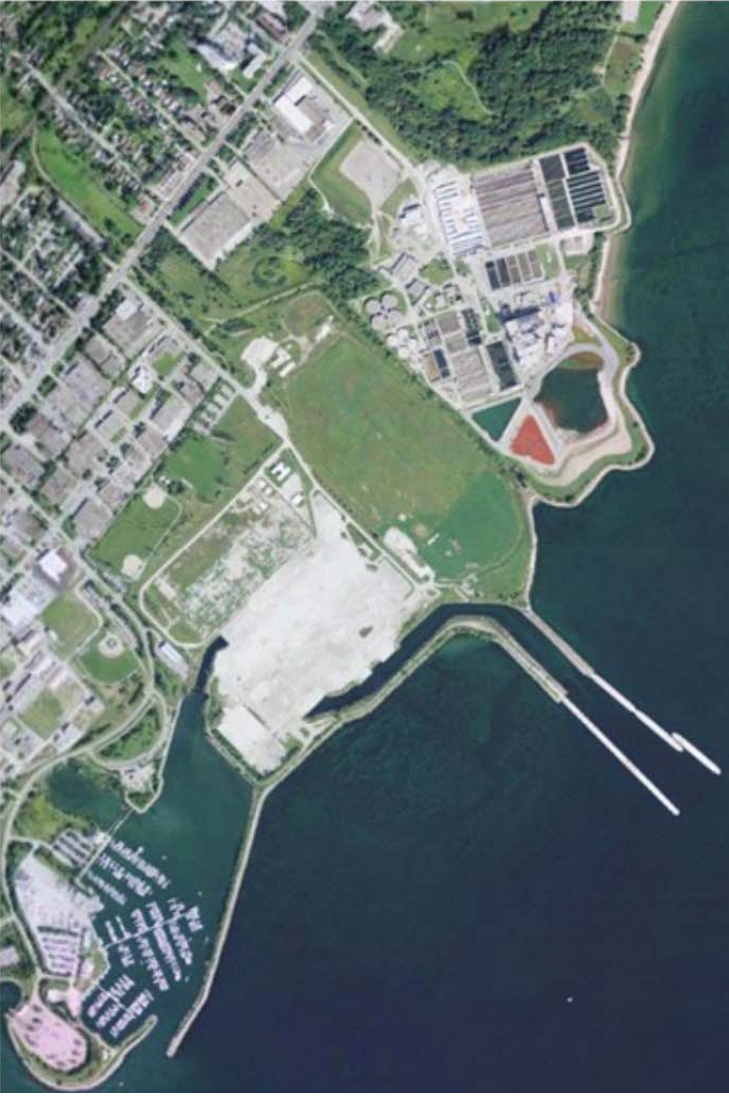
APPENDIX G

ECOLOGY TECHNICAL REPORT



LAKEVIEW WATERFRONT CONNECTION

ECOLOGY TECHNICAL REPORT

April 2014

Prepared by:

Credit Valley Conservation Authority

and

Toronto and Region Conservation Authority

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1.0 INTRODUCTION

1.1 LWC PROJECT BACKGROUND

Credit Valley Conservation (CVC) and the Region of Peel and with the support of the City of Mississauga and the Toronto and Region Conservation Authority (TRCA), are proceeding with an Individual Environmental Assessment (EA) for the Lakeview Waterfront Connection (LWC). This document describes the natural environment work being carried out in support of the EA. It describes the baseline inventory of natural environment conditions, the development and assessment of alternative concepts, a detailed assessment of the preferred alternative, and the identification of mitigation measures.

1.2 OVERVIEW OF NATURAL HERITAGE FEATURES

In this report the biological environment of the LWC Regional Study Area and the LWC Project Study Area are described separately. The LWC Regional Study Area discussion provides the broad landscape context that frames the discussion on the particular ecological features and functions provided by the LWC Project Study Area which are described in more detail. The interaction and nesting among spatial and ecological scales sets the foundation for the examination of the existing conditions and the formulation of an integrated approach to natural heritage assessment.

1.3 DESCRIPTION OF THE LWC PROJECT STUDY AREA AND LWC REGIONAL STUDY AREA

1.3.1 LWC Project Study Area

The LWC Project Study Area is bounded to the east by Etobicoke Creek, to the west by the eastern pier extending from OPG's Lakeview site, and to the north by Lakeshore Road. This study area extends approximately 1 kilometre south into Lake Ontario (**Figure 1**). For the purposes of aquatic Natural Heritage, Etobicoke Creek is considered within the LWC Project Study area, as the fish community surveyed along Etobicoke Creek are part of the broader LWC Project Study Area.

It is an area of dense human population, land conversion and relatively low natural cover. Ecologically, this area is part of the 7E4 Ecoregion which is associated with the easternmost extension of the deciduous forest zone within Southern Ontario. This ecoregion, and the LWC Project Study Area in particular, are influenced by the dynamics of Lake Ontario and the moderating effects of the Lake on climate and temperature. As a result, certain species and community types representative of Carolinian ecosystems are present within the area.

Figure 1: LWC Project Study Area

1.3.2 LWC Regional Study Area

The LWC Regional Study Area extends from the western-most extent of CVC's jurisdictional boundaries on the border with Oakville, into TRCA's jurisdiction as far as east as Colonel Samuel Smith Park in the City of Toronto. The northern most limit of the Regional Study Area roughly coincides with Lakeshore Road, but ranges from about 0.5 to 2-km inland, and about 2 to 3-km offshore (**Figure 2**).

Over the last 30 years, a number of waterfront parks have been created by the TRCA, CVC and local municipalities. While these waterfront parks do have some constructed habitat elements as part of their design, these habitats typically are small and remain relatively isolated, particularly from an east-west wildlife migration perspective. Some of these parks, including Colonel Sam Smith Park (Toronto) have been the recent focus of intense efforts to enhance the aquatic and terrestrial ecological functions while balancing the needs for recreation and public access to the lakeshore.

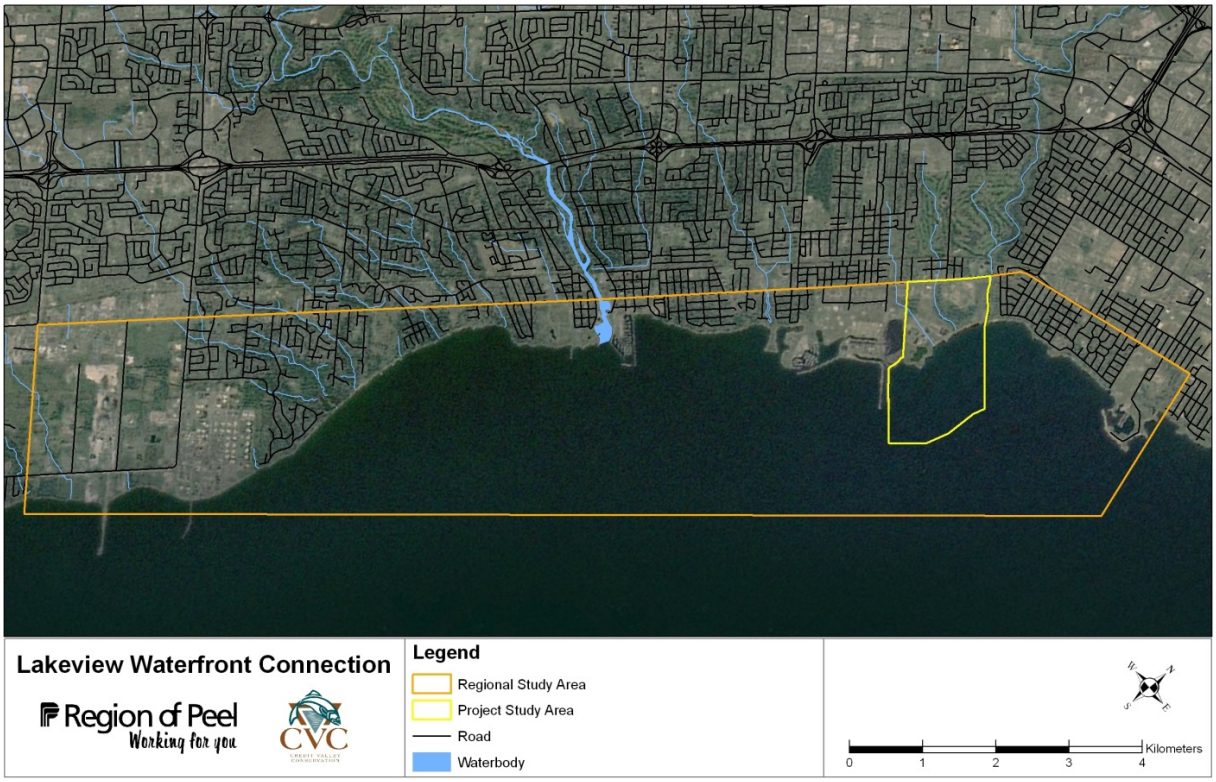

Figure 2: LWC Regional Study Area

2.0 BASELINE ENVIRONMENTAL CONDITIONS

2.1 AQUATIC HABITAT

Aquatic habitats along Ontario's Great Lakes and the LWC Project Study Area have undergone substantial change from their historical conditions.

- Approximately 75% of historic wetlands within heavily settled Great Lakes environments have been lost to activities such as land use change, filling, dredging, and disturbance (Whillans 1982).
- The Lake Ontario shoreline within CVC's jurisdiction is almost completely hardened, with less than 20% of the shoreline retaining some natural structure and function.
- Historical stonehooking activities along the Mississauga shoreline has resulted in wholescale changes in, and destruction of, nearshore aquatic habitat through the removal of structure and shelter for fish, including the now extinct Lake Ontario population of Atlantic Salmon (Martin 2007). The loss of virtually all cobble substrates and the elimination of Lake Trout spawning reefs are also attributed to stonehooking (Whillans 1979), with estimates of as much as 4 million tonnes having been removed from the nearshore Regional Study Area (CVC unpublished).
- Past lakefill and shoreline modifications associated with OPG's Lakeview site and the Region of Peel's G.E. Booth Wastewater Treatment Facility (WWTF) lots were undertaken to allow for the expansion and protection of industrial activities, and was not designed to provide for, or to augment, fish or wildlife habitat.
- Much of the nearshore habitat is now dominated by non-native, invasive quagga mussels and round gobies, both of which negatively influence benthic invertebrate diversity and associated food sources for fish and other aquatic wildlife.
- Quagga mussels are believed to recycle phosphorus in the nearshore and to exacerbate algal blooms.

2.1.1 Lake Ontario

2.1.1.1 LWC Regional Study Area

The shoreline in the LWC Regional Study Area consists primarily of erosion protection structures, such as armourstone, revetments, concrete, rubble and rip rap, with approximately 80% of the shoreline west of the LWC Project Study Area hardened. Hardening the shoreline impedes the movement of species between upland and lake habitats; restricts the ability of vegetation to take hold; and in many cases eliminates the potential habitat and feeding areas for waterfowl, shorebirds, and aquatic organisms. The armoured shorelines within the LWC Regional Study Area were designed specifically to protect infrastructure, and provide very little in the way of fish habitat.

Forty-three (43) species of fish have been recorded to the west of the LWC Project Study Area since 2008. While the diversity of fish species is relatively high, the abundance of fish captured in this area is low and the nearshore community is comprised of resilient species typical of this type of environment (i.e., degraded, low availability of fish habitat), including Smallmouth Bass, Northern Pike, Pumpkinseed, Yellow Perch and Brown Bullhead. Records also include the following species of note: American Eel; Atlantic Salmon; Walleye; Longnose Gar; Bowfin; and White Bass.

To the east of the LWC Project Study Area (primarily around and within Colonel Sam Smith Park), 37 species of fish have been recorded along the open coast and embayment area, since 1989. White Sucker was the most numerous and consistently caught fish throughout the period of record, while Common Carp was also ubiquitous throughout the samples. Interestingly, American Eel and Brown Trout were frequently caught throughout the 1990s, but reduced to sporadic captures in the 2000s. American Eel are typically found within the embayment of Colonel Sam Smith Park, though occasionally on the open coast side of the Park. They were last found there is 1998. Conversely, the incidence of capture for Alewife, Emerald Shiner, Lake Chub, Northern Pike, Pumpkinseed, Rock Bass, Smallmouth Bass, Walleye, and Yellow Perch seems to have increased over the last ten years.

American Eel, a Provincially and Federally listed species, is the only Aquatic Species at Risk found within the LWC Regional Study Area. Within the entire LWC Regional Study Area, 52 species of fish have been observed.

Overall, there are 11 introduced and/or invasive species found within the LWC Regional Study Area, including Round Goby and Common Carp. In addition, Zebra Mussel (*Dreissena polymorpha*) and Quagga Mussel (*D. rostriformis bugensis*) populations have been found all along the Mississauga shoreline (Pollutech 2012), and likely exist along the length of the Lake Ontario shoreline.

2.1.1.2 LWC Project Study Area

Open coast habitat dominates the LWC Project Study Area. Substrates in this habitat are generally sands, rip-rap, or cobbles over shale. The associated shoreline types within the LWC Project Study Area range from a sandy cobble beach at Marie Curtis Park West; a remnant beach located south of the WWTF (which is bounded by two armoustone headlands); armourstone and revetment south of the WWTF; and concrete reinforced barges, used to create the eastern pier off OPG's Lakeview site. As the majority of the shoreline has been protected, the elimination of bluff erosion has resulted in sediment starved littoral conditions along this portion of the Lake Ontario waterfront.

Nearshore forage habitat is important for spawning and feeding. However, the extensive shoreline hardening, and erosion-resistant bedrock within the nearshore lakebed (largely a result of historic stonehooking activities), provides for limited habitat diversity in the nearshore area. In addition, there is no submergent vegetation within the entire LWC Project Study Area.

Appendix 1 provides a list of all fish species recorded within the LWC Project Study Area. Seventeen (17) species of fish have been found along the open coast portions of the LWC Project Study Area, which will be the primary location where project works will occur. Within the estuary of Etobicoke Creek an additional 31 species of fish have been observed. Four species of fish have been found in the adjacent small streams. In total, 36 species of fish have been found in the LWC Project Study Area. The fish community consists of fish species typically found in this type of habitat (i.e., low availability of fish habitat), including common fish such as White Sucker, Common Carp, Alewife, Lake Chub, Longnose Dace and Emerald Shiner. The invasive Round Goby has also been caught regularly in recent years. While American Eel was is found within the Regional Study Area, it has not been captured within the LWC Project Study Area.

2.1.2 Creeks

The life cycle of several species living in Lake Ontario, especially fish, have critical stages of their life located upstream within adjoining watersheds or at the mouth of creeks feeding Lake Ontario. Creek mouths are typically associated with coastal wetlands. These areas provide the necessary habitat conditions for many fish species and life stages including reproduction, juvenile rearing, and end of life. Given the historic loss of the entire coastal wetlands that once connected the mouths of Etobicoke, Serson and Applewood Creeks, and the complete isolation of the Serson Creek watershed from Lake Ontario, the LWC Project offers the opportunity to re-establish missing habitat that is critical for many life cycle stages for fish and other species.

2.1.2.1 LWC Regional Study Area

In total, 15 creeks discharge directly to Lake Ontario within the LWC Regional Study Area, all located to the west of the LWC Project Study.

Of these creeks, three (Lakeside, Moore, and Cumberland Creeks) either contain no fish due to blockages near the shoreline, or there are no data for these watercourses. Fish records in Avonhead, Clearview, Turtle, Birchwood, Tecumseh and Lornewood Creeks indicate tolerant warmwater communities typical of urban streams. Sheridan Creek supports a tolerant warmwater fish community, as well as a spring run of White Sucker. Rattray Marsh at the mouth of Sheridan Creek is dominated by Common Carp. Typical lake residents such as Gizzard Shad, Rainbow Smelt, Alewife, and Emerald Shiner are also found in the Marsh. Similar to Sheridan Creek, Cooksville Creek supports a tolerant warmwater community with lake and stream species. Cooksville Creek also supports a run of White Sucker in the spring.

The Port Credit Marshes near the mouth of the Credit River have been sampled annually since 2008 and data identified 26 species in the marshes including Trout-perch. Other species of note include White Sucker, Smallmouth and Rock Bass, and Northern Pike. The biomass is dominated by Common Carp and Brown Bullhead. Runs of desirable species such as Atlantic Salmon, Brown Trout and Rainbow Trout are allowed passage upstream of the dam in Streetsville. This dam prevents the migration of invasive species such as Sea Lamprey and Round Goby and non-natives species such as Pacific Salmon.

In total, 32 species of fish have been found in the streams and estuaries of creeks and rivers within the LWC Regional Project Area.

Appendix 1 provides a list of all fish species recorded within the LWC Regional and Project Study Areas, including those found in creeks and streams.

Wetland communities within the LWC Regional Study Area make up less than 1% of the land cover, and only exist in isolated pockets. The largest wetlands occur at Rattray Marsh and Credit River Marshes to the west of the LWC Project Study Area, and smaller communities dot many of the urban creeks and creek mouths throughout the area. The scarcity of wetland habitat in the LWC Regional Study Area echoes the state of wetlands across southern Ontario and the GTA where settlement, land conversion, and intensification have historically resulted in the especially high loss of wetland vegetation. Approximately 50% of the wetlands along Ontario's Great Lakes have been lost; and up to 90% have been lost along the most urbanized shorelines (Governments of Canada and The United States of America, 2005). Land use change, filling, dredging, and disturbance are the most notable causes of the reduction.

2.1.2.2 LWC Project Study Area

Within the LWC Project Study area, three creeks discharge directly to Lake Ontario (from east to west): Etobicoke Creek, Applewood Creek, and Serson Creek. Historically, these tributaries played a significant role as spawning and nursery areas for numerous lake resident fish, including a large coastal wetland that connected all three creeks at their mouths. Today, these are highly urbanized systems, with limited fish access and poor quality fish habitat.

Fish records for two Etobicoke Creek monitoring stations indicate that 31 species were recorded at the mouth of the creek and 16 species found upstream to Lakeshore Road. Seven of the upstream species were not previously identified at the mouth for a total of 35 unique species. The most consistent and most numerous fish caught at the mouth of Etobicoke Creek are White Sucker and Common Carp. However, since 2003, Emerald Shiner and Alewife have been routinely captured in large numbers. Gizzard Shad, Spottail Shiner, Freshwater Drum, Brown Bullhead and Smallmouth Bass are also caught relatively frequently in moderate numbers. Many of the species found in Lake Ontario are found in the lower reaches of Etobicoke Creek, supporting the need for tributary access from the Lake. This fish community depicts a fish population dominated by resilient, cool, and warmwater species.

While Applewood Creek is enclosed upstream of South Service Road, the confluence with Lake Ontario and Applewood Creek remains natural, and fish are regularly able to access this watercourse. A total of six species have been recorded up to Lakeshore Road, including migratory White Sucker. No fish were caught upstream of Lakeshore Road. Lakeshore Road is currently identified as a barrier to fish migration, although the City of Mississauga is currently upgrading the culverts at Lakeshore for both Serson and Applewood Creeks, with associated efforts to re-establish fish passage. The wetland at the mouth provides habitat for species such as Fathead Minnow and Lake Chub.

Serson Creek has undergone numerous diversions (including a diversion west to its present location sometime between 1954 and 1966), and currently splits upstream of the WWTF, with baseflows diverted through a wet-forest north of the WWTF before being directed through a culvert under the WWTF to Lake Ontario, and high flows diverted through a straight, open channel, along the eastern boundary of the OPG Lakeview site. No fish were captured during electrofishing surveys conducted in June 2011 in Serson Creek above the diversion channel. The underground diversion prevents fish from entering the creek from the lake, while the higher flow channel is dry the majority of the time and is frequently blocked with debris at the mouth, as such, sampling has not found any fish present in Serson Creek.

Appendix 1 provides a list of all fish species recorded within the LWC Regional and Project Study Areas.

2.1.2.3 Wetlands

Wetlands are areas where the water table is at or near the surface of the land for a portion of time. Wetland communities include swamps, marshes, fens and bogs; each of which provides unique habitat for wildlife and plants. Great Lakes Coastal Wetlands are unique ecosystems whose hydrology and ecology are dictated in part by the dynamics of the lake water levels. Wetland habitat in southern Ontario is no longer common. Agricultural expansion, urban development, and human disturbance have significantly reduced pre-settlement wetland habitat.

Coastal wetlands have especially been reduced in urbanized parts of the Great Lakes due to lake filling and other forms of development (Whillans 1982).

Wetlands provide important ecological goods and services and support the health of the entire watershed. They provide habitat for plants and animals that depend on wet areas for part or all of their life cycle, act as water filters for pollutants, nutrients and trapping sediments, influence groundwater recharge and discharge and are important stabilizers of shoreline areas. Wetlands and the wildlife they support are sensitive to surface water and groundwater pollution.

An historical air photo from 1945 suggests that a significant linear open water wetland was likely to exist connecting the mouths of Etobicoke and Applewood Creeks and was protected by a long barrier beach along the shore of Lake Ontario (**Figure 3**). Air photos in the mid-1950s suggested that the mouth of Etobicoke Creek had breached across the barrier beach, and by the mid-1960s, the linear wetland was lost, possibly due to the infilling by municipal waste (**Figure 4**).

There are only 0.7-ha of wetlands within the LWC Project Study Area, including four isolated cattail shallow marshes within (or adjacent to) the old field community in the former Arsenal Lands and Marie Curtis Park. A Common Reed Mineral Marsh (MAM2-a) was also observed in 2010 within the meadow community and a Duckweed Floating-leaved Shallow Aquatic (SAF1-3) community also exists, though it is mapped as in inclusion in a larger marsh community. Though all the wetlands are small in size and relatively low in diversity, they do provide the only known habitat for breeding amphibians in the LWC Project Study Area. One wetland area is associated with a low, wet seepage area within the forested community at Marie Curtis Park and forms a small tributary that outlets to Lake Ontario through the beach between Etobicoke Creek and Applewood Creek. The wetland vegetation communities recorded are summarized in **Table 1.**

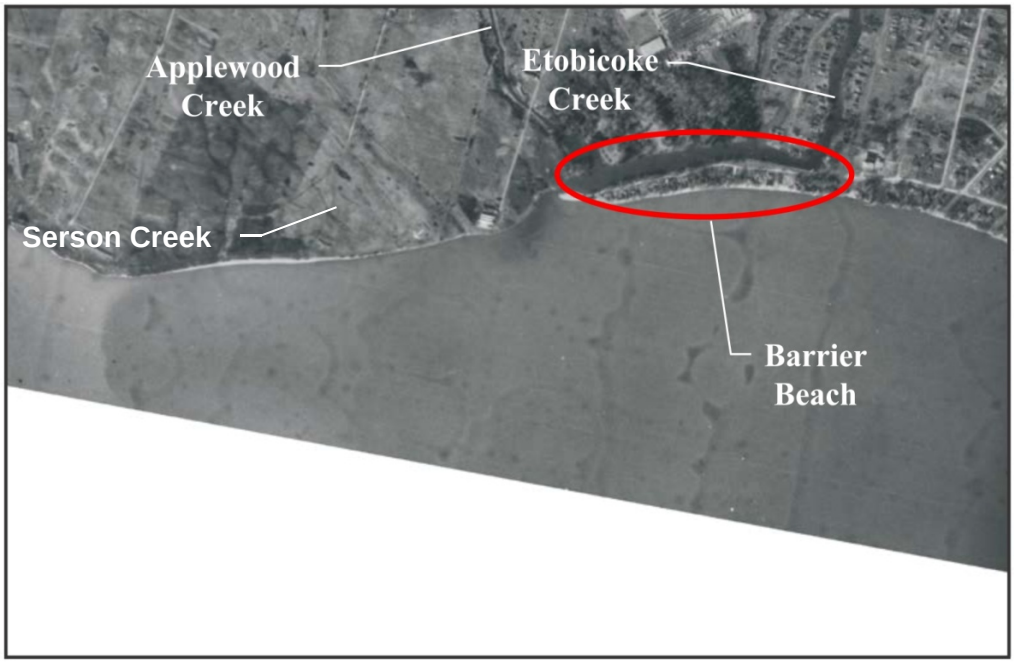

Figure 3: Aerial Photograph of Mississauga Shoreline (OPG Lakeview Site to Etobicoke Creek), 1946

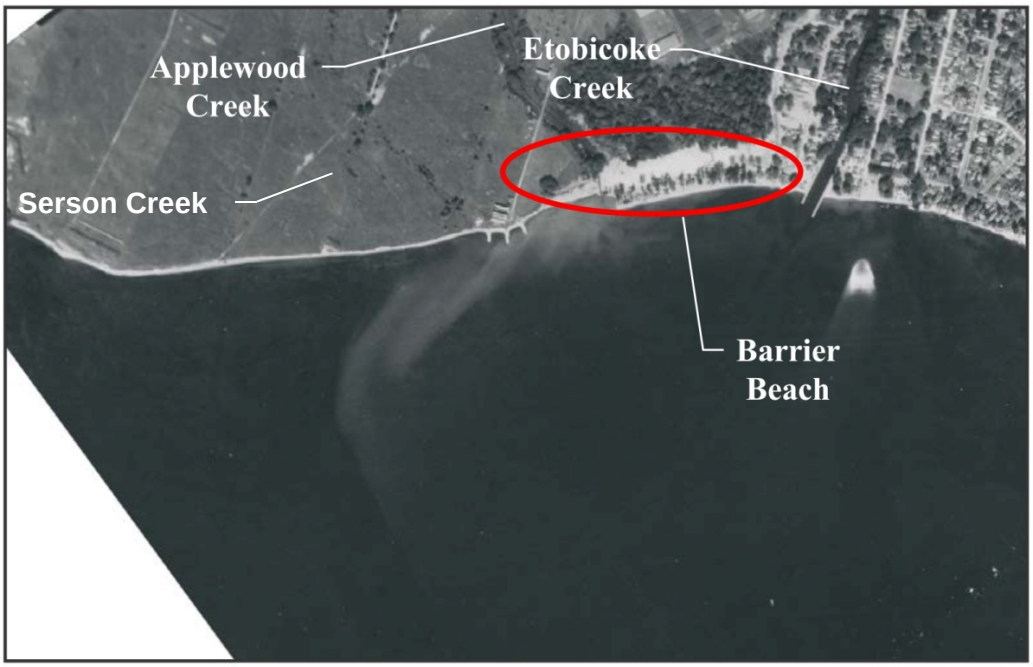

Figure 4: Aerial Photograph of Mississauga Shoreline (OPG Lakeview Site to Etobicoke Creek), 1954

Table 1: Wetland Vegetation Community Types within the LWC Project Study Area

Vegetation type	ELC code	TRCA Ranking	Notes	Source
Narrow-leaved Cattail Mineral Shallow Marsh	MAS2-1B	L+		TRCA, 2012
Broad-leaved Cattail Mineral Shallow Marsh	MAS2-1A	L4		TRCA, 2012
Duckweed Floating-leaved Shallow Aquatic	SAF1-3	L4	Noted as an inclusion in a MAS2-1A community.	CVC 2010, unpublished
Common Red Mineral Meadow Marsh	MAM2-A	L+	Noted as an inclusion in a meadow community.	TRCA, 2012

In addition to the natural wetland communities, the WWTF currently contains three on-site settling ponds that may be acting as surrogate open water and wetland habitat. The largest and most easterly of the ponds includes a small willow thicket swamp. During the spring, migration has been known to support waterfowl and shorebirds which would otherwise require more natural wetland habitat to for feeding and resting ("stopover habitat").

2.2 TERRESTRIAL HABITAT

Terrestrial habitat found within a few kilometres of the Lake Ontario shoreline serves an important role in supporting both resident and migratory species. With the limited natural cover that exists along the Lake Ontario shoreline, even small habitat patches in urban and urbanizing areas are of value and associated losses and/or gains have a much greater relative impact to overall ecosystem functions (CVC 2012; NSEL 2009; TRCA 2007).

2.2.1 LWC Regional Study Area

The natural cover within the LWC Regional Study Area is composed of forested and successional areas; small wetland communities exist but are restricted to riparian areas along streams, the Credit River, and coastal embayments.

The majority of natural forest cover within the LWC Regional Study Area occurs in concentrated pockets isolated from one another by a matrix of urban land uses. These small forests occur along the shoreline, inland, and along the Credit River valley. The matrix of residential, commercial/industrial and institutional land that fills the spaces between natural areas is not devoid of vegetation, nor is it completely lacking in ecological activity. Because of the history of development in areas such as Port Credit, Mineola and Clarkson, many communities support an urban forest composed of mature tree canopy and understories of both native and non-native vegetation.

The forests in the LWC Regional Study Area are similar to those in other heavily urbanized areas in that they contain a significant component of non-native vegetation. Human disturbances related to encroachments and off trail uses and intensive management are evident in many forests where reduced regeneration and forest understory structure are evident.

Successional communities include cultural meadows, cultural savannahs, cultural thickets, cultural woodlands and cultural hedgerows are relatively spread out in the LWC Regional Study Area. They occur on both public and private lands and generally have been created or maintained as the result of human influences or other factors. As a result of human influences, often the composition and function of the community is altered compared to more naturally derived communities. Within the LWC Regional Study Area, successional communities make up a considerable portion of the non-urban land use in the nearby OPG Lakeview lands and are also clearly evident near Port Credit (the Imperial Oil lands).

Dynamic communities, such as sand and cobble beaches (including treed beach ridge), are restricted to shoreline areas. Within the LWC Regional Study Area only about 16% of the Mississauga shoreline is made up of natural beaches, bars, or short bluffs; other man-made beaches occur to the east at Colonel Sam Smith Park. Beaches are difficult to classify with the mapping protocol for Ecological Land Classification (ELC) due to their narrow linear shape and small size. ELC is a tool developed by the Ontario Ministry of Natural Resources (OMNR) which enables practitioners to interpret the diversity of vegetative community types present within a natural area. The standardization of ELC across Southern Ontario allows for analysis of natural areas on municipal, regional, watershed, and provincial scales. Based on current mapping, there are less than 10-ha of beach habitat (open or treed, natural or created) within the LWC Regional Study area.

2.2.2 LWC Project Study Area

Similar to the LWC Regional Study Area, successional communities within the LWC Project Study Area make up a considerable portion of the non-urban land use within Marie Curtis Park west and the associated Arsenal Lands. The natural areas within the LWC Project Study Area are isolated from each other via industrial lands associated with the WWTF and the hardening of the shoreline. East-west connections along the shoreline and via offshore aquatic habitat may offer some limited connectivity; however, uninterrupted terrestrial connections do not exist.

North-south connections are limited to riparian habitat along Serson, Applewood and Etobicoke Creeks. Opportunities to improve habitat connectivity through ecological restoration activities are noted as an enhancement opportunity in the Marie Curtis Park Terrestrial Biological Inventory and Assessment (TRCA in 2012).

This area is one of the only opportunities for a natural coastal ecosystem on the western part of the Lake Ontario shoreline within the TRCA jurisdiction (TRCA, 2012), and is identified as including high functioning habitat patches within CVC's jurisdiction (CVC 2012a).

The vegetation communities within the LWC Project Study Area are shown in **Figure 1**. **Table 2** summarizes these natural and semi-natural[1] communities.

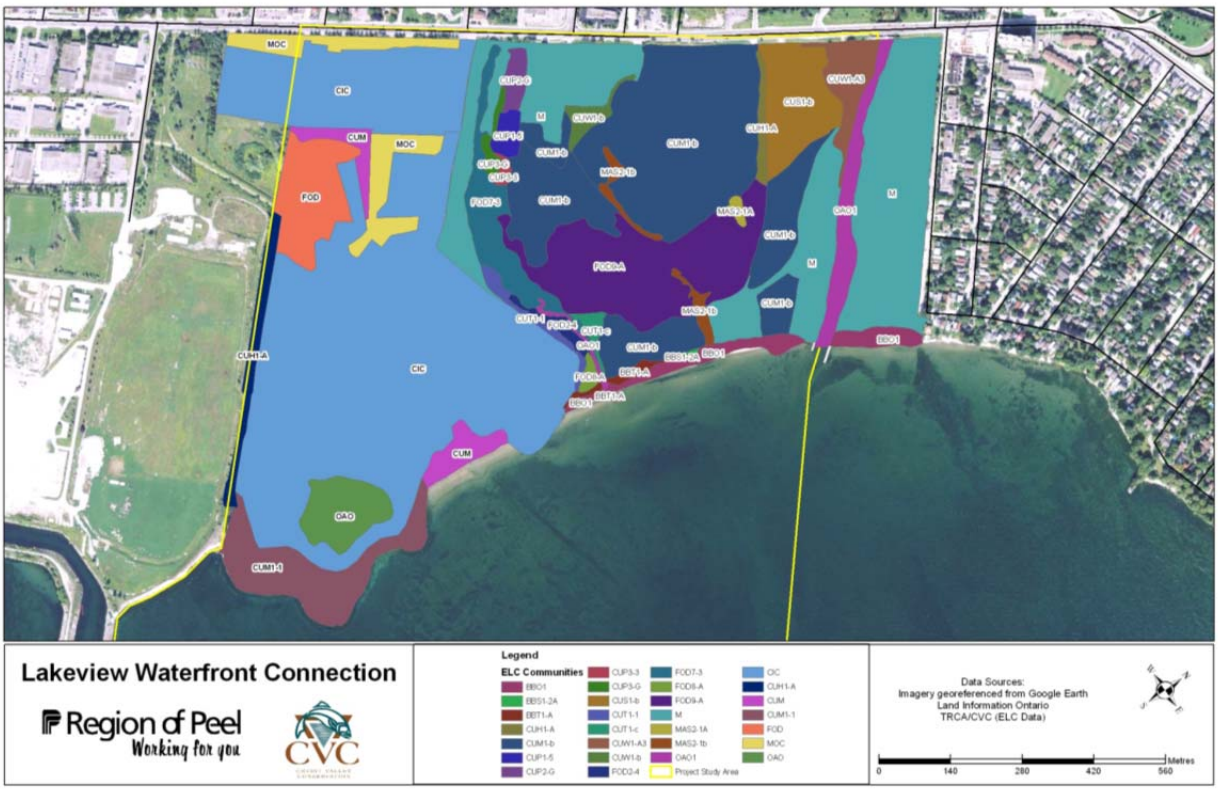

Figure 5: Vegetation Communities within the LWC Project Study Area

[1] Semi-natural communities are those that are, or have been, disturbed by human activities or development and are in various states of succession.

