program
- Paragon Engineering Limited (1996) Fletcher's Creek Subwatershed Study

- Philips Emgineeing Limited (2007) North West Brampton Urban Development Area Huttonville and Fletcher's Creeks Subwatershed Study – Characterization Report and Data (Draft December 2007)
- Plourde et al (1989) Distribution and Status of the Herpetofauna of Central Region, Ontario Ministry of Natural Resources
- Region of Peel Official Plan (2006)
- Region of Peel/Town of Caledon Significant Woodlands and Significant Wildlife Habitat Study (Draft October 2008)
- Region of Peel Draft Regional Official Plan Amendmant 21; draft Natural Heritage Policies (February 2009)
- Stantec (2005) Mayfield Station Preliminary Environmental Study
- Town of Caledon Official Plan (2004)
- Town of Caledon (2008) LIDAR contour mapping (provided by Town courtesy of Mayfield West Landowners)
- TRCA. 2006. Mayfield West Natural Features Study; Appendix: ELC Mapping and Significant Species Mapping
- TRCA (2007) Terrestrial Natural Heritage System Strategy
- TRCA (2008) Etobicoke Creek Headwaters Subwatershed Study
- TRCA (2008) List of Vascular Plants Species Ranks
- TRCA (2008) List of Vegetation Community Ranks
- Varga et al (draft 2005) Status of Vascular Plants of the Greater Toronto Area (Varga et al draft 2005)

4.7.2.2 Fletcher's Creek Subwatershed Study and EIR

The Fletcher's Creek studies (Fletcher's Creek Subwatershed Study - Paragon 1996; EIR for Fletcher's Meadow Secondary Planning Area -Marshall Macklin Monaghan 1997; Northwest Sandalwood Secondary Plan and EIR - Candevcon 1997 & 1999) predated the PPS and ELC system; however these studies provided guidance on linkage functions and feature sensitivity related to that subwatershed. A greenspace hierarchy was identified related to ecological functions, reflecting stream hydrology, habitat, and linkages. Greenspace components included Natural Core Areas, Regulatory Floodplain, Valley Land Corridors, Support Natural Areas, Isolated Natural Areas, and Linkage/Rehabilitation Areas. Woodlots were identified as Medium function habitats, with Low function linkage corridors (requiring extensive enhancement) identified on watercourses linking terrestrial features. Watercourse-based linkages 60 to 100 m wide were recommended. The EIR documents were reliant on the Subwatershed Study findings with respect to identification of terrestrial features and linkages; although somewhat dated in approach, this analysis can inform the future Natural Heritage System in the present study.

4.7.2.3 Northwest Brampton Environmental Open Space Study (Dougan and Associates 2005)

The North West Brampton Environmental Open Space (EOS) Study (Dougan & Associates 2005) was focused on a study area bounded by Winston Churchill Blvd. and the Credit River on the west, Mayfield Road on the north, and the existing urban area on the east. The existing landscape in North West Brampton is primarily rural and agricultural in character. Although linked natural cover occurs in proximity to the Credit River and along minor tributaries, natural cover in most of the EOS study area is highly fragmented. The estimated natural cover by ELC Community Series; natural terrestrial cover (i.e. forest and wetland) in the EOS study area was 6.51%, compared to 8.49% natural cover outside the urban boundary of Brampton in 1992 (AgPlan 1992). The EOS determined that within North West Brampton, 39.95 ha or 24.3% of the natural cover was located within defined 'crest of slope' areas, and the balance is located on tableland.

The EOS concluded that the low amount of forest, wetland and riparian cover favours common wildlife species such as raccoons, skunks and deer, but significantly limits the opportunities for more sensitive habitat specialists such as amphibians and 'forest interior' or other area sensitive songbirds except where more contiguous cover is available (such as in the lower reaches of tributaries near the Credit River). Wildlife species observed were indicative of the types of habitats present within the study area. Only four of 23 habitat blocks in the EOS study area contained "forest interior", defined as having a core area more than 100 m from any edge. Swamp polygons were documented in conjunction with upland forest, and were identified as potentially supporting species adapted to seasonal or 'vernal' pools.

The EOS study concluded that the relative lack of existing natural cover in North West Brampton results in reduced 'natural services' or functions. That is, retention of runoff, nutrients and sediments is limited, infiltration is limited, and downstream impacts of local land uses are increased. Contribution of the area to improvement of regional air quality is constrained by lack of tree cover, and microclimates are relatively extreme, dominated by open field conditions. The resilience of populations of native flora and fauna is reduced due to the small size and relative isolation of habitat fragments, and local biodiversity can be expected to be constrained. In the context of climate change, the isolation of features increases the vulnerability of habitats to local extirpation of species as gene flow of more adapted populations is constrained. From a functional perspective, the current landscape is operating in a deficit condition, contributing downstream impacts while providing limited local and regional benefits to air, water and biodiversity management.

The EOS included a Proposed Environmental Features Schedule "D" for inclusion in the City of Brampton Official Plan, based on a ranking of features. The Schedule identified those habitat features ranked as regionally to locally significant, and potential linkages using defined crest of slope, and defined surface drainage features. The size threshold for significant woodlands was established as 2 ha. These proposed designations conformed to PPS policy criteria and are the basic framework for the future Natural Heritage System. The EOS Study discussed the nature and extent of these features, and their organization and enhancement as part of future development.

The EOS identified significant features and linkages that are in the vicinity to the Mayfield West study area, and will be considered as part of an integrated Natural Heritage System for surrounding areas of the Peel Plan that are proposed for future urbanization, as well as connections with protected areas such as the Greenbelt.

4.7.2.4 North West Brampton Urban Development Area Huttonville and Fletcher's Creeks Subwatershed Study); North West Brampton Landscape Scale Analysis

The North West Brampton Urban Development Area - Huttonville and Fletcher's Creeks Subwatershed Study (Philips Engineering Ltd. et. al., Dec 2007 draft) has been underway since 2006, and its study area includes headwater areas of the Fletcher's Creek and Huttonville Creek subwatershed which extend into the south periphery of the Town of Caledon. This overall study area has undergone relatively intensive terrestrial field studies between 2005 and 2007, and wetlands in this area have also been evaluated by the Ministry of Natural Resources, with two wetland complexes identified (Huttonville Creek & Area, and West Upper Fletcher's Creek Wetlands). In addition, terrestrial and aquatic studies have also been undertaken on by LGL Limited, Stantec Limited, and Savanta Inc. on behalf of landowners in the area.

The understanding of the broader landscape in the vicinity is the subject of an ongoing Landscape Scale Analysis (LSA) study being conducted by Dougan & Associates on behalf of CVC and the City of Brampton as a parallel study to the North West Brampton Urban Development Area Subwatershed Study, to help inform decisions on future urban development including configuration of a sustainable Natural Heritage System as required under Provincial, Regional and City policies. The LSA study area extends 2.5 km beyond the limits of the Fletcher's / Huttonville subwatersheds, and therefore encompasses the Mayfield West study area. A Draft LSA Report was issued in August 2007; it includes principles and strategies to guide development in the Mount Pleasant Secondary Plan area as well as for the larger LSA area; eventually the study will include summaries and general strategies for all subwatersheds within CVC jurisdiction that area contained in the LSA study area.

4.7.2.5 Other Data Sources

Natural Heritage Information Centre (NHIC)

Melinda Thompson-Black, Species at Risk Biologist (OMNR Aurora District) provided findings of a geographic query of rare species and natural areas for the Mayfield West study area. The results of this query were forwarded to Dougan & Associates on November 11, 2007. According to the search results, there are no recorded Species at Risk element occurrences in the study area. It was also noted however that a portion of the Upper Fletcher Creek Wetland Complex is located within the study area. Two spreadsheets with flora and fauna records that were compiled by the TRCA in 1996 – 2003 were attached for analysis and incorporation.

MNR Wetland Inventories (2005 onward)

In 2005 and 2006, the Ministry of Natural Resources conducted wetland inventories and field work in the Fletcher's Creek headwaters that partially includes the Mayfield West study area. Results from these inventories were released on February, 2007. Information released related to the Fletcher's Creek headwaters included 1:10,000 hardcopy map depicting external wetland polygon boundaries and internal wetland community boundaries as well as the digital wetland layer.

Updated results that include the Etobicoke Creek headwaters were released on January, 2009. Information obtained from MNR included 1:11,000 hardcopy of the Caledon Wetland Mapping, however it has not been received in digital form as of the date of the present report.

The updated wetland mapping for the Mayfield West study area was used to confirm (and in a few areas refine) ELC mapping prepared for this report. Further field review and discussion with MNR may be required to fully integrate and verify the wetland mapping, which is considered preliminary as the evaluation scoring has not been completed. In addition, MNR may have additional inventory data; to date we have not received the most recent wetland mapping.

MNR will be advancing its wetland evaluations within the Etobicoke Creek Headwaters west of Hurontario Street. The timing of the evaluation has not been finalized, however 2009 fieldwork is anticipated.

2006 MNR Wildlife Survey Data

Mark Heaton, MNR Aurora District Fish and Wildlife Biologist, collected wildlife information in 2006 for the area directly south of the Mayfield West study area (Philips et al., 2007). In particular he obtained wildlife data for a woodlot located directly south of Mayfield Road, between Chinguacousy Road and McLaughlin Road. Upon conversation with a local resident, two ‘Species at Risk’ were determined by MNR to be associated with the woodlot: Western Chorus Frog (***Pseudacris triseriata***) and Milksnake (***Lampropeltis triangulum***). Western Chorus Frog was recently designated as “Threatened” by COSEWIC (2008). It has yet to be evaluated by provincial agencies. Milksnake is designated “Special Concern” in Ontario (OMNR, 2008) and Canada (COSEWIC, 2007). It is not clear how recently these species were last observed. Although the woodlot is not within the Mayfield West study area, the northern edge is only approximately 75 m away from the southern boundary (Mayfield Road) and it is conceivable that if these species are not present within the Mayfield West study area now, they could possibly be recorded there in the future.

Toronto and Region Conservation Authority

A number of significant vascular plant species were documented from the Mayfield West study area by TRCA staff between 1996 and 2003. These species are considered significant based on the TRCA L-ranking system (TRCA 2008). Data obtained from TRCA included records for a total of 43 significant plant species from 101 locations. Records for two of the listed species, white spruce (***Picea glauca***) and woolly bulrush (***Scirpus cyperinus),*** were determined to be from outside the study area and were excluded from the overall species list and analysis’leaving a net total of 41 TRCA-documented significant plant species based on 97 discrete locations within the Mayfield West study area. These include two L2, twenty-nine L3 and ten L4 ranked species. A complete list of the significant plant species and their ranking is provided in Table 4.7.1.

Table 4.7.1. List of Rare Plant Species Documented by TRCA Staff in the Study Area

No.	Scientific Name	Common Name	TRCA Status[1]
1	***Alnus incana ssp. rugosa***	speckled alder	L3
2	***Anemone quinquefolia var. quinquefolia***	wood-anemone	L3
3	***Cardamine bulbosa***	spring cress	L2
4	***Carex communis***	fibrous-rooted sedge	L4
5	***Carex crinita***	fringed sedge	L3
6	***Carex gracillima***	graceful sedge	L4
7	***Carex laxiflora***	loose-flowered sedge	L4
8	***Carex lupulina***	hop sedge	L3
9	***Carex molesta***	troublesome sedge	L3
10	***Carex sprengelii***	long-beaked sedge	L4
11	***Carex tuckermanii***	Tuckerman's sedge	L3
12	***Carya ovata***	shagbark hickory	L3
13	***Ceratophyllum demersum***	coontail	L3
14	***Chelone glabra***	turtlehead	L3
15	***Claytonia caroliniana***	broad-leaved spring beauty	L3
16	***Claytonia virginica***	narrow-leaved spring beauty	L3
17	***Cystopteris tenuis***	Mackay's fragile fern	L3
18	***Dicentra canadensis***	squirrel-corn	L3
19	***Dryopteris clintoniana***	Clinton's wood fern	L3
20	***Elodea canadensis***	common water-weed	L4
21	***Equisetum sylvaticum***	woodland horsetail	L3
22	***Euonymus obovata***	running strawberry-bush	L3
23	***Geum laciniatum***	cut-leaved avens	L4
24	***Gymnocarpium dryopteris***	oak fern	L3
25	***Iris versicolor***	blue flag	L3
26	***Juglans cinerea***	butternut	L3
27	***Lilium michiganense***	Michigan lily	L3
28	***Oryzopsis asperifolia***	white-fruited mountain-rice	L3
29	***Polygonum amphibium***	water smartweed	L4
30	***Polystichum acrostichoides***	Christmas fern	L3
31	***Potamogeton natans***	floating pondweed	L3
32	***Rubus pubescens***	dwarf raspberry	L4
33	***Salix lucida***	shining willow	L3
34	***Sisyrinchium montanum***	blue-eyed grass	L3
35	***Solidago arguta var. arguta***	sharp-leaved goldenrod	L2
36	***Sparganium eurycarpum***	great bur-reed	L3
37	***Spiraea alba***	wild spiraea	L4
38	***Streptopus roseus***	rose twisted-stalk	L3
39	***Uvularia grandiflora***	large-flowered bellwort	L3
40	***Viola affinis***	Le Conte's violet	L3
41	***Waldsteinia fragarioides***	barren strawberry	L4

[1]Status based on the TRCA List of vascular plant species, 2008.

In addition, TRCA provided data for 49 ELC polygons documented from the vicinity of Mayfield West. Of these, 31 polygons were determined to be from the current study area. These polygons represent 24 vegetation communities classified into 12 types (Table 4.7.2). Three vegetation communities were identified as having L4 status according to the TRCA ranking system.

Table 4.7.2. List of Vegetation Communities Documented by TRCA Staff in the Study Area			
No.	**ELC Code**	**Vegetation Type**	**TRCA Status[1]**
1	CUM1-b	Exotic Cool-season Grass Old Field Meadow	L+
2	CUM1-b	Exotic Cool-season Grass Old Field Meadow	L+
3	CUM1-b	Exotic Cool-season Grass Old Field Meadow	L+
4	CUM1-b	Exotic Cool-season Grass Old Field Meadow	L+
5	CUM1-b	Exotic Cool-season Grass Old Field Meadow	L+
6	CUM1-b	Exotic Cool-season Grass Old Field Meadow	L+
7	CUM1-b	Exotic Cool-season Grass Old Field Meadow	L+
8	CUS1-1	Hawthorn Cultural Savannah	L5
9	CUW1-A3	Native Deciduous Cultural Woodland	L5
10	FOD4-G	Dry-Fresh Basswood Deciduous Forest	L4
11	FOD4-H	Dry-Fresh Hawthorn - Apple Deciduous Forest	L4
12	FOD6-1	Fresh-Moist Sugar Maple - Ash Deciduous Forest	L5
13	FOD7-1	Fresh-Moist White Elm Lowland Deciduous Forest	L5
14	FOD7-3	Fresh-Moist Willow Lowland Deciduous Forest	L5
15	FOD7-a	Fresh-Moist Manitoba Maple Lowland Deciduous Forest	L5
16	MAM2-2	Reed Canary Grass Mineral Meadow Marsh	L5
17	MAM2-2	Reed Canary Grass Mineral Meadow Marsh	L5
18	MAM2-2	Reed Canary Grass Mineral Meadow Marsh	L5
19	MAM2-2	Reed Canary Grass Mineral Meadow Marsh	L5
20	MAM2-2	Reed Canary Grass Mineral Meadow Marsh	L5
21	MAM2-2	Reed Canary Grass Mineral Meadow Marsh	L5
22	MAM2-6	Broad-leaved Sedge Mineral Meadow Marsh	L4
23	MAS2-1b	Narrow-Leaved Cattail Mineral Shallow Marsh	L5
24	OAO1	Open Aquatic Ecosite (deep or riverine)	L5

[1]Status based on the TRCA List of vegetation communities, 2008.

The TRCA studies were conducted several years ago, and vegetation surveys covered approximately one third of the study area. Changes have subsequently occurred due to anthropogenic impact and community succession, mainly within ELC ‘cultural’ features. Because of this “evolution in action”, the shift in cultural community structure along the gradient meadow>thicket>savannah>woodland has often been observed. A number of refinements were therefore made to update the community mapping from these studies to the level of detail required for the present study. Changes to mapping had included updating ELC vegetation classifications, modifying polygon boundaries, and splitting polygons to reflect the current heterogeneity of communities.

Credit Valley Conservation

Credit Valley Conservation digital GIS data was reviewed for relevant information regarding the Mayfield West study area. The closest Environmentally Sensitive Areas in the vicinity include the Upper Canada College Property ESA located on the Credit River at Norval, and the Huttonville Valley ESA along lower Huttonville Creek. No CVC-mapped crest of slope areas occur within the study area; CVC digital wetland mapping does not reflect North West Brampton wetlands which were mapped by MNR in 2006 and which will eventually be scored to determine its significance.

Credit River Watershed and Region of Peel Natural Areas Inventory

Credit Valley Conservation (CVC), the Halton/North Peel Naturalist Club and the South Peel Naturalists' Club are currently collaborating on a Natural Areas Inventory of the Credit River Watershed and Region of Peel. Although data is being collected from many locations, the Mayfield West study area has not been surveyed as part of the project (D. Renfrew, NAI coordinator, pers. comm., 2008).

Ontario Herpetofaunal Atlas Information

Michael Oldham (Herpetologist, Natural Heritage Information Centre) conducted a query the Ontario Herpetological Summary database for records for the Mt. Pleasant Subwatersheds study area and vicinity (including the Landscape Scale Analysis area). The 2007 query included lands contained with the Mayfield West study area, no records of herpetofauna were on file for the area as of the query date.

Ontario Breeding Bird Atlas

The Mayfield West study area falls entirely within atlas square 17NJ94. All of the Ontario Breeding Bird Atlas records associated with this square were acquired from the Ontario Breeding Bird Atlas website (http://www.birdsontario.org/atlas/datasummaries.jsp) and have been reproduced for convenience in Appendix 'H'. This represents all of the breeding bird observations collected between 2001 and 2005.

According to the list, 106 species of breeding birds were documented from the 10 x 10 km atlas square. For comparison, all of the breeding birds documented by Dougan & Associates (D&A) and Toronto and Region Conservation Authority (TRCA) are also shown, at least those that were also observed as part of the Ontario Breeding Bird Atlas (OBBA). Two species recorded by D&A and TRCA from the Mayfield West study area [Turkey Vulture (***Cathartes aura***) and Cliff Swallow (***Petrochelidon pyrrhonota***)] were not recorded as part of the OBBA:.

Of the 106 species documented, two are designated as 'Species at Risk'; ***i.e.*** two of the 106 species are designated as "Special Concern", "Threatened", or "Endangered" in Canada (COSEWIC, 2007; COSEWIC, 2008) or Ontario (OMNR, 2008). The two species are Common Nighthawk (***Chordeiles minor***) and Chimney Swift (***Chaetura pelagica***). Both species are listed as "Threatened" in Canada (COSEWIC, 2007; COSEWIC, 2008). Both were recorded as possible breeders only.