Table 2: Summary of Vegetation Communities within the LWC Project Study Area

	Class	Vegetation Community	Number of Vegetation Community Types	Area (hectares)
Natural	Forest	Deciduous Forest	5	13.2
	Dynamic	Beach and Dune	3	1.5
	Wetland	Marsh	2	0.7
Semi-natural	Forest	Plantation	4	1.3
	Successional	Woodland	2	1.8
		Savannah	1	2.8
		Hedgerow	2	1.5
		Thicket	2	0.7
		Meadow	1	17.2

For the most part, the vegetation communities within the LWC Project Study Area were delineated and identified to discrete vegetation types following the ELC system for Southern Ontario (Lee *et al*., 1998). Information on the vegetative community types comes from several sources as noted in **Table 3**. Except where otherwise noted, for the purposes of this report "Marie Curtis Park" includes Marie Curtis Park west of Etobicoke Creek, the Arsenal Lands, and the eastern section of the WWTF lands.

A total of 21 unique vegetation community types are represented in the LWC Project Study Area (**Table 2**). Nine of the 21 vegetation types are considered of conservation concern within TRCA's[2] jurisdiction (TRCA, 2012) and only one could potentially be considered a 'Rare Vegetation Community' according to the recommended criteria in the Region of Peel Significant Woodlands and Significant Wildlife Habitat Study (North-South Environmental *et al*. 2009). Detailed descriptions of each major community classes are provided in the following sections.

Table 3: Data Sources for Vegetation Community Descriptions within the LWC Project Study Area

Site	Study
Marie Curtis Park	TRCA, 2012
Arsenal Lands	TRCA, 2012
WWTF (eastern section)	TRCA, 2012
WWTF (north-western section and shoreline area)	City of Mississauga NAS CVC field observations (2011, 2012)

2.2.2.1 Forested Communities

Forest is the dominant habitat type in Southern Ontario, and harbours much of the region's biological diversity, ranging in scale from genetic material to species and communities (Larson *et al*. 1999). However, in intensely urbanized parts of the region, including the LWC Regional Study Area, forests account for relatively little of the landscape, though they can perform a

[2] TRCA assesses the quality of each habitat patch through an evaluation of size, shape and matrix influence. These criteria are weighted together to determine an average measure of habitat quality that corresponds to a 'local rank' or L-Rank ranging from L1 (the highest quality) to L5 (the poorest quality).

number of ecological, economic, cultural and social services (OMNR 1999) including, but not limited to:

- They provide erosion and sediment control, when in proximity to aquatic features;
- They improve infiltration of water into the ground;
- Provide thermoregulation of water bodies by shading water, this is particularly important in maintaining cold water streams for fish habitat;
- They affect water quantity by reducing the intensity and volume of stormwater runoff and by decreasing soil erosion and flooding;
- Woodland vegetation contributes to the maintenance of water quality by removing nutrients, sediments and toxins from surface water runoff and sub-surface flows;
- The shade provided by woodlands located adjacent to water bodies helps keep water temperatures cool, which assists in the maintenance of high quality habitat for fish species;
- Woodlands are also thought to contribute to the protection of groundwater recharge areas;
- Forests sequester vast amounts of carbon, which would otherwise be released into the atmosphere and contribute to global warming;
- Woodland linkages are important factors in maintaining woodland integrity and ensuring the survival of species that depend on them; and
- Remnant forests in conservation areas across the region serve as centres of education, tourism and biological research.

There are approximately 13-ha of natural forest habitat within the LWC Project Study Area. These communities are associated with Marie Curtis Park, Arsenal Lands and the WWTF and comprise some of the only forested habitat within the larger Applewood Creek and Serson Creek watersheds.

The mosaic of natural forests within the LWC Project Study Area is described in **Table 4**. The forests and beaches (section 2.2.2.2) were mainly classified by field work (2003, 2005, 2010 and 2013) in areas for Marie Curtis Park, the Arsenal Lands, and the eastern section of the WWTF. Surveys were also conducted for these same properties by the Mississauga Natural Areas Survey (City of Mississauga, 2011) and additionally for the small forest on the north-west section of the WWTF (known as NAS site LV2).

The field surveys revealed populations of trees and ground vegetation consistent with Carolinian ecosystems. Some of these species include: Shagbark Hickory (*Carya ovata*), Butternut (*Juglans cinerea*), Glaucous Honeysuckle (*Lonicera dioica*), Wood Anemone (*Anemone quinquefolia*), Wild Geranium (*Geranium maculatum*) and Witch Hazel (*Hamamelis virginiana*). Forests that exhibit southerly Carolinian woodland features are becoming increasingly rare within southern Ontario (TRCA, 2012).

The forest located on the Arsenal Lands was inventoried in 2005; at the present time, the stand seems to be converting from a forest dominated by Red Oak (*Quercus rubra*) and Sugar Maple (*Acer saccharum*) to one composed of White Ash (*Fraxinus Americana*). Trampling and compaction by human traffic are likely affecting the ability of seedlings to germinate and establish. There is also very little organic matter in much of the stand. From a forest health perspective, the only activities that are immediately required, are limiting public access to the

stand, and the removal of the Japanese knotweed (*Polygonum cuspidatum*). These two activities alone would go a long way toward improving the overall health and vitality of this forest.

In addition to these remnant natural forests, treed/wooded communities exist where lands have been modified for human use, or where there has been disturbance and/or restoration in the past. In the LWC Project Study Area there are approximately 1.3-ha of plantation and another 1.8-ha of cultural woodland[3].

Table 4: Natural Forest Communities within the LWC Project Study Area

Vegetation type	ELC code	TRCA Ranking	Notes	Source
Fresh - moist lowland Deciduous Forest	FOD7-3	L5	Covering much of the central portion of Marie Curtis Park	TRCA, 2012
Dry-fresh Oak Hardwood Deciduous Forest	FOD2-4	L4		TRCA, 2012
Fresh - moist Popular Deciduous Forest	FOD8-1	L5	Only exists as an inclusion in a larger forested community.	TRCA, 2012
Fresh - moist Oak-Beech Deciduous Forest	FOD9-A	L3	Covering much of the central portion of Marie Curtis Park. FOD 9s could potentially be considered a 'Foraging Area with Abundant Mast'[4]	TRCA, 2012
Fresh - moist Cottonwood Coastal Deciduous Forest	FOD8-A	L3	Area in transition and stabilizing as forest. Jack Poplar reaching end of life. Oak understory developing.	TRCA, 2012/2013
Dry - fresh White Pine – Oak Mixed Forest	FOM2-1	L2	Only exists as a complex community and as such is not mapped. This vegetation type could be considered a 'rare vegetation community' in Peel[5].	TRCA, 2012
Fresh - moist lowland Ash deciduous forest type	FOD7-2	CVC jurisdiction*	Present on the north-west section of WWTF.	City of Mississauga NAS – site LV2

*as of the writing of this report, CVC does not have rankings for vegetation communities

[3] Cultural woodlands are treed communities with lower tree canopy cover than natural forests due to disturbance, management or being in an early state of succession

[4] See recommended criteria in the Region of Peel guidelines for Significant Wildlife Habitat (North-South Environmental *et al*., 2009)

[5] Ibid.

2.2.2.2 Beach Community Habitat

Beach communities are unique habitat restricted to shoreline and riverine areas.

Direct access to and from beach habitats is of importance to many species wildlife including waterfowl, molluscs, insects, reptiles, amphibians, and some mammals. Hardening the shoreline impedes the movement of species between upland and lake habitats, restricts the ability of vegetation to take hold, and in many cases eliminates the potential habitat and feeding areas for waterfowl, shorebirds, and aquatic organisms.

Beach habitats also support distinctive vegetation that require sandy sediments and can tolerate disturbance from wave action. Examples of this include Sandbar Willow (*Salix exigua*), and American Sea Rocket (*Cakile edentula*) both found in Marie Curtis Park.

Approximately 1.3-ha of natural, but highly impaired, beaches are found along Marie Curtis Park and the WWTF. These beach communities are described in **Table 5**.

Table 5: Dynamic Vegetation Communities (Beach and Dune) within the LWC Project Study Area

Vegetation type	ELC code	TRCA Ranking*	Source
Mineral Open Beach	BBO1	L3	TRCA, 2012; and CVC field observations
Willow Shrub Beach	BBS1-2A	L4	TRCA, 2012
Treed Beach Ridge	BBT1-A (inclusion for BB01)	n/a	TRCA, 2012; and CVC/TRCA field observations 2013

*as of the writing of this report, CVC does not have local rankings for vegetation communities

Mineral Open Beach
The Mineral Open Beach feature (BBO1-1) consists of one vegetation layer (5% or less cover, <0.5 m height), predominantly cocklebur (*Xanthium strumarium*) with smartweeds (*Persicaria lapathifolia, P. pensylvanica*), evening-primrose (*Oenothera biennis*), and silver-weed (*Potentilla anserina*). The beach found at Marie Curtis Park is infrequently artificially augmented with sand by the City of Toronto. Excavation of the surface sand revealed a composition that was a mix of particle sizes, including sand, more- or-less fine gravel (0.5-3 cm), and shingle (mostly flat stones 3-10 cm), which indicates the natural substrate is a mix of cobbles, gravels and sand (TRCA and CVC field work 2013) (**Figure 6**).

The isolated remnant Mineral Open Beach feature (BB01-1) found immediately south of the WWTF is likely an artifact of the revetment headlands built on either end of the beach as part of the shoreline protection works for the WWTF. This has created a bay in which sand that has transported westward by longshore currents from Marie Curtis Park gets trapped and has resulted in its accumulation over the years. Air photographs prior to the establishment of these revetment headlands suggest a very narrow strip of beach likely consisting of gravel and cobbles that would have occurred naturally in this area prior to significant alterations of the shoreline and would be consistent with the materials found underlying the Marie Curtis Park Beach to the east.

Figure 6: Beach Profile and Particle Size at Marie Curtis Park West

Treed Beach Ridge

At the western end of the beach at Marie Curtis Park, a Treed Beach Ridge was identified as part of the Mineral Open Beach feature (as there is no existing ELC designation for Treed Beach, ELC designation BBT1-A "Mineral Treed Beach" is closest). The feature was assessed in 2003 and again in 2013. The vegetation type of this feature was originally classified as a Treed Sand Dune, as this was the closest official designation at that time. However, it has since been redefined by additional field work as a Treed Beach Ridge, since the substrate and coastal processes do not fit the definition of a dune. On the east side of Applewood Creek, the feature is dynamic and continues to function as a natural Treed Beach Ridge. On the west side of Applewood Creek, the feature is undergoing succession to an upland forest as a result of limited wave action due to regulation of Lake Ontario coastal processes.

The feature occurs at the top of an open sand beach and roughly corresponds to the highest storm surge level of lake. This is not a dune as the sand is deposited through wave action rather than being formed by wind. A beach ridge is a wave-swept or wave-deposited ridge running parallel to a shoreline; whereas, a sand dune is a hill of sand built by wind processes .

The Treed Beach Ridge is characterized by Jack Poplar (*Populus xjackii*) [Hybrid of Cottonwood and Balsam Poplar] dominating the area west of Applewood Creek and Crack Willow (*Salix rubens*), with some Manitoba maple (*Acer negundo*) and Siberian elm (*Ulmus pumila*). The shrub and sapling layer includes green ash (*Fraxinus pennsylvanica*), red-osier dogwood (*Cornus stolonifera*), and Japanese knotweed (*Fallopia japonica*), dominating the narrow beach ridge east of Applewood Creek.

Based on available information, it does not appear that the rarity of Treed Beach communities in Ontario has been assessed by the NHIC; however, beaches are considered to be rare to uncommon (S2-S3) by the NHIC. While this reclassification more accurately describes the feature found at the far western end of Marie Curtis Park West, beaches (including Treed Beach Ridges) are likely rare in the Credit River Watershed and the Region of Peel as there are not a lot of waterbodies capable of sustaining a beach and the actual area of these jurisdictions covered by beaches is very small. Geographically, it is a significant feature for the western part of Lake Ontario, but ecologically, it is quite low-quality. This feature does present significant restoration opportunities.

2.2.2.3 Successional Communities

Successional communities are those that are defined as cultural or old-field communities. In ELC descriptions they encompass cultural meadows, cultural savannahs, cultural thickets, and cultural woodlands. Generally, these are habitats which have been created or maintained as the result of human influences or other factors. As a result of human influences, often the composition and function of the community is altered compared to more naturally derived communities. Successional communities reflect the stage of natural succession from field (i.e., cultural meadow) to sparse forest (i.e., cultural woodland).

Successional communities can be important habitat for many species of wildlife. Migrant butterflies require areas with abundant wildflowers that are the source of their food. Open habitats including old fields and meadows can support species of raptors who hunt prey, and species of grassland birds that require large open spaces for breeding. Meadows, shrub thickets and sparsely treed areas are often those that support a high abundance of fall fruit and seeds. These rich food resources are often important for migrating species of birds who use shoreline areas to rest and feed before embarking on their long migration southward in the fall.

Successional communities are relatively spread out in the LWC Regional Study Area occurring on both public and private lands. Successional communities make up a considerable portion of the nonurban land use in the area west of Southdown Road. They are also clearly evident near Port Credit (e.g., Imperial Oil lands), Jack Darling Park, Richards Memorial Garden, and OPG's Lakeview lands. The naturalizing areas associated with OPG's Lakeview lands, RK MacMillan / Lakefront Promenade Park are the closest successional communities to the west. Approximately 11% of the LOISS area was reported to be composed of successional communities including meadows (CVC, 2011).

To the east, TRCA land use mapping available for the Etobicoke waterfront area reveal about 6% of the area consists of meadow and successional habitat, with the vast majority of the area centralized at Colonel Samuel Smith Park, and lesser amounts between the mouths of Mimico Creek and the Humber River. Studies conducted in Colonel Samuel Smith Park in 2009 by North-South Environmental Inc., indicated the presence of several meadow types.

There are approximately 24-ha of successional communities within the LWC Project Study Area (**Table 2**); the majority of this is comprised of meadow habitat (17.2-ha). The remaining successional habitat is composed of communities in various states of regeneration from meadow to forest (cultural woodland, cultural savannah, cultural hedgerow, and cultural thicket).

The successional and meadow habitats are contained mainly within the Marie Curtis Park and Arsenal Lands section of the LWC Project Study Area. A small cultural meadow community exists along the shoreline at WWTF and a narrow Treed Hedgerow exists along Serson Creek at the west border of WWTF and the OPG Lakeview site.

A large proportion of the Arsenal Lands and Marie Curtis Park area consists of exotic old field meadows (CUM1-b) and cultural savannahs (CUS1-b). However, despite an abundance of introduced and invasive meadow species within these areas, the extensive amount of open meadow associated with these areas likely support a wide range of birds and butterflies. In addition, the small cultural meadow at the WWTF contains a record made during the breeding season of a Bobolink (*Dolichonyx oryzivorus*), a Species at Risk, which is an open country area-sensitive species that usually requires large expanses of open meadow or grassland to breed.

2.3 DESIGNATED ECOLOGICAL FEATURES

Designated ecological features are those areas within the LWC Regional and Project Study Areas which support key ecological features and functions, and/or have been identified for protection, conservation or management through various policies or programs. This category includes: Provincially Significant Wetlands, Areas of Natural and Scientific Interest, Environmentally Significant Areas and City of Mississauga Natural Area Survey Sites.

2.3.1 Provincially Significant Wetlands (PSWs)

PSWs are wetlands identified by the Ministry of Natural Resources as being the most ecologically valuable in Ontario based on four broad categories: biological, social, hydrological and special features. One PSW is present in the LWC Regional Study Area (Rattray Marsh Wetland Complex), although there are others that may meet the criteria for designation as provincially significant and these are being assessed as part of LOISS (i.e., Turtle Creek). One other PSW (Credit River Marshes) is located just outside of the LWC Regional Study Area. There are no PSWs located in the LWC Project Study Area.

2.3.2 Areas of Natural and Scientific Interest (ANSIs)

ANSIs are areas of land and water that represent significant geological (earth science) and biological (life science) features. Provincially significant ANSI's are identified by Ministry of Natural Resources (MNR) and are considered to have the highest value for conservation, scientific study and education. One ANSI is present in the LWC Regional Study Area (Rattray Coastal Marsh); a second is located just outside of the LWC Regional Study Area (Credit River Coastal Marsh). There are no ANSIs located in the LWC Project Study Area.

2.3.3 Environmentally Significant Areas (ESAs)

CVC has identified ESAs within the watershed based on 1) their importance to ecological structure and function, and/or 2) the value their geological features or native flora or fauna provide to society. One ESA is located within the LWC Regional Study Area (Rattray Marsh) while one additional ESA is located slightly outside of the LWC Regional Study Area (Credit River – QEW to CNR). There are no ESAs located in the LWC Project Study Area.

2.3.4 City of Mississauga Natural Area Survey (NAS) Sites

NAS sites are those that have been classified and evaluated by the City of Mississauga and have been shown to provide ecological functions to the City. There are six designations under the NAS system, each of which has corresponding policies identified in the municipal official plan to encourage the protection and long term maintenance of the ecological functions they support. There is recognition that all remaining natural areas within the City are part of a system and that the degradation and loss of any natural area will have negative impacts on the entire system. Wherever possible the protection and enhancement of natural areas is encouraged through land acquisition, restrictions on development, and the promotion of restoration and stewardship initiatives. The LWC Regional Study Area contains 17 NAS sites:

- Significant Natural Sites: SD1, SD7, CL1, SD5, CL9, CL8, CL16, LV1
- Natural Sites:SD4, CL52, CL15, LV3, LV2, LV4, PC1
- Natural Green Space: PC2
- Residential Woodlands: CL17

Two of these sites are present within the LWC Project Study Area:

- Site LV1 – This is an almost 13-ha site roughly corresponding to the portion of Marie Curtis Park, Arsenal Lands and the eastern section of the WWTF property that are within the City of Mississauga boundary. It is classified as a Significant Natural Site.
- Site LV2- A small, 2.51-ha forest located at the north-west corner of the WWTF. This site is classified as a Natural Site.

2.4 WILDLIFE & WILDLIFE HABITAT

2.4.1 Wildlife Corridors

Wildlife corridors are areas that are functionally or ecologically connected and provide important habitat or resources to allow wildlife movement. Within a heavily urbanized landscape, where natural communities are fragmented and dispersed, wildlife corridors can help to preserve populations of wildlife over the long term and should be an important consideration in the determination of any natural heritage system.

Ensuring connectivity for all species is virtually impossible in a fragmented landscape; nevertheless it is essential to plan for local and regional connectivity to maintain healthy ecosystems that are resilient to disturbances. Because functional connectivity is species specific, the common focus is on structural connectivity, as evidence suggests that habitats closer together improve the ability of the majority of species to disperse, feed, reproduce, and migrate. Structural connectivity includes the identification and protection of corridors or stepping

stones linking habitat patches or improving the matrix by minimizing the gaps among natural areas (TRCA 2006a, b).

Wildlife migration within the Mississauga and Toronto areas is highly dependent on critical linkages between the ravine systems and the Lake Ontario shoreline. Potential corridors and linkages in the LWC Regional Study Area have not been identified through LOISS but are expected in future stages (CVC, 2011). Many of the natural areas that exist in the LWC Regional Study Area are situated along creeks or the shoreline providing linkages for many species. Some natural areas link many different habitat types, and allow species to occupy and move between diverse habitats without many barriers. Historic (and current) disturbances to the shoreline can impact the long-term viability of fragmented populations and habitats, and can disrupt ecological connections between the terrestrial, nearshore and aquatic habitats.

Within the LWC Project Study Area, Etobicoke, Serson and Applewood Creeks, and the Lake Ontario shoreline all create an essential migration corridor that facilitates the regional movement of wildlife to areas further upstream and in-land. This corridor provides important habitat for the movement of songbirds which rely on the vegetated shorelines and ravines when in need of rest, food, or shelter from adverse weather conditions during migration. Additionally, this corridor offers important cover for the movement of mammal, herpetofauna, and fish populations within the LWC Project Study Area.

Generally, corridors within the LWC Project Study Area are limited, and the remnant natural areas at Marie Curtis Park and WWTF are functionally isolated for many species of wildlife. To describe the potential for wildlife movement within the LWC Project Study Area corridors have been categorized into several types: Riparian Corridors, Shoreline Corridors, Stepping Stone Habitat, Nearshore Corridors. Each of these is described in the following sections.

2.4.1.1 Riparian corridors

Serson Creek is highly engineered in its downstream reaches and has the potential, through restoration, to provide for a riparian/upland buffer to the creek linking Lake Ontario to the small woodland contained within the LWC Project Study Area. The corridor is currently highly altered and impaired.

Applewood Creek is the most naturally vegetated of the three creeks within the LWC Project Study Area, but lacks a significant connection beyond the LWC Project Study Area to upstream locations.

Within the LWC Regional Study Area, while the mouth of Etobicoke Creek is mainly surrounded by manicured vegetation and open areas, it does provide a ravine system that extends from Lake Ontario to the Oak Ridges Moraine. The value of Etobicoke Creek as a riparian corridor is most impaired for migratory fish given that there are 179 barriers to fish passage for non-jumping species, with 125 of those barriers likely preventing upstream access for jumping species (TRCA 2010). These barriers are associated with weirs, stream crossings, natural barriers, and dams. Many of these barriers would also represent significant barriers for wildlife migration between Lake Ontario and the Oak Ridges Moraine. However, this corridor does provide important habitat for the movement of songbirds which rely on the vegetated ravines when in need of rest, food, or shelter from adverse weather conditions during migration.

2.4.2 Shoreline Corridors

Shoreline corridors refer to natural features adjacent to the Lake that largely consist of unhardened beaches and intact littoral zones. This provides an important east-west corridor linkage for wildlife movement, and provides stopover and staging habitat for migratory wildlife.

The remnant sandy beach south of the WWTF and beach at Marie Curtis Park provide some opportunities for wildlife movement along the shore, as well as from between the lake and upland areas; however, the remainder of the LWC Project Study Area shoreline is hardened, creating a barrier between terrestrial and nearshore habitats. The extensive use of fences along the shoreline of the WWTF site provides further fragmentation along the shoreline corridors for both people and wildlife.

2.4.2.1 Stepping Stone Habitat

'Stepping stones' are isolated inlands of natural habitat that provide landscape level connectivity to species and genetic material that can transcend the urban matrix. For many species of wildlife that cannot move through the urban matrix these habitats are functionally isolated; however, some species of birds and mammals may be able to move over/through developed areas to move to other remnant natural areas. For example, the forests at Marie Curtis Park are functionally isolated from the small forest at the north-west corner of WWTF; however, many species of birds may be able to move between them if necessary.

2.4.2.2 Nearshore Corridors

Nearshore corridors are aquatic areas close to shore that provide habitat and food resources for species that move along the shore, up the river, or out to the deeper sections of Lake Ontario. With the extent of stonehooking in this portion of Lake Ontario, most of the nearshore habitat elements that may have provided this function are now absent from the LWC Project Study Area and much of the LWC Regional Study Area.

The composition of the faunal communities in the LWC Project Study Area has been assessed through the results of field surveys, observations and incidental reports of the various species groups. These wildlife observations are discussed in more detail below. In some cases the lack of consistent multi-year surveys precludes formal designations of 'significance' to be made; however, their presence indicates that further investigation may be warranted.

One of the LWC Project objectives is to increase habitat and sustain diverse communities of native species. In the pursuit of this objective, existing communities should be assessed, enhanced, and restored where necessary.

Several recent studies have taken place which has improved the knowledge regarding the use of the LWC Project Study Area by wildlife; these are itemized in **Table 6.**

Table 6: Wildlife Studies within the LWC Project Study Area

Study	Year(s)	Location	By
Acoustic Bat Survey	2011	WWTF	CVC
Spring Migrant Landbird Survey	2011 and 2012	WWTF; Marie Curtis Park	CVC
Fall Migrant Shorebird Survey	2011	WWTF; Marie Curtis Park	CVC
Fall Migrant Waterfowl Survey	2011	WWTF	CVC
Fall Migrant Landbird Survey	2012	WWTF	CVC
Ecological Land Classification	2012	OPG Lakeview	CVC
Breeding Bird Surveys	2011	Marie Curtis Park	TRCA
Amphibian Breeding Surveys	2011	Marie Curtis Park	TRCA

2.4.3 Mammals

There have been no targeted, comprehensive surveys for mammals within the LWC Project Study Area. However, various reports and natural heritage surveys focused on other groups (e.g., plants, communities, birds, *etc*.) have revealed that there are potentially up to 30 mammal species within the LWC Regional Study Area and up to 16 mammals making use of the habitat within the LWC Project Study Area for at least a portion of their life cycles. **Table 7** provides the list of mammals observed within the LWC Project Study Area. Information on mammals in the LWC Regional and Project Study Areas has been generated from:

- Terrestrial Biological Inventory and Assessment of Marie Curtis Park (TRCA field work 2003, 2011)
- Acoustic Bat Survey – WWTF (CVC field work 2011)
- City of Mississauga Natural Areas Survey Database sites LV1 and LV2 (updated 2008)

Table 7: Mammals observed within the LWC Project Study Area

Scientific Name	Common Name	COSEWIC Status[1]	SARA Status[2]	SARO Status[3]
Canis latrans	Coyote	-	-	-
Eptesicus fuscus	Big Brown Bat	-	-	-
Lasionycteris noctivagans	Silver-haired Bat	-	-	-
Lasiurus borealis	Red Bat	-	-	-
Lasiurus cinereus	Hoary Bat	-	-	-
Marmota monax	Woodchuck	-	-	-
Mustela vison	American Mink	-	-	-
Myotis lucifugus	Little Brown Bat	Endangered	-	Endangered
Myotis septentrionalis	Northern Long-eared Bat	Endangered	-	Endangered
Odocoileus virginianus	White-tailed Deer	-	-	-
Ondatra zibethicus	Muskrat	-	-	-
Pipistrellus subflavus	Eastern Pipistrelle	Endangered	-	-
Procyon lotor	Northern Raccoon	-	-	-
Sciurus carolinensis	Eastern Gray Squirrel	-	-	-
Sylvilagus floridanus	Eastern Cottontail	-	-	-
Tamias striatus	Eastern Chipmunk	-	-	-

[1] COSEWIC_STATUS Status assigned by the Committee on the Status of Endangered Wildlife in Canada
[2] SARA_STATUS Status according to the *Species at Risk Act* (Federal)
[3] SARO_STATUS Status according to the Species at Risk in Ontario list

The small number of species is typical of urban areas and includes some of the typical common mammals that exist within an urban landscape. Raccoons (*Procyon lotor*) and Eastern Gray Squirrel (*Sciurus carolinensis*) are common sights to most urban residents. Some not so common species such as Eastern Chipmunk (*Tamias striatus*) indicate that there are still some larger habitat patches supporting area-sensitive species (Marie Curtis Park). Other mammals such as American Mink (*Mustela vison*) indicate the importance of the shoreline area to species that make use of both terrestrial and wetland communities. It is likely that we do not know the extent or range of movement of mink along this section of the shoreline but maintaining connections through natural areas along the lakeshore and Lake Ontario tributary creeks is important in providing the ability of these species to find adequate resources for food and shelter.

Larger mammals such as White Tailed Deer (*Odocoileus virginianus*) and Coyote (*Canis latrans*) are common visitors in the Marie Curtis Park area. These species may be making use natural areas along of the Applewood Creek and Etobicoke Creek to navigate through the urban matrix. MNR undertook tracking of coyotes within the LOISS study area and these data are being used to better understand use of the LWC Regional Study Area by larger mammals (MNR 2012 unpublished).

Of particular interest was the detection of six bat species within and surrounding the WWTF during a survey in 2011. There are only eight species of bats known from all of Ontario and within CVC's jurisdiction. Of the different species of bats observed, only two are particularly well adapted to urban environments: the Big Brown Bat (*Eptesicus fuscus*) and the Little Brown Bat (*Myotis lucifugus*). These species have even been known to roost in buildings during the summer and overwinter in houses or abandoned buildings in the winter.

Generally, bats can use habitat for a number of different reasons: foraging, roosting and hibernating. Most bats rely on areas over open water to forage as these areas are important sources of the flying insects which make up the majority of their diet. Bats in Ontario are insectivorous and shoreline areas often provide abundant food resources in the form of invertebrates which rely on open water habitat to complete their life cycle. Sites that contain terrestrial and aquatic or wetland habitat are therefore very valuable to bats both during the summer and migration period.

Some, like the Eastern Red Bat (*Lasiurus borealis*) and Big Brown Bat prefer open woods and forest edges to feed. Deciduous forests with large trees are also important to provide roosting/denning sites for bats like the Silver-haired Bat (*Lasionycteris noctivagans*). Given its proximity to forests, Lake Ontario and the sewage lagoons at WWTF, the LWC Project Study Area is well situated to provide good foraging habitat close to potential denning or roosting sites.

Three of the observed species of bats are known to be migrants to southern Ontario: Silver-haired Bat, Eastern Red Bat and Hoary Bat (*Lasiurus cinereus)*. To these migrant species shoreline areas are especially important. Large bodies of water like Lake Ontario pose an impediment to migration, and bats will tend to congregate along shorelines before crossing or flying around them. Maintaining and expanding the amount of suitable habitat along shorelines would help to conserve and promote a healthy bat community.

2.4.4 Reptiles

Reptile populations in the larger Lake Ontario shoreline area have not been studied in depth, and there have been no targeted, comprehensive surveys for reptiles within the LWC Project Study Area.

Incidental reports compiled in the City of Mississauga Natural Areas Survey (2011) and TRCA (unpublished data) indicate there are 13 reptile species using the LOISS study area for a portion of their lifecycle (**Table 8**). There are five known turtle species (one species only exists as a historic record) and eight species of snakes (five species exist only as historic records). Eastern Snapping Turtles (*Chelydra serpentina*) can be found in abundance in Rattray Marsh Conservation Area and along the Credit River Marshes. Observations of Northern Map Turtles (*Graptemus geographica*) have been made in the Credit River near Port Credit, but the opportunity for them to disperse and use the lake as habitat has not been assessed.

Table 8: List of Reptile Species known within the LWC Regional Study Area

Scientific Name	Common Name	Most Recent Observation
Diadophis punctatus	Ring-necked Snake	Not Recorded
Heterodon platirhinos	Eastern Hog-nosed Snake	1924
Lampropeltis triangulum triangulum	Eastern Milksnake	2010
Narodia sipedon sipedon	Common Watersnake	2000
Opheodrys vernalis	Smooth Greensnake	1976
Storeria dekayi dekayi	Northern Brownsnake	1990
Storeria occipitaomaculata occipitomaculata	Northern Red-bellied Snake	1990
Thamnophis sirtalis sirtalis	Eastern Gartersnake	2011
Trachemys scripta elegans	Red-eared Slider	2008
Chelydra serpentine	Eastern Snapping Turtle	2011
Chrysemys picta marginata	Midland Painted Turtle	2006
Emydoidea blandingii	Blanding's Turtle	1988
Graptemys geographica	Northern Map Turtle	2011

Incidental observations by CVC staff in 2012 indicated only one species of reptile within the LWC Project Study Area, the Midland Painted Turtle (*Chrysemys picta marginata*) using the wetland communities within Marie Curtis Park. The lack of reptile observations for the LWC Project Study Area is not surprising, as reptiles (e.g., snakes and turtles) often fare poorly in urban environments, where loss of habitat and conflict with humans is high. Though only one reptile species is noted for the LWC Project Study Area, some species, such as the Eastern Garter snake (*Thamnophis sirtalis sirtalis*) continue to persist in urban environments making use of marginal habitats, riparian areas and woodlands to find the necessary resources to survive. Gregory (2001) indicated that Garter snakes were found regularly on OPG's Lakeview site, adjacent to the LWC Project Study Area. The lack of wetland habitat in the LWC Regional and Project Study Areas, and the high degree of shoreline hardening are impediments to a robust turtle population. Restoration of shoreline areas to allow for permeable wildlife movement between aquatic and terrestrial habitats would greatly improve the potential for turtles to use the area.

2.4.5 Amphibians

Amphibians are key ecological indicators as most spend a portion of their life in aquatic and terrestrial habitats. Because of this dependency on multiple habitats, amphibians are sensitive to ecological stressors and the quality of the ambient environment. Human disturbance (e.g. urban development, noise, incidental kill, *etc*.), pollution (e.g. water contamination), climate change, and alterations to the hydrologic cycle from development can have an impact on population size and health.

Urban development and anthropogenic disturbances alter the ability of amphibians to survive and reproduce. Habitat destruction or conversion restricts the availability of suitable breeding and overwintering sites and the connections between them. Contamination of water sources leading into amphibian breeding habitat can cause reproductive damage or death. Noise from adjacent roads, human activities and nearby land uses can interfere with the ability of amphibians to attract mates through calling. Some species are more resilient than others when faced with urban stresses. American Toads (*Bufo americanus*), Green Frogs (*Rana clamitans*) and Northern Leopard Frogs (*Rana pipiens*) can generally make do with the limited habitat, resources and decreased quality that is often available in urban areas.

Observations made over the last 20 years indicate that the natural areas along Lake Ontario Shoreline in CVC jurisdiction and the western portion of TRCA's jurisdiction appear to only harbour seven species of frogs and toads (**Table 9**).

Table 9: List of Amphibian Species known with the LWC Regional Study Area

Scientific Name	Common Name	Most Recent Observation
Rana clamitan malanota	Green Frog	Not Recorded
Bufo americanus	American Toad	Not Recorded
Rana catesbeiana	Bullfrog	Not Recorded
Rana sylvatica	Wood Frog	Not Recorded
Pseudacris triseriata	Western Chorus Frog (Great Lakes St. Lawrence Population)	Not Recorded
Pseudacris crucifer crucifer	Northern Spring Peeper	Not Recorded
Rana pipiens	Northern Leopard Frog	Not Recorded

Salamander diversity and abundance within the broader Lake Ontario shoreline in CVC's jurisdiction are low. The most common salamander species is the Red-backed salamander (*Plethodon cinereus*) which has current records at eight City of Mississauga NAS sites and historical records for another two locations. Other salamanders found in the area are the Spotted Salamander (*Ambystoma maculatum*) which occurs at two sites (one other site with a historical record). The Eastern Newt (*Notophthalmus viridescens viridescens*) is also known from one site, and has a historical record for one more area.

Suitable breeding habitat for forest and wetland breeding amphibians is extremely limited in the LWC Project Study Area. Three small cattail marshes in Marie Curtis Park support the only known breeding amphibian populations (**Figure 7**). Surveys conducted by TRCA in 2003, 2007 and 2011, and by CVC in 2009 and 2011 documented Green Frog, American Toad, Northern

Leopard Frog and Gray Treefrog[6] (*Hyla versicolor*) in this area (the results have been summarized in **Table 10**). It is likely that these populations are very small as only a few individuals of each species were heard on any given sampling occasion (TRCA 2012).

The presence of Northern Leopard Frog is considered unique based on the urban land use that surrounds the site.

Given its size and composition, the forested habitat at Marie Curtis Park is also a potential place for forest breeding amphibians such as the Redback Salamander (*Plethodon cinereus*). Though no surveys were undertaken to determine if they are present, the disturbance caused by ad-hoc trails, mountain biking and other human impacts would likely degrade the quality of potential habitat for this species.

Figure 7: Amphibian Breeding Habitat with the LWC Project Study Area

[6] Only one call of the Gray Treefrog was observed in 2011 by CVC staff members and could be a mis-identification. Future studies during peak breeding periods should occur in order to confirm whether this species is present in the marsh.

Table 10: Amphibian Species Documented at Marie Curtis Park

Marsh Site	Species	Year Recorded
Northwest Marsh	Green Frog (*Rana clamitans*)	2011, 2009
	American Toad (*Bufo americanus*)	2003, 2011
	Northern Leopard Frog (*Rana pipiens*)	2003
Southwest Marsh	Green Frog (*Rana clamitans*)	2011 , 2009
	American Toad (*Bufo americanus*)	2003
	Northern Leopard Frog (*Rana pipiens*)	2009, 2003
East Marsh	Green Frog (*Rana clamitans*)	2011
	American Toad (*Bufo americanus*)	2011
	Northern Leopard Frog (*Rana pipiens*)	2007, 2003
	Gray Treefrog (*Hyla versicolor*)	2007, 2011

2.4.6 Birds

The ecological needs of bird species differ depending on their behaviour and life history characteristics. For many groups of birds the specific habitat requirements can be readily identified and conserved based on these differences. Generally, birds can be grouped into five categories based on their ecological requirements:

- Year-round residents;
- Spring Migrants (passing through to summer territories);
- Fall migrants (passing through to winter territories);
- Breeding migrants (migrants that stay in the area to breed); and
- Wintering birds (birds that migrate from further north).

The ecological needs of migratory birds differ from that of resident birds. Migrating birds are temporary visitors (days or week) that pass through during a short window in the spring and/or fall. These birds require habitat with high concentrations of food and adequate cover. Often migration coincides with the spring emergence of flying insects, the bloom of fall flowers and ripening of seeds, fruits and berries. Resident birds perform smaller local migrations, but their winter habitat and breeding habitat are identical. Resident birds tend to inhabit larger territories and with dispersed food sources. The protection of breeding and migratory habitat is an important consideration for the LWC Project.

Different bird groups (or guilds) use different areas of the shoreline, nearshore and in-land habitat preferentially. The investigation of these areas is important to describe how significant they may be to the local bird community. A description of some of the ways that groups of birds use these areas is below.

- <u>Shorebirds</u>: Shorebirds prefer to use exposed mudflats, shorelines and beaches for feeding and resting. To this end, wetland and beach habitats that provide for these types of conditions are likely to support species of shorebirds. During the spring and fall, migratory species require these open areas for resting and staging in order to gain the necessary resources required to make the long trip around the lake, or to rest and refuel after it;

- Waterfowl: Wetlands, watercourses and areas containing permanent open water are preferred by waterfowl. In urban and rural areas, even temporarily flooded areas can play a supportive role especially during the migratory period. Upland or riparian communities adjacent to the open water create diverse microhabitats, productive littoral zones for feeding, nesting and shelter. Waterfront areas are also home to species of wintering waterfowl that are not present at other times of the year. Where the lake has not frozen over, open areas of water are an attractant to wintering waterfowl;

- Landbirds: These are birds that almost exclusively live on land. Familiar examples include songbirds, hawks and owls. Many landbirds are migrant species making use of habitats dispersed throughout the broader landscape, country, continent or beyond. Other species are resident in southern Ontario year-round and are familiar to the general public (Black-capped chickadee, *Parus atricapillus*; and Downy Woodpecker, *Picoides pubescens*). Large, undisturbed natural forests, fields and wetlands provide the most useful habitat for these species, however during migration period they can make use of smaller, marginal and less optimal habitat where it exists especially along the shoreline. Manicured (non-natural) spaces providing adequate vegetation cover can also act as surrogate habitat for landbird migrants looking to stopover after a long flight around or over the lake; and

- Migrant birds: Intact riparian areas along small creeks are important. They may act as corridors or funnels for birds that make their way across the otherwise urbanized landscape. By providing continuous vegetated cover along these creeks we can help allow birds to migrate short and long distances throughout an otherwise potentially hostile environment.

2.4.6.1 LWC Project Study Area

Waterfront parks in the Mississauga and Toronto areas have been known to play an important role in sustaining migratory bird populations. The LWC Project Study Area is located within an important migratory zone, which encompasses both the Atlantic and Mississippi flyways. Marie Curtis Park has been identified in the Toronto Bird Flyways and Sanctuaries Project. This initiative of the Toronto Parks, Forestry & Recreation Division, has focused on ecological enhancements at park sites located in watersheds and along the Lake Ontario shoreline, and has sought to enhance migratory bird habitat by implementing the following features:

- Planting native trees and shrubs that serve as food and shelter;
- Installing habitat structures to provide additional shelter;
- Expanding wooded areas and reducing mown grass;
- Controlling invasive species;
- Keeping dead trees and shrubs on the site, that either remain standing (snags) or fallen (downed woody debris) and preserving existing habitat such as nest cavities that serve as bird habitat;
- Blocking off unsustainable trails that impact on bird habitat; and
- Installing interpretive signage.

In an effort to document the birds that use the LWC Project Study Area for at least part of their life cycle, all bird observations have been combined in this report. Records include breeding bird observations (Marie Curtis Park 2003 and 2011), migratory bird observations (Marie Curtis Park and WWTF 2011 and 2012) and other incidental observations made by TRCA or CVC in pursuit of other wildlife or vegetation surveys.

157 species of birds have been observed within the LWC Project Study Area. Of these species, six are listed as Species at Risk; these are discussed in more detail in the Species of Concern section below.

The relatively extensive forest cover within Marie Curtis Park allows for the persistence of a few area-sensitive species that require larger blocks of forest habitat to find suitable habitat. These include American redstart (*Setophaga ruticilla*), Blue-gray gnatcatcher (*Polioptila caerulea*), Great-crested Flycatcher (*Myiarchus crinitus*), and Cooper's Hawk (*Accipiter cooperii*). Eastern Screech-owl (*Megascops asio*) was also noted by TRCA to occur in this area, and observations in 2011 and 2012 by CVC indicate that there is the potential for American Kestrels (*Falco sparverius*) to be nesting within the park. Unfortunately, due to the heavy prevalence of recreation and off-trail use, many of the birds that nest on the ground or in the understory have been impacted. Improving the quality of forest habitat by encouraging the regeneration of the forest understory and ground-layer would help improve the habitat for forest breeding birds.

The meadows and successional areas of the park (mainly associated with the Arsenal lands) have been noted to support species that rely on open areas to breed; some of which are sensitive to disturbance. TRCA (2012) noted that in 2003 the community of ground-nesting birds in the open meadows included species such as the Bobolink (*Dolichonyx oryzivorus*), and Savannah Sparrow (*Passerculus sandwichensis*); however these species have not been documented to breed since. The loss of this community of birds is alarming as it indicates a heavy level of disturbance (mainly due to dog-walkers within an otherwise restricted area of the park). Though it may not be currently breeding at Marie Curtis Park, records of Bobolink (a Species at Risk) from 2011 indicate that it is still present and breeding elsewhere in the LWC Project Study Area.

The sewage lagoons of WWTF attract a variety of bird guilds. A small Bank Swallow (*Riparia riparia*) breeding colony was located on the easternmost settling pond (**Figure 8**). Approximately 22 burrows were located within the eroding bank of the fly-ash material.

Figure 8: **Bank Swallow Burrows in Fly-ash Material, WWTF. Photo: K. Vande Sompel, CVC**

This colony is one of only two known Bank Swallow colonies that were confirmed in 2011 as part of a CVC survey within Mississauga. Although the location of the colony and the material in which the burrows were made was not ideal, this feature would have met the criteria for Significant Wildlife Habitat (North-South Environmental Inc. *et al* 2009). However, observations in 2013 determined that this bank has since become overgrown with vegetation and is no longer occupied by bank swallows. Though the location of the colony and the material in which the burrows were made is not ideal, this feature is unique.

Habitats of lower quality during the breeding season can be very important during migration seasons. Shoreline areas and those close to water often provide food resources for migrant birds in the form of invertebrates which rely on open water habitat to complete their life cycle. In many cases the timing of the emergence of flying insects coincides to the arrival of spring birds. Sites that contain terrestrial and aquatic or wetland habitat are therefore very valuable to birds during the spring migration period.

During the 2011 and 2012 spring and migration period, the forest in the northwest corner of WWTF may be disturbed and appear as a lesser 'quality' forest but during the 2011 and 2012 spring and migration period contained diversity of birds (72 species), many of which were migrants, including a diverse array of woodland warblers (15 species) and other songbirds. Its proximity to the shoreline and key migratory bird corridors allowed many species of birds to use this area as a stopover ground to rest and wait out inclement conditions.

As observed during CVC's 2011 and 2012 surveys, the WWTF lagoons also host an array of resident waterfowl, including nesting Trumpeter swans (*Cygnus buccinator*) and a pair of Northern Shovelers (*Anas clypeata*). A variety of migratory and resident shorebirds have been

seen along the lagoons mud flats. Several visits to the lagoon have revealed a breeding pair of Spotted Sandpiper (*Actitis macularius*), flocks of migratory Least Sandpipers (*Calidris minutilla*), Dunlins (*Calidris alpina*) and Pectoral Sandpipers (*Calidris melanotos*). A few uncommon transient species were also observed, including Ruddy Turnstone, Baird's Sandpiper and Wilson's Phalarope.

The cultural meadow that exists upon the berm blocking Lake Ontario from engulfing the lagoon hosts a variety of interesting birds. Bobolinks, Savannah and Vesper Sparrows, Willow Flycatcher (*Empidonax traillii*), and variety of other grassland bird species have been observed.

The WWTF buildings and structures provide plenty of opportunities for urban birds to nest. Barn Swallows (*Hirundo rustica*), a threatened species of insectivorous bird, were observed frequenting the grounds of the sewage plant foraging and roosting. No visible nests were detected but evidence of breeding activity (i.e., carrying food, the presence of fecal sacs) was observed.

Marie Curtis Park encompasses a variety of habitats (forest, meadow and beach lake front) that attracts a diverse population of birds especially during migration. The mature forest community hosts a diverse population of woodland warblers. Uncommon birds such as Wilson's warbler (*Wilsonia pusilla*), Blackpoll Warbler (*Dendroica striata*) and Yellow-bellied Flycatcher (*Empidonax flaviventris*) were common during the 2011 spring migration period. The Blue-Gray Gnatcatcher (*Polioptila caerulea*) was confirmed breeding in the forest. Along the beach front Red-necked Grebes (*Podiceps grisegena*) often flock and forage offshore. The open meadow with shrub cover features an old water tower from which a Red-tail Hawk (*Buteo jamaicensis*) and an American Kestrel have been observed perching. Willow flycatchers, Tree Swallows, and Eastern Kingbirds (*Tyrannus tyrannus*) were seen often foraging over the ponds. Maintaining the diversity in vegetation communities at this site will help to conserve the local bird community.

2.4.6.2 LWC Regional Study Area

At a broader scale, the region is recognized as an ecologically unique area for birds. The LWC Regional Study Area is located within the Western Lake Ontario Important Bird Area (see www.ibacanada.ca for more information). This area along Lake Ontario is recognized for its impressive congregations of waterfowl, particularly overwintering waterfowl.

The LWC Regional Study Area is included in the Southwest subregion of Lower Great Lakes/St. Lawrence Plain North American Bird Conservation Region 13 (ON BCR13) (Ontario Partners in Flight, 2005). Recognizing the important habitat that exists in this region for landbirds, the ON BCR13 plan aims to guide conservation efforts for priority species of landbirds within the area, with a particular focus of forest habitats, grasslands, agricultural habitats, shrub and early successional habitats.

This area is characterized by high frequencies of landbirds that are both resident and migrant in nature. ON BCR13 is of particular importance to the conservation of 20 of the report's Species of Continental Importance (Ontario Partners in Flight, 2005).

Waterfront parks in the Mississauga and Toronto areas are known to play an important role in sustaining migratory bird populations. The LWC Regional Study Area is located within an important migratory zone, which encompasses both the Atlantic and Mississippi flyways. LOISS highlights the importance of the LWC Regional Study Area to migratory bird populations, and Marie Curtis Park has been identified in the Toronto Bird Flyways and Sanctuaries Project (City of Toronto 2012).

A comprehensive waterfowl survey was completed for the LWC Regional Study Area (CVC 2011). During winter months, areas with direct access to open water typically support waterfowl within the LWC Regional Study Area (McIlveen 2009). A survey in the winter of 2008-2009 at 12 locations within the LOISS Study Area found that a great number of waterfowl are present and particularly attracted to the nearshore areas that remained ice-free. The four species present in highest numbers during the survey period were Greater Scaup, Canada Goose, Ring-billed Gull and Mallard. Other winter resident species present in relatively high numbers included Long-tailed Duck, Bufflehead, and Common Goldeneye. Of the other species encountered, the list appears to be relatively consistent with the species commonly encountered during the annual Christmas Bird Census (McIlveen 2009). Additional waterfowl surveys have been conducted by CVC as part of LOISS within both the LWC Regional and Project Study Areas.

2.4.7 Butterflies

There are over 100 butterfly species known to have been observed in the Greater Toronto Area (Harrison 2007), which may be found within the LWC Regional Study Area. The majority of these species are residents who live, breed and over-winter in the local area. Approximately 11 species are known to be ‘seasonal colonists’ immigrating to the area in the spring to breed. Other species also have migratory tendencies and the area is occasionally visited by ‘accidental’ migrants. In the fall, other species of butterflies are migratory and make the reverse journey from southern Ontario to areas further south. The most familiar of these is the Monarch (*Danaus plexippus*); but other common migrants include: Painted Lady (*Vanessa cardui*); American Lady (*Vanessa virginiensis*); Red Admiral (*Vanessa atalanta*); Mourning Cloak (*Nymphalis antiopa*), and Question Mark (*Polygonia interrogationis*).

Similar to many other migratory species, the size of Lake Ontario presents an obstacle to butterfly migration. As a result, these species tend to congregate in shoreline areas to rest, feed, and engage in activities pertaining to migration either before their flight over/around the lake, or thereafter. The habitat quality of sites along Lake Ontario and the resources available in them are important factors in maintaining a viable population of resident and migrant butterflies. Butterfly and odonate surveys were conducted as part of LOISS.

Attempts to characterize the use of the Lake Ontario shoreline in Mississauga by fall migratory butterflies were made in 2009 and 2010. Within the LWC Project Study Area, the only site to be visited was Marie Curtis Park (2009 and 2010). In 2010, Marie Curtis Park showed the highest diversity of butterflies (nine species) from 20 survey locations (McIlveen 2010). In 2009, Marie Curtis Park supported the highest numbers of observed Monarch butterflies, likely owing in part to the large patches of Common Milkweed (*Asclepias syriaca*), Goldenrods (*Solidago* spp.), Asters (*Symphyotrichum* spp.) and thistles (*Carduus* spp.) (McIlveen 2009).

Incidental observations of butterflies between 2009 and 2012 have noted that there are at least 16 species within the LWC Project Study Area. Odonate and Lepidoteran surveys were completed in 2013 at the WWTF and found several migratory species, including mornarch butterflies (*Danaus Plexippus*), black saddlebags (*Tramea lacerate*), and green darners (*Anax junius*). Some are migrants, others breed in the area and these are listed in **Table 11**.

Table 11: Butterflies observed within the LWC Project Study Area between 2009 and 2012

Scientific Name	Common Name	Generalized Rarity	Breeding Status[7]
Celastrina argiolus	Spring Azure	Generally Common	-
Celastrina neglecta	Summer Azure	Generally common	-
Everes comyntas	Eastern Tailed Blue	Generally common	-
Limenitis archippus	Viceroy	Generally common	-
Papilio glaucus	Eastern Tiger Swallowtail	Generally common	-
Papilio polyxenes	Black Swallowtail	Generally common	-
Danaus plexippus	Monarch	Generally common	Breeding migrant
Junonia coenia	Common Buckeye	Uncommon	Breeding migrant
Colias eurytheme	Orange Sulphur	Generally common	Breeds here annually, likely renews through migration, at least initially.
Coenonympha tullia	Common Ringlet	Generally common	Can often migrate
Nymphalis antiopa	Mourning Cloak	Generally common	Can often migrate
Eurema lisa	Little Yellow	Uncommon	Migrant with no evidence of breeding here
Hylephila phyleus	Fiery Skipper	Uncommon	Occasionally breeding migrant
Erynnis baptisiae	Wild Indigo Duskywing	Uncommon	Partial migrant starting temporary or permanent colonies
Colias philodice	Clouded Sulphur	Generally Common	Strong migrational tendencies but full implications unclear
Pieris rapae	Cabbage White	Generally common	Strong migrational tendencies but full implications unclear
Enallagma civile	Familiar Bluet	-	-
Ischnura verticalis	Eastern Forktail	-	-
Lestes rectangularis	Slender Spreadwing	-	-
Anax junius	Common Green Darner	-	-
Erythemis simplicicollis	Eastern Pondhawk	-	-
Libellula pulchella	Twelve-spotted Skimmer	-	-
Pachydiplax longipennis	Blue Dasher	-	-
Pantala flavescens	Wandering Glider	-	-
Pantala hymenaea	Spot-winged Glider	-	-
Tramea Carolina	Carolina Saddlebags	-	-
Tramea lacerate	Black Saddlebags	-	-

[7] Generalized rarity and Breeding Status are taken from Harrison, B., 2007.

Due to the presence of forests and large open meadows, it is suspected that the Marie Curtis Park, Arsenal Lands, and the WWTF offer great potential for shelter and foraging habitat for migratory butterflies during their flights over/around the Lake.

2.4.8 Species of Concern

Species of Concern in this report refers to those species of plants and animals that are:

- considered species at risk;
- tracked by the Natural Heritage Information Centre;
- are rare or uncommon within the LWC Project Study Area; or
- tracked by the TRCA.

Species at Risk include species:

- designated as Special Concern, Threatened or Endangered by the Committee on the Status of Species at Risk in Ontario (COSSARO);
- those listed as Special Concern, Threatened or Endangered on the provincial Endangered Species Act; and
- those identified through regional and municipal natural heritage strategies.

Due to the sensitivity of this data, SAR occurrences have not been mapped. Species tracked by the Natural Heritage Information Centre are those with a provincial ranking of S1 to S3S4 or S3. Rare or uncommon species within the LWC Project Study Area pertain only to floral species that are believed to be rare or uncommon within the Peel Region or the Credit Valley Watershed (Kaiser 2001), or within EcoRegion 7E4 (Varga 2000). TRCA tracked species include those with a TRCA ranking of L1 to L4.

Based on this information, there are 128 Species of Concern which have been recorded (CVC 2012) within the LWC Project Study Area. Of these species of Conservation Concern, there are 25 faunal Species at Risk known to occur within the LWC Project Study Area either currently or historically. Floral records indicated 265 Species of Concern were recorded.

The 13 Species at Risk observed within the LWC Project Study Area are noted in **Table 12**.

Table 12: Floral and faunal Species at Risk known from the LWC Project Study Area

Taxa Type	Scientific Name	Common Name	COSEWIC Status[1]	SARA Status[2]	SARO Status[3]
Bird	*Contopus virens*	Eastern Wood-pewee	Special Concern	-	-
Bird	*Euphagus carolinus*	Rusty Blackbird	Special Concern	Special Concern (Schedule 1)	NAR
Bird	*Falco peregrinus*	Peregrine Falcon	Special Concern	Threatened (Schedule 1)	Special Concern
Bird	*Podiceps auritus*	Horned Grebe	Special Concern	-	Special Concern
Bird	*Dolichonyx oryzivorus*	Bobolink	Threatened	-	Threatened
Bird	*Hirundo rustica*	Barn Swallow	Threatened	-	Threatened
Bird	*Hylocichla mustelina*	Wood Thrush	Threatened	-	-
Bird	*Sturnella magna*	Eastern Meadowlark	Threatened	-	Threatened
Lepidoptera	*Danaus plexippus*	Monarch	Special Concern	Special Concern (Schedule 1)	Special Concern
Mammal	*Myotis lucifugus*	Little Brown Myotis	Endangered	-	Endangered
Mammal	*Myotis septentrionalis*	Northern Myotis	Endangered	-	Endangered
Mammal	*Pipistrellus subflavus*	Eastern Pipistrelle	Endangered	-	-
Tree	*Juglans cinerea*	Butternut	Endangered	Endangered (Schedule 1)	Endangered

[1] COSEWIC_STATUS Status assigned by the Committee on the Status of Endangered Wildlife in Canada
[2] SARA_STATUS Status according to the *Species at Risk Act* (Federal)
[3] SARO_STATUS Status according to the Species at Risk in Ontario list

2.4.9 Invasive Species

A thorough survey of all natural features in the LWC Regional and Project Study Areas has not been undertaken. However, as with many highly disturbed urban natural areas invasive species are common within the LWC Regional and Project Study Areas. Information on the presence, abundance and impacts of invasive species was drawn from terrestrial natural heritage studies conducted on the Arsenal Lands (2005) and Marie Curtis Park (2003 & 2010) by TRCA staff, and the Mississauga Natural Areas Survey and the Credit Valley Conservation Terrestrial Ecological Land Classification report (NRSI May 2009).

Forested areas in Marie Curtis Park are dominated by Garlic Mustard (*Alliaria petiolata*), Japanese knotweed (*Polygonum cuspidatum*), and Tartarian honeysuckle (*Lonicera tartarica*). The beach component of the park is predominantly devoid of vegetation but where it is vegetated, it is dominated by non-native crack willows (*Salix fragilis*), Manitoba maple (*Acer negundo*) and Black locust (*Robinia pseudoacacia*). The exotic old field meadows found in Arsenal Lands and Marie Curtis Park also contained significant populations of Dog-strangling vine (*Cynanchum rossicum).* Moist areas include Narrow-leaved Cattail (*Typha angustifolia)* and

Common Reed *(Phragmites australis)* which can out-compete native species ultimately reducing native biodiversity and altering the community structure.

The forest on the north-western part of the WWTF is relatively degraded due to a high frequency of Garlic Mustard, Buckthorn (*Rhamnus cathartica*), and Tartarian Honeysuckle.

2.5 OVERALL ECOLOGICAL FUNCTION OF THE LWC PROJECT STUDY AREA

There are many ecological functions represented and maintained by the natural and non-natural features within the LWC Project Study Area (**Table 13**). Overwhelmingly these functions stem from the LWC Project Study Area's unique location along the Lake Ontario Shoreline and in the transition zone between lake and terrestrial habitats. At the landscape scale, natural features and shorelines in this area offer either direct connections or connections via stepping stone habitat, to the Credit River and the various smaller creeks that outlet to Lake Ontario along the coast.

As a consequence, this area is vital to species whose life cycles involve aquatic and terrestrial phases; those that require the ability to move between the Lake and the Lake Ontario tributary creeks, and those whose tendencies require them to make use of Lakeshore habitat during their annual migrations. The natural areas within the LWC Project Study Areas may be able to provide unique functions at the local, watershed, municipal, and Lake Ontario scale.

Table 13 describes some of the most important functions of the natural features within the LWC Project Study Area.

In some cases, the lack of data on specific species or habitats may preclude the use of the term 'significant' in a policy sense; however, the presence or potential presence of these features or functions on the landscape indicate that there are great possibilities for the LWC Project Study Area, and that more field work is warranted to justify any policy-defined designations in the future.

In addition to the natural areas noted above, many of the human-influenced or urban features support habitat for wildlife and provide valuable ecological functions. Developed areas in the vicinity of the LWC Project Study Area, especially near the lake, exhibit a higher tree cover than areas outside of the area. This tree cover provides all of the benefits of a maturing urban forest in terms of air quality, amelioration of the heat-island effect, carbon sequestration and storage, stormwater management and a host of social and cultural benefits.

Some species are more flexible in habitat requirements and their sensitivity to disturbance. Consequently they are better able to utilize man-made structures or co-exist in areas where human presence is higher and the alteration to the landscape is more extreme. Moreover, migrant species that need a spot to rest after a long journey over Lake Ontario may be more likely to use this habitat than areas devoid of trees. Though many of these migrants may not linger long in these habitats, they function as stepping stones to more natural and higher quality habitats nearby.

Table 13: Overall Ecological Functions of the LWC Project Study Area

	Site			
Ecological Function	**Marie Curtis Park, Arsenal Lands & G.E. Booth property (east)**	**G.E. Booth North-west Woodland**	**G.E. Booth Successional Area (meadow and hedgerow)**	**G.E. Booth Lagoons**
Known Habitat for Endangered or Threatened or Special Concern Species	Yes	No	Yes	Feeding areas for Barn Swallows.
Wetland Habitat	Yes	No	Yes	Non-natural
Woodland / Forest Habitat	Yes	Yes	No	No
Colonial Nesting Bird Habitat	Potential colonial shorebird nesting habitat along open beach and shrub beach.	No	No	Yes. Bank Swallow colony present.
Land bird Migratory 7Stopover/Staging Areas	Habitat associated with forest community as well as adjacent successional areas.	Habitat associated with forest community as well as adjacent successional areas.	Potential. Habitat associated with successional areas.	Unlikely
Waterfowl Stopover / Staging Areas	Opportunities provided along open and shrub beach communities.	No	No	Yes
Waterfowl Overwintering Areas	Yes	No	No	No
Shorebird Stopover/ Staging Area	Opportunities provided along open and shrub beach communities.	No	No	Yes
Habitat for Open country and Early Successional Breeding Birds	Potential. Large areas of meadow supported diverse breeding community in 2003. With restoration it could support open country species again.	No	Yes, though limited in size.	No
Migratory Butterfly Stopover/Staging Areas	Opportunities provided within successional communities.	Potential.	Potential opportunities provided within successional communities	Unlikely
Migratory Bat Stopover / Staging Areas	Potential exists along forest edges.	Potential exists along forest edges.	Unlikely	Unlikely. Open water can provide feeding opportunities.

	Site			
Ecological Function	**Marie Curtis Park, Arsenal Lands & G.E. Booth property (east)**	**G.E. Booth North-west Woodland**	**G.E. Booth Successional Area (meadow and hedgerow)**	**G.E. Booth Lagoons**
Amphibian Breeding Habitat	Yes. Three cattail marshes supporting only known amphibian breeding populations in Study Area. This site also may support breeding Midland Painted turtles.	No	No	No
Mink Denning Sites	Potential. Mink are noted for the natural area and natural shoreline conditions exist but are highly disturbed by human traffic.	No	Potential. Meadow borders armour stone hardened shoreline which may provide refuge and denning opportunities.	No
Wildlife Movement Corridors	Yes. Riparian corridors along creeks. Natural beach connection along shoreline.	Yes. Stepping stone habitat. Riparian corridor connection with Serson Creek.	Yes. Meadow is a corridor along the dyke along the shoreline linking Serson Creek mouth with beach habitat to the east of property. Stepping stone habitat. Riparian corridor connection with Serson Creek.	Stepping stone for migrants.
Raptor Breeding Habitat	Yes. Cooper's Hawk noted to be nesting. Potential for American Kestrels to be nesting.	Unlikely	No	No
Habitat for Area Sensitive Breeding Birds	Potential, though limited.	Unlikely	No	No
Rare Vegetation Communities	Yes. FOM 201 inclusion.	No	No	No
Foraging Areas with Abundant Mast	Yes	No	No	No
Turtle Nesting Habitat / Turtle Overwintering Habitat	Potential	No	No	No

3.0 DEVELOPMENT OF ALTERNATIVE LWC PROJECT CONFIGURATIONS

This chapter describes the ecological considerations that provided the foundation for the development of habitat components for the Alternative LWC Project Configurations.

3.1 PRELIMINARY IDENTIFICATION OF HABITAT COMPONENTS FOR THE ALTERNATIVE LWC PROJECT CONFIGURATIONS

Due to the historical mix of industrial and residential land uses within the LWC Project Study Area, opportunities for sizeable and functional habitat patches were limited or unfeasible. The LWC Project provides an opportunity to create a considerable naturalized area, which will provide connectivity both regionally and locally for migrating terrestrial and aquatic species.

As part of the preliminary identification of habitat components for the Alternative LWC Project Configurations, three broad community types (coastal terrestrial, stream and wetland, and shoreline and nearshore habitats) were identified as providing an appropriate foundation for local and regional ecological processes, and are discussed as follows.

Coastal Terrestrial Habitat

The spatial arrangement of coastal terrestrial vegetation patterns along the north shore of Lake Ontario can vary with slope and exposure to elements in the nearshore area. Herbaceous vegetation often dominates closest to the water, followed by hardy shrubs, and successional tree species. Generally, the coastal forest area could consist of oak savannah and Carolinian type trees including cottonwood. The site would be typified by vegetation species which would maximize the quality and quantity of stopover habitat to benefit migratory species in the fall fruiting period. It also offers habitat that would maximize invertebrate diversity in the spring that would also benefit both migratory and resident wildlife, and encourage the production of terrestrial and aquatic invertebrates given the proximity to water in the streams, wetlands and shoreline areas.

Stream and Wetland Habitat

Within the proposed land creation area two creeks are present: Applewood Creek and Serson Creek. Applewood Creek is currently connected ecologically with Lake Ontario up to Lakeshore Road. Serson Creek is currently bisected north of the WWTF, with base flows running through a culvert under the WWTF and outletting on a remnant sandy beach immediately south of the WWTF. A large, straight stormwater channel has also been cut between the WWTF and the OPG Lakeview site, diverting overbank flood flows in Serson Creek directly to the lake. Given this configuration, fish are unable to migrate from Lake Ontario to Serson Creek. Opportunities to provide connections between Lake Ontario and Serson Creek were explored as part of the LWC Project to maximize benefits of the proposed constructed wetlands. In addition, the Inspiration Lakeview planning activities currently contemplate re-routing Serson Creek through the middle of the OPG Lakeview site. Wetland patch size and orientation were considered in the development of the Serson Creek wetland to accommodate that potential future change.

As in many similar coastal marshes on the north shore of Lake Ontario, the connectivity of these streams would be highly reliant on balancing watershed and lake driven inputs. The optimal wetland habitat size should replicate historical conditions and other similar watersheds found along the north shore of Lake Ontario, while considering current watershed conditions. Ensuring

stream connectivity and structure within the wetlands will also maximize the use of water, and create additional habitat diversity.

Shoreline & Nearshore Habitat

The land creation area should be designed to benefit the coastal habitats within the LWC Project Study Area, allowing for transitions from the water to the beach and terrestrial habitats. Structurally diverse shoreline treatments should be favoured. Given the depths of 5-m to 6-m on the lakeward edge of the landform, shoreline treatments should be structured to augment fish habitat.

In general, the more complex and diverse the Alternative LWC Project Configuration, the more effective that shoreline will function for fish and wildlife uses. Further, shorelines that have shallower slopes transitioning from the terrestrial lands down to the water's edge will be deemed as providing better functioning habitat for most species of fish and wildlife.

The range of shoreline types considered include: revetments, headland and beaches, and different configurations of island and beaches.

Revetments consist of large interlocking quarried blocks forming a steep wall from the lake bed to the top of the landform, making the movement from the lake to the shore difficult for most wildlife. Shorelines using armourstone tend to be relatively uniform and offer limited opportunity for fish communities.

Headland beaches consist of a series of spaced constructed armourstone headlands that are connected to the landform, but protrude further out into the lake. Linear beaches consisting of smaller, mobile materials such as sand, gravel and cobbles are located along the shoreline between these hardened headlands, which prevent the beaches from washing away. These beach shorelines provide more diverse habitat structure, and offer opportunities for movement of resources and wildlife between the land and water than revetments. In the case of the LWC Project, given the depth of water, beach materials will largely consist of cobbles with withstand the wave energy.

Island-Beaches consist of a series of constructed low-lying armourstone islands that are not connected to the landform above water under average water levels. The shorelines then consist of a long, uninterrupted beach front consisting of smaller mobile materials such as gravel and cobble. These shorelines offer the most diverse structural habitat, the most shoreline/water interface area, and unique "sheltered" habitat on the shoreside of the islands. As with the headland beaches, the Island-Beach materials will largely consist of cobbles in the deeper watered areas, but where proposed beaches approach the existing shorelines, the beach will grade to smaller material due to smaller waves.

3.2 REFINEMENT OF HABITAT COMPONENTS FOR THE ALTERNATIVE LWC PROJECT CONFIGURATIONS

In developing the Alternative LWC Project Configurations, further refinements in the form and features proposed by the coastal terrestrial; stream and wetland; and shoreline habitats were implemented based on a number of defining principles. These principles are based on our current understanding of ecosystem form and functions for similar areas along Lake Ontario.

The following text summarizes the principles used in the refinement of the Alternative LWC Project Configurations.

Aquatic habitat principles considered:

- Historical natural heritage conditions;
- Current watershed conditions;
- Wetland functions;
- Maximize habitat diversity within natural limitations;
- Other relevant reference sites along the northwestern Lake Ontario shoreline; and
- Consideration of all aquatic habitat enhancements to achieve “No Net Less” of fish habitat

Terrestrial habitat principles considered:

- Creation of habitat areas that were large enough to provide wildlife refuges and functions;
- Orientation and zonation of natural habitat areas in relation to distance from the Lake;
- Topographical variations (macro and micro); and
- Connections to adjacent natural areas.