Twenty of the 106 breeding bird species were considered to be priority landbird species for conservation in Bird Conservation Region (BCR) 13 – the Lower Great Lakes - St. Lawrence Plain – by Ontario Partner's in Flight (OPIF, 2006) (ref. Appendix 'H'). At the local level, 42 of the 106 breeding bird species are listed by TRCA (Toronto and Region Conservation Authority) as L1, L2 or L3. These local ranks are generally regarded as significant. Credit Valley Conservation (1997) considers 55 species to be of "Conservation Concern". It should be noted that the atlas square encompasses a much larger area that the Mayfield West study area, and many of the regionally and locally significant species were likely recorded outside of this study area.

Ontario Mammal Atlas

The Atlas of the Mammals of Ontario (Dobbyn, 1994) was reviewed to see what species have been documented from the 10 x 10 km atlas square that contains the Mayfield West study area. Table 4.7.3 summarizes the results of this review. In total 15 species were documented from the atlas square 17NJ94.

Table 4.7.3. Mammals Documented from Atlas Square 17NJ94 as part of the Ontario Mammal Atlas.

	Common Name	Scientific Name	Conservation Status					Area Sensitivity[6]	Atlas Time Period
			National	Provincial		Local			
			COSEWIC[1]	MNR[2]	Srank[3]	TRCA[4]	Credit Watershed[5]		
1	Northern Short-tailed Shrew	Blarina brevicauda	---	---	S5	L4	?	---	1900 - 1969
2	Big Brown Bat	Eptesicus fuscus	---	---	S5	L4	?	---	1970 - 1993
3	Eastern Cottontail	Sylvilagus floridanus	---	---	S5	L4	?	---	1900 - 1969
4	Cape or European Hare*	Lepus europaeus	---	---	SE	L+	?	---	1900 - 1969
5	Grey Squirrel*	Sciurus carolinensis	---	---	S5	L5	?	---	1900 - 1969
6	Beaver*	Castor canadensis	---	---	S5	L4	?	---	1970 - 1993
7	White-footed Mouse	Peromyscus leucopus	---	---	S5	L5	?	---	1900 - 1969
8	Meadow Vole	Microtus pennsylvanicus	---	---	S5	L4	?	---	1970 - 1993
9	Norway Rat	Rattus norvegicus	---	---	SE	L+	?	---	1900 - 1969
10	Muskrat	Ondatra zibethicus	---	---	S5	L4	?	---	1970 - 1993
11	Meadow Jumping Mouse	Zapus hudsonius	---	---	S5	L3	?	---	1900 - 1969
12	Porcupine	Erethizon dorsatum	---	---	S5	L2	?	---	1970 - 1993
13	Red Fox	Vulpes vulpes	---	---	S5	L4	?	---	1970 - 1993
14	Raccoon	Procyon lotor	---	---	S5	L5	?	---	1970 - 1993
15	Mink	Mustela vison	---	---	S5	L4	?	---	1970 - 1993

* = Imprecise location information. Mammal record may not be from this square.
1 – 6 = See the Legend in Appendix 'H' for detailed status information.

Two species are rated as significant by the Toronto and Region Conservation Authority (TRCA): Meadow Jumping Mouse (***Zapus hudsonius***) and Porcupine (***Erethizon dorsatum***) (TRCA, 2008a,b). All of the other species are generally regarded as common. Credit Valley Conservation (CVC) does not currently have status information for mammals for the Credit watershed.

4.7.3. Methods

4.7.3.1 Significant Natural Heritage Features

The Provincial Policy Statement (2005) defines significant features including Significant Valleylands, Significant Woodlands, Significant Wetlands, Significant Wildlife Habitat, Areas of Natural and Scientific Interest, and Significant Portions of the Habitat of Threatened and Endangered Species.

The Region of Peel Official Plan is currently being updated, and the Draft Regional Official Plan Amendment 21 (ROPA 21) identifies the following categories of natural heritage features: Areas of Natural and Scientific Interest, Environmentally Sensitive or Significant Areas, Escarpment Natural Areas, Fish and Wildlife Habitat, Habitats of Threatened and Endangered Species, Natural Corridors, Shorelines, Valley and Stream Corridors, Wetlands and Woodlands. These are discussed where relevant in the following sections.

The Greenbelt Plan identifies the following natural heritage features and areas as Key Natural Heritage Features (KNHF):

- significant habitat of endangered species, threatened species and special concern species;
- fish habitat;
- wetlands;
- life science “areas of natural and scientific interest” (ANSIs);
- significant valleylands;
- significant woodlands;
- significant wildlife habitat;
- sand barrens, savannahs, tallgrass prairies; and
- alvars.

Section 3.2.4 of the Greenbelt Plan states that wetlands are also key hydrologic features.

4.7.3.2 Vegetation Resources

All accessible natural and semi-natural vegetation communities within the Mayfield West study area were visited during the 2008 field season. Dougan & Associates also surveyed lands within the Fletcher’s Creek headwaters as part of the North West Brampton Subwatershed Study in 2007.

Botanical surveys were timed to capture key seasonal observation periods for plant species; other vegetation data was collected in these periods. Spring flora was observed mainly in the forests and woodlands during May 2008. Observed species were included in both the mapping of significant plant species and the description of ground layers in vegetation communities. Forest and woodland habitats were surveyed on multiple visits in summer to capture the seasonal flora. Other areas (wetlands, cultural, etc.) were visited over the course of the summer and early fall (August – September) when the greatest number of herbaceous species are most easily identified in these habitats. Species records are associated with specific ELC polygons and GPS data were collected for significant plant species. In some cases, within large polygons, several GPS readings were taken for the same significant plant species when the distance between observations was over 100 m. Representative photos of habitat types, and plant species were taken.

Vegetation and disturbance data were collected from natural and cultural communities; detailed data on community structure, composition and soils was collected from natural communities. This information was used to classify natural vegetation communities to the Vegetation Type level according to the ELC (Ecological Land Classification) methodology for Southern Ontario (Lee ***et al***., 1998). Vegetation communities were mapped as polygons onto 2005 photography provided by the Region of Peel. A summary of dates of field visits is presented in Table 4.7.4.

Table 4.7.4. Summary of 2008 Survey Dates – Flora and Vegetation

Date	Polygons Visited	Purpose Of Visit	Observer(s)
May 08/08	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 16, 20, 21	Botanical Surveys	V. Kricsfalusy
May 09/08	27, 29, 30, 31, 32, 33, 35, 37, 41, 42, 43, 44, 45, 46	Botanical Surveys	V. Kricsfalusy
May 24/08	61, 65, 66, 67, 68, 69, 79, 80, 82, 83, 84, 88, 87, 90, 91	Botanical Surveys	V. Kricsfalusy
Aug. 12/08	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 16, 17, 18, 19, 20, 21	Vegetation mapping, Botanical Surveys	V. Kricsfalusy
Aug. 20/08	27, 28, 34, 35, 36, 38, 41, 42, 43, 44, 45, 46, 103, 104	Vegetation mapping, Botanical Surveys	V. Kricsfalusy
Aug. 28/08	26, 39, 40, 47, 48, 72, 75, 76, 77, 80, 84, 85, 86, 111, 112	Vegetation mapping, Botanical Surveys	V. Kricsfalusy
Sept. 24/08	64, 78, 81, 82, 83, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95	Vegetation mapping, ELC classification, Botanical Surveys	V. Kricsfalusy
Sept. 30/08	14, 15, 20, 22, 23, 24, 25, 26, 27, 28, 30, 31, 58, 59, 63, 69, 70, 71, 73, 74, 99	Vegetation mapping, ELC classification, Botanical Surveys	V. Kricsfalusy
Oct. 10/08	49, 50, 51, 52, 53, 54, 55, 56, 57, 60, 62, 65, 66, 67, 68, 93, 95, 96, 100, 101, 102	ELC classification, Vegetation mapping, Botanical Surveys	V. Kricsfalusy
Nov. 04/08	1, 2, 3, 4, 5, 20, 21, 24, 27, 29, 31, 34, 35, 37, 38, 39, 41, 42, 43, 44, 46, 52, 53, 55, 63, 64, 67, 70, 73, 80, 81, 91, 92, 93, 108, 109, 110, 114, 115, 120, 121, 122	ELC classification, Vegetation mapping	J. Dougan, V. Kricsfalusy

4.7.3.3 Wildlife Resources

Wildlife data was incorporated from surveys beginning in 2005 as part of the Northwest Brampton subwatershed characterization, which included the Fletcher's Creek headwaters north of Mayfield Road. Surveys continued through 2006 and 2007 and documented calling frogs and toads using roadside surveys and walk-in surveys. Breeding bird work was also conducted in 2006 and 2007 in the Fletcher's Creek headwater area. The remainder of the Mayfield West study area was surveyed during the spring and summer of 2008 to document breeding birds and calling amphibians. Selective surveys were conducted in the summer and fall of 2008 for odonates (damselflies and dragonflies), snakes and other fauna. Incidental wildlife observations were also made on September 15, 2006 and October 26, 2006 during vegetation surveys. No winter surveys are scheduled based on the approved work plan. Details of the various wildlife survey visits are summarized in Table 4.7.5.

Nocturnal amphibian call surveys were conducted in the vicinity of all wetland and aquatic features. Calling levels were documented according to the Marsh Monitoring Program protocol (BSC, 2003). Breeding birds were documented from almost all natural and semi-natural communities according to the Ontario Breeding Bird Atlas protocols (OBBA, 2001). The timing (June through early July) corresponded with the peak singing for most songbirds. All existing woodlots were surveyed, as were the successional areas. Given the extent of agricultural lands within the survey area, open country species, a bird category showing significant declines across North America, were documented.

Table 4.7.5. Summary of Survey Dates, Times and Weather – Wildlife

	Date	Observer	Time	Person Hrs	Weather Conditions*	Purpose
1	April 18, 2005	K. Konze	2249 – 2255 2325 –2327 2328 – 2332	0.200	Wind 1 from SW. Temp. 9.5° C.	Roadside amphibian call survey
2	May 28, 2005	K. Konze	2239 – 2254	0.250	Mostly cloudy. Temp. ≈ 14° C. SW winds at 14 km/hr.	Roadside amphibian call survey
3	April 18, 2006	C. Cecile	2131 - 2147	0.266	Wind 1 to 2, Temp. 9° C. Clear.	Roadside amphibian call survey
4	May 24, 2006	C. Cecile	2332 – 2335	0.050	Partly cloudy, calm. 14 °C.	Walk-in amphibian call survey
5	June 1, 2006	C. Cecile	2125 – 2155	0.500	Mostly clear, calm, 17° C.	Walk-in and roadside amphibian call surveys
6	July 7, 2006	C. Cecile	0730 – 0830	1.000	Sunny, clear & calm. 20 – 23° C.	Breeding bird & miscellaneous wildlife survey
7	April 22, 2007	C. Cecile	2035 – 2210	1.583	Wind 0. Temp. 16° C at start.	Walk-in amphibian call survey
8	June 17, 2007	K. Konze	0545 – 1005	4.333	Mostly overcast. Slight breeze from NW. 21° – 27° C.	Breeding bird & miscellaneous wildlife survey
9	April 16, 2008	C. Cecile	2035 – 2325	2.833	Wind 3 to 1, Temp. 13° – 6° C.	Walk-in amphibian call survey
10	April 17, 2008	C. Cecile	2031 – 2305	2.566	Wind 0, Temp. 15° – 11° C	Walk-in amphibian call survey
11	April 18, 2008	C. Cecile	2034 – 2204	1.500	Wind 0, Temp. 17° – 15° C	Roadside amphibian call survey
12	May 26, 2008	C. Cecile	2120 – 0035	3.25	Wind 3 to 1, Temp. 23° – 17° C	Walk-in amphibian call survey
13	May 28, 2008	C. Cecile	2110 – 2210	1.00	Wind 3 to 2, Temp. 12° – 10° C	Roadside amphibian call survey
14	June 25, 2008	C. Cecile	0540 – 1015	4.583	Sunny, bright. Wind 0 to 4/5, Temp. 13° C to ≈ 20°C	Breeding bird & miscellaneous wildlife survey
15	June 26, 2008	C. Cecile	0540 – 0945	4.083	Bright, sunny. Wind 0 to 3/4. Temp. 19° C to ≈ 25° C.	Breeding bird & miscellaneous wildlife survey
16	June 27, 2008	C. Cecile	0535 – 0920	3.750	Bright, partly cloudy to overcast. Wind 0. Temp. ≈ 25 C.	Breeding bird & miscellaneous wildlife survey
17	July 2, 2005	C. Cecile	0630 – 1010	3.666	Sunny, bright. Wind 2 to 4/5, Temp. ≈ 14° C	Breeding bird & miscellaneous wildlife survey
18	July 4, 2008	C. Cecile	0640 – 0945	3.083	Bright, sunny. Wind 1 to 2/3, Temp. ≈ 15° C to ≈ 20° C.	Breeding bird & miscellaneous wildlife survey
19	July 5, 2008	C. Cecile	0605 – 0930	3.416	Bright, sunny. Wind 1. Temp. 13° C to ≈ 20°+ C.	Breeding bird & miscellaneous wildlife survey
20	July 25, 2008	K. Konze	1010 – 1500	4.833	Sunny. 22° – 27° C.	Breeding bird, odonate and miscellaneous wildlife survey
21	September 26, 2008	K. Konze	1030 – 1330 1345 – 1445	4.000	Sunny changing to cloudy, slight ENE breeze. 21.3° C –	Reconnaissance, miscellaneous wildlife survey
22	September 29, 2008	K. Konze	1130 – 1330 1345 – 1445	3.000	Mostly cloudy. Winds 2 from SE. Temp. ≈ 8° – 6° C.	Reconnaissance, miscellaneous wildlife survey
			Total hours	**53.750hrs**		

* Winds speeds refer to Beaufort scale.

All wildlife species documented in the Mayfield West study area between 2005 and 2008 were entered into a wildlife database created for this study. As of November 24, 2008 this contains 818 records, including negative data where no species were detected (***e.g***. roadside amphibian call survey stop). Most observations have corresponding UTM (Universal Transverse Mercator) location information (i.e. they can be mapped), and others are linked directly to specific vegetation polygons. The database was created to facilitate analysis of results (e.g. mapping significant wildlife observations), but could also potentially serve as a foundation for additional observations to be added later in the planning process. The following information was entered into the database for each record:

- Wildlife Observation Number
- Polygon Number
- Fauna Code (which populates Common & Scientific Name)
- Observer
- Observation Date
- UTM coordinates
- Data Source
- Comments
- Amphibian Call Code
- Breeding Status
- Breeding Bird Evidence
- Local Breeding Status
- Number of Individuals

4.7.4. Results

Note: The following report sections should be considered preliminary based on the ongoing review of data. Further refinement of text and mapping is anticipated.

4.7.4.1 Significant Natural Heritage Features

No life science or earth science Areas of Natural and Scientific Interest (ANSI's) have been identified by MNR within the study area. One plant species was identified that is currently listed as 'Endangered' in Ontario by MNR, and two wildlife species listed as 'Special Concern' in Ontario were documented. There are no designated Environmentally Sensitive or Significant Areas within the study area. The ravines of Etobicoke Creek qualify as Natural Corridors as defined in draft ROPA 21. Although degraded in some areas by active agricultural uses, the valleys associated with Etobicoke Creek are well defined as distinctive landforms, and meet the ROPA 21 definitions as Valley and Stream Corridors, and as Significant Valleylands as defined in the PPS and Greenbelt Plan. No sand barrens, savannahs, tallgrass prairies or alvars have been identified in the study area. Fish habitat, Wetlands, Significant Woodlands and Significant Wildlife Habitat are discussed in other sections of this report.

4.7.4.2 Vegetation Resources

Vegetation Communities

A total of 124 ELC vegetation polygons were documented in 2007 - 2008 field surveys in the Mayfield West study area. Data was included for 10 ELC vegetation polygons that were assessed in the Fletcher's Creek headwaters in 2007. Polygons identified in 2007 were merged with the data collected in 2008 as they were found to be similar in character. Current ELC mapping of vegetation resources is shown on Figure T1 (ref. Appendix 'H-2').

Overall 15 different ELC Community Series were documented, and further classified into 57 Vegetation Types. Vegetation Type is the most detailed category of the ELC Classification system and is based on the dominant plant species in the polygon. The Vegetation Type is part of an ecosite, and represents a specific assemblage of species which generally occur in a site with a more uniform parent material, soil and hydrology, and a more specific stage within a chronosequence.

In some cases, particularly for the cultural communities, there are no existing categories in published ELC classification system (Lee ***et al***., 1998) which describes the dominant vegetation encountered in some of the sites. In other cases, disturbed or successional communities are too heterogeneous to fit into one vegetation type. We applied the most current ELC vegetation type codes, (MNR draft, 2007) and the TRCA List of Vegetation Communities, 2008 (draft). The breakdown of the polygons by Community Series and Vegetation Types for the study area is shown in Appendix 'H-2'. Table 4.7.6 summarizes the general vegetation cover types and percentage by polygon type.

Table 4.7.6. Summary of Polygons by General Cover Type

Cover Type	**# of Polygons**	**Area (ha)**	**% Study Area**
Anthropogenic	39	60.16	7.59
Agricultural	22	580.33	73.26
Cultural (meadow, plantation, thicket, hedgerow, savannah, woodland)	31	45.52	5.73
Forest	39	63.53	8.02
Other Natural (native thicket, hedgerow, savannah, woodland)	15	8.74	1.13
Wetland (swamp, marsh)	36	33.30	4.20
Aquatic	3	0.53	0.07
Total study area	**185**	**792.11**	**100.00**

Active agriculture is the most abundant land cover type, representing 73.26% of the study area, with anthropogenic uses (built uses and manicured areas) making up 7.59%. Natural cover comprises 13.42%, with the most abundant natural cover type being forest (upland and swamp), representing 8.02% of the study area. Wetlands, including swamps and marshes, constitute 4.20% of the study area. Cultural cover (meadows, plantations, thickets, hedgerows, savannahs, and woodlands) makes up 5.73%. Hedgerows in the study area are generally small, linear features and the majority have significant gaps in canopy which limits their function as local linkages. For the most part they do not form discrete connections between natural features.

On the non-agricultural/anthropogenic lands, the majority of vegetation communities are represented by forests (deciduous, mixed and coniferous). Deciduous Forests are the most numerous natural habitats in the study area, representing a total of 35 polygons. Upland forests (20 polygons) are very common, the majority being dominated by Sugar Maple in association with other hardwoods. Lowland Deciduous Forests are also common in the study area (15 polygons), occurring as individual communities or as pockets within or adjacent to larger upland forests. Green Ash Swamps and Silver Maple Swamps are most common Deciduous Swamp types in the study area. However, Green Ash Swamps tend to be more disturbed and of lower quality than the Silver Maple and Red Maple Swamps.

The majority of Lowland Deciduous Forests, Deciduous Swamps and Meadow Marshes are associated with Etobicoke Creek and headwater tributaries of Fletcher's Creek. Less common natural habitats in the study area include Swamp Thickets, Shallow Marshes and Shallow aquatic vegetation types.

Active agriculture is the most abundant land cover type, representing 73.43% of the study area, with anthropogenic uses (built uses and manicured areas) making up 7.59%. Natural cover comprises 13.44%, with the most abundant natural cover type being forest (upland and swamp), representing 8.07% of the study area. Wetlands, including swamps and marshes, constitute 4.32% of the study area. Cultural cover (meadows, plantations, thickets, hedgerows, savannahs, and woodlands) makes up 5.54%. Hedgerows in the study area are generally small, linear features and the majority have significant gaps in canopy which limits their function as local linkages. For the most part they do not form discrete connections between natural features,

A total of 20 polygons (L1-L4 ranks) documented in the study area have been rated as less common according to TRCA ranking of vegetation communities; these are summarized in Table 4.7.7. They collectively constitute 5.09% of the study area, and include almost equal parts of forest (2.66%) and wetland (2.32%) vegetation communities. None of these communities have been rated as provincially rare (NHIC 2008).

Table 4.7.7. List of Significant Vegetation Communities Documented in the Study Area					
ELC Code	**Vegetation Type**	**TRCA Status[1]**	**Number of Polygons**	**Area (ha)**	**% Study Area**
SWT3-1	Alder Organic Thicket Swamp	L2	1	0.30	0.04%
FOD9-4	Fresh-Moist Shagbark Hickory Deciduous Forest	L2	1	4.25	0.54%
FOD4-1	Dry-Fresh Beech Deciduous Forest	L3	3	3.17	0.40%
SAS1-1	Pondweed Submerged Shallow Aquatic	L3	1	0.08	0.01%
SWD3-1	Red Maple Mineral Deciduous Swamp	L3	1	0.25	0.03%
SWD3-2	Silver Maple Mineral Deciduous Swamp	L3	2	2.15	0.27%
SAS1-2	Waterweed Submerged Shallow Aquatic	L3	1	0.38	0.05%
MAM2-6	Broad-leaved Sedge Mineral Meadow Marsh	L4	1	0.10	0.01%
FOD4-G	Dry-Fresh Basswood Deciduous Forest	L4	1	1.73	0.22%
FOD4-H	Dry-Fresh Hawthorn - Apple Deciduous Forest	L4	2	3.42	0.43%
FOD5-6	Dry-Fresh Sugar Maple - Basswood Deciduous Forest	L4	1	1.99	0.25%
FOD5-3	Dry-Fresh Sugar Maple - Oak Deciduous Forest	L4	1	2.36	0.30%
FOD5-10	Dry-Fresh Sugar Maple - Paper Birch - Poplar Deciduous Forest	L4	3	5.54	0.70%
FOD5-9	Dry-Fresh Sugar Maple - Red Maple Deciduous Forest	L4	1	0.91	0.11%
FOC3-1	Fresh-Moist Hemlock Coniferous Forest	L4	1	1.10	0.14%
FOD6-1	Fresh-Moist Sugar Maple - Ash Deciduous Forest	L4	2	4.25	0.54%
SWD2-2	Green Ash Mineral Deciduous Swamp	L4	3	2.58	0.33%
SWD4-3	Paper Birch - Poplar Mineral Deciduous Swamp	L4	1	0.79	0.10%
SAS1-3	Stonewort Submerged Shallow Aquatic	L4	1	0.08	0.01%
SWD3-3	Swamp Maple Mineral Deciduous Swamp	L4	2	4.90	0.62%
	Total		**30**	**40.31**	**5.09%**

[1]Status based on the TRCA List of vegetation communities, 2008.

Vegetation Species

Biodiversity studies have often been considered only in terms of species richness for a given area. Species richness, however, is only one aspect of biodiversity (Bisby 1995). Species composition, ecosystem processes and species abundance are also important measures of biodiversity for prioritizing conservation areas. Complicated regional patterns of species assemblages may originate from the operation and interaction of historical, causal, and functional factors (Bisby 1995).

Three hundred forty four (344) vascular plant taxa (species, subspecies, varieties and native hybrids) that belong to 75 families and 211 genera were documented by Dougan & Associates and TRCA from the study area (Appendix H-3). The analysis of systematic structure of the flora (Table 4.7.8) shows that the top 10 families together include more than half of all documented species (201 taxa or 58.4% of total). The largest number of species (125 taxa or 36.2% of total) belongs to ***Asteraceae, Cyperaceae, Poaceae*** and ***Rosaceae*** families. The top 10 genera include almost one quarter of all species diversity (81 taxa or 23.6% of total). Such genera as ***Carex, Salix, Aster (sensu lato)*** and ***Solidago*** take the leading place of species richness and together they include 15% of all flora species in the study area.

Table 4.7.8. Statistics on Flora in the Study Area

No.	Family	# species	% total	Genus	# species	% total
1	***Asteraceae***	42	12.2	***Carex***	28	8.1
2	***Cyperaceae***	33	9.6	***Salix***	10	2.9
3	***Poaceae***	25	7.2	***Aster s.l.***[1]	7	2
4	***Rosaceae***	25	7.2	***Solidago***	7	2
5	***Brassicaceae***	15	4.4	***Acer***	6	1.7
6	***Liliaceae***	15	4.4	***Cardamine***	5	1.5
7	***Salicaceae***	14	4.1	***Geum***	5	1.5
8	***Fabaceae***	13	3.8	***Rubus***	5	1.5
9	***Ranunculaceae***	11	3.2	***Dryopteris***	4	1.2
10	***Dryopteridaceae***	8	2.3	***Elymus***	4	1.2
	Subtotal	201	58.4	***Subtotal***	81	23.6
	Total # species	**344**	**100**	**Total # species**	**344**	**100**

[1] Includes: ***Aster (sensu stricto), Eurybia*** and ***Symphyotrichum.***

Small families are often ignored during flora analysis at the local level. At the same time they could be an important component of local biodiversity and great interest for conservation. It has been estimated that 28 families in the study area include only one genera/species, and a quarter of them are identified as significant species with the L3-L4 TRCA rank .

One hundred seventeen (117) introduced or exotic plant species of the flora (34% of total) were documented from the study area. The list of top families that include more than half of all introduced species (51.3%) area as follows: ***Asteraceae* -**18 species***, Poaceae* -**12 species***, Brassicaceae*** and ***Fabaceae* -** each with 11 species, and ***Rosaceae*** – 8 species. Introduced plant species are usually infrequent in natural habitats of the study area; they are mainly restricted to agricultural habitats, and they penetrate within disturbed natural habitats.

A numerical value (Wetness Index) has been assigned for flora species of Ontario (Oldham et al. 1995) which reflects their relative affinity for and tolerance of wetland conditions. Applying this approach to analysis of plant species habitat preferences in the study area the ecological spectrum of the flora was created (Figure 4.7.1). It shows that overall flora of the study area is dominated by upland plants (84 species or 26%) followed by obligate wetland plants (45 species or 14%) and group of facultative plants (41 species or 14%) that equally likely to occur in wetlands or non-wetlands.

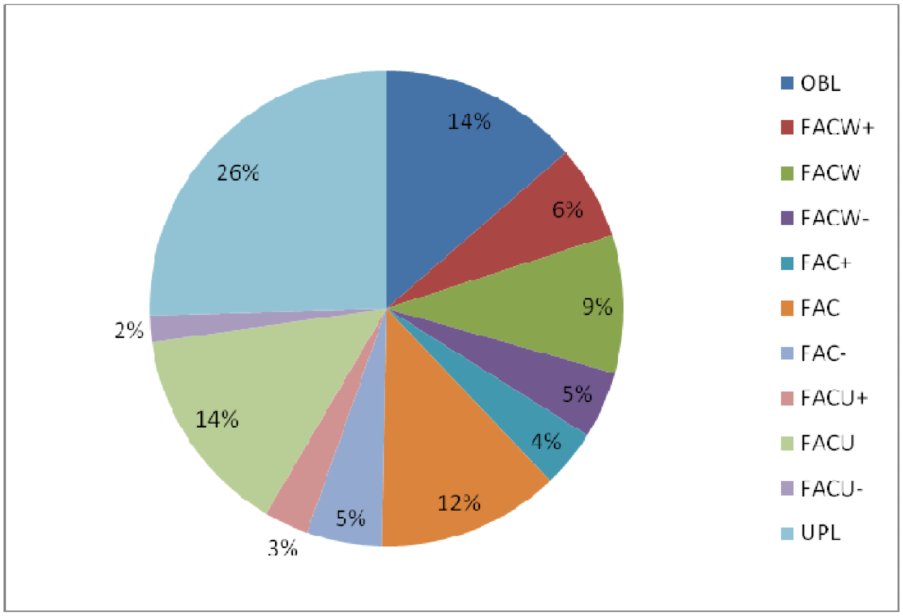


Figure 4.7.1. Ecological spectrum of the flora of the study area: wetness index - OBL, FACW+, FACW, FACW-, FAC+, FAC, FAC-, FACU+, FACU, FACU-, UPL (see Appendix H-3 for species ratings).

The distribution of 93 significant plant species was GPS documented during the 2008 field season. In addition, in 2006-2007, Dougan & Associates observed 16 significant plant species within the Fletcher's Creek headwaters portion of the study area. Of these, 6 species were tied to specific ELC polygons, and the remaining 10 species were documented with greater accuracy by GPS in 2008. Therefore, the total number of significant plant species documented to date by Dougan & Associates totals 99 species. TRCA provided data on 41 significant plant species, 9 of which were not observed by Dougan &Associates. Therefore, the final list of significant plants documented in the study includes 108 species or 31.4% of total flora species. These are summarized in Table 4.7.9 including their status. Locations are summarized on Figure T1. Distribution of significant plant species is further discussed below.

Of the total 108 significant species documented to date in the study area, 42 are considered uncommon or rare in Peel Region and 39 in the GTA (Varga ***et al.,*** 2005). The highest number of significant species – 108 are ranked in the TRCA List of vascular plant species (2008), and 31 of them are rare for the CVC jurisdiction (Kaiser 2000). One provincially (OMNR 2008) and federally (COSEWIC 2008) "Endangered" species, Butternut (***Juglans cinerea***), was documented. Two provincially rare species, sharp-leaved goldenrod (***Solidago arguta var. arguta***) and honey locust (***Gleditsia triacanthos***) were also documented; the latter species consisted of planted roadside specimens and is not a concern in the study area. Despite the fact, that number of significant plant species documented in the study area is relatively high, it should be noted that only 46 species (42.6% of total significant plants) are included in more than two different status lists. Furthermore, more than half of the significant plants (59 species or 54.6% of its total) have some status only at the TRCA jurisdiction.

Table 4.7.9. List of Significant Plant Species Documented in the Study Area

Scientific Name	Common Name	Data Source		Species Status*						
		D&A	TRCA	COSEWIC	MNR	SRank	Peel	GTA	TRCA	CVC
Acer rubrum	Red Maple	x							L4	
Acer saccharinum	Silver Maple	x							L4	
Actaea pachypoda	White Baneberry	x							L4	
Alisma plantago-aquatica	Broad-leaved Water-plantain	x							L4	
Allium tricoccum	Wild Leek	x							L3	
Alnus incana spp. rugosa	Speckled Alder	x	x						L3	
Amelanchier laevis	Smooth Serviceberry	x					U	U	L4	
Anemone quinquefolia var. quinquefolia	Wood Anemone	x	x					U	L3	
Apocynum androsaemifolium ssp. androsaemifolium	Spreading Dogbane	x							L4	
Arisaema triphyllum ssp. triphyllum	Jack-in-the-pulpit	x							L4	
Asclepias incarnata ssp. incarnata	Swamp Milkweed	x							L4	
Betula alleghaniensis	Yellow Birch	x							L4	
Betula papyrifera	Paper Birch	x							L4	
Bidens vulgate	Tall Beggar's Ticks	2006					R1	U	L3	L
Boehmeria cylindrical	False Nettle	x							L4	
Caltha palustris	Marsh Marigold	x							L4	
Cardamine concatenate	Cutleaf Toothwort	x							L3	
Cardamine diphylla	Broad-leaved Toothwort	x							L4	
Cardamine bulbosa	Spring-Cress	x	x				E	R6	L2	R/L
Cardamine pensylvanica	Pennsylvania Bitter-cress	x					U	U	L4	
Carex bromoides	Brome-like Sedge	2006					R3	R	L3	R/L
Carex brunnescens ssp. brunnescens	Brownish Sedge	2006					R3	R	L3	R/L
Carex communis	Fibrous-root Sedge	x	x						L4	
Carex crinita	Fringed Sedge	x	x				U	U	L3	
Carex gracillima	Graceful Sedge	x	x						L4	
Carex grayi	Asa Gray Sedge	x					R3	R	L2	R/L
Carex hirtifolia	Pubescent Sedge	2006					R3	U	L3	L
Carex intumescens	Bladder Sedge	x							L4	
Carex lacustris	Lake-bank Sedge	x							L4	
Carex laxiflora	Loose-flowered Sedge	x	x				R7	U	L4	L
Carex lupulina	Hop Sedge	x	x						L3	
Carex molesta	Troublesome Sedge	x	x				R5	U	L3	L
Carex pensylvanica	Pennsylvania Sedge	x							L4	
Carex scoparia	Pointed Broom Sedge	2007					R5	R	L3	R/L
Carex sprengelii	Long-beaked sedge		x				R1	R	L4	R/L
Carex tenera	Slender Sedge	x							L4	
Carex tribuloides	Blunt Broom Sedge	2006					R5	R	L3	R/L
Carex tuckermanii	Tuckerman Sedge	x	x					U	L3	L
Carya ovata var. ovata	Shagbark Hickory	x	x					U	L3	
Caulophyllum giganteum	Blue Cohosh	x							L4	R/L
Ceratophyllum demersum	Coontail		x						L3	
Chelone glabra	Turtlehead		x				U	U	L3	
Cinna arundinacea	Stout Wood Reedgrass	x					R3	R	L3	R/L

Table 4.7.9. List of Significant Plant Species Documented in the Study Area										
Scientific Name	**Common Name**	**Data Source**		**Species Status***						
		D&A	**TRCA**	**COSEWIC**	**MNR**	**SRank**	**Peel**	**GTA**	**TRCA**	**CVC**
Cinna latifolia	Slender Wood Reedgrass	x					R4	U	L3	L
Claytonia caroliniana	Carolina Spring Beauty	x	x				R5	U	L3	L
Claytonia virginica	Narrow-leaved Spring Beauty	x	x						L3	
Cystopteris tenuis	Machay's Fragile Fern	x	x				U	U	L2	
Dicentra canadensis	Squirrel-corn	x	x				U	U	L3	
Diervilla lonicera	Northern Bush-honeysuckle	x							L4	
Dryopteris clintoniana	Clinton Wood Fern	x	x				R6	U	L2	L
Dryopteris intermedia	Evergreen Wood Fern	x							L4	
Dryopteris marginalis	Marginal Wood Fern	x							L4	
Elodea canadensis	Broad Waterweed	x	x				R3	U	L3	L
Elymus hystrix	Bottle-brush Grass	x							L4	
Elymus riparius	River-bank Wild-rye	x					R3	R	L4	R/L
Epifagus virginiana	Beechdrops	x							L4	
Equisetum pratense	Meadow Horsetail	x					R7	R	L3	R/L
Equisetum sylvaticum	Woodland Horsetail	x	x				U	R	L3	R
Euonymus obovata	Running Strawberry-bush	x	x						L3	
Fagus grandifolia	American Beech	x							L4	
Galium palustre	Marsh Bedstraw	x							L4	
Geum laciniatum	Cut-leaved avens		x				U		L3	R-A
Gleditsia triacanthos*	Honey Locust	x				S2			L+	
Gymnocarpium dryopteris	Oak Fern	x	x						L3	
Iris versicolor	Blue flag		x				U		L3	
Juglans cinerea	Butternut	x	x	END	END				L3	
Juncus effusus ssp. solutus	Soft Rush	x							L4	
Leersia virginica	White Cutgrass	x					R4	R	L4	R/L
Lilium michiganense	Michigan Lily	x	x				U	U	L3	
Luzula acuminata	Hairy Woodrush	x					U	U	L3	
Lycopus americanus	American Bugleweed	x							L4	
Maianthemum canadense	Wild-lily-of-the-valley	x							L4	
Monotropa uniflora	Indian-pipe	x							L3	
Oryzopsis asperifolia	White-fruited mountain-rice		x						L3	U
Picea glauca*	White Spruce	x					R3		L3	L
Pinus strobus	Eastern White Pine	x							L4	
Podophyllum peltatum	May Apple	x							L4	
Polygonatum pubescens	Downy Solomon's Seal	x							L3	
Polygonum amphibium	Water Smartweed	x	x				U		L3	
Polystichum acrostichoides	Christmas Fern	x	x						L3	
Potamogeton natans	Floating Pondweed	x	x				U	U	L3	
Quercus alba	White Oak	x							L2	
Quercus macrocarpa	Bur Oak	x							L4	
Quercus rubra	Northern Red Oak	x							L4	
Rubus pubescens	Dwarf Raspberry	x	x						L4	
Rudbeckia hirta	Black-eyed Susan	x							L4	
Sagittaria latifolia	Broadleaf Arrowhead	x							L4	
Salix amygdaloides	Peach-leaved Willow	x					R6		L4	L
Salix bebbiana	Bebb's Willow	x							L4	
Salix discolor	Pussy Willow	x							L4	

Table 4.7.9. List of Significant Plant Species Documented in the Study Area										
Scientific Name	**Common Name**	**Data Source**		**Species Status***						
		D&A	**TRCA**	**COSEWIC**	**MNR**	**SRank**	**Peel**	**GTA**	**TRCA**	**CVC**
Salix lucida	Shining willow		x				R5	U	L3	L
Schoenoplectus tabernaemontani	Soft-stemmed Bulrush	x							L4	
Scirpus cyperinus	Cottongrass Bulrush	x							L3	
Sisyrinchium montanum	Blue-eyed grass		x				L5		L3	L
Smilax tamnoides	Hispid Greenbrier	x					U	U	L4	
Solidago arguta var. arguta	Sharp-leaved goldenrod		x			S3	R2	R	L3	
Solidago patula	Rough-leaved Goldenrod	x					R4	R	L3	R/L
Sparganium eurycarpum	Large Bur-reed	x	x				R6	U	L3	L
Spiraea alba	Narrow-leaved Meadowsweet	x	x						L3	
Streptopus lanceolatus var. roseus	Rosy Twisted-stalk	x	x						L3	
Tiarella cordifolia	Heart-leaved Foam-flower	x							L4	
Trillium erectum	Red Trillium	x							L3	
Trillium grandiflorum	White Trillium	x							L3	
Tsuga canadensis	Eastern Hemlock	x							L4	
Typha latifolia	Broad-leaf Cattail	x							L4	
Uvularia grandiflora	Large-flowered Bellwort	x	x						L3	
Viola affinis	Lecontes Violet	x	x				R3	U	L3	
Waldsteinia fragarioides	Barren Strawberry	x	x						L4	
	Total	**99**	**41**	**1**	**1**	**2**	**42**	**39**	**108**	**31**

* Species status based on: ***COSEWIC*** 2008; ***OMNR*** 2008; ***Status of the Vascular Plants of the Greater Toronto Area*** (Varga ***et al***. 2005); ***TRCA*** List of vascular plant species 2008; ***CVC*** (Kaiser 2000); see Appendix D for details.
** Species was found in cultural unit and was likely planted.