These principles and associated goals are discussed in greater detail in the following sections.

3.2.1 Historical Natural Heritage Conditions

Historical conditions of the LWC Project Study Area provide context for the natural heritage conditions which would have naturally existed in the absence of urbanization, and provides appropriate baseline knowledge regarding the appropriate ecological features for the area. While wetlands were once abundant across the lower Great Lakes basin, wetlands have experienced a significant decline since the late 1700’s, with approximately 57% of historical wetlands west of the Bay of Quinte, and up to 75% of historic wetlands within heavily settled Great Lakes environments have been lost to activities such as land use change, filling, dredging, and disturbance (Whillans 1982).

Within and immediately adjacent to the LWC Project Study Area, historical aerial imagery and mapping (**Figure 3**) indicates the presence of a well vegetated, 1.60-ha, low-lying coastal marsh at the mouths of Serson Creek, Applewood Creek, and Etobicoke Creek, established behind a barrier beach. Also present were 1.37-ha and 0.4-ha of estuarine habitat, associated with Applewood Creek and Etobicoke Creek, respectively. As the coastal marsh system was open to the lake at the western end, the wetland water levels would have been highly dependent on lake level fluctuation; while the wetland temperature regime would have been influenced by both the river and lake water inputs. It should be noted however, that the mouth of Etobicoke Creek had already undergone significant change due to human influences by 1946, and that these wetlands had already experience significant modifications and stress. Historical maps from the 1700s, provided by European colonists to the area, suggest a much more extensive coastal wetland system at the mouth of Etobicoke Creek.

In addition to the coastal wetland system, aerial imagery from the late-1950s suggests that the LWC Project Study Area has historically supported numerous surficial drainage wetlands, in which surface water was impounded onsite. This is a significant finding as it suggests that historical soil condition could have potentially supported wetlands at the site. There is an

opportunity with the LWC Project to create "river-sourced" wetland habitat by incorporating flows from Applewood Creek and Serson Creek. However, depending on the final elevation of the proposed wetlands, a portion may be somewhat influenced by lake water. The lake water connection is vital, as in other coastal wetlands on the north shore of Lake Ontario, to provide a functional habitat connection for the marshland ecotone.

Due to the historical presence of wetlands and their limited nature, there is an opportunity to provide a valuable and limiting ecological resource on site. There is an opportunity with the LWC Project to create "river-sourced" wetland habitat by incorporating flows from Applewood Creek and Serson Creek. Depending on the final elevation of the proposed wetlands, a portion will be influenced by lake water which will be vital to provide a functional habitat connection for the marshland ecotone.

Key Principle:

- Coastal wetland systems associated should be influenced by both river and lake inputs.
- The historical air photo of the LWC Project depicts a total of approximately 3.5-ha of coastal wetland in the 1940s. This represents a reasonable lower limit for wetland habitat to be considered in refining the Alternative LWC Project Configurations.

3.2.2 Wetland Function

Although water levels in Lake Ontario have been semi-regulated as a result of the Saint Lawrence Seaway Project (1954), seasonal and 'seiche-driven' water level fluctuations can impact thermal regimes, and thus the extent and composition of coastal wetland vegetation composition (Keough *et al.* 1999). While these fluctuations can provide ecological benefits, they can also introduce negative impacts to the system, such as sudden coldwater upwellings, and the proliferation of invasive species (e.g., the common carp, *Cyprinus carpio*). As such, in order to buffer the negative impacts from these fluctuations, the coastal wetlands proposed for the LWC Project will be designed with regards to wetland function.

Wetland function, in the case of constructed and managed wetlands, refers to the regulation of water levels in order to promote, adjust, or maintain a diversity of wetland flora and fauna. For the LWC Project, there is an opportunity to utilize water control structures for the coastal wetlands in order to provide variable environmental conditions, such as water level and temperature fluctuations, and the transfer of sediment. These conditions can be achieved by using coastal wetland designs, which will be based on the following geomorphic types of wetlands which are found along the north shore of Lake Ontario, as described by Keough *et al.* (1999): protected wetlands; and drowned-river mouth and flooded-delta wetlands.

- Drowned-river mouth and flooded-delta wetlands have direct surface-water connections that occupy flooded river valleys or cap drowned deltas that driven by both lake and riverine water inputs. These wetlands often have narrowed lake opening, and depending on the rate of inundation, may have river banks that form a natural levee system from fluvial deposits. These levees provide the conditions for overbank pocket wetlands which often become connected to streams by bank breaching.
- Protected wetlands are isolated from most of the direct hydraulic processes generated by the lake. Historically, protected wetlands may have existed within the LWC Project Study Area during years of low lake levels and when littoral sediments formed a contiguous barrier beach.

Key Principles:

- Wetland areas should depict similar characteristics to other coastal wetlands found on the north shore of Lake Ontario. Two applicable wetland forms for consideration include: drowned-river mouths with natural appearing levees and pocket wetlands; and coastal wetlands that are periodically protected from direct lake effects through the establishment of barrier beaches.

3.2.3 Relevant Reference Sites Along the Northwestern Lake Ontario Shoreline

Using reference sites which possess similar conditions to the historical conditions of the LWC Project Study Area provides insight into habitat features for the LWC Project Study Area.

Rattray Marsh and Turtle Creek Marsh are located along the western Lake Ontario shoreline within the vicinity of Project Study Area. Rattray and Turtle Creek Marshes are a drowned river-mouth (bay-bar) coastal wetlands, approximately 13.9-ha and 2.4-ha in size, respectively. Rattray Marsh is located behind a barrier beach system. The Rattray and Turtle Creek wetlands are classified as 78% and 53% marsh; and 22% and 47% swamp, respectively, while the surrounding areas are composed of forest, subdivision, and parkland.

Gold Point Marsh, located along the City of Oshawa shoreline, is composed of similar wetland habitat as would have historically been found in the LWC Project Study Area. Gold Point Marsh is a drowned river-mouth coastal wetland, approximately 4-ha in size, located behind a barrier beach system. The wetland is classified as 65% marsh and 35% swamp, while the surrounding area is composed of forest, thicket, and meadow (CLOCA 2011).

As the above examples and Applewood Creek possess a similar drainage area and both exhibit urban headwaters, they were deemed appropriate reference sites for the design of the wetland complex at the mouth of Applewood Creek.

Key Principles:

- The watersheds, coastal wetland, and surrounding terrestrial habitat at Rattray Marsh, Turtle Creek Marsh, and Gold Point Marsh possess similar conditions to would have been found for the Applewood Creek area in the 1940s. Features observed at these sites were used as a reference site for the LWC Project.
- As a reference site, the Gold Point Marsh depicts a wetland habitat size of 3.5-ha to 4-ha that would be appropriate for each of the Serson Creek and Applewood Creek coastal wetlands.

3.2.4 Consideration of all Aquatic Habitat Enhancements in Achieving “No Net Loss” of Fish Habitat

Land creation activities will create a loss of aquatic habitat which will require compensation under CVC’s management goal of no net loss of productive capacity of fish habitat. As such, an important consideration in the development of the natural heritage components of the Alternative LWC Project Configurations is an understanding of the potential loss of productive fish habitat, such that habitat components may be designed to be as self-compensating as possible. CVC’s policy encourages all planning and permit applications to achieve an ecological gain. Where it has been demonstrated an ecological gain is not feasible, CVC will promote the principle of no net-loss of ecological functions and hydrologic functions (CVC 2010). This approach is consistent with the new Fisheries Act Regulation approach to off-setting whereby

residual serious harm to fish that cannot be avoided or mitigated are offset through projects with tangible conservation outcomes.

In order to estimate the potential extent of compensation required, a preliminary assessment of the maximum land creation area (i.e., 2 million m^3 of fill) with a headland-beach shoreline, and 9-ha of created wetland habitat, was completed using the Habitat Alteration Assessment Tool (HAAT). A full description of the HAAT model is provided in **Chapter 4**. This preliminary analysis identified a number of habitat components important in offsetting the loss of productive fish habitat:

- Large in-land wetlands: While coastal wetlands provide a benefit for fish production, large in-land wetlands provide warm, highly vegetated areas for fish spawning and rearing.
- Large stretches of cobble beach: The shallow water provided by cobble beaches provides foraging and spawning opportunities for nearshore pelagic species.

Key Principles:

- Alternative LWC Project Configurations should be designed to be as self-compensating as possible with regards to the loss of productive fish habitat.
- The preliminary HAAT model run provided a reasonable upper limit of approximately 9-ha of wetland habitat creation that would be considered in the refinement of Alternative LWC Project Configurations.
- Coastal wetlands that provide a benefit for fish production, and large in-land wetlands that provide warm, highly vegetated areas for fish spawning and rearing should be included as habitat components, in addition to the proposed shoreline treatments.
- Cobble beaches are preferable over revetment, or other hardened shoreline treatments as they provide foraging and spawning opportunities for nearshore pelagic species.
- Maximizing shoreline diversity is recommended to maximize habitat gains required to offset losses generated with land creation activities.

3.2.5 Create Habitat Areas Large Enough to Provide Wildlife Refuges and Functions

Habitat quality is based on a number of factors, including but not limited to: habitat size and cohesiveness, shape, diversity and ability to provide linkages. In general, the larger the habitat, the less bisected by infrastructure it is, the more diverse, and the higher level of connectivity to other adjacent habitats it is, the more productive habitat will be and more able to act as a wildlife refuge. In the development of Alternative LWC Project Configurations, general guidelines identified in the Peel – Caledon Significant Woodlands and Significant Wildlife Habitat Study (2009), were used to benchmark minimum habitat size targets for functional forest habitat (4-ha) and meadow habitat (10-ha) in the design of the LWC Project.

The presence of humans can result in trampling of vegetation and discouraging wildlife, resulting in significant impacts on the quality of such habitats. Wildlife needs large blocks of natural habitat, free from trails, hikers, and other traffic. Large blocks of habitat are wildlife refuges where plants and wildlife remain undisturbed and nature is encouraged. The Alternative LWC Project Configurations should include wildlife refuges where people-access is excluded entirely, as well as natural areas where controlled access is provided by trails, signage, and other public amenities. In general, larger blocks of natural habitat are better for wildlife than smaller blocks fragmented by trails. Where possible, trails should be placed along the edges of habitat, especially for forests and wetlands. Trails adjacent to the shoreline treatment or through meadows are more desirable than other areas, such as forest and wetlands.

Key Principles:

- Create large contiguous blocks of habitat, with minimum targets of 4-ha for forest and 10-ha for meadow habitat.
- The western end of the land creation area could make up a large wildlife refuge area.
- Islands with no "people-access" are desirable and can be considered as wildlife refuge. These would act help attract migrating birds during fair weather conditions.
- The following items will make the natural areas more attractive to wildlife:
    - **Shape:** Blocks should be generally round or square to reduce edges and provide more sheltered interior conditions. Thicker blocks are better than thinner blocks.
    - **Diversity:** A variety of habitats, including forest, meadow, successional and wetland, are better to encourage different types of wildlife. Wildlife uses more than one type of habitat.
    - **Linkage:** Connect existing and future habitats to create larger matrixes of natural areas.

3.2.6 Orientation and Zonation of Natural Habitat Areas in Relation to Distance from the Lake

The Lake Ontario shoreline is a harsh environment. The vast open fetch lengths of the lake allows for the development of strong winds and large waves. Where shorelines drop off rapidly, wave and wind energy can be particularly strong. As a result, features found along shorelines and the coastal terrestrial areas are reflective of these harsh conditions. Beaches in an environment similar to the LWC Project Study Area would be long and linear, consisting of larger cobbles and shingles that are regularly moved by the waves. The adjacent terrestrial coastal habitats adjacent to the beach usually consist of low-lying meadow grasses and hardy shrubs that are able to withstand the desiccating influence of strong winds. As you move further inland, conditions become less severe and more woody shrubs and treed vegetation begin to establish. Thus, when seen from above, a natural shoreline would appear to have linear bands running the length of the shoreline of beach, meadow, shrubs and forest. The configuration of these bands can be influenced by underlying geology, wave climate, the presence of wetlands, and changes in topography.

Key Principles:

- Design the natural areas as they appear in nature. Follow the natural patterns observed at other sites on Lake Ontario.
- Natural coastal areas adjacent to shorelines allow for:
    - Natural beach features (whether sand, gravel or cobble) offer dynamic processes to occur that provides higher function than static armoured shorelines;
    - Transitional access points for wildlife to cross from aquatic to terrestrial habitats and allow for other food web interactions; and
    - Establish appropriate habitat zones in relation to proximity to the shorelines: generally speaking, as you move further from the beach areas, vegetation transitions from hardy meadow species to woody shrubs to coastal forest species.
    - A unique habitat proposed along the existing shoreline of the WWTF is a treed swamp, designed to connect the Serson Creek and Applewood Creek wetland complexes.

3.2.7 Incorporate Topographical Variations

Natural areas in nature aren't flat. Small changes to elevation on large and small scales create a diversity of habitat needed for wildlife. Topography designed for trails through natural areas can also help deter off trail disturbances in natural areas. Furthermore, the Alternative LWC Project Configurations were established on the basis of a uniform topography (approximately 79-m elevation or approximately 4-m above lake level), in the calculation of fill volumes required for each footprint. In reality, each footprint requires a much lower elevation to establish the coastal wetland areas proposed for each of the two creeks. As such, fill that is not available for placement in the wetland areas must be accommodated on the remaining adjacent terrestrial lands within the Alternative LWC Project Configurations in order to retain the mass balance between areas of cut and fill. The fill volume balance will not be undertaken for each Alternative LWC Project Configuration, but the need to maintain this balance in cut and fill will be considered when establishing maximum wetland sizes in the development of the Alternative LWC Project Configurations. However, the following key principles will only be considered at the refinement of the Preferred Alternative stage.

Key Principles (in refining the Preferred Alternative):

- ***Small Hills (elevation changes):*** The ground should be designed to include a variety of heights and public viewing points. Small hills can be created to diversify habitats. They can be used to direct or deter public access to particular areas. Hills are typically drier sites and could be suitable for meadow habitat. Sheltered areas between hills are more suitable to forests.
- ***The ground shouldn't be flat (microtopography)*:** There should be smaller pockets of ground that rises and falls similar to what would be found in an area that has not been disturbed by development. Small areas with changes in height create specialized areas for plants and animals called microhabitat. Microhabitat can be more sheltered and have special conditions that develop specialized wildlife, plants and soil.
- ***Bluffs*:** Small hills with one very steep face are natural on shorelines and provide habitat for certain wildlife, birds and plants, such as the Bank Swallow. Bluffs can also act as a people-deterrent (i.e. around the WWTF).
- ***Top-Soil (to be determined at Detailed Design)****:* Type and quality are important to the natural areas. The amount and quality of soil will help effects what plants will grow. Less soil and poor quality soil means the plants will struggle to survive. Specific amounts of top soil for each community will be determined at detailed design. The source of the original topsoil and testing of the soil will be required to minimize risk with regards to contamination and invasive species.

3.2.8 Connect to Adjacent Natural Areas

Being able to establish linkages and connections between habitat types is critical in allowing for species to migrate and to provide resources for the various activities and life stages for wildlife. Mammals, such as White-tailed deer and others, use the natural areas along creeks to move south from the Oak Ridges Moraine to Lake Ontario. Similarly, White-tailed deer make different uses for creek, wetland, meadow, and forest habitats. Species, such as frogs and turtles, would be able to use the treed swamp as a migratory corridor to be able to access one marsh area to another. Mink would be able to access meadows from either beach or wetland areas. Birds migrating across Lake Ontario are able to home in on natural greenspaces along the shoreline. Providing diverse habitat types, the LWC Project has the potential to provide perching and resting areas for birds, as well as foraging areas for migratory and resident birds. Some species

would also be able to nest and reproduce in the various habitat types. Allowing for a diversity of complementary and accessible habitats within an area provides better opportunities for establishing migration corridors and providing the necessary resources for resident and migratory species.

Key Principles:

- The new natural areas should connect directly to existing creek natural areas (i.e. Applewood Creek, Serson Creek, the Lake Ontario shoreline, Arsenal Lands, Marie Curtis Park, and Etobicoke Creek) to allow wildlife movement.
- The LWC Project should provide important connections between land and water ecozones: from the beach to land and from the creeks/wetlands to land.
- Forests and meadow habitats should provide complementary habitat functions for a wide range of species and activities.
- The LWC Project should provide important layover habitat for species migrating across Lake Ontario and habitat for species migrating along the shoreline.
- At detailed design, trail alignment and strategies should be implemented to minimize fragmentation of critical habitats and functions.

3.3 NATURAL HERITAGE COMPONENTS OF THE ALTERNATIVE LWC PROJECT CONFIGURATIONS

All Alternative LWC Project Configurations were developed on the assumption of a maximum of 2M cubic metres of fill being utilized in the creation of its footprint. On this basis, each Alternative LWC Project Configuration was developed using the following similar coastal terrestrial and stream/wetland features as defined through the principles identified previously. The primary difference between Alternative LWC Project Configurations is on the basis of differences in the shoreline condition, which will be discussed more fully in Chapter 6.

3.3.1 Stream and Wetland Habitat Features

All Alternative LWC Project Configurations assume that the majority of flow conditions, including baseflow conditions, for Serson Creek will be redirected down the Serson Creek stormwater channel between the OPG lands and the WWTF. Some locally generated stormwater may continue to discharge from the perched culvert under the WWTF. It is also assumed that the channel of Applewood Creek would be extended from its existing outlet in a westward direction through the land creation area before outletting into Lake Ontario.

As outlined in previous chapters, an initial range of wetland habitat size between 3-ha and 9-ha was suggested as providing a “reasonable” amount of wetland for the proposed LWC Project. As such, in the development of Alternative LWC Project Configurations, it was deemed a narrower range of wetland habitat be established totalling a combined area of 7.0 to 8.0-ha, consisting of two coastal wetlands ranging in size from 3.5-ha to 4.5-ha, one each for Serson and Applewood Creeks. These wetlands would be established in the land creation area for each Alternative LWC Project Configuration. In considering the implications of topography, it was also deemed that 8-ha of wetland is approaching the maximize size of wetland that a 2 M m^3 footprint would be able to accommodate in terms of the cut/fill balance in the design.

In the event a smaller fill volume is considered for the development of the LWC Project in the future, it is anticipated that the wetland sizes will be reduced proportionately to reflect the ability of the footprint to retain its ability to accommodate the cut/fill balance needs in the design. The habitat types have been considered at a coarse community level. In general, the two coastal wetland forms identified previously will be considered for the LWC Project – the drowned-river

mouth and flooded-delta wetlands, and the protected wetlands. The form of wetland will be dependent on the shoreline condition proposed at the outlet of each wetland for the various Alternative LWC Project Configurations.

- Drowned-river mouth and flooded-delta wetlands have direct surface-water: connections that occupy flooded river valleys or cap drowned deltas that are driven by both lake and riverine water inputs. These wetlands often have a narrowed lake opening and depending on the rate of inundation, may have river banks that form a natural levee system from fluvial deposits. These levees provide the conditions for overbank pocket wetlands which often become connected to streams by bank breaching.
- Protected wetlands are isolated from most of the direct hydraulic processes generated by the lake. Historically, protected wetlands may have existed within the LWC Project Study Area during years of low lake levels and when littoral sediments formed a contiguous barrier beach.

As the majority of flows from Serson Creek would be diverted through the stormwater channel, it is critical that the flows from Applewood Creek be incorporated to ensure the proper functioning of the more northeasterly coastal wetland system.

In order to maximize connectivity opportunities in the various Alternative LWC Project Configurations, a linear treed wetland (termed generically as a treed swamp for public consumption purposes) feature is proposed to extend along the existing shore of the WWTF and connect the two proposed coastal wetlands. This treed swamp will cover approximately 3.5-ha of area, and will be sourced with locally generated flows from the adjacent terrestrial lands, and partially by periodic inundation by high lake levels. The treed swamp will be considered an ephemeral wetland, allowing the soils to dry for parts of the season. Species will include trees such as cottonwood, willow, and poplars which are usually found along the shoreline with poorly drained soils. This treed swamp habitat will provide excellent, isolated opportunities for birds, amphibians, and reptiles to migrate between the two coastal wetland habitats. Portions of the treed swamp may also provide seasonal fish spawning habitat, such as for northern pike.

3.3.2 Terrestrial Habitat Features

Approximately 14-ha to 21-ha of naturalized terrestrial habitat is proposed for the Alternative LWC Project Configurations. The area remaining available for terrestrial habitat will be based on the different types of shoreline treatments considered by the various Alternative LWC Project Configurations. The habitats described below are at a coarse community level. Site level details and specific habitats will be determined at detailed design. These habitat types are recommended based on similar shoreline sites along north shore of Lake Ontario.

Table 14 provides a summary of the proposed terrestrial habitat units, potential locations and constraints. The two principal habitat types are:

- Upland forest
- Meadow

At detailed design other factors that will be considered include (but are not limited to):

- amount and type of soil and subsoil amendments
- species specific habitat (i.e. hibernacula, bank swallow habitat, cavity nesting, turtle nesting, woody deadfall etc.)
- planting for ecosystem succession
- maintenance and invasive management
- fencing for habitat refuge areas where appropriate

Table 14: **Summary of the Proposed Terrestrial Habitat Units, Potential Locations and Constraints**

Habitat Type	Characteristics	Constraints	Potential Locations
Meadows	• Found naturally along shoreline due to disturbances i.e., wind, water, ice. • Important bird habitat. Nectar producing flowers, fruits and seeds. • Need large un-treed areas for breeding and raptors for prey. • Rest and launch spot for birds and butterflies flying over the lake. • 10-ha is the recommended size for meadows. Peel recommends Open Country habitats larger than 10-ha that are not farmed for 5 years and are used by area sensitive species be considered significant. Many studies indicate 10-ha as significant threshold for wildlife use.	• Continuous 10-ha blocks may be difficult to accommodate depending on site configuration.	• Directly along shoreline next to bank and beaches. • Along the WWTF adjacent to existing berm currently used by both breeding and migratory species • Next to trails and vista points. Allows clear sight lines, sense of security, are impacted less by off trail use than wetlands and forests.
Forest	• Rest and launch spot for birds flying over the lake. • Upland forest will include Carolinian species that are appropriate for the site, such as oaks, hickories, Wood Anemone, Maple Leaf Viburnum and Witch Hazel, with sandy and well-drained soils. • Plant a variety of fruit and seed shrubs, grasses, and nectar producing flowers. • Plants: Pioneering and tolerant of open conditions would form early forest, before other larger and slower growing trees could take over. • Mix of different plant heights (vertical structure: low groundcovers, higher shrubs and tall trees). • Plant shrubbed edge along forest to protect from elements • Individual forest blocks should be at least 4-ha. This is a threshold where many species of wildlife will begin to use the forest. 4-ha would also be considered significant based on criteria from Peel-Caledon Significant Woodland and Significant Wildlife Habitat Study.	• Continuous 4-ha blocks may be difficult to accommodate depending on site configuration.	• Western edge of site would allow for largest and thickest forest block. • Along the shoreline or setback from shoreline behind meadow blocks. • Connecting to existing treed areas at Serson and Applewood Creeks.

3.3.3 Shoreline and Nearshore Features

For the open coast components of the various Alternative LWC Project Configurations, a wide suite of shoreline conditions will be considered, and will form the primary basis of the evaluation: revetments; beaches; revetment headlands; revetment islands; and embayments. In general, the more complex and diverse the Alternative LWC Project Configuration, the more effective that shoreline will function for fish and wildlife uses. Further, shorelines that have shallower slopes transitioning from the terrestrial lands down to the water's edge will be deemed as providing better functioning habitat for most species of wildlife.

4.0 COMPARATIVE EVALUATION OF ALTERNATIVES

The comparative evaluation of Alternatives is intended to assess the impacts (both positive and negative) of the Alternative LWC Project Configurations on the terrestrial and aquatic ecosystems.

4.1 ALTERNATIVE LWC PROJECT CONFIGURATIONS

The following sections detail the specific features and elements observed within each Alternative LWC Project Configuration. The opportunity to divert all baseflows from Serson Creek down the existing stormwater channel between the OPG Lakeview site and the WWTF was considered and was deemed to be consistent between the various Alternative LWC Project Configurations. For the purposes of this stage of the LWC Project, the diversion of the Serson Creek flows was a possibility to be detailed at the refinement of the Preferred Alternative stage.

4.1.1 Alternative Footprint 1: Revetment

Open Coast Habitat

A revetment is a sloping structure consisting of an outer layer of primary protection armour stone and sub layers of secondary armour stone or rip rap. The slope of the revetment will be about 2h:1v. Under design high water level the depth at the revetment varies between 4.8-m and 5.8-m. Typical average summer water depth will vary between 4.0-m and 5.0-m. The placement of the armour stones will be “random”. Random placement means that each stone is placed individually and keyed in with adjacent stones so that it touches adjacent stones on at least three sides. The crevices between stones of a randomly placed revetment tend to be larger, providing potential niche spots in the wall for some aquatic life. The revetment does not provide sheltered and diverse shoreline habitats.

This Alternative LWC Project Configuration consists entirely of revetments, producing the most uniform shoreline with no diversity. This shoreline is 1.3 times more irregular than a straight, linear shoreline. There is no length of beach created, and 363-m of existing beach is lost. This Alternative LWC Project Configuration extends approximately 135-m along the western end of the sand beach at Marie Curtis Park. In summary, the Revetment results in an overall loss of shoreline diversity, the least irregular shoreline, and no easy access between the terrestrial and aquatic environment for wildlife as there are no beaches.

In total, 30.7-ha of existing lake bed is lost or changed, requiring 7.2-ha of habitat compensation (or 4.3-ha of fill per 1-ha of compensation).

Wetland Habitat

Two main coastal wetland complexes are contemplated with a combined area of approximately 8.0-ha. The southern-most wetland is at the base of the Serson Creek stormwater channel, while the northernmost wetland connects with Applewood Creek and the perched culvert under the WWTF. For both Applewood and Serson Creeks, the wetlands outlet directly through the revetment and into the lake. The wetlands will either take the form of a river-levee system meandering through a flooded-delta wetland, or a drowned-river mouth wetland. A suite of wetland types are likely to be associated with these wetland complexes, including submergent and emergent marsh, and some component wet meadow and levee habitats. The Serson Creek wetland is orientated such that, if in the future, Serson Creek is diverted through the middle of

the OPG Lakeview site as part of the Inspiration Lakeview, the wetland would be able to accommodate flows from the new creek alignment with minimal disturbance.

Treed Swamp

Two narrow, linear habitat patches of treed swamp are proposed, covering approximately 2-ha. The treed swamp is located along the existing shoreline between the two coastal wetlands, and between the Applewood coastal wetland and the existing outlet of Applewood Creek. The swamps will likely be ephemeral in nature, and will be low-lying, situated around the high lake level elevations. For the southernmost treed swamp, water will likely be sourced primarily from run-off from the adjacent forested hill to the south. The treed swamp to the north will likely represent a transition from submergent marsh to emergent marsh to treed swamp along the base of the north valley wall. The treed swamps will provide a multitude of functions: providing an isolated corridor for wildlife, such as amphibians and reptiles, to migrate between the Serson and Applewood Creek wetlands; to increase the wetland and forest habitat diversity in the park; and to act as a further deterrent for public access to the WWTF.

Forest Habitat

A single contiguous section of upland forest is proposed, located to the south of the WWTF ash lagoons, between the two main coastal wetland complexes. This forest will be generally based on the endemic Carolinian forest species and will initially be dominated by Cottonwood and Oak species. The forest has been situated to maximize forest cover connections between the wetlands, to allow views from the OPG Lakeview site out over the water, and to help block sight lines to the WWTF from the new park. The forest covers approximately 6.7-ha, which exceeds the minimum patch size target of 4-ha. It is anticipated that this forest will be located on a hill on the park. Isolated wildlife refuge areas are not provided.

Meadow

Three extensive upland meadow habitat patches are proposed, covering an area of 16-ha. These meadow habitats consist of native hardy grasses, herbaceous plants, and woody shrubs, which provide an important transition between the harsh open coast conditions and more sheltered conditions of the forest and adjacent landscapes at Marie Curtis Park and the OPG Lakeview site. The smallest patch is proposed for the area adjacent to the eastern OPG pier, with a large central patch connecting the two coastal wetlands, and another larger patch connecting Marie Curtis Park with the outlet to Applewood Creek. Public input in the development of Alternative LWC Project Configurations clearly identified a desire to retain sight lines from the OPG Lakeview site out onto the lake along the pier, as such meadow habitat rather than forest was proposed for the southernmost meadow area.

4.1.2 Alternative Footprint 2: Headland Beach

Open Coast Habitat

The Headland Beach Alternative LWC Project Configuration proposes the use of four connected revetment armourstone headlands, protecting three isolated cobble beaches, each approximately 150-m long. The three northern headlands are relatively small and circular in shape. The fourth headland, located to the south, forms a much larger promontory and transitions into a long embayed revetment that ties into the eastern OPG pier. This Alternative LWC Project Configuration effectively replaces the existing shoreline with similar shoreline conditions (e.g., while 449-m of beach is created, a similar length of beach is lost), though the existing sand beach would be replaced with cobble beaches. The revetments have been

described previously as part of **Section 4.1.1**. As a result, there is no change in shoreline diversity from existing conditions.

The three cobble beaches consist primarily of large stones, approximately 200-mm in diameter. Use of smaller cobbles is possible (50-mm), which would reduce the beach slopes but require more material being purchased. The use of mobile cobble beaches provides moderately sheltered and diverse shoreline habitats, while the sloped cobble beach provides easier access (compared to Revetment) for wildlife to migrate from the water's edge to the shore and back.

Overall, the proposed shoreline is more irregular than the Revetment Alternative LWC Project Configuration, as a result of the undulating nature of the headlands and beaches (1.7 times more irregular than a straight linear shoreline). This Alternative LWC Project Configuration extends approximately 135-m along the western end of the sand beach at Marie Curtis Park.

In total, approximately 32-ha of open habitat is lost or changed, requiring 6.1-ha of habitat compensation (or 5.2-ha of fill per 1-ha of compensation).

Wetland Habitat

Two main coastal wetland complexes are proposed, with a combined area of approximately 7.7-ha. The southern-most wetland is at the base of the Serson Creek stormwater channel, while the northernmost wetland connects with Applewood Creek and the perched culvert under the WWTF. For Serson Creek, the wetland outlets directly through the revetment and into the lake. The Serson Creek wetland will take the form of a river-levee system meandering through a flooded-delta wetland. For Applewood Creek, the wetland will outlet through one of the cobble beaches and likely take on the form of a drowned-river mouth wetland. For Applewood Creek, it is anticipated that movement of the cobble beach material will periodically block the outlet – forming a barrier beach. As water levels increase upstream and during flood events, the river will reopen the channel by moving beach materials from the outlet.

A suite of wetland types are likely to be associated with these wetland complexes, including submergent and emergent marsh, and some component wet meadow and levee habitats. The Serson Creek wetland was orientated such that, if in the future, Serson Creek is diverted through the middle of the OPG Lakeview site as part of the Inspiration Lakeview, the wetland would be able to accommodate flows from the new creek alignment with minimal disturbance.

Treed Swamp

Two narrow, linear habitat patches of treed swamp are proposed and would cover 2-ha. This treed swamp is located along the existing shoreline between the two coastal wetlands, and between the Applewood coastal wetland the existing outlet of Applewood Creek. The swamps will likely be ephemeral in nature, and will be low-lying, situated around the high lake level elevations. For the southernmost treed swamp, water will likely be sourced primarily from run-off from the adjacent forested hill to the south. The treed swamp to the north will likely represent a transition from submergent marsh to emergent marsh to treed swamp along the base of the north valley wall. The treed swamps will provide a multitude of functions: providing an isolated corridor for wildlife, such as amphibians and reptiles, to migrate between the Serson and Applewood Creek wetlands; to increase the wetland and forest habitat diversity in the park; and to act as a further deterrent for public access to the WWTF.

Forest Habitat
A single contiguous section of upland forest is located to the south of the WWTF ash lagoons, between the two main coastal wetland complexes. This forest will generally be based on the endemic Carolinian forest species and will initially be dominated by species such as Cottonwood and Oak. The forest has been situated to maximize forest cover connections between the wetlands; to allow views from the OPG Lakeview suite out over the water; and to help block sight lines to the WWTF from the new park. The forest covers approximately 6.4-ha, which exceeds the minimum patch size targets of 4-ha. It is anticipated that this forest will be located on a hill on the park, but will not likely provide isolate wildlife refuge areas.

Meadow
Three extensive upland meadow habitat patches are proposed for this Alternative LWC Project Configuration, covering an area of 17-ha. These meadow habitats consist of native hardy grasses, herbaceous plants, and woody shrubs, and provide an important transition between the harsh open coast conditions and more sheltered conditions of the forest and adjacent landscapes at Marie Curtis Park and the OPG Lakeview site. The smallest patch is proposed for the area adjacent to the eastern OPG pier, with a large central patch connecting the two coastal wetlands, and the third, and largest, patch connecting Marie Curtis Park with the outlet to the Applewood Creek outlet. Public input in the development of Alternative LWC Project Configurations clearly identified a desire to retain sight lines from the OPG Lakeview site out onto the lake along the eastern OPG pier, as such meadow habitat rather than forest was proposed for the southernmost meadow area.

4.1.3 Alternative Footprint 3: Island-Beach A

Open Coast Habitat
Island-Beach A proposes the use of two connected revetment armourstone promontories, and two low-lying offshore armourstone islands to protect a contiguous cobble beach approximately 847-m long. The two large promontories are located on either end of the continuous beach: one in the north and one in the south. These promontories will consist of revetments and will site at least 4-m above average lake level. The form and placement of the revetments will be the same as described in **Section 4.1.1**. The southern promontory transitions into a long embayed revetment which ties into the eastern OPG pier. In total, approximately 847-m of beach, 402-m of lee island shoreline, and 1,656-m of revetment are created.

The islands are approximately 150-m long, and range between 50-m and 75-m offshore. The islands will consist of an armourstone revetment, possibly with a construction rubble core to minimize costs. The islands will be low-lying and regularly overtopped during the winter storms to prevent soil and treed vegetation from establishing on the islands. The islands will provide some isolated wildlife refuge areas and seasonal loafing habitat for some birds, but will not provide suitable nesting habitat for species such as cormorants. Approximately half the beach will be sheltered in the lee of the islands.

The long contiguous cobble beaches will consist primarily of large stones. Use of smaller cobble is possible (50-mm), which would reduce the beach slopes but require more material being purchased. The use of mobile cobble beaches provides excellent near shore habitat for young feeder fish along the shoreline, while the sloped cobble beach from provides easier access (compared to Revetment) for wildlife to migrate from the water's edge to the shore and back. This Alternative LWC Project Configuration provides a 28% increase in the amount of beach

versus hardened shoreline habitat (over existing conditions), and results in a 2% overall increase in total beach habitat over existing conditions.

Overall, the proposed shoreline provides moderately sheltered and diverse shoreline habitats and provides a more irregular shoreline than both the Revetment and Headland Beach Alternative LWC Project Configurations (2.3 times more irregular than a straight linear shoreline) as a result of the significant increase in shoreline conditions created by the beach, promontories and islands (e.g., the lee island shoreline provides increased diversity). This Alternative LWC Project Configuration extends approximately 200-m along the western end of the sand beach at Marie Curtis Park.

In total, approximately 34.2-ha of open habitat is lost or changed, requiring 6.7-ha of habitat compensation (or 5.1-ha of fill per 1-ha of compensation).

Wetland Habitat

Two main coastal wetland complexes are proposed, with a combined area of approximately 7.8-ha. The southern-most wetland is at the base of the Serson Creek stormwater channel, while the northernmost wetland connects with Applewood Creek and the perched culvert under the WWTF. For Serson Creek, the wetland outlets directly through the revetment and into the lake. The Serson Creek wetland will take the form of a river-levee system meandering through a flooded-delta wetland. For the Applewood Creek, the wetland will outlet through one of the cobble beaches and likely take on the form of a drowned-river mouth wetland. For Applewood Creek, it is anticipated that movement of the cobble beach material will periodically block the outlet, forming a barrier beach. As water levels increase upstream and during flood events, the river will reopen the channel by moving beach materials from the outlet.

A suite of wetland types are likely to be associated with these wetland complexes, including submergent and emergent marsh, and some component wet meadow and levee habitats. The Serson Creek wetland was orientated such that, if in the future, Serson Creek is diverted through the middle of the OPG Lakeview site as part of the Inspiration Lakeview, the wetland would be able to accommodate flows from the new creek alignment with minimal disturbance.

Treed Swamp

Two narrow, linear habitat patches of treed swamp are proposed and cover 2-ha. This treed swamp is located along the existing shoreline between the two coastal wetlands, and between the Applewood coastal wetland the existing outlet of Applewood Creek. The swamps will likely be ephemeral in nature, and will be low-lying, situated around the high lake level elevations. For the southernmost treed swamp, water will likely be sourced primarily from run-off from the adjacent forested hill to the south. The treed swamp to the north will likely represent a transition from submergent marsh to emergent marsh to treed swamp along the base of the north valley wall. The treed swamps will provide a multitude of functions: providing an isolated corridor for wildlife, such as amphibians and reptiles, to migrate between the Serson and Applewood Creek wetlands; to increase the wetland and forest habitat diversity in the park; and to act as a further deterrent for public access to the WWTF.

Forest Habitat

A single contiguous section of upland forest is proposed located to the south of the WWTF ash lagoons, between the two main coastal wetland complexes. This forest will be generally based on the endemic Carolinian forest species and will initially be dominated by species such as

Cottonwood and Oak. The forest has been situated to maximize forest cover connections between the wetlands, to allow views from the OPG Lakeview site out over the water, and to help block sight lines to the WWTF from the new park. The forest covers approximately 6.7-ha, which exceeds the minimum patch size target of 4-ha. It is anticipated that this forest will be located on a hill on the park.

Meadow

Three extensive upland meadow habitat patches are proposed for this Alternative LWC Project Configuration, covering an area of 18.2-ha. These meadow habitats consist of native hardy grasses, herbaceous plants, and woody shrubs, and provide an important transition between the harsh open coast conditions and more sheltered conditions of the forest and adjacent landscapes at Marie Curtis Park and the OPG Lakeview site. The smallest patch is proposed for the area adjacent to the eastern OPG pier, with a large central patch connecting the two coastal wetlands, and another larger patch connecting Marie Curtis Park with the outlet to Applewood Creek. Public input in the development of Alternative LWC Project Configurations clearly identified a desire to retain sight lines from the OPG Lakeview site out onto the lake along the eastern pier, as such, meadow habitat rather than forest was proposed for the southernmost meadow area.

4.1.4 Alternative Footprint 4: Island-Beach B

Open Coast Habitat

Island-Beach B proposes the use of a large connected revetment armourstone promontory and a long armourstone peninsula forming a sheltered embayment, combined with one low-lying offshore armourstone island to protect a continuous cobble beach 935-m long. The large promontory will be at the southern end of the proposed beach and will consist of revetments at least 4-m above average lake levels. The southern promontory transitions into a long embayed revetment which ties into the eastern OPG pier. The northern end of the constructed beach will be protected by the large peninsula made of revetments that will also be approximately 4-m above average lake levels. The form and placement of the revetments will be the same as described in **Section 4.1.1**. Overall, 935-m of beach, 518-m of lee island shoreline, and 1,724-m of revetment are created. Well sheltered and diverse shoreline habitats are provided.

The island is approximately 150-m long and ranges between 50-m and 75-m offshore. The island will consist of an armourstone revetment, possibly with a construction rubble core to minimize costs. The island will be low-lying and regularly overtopped during the winter storms to prevent soil and treed vegetation from establishing on the island. The island will provide some isolated wildlife refuge areas, increased shoreline diversity, and seasonal loafing habitat for some birds, but will not provide suitable nesting habitat for species such as cormorants. More than half of the beach will be sheltered in the lee of the island and peninsula.

The embayment would be between 3-m and 5-m deep, and would likely over time, establish extensive areas of submergent vegetation, similar to those found at Ashbridge's Bay and Colonel Sam Smith Park. Applewood Creek would outlet directly into the embayment area to increase flows and circulation in the embayment.

The long contiguous cobble beach will consist primarily of large stones, approximately 200-mm in diameter. Use of smaller cobble is possible (50-mm), which would reduce the beach slopes but require more material being purchased. The use of mobile cobble beaches provides

excellent near shore habitat for young feeder fish along the shoreline, while the sloped cobble beach from provides easier access (compared to Revetment) for wildlife to migrate from the water's edge to the shore and back. This Alternative LWC Project Configuration provides a 29% increase in the amount of beach versus hardened shoreline habitat (over existing conditions), and results in an overall 3% increase in total beach habitat over existing conditions.

Overall, the proposed shoreline is more irregular than both the Revetment and Headland Beach Alternative LWC Project Configurations, and a similar amount of irregularity as Island-Beach A (2.4 times more irregular than a straight linear line) as a result of the significant increase in shoreline conditions created by the beach, promontory, peninsula and islands. This Alternative LWC Project Configuration extends approximately 200-m along the western end of the sand beach at Marie Curtis Park.

In total, approximately 34.8-ha of open habitat is lost or changed, requiring 2.3-ha of like habitat to compensate for the land creation activity (or 15.1-ha of land creation for 1-ha of habitat compensation).

Wetland Habitat

Two main coastal wetland complexes are proposed, with a combined area of approximately 7.7-ha. The southern-most wetland is at the base of the Serson Creek stormwater channel, while the northernmost wetland connects with Applewood Creek and the perched culvert under the WWTF. For Serson Creek, the wetland outlets directly through the revetment and into the lake. The Serson Creek wetland will take the form of a river-levee system meandering through a flooded-delta wetland. For the Applewood Creek, the wetland will outlet through one of the cobble beaches and likely take on the form of a drowned-river mouth wetland. Given that Applewood Creek discharges into the embayment, it is anticipated that movement of the cobble beach material will not be as significant, and as such, the wetland would be less prone to being influenced by a barrier beach than would occur on the open beach front.

A suite of wetland types are likely to be associated with these wetland complexes, including submergent and emergent marsh, and some component wet meadow and levee habitats. The Serson Creek wetland was orientated such that, if in the future, Serson Creek is diverted through the middle of the OPG Lakeview site as part of the Inspiration Lakeview, the wetland would be able to accommodate flows from the new creek alignment with minimal disturbance.

Treed Swamp

Two narrow, linear habitat patches of treed swamp are proposed, covering an area of 2-ha. This treed swamp is located along the existing shoreline between the two coastal wetlands, and between the Applewood coastal wetland the existing outlet of Applewood Creek. The swamps will likely be ephemeral in nature, and will be low-lying, situated around the high lake level elevations. For the southernmost treed swamp, water will likely be sourced primarily from run-off from the adjacent forested hill to the south. The treed swamp to the north will likely represent a transition from submergent marsh to emergent marsh to treed swamp along the base of the north valley wall. The treed swamps will provide a multitude of functions: providing an isolated corridor for wildlife, such as amphibians and reptiles, to migrate between the Serson and Applewood Creek wetlands; to increase the wetland and forest habitat diversity in the park; and to act as a further deterrent for public access to the WWTF.

Forest Habitat

A single contiguous section of upland forest is proposed, located to the south of the WWTF ash lagoons, and between the two main coastal wetland complexes. This forest will be generally based on the endemic Carolinian forest species and will initially be dominated by such species as Cottonwood and Oak. The forest has been situated to maximize forest cover connections between the wetlands, to allow views from the OPG Lakeview site out over the water, and to help block sight lines to the WWTF from the new park. The forest covers approximately 7.2-ha, which exceeds minimum patch size target of 4-ha. It is anticipated that this forest will be located on a hill on the park.

Meadow

Three extensive upland meadow habitat patches are proposed for this Alternative LWC Project Configuration, covering an area of 18.5-ha. These meadow habitats consist of native hardy grasses, herbaceous plants, and woody shrubs, and provide an important transition between the harsh open coast conditions and more sheltered conditions of the forest and adjacent landscapes at Marie Curtis Park and the OPG Lakeview site. The smallest patch is proposed for the area adjacent to the eastern OPG pier, with a large central patch connecting the two coastal wetlands, and the largest patch connecting Marie Curtis Park with the outlet to Applewood Creek. Public input in the development of Alternative LWC Project Configurations clearly identified a desire to retain sight lines from the OPG lakeview site out onto the lake along the eastern OPG pier, as such meadow habitat rather than forest was proposed for the southernmost meadow area.

4.1.5 Alternative Footprint 5: Island-Beach C

Open Coast Habitat

Island-Beach C proposes the use of a large connected revetment armourstone promontory at the southern end of the constructed beach, combined with three low-lying offshore armourstone islands to protect a contiguous cobble beach approximately 1,307-m long. This cobble beach will transition to sand towards the mouth of Etobicoke Creek. The large promontory will be at the southern end of the proposed beach, and will consist of revetments at least 4-m above average lake levels and will transition into a long embayed revetment which ties into the eastern OPG pier. The form and placement of the revetments will be the same as described in **Section 4.1.1**. The northern end of this Alternative LWC Project Configuration does not require a large revetment promontory or peninsula, as it is designed to taper into the existing sand beach at Marie Curtis Park West. Overall, 1,307-m of beach, 515-m of lee island shoreline, and 1,413-m of revetment are created.

The islands are approximately 150-m long and range between 50-m and 75-m offshore. The islands will consist of an armourstone revetment, possibly with a construction rubble core to minimize costs. The islands will be low-lying and regularly overtopped during the winter storms to prevent soil and treed vegetation from establishing on the island. The islands will provide the most isolated wildlife refuge areas, increased shoreline diversity, seasonal loafing habitat for some birds, but will not provide suitable nesting habitat for species such as cormorants. About 40% of the proposed beach will be sheltered in the lee of the islands. Overall, there is moderately sheltered and diverse shoreline habitat.

The long contiguous cobble beach will consist primarily of large stones, approximately 200-mm in diameter. Use of smaller cobbles is possible (50-mm), which would reduce the beach slopes but require more material being purchased. The use of mobile cobble beaches provides excellent near shore habitat for young feeder fish along the shoreline, while the slope cobble beach from provides easier access (compared to Revetment) for wildlife to migrate from the water's edge to the shore and back. This Alternative LWC Project Configuration provides a 40% increase in the amount of beach versus hardened shoreline habitat (over existing conditions), and results in an overall 5% increase in total beach habitat over existing conditions.

Overall, the proposed shoreline is more irregular than both the Revetment and Headland Beach Alternative LWC Project Configurations, and a similar amount of irregularity as Island-Beach A and Island-Beach B (2.1 times more irregular than a straight linear line), as a result of the significant increase in shoreline conditions created by the beach, promontory and islands. Island-Beach C extends over most of the sand beach at Marie Curtis Park West. The beach from the northern-most island will consist of the smaller cobbles before transitioning to gravel and sand moving west towards Marie Curtis Park West.

In total, approximately 34.7-ha of open habitat is lost or changed, requiring 3.4-ha of compensation (or 10.2-ha of land creation for 1-ha of habitat compensation).

Wetland Habitat

Two main coastal wetland complexes are contemplated with a combined area of approximately 7.8-ha. The southern-most wetland is at the base of the Serson Creek stormwater channel, while the northernmost wetland connects with Applewood Creek and the perched culvert under the WWTF. For Serson Creek, the wetland outlets directly through the revetment into the lake. The Serson Creek wetland will take the form of a river-levee system meandering through a flooded-delta wetland. For Applewood Creek, the wetland will outlet through one of the cobble beaches and likely take on the form of a drowned-river mouth wetland. For Applewood Creek, it is anticipated that movement of the cobble beach material will periodically block the outlet, forming a barrier beach. As water levels increase upstream and during flood events, the river will reopen the channel by moving beach materials from the outlet.

A suite of wetland types are likely to be associated with these wetland complexes, including submergent and emergent marsh, and some component wet meadow and levee habitats. The Serson Creek wetland was orientated such that, if in the future, Serson Creek is diverted through the middle of the OPG Lakeview site as part of the Inspiration Lakeview, the wetland would be able to accommodate flows from the new creek alignment with minimal disturbance.

Treed Swamp

Two narrow, linear habitat patches of treed swamp are proposed, covering and area of 2-ha. This treed swamp is located along the existing shoreline between the two coastal wetlands, and between the Applewood coastal wetland and the existing outlet of Applewood Creek. The swamps will likely be ephemeral in nature, and will be low-lying, situated around the high lake level elevations. For the southernmost treed swamp, water will likely be sourced primarily from run-off from the adjacent forested hill to the south. The treed swamp to the north will likely represent a transition from submergent marsh to emergent marsh to treed swamp along the base of the north valley wall. The treed swamps will provide a multitude of functions: providing an isolated corridor for wildlife, such as amphibians and reptiles, to migrate between the Serson and Applewood Creek wetlands; to increase the wetland and forest habitat diversity in the park; and to act as a further deterrent for public access to the WWTF.

Forest Habitat

A single contiguous section of upland forest is proposed located to the south of the WWTF ash lagoons, between the two main coastal wetland complexes. This forest will be generally based on the endemic Carolinian forest species and will initially be dominated by species such as Cottonwood and Oak. The forest has been situated to maximize forest cover connections between the wetlands, to allow views from the OPG Lakeview site out over the water, and to help block sight lines to the WWTF from the park. The forest covers approximately 6.7-ha, which exceeds the minimum patch size target of 4-ha. It is anticipated that this forest will be located on a hill on the park.

Meadow

Three extensive upland meadow habitat patches are proposed for this Alternative LWC Project Configuration, covering an area of 18.2-ha. These meadow habitats consist of native hardy grasses, herbaceous plants, and woody shrubs, and provide an important transition between the harsh open coast conditions and more sheltered conditions of the forest and adjacent landscapes at Marie Curtis Park and the OPG Lakeview site. The smallest patch is proposed for the area adjacent to the eastern OPG pier, with a large central patch connecting the two coastal wetlands, and the largest patch connecting Marie Curtis Park with the outlet to Applewood Creek. Public input in the development of Alternative LWC Project Configurations clearly identified a desire to retain sight lines from the OPG Lakeview site out onto the lake along the eastern pier, as such meadow habitat rather than forest was proposed for the southernmost meadow area.

4.2 EVALUATION CRITERIA

The comparative evaluation of Alternative LWC Project Configurations was based on specific criteria which measured the potential impacts (both positive and negative) of the Alternative LWC Project Configurations on the terrestrial and aquatic habitats. Criteria and indicators were developed to measure how effectively each Alternative LWC Project Configuration met the naturalization objective. Qualitative, and whenever possible quantitative, evaluations were undertaken for each indicator.

The indicators were organized by functional habitat criteria and levels of ecological function (landscape and community). A significant number of criteria and indicators were originally developed; however, if those criteria and indicators were not deemed effective in identifying differences between Alternative LWC Project Configurations, those criteria and indicators were ultimately dropped from the evaluation.

The final criteria and indicators are:

1. Change in shoreline Character
    a. Change in diversity of shoreline types;
    b. Irregularity of shoreline to provide nearshore forage fish habitat; and
    c. Ease of access to water for wildlife.
2. Ability to create functional habitat blocks
    a. Ability to meet minimum habitat area guidelines; 7-8-ha of wetland; 4-ha of forest; and 10-ha of meadow; and
    b. Qualitative assessment of habitat created.
3. Ability of alternative to be self-compensating with respect to fish habitat
    a. Area of aquatic habitat lost or change (in-ha);
    b. HAAT model estimates of area requiring compensation lost (in-ha); and

c. Area of aquatic habitat lost compared to HAAT model estimate of area requiring compensation.

The criteria and indicators are discussed in greater detail in the following sections. A description of the measures used in the effects assessment is also provided.

4.2.1 Criteria: Change in Shoreline Character

4.2.1.1 Indicator: Change in Diversity of Shoreline Types

The indicator focuses on the "change in the diversity of shoreline types", whether created or lost. Specifically, "change in diversity of shoreline types" measures the amount of beach created or lost, the amount of revetment created or lost, and the amount of change in both beach and revetment compared to the existing shoreline (**Table 15)**.

There is a desire for greater shoreline diversity, and Alternative LWC Project Configurations that result in greater shoreline diversity are ranked higher. Beaches are preferred to revetments along the shoreline due to their function as both terrestrial and aquatic habitat, and their function in providing access to wildlife between terrestrial and aquatic habitat (see descriptions of *measures* below). Generally speaking, beach habitat provides a greater functional transition area between the lake and land, as opposed to revetments. Cobble beaches have been identified as ecologically important for the maintenance of biodiversity in the Great Lakes, yet are considered globally rare (United States Environmental Protection Agency *et al.* 2009).

Beach habitat (cobble and sand) is the centre of productivity and biodiversity for pelagic forage fish species, as the open coast shoreline along beach habitat provides excellent habitat conditions for foraging and spawning. As prey for the top predators, such as pelagic salmonids, these pelagic forage fish species provide an excellent foundation for a healthier and broader fisheries community. As such, is consistent with the overall Lake Ontario Fisheries Management Plan objective of "Increase prey-fish diversity by maintaining and restoring the prey-fish community" (Great Lakes Fishery Commission 2012) as the replacement of armourstone (or hardened shorelines) increases the convolution of the shoreline and overall habitat diversity. Monitoring by TRCA at sites such as Port Union has shown as much as 600x higher Catch Per Unit Effort at newly created cobble beaches, as compared to revetments (TRCA 2012).

With regards to terrestrial wildlife, the longer the natural shoreline available for wildlife to move between land and water, the higher the function of the shoreline. The measure "length of new beach (m)," is a surrogate measure for aquatic habitat productivity and ability for terrestrial wildlife to move between land and water. Alternative LWC Project Configurations that provide greater lengths of new beach are ranked higher. It should be noted that the loss of sand beach is measured through the indicator: "Area of aquatic habitat lost (ha)."

The various identified measures identified have been used to not only document how the shoreline would be changed in comparison to the existing conditions, but also as a relative change between each of the Alternative LWC Project Configurations. Even though each assumes a standard of 2M cubic metres of fill, the different shoreline types proposed require different overall footprints in order to accommodate the varying shoreline conditions. Measuring the absolute and relative differences in shoreline change allows us to compare each of the Alternative LWC Project Configurations directly.

Table 15: **Change in Diversity of Shoreline Types**

Indicator	Measures	Description	Methodology
Change in diversity of shoreline types	Length of new beach	The "Length of new beach" is a direct measure used to compare how much new beach is created between the Alternative LWC Project Configurations, on the basis that more new beach is better than less new beach.	This measure was calculated using GIS to determine the length of new beach created for each Alternative LWC Project Configuration.
	% New beach length to new total shoreline length	The measure "% new beach length to new total shoreline length (m)" was used to take into consideration that the Alternative LWC Project Configurations occupy different shoreline lengths as a result of the different shoreline types proposed. This measure standardizes the relative amount of new beach created in relation to the overall length of shoreline that would be changed for each Alternative LWC Project Configuration. Alternative LWC Project Configurations that provided a higher percentage of new beach (cobble or sand) along the total shoreline length were ranked higher.	This measure was calculated using GIS to determine the % new beach length to new total shoreline length for each Alternative LWC Project Configuration.
	% Change in overall beach length	The measure "% change in overall beach length" recognizes that there are some existing sand beaches within the LWC Project Study Area. This measure quantifies the net change in one type of beach to another (from sand to cobble) and standardizes it in relation to the overall length of shoreline for each Alternative LWC Project Configuration.	This measure will be calculated using GIS to determine the % change in overall beach length for each Alternative LWC Project Configuration.
	Length of lee island shoreline	The lee side of created islands would be sheltered from much of the wave energy from Lake Ontario, and would provide habitat conducive to important feeder fish species such as Emerald Shiner, Lake Chub and Spottail Shiner. Monitoring of island habitat by TRCA at sites such as the Humber Bay Shores Waterfront Park, have shown the lee side of islands to be very productive habitats (TRCA Unpublished Data 2012). The "length of lee island shoreline (m)" is therefore a measure of aquatic habitat productivity which was used to capture the benefits of these higher quality unique habitats that the side of an island. Alternative LWC Project Configurations that provide more shoreline length associated with the lee side of an island were ranked higher.	This measure will be calculated using GIS to determine the length of lee island shoreline for each Alternative LWC Project Configuration.

Indicator	Measures	Description	Methodology
	Length of new revetment	Much of the natural shoreline has been lost to shoreline hardening within the LWC Project Study Area. Hardened shorelines (i.e., revetments) do not provide the productive fish habitat that beach and lee island habitats provide, as discussed above (United States Environmental Protection Agency & Environment Canada 2009). Monitoring by TRCA has shown significantly lower CPUE at revetments, when compared to natural or created beaches (TRCA Unpublished Data 2012). The length of new revetment is therefore a surrogate measure of aquatic habitat productivity. Although revetments lack the habitat and structural diversity required for a productive aquatic community, different lengths of revetments are required in each of the Alternative LWC Project Configurations in order to protect the natural features (i.e., cobble beaches, protected embayment) from the coastal processes. With regards to terrestrial wildlife, revetments also present a barrier to wildlife movement between land and water. This measure calculates the overall length of revetment required for the Alternative LWC Project Configurations. Alternative LWC Project Configurations with lower lengths of new revetment are ranked higher.	This measure will be calculated using GIS to determine the length of new revetment for each Alternative LWC Project Configuration.
	% new revetment to new total shoreline length	Similar to the relative amount of new beach created, the various Alternative LWC Project Configurations possess different lengths of shoreline. As such, the length of new revetment required for the Alternative LWC Project Configurations was standardized as a function of the total length of shoreline required so that more meaningful comparisons between the Alternative LWC Project Configurations could be made. This measure was “new revetment to new total shoreline length” in order to account for the differing shoreline lengths of each Alternative LWC Project Configuration.	This measure will be calculated using GIS to determine the length of new revetment to new total shoreline length for each Alternative Project Configuration.

4.2.1.2 Indicator: Irregularity of shoreline to provide nearshore forage fish habitat

Generally speaking, more irregular shorelines provide more available and functional nearshore fish habitat. By increasing the length of shoreline habitat within a standard amount of area, one will in effect, increase the opportunity for more shallow waters (littoral zone) to be present, which is important for fish spawning and feeding (Kent and Wong 1982). The Ontario Ministry of Natural Resources identifies a Shoreline Development Factor (S.D.F) in their '*Manual of Instructions - Aquatic Habitat Inventory Surveys (1987)*' as a way to describe the irregularity of a shoreline in relation to the overall area of a lake.

For the purposes of the LWC EA, attempts to measure the differences in shoreline irregularity between the various Alternative LWC Project Configurations in relation to the total area of Lake Ontario would effectively be inconsequential. Instead, a more direct measure of irregularity was established by calculating the ratio of the total amount of shoreline proposed by a particular Alternative LWC Project Configuration in relation to the straight line distance with which that shoreline could have been constructed from the southernmost to northernmost limit **Table 16**. This ratio is called the Shoreline Irregularity Factor.

Table 16: **Irregularity of Shoreline to Provide Nearshore Forage Fish Habitat**

Indicator	Measure	Description	Methodology
Irregularity of shoreline to provide nearshore forage fish habitat	Ratio between a straight shoreline and the length of created shoreline	Thus, Alternative LWC Project Configurations that are close to one (1) indicates that the shoreline is very regular and as such, are ranked lower than shoreline ratios that are larger. For example, a ratio of 2:1 indicates that an Alternative LWC Project Configuration has twice as much shoreline as would be possible under a straight shoreline configuration. Thus, the greater the ratio, the higher the shoreline irregularity, the higher ranked the Alternative LWC Project Configuration is.	This measure will be calculated using GIS to determine the irregularity of the shoreline for each Alternative LWC Project Configuration.

4.2.1.3 Indicator: Ease of access to water for wildlife

Some wildlife require easy and safe access to the water for different aspects of their lifecycle. Different shoreline treatments create or discourage easy access. This indicator focuses on how easy it is for herptiles and mammals to move between wetland habitat and Lake Ontario to terrestrial habitats. Providing a gentler sloped shoreline for wildlife allows easy access to and from the water, while retaining walls or revetments prevent important life process such as mating and spawning (New York State Department of Environmental Conservation, 2010) (**Table 17).**

Table 17: Ease if Access to Water for Wildlife

Indicator	Measure	Description	Methodology
Ease of access to water for wildlife	Presence / absence of a beach to determine whether wildlife would be able to access the water's edge	This indicator measures each Alternative LWC Project Configuration's ability to provide access between terrestrial and aquatic environments based on the presence or absence of beaches	This measure will be evaluated based on professional judgement (i.e., qualitative measurement) to determine the ease of access to water for wildlife for each Alternative LWC Project Configuration.

4.2.2 Criteria: Ability to Create Functional Habitat Blocks

4.2.2.1 Indicator: Ability to Meet Minimum Habitat Area Guidelines; 7-8-ha of Wetland; 4-ha of Forest; and 10-ha of Meadow

Minimum area habitat standards were established for the three broad habitat types: forest, meadow and wetland. These minimum habitat standards were established based on analysis of historical conditions and reference sites (for wetlands), and from criteria from the Peel-Caledon Significant Woodland and Significant Wildlife Habitat Study (Region of Peel 2008) (for meadows and forests). **Table 18** summarizes the minimum standard indicator and measure considered in the evaluation.

Table 18: Ability to Create Functional Habitat Blocks

Indicator	Measure	Description	Methodology
Ability to meet minimum habitat area guidelines; 7-8 ha of wetland; 4-ha of forest; and 10-ha of meadow.	Area of treed swamp & forest, wetland and meadow created.	Meeting the minimum habitat area guidelines will provide adequate functional habitat for broad ecological building block. The specific criteria include: 7-8-ha for wetlands, 4-ha for forests, and 10-ha for meadows. The area analysis for each habitat type was undertaken for the Alternative LWC Project Configurations.	This measure will be calculated using GIS to determine the habitat area created for each Alternative LWC Project Configuration.

4.2.2.2 Indicator: Qualitative Assessment of habitat created

Ecological function is related to the relative quality of new habitat created (**Table 19).** Considerations of habitat patch size, shape, and potential for disturbance by humans through trails and infrastructure were evaluated in the assessment of overall ecological function and ability to provide wildlife refuge areas.

Table 19: Qualitative Assessment of Habitat Created

Indicator	Measure	Description	Methodology
Qualitative assessment of habitat created	Includes consideration of habitat patch size, shape, potential for human disturbance through trails and infrastructure. Ability to provide refuge areas also considered.	Alternative LWC Project Configurations deemed to provide higher quality habitats are scored higher.	Professional judgment will be used to assess the relative differences in habitat functions and quality based on fundamental differences in the arrangement of habitat types for the Alternative LWC Project Configurations.

4.2.3 Criteria: Ability of Alternatives to be Self-Compensating with Respect to fish Habitat

4.2.3.1 Indicator: Area of Aquatic Habitat Lost or Changed (in hectares)

Land creation activities will create a loss of existing, albeit highly degraded, aquatic habitat. The principle of self-compensation means that any habitat lost should be replaced, preferably with higher quality habitat in the event that the habitat area created is not equal to the area lost. **Table 20** summarizes the area of aquatic habitat lost or changed (ha).

Table 20: **Area of Aquatic Habitat Lost or Changed (ha)**

Indicator	Measure	Description	Methodology
Area of aquatic habitat lost or changed (ha)	Area of aquatic habitat lost as determined by the total landform area.	The area of loss is a key consideration in the ability of the LWC Project to be self-compensating with respect to fish habitat.	The indicator “area of aquatic habitat lost or changed” measures the area of aquatic habitat lost based on the footprint of each Alternative LWC Project Configuration

4.2.3.2 Indicator: HAAT Model Estimates of Area Requiring Compensation Lost

The HAAT model is a practical fish habitat management tools for site assessment and ecosystem management. It is used to measure the ecological impacts of land creation activities greater than 200-m^2 on large inland bodies of water that have a long fetch. The application of the HAAT model is useful in determining the amount of area lost and which alternatives are better able to self-compensate by minimizes the net loss of habitat.

The HAAT model is a computer model that adds up segments of fish habitat and compares the pre-development and post-development conditions.

For the Lakeview Waterfront Connection EA, the HAAT model was utilized to determine the amount of area lost and which alternatives are better able to self-compensate by minimizes the net loss of habitat. It should be noted that HAAT model runs were undertaken at the coarse level of information available at this stage of the EA.

HAAT analysis was conducted on the five LWC alternative project configurations in order to provide a better understanding of the range of compensation requirements for the various scenarios. For the assessment, the following assumptions were made:

- The change in the four variables (area, depth, substrate, cover) would be compared to the Lake Ontario fish species habitat suitability index. At the request of DFO, the Toronto waterfront species list was used to determine the sensitivity of the proposed works with each species list.
- The six fish species groups (i.e., warmwater piscivores, warmwater non-piscivores, coolwater piscivore, coolwater non-piscivores, coldwater piscivores and coldwater non-piscivores) had equal weighting. At the request of DFO, a coldwater discount was used for comparative purposes as habitat elements proposed in the concept plan favoured warm and cool water fish species. For this exercise the following weighting scheme was applied for the coldwater discount, 0.1,0.1,0.2,0.2,0.2,0.2 coldP, coldNP, coolP, coolNP, warmP, warmNP.
- The fish species life stages (i.e., adult, spawning, young of the year) had equal weighting.
- Alternative LWC Project Configurations that contained features which caused sheltering effects from waves were scored as beneficial features to the nearshore fish community.

Alternative LWC Project Configurations that contained features which caused sheltering effects from waves were scored as beneficial features to the nearshore fish community. In addition, HAAT results were further refined using the Productive Capacity Index (PCI). PCI expresses the relative maximum productive capacity among ecosystem types (Minns *et al* Unpublished). In other words, habitat compensation requirements can be further refined to provide appropriate levels of habitat based on their productive capacity (i.e., impacts to lower productive habitat require commensurate levels of improvement).

The HAAT model output provides a measure of habitat compensation requirement with a weighted suitable area (m^2). This output is considered a surrogate measure of total productivity of the habitats affected at a development site (Minns *et al*. 2001). Since the scale of the proposed land creation area was large, the output is presented in hectares (ha). The indicator was refined to reflect the area of aquatic habitat lost compared to the HAAT model estimate of area requiring compensation. **Table 21** provides a summary of the development of the final indicator and measure. It should be noted that HAAT model runs were undertaken at the coarse level of information available at this stage of the EA. During the refinement of the Preferred Alternative, it is anticipated that discussions with DFO will occur to further mitigate the effects of loss of habitat to maximize opportunities for self-compensation. Thus, Alternative LWC Project Configurations with the most intrinsic ability to be self-compensating at this early stage of the EA, will allow for more capacity within the LWC Project to be self-compensating at later stages of the EA process.

At the time of the LWC EA, substantive changes at DFO regarding their federal habitat policy, as well as changes in their HAAT model were underway. In fact, the HAAT model was formally taken off-line in April 2013 to make way for DFO's new Habitat/Ecosystem Assessment Tool HEAT model), which is to come online in late-2013. The HEAT model is similar to the HAAT model, except that it is intended to consider multiple environmental stressors, including temperature, affecting changes to aquatic habitat in lakes and rivers.

Table 21: HAAT Model Estimates of Area Requiring Compensation Lost

Indicator	Measure
Area of aquatic Habitat Lost compared to HAAT Model estimate of area requiring compensation.	The measure of weighted suitable area (m2) was changed to a ratio of amount of fill that would occur for each alternative before 1 ha of habitat compensation is required.

4.2.3.3 Indicator: Area of Aquatic Habitat Lost Compared to HAAT Model Estimates of Area Requiring Compensation

The Alternative LWC Project Configurations possess very different in water footprint requirements given the differences in shoreline configuration. Recognizing the differences in footprints required, a simple comparison of the amount of habitat lost, or the amount of habitat requiring compensation, is difficult to assess between the Alternative LWC Project Configurations, unless the areas are standardized. Thus, a comparison of the number of hectares (ha) of fill required for each hectare (ha) of compensation was calculated by dividing the area of aquatic habitat lost by the amount of habitat compensation required, as defined through the HAAT model for each Alternative LWC Project Configuration. Alternative LWC Project Configurations that allowed for larger areas of water to be lost for each hectare (ha) of compensation that is required were scored higher. This standardized the relative ability of the Alternative LWC Project Configurations to be self-compensating.