The distribution of significant plant species within vegetation communities is generally uneven. Of the species listed in Table 4.7.9, 41 were observed in only one polygon, 34 in 2-3 polygons, 27 in 4-8 polygons, and 6 species in more than 10 polygons. Of the species considered significant by TRCA, White Trillium, May Apple, Running Strawberry-bush, Fringed and Bladder Sedges, Barren Strawberry, Michigan Lily, Christmas Fern and Carolina Spring Beauty are the most widespread in the study area.

Overall no correlation between the number of significant plant species per polygon and the size of the polygon was identified. Significant plant species richness (the number of significant species per 1 ha of given polygon) varied from 0 to 20.87. Only in two of the ten polygons with high significant plant species richness (9.90-20.87) could a positive correlation between the size and area parameters be identified. Those polygons are Swamp Maple Mineral Deciduous Swamp (Polygon 1) and Dry-Fresh Beech Deciduous Forest (Polygon 2).

4.7.4.3 Significant Woodlands

Significant Woodlands are identified in the PPS (2005) and the Greenbelt Plan (2005) for protection. In February 2009, the Region of Peel released Draft ROPA 21 which upon approval will update the Natural Heritage Policies within the Regional OP. The present updated characterization has applied the draft criteria for Significant Woodlands under these draft policies.

Features that meet the Significant Woodlands Criteria are noted on Figure T1 in Appendix ‘H’. Under the draft criteria, woodlands within the rural area which exceed 16 h in size, are considered Core Significant Woodlands; for those in the urban area the draft criterion threshold area is 4 ha. Woodlands located in the rural area which are between 4 and 16 ha in size are considered Natural Areas and Corridors (NAC); for the urban area the NAC size criterion is 2 to 4 ha. Features that are 0.5 ha or larger may be considered as NAC if they contain at least 0.5 ha of woodland older than 90 years, if they are identified as supporting a linkage function in a natural heritage study approved by the Region of area municipality, if they are within 100 m of another significant feature, of if they are within 30 m of a watercourse, surface water feature, or evaluated wetland.

On the basis of these criteria, all of the woodlands and forested valley lands in the study area would qualify as Significant Woodlands, under a rural definition. The three tableland woodlots (one traversed by railway tracks) all contain wetlands that have been evaluated by MNR. The valley features either meet the Core size thresholds or are associated with the tributaries of Etobicoke Creek, and with wetlands (identified by MNR but yet to be evaluated).

4.7.4.4 Wetlands

The Fletcher’s Creek headwaters wetlands mapped by MNR in 2005 and 2006 are currently being evaluated to determine wetland significance. In January 2009 the Caledon Area Wetland Mapping was provided by MNR. (Appendix H-6). As indicated on the MNR mapping, small wetlands are scattered mainly within the Fletcher’s Creek headwaters area in conjunction with upland forest units while medium size wetland complexes tending to be located in the Etobicoke Creek headwaters area along watercourses. There are no Provincially Significant Wetlands assigned to date.

There are some minor differences between MNR wetland mapping (using the Ontario Wetland Evaluation System) and wetland mapping according to the Ecological Land Classification system (as shown on Figure T1 in Appendix ‘H’) which we conducted in 2008. Wetlands in Fletcher’s Creek headwaters area were mapped almost identically under both systems, except for two small areas (approximately 0.5 ha) that we had recognized as inclusions within polygons 20 and 12.

Wetland mapping in our 2008 study was more detailed than what is indicated on current MNR wetland mapping for the Etobicoke Creek portion of the study area. MNR intends to refine its coverage in this area.

Existing wetland cover currently represents 4.32% of cover the Mayfield West study area, which is below the Environment Canada guidelines (1998) which recommend that 6% of any subwatershed should be comprised of wetlands to reduce flooding and increase baseflow of streams. This deficiency should be addressed through works associated with surface water management in the study area.

4.7.4.5 Wildlife Resources

The following summary reflects data collected by Dougan & Associates (D&A) between 2005 and 2008, as well as data collected by the Toronto and Region Conservation Authority (TRCA) between 1996 and 2003. The TRCA data was integrated into the summary since the data was considered relatively current and helps provide additional insight as to the range of species supported by the Mayfield West study area. The multi-year year data suggests that not all species are present every year.

One hundred and fifteen (115) species of wildlife were documented from the Mayfield West study area by Dougan & Associates and TRCA (Appendix H-5). This included 14 species of odonates (damselflies and dragonflies), 12 species of butterflies, 8 species of amphibians and reptiles, 71 species of birds, and 10 species of mammals. However, not all of the species were considered permanent or breeding residents. Four species were considered migrants and 2 others were observed during the breeding season but showed no evidence of breeding. Locations of significant wildlife observations, including those by TRCA, are indicated on Figure T1 in Appendix 'H'.

Significant Species

Of the 115 species, two are designated 'Species at Risk' (***i.e.*** designated "Special Concern", "Threatened" or "Endangered". This included the Monarch Butterfly (***Danaus plexippus***) and Short-eared Owl (***Asio flammeus***), both designated "Special Concern" in Ontario (OMNR, 2008) and Canada (COSEWIC, 2007; COSEWIC 2008). Monarchs were observed on four different occasions in the study area. Although some may have been migrants passing through, but Common Milkweed (***Asclepias syriaca***) and Swamp Milkweed (***Asclepias incarnata***), their primary larval food source, were observed in appropriate habitats in the study area suggesting they could also breed within the study area.

Short-eared Owl (***Asio flammeus***), a provincially rare species (***i.e.*** with a conservation rank of S1 [critically imperiled], S2 [imperiled], S3 [vulnerable], or S3S4[uncertain whether vulnerable or apparently secure] [NHIC 2008a,b,c,d,e,f]) was recorded on April 18, 2008 by Dougan & Associates field personnel. It was first observed just south of Old School Road, and later hunting along a grassy swale east of Chinguacousy Road. Subsequent visits were made to the same areas to determine if it was a local resident or a migrant; it was not detected again, and it was therefore considered a migrant. All of the other wildlife species recorded are designated S4 (apparently secure) or S5 (secure).

Seventeen (17) species of wildlife documented from the study area by D&A and/or TRCA are considered regionally significant (Table 4.7.10). All except one are breeding birds.

Table 4.7.10. Regionally Significant Wildlife Species Documented from the Mayfield West Study Area by Dougan & Associates and/or TRCA

No.	Common Name	Scientific Name	Breeding Habitat	Data Source	
				D&A	TRCA
Amphibians and Reptiles					
1	Red-bellied Snake	Storeria occipitomaculata	Woods/adjacent fields/pref. moist sites	X	X
Birds					
1	American Kestrel	Falco sparverius	Grassland/Agriculture/Open	X	
2	Black-billed Cuckoo	Coccyzus erythropthalmus	Shrub and Early Succession	X	X
3	Belted Kingfisher	Ceryle alcyon	Wetlands	X	
4	Northern Flicker	Colaptes auratus	Woods and Forests	X	
5	Eastern Wood Pewee	Contopus virens	Woods and Forests	X	X
6	Willow Flycatcher	Empidonax traillii	Shrub and Early Succession	X	
7	Eastern Kingbird	Tyrannus tyrannus	Grassland/Agriculture/Open	X	
8	Wood Thrush	Hylocichla mustelina	Woods and Forests	X	X
9	Brown Thrasher	Toxostoma rufum	Shrub and Early Succession	X	X
10	Vesper Sparrow	Pooecetes gramineus	Grassland/Agriculture/Open	X	
11	Savannah Sparrow	Passerculus sandwichensis	Grassland/Agriculture/Open	X	
12	Grasshopper Sparrow	Ammodramus savannarum	Grassland/Agriculture/Open		X
13	Rose-breasted Grosbeak	Pheucticus ludovicianus	Woods and Forests	X	X
14	Bobolink	Dolichonyx oryzivorus	Grassland/Agriculture/Open	X	X
15	Eastern Meadowlark	Sturnella magna	Grassland/Agriculture/Open	X	X
16	Baltimore Oriole	Icterus galbula	Woods and Forests	X	

Regional significance of breeding birds was determined using the list prepared by Ontario Partners in Flight for BCR 13(OPIF, 2008), the Lower Great Lakes - St. Lawrence Plain Bird Conservation Region (Figure 4.7.2). It is worth emphasizing that this only covers a subset of birds, albeit a large one, landbirds (OPIF, 2008). Other types of birds such as waterbirds (including waterfowl) and shorebirds are not included.

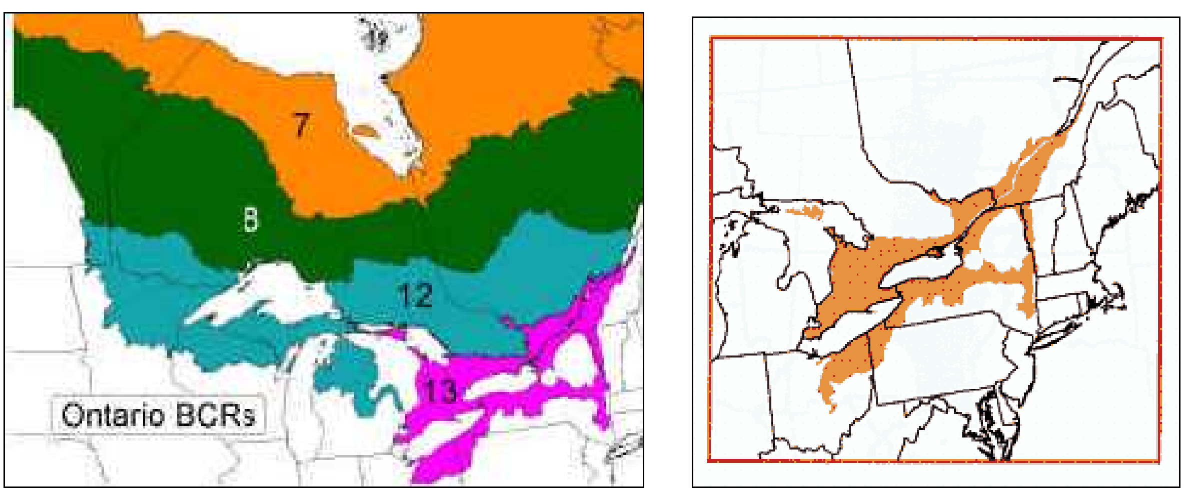


Figure 4.7.2: Location Maps showing the extent of BCR 13 (Ontario Partners in Flight, 2008)

Regional status lists only exist for one other group of wildlife species, amphibians and reptiles. Plourde ***et al.*** (1989) was used to determine regional significance for this group. Species listed as “uncommon” or “rare” were considered significant. It is also worth noting that the area covered by Plourde ***et al.*** (1989) is not ecologically defined; rather it is based on OMNR’s former “Central Region” planning jurisdiction (Figure 4.7.3).

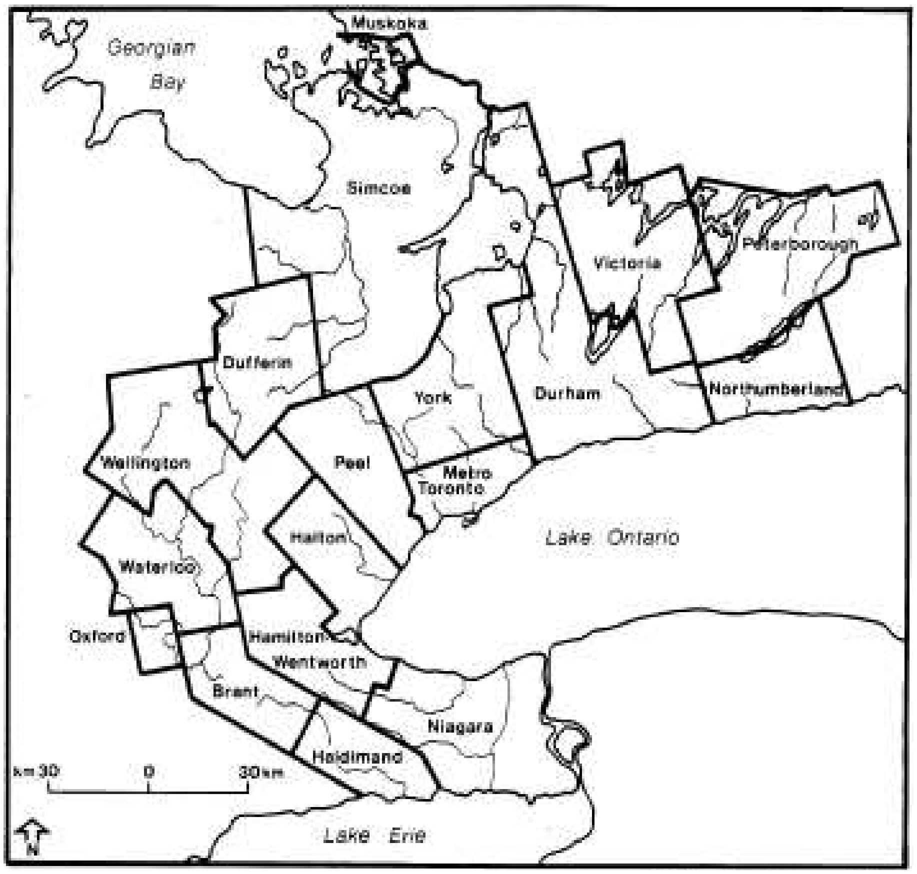


Figure 4.7.3: Ontario Ministry of Natural Resources former “Central Region”

Almost half (7) of the 16 landbird species observed are associated with grasslands or agriculture. Of the remaining 9 species, 3 are associated with successional areas, 5 with forests and one with wetlands (OPIF, 2006). This breakdown reflects the fact that the majority of the study area is dominated by agricultural land, successional areas associated with local drainage features and scattered, relatively isolated wooded areas. Breeding habitat descriptions are based on those used in the Ontario Breeding Bird Atlas (Cadman ***et al.,*** 2007).

With respect to the one regionally significant species of herpetofauna (amphibian and reptile), Red-bellied Snake (***Storeria occipitomaculata***), Plourde et al. (1989) do note that this species, along with a few others, appear to be under-recorded in “Central Region”, either through lack of search in appropriate habitats, or through difficulties in viewing species with secretive habits. This seems to suggest that if more effort was invested in searching for the species it may not be designated uncommon after all.

At the local scale, the Toronto and Region Conservation Authority (TRCA) and Credit Valley Conservation (CVC) have status lists that apply to their respective portions of the Mayfield West study area. Based on these lists, 33 of the resident species of wildlife documented in 2008 (5 amphibians and reptiles, 27 birds, and 1 mammal) are considered significant (Table 4.7.11).

Table 4.7.11. Locally Significant Resident Wildlife Species Documented from the Mayfield West Study Area by Dougan & Associates and/or TRCA.

No.	Common Name	Scientific Name	Breeding Habitat	Data Source	
				D&A	TRCA
Amphibians and Reptiles					
1	Gray Treefrog	Hyla versicolor	Ponds/swamps/floodings	X	
2	Spring Peeper	Pseudacris crucifer	Ponds/marshes/floodings/ditches	X	
3	Northern Leopard Frog	Rana pipiens	Marshes/ponds/ lake & stream edges	X	
4	Wood Frog	Rana sylvatica	Vernal ponds/wooded swamps	X	
5	Red-bellied Snake	Storeria occipitomaculata	Woods/adjacent fields/pref. moist sites	X	X
Birds					
1	Wood Duck	Aix sponsa	Wetlands	X	
2	Killdeer	Charadrius vociferus	Grassland/Agricultural/Open	X	
3	Upland Sandpiper	Bartramia longicauda	Grassland/Agricultural/Open	X	
4	American Woodcock	Scolopax minor	Woods and Forests	X	X
5	Yellow-billed Cuckoo	Coccyzus americanus	Shrub/Early Succession	X	
6	Black-billed Cuckoo	Coccyzus erythropthalmus	Shrub/Early Succession	X	X
7	Belted Kingfisher	Ceryle alcyon	Wetlands	X	
8	Hairy Woodpecker	Picoides villosus	Woods and Forests	X	
9	Pileated Woodpecker	Dryocopus pileatus	Woods and Forests	X	
10	Eastern Wood-Pewee	Contopus virens	Woods and Forests	X	X
11	Eastern Kingbird	Tyrannus tyrannus	Grassland/Agricultural/Open	X	
12	Horned Lark	Eremophila alpestris	Grassland/Agricultural/Open	X	
13	Cliff Swallow	Petrochelidon pyrrhonota	Grassland/Agricultural/Open	X	
14	Barn Swallow	Hirundo rustica	Grassland/Agricultural/Open	X	
15	Sedge Wren	Cistothorus platensis	Wetlands		X
16	Wood Thrush	Hylocichla mustelina	Woods and Forests	X	X
17	Gray Catbird	Dumetella carolinensis	Shrub/Early Succession	X	
18	Brown Thrasher	Toxostoma rufum	Shrub/Early Succession	X	X
19	American Redstart	Setophaga ruticilla	Woods and Forests	X	X
20	Ovenbird	Seiurus aurocapilla	Woods and Forests		X
21	Mourning Warbler	Oporornis philadelphia	Woods and Forests	X	X
22	Vesper Sparrow	Pooecetes gramineus	Grassland/Agricultural/Open	X	
23	Savannah Sparrow	Passerculus sandwichensis	Grassland/Agricultural/Open	X	
24	Grasshopper Sparrow	Ammodramus savannarum	Grassland/Agricultural/Open		X
25	Bobolink	Dolichonyx oryzivorus	Grassland/Agricultural/Open	X	X
26	Eastern Meadowlark	Sturnella magna	Grassland/Agricultural/Open	X	X
27	Common Grackle	Quiscalus quiscula	Grassland/Agricultural/Open	X	
Mammals					
1	Meadow Jumping Mouse	Zapus hudsonius	Fallow fields, woodland edges & shrubby thickets, esp. damp meadows		X

Ten of the significant bird species are categorized as "area-sensitive. This includes:

1. Upland Sandpiper (***Bartramia longicauda***) – open-country species
2. Hairy Woodpecker (***Picoides villosus***) – woodland species
3. Pileated Woodpecker (***Dryocopus pileatus***) – woodland species
4. White-breasted Nuthatch (***Sitta carolinensis***) – woodland species
5. American Redstart (***Setophaga ruticilla***) – woodland species
6. Ovenbird (***Seiurus aurocapilla***) – woodland species
7. Savannah Sparrow (***Passerculus sandwichensis***) – open-country species
8. Grasshopper Sparrow (***Ammodramus savannarum***) – open-country species
9. Bobolink (***Dolichonyx oryzivorus***) – open-country species
10. Eastern Meadowlark (***Sturnella magna***) – open-country species

Area-sensitive species require larger areas of suitable habitat in order to sustain their populations and are therefore considered more sensitive to habitat loss and fragmentation. Five of the identified species are associated with open-country habitats and five are associated with woodlands.