Table 22: Area of Aquatic Habitat Lost Compared to HAAT Model Estimate of Area Requiring Compensation

Indicator	Measure
Area of aquatic Habitat Lost compared to HAAT Model estimate of area requiring compensation.	Indicator measures the amount of fill that would occur for each alternative before 1 ha of habitat compensation is required. This combines the total area loss indicator with the HAAT model results in order to standardize the total area requiring compensation.

4.2.4 Other Criteria and Indicators Considered

There were a number of other indicators considered for inclusion in the assessment of Alternative LWC Project Configurations (**Table 23**). These indicators were not included in the final assessment as there was not sufficient detail at this coarse level to differentiate between the Alternative LWC Project Configurations. These criteria and indicators may be considered as part of effects assessment for the refined Preferred Alternative.

Table 23: Additional Naturalization Indicators Considered

Criteria and Indicators	Measure
Regional natural heritage analysis	% cover
Amphibian habitat	Area of amphibian habitat including wet meadow, shorelines and wetlands
Wetland birds	Area open water in wetland
Ability for alternative to provide for reptile habitat	Area of reptile habitat including meadow, flat rocks and wetlands connected to sandy cobble beach
Ability for alternative to provide for migratory shorebird habitat	Area of functional stop over shoreline habitat
Ability for alternative to provide for migratory waterfowl habitat	Area of wetland and or sheltered embayments or protected habitat
Ability for alternative to provide migratory land bird habitat	Area of forest cover
Ability for alternative to provide resident breeding bird habitat	Area of core habitat
Ability for alternative to provide raptor habitat	Area of meadow habitat and proximity to forest
Small mammals	Area of natural habitat
Aquatic mammals	Area of wetland habitat and connection to watersheds and shoreline
Large mammals	Quality of connections to existing migration corridors
Bats	Area of forest adjacent to open water
Insects, Butterflies and Odonates	Area of meadow habitat adjacent to forests and wetlands

4.3 RESULTS OF EFFECTS ASSESSMENT

An overview of the effects assessment is discussed below.

4.3.1 Revetment

Revetment is scored as Least Preferred in terms of natural heritage components. The Revetment Alternative LWC Project Configurations results in a reduction in the total and relative amount of beach shoreline characteristics than currently exists, provides a more uniform regular shoreline with no habitat diversity (at only 1.3 times more irregular than a straight line). There is a complete loss of sand beach of 363-m, with no new beach offered in compensation. Revetment also provides for the least amount of forage fish habitat, as compared to the other Alternative LWC Project Configurations. The lack of beach shoreline prevents opportunities for wildlife to transition between terrestrial and aquatic habitats on the open coast. Despite having the smallest overall footprint for habitat loss due to land creation activities, Revetment requires the greatest amount of habitat compensation due to the worsening of the shoreline habitat conditions over existing conditions (i.e., was the least able to be self-compensating). While the revetment does provide more than the minimum habitat size guidelines for forest, wetland and meadow, there is limited opportunity to provide isolated habitat conditions for wildlife.

4.3.2 Headland-Beach

Headland-Beach was scored as Moderately Preferred in terms of natural heritage components. Overall, there is little change in shoreline diversity when compared to the existing shoreline conditions (i.e., although 449-m of beach habitat is created, a similar length of beach is lost). The shoreline is more irregular than Revetment (at 1.7 times more irregular than a straight line), and provides opportunities for wildlife to transition from terrestrial to aquatic habitats along the

proposed beaches. The Headland-Beach Alternative LWC Project Configuration does provide more area than the minimum habitat type guidelines, but offers limited opportunities for providing isolated habitats for wildlife. Headland-Beach provides lower availability of forage fish habitat compared to the Island-Beach Alternative LWC Project Configurations. This Alternative LWC Project Configuration has a moderate area of aquatic habitat lost, and is moderately able to compensate for that loss (for every 10.3-ha of land creation, it is calculated that 1-ha of compensation is required).

4.3.3 Island-Beach A

Island-Beach A was scored as Most Preferred in terms of the natural heritage components. Island-Beach A provides increased shoreline diversity, creates a total of 847-m of beach, 402-m of lee island shoreline, and 1,656-m of revetment. There is a 28% increase in the amount of beach versus hardened shoreline, and a 2% increase in beach overall. Island-Beach A provides one of the most amounts of forage fish habitat, as a result of the shoreline irregularity (which is 2.5 times longer than a straight shoreline). The extensive length of beach habitat provides opportunities for wildlife to transition between terrestrial and aquatic habitats. As with all the Alternative LWC Project Configurations, Island-Beach A exceeds the minimum habitat size guidelines and provides opportunities for some isolated wildlife habitat (primarily on the islands). While Island-Beach A has one of the largest areas of aquatic habitat lost, it was moderately able to self-compensate for that loss (i.e., for every 10.4-ha of land creation, 1-ha of compensation was deemed necessary).

4.3.4 Island-Beach B

Island-Beach B was scored as Most Preferred in terms of the natural heritage components. Island-Beach B provides increased shoreline diversity, and creates a total of 935-m of beach, 518-m of lee island shoreline, and 1,724 m of revetment. There is a 29% increase in the amount of beach versus hardened shoreline, and a 3% increase in beach overall. Island-Beach B provides the most amount of forage fish habitat, as a result the irregular shoreline, and was able to exceed the minimum habitat size guidelines. Island-Beach B was able to provide isolated wildlife habitat associated with the islands, and provides opportunities for wildlife to transition from terrestrial to aquatic habitats along the beaches. Although Island-Beach B has the greatest area of aquatic habitat lost, it is best able to compensate for that loss, primarily due to the habitat opportunities within the proposed embayment (for every 15.1-ha of land creation, 1-ha of habitat compensation is required).

4.3.5 Island-Beach C

Island-Beach C was also scored as Most Preferred in terms of the natural heritage components. Island-Beach C provides increased shoreline diversity, creates a total of 1,307-m of beach, 515-m of lee island shoreline, and 1,413-m of revetment. There is a 40% increase in the amount of beach versus hardened shoreline, and a 5% increase in beach overall. Island-Beach C provides the most amount of forage fish habitat as a result of the irregular shoreline, and exceeds the minimum habitat size guidelines for forest, wetland and meadow. Island-Beach C also provides opportunities for isolated wildlife habitat, located primarily on the islands. Island-Beach C does result in the second greatest area of aquatic habitat lost, but is moderately able to self-compensate for that loss (for every 10.2-ha of land creation, 1-ha of habitat compensation is required).

5.0 DETAILED ASSESSMENT OF THE REFINED PREFERRED ALTERNATIVE

5.1 OVERVIEW OF THE REFINED PREFERRED ALTERNATIVE

Approximately 33-ha of naturalized habitat will be created as part of the refined Preferred Alternative, including approximately 7.5-ha of wetland habitat; approximately 3.5-ha of treed swamp; 5-ha of upland forest; 14.5-ha of meadow; 1.5-ha of beach; and 1-ha of rocky island habitat. In all cases, maximum efforts will be made to use plant species that are phenotypically best suited to the Great Lakes/St. Lawrence Lowlands, including use of Carolinian species where appropriate, recognizing the fact that grassland habitats were historically limited to only a few locations in the City of Mississauga. Additional opportunities to create and improve aquatic habitat conditions within the LWC Project Study Area will be discussed for the nearshore and pelagic zones. It should be noted that none of the natural environment features will increase flooding conditions.

There are a number of key principles that have guided the design proposed for the naturalized component of the LWC Project and which will continue to influence the design following the EA. These principles are:

1. That the design of the naturalized habitat is based on similar shoreline sites along the north shore of Lake Ontario, as it relates to terrestrial habitats (e.g., transition from beach to meadow to upland forest) and coastal wetland habitats.

2. That the two proposed coastal wetlands will be sustained through differing degrees of riverine and lake inputs (based on the known cycle of Lake Ontario water level fluctuations). The hydraulic connections will primarily involve feeder channels between the river channel and the downstream end of the wetlands.

3. That the wetlands will be separated from the channel primarily by a river-levee system which forms the banks of the river channel. Water control structures such as stoplogs and metal grates can be placed at the mouth of the wetland feeder channels to manage water levels and exclude carp from these areas.

4. That the ecological diversity within the lake-connected wetlands will be established fundamentally by variations in constructed bathymetry and topography. Designing the wetlands to have diverse microtopography will provide for the development of diverse habitat communities.

5. That terrestrial microhabitat conditions change not only with varying proximity to the Lake Ontario shoreline, but also with variations in topography, slope and aspect.

As the design of the naturalized areas reflects only the vegetation communities, rather than the specific species that will be planted, there remains considerable flexibility with regards to the composition and arrangement of these areas. Nonetheless, the ultimate design will need to be consistent with the areas of naturalization proposed in the conceptual design.

5.1.1 Terrestrial Habitat

Approximately 23-ha of naturalized terrestrial habitat is proposed in the conceptual design. The habitats described below are at a coarse community level. Site level details and specific habitats will be determined at detailed design. These habitat types are recommended based on similar

shoreline sites along north shore of Lake Ontario. A detailed description of the habitat types are found below.

At detailed design other factors that will be considered include (but are not limited to):

- amount and type of soil and subsoil amendments;
- species specific habitat (i.e., hibernacula, bank swallow habitat, cavity nesting, turtle nesting, woody deadfall, *etc.*);
- planting for ecosystem succession;
- maintenance and invasive management; and
- fencing for habitat refuge areas where appropriate.

5.1.1.1 Forest Habitat

Approximately 5-ha of upland forest will be created as part of the LWC Project. The upland forest will be located adjacent to the treed swamp community forming a continuous large forest block adjacent to the meadow and wetland communities. Portions of the landform will be sloped to drain towards the treed swamp and will be located at elevations above the treed swamp and normal water levels of the wetlands and lake.

The community could include native Carolinian species which are appropriate for the site, such as oaks, hickories, Wood Anemone, Maple Leaf Viburnum and Witch Hazel. Pioneering softwood species such as cottonwoods, willows and poplars could also be included. The forest should be designed to provide a number of habitat functions including, but not limited to, habitat elements for mammals, herpetofauna, migratory bird and butterflies and breeding birds. Invasive species management, and successional vegetation community monitoring and maintenance will be required to achieve the desired ecological function.

5.1.1.2 Meadow Habitat

Approximately 14.5-ha of meadow habitat will be created, and will be located along the shoreline between the shoreline treatments (e.g., beach / revetment), forest, and wetlands. Some of this landform should be sloped to drain towards the wetlands and the rest towards the lake to provide an appropriate water to land transition.

The meadow will be designed to provide a number of habitat functions including, but not limited to, habitat elements for mammals, herpetofauna, migratory bird and butterflies and breeding birds. The community will consist largely of meadow species intermingled with nectar producing flowers, fruits and seeds. Species will be chosen that are consistent with CVC's approved planting lists however due to the unique location and climate along the lake, Carolinian species that would otherwise not be considered appropriate may be used. All vegetation to be installed will be approved by CVC and other applicable agencies. Some characteristic species could include, Heath Aster, New England Aster, Canada Golden Rod, Staghorn Sumac, St. Johns Wort, Virginia Wildrye, milkweeds and Black Eyed Susan. This habitat will serve as important migratory rest and launching habitat for birds and butterflies flying over the lake. The largely un-treed area would also serve as potential breeding and raptor prey habitat. Invasive species management, and successional vegetation community monitoring and maintenance will be required to achieve the desired ecological function. Periodic mowing may be required to maintain the meadow ecological function.

5.1.2 Aquatic Habitat

5.1.2.1 Treed Swamp

Approximately 3.5–ha of treed swamp will be created, located south of the WWTF, and connecting the upland forest and wetlands (see section 5.1.2.2 for a discussion of the wetland habitat). Vernal pool features will be seasonally wet, detaining water in the spring or after larger rain events, periodically receiving water from Lake Ontario during high lake levels during the spring and early summer, and possibly during larger flood events in Serson and Applewood Creeks. The landform will be sloped towards the treed swamp habitat in order to allow for overland drainage towards this feature. Runoff will be directed from the adjacent upland forest and meadow communities, and will drain to the wetlands. The treed swamp will be located at elevations above the normal wetland and lake levels (i.e., 75.4 metres above sea level (masl) to 75.8 masl), within an internally drained area.

The plant community could consist of softwood species such as cottonwoods, willows, silver maple and other shrub, tree and herbaceous species appropriate to seasonally wet habitat, such as Red Osier Dogwood, Flowering Dogwood, Boneset, Blue Vervain, and Spotted Jewel Weed.

The treed swamp will be designed to provide a number of habitat functions including, but not limited to, habitat elements for herpetofauna, migratory birds and butterflies, and breeding birds. The treed swamp will also act to connect the two primary wetlands for increased habitat and connectivity functions, and act as a visible barrier to the WWTF. Invasive species management, and successional vegetation community monitoring and maintenance will be required to achieve the desired ecological function.

5.1.2.2 Wetland Habitat

The primary function of the wetland complexes is to provide diverse aquatic habitat which supports a range of migratory and resident fish; waterfowl; herpetofauna; and aquatic mammals. A total of 7.5-ha of coastal wetland habitat will be created as part of the LWC Project, in the form of two river channels and wetland complexes located at the outlets of Serson Creek and Applewood Creek. The Serson Creek wetland complex will be approximately 2.5-ha in size, and the Applewood Creek wetland complex approximately 5.0-ha in size. While the total wetland habitat will total 7.5-ha, the final size and orientation of the Serson Creek and Applewood Creek wetland complexes may be further refined during detailed design.

The wetlands will be designed to mimic similar coastal wetlands found along the north shore of Lake Ontario. The Serson Creek wetland complex will act as a drowned-river mouth and flooded delta wetland (i.e., has direct surface-water connections, occupies flooded river valleys or cap drowned deltas, and is driven by both lake and riverine water inputs); while the Applewood Creek wetland complex will act as a drowned-river mouth and protected wetland (i.e., although direct surface-water connections are present through the river-levee system, the wetland is protected behind a cobble beach, shielding the wetland from the direct hydraulic processes generated by the lake). These new wetlands will also provide connectivity between habitats along the north western Lake Ontario shoreline and attract biota from neighbouring wetlands.

The Applewood Creek wetland complex will extend south from the outlet of Applewood Creek to the outlet of the Serson Creek baseflow channel, and then south to the lake. The Serson Creek wetland complex will be located at the outlet of the Serson Creek stormwater channel, and extend directly towards the lake.

5.1.2.3 River-Levee Systems

A river-levee system will be used to direct flows from both Applewood Creek and Serson Creek to Lake Ontario. It is anticipated that a constructed levee will form the banks of the meandering channel for Serson Creek within the middle of the Serson Creek wetland complex. The exact dimensions of the Creek are further defined in the Fluvial Geomorphology Technical Report prepared by Parish Geomorphic. For Applewood Creek, it is anticipated that only one channel bank will take the form of the constructed levee, with the other channel bank tied into the adjacent meadow landform feature. A large contiguous coastal wetland complex will be located to the south of the constructed levee for Applewood Creek. In both wetlands, small feeder channels (or sills) will be constructed through the levees at the downstream end of meanders to allow lake water to decant back into the wetland areas. During flood events in both creeks (greater than the 2 year event), flows from the creeks will overtop the constructed levees and enter directly into the wetlands, providing water, sediment and nutrients to the wetland systems. As water levels and the presence of carp (through their spawning and foraging behaviour) can greatly influence the establishment and long-term survival of wetland vegetation, water control structures (likely consisting of stoplogs and a metal grate) will be placed at the mouth of the wetland feeder channels to manage water levels and exclude adult carp from entering the wetlands. Spaces within the water control structures can be either opened (either partially or fully) or closed to control fish access into the wetlands (e.g., while larger carp may not fit through the spaces, smaller fish may). (**Figure 9**).

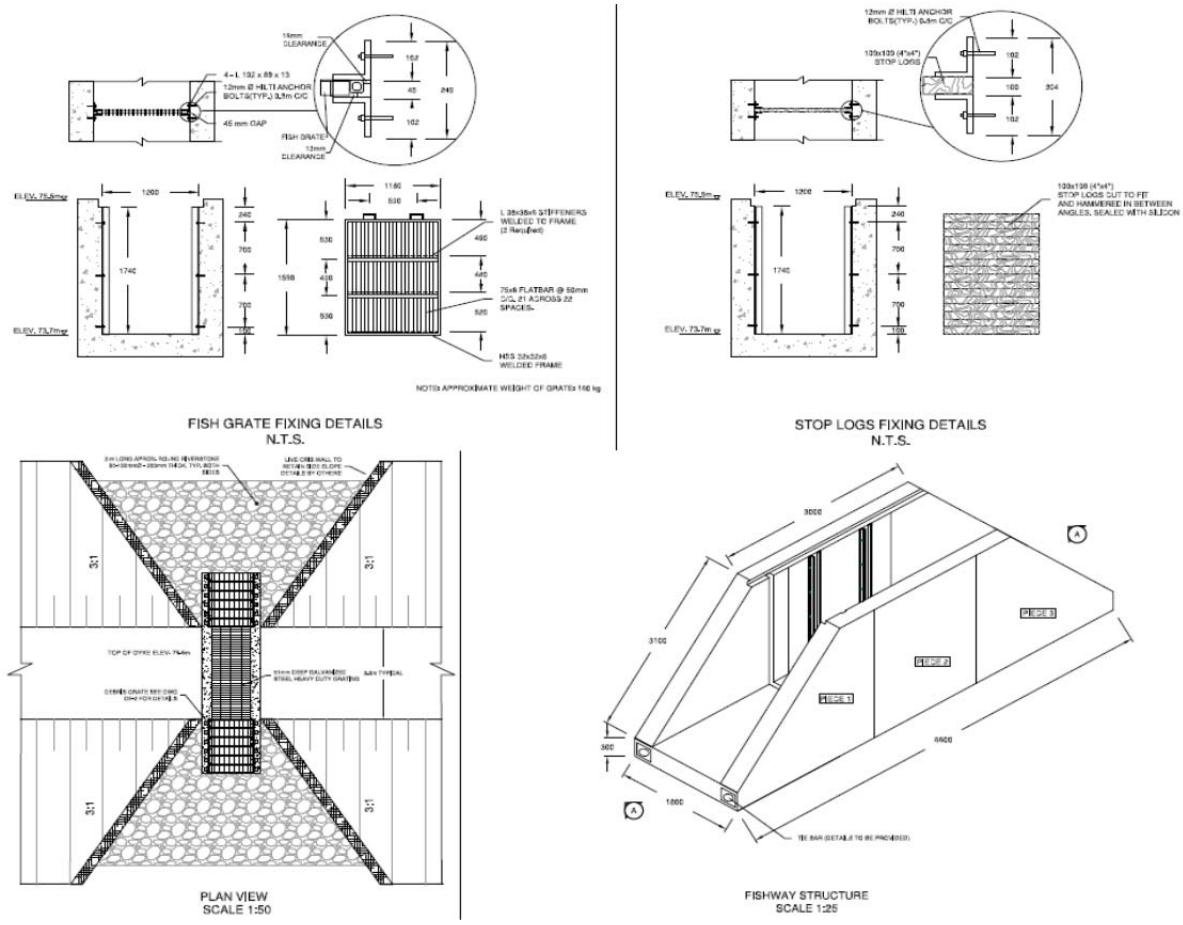

Figure 9: Example of Water and Carp Control Structure

The variation in topography provided by the levees along the creek channels will provide streambank habitat, supporting a diverse vegetation community, which includes riparian, emergent, and submergent vegetation (**Figure 10**). This streambank habitat increases the area of primary production and essential habitat for cool and cold water riverine species and nearshore pelagic fish species, while improving foraging opportunities for both aquatic and terrestrial species.

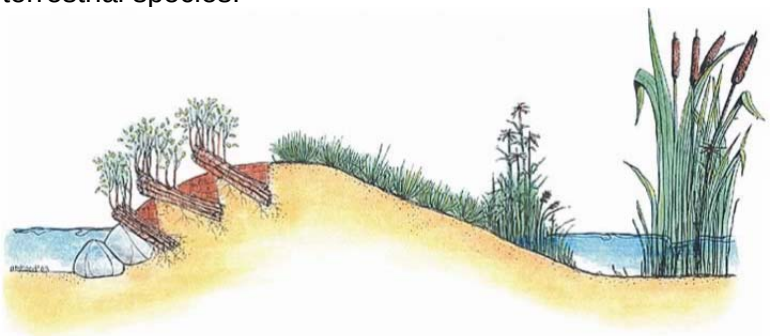

Figure 10: **Example of a Constructed Levee Separating the Creek Channel Conditions (on the left) from Coastal Wetland Conditions (on the right)**

The inclusion of estuary hooks (i.e., stone placed adjacent to the banks in a hook fashion) within the lower downstream portions of river-levee channels of both Applewood Creek and Serson Creek will provide for additional habitat conditions. The estuary hooks help deflect and concentrate flows, entrain bedload sediments, encourage establishment of emergent vegetation, and provide small eddy pools and backwater areas for resting and refuge. **Figure 11** shows a typical low profile estuary hook (i.e., remains underwater at all times), and high profile estuary hook (i.e., has material that is above base flow water levels). The capacity to which both the low profile and high profile estuary hooks will be used will be determined during detailed design.

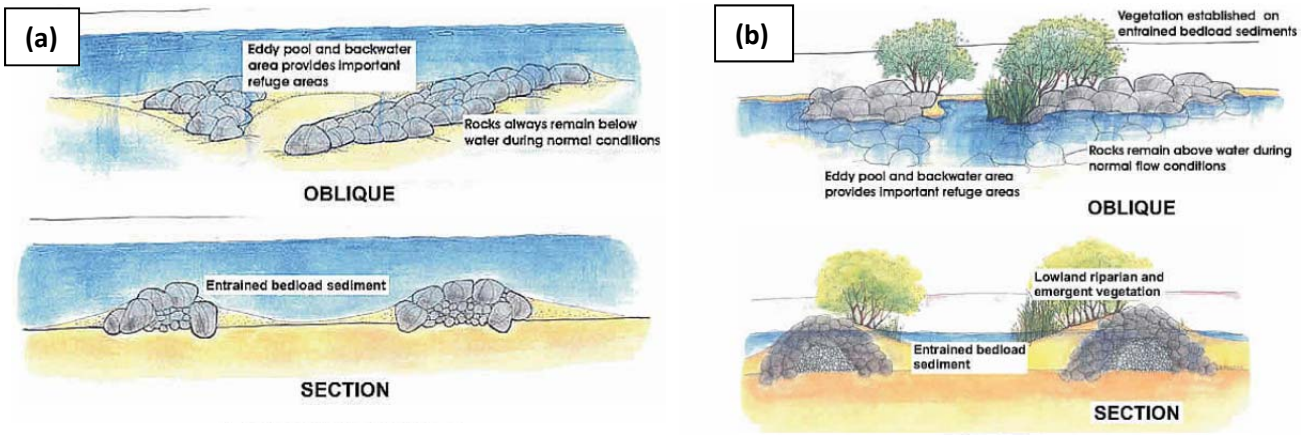

Figure 11: (a) Example of a Low Profile Estuary Hook. (b) Example of a High Profile Estuary Hook

In order to prevent debris blockages, and allow for levee overtopping into the wetlands during large flood events, the Serson Creek river-levee channel will outlet downstream of the wetland complex. As the river channel outlets directly to Lake Ontario, it will be designed to maintain a constant lake connection throughout the year. As such, the Serson Creek wetland complex will be primarily regulated by both riverine and lake inputs. The channel will also provide estuary

habitat (i.e., areas which represent a physical connection between the lake and riverine systems), providing stable thermal conditions, and habitat for species that require access to both open water and riverine systems throughout their lifecycles.

As with the Serson Creek outlet, Applewood Creek will outlet to Lake Ontario downstream of the wetland in order to avoid debris blockages, and allow levee overtopping. Unlike the Serson Creek river-levee channel, the Applewood Creek river-levee channel will outlet through a cobble beach to Lake Ontario. While the Applewood Creek wetland complex may be opened to the Lake following wave overtopping of the beach or breaches caused by large flood events upstream, it is expected that the wetland will be regulated primarily by inputs from Applewood Creek. It is also noted that watershed-wide restoration efforts to be undertaken as part of LOISS will help improve watershed inputs and flow regime and attract more fish upstream from these newly created refuge areas in the estuaries.

5.1.2.4 Wetland Depth and Vegetation

For the north shore of Lake Ontario, efficient primary production of coastal wetland plants occurs between 72.5 and 75.0 masl. However, the type of vegetation that occurs within this range of elevation can be further refined as follows: lowland riparian vegetation (such as grasses, sedges and shrubs) occurs between 75 and 75.8 masl; the emergent vegetation zone (such as cattails) is restricted to elevations between 74.5 and 75.0 masl; and submergent vegetation is found at depths greater than 74.25 masl. As such, the wetland complexes within the LWC Project will have diverse bathymetry and microtopography, in order to provide for the establishment of various habitat communities and provide sufficient diversity to allow the wetlands to adapt over a range of Lake Ontario water levels. **Table 24** provides a relative breakdown of the amount of wetland areas available at each depth range. The functional wetland depth for the Serson Creek and Applewood Creek wetland complexes will be finalized during detailed design to optimize the diversity of habitat created.

Table 24: Relative Breakdown of the Amount of Wetland Areas Available at Each Depth Range

Depth	Applewood Creek (% depth)	Serson Creek (% depth)	Description of Habitat
Less than 72.5 masl	~ 25%	~10%	Produces open water an submergent habitat
72.5 to 74.5 masl	~ 25%	~ 45%	Produces submergent and emergent habitat, depending on seasonal lake levels
Greater than 75.0 masl	~ 50%	~ 45%	Produces emergent and low land riparian habitat

The variation in wetland vegetation communities will provide a range of habitat features. Wide vegetation stands of lowland riparian and emergent vegetation around the edges of the Serson Creek and Applewood Creek wetland complexes will provide a buffer from upland terrestrial habitats, and provide opportunities for foraging, spawning, and nesting for waterfowl, herpetofauna, invertebrates, and aquatic mammals. Zones of submergent vegetation will be located near the feeder canals (in order to ensure these areas remain wet for longer periods), and will provide important habitat features for invertebrates, fish, and waterfowl, including shelter, feeding, and spawning.

Additional opportunities for enhancing the wetland habitat to be explored during detailed design are presented in the following section.

5.1.2.5 Wetland Habitat Opportunities

The Applewood Creek and Serson Creek wetland complexes are separated from the creek flow by the river-levee channel, described above. While water control structures can be installed and used to regulate inputs to the wetland; short-term water level fluctuations may occur as a result of local flooding events or low-lake levels. Water level fluctuation is an integral part of wetland ecosystems, affecting currents, wave action, turbidity, temperature, pH, and nutrients. Wetland plants and animals are generally adapted to these changes, and in many cases, depend on the water level fluctuations for certain functions (e.g., germination of seeds from sediments exposed by low water levels). During periods of low lake levels, mud flats and isolated pools may form in certain areas within the emergent zone, which will provide high quality habitat in the form of basking features for herptiles and secluded resting areas for shorebirds. The wetland shorelines will also be designed to be irregular in shape, with a variety of vegetation and substrate types to improve nearshore habitat (**Figure 12 and Figure 13**). Isolated deeper pools will be provided to add additional wetland diversity in order to maximize the wetlands ability to adapt for potentially lower lake levels due to climate change.

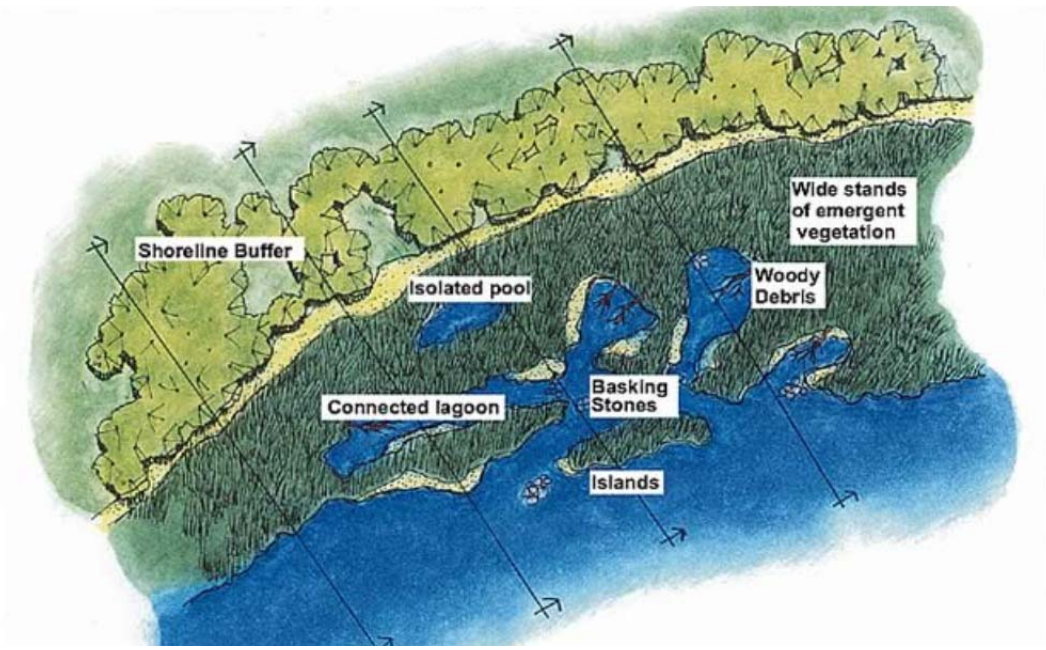

Figure 12: Sample Wetland Shoreline Transition Areas, Planform View

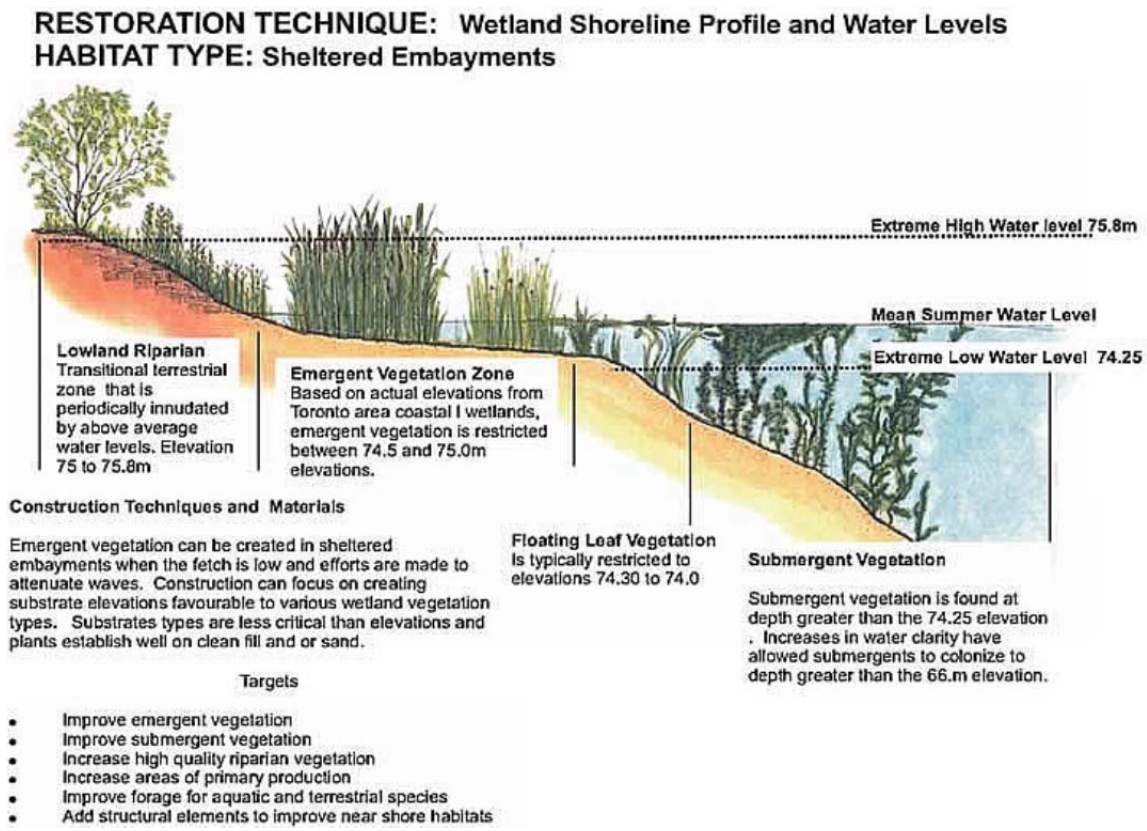

Figure 13: Sample Wetland Transition Area, Cross-sectional View

Additional opportunities to improve reptile and amphibian habitat within the wetland complexes include the use of south facing sand and gravel mounds, which will provide breeding habitat for turtle species; rock piles, which will provide snake hibernacula; logs and rocks, which will provide areas for basking; and deep organic muds, which will provide overwintering habitat for turtles (**Figure 14**). The use and location of such features will be determined during detailed design.

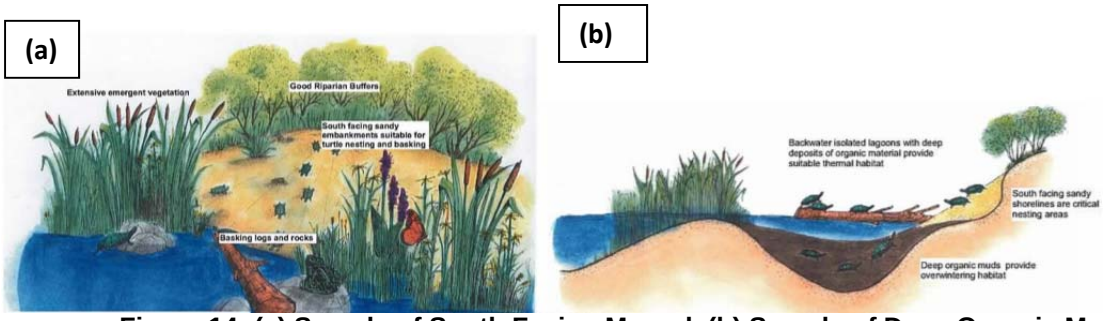

Figure 14: (a) Sample of South Facing Mound. (b) Sample of Deep Organic Muds

5.1.2.6 Shoreline and Nearshore Aquatic Habitat Opportunities

The refined Preferred Alternative results in the creation of 1,110-m of new beach (including 795-m of cobble beach with grain size of 15-cm; and 295-m of cobble/gravel beach with grain size from 1 to 5-cm with finer material dominating in the summer); 485-m of lee island shoreline; and 1,285-m of revetment. There is a 29% increase in the amount of beach versus hardened shoreline and a 3% increase in beach overall. Creation of cobble beaches will help maintain biodiversity in the Great Lakes since they are considered globally rare. (United States Environmental Protection Agency & Environment Canada 2009). Beaches are highly productive for pelagic forage fish that support and feed the economically important pelagic salmonids and top predators. The new open coast shoreline will provide excellent forage, spawning, and nursery habitat conditions, and the lee side islands habitat will provide sheltered habitat for Lake Ontario species. Important feeder fish species such as Emerald Shiner, Lake Chub and Spottail Shiner will be provided habitat. This will provide an excellent foundation for a healthier and broader fisheries community.

Increasing structural diversity of the nearshore habitat through the use of surcharged areas, underwater reefs, boulder piles, and point shoals, will improve the transitional habitat between the nearshore and pelagic areas; increase the area of primary production; improve foraging conditions for aquatic species; and increase essential habitats for cool and cold water fish species. Structural aquatic habitat features can be incorporated along the toe of the revetment in order to improve relative poor habitat conditions along the open coast, providing shelter and additional habitat elements for fish along the harsh open coast.

The islands provide sheltered habitat between the shoreline and the islands, providing refuge from coastal processes. Sediment accretion on the leeward side of the islands provides high quality cool and cold water fish habitat for spawning and foraging, which will be augmented through areas surcharged with point shoals and sand rock piles. The rocky islands themselves may also be surcharged with a diversity of substrates to create a crenulated shoreline, with changes in vertical relief, designed to attract and support a variety of cool and cold water species. **Figure 15** provides an example of how surcharge substrates have been applied to groyne systems along the open coast to improve habitat.

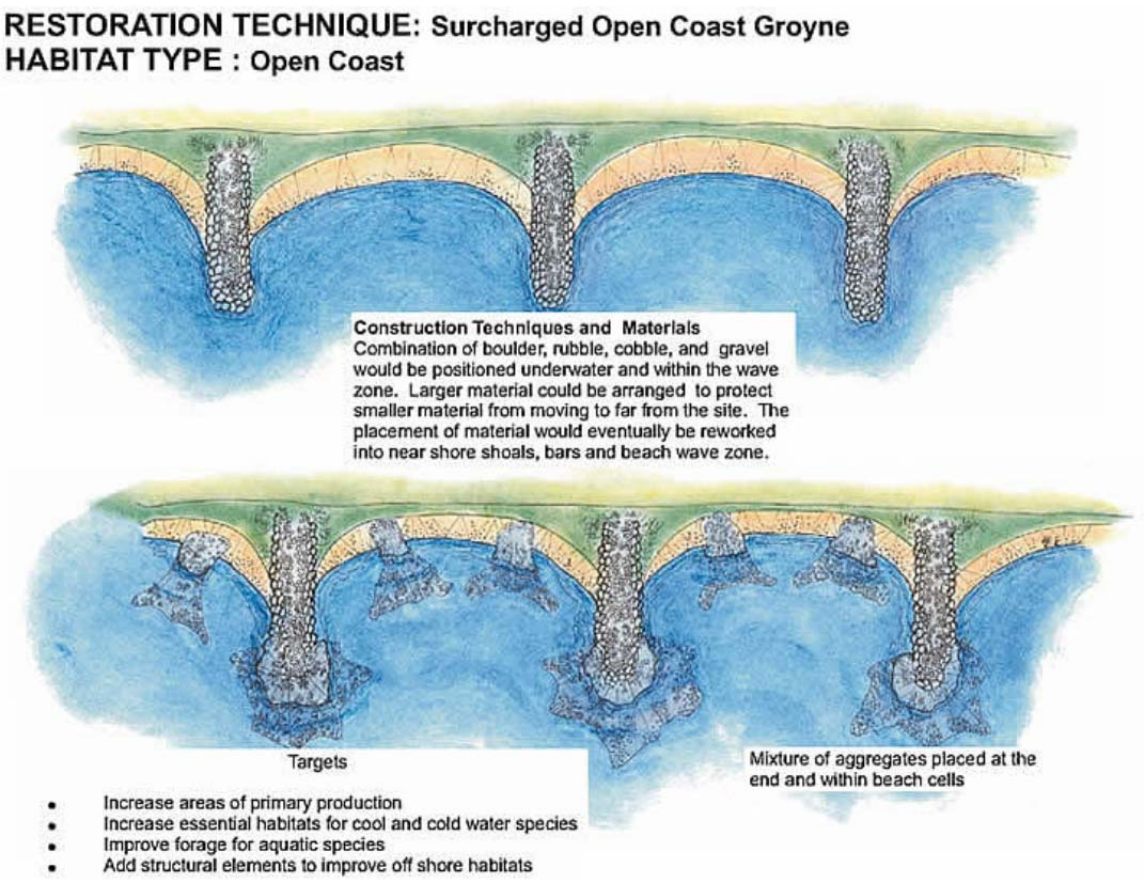

Figure 15: Example of Surcharged Substrates Placed Around Groynes to Improve Habitat Quality Along the Open Coast Area

5.1.2.7 Serson Creek Stormwater Channel Habitat Enhancement

At the upstream end of the stormwater channel, a flow diversion currently exists where low flows are directed through a small forest before being diverted into a culvert under the WWTF, and high flows (greater than bankfull) top the banks where they are diverted down the stormwater channel that borders OPG's Lakeview site and Region of Peel land. A minor tributary currently connects with Serson Creek downstream of the WWTF culvert. A plug will be used to either continue to direct flows from this tributary through the forest to the culvert under the WWTF; or divert flows alongside the western-edge of the forest to the Serson Creek overflow channel. The location of the plug, either upstream or downstream of the small tributary, will be explored during detailed design.

The current configuration of the Serson Creek stormwater channel consists of approximately 680-m of straightened stream length offering limited functional habitat for fish and wildlife. This channel accepts water during precipitation events and as a result may remain dry during certain periods of the year and thereby provides poor quality fish habitat. In addition, the channel is lined with boulder and rip-rap sized substrates which may result in a barrier to fish migration in low flow conditions. The refined Preferred Alternative seeks to incorporate baseflow into the overflow channel. With the addition of baseflow inputs, the capacity for functional habitat is expected to increase considerably.

The primary function of habitat enhancements within the stormwater channel is to facilitate the movement of fish and invertebrates by creating transitional habitat elements between the lower reach of Serson Creek and the newly created wetland complex. A primary component of this enhancement is the creation of riparian planting nodes as shown in **Figure 16**. These nodes will act to provide a forage base for fish and invertebrates as well as provide structural habitat for resting and refuge. In addition, riparian plantings aid in the stabilization of stream banks and mitigate soil erosion caused by flowing water. Supplementary streambed habitat may be provided through the select placement of boulders, rock and secured large woody material in areas that require structural augmentation to provide refuge and feeding areas for fish and invertebrates. It is of critical importance that the habitat features proposed above, do not impede the capacity of the channel to efficiently convey stormwater discharges to Lake Ontario.

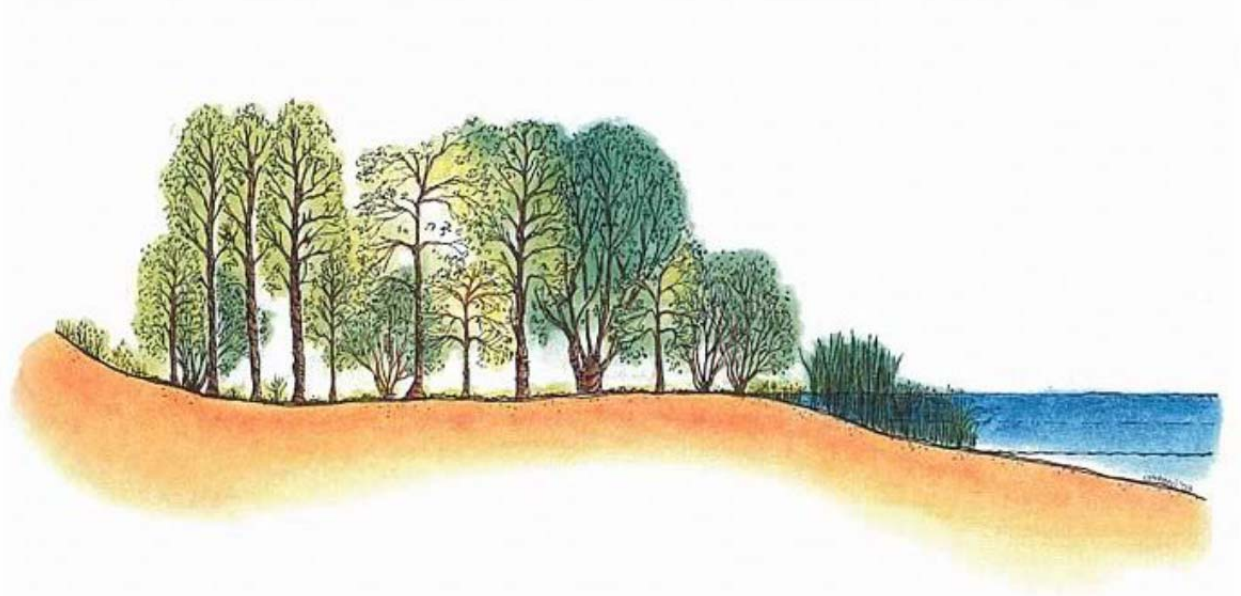

Figure 16: Example of Riparian Planting Node

5.2 EVALUATION CRITERIA & EFFECTS ASSESSMENT

Using the evaluation criteria developed in Section 4 as a basis, a set of indicators and their associated measures were defined for construction and establishment to structure, and where possible, quantify the effects of the construction and establishment of the LWC Project on the environment.

For each indicator, the effects to the existing conditions due to the LWC Project works and activities were evaluated. In some cases, no effects were predicted due to the application of mitigation or avoidance measures. Where net effects were predicted (i.e., effects remaining after mitigation is applied), they were classified as positive, negative, or negligible. Positive effects (e.g., improved habitat) are generally associated with establishment/post-establishment, and were quantified where possible. As described above, these are generally considered to be minimum design requirements that the LWC Project must achieve in detailed design and construction.

5.2.1 Criteria: Change in Shoreline Character

5.2.1.1 Indicator: Change in Diversity of Shoreline Types

Potential Effects during Construction
This criterion is not relevant to the construction phase.

Potential Effects during Establishment / Post-Establishment
The change in diversity of shoreline types refers to the difference, in metres (m), between the pre-construction and post-construction shoreline lengths by type (cobble beach, sand beach, and revetment). The pre-construction shoreline lengths by type were measured from geo-referenced aerial imagery using Arc GIS. Post construction shoreline lengths by type were measured from the LWC Project Grading Plan (2013).

Potential Effects at the LWC Project Study Area
Historically, the shoreline within the LWC Project Study Area was characterized by a thin layer of till covering a large shale bedrock outcrop. Gravel, cobbles and boulders within the till, combined with eroded shale bedrock, would have formed narrow beaches at the base of the eroding tills. Sand beaches are common close to the mouths of larger rivers, such as those found at Etobicoke Creek, but would grade to the larger materials as you increase distance from the river mouths. The western shoreline of the LWC Project Study Area has been changed extensively through stone-hooking and armouring.

The existing shoreline between the eastern OPG pier tie-off point and the mouth of Etobicoke Creek is approximately 1,765-m. This shoreline consists of:

- 1,325-m of revetment (including a mix of armourstone, construction rubble, and riprap); and
- 240-m of beach composed of 205-m of private beach (located south of the WWTF) and 235-m of public beach.

Following construction, the LWC Project will increase the overall shoreline length to approximately 2,880-m, over the same area, resulting in an overall positive effect on the diversity of shoreline types. The new shoreline will consist of:

- 1,285-m of revetment;
- 485-m of lee rocky island shoreline; and
- 1,110-m of public beach.

The 235-m of publically accessible sand beach located behind the proposed LWC Project footprint will be replaced with 1,110-m of new publically accessible beach, including:

- 795-m of cobble beach ranging in size from 10-cm to 20-cm (median size of 15-cm);
- 265-m of gravel/cobble beach ranging in size from 1-cm to 10-cm (median size of 5-cm); and
- 50-m of sandy/gravel beach ranging in size from 1-cm to 5-cm (with sand predominance in the summer and the smaller gravel-pebbles in the winter).

The majority of the western most sand beach located behind the land creation area (235-m of which is publically accessible), will remain in place as a sandy beach ridge area behind the land creation.

The beach ridge currently found on the west side of Applewood Creek is currently succeeding. This area will be further isolated from coastal processes once the LWC Project is established. The area will still experience periodic flooding from Applewood Creek; however the change in exposure may influence vegetation succession over time.

Currently, the east side of Applewood Creek is dominated by invasive species and these conditions could be improved upon establishment.

The provision of shallow sand and gravel substrates provide high quality habitat for nearshore cyprinids for spawning and feeding. The cobble beach cells which will be sheltered by island features will also provide excellent staging and nursery areas. The potential addition of surcharged points and shoals (to be considered during detailed design) could provide additional complexity to the shoreline on a local scale, by providing further shoreline irregularity, variations in substrate size, and added vertical complexity which is beneficial to aquatic organisms.

Finally, there is net decrease in revetment shoreline, which has been replaced by mostly cobble beach, which provides a net benefit to aquatic habitat.

Potential Effects at the LWC Regional Study Area
Given the length of the Regional Study Area shoreline, the effects of the increased diversity of the shoreline at the LWC Project Area will be substantially less at the Regional Study level. However, this increase in diversity at the local level will be an important first step at improving the overall shoreline composition within the Regional Study Area.

Mitigation Measures
As the net effects are positive, no mitigation measures are identified.

Net Effects
Overall, the net effects during Establishment are positive as there is an increase in diversity and length of substrate types, which provides an increase in high quality nearshore habitat.

5.2.1.2 Indicator: Quantitative Assessment of Shoreline Irregularity and the Ability to Provide Nearshore Habitat

Potential Effects during Construction
This criterion is not relevant to the construction phase.

Potential Effects during Establishment / Post-Establishment
Where shorelines are left unprotected, the combination of bedrock outcrops and glacial till would have created localized areas of more erosion resistant shoreline forming protruding headlands surrounded by less erosion resistant areas. In some instances, the less resistant area would recede to the point that they detach from the erosion resistant headlands, turning the headlands into islands. This shoreline dynamic greatly increases the shoreline length and irregularity. In contrast, armouring a shoreline simplifies and straightens (shortens) the shoreline, thereby inhibiting natural shoreline dynamic processes.

The shoreline irregularity factor describes the irregularity of a shoreline and the potential for the creation of additional nearshore habitat. The shoreline irregularity factor is a ratio which compares the post-construction and pre-construction shoreline lengths. A ratio greater than 1.0 indicates that the LWC Project provides more nearshore habitat than the existing conditions. The greater this ratio, the more irregular the shoreline and the greater the ecological value of the transition from water and land.

To calculate the ratio, pre-construction shoreline lengths were measured from geo-referenced aerial imagery using ArcGIS and post construction shoreline lengths were measured directly from the LWC Project Grading Plan (2013) using ArcGIS.

Potential Effect at the LWC Project Study Area
During the establishment phase, the new shoreline will provide a shoreline that is 1.6 times longer than the former shoreline over the same area. The refine Preferred Alternative increases shoreline irregularity and the ability to provide nearshore habitat. In addition, this shoreline simulates natural shoreline features such as headlands and islands, which will provide a sheltering effect for fish and wildlife, in an otherwise exposed, harsh shoreline environment.

Potential Effect at the LWC Regional Study Area
Given the length of shoreline within the LWC Regional Study Area shoreline, the effects will be substantially less at the Regional Study level. However, this increase in shoreline irregularity at the LWC Project Study Area level will be an important first step at improving the overall shoreline within the LWC Regional Study Area.

Mitigation Measures
As the net effects are positive, no mitigations measures are required.

Net Effects
Overall, the net effects during Establishment are positive as the preferred design increases shoreline irregularity and nearshore habitat with features similar to those that would occur naturally along the north shore of Lake Ontario.

5.2.2 Criteria: Ability to create functional habitat blocks

5.2.2.1 Indicator: Area of habitat creation (ha) of wetland, forest, and meadow.

Potential Effects during Construction

This criterion is not relevant to the construction phase.

Potential Effects during Establishment / Post-Establishment
Using ecological principles, optimum habitat sizes were established as a guideline to ensure appropriate levels of ecosystem function within the LWC Project Study Area once the site is fully established. This indicator measures the area of habitat proposed in the refined Preferred Alternative to ensure compliance with minimum habitat size guidelines of 3.5-ha to 9-ha of wetland; 4-ha of forest; and 10-ha of meadow. The sizes of the proposed habitats were measured from the LWC Grading Plan (2013) using Arc GIS and compared to the minimum habitat guidelines set out earlier in the process.

Potential Effects at the LWC Project Study Area
The LWC Project will create approximately 33-ha of terrestrial and wetland habitat, including 14.5-ha of meadow; 1.5-ha of beach; 5-ha of forest; 7.5-ha of wetland; 3.5-ha of treed swamp; and 1-ha associated with rocky island habitat. As the minimum recommended habitat size guidelines are exceeded this indicator results in a positive effect.

Mitigation Measures
As the potential effects are positive, no mitigation measures are required.

Net Effects
Overall, the net effects during Establishment are positive as the LWC Project will result in the creation of approximately 33-ha of new terrestrial and wetland habitat, and will exceed minimum habitat size objectives.

5.2.2.2 Indicator: Assessment of Improvements to Aquatic Habitat Created and Ecological Benefits Achieved Through the Changes to Serson and Applewood Creeks

Potential Effects during Construction
This criterion is not relevant to the construction phase.

Potential Effects during Establishment / Post-Establishment
This indicator measures: (a) the length of new stream habitat created in metres; (b) the ability of the watershed to connect to the lake; and (c) connection(s) created to the wetland features. The pre-construction shoreline lengths were measured from geo-referenced aerial imagery using Arc GIS, and post construction shoreline lengths were measured from the LWC Project Grading Plan (2013) using ArcGIS.

Potential Effects at the LWC Project Study Area
Under existing conditions, Serson Creek is ecologically disconnected from Lake Ontario, and coastal wetlands at the mouths of both creeks have been all but eliminated as a result of human activity over the last 150 years. The construction of the new river channels and coastal wetlands for Serson and Applewood Creeks will create a new watershed connection to Lake Ontario (in the case for Serson Creek), and will re-establish coastal wetland habitats at the mouths of both creeks, resulting in a positive effect.

The LWC Project will also create approximately 240-m and 330-m of extended channels within the new feature for Applewood Creek and Serson Creek, respectively, as well as approximately 690-m of new channel opened up in the Serson Creek stormwater channel. The new river channels within the new LWC feature will provide critical estuary habitat which is considered highly productive fish habitat. These new stream lengths are included in the 7.5-ha of wetland habitat identified previously, as they are intrinsic components of the wetland complexes. Serson Creek will have an open connection to Lake Ontario and will thus provide continual connectivity for fish. Applewood Creek will drain across a gravel-cobble beach with substrates of 1-cm to 10-cm (with a median diameter of approximately 5-cm). This will provide connectivity during moderate to high discharge events. Applewood and Serson Creek will have one (1) and two (2) connections to the wetlands, respectively. These connections will provide continual connectivity to the wetlands for riverine and pelagic fish as they are also highly productive fish habitats. Overall, these are positive effects of the LWC Project.

Potential negative effects relate to the potential for fish to become trapped in Serson and Applewood Creeks during construction, and potential disruption of fish migration in the lower portion of Applewood Creek (between Lake Ontario and Lakeshore Road).

The realignment of Serson Creek north of the WWTF will require the removal of young pioneering trees within the existing stormwater channel, and the infilling of the existing baseflow channel downstream from the stormwater channel entrance. The existing baseflow channel downstream from the sediment plug will remain in place, to allow floodwaters that overtop the channel to continue to be discharged through the culvert under the WWTF, providing additional flood conveyance under large events. Locally generated surface flows will also continue to flow through the culvert. No fish have been surveyed in the existing Serson Creek channel north of the WWTF. As such, the realignment will allow fish access to the Serson Creek watershed.

To improve habitat within the stormwater channel (which will become the primary channel for Serson Creek), no modifications to the underlying soils of the bed and banks will occur. Aquatic habitat features such as rocky steps will be incorporated within the channel as well as riparian vegetation plantings along the top of valley, in areas where it will not increase flood risk, affect flow conveyance, or promote bank erosion. As such, there is no significant construction related effects anticipated as a result of the proposed channel realignment for Serson Creek.

Potential Effects at the Regional Study Area

At the Regional Study Area, the LWC Project will significantly improve fish community assemblages by: (a) providing critical habitat for a range of life cycle stages, including reproduction; and (b) significantly improving the ability for certain specifies to migrate along the shoreline by providing stream and wetland refuge areas during severe events along the open coast of Lake Ontario. There are currently very few sheltered embayment areas within the Regional Study Area, and all of the existing ones are a result of human activities (e.g., marinas and the 'thumb basin' at Lakefront Promenade Park). Overall, these are positive effects.

The LWC Project will connect Serson Creek with Lake Ontario up to Lakeshore Road. CVC is working with the City of Mississauga to ensure that the culvert improvement at Lakeshore Road for Serson Creek includes measures to reestablish fish passage. The combination of these efforts could potentially translate to significant gains in access to the Serson Creek watershed, resulting in a positive benefit.

Mitigation Measures

To reduce harm to the existing fishery, in-water works will be consistent with the designated fisheries windows (open water construction operations will be undertaken between July 1 and March 31).

For the Serson Creek realignment works, the channel will be isolated and fish salvage conducted to ensure no fish remain in the construction area of the channel; the banks of the channel will not be excavated; rocky steps and riparian vegetation plantings will be incorporated as aquatic habitat features; and the existing soils will not be disturbed within the stormwater channel. Opportunities to add habitat features will be explored further during detailed design.

During construction, culverts will be placed to direct Applewood Creek under the access route and maintain connection between Applewood Creek and Lake Ontario.

Net Effects
The net effects are positive as the LWC Project results in the creation of highly productive aquatic habitat not previously available. The connections to the Serson Creek watershed will provide an additional linkage that will transform this degraded site into a regionally productive site by linking Lake Ontario to the wetlands and watersheds.

5.2.2.3 Indicator: Qualitative Assessment of Habitat Created, Including Benefits Created by LWC with Respect to Providing Missing and/or Impaired Portions of Aquatic and Terrestrial Ecosystems in this Part of the Mississauga Waterfront

Potential Effects during Construction
This criterion is not relevant to the construction phase.

Potential Effects during Establishment / Post-Establishment
It is important to examine the ecological function and quality of the newly created habitat in the geographic context of the Mississauga waterfront. Habitat patch size, shape, and potential for human disturbance through trails and infrastructure, dictate future ecological function of the created habitat patches. This indicator qualitatively evaluates the ability of the refined Preferred Alternative to provide an increase in ecologically functional areas within this part of the Mississauga waterfront.

The qualitative assessment was undertaken by terrestrial and aquatic ecologists, who reviewed the refined Preferred Alternative with respect to the local aquatic and terrestrial ecosystems along the Mississauga waterfront. The refinements were further reviewed in the context of CVC's LOISS and Landscape Scale Analysis of the City of Mississauga (CVC 2012a).

Potential Effects at the Project Study Area
The LWC Project results in the creation of approximately 33-ha of new terrestrial and aquatic habitat features. During the establishment phase, the newly created habitat will provide areas of isolated wildlife refuge where plants and wildlife remain undisturbed and nature is encouraged. A diversity of shoreline habitats that are moderately sheltered will also be created. Given the linear nature of the LWC Project, core forest habitat will not be established at the Project Study Area level. However, the proposed treed swamps will provide critical habitat linkages for certain species of amphibians, reptiles and birds between the Serson and Applewood Creek wetland complexes. The proximity and arrangement of the forest, meadow and wetland complexes also provides important habitat for local bird and wildlife species, in conjunction with habitats provided in Marie Curtis Park and the Arsenal Lands. Overall, the created habitat patches provide a positive effect.

Potential negative effects during establishment relate to the establishment of nuisance and invasive species, such as Canada Geese; Common Carp and Common Reed in the wetlands; and dog straggling vine and garlic mustard in meadows and forests, have the potential to negatively affect the ecological function and quality of the habitat patches created by outcompeting and displacing desirable native species.

Potential Effects at the Regional Study Area
At the Regional Study Area, LOISS and CVC's Terrestrial Natural Heritage strategy indicate significant gaps in natural vegetation and habitats throughout the City of Mississauga, especially along the Lake Ontario shoreline. The LWC Project will produce a significant increase in natural

habitat cover within the LWC Regional Study Area, thus providing critical “stepping-stone habitats” for birds, mammals, fish and other wildlife to other isolated greenspaces along the Lake Ontario shoreline and further upstream within the watersheds.

The consolidated and connected forest, meadow and wetland habitat patches are arranged linearly in proximity of the shoreline, thereby providing optimal ecological function for migratory stop-over habitats, buffers to adjacent urban areas, and longshore corridors from Etobicoke Creek westwards. The habitat creation is consistent with recommendations from LOISS and CVC’s Landscape Scale Analysis (CVC 2012a), and results in an overall positive effect.

Mitigation Measures

Best Management Practices (BMPs) will be used during construction to minimize invasive species developing on the site, including avoiding the transport of non-native and invasive species into sensitive vegetation communities; and cleaning all equipment working in the identified invasive species locations. Incorporation of such features such as access gates at the inlets between the estuarine channels and coastal wetlands will further allow controls against undesirable species such as Common Carp. Maximizing natural vegetation cover within the wetland and along the adjacent terrestrial areas will help to reduce the numbers of Canada Geese using these areas. Canada Geese prefer short cut manicured grasses adjacent to waterbodies, rather than the proposed deeper grasses and shrubs combined with the tall emergent vegetation that could hide predators.

Net Effects

The net effect of the LWC Project is positive at both the Project Study Area and Regional Study Area, as the created habitat patches provide an increase in ecologically functional areas within this part of the Mississauga waterfront. Potential effects related to the establishment of invasive species will be mitigated through BMPs.

5.2.2.4 Indicator: Qualitative Assessment of Connectivity between Habitats for the Movement of Wildlife (e.g., Mammals, Herptofauna, Fish, Birds, etc.)

Potential Effects during construction

This criterion is not relevant to the construction phase.

Potential Effects during Establishment/Post-Establishment

Wildlife may require access to a variety of habitat types to fulfill various aspects of their lifecycle and/or behaviours such as foraging, feeding and reproduction. The ease of access throughout the habitat may encourage or discourage movement between the various habitat types. This indicator assesses the functionality of the habitat. The functional habitat blocks were reviewed by terrestrial and aquatic ecologists with respect to their ability to provide functional habitat blocks and connectivity between habitats.

The LWC Project will result in improved connectivity within and outside the Project Study Area and improved structure to the vegetation communities created. The newly created habitat will provide the potential for migratory birds, bats and insects to move through the LWC Project Study Area as vegetation matures. New connections between the creeks, Lake Ontario, the newly created wetlands, estuary habitat, and the Serson Creek watershed will be significantly

improved over current conditions. In particular, Serson Creek will be reconnected to Lake Ontario, allowing fish to re-colonize and use reaches that are currently inaccessible.

Mitigation Measures
As the net effects are positive, no mitigation measures are required.

Net Effects
The net effects of the LWC Project are positive as it will result in an overall improved connectivity; across the shoreline; to existing terrestrial communities; between the water/land interfaces and between the newly created vegetation communities.

5.2.3 Criteria: Ability of Alternative to be Self-compensating with Respect to Fish Habitat

5.2.3.1 Indicator: Area of Aquatic Habitat Loss of Altered (ha)

Potential effects during construction
Land creation activities will result in a loss of, and change to, existing aquatic habitat in Lake Ontario. A significant amount of that area will be lost or altered permanently as a result of land creation activities, which will create new terrestrial habitats such as meadows, forests and treed swamps. However, a significant amount of that habitat will also be converted from degraded open coast habitat to highly productive coastal wetland and estuarine habitat, as well as a more natural beach habitat and sheltered island habitat.

This indicator was quantitatively assessed by measuring the footprint of the land creation of the refined Preferred Alternative from geo-referenced aerial imagery and the LWC Project Grading Plan (2013) in ArcGIS.

During the construction phase, land creation activities as part of the LWC Project will result in the loss of 39-ha of degraded open coast habitat within the LWC Project Study Area.

Mitigation Measures
The 39-ha of aquatic habitat lost or altered due to land creation activities will be used to create 23-ha of meadow; forest and treed swamp habitat; 1.5-ha of beach habitat; 7.5-ha of wetland and estuarine habitat. The LWC Project will also create approximately 240-m and 330-m of extended channels within the new feature for Applewood Serson Creeks, respectively, as well as approximately 690-m of new riverine habitat in the Serson Creek stormwater channel that is currently inaccessible.

Net Effects
With the creation of new habitat, the net effect of the loss or alteration of the current aquatic habitat is expected to result in a negligible effect on aquatic habitat and the establishment of higher quality habitat will have positive effects within the LWC Project Study Area. While the loss or alteration of degraded fish habitat cannot entirely be mitigated strictly from an area perspective, the proposed changes in aquatic productivity and the opening of the Serson Creek watershed is anticipated to result in neutral impacts on fish habitat.

Potential for effects during Establishment / Post-establishment
This criterion is not relevant to the establishment phase.

5.2.3.2 Indicator: HAAT model estimates of area requiring compensation

Potential for effects during Construction
DFO uses a suite of tools such as the Habitat Alteration Assessment Tool (HAAT) to assess the change in habitat amount and function (from a fisheries perspective) from an existing condition to the proposed modified condition based on the following four variables: area, depth, substrate, and cover. The model seeks to identify whether there is a net benefit or impairment to the existing ecological function of a project area for a suite of fish species.

For the Lakeview Waterfront Connection EA, HAAT analysis was conducted on the Refined Preferred Alternative at 2.0M cubic **metres, in order to provide a better understanding of the range of compensation requirements.** For the assessment, the following assumptions were made:

- The change in the four variables (area, depth, substrate, cover) would be compared to the Lake Ontario fish species habitat suitability index. At the request of DFO, the Toronto waterfront species list was used to determine the sensitivity of the proposed works with each species list.
- The six fish species groups (i.e., warmwater piscivores, warmwater non-piscivores, coolwater piscivore, coolwater non-piscivores, coldwater piscivores and coldwater non-piscivores) had equal weighting. At the request of DFO, a coldwater discount was used for comparative purposes as habitat elements proposed in the concept plan favoured warm and cool water fish species. **For this exercise the following weighting scheme was applied for the coldwater discount, 0.1,0.1,0.2,0.2,0.2,0.2 coldP,coldNP,coolP,coolNP,warmP,warmNP.**
- The fish species life stages (i.e., adult, spawning, young of the year) had equal weighting.

The HAAT model results indicate a deficit of 5.8-ha of fish habitat that would require compensation.

Recognizing that the HAAT model is only one of the assessment tools used to determine overall ecological benefits of the LWC Project, it is important to utilize professional judgment of the technical team to recognize additional ancillary ecological benefits that have not been accounted for in the HAAT modeling exercise. Ancillary ecological benefits include: improved watershed function; the inclusion of functional terrestrial habitats in the design and increased primary and secondary production. Ecological benefits to the watershed will be achieved by connecting Serson Creek to Lake Ontario for the first time in a decade, allowing fish movement into the Serson Creek watershed from the lake. As a direct result of the LWC Project, 1,400-m of Serson Creek, through the new land creation area up to Lakeshore Road, will be accessible to fish. Complimentary benefits associated with concurrent projects is anticipated to open up an additional approximately 400-m of Serson Creek north of Lakeshore Road for fish access.

Approximately 3,200-m of riparian habitat will be created which will improve stream habitat structure and availability. Finally, a net increase in primary and secondary production is expected through inputs of plant material, insects and amphibians and an increase in coastal forage species such as emerald shiners. From an aquatic habitat perspective, these features

will create habitat improvements on both local and regional scales. Overall these improvements will provide a functional linkage between open coast, watershed and wetland habitats and adjacent aquatic habitat refuges such as Colonel Sam Smith Park and Etobicoke Creek to the east, and Lakefront Promenade Park and the Credit River to the west.

Mitigation Measures
During detailed design, the Project team will continue to work with DFO and MNR to incorporate additional habitat features for specific fish species along the new revetment sections (i.e., rocky shoals), and within the wetlands and estuarine habitats. Wetland access gates will also contribute to further enhancements in wetland quality for fish habitat purposes.

Net Effect
The LWC Project will significantly enhance the quality of fish habitat in an area of highly degraded fish habitat. Through discussions with MNR, DFO and Conservation Authority biologists during detailed design, it is anticipated that the ancillary ecological benefits that are not captured in the HAAT model will result in neutral (i.e., no) net effects on fish habitat.

Potential for effects during Establishment / Post-establishment
This criterion is not relevant to the establishment phase.

5.2.3.3 Indicator: Potential Disruption to Fish Habitat as a Result of Land Creation Activities (i.e., Siltation, Fish Removal).

Potential effects during construction
Activities pertaining to the construction of the LWC Project have the potential to have a negative effect on the natural environment. Berm construction and placement of fill has the potential to disrupt fish habitat in adjacent areas through:

- Water quality impairment due to siltation during placement of the stone;
- Release of deleterious substances from construction equipment and construction site runoff;
- Erosion of surface soils by wind and water following completion of a containment cell; and
- Entrapment of fish within the land creation area.