Damselflies and Dragonflies (Odonates)/Butterflies

Formalized surveys to document odonates (***i.e***. damselflies and dragonflies) and butterflies were not undertaken as part of this study. Incidental efforts to survey these groups of insects took place in July and September 2008. Nevertheless, 14 provincially common odonates and 12 provincially common butterflies were recorded (Appendix 'H-5'). No local (***i.e***. region of Peel) conservation status information currently exists for these groups.

Herpetofauna

Eight (8) species of herpetofauna (amphibians and reptiles) were documented from the Mayfield West study area by Dougan & Associates between 2005 and 2008 and Toronto and Region Conservation Authority (TRCA) between 1996 and 2003(Appendix E).

1. American Toad (***Bufo americanus***)
2. Gray Treefrog (***Hyla versicolor***)
3. Spring Peeper (***Pseudacris crucifer***)
4. Green Frog (***Rana clamitans***)
5. Northern Leopard Frog (***Rana pipiens***)
6. Wood Frog (***Rana sylvatica***)
7. DeKay's Brownsnake (***Storeria dekayi***)
8. Red-bellied Snake (***Storeria occipitomaculata***)

Species were generally distributed across the study area but nevertheless closely linked with waterbodies (i.e. riparian marshes and swamps) and uplands within existing natural features. Amphibian abundance was considered low to moderate and is likely a reflection of the fact that suitable breeding habitat is relatively limited in size and occurrence. American Toads (***Bufo***

americanus) were encountered most often and were most widespread. A full chorus of American Toads was heard next to the woodlot in the southeast corner of the study area and moderate numbers were also recorded elsewhere. Next most common was Wood Frog (***Rana sylvatica***) and Green Frog (***Rana clamitans***) respectively. The remaining amphibian species were only encountered once, suggesting their continued presence within the study area is tenuous. DeKay's Brownsnake and Red-bellied Snake were recorded twice each from opposite ends of the study area. Given the fact that snakes are not generally easily detected, it is possible that they may be more common than documented to date. Common Gartersnake should also be present within the study area. Suitable habitat is present.

Breeding Birds

Of the 71 species of birds documented from the Mayfield West study area by Dougan & Associates between 2005 and 2008 and/or Toronto and Region Conservation Authority (TRCA) between 1996 and 2003, 67 were documented during the breeding season. Of these 64 showed breeding evidence. All 71 species are listed in Appendix 'H-1'. Great Blue Heron (***Ardea herodias***), Turkey Vulture (***Cathartes aura)*** and Ring-billed Gull (***Larus delawarensis***) were either observed flying overhead, foraging or resting within the study area limits, but did not show direct breeding evidence. Great Blue Heron and Turkey Vulture were observed in or directly adjacent to suitable breeding habitat and therefore could be possible breeders. However, given the number of site visits made to the study area it is our expectation that any active heron nests would have been discovered. Great Blue Heron tends to be a colonial breeder making its nesting activity obvious. Four Turkey Vultures were observed sitting in a snag close to a deciduous woodlot, in the northwest corner of the study area on July 25, 2008. According to the breeding phenology of this species, the birds observed were likely roosting colonially rather than locally fledged young (Kirk & Mossman, 1998). If either Great Blue Heron and Turkey Vulture were breeding on site, they would be considered locally significant (TRCA 2008; CVC, 1997).

In general, the breeding bird surveys revealed patterns of occurrence typical of the extent and type of natural heritage features present within the Mayfield West study area. Open country breeding bird species present in the agricultural areas were generally widely distributed and common within the study area. Examples included Savannah Sparrow (***Passerculus sandwichensis***), Horned Lark (***Eremophila alpestris***) and Vesper Sparrow (***Pooecetes gramineus***). Others which were observed in only a few or single locations included Eastern Kingbird (***Tyrannus tyrannus***), Eastern Meadowlark (***Sturnella magna***), Bobolink (***Dolichonyx oryzivorus***), Grasshopper Sparrow (***Ammodramus savannarum***) and Upland Sandpiper (***Bartramia longicauda***). Based on their TRCA status, the most significant birds present in the Mayfield West study area are Upland Sandpiper and Grasshopper Sparrow; both are ranked L2; (L1 species are the most significant and L5 the least significant in TRCA ranking).

One area of species concentration was noted. The area in question, measuring approximately 10 ha, is situated along Etobicoke Creek, between McLaughlin Road and polygons 63–68 to the east. Almost the entire area is contained within the Protected Countryside designation of the Greenbelt Plan. It was being intensively used as a pasture.

Notably, five of the open-country breeding bird species require large areas of suitable habitat to sustain their populations i.e. are “area-sensitive”. The five species are Upland Sandpiper, Savannah Sparrow, Grasshopper Sparrow, Bobolink and Eastern Meadowlark. The majority of these species were present outside the Protected Countryside Greenbelt designation. The amount of habitat required by each species is variable and depends on habitat type characteristics. Most of these species require at least 10 ha of suitable habitat to nest successfully (OMNR, 2000).

Birds preferring to nest in successional habitats such as abandoned fields, wooded pastures, thickets, riparian valleys were relatively common within the study area. However, the majority of these species were associated with larger woodlot features where these pockets of habitat occur.

The number and diversity of forest bird species present were mostly characteristic of smaller habitat patches, species tolerant of forest edge habitats. Most species were relatively common. Nevertheless, five area-sensitive forest species were also noted suggesting some of the patches are of large enough size or contain habitat features necessary to support this group. The five species were Hairy Woodpecker, Pileated Woodpecker, White-breasted Nuthatch, American Redstart, and Ovenbird. Of these, White-breasted Nuthatch was recorded most often, in 15 polygons. Next most reported was Hairy Woodpecker from 6 polygons. The rest ranged from one to four polygons each. In addition, about half of the observations came from areas within the Protected Countryside Greenbelt designation. The remaining observations were documented from the wooded valley in the northeast corner of the study area as well as the two woodlots closest to Mayfield Road.

Mammals

Mammals were documented on an incidental basis; no formalized surveys were conducted (i.e. no small mammal trapping or winter surveys for tracks). In total, 10 provincially common mammal species were recorded; 9 by Dougan & Associates and 1 by Toronto and Region Conservation Authority (TRCA) (Appendix ‘H-5’). If focused surveys were to have been conducted, additional small mammal species would likely be encountered.

Of the ten species observed, one is considered locally significant by TRCA; Meadow Jumping Mouse (***Zapus hudsonius***) has a rank of L3 in TRCA’s jurisdiction. No corresponding local conservation status information currently exists within CVC’s jurisdiction. Meadow Jumping Mouse was documented in 1996 by Ken Towle of TRCA, in riparian habitat along Etobicoke Creek, west of Hurontario Street. Given its habitat preference for fallow fields, woodland edges, and shrubby thickets, especially damp meadows and streamside vegetation (Kurta, 1995), its presence in the study area is not unexpected. Of the 15 species on record in Ontario Mammal Atlas square 17NJ94 (the 10 x 10 km square containing the Mayfield West study area), Meadow Jumping Mouse was documented.

4.7.4.6 Significant Wildlife Habitat

Significant Wildlife Habitat (SWH) is protected under the Provincial Policy Statement (2005). As discussed in Chapter 3 of this report, the Region of Peel and Town of Caledon are currently developing criteria for their jurisdictions which will eventually be adopted as policy. A draft version of the criteria and thresholds was used to assess the presence or absence of Significant Wildlife Habitat within the study area (NSE et al., 2008). However, it should be noted that the identification of Significant Wildlife Habitat was not a primary focus of the field studies conducted within the study area and the results depicted in Table 4.7.12 should be considered preliminary. Additional field studies should help define what features or functions qualify as SWH and exactly where they are found.

Table 4.7.12. Significant Wildlife Habitat Assessment of the Mayfield West Study Area

Feature Or Function	Polygon #'s	Comments
Seasonal Concentrations of Animals		
A1. Deer wintering area	???	A methodology to identify deer wintering areas as significant wildlife habitat in the Region of Peel has not yet been prepared by OMNR. Until then, it will not be possible to confirm the presence or absence of this criterion. Focused surveys to document deer or their potential wintering areas were not conducted as part of this survey. Polygon 16 was identified as a vegetation community providing abundant mast. This may be one factor incorporated into the methodology?
A2. Colonial bird nesting sites	---	None detected by TRCA (1996 – 2003) or D&A (2005 – 2008) during their field studies, nor are any expected to occur, with the possible exception of Green Heron. No background sources mention any such sites.
A3. Waterfowl nesting habitat	---	Only two species of waterfowl (Wood Duck and Mallard) were documented during the field studies. Both were documented in low numbers. None of the observations suggested that the thresholds for significance would be met.
A4i. Migratory landbird stopover areas	---	None are expected. Study area is too far from Lake Ontario shore.
A4ii. Migratory bat stopover areas	---	None detected although specific bat surveys were not conducted. None are anticipated since study area is too far from Lake Ontario shore or other natural heritage features that would realistically concentrate numbers in any significant manner.
A4iii. Migratory butterfly stopover areas	---	None are expected to occur. The study area is too far from the shore of Lake Ontario. Monarch (see criteria C2 below) was detected at four locations, three of which were during the summer. The highest number detected was two.
A4iv. Migratory waterfowl stopover and/or staging (terrestrial)	---	None expected to occur in the study area but daytime searches during the spring and fall migration periods were not conducted. Small numbers may utilize flooded fields in spring.
A4v. Migratory waterfowl stopover and/or staging (aquatic)	---	None expected to occur in the study area but daytime searches during the spring and fall migration periods were not conducted. Little open water or marsh habitat of substantial size is present.
A4vi. Migratory shorebird stopover areas	---	None expected to occur in the study area but daytime searches during the spring and fall migration periods were not conducted. Some shorebirds may forage in agricultural fields.
A5. Raptor winter feeding and roosting	---	Based on the fact that the vast majority of the agricultural lands are in active use, no significant areas expected in the study area. No winter surveys were conducted. Local birdwatchers have not reported any observations on the ONTBIRDS Listserv during the past couple years.
A6. Snake hibernacula	69?	None detected but most surveys were not timed to coincide with periods when snakes would be most likely to be near their hibernacula sites. However, 3 snakes (2 DeKay's Brownsnake and 1 Red-bellied Snake) were detected together under a plywood board on September 29, 2008. Given the late date in the season it is possible that a local hibernaculum was located nearby. The board was located on the SE side of Etobicoke Creek opposite the school. Eastern Gartersnake was not documented from the study area but is also expected to occur.

Table 4.7.12. Significant Wildlife Habitat Assessment of the Mayfield West Study Area		
Feature Or Function	**Polygon #'s**	**Comments**
A7. Bat maternal roosts and hibernacula	---	None detected or expected to occur.
A8. Bullfrog concentration areas	---	It seems very unlikely Bullfrog concentration areas are present within the study area. No bullfrogs were detected and potentially suitable habitat is limited to three small open water bodies. The closest record was from south of Wanless Drive, between Creditview and Chinguacousy Roads (i.e. approximately 2 km south of the study area) in July 1996. The number of individuals present was not noted. Except for a woodlot, remaining natural habitat in this area has been lost to development.
A9. Wild Turkey winter range	---	This criterion is not being recommended as a Significant Wildlife Habitat. Wild Turkey is no longer considered to be of conservation concern in Ontario, the Region of Peel or Town of Caledon. No Wild Turkeys were detected during the field surveys but the species has recently been documented by MNR south of Mayfield Road. The species was also detected between 2001 and 2005 from the 10 x 10 km Ontario Breeding Atlas square that the study area is in (Cadman et al., 2007).
A10. Turkey Vulture summer roosting areas	---	Four Turkey Vultures were observed sitting in a snag close to a deciduous woodlot, in the northwest corner of the study area on July 25, 2008. According to the breeding phenology of this species, the birds observed were likely roosting colonially rather than locally fledged young (Kirk & Mossman, 1998). However, no thresholds have yet to be established for this criterion.
Rare Vegetation Communities or Specialized Habitats for Wildlife		
B1. Rare vegetation types	---	None of the qualifying vegetation communities were documented from the study area.
B2. Forests providing a high diversity of habitats	???	Although it is expected that most of the forested blocks in the study area would qualify as Significant Woodland in the Region of Peel, the following three forested blocks are most diverse and could be considered potential SWH. • Forested block containing polygons 18, 19, 37, 41, 42, 44, 45 & 55 • Forested block containing polygons 27, 29, 30, 31, 32, 34, & 35 • Forested block containing polygons 79, 80, 82, 83, 84, 88, 91 & 115
B3. Old-growth or mature forest stands	---	No obvious candidate areas were observed. However, very localized older growth was detected in polygons 4, 20, 31, 33, 42, and 91.
B4. Foraging areas with abundant mast	16	Polygons 16 contains a Fresh-Moist Shagbark Hickory Deciduous Forest type(FOD 9-4).
B5. Highly diverse areas	---	None were identified using the threshold recommended in the Peel-Caledon Significant Woodlands and Significant Wildlife Habitat Study (i.e. top 5% most diverse habitat patches in the Town of Caledon).
B6. Cliffs and caves	---	None detected and not expected to occur.
B7. Seeps and springs	---	No seeps or springs were detected by our study team.
B8i. Amphibian breeding habitat – forested sites	1	A full chorus of American Toads was heard on April 18, 2006, likely originating in polygon #1. Spring Peeper, Northern Leopard Frog and Wood Frog have also been documented from these woods at other times. Combined, the total number may have exceeded the threshold of 40 individuals? However, since American Toad calls are so long and overlap significantly, the total number of individuals present could not be determined with certainty. No other sites where thought to approach the threshold for significance.
B8ii. Amphibian breeding habitat – non-forested sites	---	No breeding sites were documented that approached the minimum threshold of 40 individuals. Suitable habitat was limited in occurrence and size.
B9. Turtle nesting habitat and turtle overwintering areas	---	None detected. In fact, no turtles were observed from the study area. The study area contains very little suitable habitat. Only two ponds are present that might support turtle species.
B10. Habitat for area-sensitive forest interior breeding bird species	---	Three qualifying species have been documented from the study area: Hairy Woodpecker, Pileated Woodpecker and Ovenbird. However, to date, all three species have not been recorded from the same forest patch and would therefore not meet the threshold for the criterion. Furthermore, only old excavations made by Pileated were noted, no individuals themselves. The largest patch of forest interior is contained in the woodlot at the northwest corner of the study area. It is 0.79 ha shy of the 4.00 ha minimum forest interior threshold size.
B11. Habitat for open country and early successional breeding bird species	---	Although 12 open country or early successional species have been documented from the study area, only one area of concentrations of species was noted. The area in question, measuring ≈ 10 ha, is situated along Etobicoke Creek, between McLauchlin Road and polygons 63–68 to the east. Almost the entire area is

Table 4.7.12. Significant Wildlife Habitat Assessment of the Mayfield West Study Area

Feature Or Function	Polygon #'s	Comments
		contained within the Protected Countryside designation of the Greenbelt Plan. If combined, species documented from the area by TRCA and Dougan & Associates would meet the SWH threshold. However, the area is currently intensively used as a pasture and would not qualify as SWH for that reason. The vast majority of habitats utilized by other listed species were associated with active agriculture.
B12. Habitat for wetland breeding bird species	---	Only one wetland breeding bird species has been documented from the study area: Sedge Wren. However, it did not meet the minimum threshold of 4 breeding pairs.
B13i. Raptor nesting habitat – wetlands, ponds and rivers	---	No listed species (i.e. Northern Harrier or Osprey) were documented despite some potential nesting habitat present along Etobicoke Creek.
B13ii. Raptor nesting habitat – woodland habitats	---	Despite some potentially suitable nesting habitat existing in a number of woodland units, no listed species have been documented to date.
B14. Mink, River Otter, Marten, and Fisher denning sites	---	None detected.
B15. Mineral licks	---	None detected.
Species of Conservation Concern		
C1. Species identified as Nationally Endangered or Threatened by COSEWIC which are not listed as Endangered or Threatened under Ontario's ***Endangered Species Act***.	---	No listed species, including the Great Lakes/St. Lawrence - Canadian Shield population of Western Chorus Frog (***Pseudacris triseriata***), have been documented by TRCA or Dougan & Associates from the study area. It is worth noting however, that a local resident reported hearing Western Chorus Frog (***Pseudacris triseriata***) from along the edge of a woodlot just south of Mayfield Road in 2006. Based on a June 16, 2006, conversation with the resident, an investigating MNR biologist concurred with the identification. Although Mayfield Road lies in between, the north edge of the woods is only approximately 75 m from the southern edge of the study area.
C2. Species identified as Special Concern based on Species at Risk in Ontario List that is periodically updated by OMNR.	---	Two species designated "Special Concern" in Ontario and Canada were documented or from the study area: MonarchButterfly (***Danaus plexippus***) and Short-eared Owl (***Asio flammeus***). However, after subsequent investigation, the Short-eared Owl observation was deemed to be that of a migrant and not a local breeding resident. Monarchs were documented on 3 occasions, of which one was a migrant. There was no indication that the remaining individuals were utilizing the area to breed but suitable host plants were documented from the study area. Common Milkweed (***Asclepias syriaca***) is common but scattered throughout the study area. One Monarch was observed along the railroad track opposite polygon 5 on June 17, 2007 and the other two individuals were observed in polygon 93 on July 25, 2008. It is also worth noting that a local resident reported a Milksnake (***Lampropeltis triangulum***) from a woodlot just south of Mayfield Road in 2006. Based on a June 16, 2006, conversation with the resident, an investigating MNR biologist concurred with the identification. Although Mayfield Road lies in between, the north edge of the woods is only approximately 75 m from the southern edge of the study area.
C3. Species that are listed as rare (S1–S3) or historical in Ontario based on records kept by the Natural Heritage Information Centre in Peterborough.	---	No such listed species have been documented from the study area.
C4. Species whose populations appear to be experiencing substantial declines in Ontario.	---	Population trend data for birds, such as that from the Ontario Breeding Bird Survey (1968 - 2005) and Ontario Forest Bird Monitoring Program (1987 - 2005), were deemed too variable for use here. Possibly due to the limitations mentioned in ***Assessment of Trends in Frog and Toad Populations in Ontario using Citizen Science Monitoring Data*** (Badzinski et al., 2008), population trends varied between different monitoring programs. As a result, it was not possible to determine which species were experiencing substantial declines in Ontario. Only one species, Western Chorus Frog, showed the same pattern of declining trend in all three programs. However, no Western Chorus Frogs were documented within the study area.
C5. Species that have a high percentage of their global population in Ontario and are rare or uncommon in the Regional Municipality of Peel	---	A list of qualifying species has not yet been prepared. Therefore assessment of this criteria is not possible at this time.

Table 4.7.12. Significant Wildlife Habitat Assessment of the Mayfield West Study Area		
Feature Or Function	**Polygon #'s**	**Comments**
C6. Species that are rare within the R.M. of Peel, even though they may not be provincially rare	---	There is insufficient data to determine what species are rare within the Regional Municipality of Peel.
C7. Species that are subjects of recovery programs	---	None of the listed species have been documented from the study area.
C7. Species considered important to the Regional Municipality of Peel, based on recommendations from the Conservation Advisory Committee	---	Not applicable as Conservation Advisory Committee has not yet been formed.
Animal Movement Corridors		
D. Animal Movement Corridors	---	Some evidence of wildlife movement was observed along Etobicoke creek. However, at this point, there is nothing to suggest its status is anything more than locally significant.

4.7.5. Existing Natural Heritage System

The Landscape Scale Analysis (LSA) prepared in support of the ongoing North West Brampton Subwatershed Study, concluded that most of the natural vegetation cover in the vicinity of the MW2 area was removed by the late 1800's, and the current distribution of remnant forest cover has not changed appreciably either in location or extent since the early 20th century. In comparison, agricultural uses of the landscape have changed substantially in terms of crops produced and the variety and intensity of livestock uses over the period since settlement. Available historic mapping (1877 onward) suggests that most watercourses were undefined (and hence probably of limited significance to settlers) in the headwater areas of Huttonville and Fletcher's Creeks. Watercourse delineation, straightening, diversion and relocation became intensive in the post-war period.

The current levels of overall natural cover (12 %) and the included wetland cover (4 %) are well below literature-based thresholds (such as those contained in Environment Canada's "How Much Habitat is Enough" document) that would support optimal terrestrial and wetland functions in the temperate zone. Remnant upland, wetland and riparian features do function at a site scale to provide natural cover for species, to moderate local climate, or to attenuate runoff, control erosion, and enhance water quality. However, the benefits are nominal compared to the effects intensive agricultural uses, farm residences, a school, and roads which occupy more than 80% of the study area. Such long-standing fragmentation can be expected to contribute to long term declines of the remaining biodiversity, resulting in local extirpations of rarer plant species and less mobile terrestrial wildlife. In particular, the past loss of substantive habitat connections to the primary natural corridors of the Credit River valley, Etobicoke Creek and Niagara Escarpment would certainly contribute to the disappearance of fragmentation- and area-sensitive species.

Natural cover is not evenly distributed in the MW2 study area (see Figure T1 in Appendix 'H'). The northern half has a higher level of connectivity for species limited by natural area connectivity, concentrated along the major Etobicoke Creek ravines and along smaller tributaries extending northward, but there are significant gaps created by agricultural activities. Where forest cover is present, riparian-based corridor width ranges from 100 to more than 250 metres, sufficient to support area sensitive and edge-avoiding species where there is adequate habitat quality. Tributaries extend well north of the study area, ultimately to the Niagara Escarpment. Hedgerows throughout the MW2 lands are limited in extent, with significant canopy gaps that limit their function as local linkages for wildlife.

The MW2 lands south of Etobicoke Creek are more fragmented, and riparian linkages are generally lacking. Amphibians, reptiles, and small mammals are isolated within forest habitat patches, reducing their potential for persistence within the landscape. The railway line fragments one woodlot, affecting hydrological flows but likely providing cover, sunning areas and movement potential to the north and south. The existing residential area in the southeast corner of MW2 represents a barrier.

Current vegetation and wildlife surveys indicate that the landscape is sustaining low but relatively consistent occurrences of species considered to be locally- to regionally-significant by relevant agencies, which are primarily associated with forest, open field and wetland features. Species at Risk sightings are confined to two species, one of which is highly localized, and the second a migratory user. The bird species are primarily comprised of relatively common forest and open field species, including area sensitive species which are of conservation concern regionally and in the CVC and TRCA jurisdictions. There is not extensive representation of wetland specialist birds, which is not surprising given the relatively low level of wetland cover and limited extent of individual features. Amphibians occur at relatively low densities in the study area, with the exception of American Toad which is more adaptive to altered landscapes. A limited number of locally- and regionally significant plant species were detected. The range of moisture regimes present tends to sustain plant diversity, and many of these species can be maintained within relatively small vegetation features, unlike area sensitive wildlife species.

The current vegetation communities represent forest species that were once more pervasive in the landscape, however diversifying elements such as coniferous cover and older growth are present within some features in the Greenbelt. Shade intolerant species such as red oak, hickory and white pine that would normally be sustained in older growth forest systems are locally present within some features. The forests in the study area are ‘working landscapes’ which have been repeatedly exploited by logging and firewood harvesting, directly or indirectly affected by drainage alterations, and in some cases actively used for livestock grazing now and in the past. These past stressors are now compounded by excessive deer browsing, which is altering successional patterns and systematically lowering plant biodiversity over time.

The soils, natural vegetation cover and hydrology of the study area were closely integrated historically. The uniformity of clay and till soils, and relatively flat topography within the Fletcher’s Creek and Etobicoke Creek headwater tablelands normally works with natural forest and wetland cover to progressively enhance runoff retention over time, creating essentially a highly attenuated surface flow system. In areas where micro-topography was lacking in the immediate post-glacial period, the clay and till soils progressively developed relief under forest cover through ‘pit and mound’ processes, whereby shallow-rooted trees were uprooted by storms, eventually dotting the landscape with small depressions and mounds. This, in combination with accumulation of woody debris and organic enrichment of soils, increased the moisture retention properties of the forest, improved infiltration, and efficiently attenuated runoff except during the spring freshet and extreme storm events. The surficial storage of water may create seasonal ‘mounding’ of moisture in forested conditions which temporarily saturates the surface soil horizon and associated organic litter.

In forested clay plain situations, the annual moisture budget is typically collected as precipitation with minimal runoff, and stored in a shallow water table perched within the surface soil horizons, in leaf litter, and in micro-pools. Only a small portion can be infiltrated due to fine-textured soils, and the balance is evapo-transpirated by vegetation over the summer, such that the system may become dry (i.e. pools dry up) unless rainfall is unusually intensive over the summer months. Seasonal (aka vernal) pools that are common in the spring typically dry up by early summer, and are therefore less likely to sustain pool-breeding amphibian populations at high levels of abundance because the standing water is unreliable from year to year. For example, no ***Ambystomid*** salamanders have been documented from the study area or vicinity; these species are reliant on longer-standing pools than typically occur in the study area. Long-standing fragmentation of forest and wetland cover, and the likelihood that a series of drier years would create temporal gaps in the viable adult populations of these species, would be expected to progressively undermine the ability of pool-reliant wildlife to be sustained in this landscape except where runoff concentration can occur.

The lands associated with Etobicoke Creek are also dominated by fine textured soils, however there is localized evidence of coarser materials that have likely been deposited through fluvial processes. These contribute to a wider diversity of forest and wetland communities within the Greenbelt, localized seepage zones along the tributaries, and wetlands on organic soils just upstream of Highway 10.

The pre-settlement characteristics of most of the landscape of the study area, from the standpoint of vegetation, soils and hydrology, likely included:

a) minimal runoff response and hence minimal stream baseflow in the forested headwater areas, with significant flows limited to the spring freshet and major storm events, with flows both moderated and sustained by factors including microtopography, leaf and woody debris cover;
b) patchy offline wetland cover ranging from small depressions to larger features where localized topography created larger depressions and caused runoff to become more concentrated; and
c) more extensive wetland cover associated with channels along Etobicoke Creek;
d) very localized discharge along the valleys of Etobicoke Creek.

In summary, the Mayfield West Phase 2 study area shows evidence of a high level of past human intervention; natural forest and wetland functions have been replaced with a highly managed landscape. Despite this alteration, remnants with localized influences on system functions have persisted.

Existing relationships of natural cover, soil properties and hydrology to land uses

Today, a range of terrestrial features and conditions representative of historic conditions are still evident in the subwatershed study area, however the remnants are limited in aerial extent and functionally ineffective at the system scale.

Based on the working hypothesis of the historic, highly attenuated flow regime on the clay plain, runoff increased in the upper subwatershed study area once forests were cleared, watercourses were better defined through minor and major human interventions, and tile drains were introduced. Flow characteristics have become more ‘flashy’ or responsive to more frequent storm events, and water quality reduced due to sediment and agricultural contamination. In this context the current limited natural cover operates at a small fraction of its former efficiency. Disturbance incidents which are evident in the remnant features (e.g. cyclic logging and firewood removal, gradual loss of woody debris, grazing, drainage channel alterations) have compounded the disintegration of the canopy, soil and hydrologic systems.

Ecosystem monitoring studies conducted in temperate watersheds have determined that altered water level fluctuation (WLF) of surface water, and altered hydroperiods (i.e. inundation periods and their cyclic patterns) become environmental stressors that affect flora and fauna as watershed forest cover is reduced and landscapes are converted to more impervious cover (see Azous and Horner 2001; Wright et al. 2006). Increased ‘flashy’ character of runoff events causes inundation during periods of the growing season which may be incompatible with the annual growth cycle of native plant communities. The effects on wetland biota typically include reduced biodiversity as invasive monotypic plant species adapted to irregular fluctuations, displace more diverse communities that are less tolerant of fluctuations. Wildlife dependent on the terrestrial/aquatic interface, such as amphibians, may be eliminated as irregular water level fluctuations threaten their eggs and larval stages. The effects become acute under urban conditions where impervious land cover further reduces the hydrologic response period, generating flows and water level fluctuations shortly after onset of relatively minor precipitation events. Urban wetlands also receive greater inputs of contaminants, typically one to two orders of magnitude greater than under pre-development conditions without stormwater best management (Schueler 1987).
The existing ecosystem conditions in the study area, as documented in the present study, can be summarized in terms of key stressor indicators:

- a high level of habitat fragmentation that is long-standing
- limited seasonal moisture storage in the landscape within remnant natural features; less moisture retention occurs where drainage has been improved
- minimal linkages at the local scale between remnant natural features, to landscape scale hydrologic functions (surface and groundwater), and to larger scale primary corridors (Credit River, Etobicoke Creek, Humber River, Niagara Escarpment, Greenbelt)
- ongoing effects of agricultural practices in the tablelands as well as some ravine areas

4.7.6. Interpretation

The following is a preliminary summary of key findings and their implications. This may be supplemented as other disciplinary information is reviewed.

1. The background information and data accessed for this study encompasses documentation by TRCA, CVC, MNR, landowner consultants, and subwatershed data from previous studies in the vicinity. Relevant policy documents related to natural heritage planning have also been reviewed.

2. Field assessments of vegetation and wildlife were completed throughout the Mayfield West study area between April and November 2008. Supplementary data was obtained from TRCA, CVC, MNR, relevant landowner consultant documents, and from the North West Brampton Urban Development Area Huttonville and Fletcher's Creeks Subwatershed Study – Characterization Report and Data (Philips Engineering Limited Draft December 2007).

3. The study area landscape is dominated (>80%) by agricultural and associated anthropogenic uses. Natural cover makes up approximately 13% of the cover, of which approximately 8% is forested, wetland makes up about 4%, and other successional and natural communities make up about 1%. A total of 124 Ecological Land Classification polygons were documented in 2007-2008 field studies, of which 20 represent less common communities according to TRCA rankings.

4. Wetlands in the Fletcher's Creek headwaters have been evaluated by MNR, however wetlands in the Etobicoke Creek portion of the study area have not been evaluated by MNR; this may be undertaken in 2009..

5. The most extensive natural communities in the study area are associated with Etobicoke Creek valleylands and adjacent uplands; the central tributary is contained in the Greenbelt. A secondary tributary valley feature, located in the northeast corner of the study area, contains substantial forested cover but is not included in the Greenbelt. These areas contain forest and wetlands, as well as thickets and other communities.

6. Three tableland woodlot complexes occur in the study area outside the Greenbelt. Two of these woodlots are located within the Fletcher's Creek headwater area, and a third is located within the Etobicoke Creek headwaters subwatershed. These features contain upland as well as localized wetland cover.

7. Significant Woodland criteria have been applied on an interim basis using the Region's ROPA 21 draft criteria; three tableland woodlots, and the forested valleylands qualify as Significant Woodlands.

8. More than 300 plant species have been documented within the study area. One federally and provincially "Endangered" plant species was encountered in the study area. One

provincially rare plant species is present but represents planted material. A total of 108 plant species have been documented which are considered locally to regionally significant (based on TRCA, CVC and MNR status lists). Twenty vegetation polygons were documented which contain communities ranked as significant by TRCA.

9. A total of 115 species of wildlife have been documented in the study area. This includes 71 bird species, 10 mammal species, 8 amphibian species, and 26 invertebrate species. Two federally and provincially "Special Concern' species were documented; one of these was likely a migrant. Sixteen bird species are considered regionally significant. Nine "area-sensitive" bird species were documented; these are reliant on open field (5 species) or woodland (4 species) habitats with critical size thresholds. Mammals were documented from background data and incidental observations only; no extensive sampling has occurred to date. One regionally significant mammal species is on record for the study area.

10. Despite the anticipated protection of large blocks of natural habitat within the study area within the Greenbelt and Significant Woodlands, some local wildlife populations may experience significant development impacts due to a direct loss of wildlife habitat and species diversity for those species associated with open country/agricultural lands. Development pressures will also exert an indirect negative influence on the remaining natural habitats (i.e. primarily woodland successional habitats). The degree to which local wildlife populations will be able to persist post development will largely be dependent on (1) how remaining natural areas are buffered from adjacent uses (e.g. physical separation, types of proposed adjoining land uses), (2) how the remaining natural areas are connected to one another and to the larger regional natural heritage system, and (3) how much human disturbance the remaining natural areas receive from recreational and other uses.

11. Significant Wildlife Habitat (SWH) is protected under the Provincial Policy Statement (2005). Based on draft criteria and thresholds developed by the Region of Peel and Town of Caledon, a preliminary assessment of SWH in the study area was conducted. The assessment revealed that a few criteria likely merit designation as SWH but additional field data, focused at identifying SWH, could help enhance understanding of the area. Those criteria that were met included: snake hibernacula, forests providing a high diversity of habitats, foraging areas with abundant mast, and amphibian breeding habitat.

12. In conjunction with the ongoing Secondary Planning process, the current study will define a Natural Heritage System (NHS) to be integrated with the future Mayfield West Secondary Plan. The current study summarizes NHS policies at the Town, Region, TRCA and Provincial Policy/Greenbelt scales which will need to be addressed by the recommended system. The approach to be recommended will be developed based on discussion with TRCA, CVC, MNR, Town of Caledon and Region of Peel, and affected stakeholders.

5. NEXT STEPS

While the actual form and context of the proposed land use planning scenarios is not currently defined, the Secondary Plan Land Use Planning, led by the Town, has provided alternative scenarios for impact assessment. With this in mind, dialogue on fundamental land use policies and future directions has been co-ordinated by Town staff and the Urban Strategies Inc. Team. This process has involved a review of the respective constraints, as well as overview of the key objectives and opportunities with respect to establishing a robust, healthy and sustainable Natural Heritage System. It has been necessary to interface with the land use planning team (and others) to provide guidance on the "best" approaches to minimize environmental impacts through integrated community design. In formulating the alternative land use concepts for the next steps of impact assessment, it has been necessary for the Environmental Study Team to provide insight on those land uses adjacent to natural areas, buffer enhancement zones, and linkages to name a few.

Various detailed Studies will be conducted by the Environmental Study Team to assess the impact of the proposed land use changes on surface water (quantity/quality), fisheries, streams, slopes, and the natural heritage systems. This has included an integrated assessment and constraint ranking for the watercourses within the study area. While the criteria applied by each discipline in ascribing the individual constraints has varied by discipline, the net constraint rankings have been established based upon the following guidelines previously applied for the North West Brampton study:

a) HIGH: If any discipline is rated "High", ne net rating is "high".
b) LOW: If one discipline other than fisheries is rated "Medium" (Moderate) and all others "Low", the net rating is "low".
c) MODERATE: all others not covered by (a) and (b).

The results of this constraint ranking are to be reviewed during a site walk with CVC and TRCA, and the constraint rankings updated as required and integrated into the overall secondary land use planning process.

INTEGRATED WATERCOURSE CONSTRAINT RANKING																						
Drainage Feature Unit and Sub Reach	Flow Assessment						Aquatic Habitat Assessment				Terrestrial Vegetation, Significance and Linkage Functions [2.]						Channel Form					Net Constraint Ranking [1.]
	Catchment Size	Flow Description	2 Year Flow (m^3/s)	Regional Flow (m^3/s)	Potential for Groundwater Discharge	Constraint Ranking	Attributes/ Species/ Abundance/ Size	Life Cycle and Habitat Functions	Habitat Classification	Constraint Ranking	Riparian Vegetation	Core Feature	Upstream Linkage	Downstream Linkage	Road or Train Crossings	Constraint Ranking	Channel Definition	Channel Morphology (where applicable)	Rapid Stream Assessment (RSAT) Condition	Stability Index (RGA)	Constraint Ranking	
Fletcher's Creek Subwatershed																						
MFC-R01	16.66	Ephemeral	0.12	2.16	Low	Low	Fish rarely if ever present based on channel form and ephemeral flow	Indirect	Simple contributing	Low	Medium	No	High	Medium	Yes	Medium	Poorly defined.	Poorly defined.	Swale	Swale	Low	Low
MFC-R02	5.16	Ephemeral	0.04	0.97	Low	Low	Fish rarely if ever present based on channel form and ephemeral flow	Indirect	Simple contributing	Low	Low	No	Low	Low	Yes	Low	Well-defined	Poorly defined.	Swale	Swale	Low	Low
MFC-R03	40.37	Intemittent	0.12	1.94	Low	Low	1 blacknose dace in 2005, 1 pumpkinseed in 2007	all functions seasonally	Seasonal downstream from Mayfield, simple contributing upstream from Mayfield	Medium/Low	Medium	No	Low	Low	Yes	Low	Poorly defined.	Gradient: moderate Substrate: silt, fine sands, pebble Banks: silt, fine sands Bank height: 1.15-1.5 m Other observations: upstream agricultural landuse downstream residential	Moderate	In Regime	Medium	Medium
MFC-R04	5.2	Ephemeral	0.015	0.25	Low	Low	Fish rarely if ever present based on channel form and ephemeral flow	Indirect	Simple contributing	Low	Low	No	Low	Low	No	Low	Poorly defined.	Poorly defined.	Swale	Swale	Low	Low
MFC-R05	10.88	Ephemeral	0.032	0.523	Low	Low	Fish rarely if ever present based on channel form and ephemeral flow	Indirect	Simple contributing	Low	Low	No	Low	Low	No	Low	Poorly defined.	Poorly defined.	Swale	Swale	Low	Low
MFC-R06A	5.88	Ephemeral	0.017	0.283	Low	Low	Fish rarely if ever present based on channel form and ephemeral flow	Indirect	Simple contributing	Low	Low	No	Low	Low	No	Low	Poorly defined.	Poorly defined.	Swale	Swale	Low	Low
MFC-R06B	4.01	Ephemeral	0.012	0.193	Low	Low	Fish rarely if ever present based on channel form and ephemeral flow	Indirect	Simple contributing	Low	Low	No	Low	Low	No	Low	Poorly defined.	Poorly defined.	Swale	Swale	Low	Low
MFC-R07	0.94	Ephemeral	0.003	0.045	Low	Low	Fish rarely if ever present based on channel form and ephemeral flow	Indirect	Simple contributing	Low	Low	No	Low	Low	No	Low	Poorly defined.	Poorly defined.	Swale	Swale	Low	Low
MFC-R08	2.6	Ephemeral	0.008	0.125	Low	Low	Fish rarely if ever present based on channel form and ephemeral flow	Indirect	Simple contributing	Low	Low	No	Low	Low	No	Low	Poorly defined.	Poorly defined.	Swale	Swale	Low	Low
MFC-R09	0.8	Ephemeral	0.002	0.004	Low	Low	Fish rarely if ever present based on channel form and ephemeral flow	Indirect	Simple contributing	Low	Medium*	No	Low	Medium	Yes	Medium	Poorly defined.	Poorly defined. Roadside drainage	Swale	Swale	Low	Low

INTEGRATED WATERCOURSE CONSTRAINT RANKING																						
Drainage Feature Unit and Sub Reach	Flow Assessment						Aquatic Habitat Assessment				Terrestrial Vegetation, Significance and Linkage Functions [2.]						Channel Form					Net Constraint Ranking [1.]
	Catchment Size	Flow Description	2 Year Flow (m^3/s)	Regional Flow (m^3/s)	Potential for Groundwater Discharge	Constraint Ranking	Attributes/ Species/ Abundance/ Size	Life Cycle and Habitat Functions	Habitat Classification	Constraint Ranking	Riparian Vegetation	Core Feature	Upstream Linkage	Downstream Linkage	Road or Train Crossings	Constraint Ranking	Channel Definition	Channel Morphology (where applicable)	Rapid Stream Assessment (RSAT) Condition	Stability Index (RGA)	Constraint Ranking	
MFC-R10	48.81	Ephemeral	0.063	1.13	Low	Low	Fish rarely if ever present based on channel form and ephemeral flow	Indirect	Simple contributing	Low	Low	No	Low	Low	Yes	Low	Poorly defined.	Poorly defined.	Swale	Swale	Low	Low
MFC-R11	36.01	Ephemeral	0.046	0.834	Low	Low	Fish rarely if ever present based on channel form and ephemeral flow	Indirect	Simple contributing	Low	Low	No	Low	Low	No	Low	Poorly defined.	Poorly defined.	Swale	Swale	Low	Low
MFC-R12	3.8	Ephemeral	0.005	0.088	Low	Low	Fish rarely if ever present based on channel form and ephemeral flow	Indirect	Simple contributing	Low	Low	No	Low	Low	No	Low	Poorly defined.	Poorly defined.	Swale	Swale	Low	Low
MFC-R13	4.4	Ephemeral	0.006	0.102	Low	Low	Fish rarely if ever present based on channel form and ephemeral flow	Indirect	Simple contributing	Low	Low	No	Low	Low	No	Low	Poorly defined.	Poorly defined.	Swale	Swale	Low	Low
MFC-R14	8.72	Ephemeral	0.35	6.31	Low	Low	Fish rarely if ever present based on channel form and ephemeral flow	Indirect	Simple contributing	Low	Low	No	Low	Low	Yes	Low	Poorly defined.	Poorly defined.	Swale	Swale	Low	Low
MFC-R15	5.15	Ephemeral	0.21	3.73	Low	Low	Fish rarely if ever present based on channel form and ephemeral flow	Indirect	Simple contributing	Low	Low	No	Low	Low	No	Low	Poorly defined.	Poorly defined.	Swale	Swale	Low	Low
MFC-R16	0.85	Ephemeral	0.003	0.615	Low	Low	Fish rarely if ever present based on channel form and ephemeral flow	Indirect	Simple contributing	Low	Low	No	Low	Low	No	Low	Poorly defined.	Poorly defined.	Swale	Swale	Low	Low
MFC-R17	0.21	Ephemeral	0.001	0.174	Low	Low	Fish rarely if ever present based on channel form and ephemeral flow	Indirect	Simple contributing	Low	Low	No	Low	Low	No	Low	Poorly defined.	Poorly defined.	Swale	Swale	Low	Low
MFC-R18	22.57	Ephemeral	0.16	2.92	Low	Low	Fish rarely if ever present based on channel form and ephemeral flow	Indirect	Simple contributing	Low	Medium	Yes	High	Low	Yes	Medium	Poorly defined.	Poorly defined.	Swale	Swale	Low	Low
MFC-R19	8	Ephemeral	0.057	1.04	Low	Low	Fish rarely if ever present based on channel form and ephemeral flow	Indirect	Simple contributing	Low	High	Yes	High	Medium**	No	Medium	Poorly defined.	Poorly defined.	Swale	Swale	Low	Low

INTEGRATED WATERCOURSE CONSTRAINT RANKING																						
Drainage Feature Unit and Sub Reach	Flow Assessment						Aquatic Habitat Assessment				Terrestrial Vegetation, Significance and Linkage Functions [2.]						Channel Form					Net Constraint Ranking [1.]
	Catchment Size	Flow Description	2 Year Flow (m^3/s)	Regional Flow (m^3/s)	Potential for Groundwater Discharge	Constraint Ranking	Attributes/ Species/ Abundance/ Size	Life Cycle and Habitat Functions	Habitat Classification	Constraint Ranking	Riparian Vegetation	Core Feature	Upstream Linkage	Downstream Linkage	Road or Train Crossings	Constraint Ranking	Channel Definition	Channel Morphology (where applicable)	Rapid Stream Assessment (RSAT) Condition	Stability Index (RGA)	Constraint Ranking	
MFC-R20	17.24	Ephemeral	0.12	2.24	Low	Low	Fish rarely if ever present based on channel form and ephemeral flow	Indirect	Simple contributing	Low	Medium	No	Medium**	Low	Yes	Medium	Poorly defined.	Poorly defined.	Swale	Swale	Low	Low
MFC-R21	4.8	Ephemeral	0.033	0.624	Low	Low	Fish rarely if ever present based on channel form and ephemeral flow	Indirect	Simple contributing	Low	Low	No	Medium**	Medium**	No	Low	Poorly defined.	Poorly defined.	Swale	Swale	Low	Low
MFC-R22	1.9	Ephemeral	0.013	0.247	Low	Low	Fish rarely if ever present based on channel form and ephemeral flow	Indirect	Simple contributing	Low	Low	No	High	Medium**	No	Medium	Poorly defined.	Poorly defined.	Swale	Swale	Low	Low
MFC-R24	37.58	Ephemeral	0.27	4.88	Low	Low	Fish rarely if ever present based on channel form and ephemeral flow	Indirect	Simple contributing	Low	Low	No	Low	High	Yes	Medium	Poorly defined.	Poorly defined.	Swale	Swale	Low	Low
MFC-R25	8.49	Ephemeral	0.062	1.1	Low	Low	Fish rarely if ever present based on channel form and ephemeral flow	Indirect	Simple contributing	Low	Low	No	Low	High	Yes	Medium	Poorly defined.	Poorly defined.	Swale	Swale	Low	Low
MFC-R26	11.4	Ephemeral	0.082	1.48	Low	Low	Fish rarely if ever present based on channel form and ephemeral flow	Indirect	Simple contributing	Low	Low	No	Low	Low	No	Low	Poorly defined.	Poorly defined.	Swale	Swale	Low	Low
MFC-R27	14.81	Ephemeral	0.3	5.28	Low	Low	Fish rarely if ever present based on channel form and ephemeral flow	Indirect	Simple contributing	Low	Low	No	Low	Low	Yes	Low	Poorly defined.	Poorly defined.	Swale	Swale	Low	Low
Etobicoke Creek Watershed																						
MEC-R01	4622.3	Permanent	9.040	209.000	Medium	High	Diverse fish community	All life stages and habitat functions	Permanent	High	Medium	No	High	High	Yes	Medium	Well-defined	Gradient: low-moderate Substrate: unknown Banks: silt/sands Bank height: ≈1.2-0.75m Other observations: steep bank angle no riffle-pool morphology road culvert *Detailed assessment site*	Moderate	In Regime	High	High
MEC-R02	2386.16	Permanent	4.721	110.843	Medium	High	Diverse fish community	All life stages and habitat functions	Permanent	High	Medium	Yes	High	High	No	High	Well-defined	Gradient: low Substrate: clay, silt, sand, pebbles Banks: clay, silt and fine sands Bank height: ≈1.0-4.5 m Other observations: in stream vegetation island formation, slumping banks	Moderate	Transitional	High	High
MEC-R03	2364.95	Permanent	4.669	109.626	Medium	High	Diverse fish community	All life stages and habitat functions	Permanent	High	High	Yes	High	High	No	High	Well-defined	Gradient: low Substrate: clay, silt, sand, pebbles Banks: clay, silt and fine sands Bank height: ≈1.0-4.5 m Other observations: island formation, slumping banks cattle have access (Portt 2009)	Moderate	Transitional	High	High

INTEGRATED WATERCOURSE CONSTRAINT RANKING

Drainage Feature Unit and Sub Reach	Flow Assessment						Aquatic Habitat Assessment				Terrestrial Vegetation, Significance and Linkage Functions [2.]						Channel Form					Net Constraint Ranking [1.]
	Catchment Size	Flow Description	2 Year Flow (m^3/s)	Regional Flow (m^3/s)	Potential for Groundwater Discharge	Constraint Ranking	Attributes/ Species/ Abundance/ Size	Life Cycle and Habitat Functions	Habitat Classification	Constraint Ranking	Riparian Vegetation	Core Feature	Upstream Linkage	Downstream Linkage	Road or Train Crossings	Constraint Ranking	Channel Definition	Channel Morphology (where applicable)	Rapid Stream Assessment (RSAT) Condition	Stability Index (RGA)	Constraint Ranking	
MEC-R04	2308.97	Permanent	4.644	106.911	Medium	High	Diverse fish community	All life stages and habitat functions	Permanent	High	Medium	No	Medium	High	Yes	High	Well-defined	Gradient: low Substrate: unknown Banks: clay, silt and fine sands Bank height: ≈0.8-3.0m Other observations: open field, farm track access rail road crossing cattle have access (Portt 2009)	Moderate	In Regime	High	High
MEC-R05	2148.48	Permanent	4.320	99.464	Medium	High	Diverse fish community	All life stages and habitat functions	Permanent	High	Medium	Yes	High	Medium	Yes	High	Well-defined	Gradient: low Substrate: unknown Banks: Vegetated Bank height: ≈2.5-5.0m Other observations: turbid water rail road crossing Mclaughlin Road crossing Cattle have access downstream from McLaughlin Road (Portt 2009)	Moderate	In Regime	High	High
MEC-R06	2078.69	Permanent	3.594	81.684	Medium	High	Diverse fish community	All life stages and habitat functions	Permanent	High	Medium	Yes	Medium	Medium	No	High	Well-defined	Gradient: moderate Substrate: clay, silt, sand, gravel Banks: clay and sands Bank height: ≈1.5-3.0m Other observations: undercutting exposing tree roots within woodland riffle-pool morphology bar formation	Moderate	Transitional	High	High
MEC-R07	980.5	Permanent	1.865	41.640	Medium	High	Diverse fish community	All life stages and habitat functions	Permanent	High	Medium	No	Low	Medium	Yes	Medium	Poorly defined	Gradient: low Substrate: clay and sand Banks: silt, fine sands and clay Bank height: ≈1.5-1.65m Other observations: farm animals can access channel from one bank bare banks in places subsequently fenced excluding leading to vegetation recovery (Portt 2009)	Low	In Regime	Medium	High
MEC-R08	2236.14	Permanent	4.560	113.000	Medium	High	Diverse fish community	All life stages and habitat functions	Permanent	High	Medium	Yes	High	High	No	High	Well-defined	Gradient: low-moderate Substrate: unknown Banks: silt/sands Bank height: ≈2m Other observations: water very turbid vegetation in-channel no riffle-pool morphology	Moderate	In Regime	High	High
MEC-R09	2232.57	Permanent	4.553	112.820	Medium	High	Diverse fish community	All life stages and habitat functions	Permanent	High	Medium	No	High	High	No	High	Well-defined	Gradient: low-moderate Substrate: fine sands, pebbles Banks: clay Bank height: ≈1-4m Other observations: active meandering d/s through woodland - erosion outside of meander bends & point bar formaton. no riffle-pool morphology water very turbid	Moderate	Transitional	High	High
MEC-R10	2207.16	Permanent	4.501	111.536	Medium	High	Diverse fish community	All life stages and habitat functions	Permanent	High	High	Yes	High	High	No	High	Well-defined	Gradient: low-moderate Substrate:sand, gravel, rocks Banks: silt and sands Bank height: ≈2.0-5.0m Other observatons: meandering planform treelined - woody debris dams riffle-pool morphology water very turbid	Moderate	In Regime	High	High

INTEGRATED WATERCOURSE CONSTRAINT RANKING																						
	Flow Assessment						Aquatic Habitat Assessment				Terrestrial Vegetation, Significance and Linkage Functions [2.]						Channel Form					
Drainage Feature Unit and Sub Reach	Catchment Size	Flow Description	2 Year Flow (m^3/s)	Regional Flow (m^3/s)	Potential for Groundwater Discharge	Constraint Ranking	Attributes/ Species/ Abundance/ Size	Life Cycle and Habitat Functions	Habitat Classification	Constraint Ranking	Riparian Vegetation	Core Feature	Upstream Linkage	Downstream Linkage	Road or Train Crossings	Constraint Ranking	Channel Definition	Channel Morphology (where applicable)	Rapid Stream Assessment (RSAT) Condition	Stability Index (RGA)	Constraint Ranking	Net Constraint Ranking [1.]
MEC-R11	813.75	Permanent	1.750	45.700	Medium	High	Diverse fish community	All life stages and habitat functions	Permanent	High	High	Yes	High	High	No	High	Well-defined	Gradient: low-moderate Substrate:sand, gravel, rocks Banks: silt and sands Bank height: ≈2.0-5.0m Other observatons: meandering planform treelined - woody debris dams riffle-pool morphology water very turbid	Moderate	In Regime	High	High
MEC-R12	352.16	Permanent	0.670	15.200	Medium	Medium	Diverse fish community	All life stages and habitat functions	Permanent	High	High	Yes	High	High	Yes	High	Well-defined	Gradient: low-moderate Banks: silt and sands Substrate:sand, gravel, rocks Other observations: meandering planform exposed tree roots ends at marsh area at confluence with reach MEC-R16	Moderate	In Regime	High	High
MEC-R13	338.82	Intermittent	0.645	14.624	Low	Medium	Limited fish community	All life stages and habitat functions	Permanent refuge in pond	Medium	Medium	Yes	Medium	High	Yes	High	Well-defined	Gradient: low Substrate: variety of sands Banks: clay and silt Bank height: ≈0.5-0.6 Other observations: road culvert with gabion walls large pond between Mclaughlin and Old School Road.	Moderate	In Regime	Medium	High
MEC-R14	913.68	Permanent	2.458	71.906	Medium	High	Diverse fish community	All life stages and habitat functions	Permanent	High	Medium	No	High	Medium	Yes	Medium	Well-defined	Gradient: low-moderate Substrate: unknown Banks: silt and sands Bank height: ≈1.5-5.0m Other observations: water very turbid scour pool downstream of culvert road crossing	Moderate	In Regime	Medium	High
MEC-R15	465.41	Permanent	0.940	22.000	Medium	High	Diverse fish community	All life stages and habitat functions	Permanent	High	High	Yes	High	High	Yes	High	Well-defined	Gradient: low-moderate Substrate: silt, clay Banks: silt and sands Bank height:≈0.5-2.0m Other observations: high channel sinuosity significant woody debris road crossing	Moderate	In Regime	High	High
MEC-R16	388.13	Permanent	0.950	25.100	Medium	High	Diverse fish community	All life stages and habitat functions	Permanent	High	High	Yes	High	High	Yes	High	Well-defined	Gradient: moderate Substrate: sand and clay Banks: clay Bank height: ≈1.0-4.0m Other observations: exposed tree roots, woody debris undercutting, lateral bar formation water very turbid	Moderate	In Regime	High	High
MEC-R17	62.24	Permanent	0.180	5.290	Medium	Medium	Diverse fish community	All life stages and habitat functions	Permanent	High	High	Yes	Low	High	No	High	Well-defined	Gradient: low Substrate: sand, silt and pebbles Banks: clay Bank height:≈3.0m Other observations: riffle-pool morphology	Moderate	In Regime	High	High
MEC-R17A	57.28	Intermittent	0.166	4.868	Low	Low	Fish rarely if ever present based on channel form and ephemeral flow	Indirect	Complex contributing	Low	Low	No	Low	High	Yes	Medium	Well-defined	Gradient: low Substrate: sand, silt and pebbles Banks: clay Bank height:≈3.0m Other observations: realigned banks highly vegetated & steep	Moderate	In Regime	Medium	Medium
MEC-R18	5.6	Ephemeral	0.015	0.441	Low	Low	Fish rarely if ever present based on channel form and ephemeral flow	Indirect	Simple contributing on tableland, complex contributing in valley	Low	Low	Yes	Low	High	No	Medium	Poorly defined	Poorly defined.	Swale	Swale	Low	Low

INTEGRATED WATERCOURSE CONSTRAINT RANKING																						
Drainage Feature Unit and Sub Reach	Flow Assessment						Aquatic Habitat Assessment				Terrestrial Vegetation, Significance and Linkage Functions[2.]						Channel Form					Net Constraint Ranking[1.]
	Catchment Size	Flow Description	2 Year Flow (m^3/s)	Regional Flow (m^3/s)	Potential for Groundwater Discharge	Constraint Ranking	Attributes/ Species/ Abundance/ Size	Life Cycle and Habitat Functions	Habitat Classification	Constraint Ranking	Riparian Vegetation	Core Feature	Upstream Linkage	Downstream Linkage	Road or Train Crossings	Constraint Ranking	Channel Definition	Channel Morphology (where applicable)	Rapid Stream Assessment (RSAT) Condition	Stability Index (RGA)	Constraint Ranking	
MEC-R19	9.18	Ephemeral	0.025	0.722	Low	Low	Fish rarely if ever present based on channel form and ephemeral flow	Indirect	Simple contributing on tableland, complex contributing in valley	Low	Medium	Yes	Low	High	No	Medium/High	Poorly defined	Poorly defined.	Swale	Swale	Low	Medium/High
MEC-R20	16.08	Ephemeral	0.043	1.265	Low	Low	Fish rarely if ever present based on channel form and ephemeral flow	Indirect	Simple contributing on tableland, complex contributing in valley	Low	Medium	Yes	Low	High	No	Medium/High	Poorly defined	Poorly defined. Through cornfield	Swale	Swale	Low	Medium/High
MEC-R21	12.34	Ephemeral	0.033	0.971	Low	Low	Fish rarely if ever present based on channel form and ephemeral flow	Indirect	Simple contributing on tableland, complex contributing in valley	Low	Low	No	Low	High	Yes	Medium	Poorly defined	Poorly defined. Livestock disturbance	Swale	Swale	Low	Low
MEC-R22	160.49	Intermittent	0.432	12.630	Low	Medium	Readily accessible to tolerant fish species from Etobicoke Creek	All seasonally	Seasonal	Medium	Medium	Yes	Low	Medium	Yes	Medium	Appears defined in aerial photographs	Channel clearly observed on aerial photography Existing tree-line along channel edge Access crossing In-channel vegetation.	*Not possible to access due to electric fence*	*Not possible to access due to electric fence*	Medium	Medium
MEC-R23	125.54	Does not flow	0.338	9.880	Low	Medium	Dry except short reach upstream of McLaughlin	None	Simple contributing.	Low	Low	No	Low	Medium	Yes	Low	Poorly defined	Poorly defined. Runs through arable land Realigned, culverted in parts	Swale	Swale	Low	Low
MEC-R24	64.34	Ephemeral	0.173	5.064	Low	Low	Fish rarely if ever present based on channel form and ephemeral flow	Indirect	Simple contributing on tableland, complex contributing in valley	Low	Low	Yes	Low	Medium	No	Medium	Poorly defined	Poorly defined Runs through agricultural field	Swale	Swale	Low	Low
MEC-R25	535.07	Permanent	1.260	33.900	Medium	High	Diverse fish community	All life stages and habitat functions	Permanent	High	High	Yes	Medium	Medium	No	High	Well-defined	Gradient: moderate Substrate: clay, fine sands / gravel Banks: clay and sands Bank height: ≈1.5-2.5m Other observations: meandering through woodland undercurring & exposed tree roots several deep scour pools *Detailed assessment site*	Moderate	In Regime	High	High
MEC-R26	219.48	Intermittent	0.530	14.800	Low	Medium	Tolerant fish species expected seasonally	All seasonally	Seasonal	Medium	Medium	Yes	High	High	No	High	Poorly defined	Poorly defined.	Swale	Swale	Low	High
MEC-R27	145.27	Intermittent	0.351	9.796	Low	Medium	Fish rarely if ever present based on channel form and ephemeral flow	Indirect	Complex contributing	Low	High	Yes*	Low	High	Yes	High	Poorly defined	Poorly defined.	Swale	Swale	Low	High
MEC-R28	44.6	Intermittent	0.120	3.510	Low	Low	Fish rarely if ever present based on channel form and ephemeral flow	Indirect	Complex contributing	Low	High	Yes*	Low	High	Yes	High	Poorly defined	Poorly defined.	Swale	Swale	Low	High
MEC-R29	303.77	Intermittent	0.720	18.600	Low	Medium	Tolerant fish species expected seasonally	All seasonally	Seasonal	Medium	High	Yes*	Low	High	Yes	High	Poorly defined	Gradient: low Substrate: clay and silt Banks:clay and sands Bank height: ≈0.75-1.8m Other observations: driveway crossing channel very small	Moderate	Swale	Low	High

INTEGRATED WATERCOURSE CONSTRAINT RANKING																						
Drainage Feature Unit and Sub Reach	Flow Assessment						Aquatic Habitat Assessment				Terrestrial Vegetation, Significance and Linkage Functions [2.]						Channel Form					Net Constraint Ranking [1.]
	Catchment Size	Flow Description	2 Year Flow (m^3/s)	Regional Flow (m^3/s)	Potential for Groundwater Discharge	Constraint Ranking	Attributes/ Species/ Abundance/ Size	Life Cycle and Habitat Functions	Habitat Classification	Constraint Ranking	Riparian Vegetation	Core Feature	Upstream Linkage	Downstream Linkage	Road or Train Crossings	Constraint Ranking	Channel Definition	Channel Morphology (where applicable)	Rapid Stream Assessment (RSAT) Condition	Stability Index (RGA)	Constraint Ranking	
MEC-R30	469.91	e (tiled portion	1.120	27.600	Low	Medium	Tolerant fish species expected seasonally, except for drop structure and tile that prevents upstream fish movement into this watercourse	All seasonally	Seasonal	Medium	Medium	No	Medium	High	No	Medium	Well-defined	Gradient: low Substrate: silt and fine sands Banks: silt and clay Bank height: ≈1.6-1.8m Other observations: soft bed residential property at downstream extent	Moderate	In Regime	Medium	Medium
MEC-R31	350	Intermittent	0.780	18.300	Low	Medium	Tolerant fish species expected seasonally, except for drop structure and tile that prevents upstream fish movement into this watercourse	All seasonally	Seasonal	Medium	Medium	Yes*	Medium	Medium	Yes	Medium	Appears defined in aerial photographs	Flows through arable field Vegetation in-channel	*Not assessed*	*Not assessed*	Medium	Medium
MEC-R32	119.91	Intermittent	0.350	8.940	Low	Medium	Tolerant fish species expected seasonally, except for drop structure and tile that prevents upstream fish movement into this watercourse	All seasonally	Seasonal	Medium	Medium	Yes*	Medium	Medium	Yes	Medium	Poorly defined	Gradient: low Substrate: clay, silt and fine sands Banks: n/a Other observations: channel loses definition downstream completely vegetated	Low	In Regime	Medium	Medium

NOTE: [1.] Net Constraint Ranking Legend:
"Low" = Feature may be elimiated subject to replicating function.
"Medium" = Feature must remain open but may be realigned subject to retaining function and applying natural channel design principles.
"High" = Feature to be protected/enhanced and remain open in its existing form and location (horizontal and vertical).
"Medium/High" = Portions of feature ranked "Medium" while other portions ranked "High"

[2.] Terrestrial, Vegetation, Significance and Linkage Functions Legend:
Medium* = constructed and planted channel
Medium** = potential linkage dependent on NWB
Yes* = potentially significant wetland (not yest evaluated by MNR)
Medium/High = allows for the re-alignment of the existing watercourse, so long as the features within core natural areas are preserved and the existing linkage function is maintained or enhanced

6. REFERENCES

Badzinski, D.S., R.W. Archer, S.T.A. Timmermans, K.E. Harrison, and K.E. Jones (Revised by M. Doyle). 2008. Assessment of Trends in Frog and Toad Populations in Ontario using Citizen Science Monitoring Data. Prepared for: The Ecological Monitoring and Assessment Network Coordinating Office, Environment Canada. http://www.naturewatch.ca/english/frogwatch/assessments/trends_in_ontario_populations/index.html

Bisby, F.A. 1995. Characterization of biodiversity. ***In:*** Global biodiversity assessment. ***Edited by*** V.H. Heywood and R.T. Watson. Cambridge University Press, Cambridge. pp. 21–107.

BSC (Bird Studies Canada). 2003. Marsh Monitoring Program - Training Kit and Instructions for Surveying Marsh Birds, Amphibians and their Habitats. 2003 Edition. 40 pages. Published by Birds Studies Canada in cooperation with Environment Canada and the U.S. Environmental Protection Agency. March 2003.

Cadman, M.D., D.A. Sutherland, G.G. Beck, D. Lepage, and A.R. Couturier (eds.) 2007. Atlas of the Breeding Birds of Ontario, 2001 – 2005. Bird Studies Canada, Environment Canada, Ontario Field Ornithologists, Ontario Ministry of Natural Resources, and Ontario Nature, Toronto. xxii + 706 pp.

Caledon Town of, 2008. LIDAR contour mapping (provided by Town courtesy of Mayfield West Landowners)

Caledon, Town of, 2004. Official Plan

Candevcon 1997 & 1999. Northwest Sandalwood Secondary Plan and EIR CVC (2003) ELC Mapping

CH2MHILL and TRCA (Toronto and Region Conservation Authority) 2008. Etobicoke Creek Headwaters Subwatershed Study Synthesis Report

Chapman, L.J. and D.F. Putnam. 1984. The Physiography of Southern Ontario, 3rd Edition. Ontario Geological Survey, Special Volume 2.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2008. Canadian Wildlife Species at Risk. Committee on the Status of Endangered Wildlife in Canada, December 2008. 84 pp. Web site: http://www.cosewic.gc.ca/eng/sct0/rpt/rpt_csar_e.cfm [accessed 9 December 2008]

COSEWIC (Committee on the Status of Endangered Wildlife in Canada. Ottawa) 2007. COSEWIC assessment and update status report on the redside dace Clinostomus elongates in Canada. (Vii + 59 pp.)

C.F. Crozier & Associates Inc., February 2005. Functional Servicing and Stormwater Management Report.

CVC (Credit Valley Conservation). 1997. The Credit Watershed Bird Species of Conservation Concern (Version 5, May 5th 1997)

Dobbyn, J.A.S. 1994. Atlas of the Mammals of Ontario. Federation of Ontario Naturalists, Don Mills, Ontario. 120pp.

Dougan & Associates, 2007. North West Brampton Landscape Scale Analysis (Draft August 2007)

Dougan & Associates. 2005. Northwest Brampton Environmental Open Space Study

Durpe C., J. Ehrlen. 2002. Habitat configuration, species traits and plant distributions. Journal of Ecology, vol. 90, p. 796-805.

Greenbelt Boundary (provided by Town)

Greenbelt Plan (2005)

Kaiser, J. 2000. The Vascular Plant Flora of the Region of Peel and the Credit Watershed. Credit Valley Conservation. Meadowvale, Ont.

Kirk, David A. and Michael J. Mossman. 1998. Turkey Vulture (Cathartes aura), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/339

KMK Consultants Ltd., 2001. Private Water Well Issues and Alternative Water Supply in Pressure Zone 7"

Kurta, A. 1995. Mammals of the Great Lakes Region (Revised Edition). University of Michigan. 376pp.

MMAH (Ministry of Municipal Affairs and Housing) October 2008. Greenbelt Plan Technical Papers 1-3 (Draft)

MMAH (Ministry of Municipal Affairs and Housing) 2005. Provincial Policy Statement

MNR (Ministry of Natural Resources) 2009. Caledon Wetland Mapping

MNR (Ministry of Natural Resources) 2008. Natural Heritage Information Centre (data queries for insects, lepidoptera, amphibians, reptiles, mammals, birds 2008)

MNR (Ministry of Natural Resources) 2008. Significant Species Data Query

MNR (Ministry of Natural Resources) 2008. Species at Risk in Ontario

MNR (Ministry of Natural Resources) 2007. Ontario Herpetological Atlas

MNR (Ministry of Natural Resources) 2007. Fletcher's Creek Headwaters Wetland Complex Mapping and Data

NHIC (Natural Heritage Information Centre). 2008a. Web-based Southern Ontario Vegetation Communities List and ranks (revised January 1997). Available: http://nhic.mnr.gov.on.ca/MNR/nhic/communities/comm_list.cfm

NHIC (Natural Heritage Information Centre). 2008b. NHIC List of Ontario Insects: Odonata. Ontario Natural Heritage Information Centre Home Page. http://nhic.mnr.gov.on.ca/MNR/nhic/species/listout.cfm?el=iiodo

NHIC (Natural Heritage Information Centre). 2008b. NHIC List of Ontario Lepidoptera. Ontario Natural Heritage Information Centre Home Page. http://nhic.mnr.gov.on.ca/MNR/nhic/species/listout.cfm?el=iile

NHIC (Natural Heritage Information Centre). 2008d. NHIC List of Ontario Amphibians. Ontario Natural Heritage Information Centre Home Page. http://nhic.mnr.gov.on.ca/MNR/nhic/species/listout.cfm?el=aa

NHIC (Natural Heritage Information Centre). 2008e. NHIC List of Ontario Reptiles. Ontario Natural Heritage Information Centre Home Page. http://nhic.mnr.gov.on.ca/MNR/nhic/species/listout.cfm?el=ar

NHIC (Natural Heritage Information Centre). 2008f. NHIC List of Ontario Birds. Ontario Natural Heritage Information Centre Home Page. http://nhic.mnr.gov.on.ca/MNR/nhic/species/listout.cfm?el=ab

NHIC (Natural Heritage Information Centre). 2008g. NHIC List of Ontario Mammals. Ontario Natural Heritage Information Centre Home Page. http://nhic.mnr.gov.on.ca/MNR/nhic/species/listout.cfm?el=am

North-South Environmental Inc., Dougan & Associates, and Sorensen Gravely Lowes. 2008. Peel-Caledon Significant Woodlands and Significant Wildlife Habitat Study: Draft for Public Comments - October 2008. Ontario: Region of Peel and Town of Caledon.

OBBA (Ontario Breeding Bird Atlas). 2001. Guide for Participants. Atlas Management Board, Federation of Ontario Naturalists, Don Mills. 34pp.

Oldham M. J., Bakowsky W. D., Sutherland D. A. 1995. Floristic Quality Assessment System for Southern Ontario. Natural Heritage Information Center, OMNR (Ontario Ministry of Natural Resources). Peterborough, Ontario. 69 pp.

ODM (Ontario Division of Mines, Map No. 2337. 1976). Palaeozoic Geology, Brampton (1:50,000),

ODM (Ontario Division of Mines) Industrial Mineral Report 23, Hewitt, D.F. 1969. Industrial Mineral Resources of the Brampton Area

ODM (Ontario Department of Mines) Map No. 2179. 1969. Brampton Area Drift Thickness Sheet (1:63,360),

ODM (Ontario Department of Mines), Map No. 2176. 1969. Brampton Area Industrial Mineral Resources Sheet (1:63,360)

OMNR (Ontario Ministry of Natural Resources). 2000. Significant Wildlife Habitat Technical Guide. 151 pp.

OMNR (Ontario Ministry of Natural Resources). 2008. Species at Risk in Ontario List. http://www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/246809.html

Ontario Ministry of Natural Resources, Peterborough, Ontario. Redside Dace Recovery Team. 2009. DRAFT Recovery Strategy for Redside Dace (Clinostomus elongatus) in Ontario. Ontario Recovery Strategy Series.(vi + 29 pp.)

OPIF (Ontario Partners in Flight). 2008. Ontario Landbird Conservation Plan: Lower Great Lakes/St. Lawrence Plain, North American Bird Conservation Region 13. Ontario Ministry of Natural Resources, Bird Studies Canada, Environment Canada. Final Draft, June 2008. Draft February 2006 version available online at: http://www.bsc-eoc.org/PIF/PIFOntario.html

Paragon Engineering Limited 1996. Fletcher's Creek Subwatershed Study

Parish Geomorphic Ltd. 2003. *Bankfull Characteristics and Regional Thresholds for TRCA Regional Monitoring Program Detailed Sites* (Submitted to: TRCA)

Parish Geomorphic Ltd. 2002. *Regional Monitoring Program – Fluvial Geomorphology Component Etobicoke Creek, Mimico Creek, and Humber River Watersheds* (Submitted to: Toronto and Region Conservation Authority)

Peel, Region of, February 2009. Draft Regional Official Plan Amendment 21; Draft Natural Heritage Policies

Peel, Region of/ Caledon, Town of, October 2008. Draft Significant Woodlands and Significant Wildlife Habitat Study

Peel, Region of, 2006. Official Plan

Philips Engineering Ltd., May 2009. Northwest Brampton Urban Area Subwatershed Impact Assessment (Draft)

Philips Engineering. 2007. Phase 1: Subwatershed Characterization and Integration. North West Brampton Urban Development Area. Draft. December 2007.

Plourde, S.A., E.L. Szepesi, J.L. Riley, M.J. Oldham and C. Campbell. 1989. Distribution and Status of the Herpetofauna of Central Region, Ontario Ministry of Natural Resources. Parks and Recreational Areas Section, OMNR, Open File Ecological Report SR8903, Central Region, Richmond Hill, Ontario. 27pp.

Stantec. 2005. Mayfield Station Preliminary Environmental Study. Appendix C: Environmental Consultant. 2005. Stantec, Markham, 14 pp.

Terraprobe Ltd. 2007. Foundation Investigation & Design Report (Part 1: Factual Information), Etobicoke Creek Bridge, Highway 410 Extension – Phase III, prepared for the Ministry of Transportation Ontario

Terraprobe Ltd. 2007. Foundation Investigation & Design Report (Part 1: Factual Information), Valleywood Boulevard Underpass Structure, Highway 410 Extension – Phase III, prepared for the Ministry of Transportation Ontario.

TRCA (Toronto and Region Conservation Authority) 2008. Etobicoke Creek Headwaters Subwatershed Study

TRCA (Toronto and Region Conservation Authority). 2008a. Toronto and Region Conservation Authority's Terrestrial Natural Heritage Program Vegetation Community and Species Ranking and Scoring Method. March 2008. 31pp.

TRCA (Toronto and Region Conservation Authority). 2008b. 2008 Fauna Ranks and Scores. PDF provided by Paul Prior November 20, 2008.

TRCA (Toronto and Region Conservation Authority). **2008c.** List of Vascular Plant Species Ranks.

TRCA (Toronto and Region Conservation Authority). **2008d.** List of Vegetation Communities Ranks.

TRCA (Toronto and Region Conservation Authority) 2007. Terrestrial Natural Heritage System Strategy

TRCA (Toronto and Region Conservation Authority) 2006. Etobicoke Creek GTAA Living City Study the Aquatic Ecosystem

TRCA (Toronto and Region Conservation Authority) 2006. Mayfield West Natural Features Study; Appendix: ELC Mapping and Significant Species Mapping

TRCA (Toronto and Region Conservation Authority) 1998. State of the Watershed Report: Etobicoke and Mimico Creek Watersheds.

TRCA (Toronto and Region Conservation Authority) 1998. State of the Watershed Report: Etobicoke and Mimico Creek Watersheds

Totten Sims Hubicki, March 2007. Etobicoke Creek Hydrology Update Final Draft Study Report.

Varga, S., D. Leadbeater, J. Webber, J. Kaiser, B. Crins, J. Kamstra, D. Banville, E. Ashley, G. Miller, C. Kingsley, C. Jacobsen, K. Mewa, L. Tebby, E. Mosley and E. Zajc. 2005. Distribution and Status of the Vascular Plants of the Greater Toronto Area. OMNR, Aurora District.

Varga et al. Status of Vascular Plants of the Greater Toronto Area, (Draft 2005)

APPENDIX 'A'
INFORMATION TRACKING CHART

APPENDIX 'B'
GEOTECHNICAL

APPENDIX 'C'
HYDROGEOLOGY

APPENDIX 'D'
HYDROLOGY/HYDRAULICS

APPENDIX 'E'
FLUVIAL GEOMORPHOLOGY

APPENDIX 'F'
SURFACE WATER QUALITY

APPENDIX 'G'
FISHERIES

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TERRESTRIAL RESOURCES

APPENDIX 'I'

NORTH WEST BRAMPTON CHARACTERIZATION EXCERPTS