It should be noted that there are no Species at Risk identified within the proposed land creation area.

Mitigation Measures
For each phase of fill operations, a containment berm will be constructed prior to placing any fill which will all but eliminate sedimentation issues from fill placement operations. Once fill has been placed, there is potential for soils to be eroded by wind or water resulting in offsite sedimentation issues. This will be mitigated by stabilizing soils using standard soil stabilization techniques such as establishing vegetation cover upon completion of a construction cell. Efforts will also be made as part of the detailed design to explore the feasibility of a phased approach to restoration. This will not only assist in maximizing soil stabilization but will also serve to expedite the restoration phase of the LWC.

Potential disruption to fish as a result of land creation construction activities is expected to be short-term in duration. In addition, a number of Best Management Practices and mitigation measures are proposed in order to mitigate effects related to siltation, the release of deleterious substances and direct effects on fish.

To mitigate potential effects related to siltation, the construction of shoreline protection will consist of the placement of clean, inert quarried stone material. Under the MOE Fill Quality Guidelines or Lakefilling in Ontario (March, 2003), quarried rock is typically considered as suitable for lakefilling as unconfined fill material. By using quarried stone products and construction rubble, the increase in turbidity is expected to be low. Placement will be limited to times when wave conditions allow safe construction operations and minimize potential for disruption of fill placement.

To minimize the risk of the release of any deleterious substance:

- All works will be undertaken in accordance with the Ontario Ministry of the Environment's Fill Quality Guidelines for Lakefilling in Ontario, March 2003;
- All materials and equipment used for the purpose of site preparation and project completion shall be operated and stored in a manner that prevents deleterious substances from entering the water;
- Any stockpiled materials shall be stored and stabilized away from the water;
- Vehicle and equipment re-fuelling and/or maintenance shall be conducted away from the water;
- Any part of a vehicle and/or equipment entering the water shall be free of fluid leaks and externally cleaned/degreased to prevent any deleterious substances from entering the water;
- All disturbed areas will be stabilized and re-vegetated immediately following the repair work;
- In-water work shall avoid storm conditions; and
- Only clean material free of fine particulate matter shall be placed in the water.

To reduce harm to the existing fishery, construction operations will be consistent with the designated fisheries windows (open water construction operations will be undertaken between July 1 and March 31). In addition, fish salvage will be done to mitigate effects related to fish entrapment within the land creation area.

Net Effect
The negative effects associated with construction of the landform are expected to be short in duration and mitigated with contractor requirements, fish salvage operations and the use of quarried stone products and construction rubble. As such, the net effects on fish and fish habitat will be negligible.

Potential effects during Establishment / Post-establishment
This criterion is not relevant during the establishment phase.

5.2.4 Criteria: Habitat removal or disruption during construction of site access road and laydown area

5.2.4.1 Indicator: Terrestrial habitat and vegetation removed or disrupted

Potential effects during construction
Some vegetation removal or disruption will be required for construction of the access road. This indicator measures the amount of vegetation required to be removed or disturbed for the construction access route. The area of vegetation removed was measured using GIS mapping of ELC communities overlain on the access route, and confirmed through visual surveys of the area.

Potential Effects at the LWC Project Study Area
Although the access route will follow the existing pathway, some vegetation (largely non-native trees) will require removal including a couple of large mature trees and a stand of Staghorn Sumac.

The access route is also anticipated to require the removal of portions of the Treed Beach Ridge to the east of Applewood Creek. While this feature is considered rare, the area to the east of Applewood Creek is dominated by non-native and invasive species including Crack Willow (*Salix rubens*), Manitoba maple (*Acer negundo*) and Siberian elm (*Ulmus pumila*). As such, there are significant opportunities for restoration of this area through the replacement of non-native with native vegetation. Following decommissioning of the access route, restoration of the treed beach ridge will be undertaken as appropriate.

In addition, construction and use of the access route (e.g., installation of construction fencing may act as a physical barrier) may result in a minor disruption to movement of medium sized wildlife species (e.g., birds and mammals) within the forest along the expanded trail.

Potential Effects at the LWC Regional Study Area
There are no effects of removing vegetation along the access route at the LWC Regional Study Area level during construction or post-construction.

Mitigation Measures
A number of mitigation measures are proposed, including:

- Salvaging native plant material to be replanted elsewhere locally to preserve local plant genetics;
- Replanting of disturbed area, or rough grading disturbed areas in support of future plans for the Arsenal Lands;
- Restoration of Treed Beach Ridge (east of Applewood Creek) through the replacement of non-native with native vegetation.
- Best Management Plans such as those related to *Migratory Birds Convention Act* will include:
    - Vegetation removal outside of the breeding bird period (typically April 21 to July 31); and
    - A nest survey conducted by a qualified avian biologist prior to commencing work.

Effects will be limited to the 7-10 year construction period.

Net Effects
With these measures in place the effect of vegetation removal and terrestrial habitat disruption will be negligible during construction. Efforts to restore any disturbed areas will be such that a positive effect is created.

Potential effects during Establishment / Post-Establishment
This indicator is not relevant to the Establishment/Post-Establishment phase.

5.2.4.2 Indicator: Number of Species at Risk Removed/Disturbed

Potential effects during construction
Number of Species at Risk removed/disrupted was examined as an indicator. Several Species at Risk (such as butternut and bobolink) have been identified within the LWC Project Study Area. This indicator measures the effects to Species of Risk as a result of construction of the construction access route. Species at Risk mapping and known occurrences were compared to the proposed route.

No Species at Risk have been identified within the proposed footprint of the construction access road and laydown area, so no effects to Species at Risk are anticipated.

Mitigation Measures
As part of the final road design and layout a detailed vegetation survey will be conducted to confirm the absence of Species at Risk. If a species is identified during final design, all efforts to mitigate (i.e., avoid, re-route around, compensation etc.) will be employed.

Net Effects
As no Species at Risk have been identified within the footprint of the access road, no net effects are anticipated.

Potential effects during Establishment/Post-Establishment
This criterion is not relevant to the establishment phase.

5.2.4.3 Indicator: Aquatic Habitat Removed or Disrupted

Potential for effects during construction
The preferred construction access route has the potential to remove aquatic habitat associated with surface water features in the LWC Project Study Area. This indicator measures the amount of aquatic habitat lost or potentially impacted. GIS mapping of ELC communities was overlain on the route and was measured using ArcGIS.

Potential Effects at the LWC Project Study Area
The route is not within the regulated floodplain of either Applewood or Serson Creeks, and the road will be a minimum 20-m from the existing wetlands. As such, these routes will not impact the creeks. However, there is a potential for discharge of sediment from the road into a constructed wetland on the Arsenal Lands property.

Potential Effects at the LWC Regional Study Area
There are no anticipated effects relating to aquatic habitats at the Regional Study Area scale.

Mitigation Measures
The access road is anticipated to be at least 20-m away from the constructed wetland and standard sediment and erosion control measures for site drainage (i.e., installation of silt fences, blankets and berms; and stabilization of exposed and newly constructed surfaces) will mitigate any potential effects from sediment discharge.

Net Effects
Overall, the potential effects to aquatic habitat from the installation and use of the site access road and laydown area are expected to be negligible. Any potential effects related to the construction wetland on the Arsenal Lands property will be mitigated through BMPs.

Potential effects during Establishment/Post-Establishment
This criterion is not relevant to the establishment phase.

5.2.5 Criteria: Effects of Hydraulics and Hydrology/Sedimentation on Sustainability of Wetland Communities

5.2.5.1 Indicator: Qualitative Assessment of Ability to Manage a Full Range of Flows without adverse Impact on Wetland Communities

Potential effects during construction
This indicator is not relevant to the construction phase.

Potential effects during establishment / post-establishment
Variable flow conditions have an effect on wetland communities. This indicator measures the potential effect of variable flow conditions on the wetland communities. This indicator was assessed by professional judgment comparing existing conditions against changes that would occur by developing the refined Preferred Alternative.

Modelling shows that velocities during the 2-year return event decrease from 6-m/s near Lakeshore Road, to 1.3-m/s in the design channel for Applewood Creek; while Serson Creek flow velocities increase between Lakeshore Road and the channel design, which is likely a result of the slightly steeper gradient of the existing overflow channel.

Both Serson and Applewood Creeks have been designed to contain flows up to the 5 year event. The main channel cross section will convey the 2 year flow while levees will contain the 5 year flow. Flows beyond this capacity will spill into the wetland features. Hydraulic conditions within the creeks are likely to be low velocity with little energy to erode the boundaries; therefore, erosional stress on the wetland boundaries is not anticipated to be an issue. Sedimentation in the design channel is likely to naturally occur, but it is expected that the channels will be able to manage sediment over time by flushing it out during higher, less frequent flows (2-year and higher). The design will maintain flow between Applewood and Serson Creeks and Lake Ontario.

Mitigation Measures
During the establishment and post-establishment phases, the design of the wetlands with:

- diverse bathymetry and microtopography, in order to provide for the establishment of various habitat communities at the elevations described above, and to provide sufficient diversity to allow the wetlands to adapt over a range lake levels in Lake Ontario; and such that

- residual fines and shear stresses experienced in wetlands under more frequent flooding events will not impact negatively wetland vegetation.

Water control gates located at the inlets to the wetlands will allow for the management of water levels within the wetlands as required in the event of water levels that exceed the anticipated range of low water levels.

Monitoring and AEM will be employed to ensure that the wetland vegetation communities are sustainable over a wide range of lake levels and river flows.

Net Effects
The effect from flows on the wetland communities is negligible as the channel will manage sediment over time, and flows will be conveyed through to Lake Ontario within the design channel and berms of a 5-year capacity. Sedimentation due to extreme flows will be evaluated when necessary.

5.3 SENSITIVITY ANALYSIS FOR SMALLER LWC PROJECT FOOTPRINT

The refined Preferred Alternative and the effects assessment are based on the LWC Project footprint utilizing a maximum of 2.0 million m^3 of clean fill. The effects assessment was conducted based on this maximum footprint to capture the "worst-case scenario" for any potential negative effects.

To confirm that the 2.0 million m^3 footprint captures the "worst-case scenario" for any potential negative effects and that the smaller 1.5 million m^3 footprint does not significantly reduce positive effects, a sensitivity analysis is presented in this section to establish that the effects associated with a smaller footprint would be the same or better.

5.3.1 Criteria: Change in shoreline character

Indicator: Change in diversity of shoreline types (% increase or % decrease)
A smaller footprint will change the dimensions of the various shoreline types. At a 1.5 million m^3 footprint, the overall length of shoreline increases from 1,700-m (current shoreline length) to 2,700-m with a similar diversity of shoreline types as described for the 2.0 million m^3 footprint. Although the change in shoreline diversity is less at the 1.5 million m^3 footprint, similar benefits compared to existing conditions are achieved. Therefore, the effects at both the 1.5 million m^3 and the 2.0 million m^3 are both positive.

Indicator: Quantitative assessment of shoreline irregularity and the ability to provide nearshore habitat
A smaller footprint will change the length of new shoreline in comparison to the existing shoreline. The 2.0 million m^3 footprint will provide a shoreline that is 2.1 times longer than the former shoreline over the same area. The 1.5 million m^3 footprint will provide a shoreline that is 1.6 times longer than the former shoreline over the same area. Although the shoreline will be slightly shorter at a smaller footprint there will still be a similar increase in diversity of shoreline types and associated ecological benefits. Therefore, the effects at both the 1.5 million m^3 and the 2.0 million m^3 are both positive.

5.3.2 Criteria: Ability to create functional habitat blocks

Indicator: Area of habitat created (m^3) of wetland, forest, and meadow.
A smaller footprint will necessitate a reduction in the area of habitat blocks described for the 2.0 million m^3 footprint. Habitat blocks have been adjusted within the 1.5 million m^3 footprint in the same general configuration as the 2.0 million m^3 footprint. Although the smaller footprint results in smaller habitat blocks, the habitat blocks still meet or exceed the recommended habitat targets within a smaller footprint. Therefore, the effects at both the 1.5 million m^3 and the 2.0 million m^3 are both positive.

Indicator: Assessment of improvements to aquatic habitat created and ecological benefits achieved through the changes to Serson and Applewood Creeks
Similar habitat improvements and ecological benefits can be achieved in Applewood and Serson Creek within a smaller footprint size. Ecological benefits are positive with either footprint size. Therefore, the effects at both the 1.5 million m^3 and the 2.0 million m^3 are both positive.

Indicator: Qualitative assessment of habitat created including benefits created by LWC with respect to filling in missing and/or impaired portions of aquatic and terrestrial ecosystems in this part of the Mississauga waterfront.
No changes are anticipated for this criterion at a smaller footprint. Ecological benefits continue to be positive with respect to improving impaired ecological function along the Mississauga waterfront. Therefore, the effects at both the 1.5 million m^3 and the 2.0 million m^3 are both positive.

Indicator: Qualitative assessment of connectivity between habitats for the movement for wildlife (e.g. mammals, herptofauna, invertebrates, fish, birds, etc.).
No changes are anticipated for this criterion at a smaller footprint. A smaller footprint will continue to have improved connectivity between habitats for the movement of wildlife. Therefore, the effects at both the 1.5 million m^3 and the 2.0 million m^3 are both positive.

5.3.3 Criteria: Ability of alternative to be self-compensating with respect to fish habitat

Indicator: Area of aquatic habitat altered (ha)
A smaller footprint will reduce the overall area of existing fish habitat lost or altered so the negligible effects described for the 2.0 million m^3 footprint will not increase for this indicator at the 1.5 million m^3 footprint. Therefore, the effects at both the 1.5 million m^3 and the 2.0 million m^3 are negligible.

Indicator: HAAT model estimates of area requiring compensation (ha)
The area requiring compensation will change based on the reduced area of land creation and reduced area of proposed habitat features. The updated HAAT model results in less compensation area estimated for the 1.5 million m^3 footprint. The 2.0 million m^3 footprint requires 5.8-ha of like compensation whereas the 1.5 million m^3 footprint will require 4.7-ha of like compensation. Ancillary ecological benefits that are not captured in the HAAT model will result in neutral (no) net effects on fish habitat at both the 2.0 and 1.5 million m^3 footprints. Therefore, there are no effects at either the 1.5 million m^3 or the 2.0 million m^3 footprints.

Indicator: Potential disruption to fish habitat as a result of land creation activities (siltation, fish removal, etc.)
Potential negative effects for the 2.0 million m^3 footprint can be mitigated BMPs resulting in negligible effects. The smaller footprint will reduce the area of fish habitat potentially affected by

land creation activities which will not increase predicted effects. Therefore, the effects at both the 1.5 million m^3 and the 2.0 million m^3 are negligible.

5.3.4 Criteria: Habitat Removal or Disruption during Construction of Site Access Road and Laydown Area

Indicator: Area of terrestrial habitat and vegetation removed or disrupted (m^2).
The access route will not change based on a smaller footprint so there will be additional negative effects resulting from a smaller footprint. Therefore, the effects at both the 1.5 million m^3 and the 2.0 million m^3 are negligible.

Indicator: Number of Species at Risk removed/disrupted
The access route will not change based on a smaller footprint so there will be additional negative effects resulting from a smaller footprint. Therefore, there are no effects at either the 1.5 million m^3 or the 2.0 million m^3 footprints.

Indicator: Area of aquatic habitat removed or disrupted (m^2)
The access route will not change based on a smaller footprint so there will be additional negative. Therefore, the effects at both the 1.5 million m^3 and the 2.0 million m^3 are negligible.

5.3.5 Criteria: Effects of Hydraulics and Hydrology/Sedimentation on Sustainability of Wetland Communities

Indicator: Qualitative assessment of ability to manage a full range of flows without adverse impact on wetland communities (high erosional stress, sediment deposits)
A smaller footprint will not affect the configuration of Serson Creek but will require changes to Applewood Creek. Changes to Applewood Creek were assessed and it was determined that the creek design within the smaller footprint results in no changes to the effects described for this indicator. Therefore, the effects at both the 1.5 million m^3 and the 2.0 million m^3 are negligible.

Indicator: Influence of lake level fluctuations on channel and wetland connectivity
Lake level fluctuation will affect channel and wetland connectivity similarly at both the 1.5 and 2.0 million m^3 footprints. Therefore, the effects at both the 1.5 million m^3 and the 2.0 million m^3 are negligible.

Indicator: Potential for sedimentation to affect channel form (including river mouths) and associated vegetation
Sedimentation will affect channel form and associated vegetation similarly at both the 1.5 and 2.0 million m^3 footprints. Therefore, the effects at both the 1.5 million m^3 and the 2.0 million m^3 are negligible.

Indicator: Qualitative assessments of the adaptability of the wetland function to climate change.
Wetland function will adapt to climate change similarly at both the 1.5 and 2.0 million m^3 footprints. Therefore, the effects at both the 1.5 million m^3 and the 2.0 million m^3 are negligible.

Indicator: Qualitative assessment to determine the ability of river channels and shoreline works to accommodate changes in flow and lake levels due to climate change
The ability of river channels and shoreline works to accommodate changes in flow and lake levels due to climate change will be similar at both the 1.5 and 2.0 million m^3 footprints. Therefore, the effects at both the 1.5 million m^3 and the 2.0 million m^3 are negligible.

6.0 ALTERNATIVE ACCESS ROUTES FROM LAKESHORE ROAD TO THE LWC PROJECT SITE AT THE WATERFRONT

6.1 OVERVIEW OF ALTERNATIVE ACCESS ROUTES

The purpose of the evaluation of Alternative Access Routes is to choose the best way to access the site construction area from Lakeshore Road. At present, there is no readily available vehicular access to the construction area, which necessitates the construction of a new, temporary access route. The sole purpose of the access route will be to provide access for trucks carrying fill and other required materials to the construction site. Once construction is complete the route will be decommissioned and removed. The Alternative Access Routes were developed by looking at logical historic and existing access points along Lakeshore Road.

The desired end point was the beach to the east of the WWTF. Between the access points and the end point there are a number of ecological constraints to be crossed or, where possible, avoided. These constraints include natural features such as woodlots, Species at Risk and Applewood Creek.

Five (5) alternative routes were developed from three (3) primary access locations off of Lakeshore Road. Each of the routes crosses or affects some or all of the constraints listed above. It is assumed that all routes will include a 12-m wide road bed, allowing two-way traffic and that the road beds will be built to high quality standards to minimize maintenance due to wear and tear by the anticipated truck volumes.

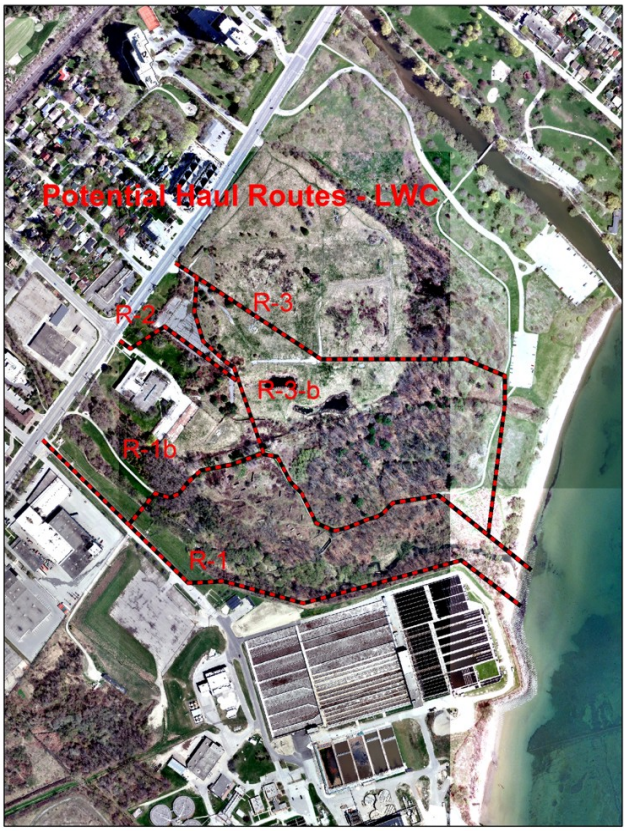

Figure 17: Proposed Construction Access Routes

6.1.1 Route 1: West of Applewood Creek

This route requires trucks and equipment to turn left across traffic on Lakeshore Road at the WWTF access road, assuming traffic is arriving from Dixie Road and/or Browns Line. Trucks will drive down this road for 325-m until just before the gates of the WWTF before turning left and down into the valley lands of Applewood Creek. The slope going down into the valley lands is too steep for truck access. Significant valley wall grading and geotechnical works will be required to bring the road down into the valley. Once in the valley lands, approximately 475-m of forest (along the western end of a woodlot) will need to be removed along the west side of Applewood Creek, in addition to the removal of another 200-m of forest to realign the river channel away from the valley wall (additional fluvial geomorphic studies would be required to clearly delineate the length and location of this woodlot removal). As such, approximately 200-m of stream channel in Applewood Creek would be realigned having a direct and significant impact on fish habitat, water quality, and riparian vegetation.

From a property perspective, all lands in question are owned by the Region of Peel. Credit Valley Conservation would be involved with permitting given that the route would be located extensively within hazard lands, and will be within the regulated flood plain. There are no wetlands along this route. Tree removal for this route would occur in an L5 vegetation community. From a habitat patch quality, these habitats are all deemed to be poor.

6.1.2 Route 1b: Applewood Creek Crossing and Along Waterfront Trail

This route requires trucks and equipment to turn left across traffic on Lakeshore Road at the WWTF access road, assuming traffic is arriving from Dixie Road and/or Browns Line. Trucks will drive down this road for approximately 170-m before turning left and over an 18-m long temporary bridge over Applewood Creek. While the bridge crossing should not impact fish habitat quality substantially, the crossing does increase the potential for direct discharges from vehicles and debris into the stream as thousands of trucks would cross directly over the water course to access the LWC Project. In addition, in the event of large flood events, the bridge structure may be designed to “fail” to ensure that the structure does not increase flood risk upstream. The failure of this structure could impact fish habitat quality downstream during the flood and during the process of retrieving the structure after the event.

Once across Applewood Creek, the road will follow the Waterfront Trail for approximately 550-m before diverting off of the trail to the shoreline for the final 120-m. The Waterfront Trail is much narrower than the road will need to be. For the first 180-m or so past the Applewood Creek crossing, the forest is located in close proximity to the trail. As such, a significant number of mature trees (approximately 25) will need to be removed in order to allow the 12-m wide road to be installed. This is a section of Waterfront Trail where tree canopy cover is nearly complete. While these trees are not Species of Concern and the majority of the trees are located within L5 and L+ communities, these do provide ecological function for birds and wildlife. For the next 155-m, the forest widens significantly around the trail, and as a result, only one (1) or two (2) mature trees were deemed to be within the required temporary road allowance. Overall, the vegetation community is identified as being L+ (poor habitat patch quality). The final 215-m of road proposed for along the Waterfront Trail remains in an area where the trees are set back beyond the 12-m road allowance, and as such, no further trees are expected to be removed. The vegetation community cover is ranked as an L3 community of poor habitat patch quality.

The final 120-m to get to the lake will cross primarily through an L+ vegetation community with the final few metres crossing over L2 and L3 beach communities.

6.1.3 Route 2: Small Arms Building at Dixie Road and Along Waterfront Trail

This route requires trucks and equipment to access at a signalized intersection at Dixie Road and Lakeshore. Trucks will either enter straight from Dixie or turn left at the lights from Lakeshore if arriving via Browns Line. Once on the Small Arms Building property, trucks will be diverted east to avoid vibrations on the Small Arms Building, which has been deemed a heritage structure by the City of Mississauga. This section of the road will be approximately 325-m long before it ties into the Waterfront Trail. This section will require the removal of a few trees but none have been identified as species of concern. This section of the route is located in L+ vegetation communities of poor habitat patch quality. There is a wetland pond approximately 50-m to the east of proposed road, approximately half the distance to the Waterfront Trail from Lakeshore Road.

Once on the Waterfront Trail, the road will follow the Waterfront Trail for approximately 370-m before diverting to the shoreline for the final 120-m. For the first 155-m, the forest widens significantly around the trail, and as a result, only one (1) or two (2) mature trees were deemed to be within the required temporary road allowance. Overall, the vegetation community is identified as being L+ of poor habitat patch quality. The final 215-m of road proposed for along the Waterfront Trail remains in an area where the trees are set back beyond the 12-m road allowance and as such, no further trees are expected to be removed. As such, no significant increase in habitat fragmentation would occur as a result of this route, and the vegetation community cover is ranked as an L3 community of poor habitat patch quality. The final 120-m to get to the lake will cross primarily through an L+ vegetation community with the final few metres crossing over L2 and L3 beach communities. While this involves the removal of a few mature trees, the species involved are not deemed to be Species of Concern. This route also avoids a soil containment site behind the Small Arms Building and does not come within the regulated flood plain for Applewood, Serson or Etobicoke Creek.

6.1.4 Route 3: Arsenal Lands East of Dixie Road and Through Marie Curtis Park West

This route requires trucks and equipment to access at an unsignalized intersection east of Dixie Road off of Lakeshore. Trucks will either enter from a right hand turn if they arrive from Dixie Road or via a left hand turn if arriving via Browns Line. Once on the Arsenal Lands property, the trucks will stick primarily to existing paved surfaces for the first 390-m before turning south through a woodlot in Marie Curtis Park West. This section will not require the removal of trees and the route will access an area primarily consisting of L+ vegetation communities primarily of poor habitat patch quality though a portion of the route will pass meadows deemed to be of fair quality in the middle of the Arsenal Lands. There are two wetland ponds along the route, one is approximately 50-m to the south of this route and another approximately 25-m south of the route.

Once the route leaves paved surfaces, the road would cut through an existing opening in the woodlot in Marie Curtis Park West for approximately 185-m. This opening is wide and would require the removal or relocation of only a few trees (less than route 1B), though at least two (2) of these trees would be mature butternuts and other significant plant species. The proximity of an access route to the remaining mature woodlot would require extensive root protection works

to ensure that further fragmentation of the woodlot (through mature tree die-off) does not occur. City of Toronto is also planning tree planting activities within this woodlot in the Spring of 2013, including along this proposed route. The woodlot has been ranked as an L3 vegetation community of poor habitat patch quality.

Once through the woodlot, the proposed route would need to cross the Waterfront Trail, near the beach volleyball courts that were constructed by the City of Toronto in 2012, and then head west towards Applewood Creek over lands consisting of municipal landfill from the 1960s. The vegetation community is ranked as an L+ community with poor habitat patch quality for this section of the route. This section of the route would extend approximately 220-m before cutting south to the lake shore for the final 45-m. The last 45-m would be through L2 and L3 beach communities. While this involves the removal of some vegetation, the species involved are deemed Species of Concern. This would also require close consideration to root protection activities to ensure that mature trees adjacent to the route are not impacted as well. This route does provide the most significant impact on implementation of the Arsenal Lands Master Plan and finalization for implementation of the City of Toronto's Marie Curtis Park West revitalization works. This route does not come within the regulated flood plain for Applewood, Serson, or Etobicoke Creek.

6.1.5 Route 3b: Arsenal Lands East of Dixie Road and Along Waterfront Trail

This access route requires trucks and equipment to access at an unsignalized intersection east of Dixie Road off of Lakeshore. Trucks will either enter from a right hand turn if they arrive from Dixie Road or via a left hand turn if arriving via Browns Line. Once on the Arsenal Lands property, the trucks will stick primarily to existing paved surfaces for the first 245-m before connecting with the Waterfront Trail approximately 330-m from Lakeshore. This section will require the removal of a few trees but none have been identified as species of concern. This section of the route is located in L+ vegetation communities of poor habitat patch quality. There is a wetland pond approximately 50-m to the east of proposed road, approximately half the distance to the Waterfront Trail from Lakeshore Road.

Once on the Waterfront Trail, the road will follow the Trail for approximately 370-m before diverting off of the trail to the shoreline for the final 120-m. For the first 155-m, the forest widens significantly around the trail, and as a result, only one (1) or two (2) mature trees were deemed to be within the required temporary road allowance. Overall, no significant increase in habitat fragmentation would occur as a result of this route, and the vegetation community is identified as being L+ of poor habitat patch quality. The final 215-m of road proposed for along the Waterfront Trail remains in an area where the trees are set back beyond the 12-m road allowance and as such, no further trees are expected to be removed. The vegetation community cover is ranked as an L3 community of poor habitat patch quality. The final 120-m to get to the lake will cross primarily through an L+ vegetation community with the final few metres crossing over L2 and L3 beach communities. While this involves the removal of a few mature trees, the species involved are not deemed to be Species of Concern. This route also avoids a soil containment site behind the Small Arms Building, and does not come within the regulated flood plain for Applewood, Serson, or Etobicoke Creek.

6.2 EVALUATION CRITERIA

The Alternative Access Routes must be evaluated to understand their relative effects to the natural environment. A number of naturalization criteria and indicators were considered to evaluate the access route alternatives. Those criteria that did not clearly differentiate between alternatives were removed from the analysis, but are included in the discussion below.

6.2.1 Criteria: Vegetation/Habitat Removed or Disturbed During Construction of Site Access Road and Laydown Area

Indicator: Area and significance of vegetation removed or altered

Site preparation and the creation of roads will require the removal of vegetation, and therefore a reduction in the amount of natural habitat within the LWC Project Study Area. This reduction in natural habitat impacts biodiversity and the resilience of the remnant communities. Some areas, such as grasslands, provide breeding bird habitat for open country and early successional breeding birds. The impacted area and vegetation removal were considered during the evaluation. Routes that resulted in the least amount of vegetation removal or habitat alteration are preferred.

The relative regional significance (i.e., L-Rank) of the affected terrestrial communities was also considered in the evaluation. L1 represents vegetation communities of maximum concern, while L5 and L+ represent areas of minimum concern. Access Routes that avoided areas impacts on areas of concern are preferred.

The new road may also provide new routes for invasive species and human encroachment. Disturbance in natural communities can provide pathways for invasive species, pets, and human activity, resulting on impacts to native flora, fauna and soil (e.g., erosion, compaction). Routes that utilize existing trails or infrastructure are preferred as they result in fewer new disturbances which would allow invasive species establishment and encroachment.

GIS mapping of ELC communities over overlain on the route alternatives and the linear distance of routes through specific communities was measured using GIS tools. This also allowed for an analysis of which terrestrial communities (and their associated “L-Rank” significance) would be affected. Potential impacts related to invasive species and human encroachment were determined by professional judgment through qualitative analysis of the ELC and route mapping.

Indicator: Potential for forest habitat fragmentation

The larger, contiguous, a habitat block is, the more resilient the associated fauna and flora communities are to developments within the landscape, or to increased user pressure. Although there are no ‘interior’ forest conditions present at Marie Curtis Park, the forest patches that exist currently are not bisected by roads or other infrastructure, and this condition should be maintained to the extent possible. The Marie Curtis Terrestrial Biological Inventory and Assessment (2012) recommends that recreation or other activities should be directed away from the main forest as much as possible. The assessment also indicates that the majority of habitat patches within the Project Study Area are of poor quality, with the exception of a small meadow patch in the middle of the Arsenal Lands which is deemed to have fair habitat quality. Generally speaking, routes that do not bisect contiguous forest blocks are preferred; however, if sufficiently large clearings currently existing through a forest block that would accommodate a

road, those routes would also be deemed preferred as the effects of fragmentation already exist (resulting in limited change to the existing conditions).

Forest habitat fragmentation was determined by professional judgment through qualitative analysis of the ELC and route mapping. Further ground-truthing with TRCA's forester was undertaken for each route to identify the specific trees that would need to be removed to accommodate a 12-m wide road way. Analysis of the significance of those tree removals were undertaken based on professional judgement.

Of particular concern, the location, age and viability of Butternut trees (*Juglans cinerea*), which is currently identified as being endangered at both the Provincial and Federal levels, was considered as part of the ground-truthing efforts. Butternuts were found along the Route 3 alignment.

6.2.2 Criteria: Disruption to Applewood Creek or Serson Creek

Indicator: Length and nature of disruption to Applewood or Serson Creeks
Disruption to creeks can result in alteration to creek function, fish habitat, changes to water quality, and changes to riparian vegetation. Routes that require creek alterations, disturbance or disturbance to riparian vegetation were evaluated for potential impacts to fish and fish habitat. Routes that minimally alter or disrupt ecological function in Applewood Creek or Serson Creeks are preferred.

Mapping of fish habitat and fish communities, water flow and the route alternatives were examined through GIS and the relative impacts of each route were then determined through professional judgment of an aquatic ecologist.

Indicator: Potential to impair water quality in Arsenal Lands wetland areas
Though the wetlands in the Project Study Area are not technically part of Applewood or Serson Creek, the effects of route selection on these wetlands were considered as an indicator under this criteria. Site preparation activities such as grading and filling may increase the risk of erosion and sedimentation in nearby wetlands. Other contaminants (oil, dust, salt, sand and debris) may also impact the water quality, which can negatively impact the success of amphibian breeding. Roads may impact the hydrology of wetlands and watercourses by creating barriers to overland flow, thereby restricting inputs to nearby wetlands or watercourses, and by creating increased run off from paved areas. Routes that avoid impacts to off-line wetland areas are preferred.

GIS was used to examine ELC, the Arsenal Lands' wetlands, and amphibian breeding survey data which was overlain on the route alternatives. The relative impacts to the off-line wetlands were determined through professional judgment of an ecologist.

6.2.3 Criteria: Disruption related to natural hazards (floodplain, erosion)

Indicator: Nature of change on flood capacity
Road construction has the potential to interfere with existing runoff flow patterns by creating barriers, and by occupying hazard lands. These impacts may result in restrictions in surface flow, thereby increasing flood risk upstream, places people and infrastructure/equipment at risk

due to flooding by put infrastructure within the flood plain, and increases the vulnerability to people and infrastructure by requiring vehicle access to potentially unstable valley slopes.

Analysis was undertaken by professionals to assess the potential natural hazards that each of the particular routes were exposed to.

6.3 EFFECTS ASSESSMENT

6.3.1 Criteria: Vegetation/Habitat Removed or Disturbed During Construction of Site Access Road and Laydown Area

Indicator: Area and significance of vegetation removed or altered
Route 1 requires the removal of the most trees by far and was ranked as least preferred: approximately 475-m of forest would be removed along the west side of Applewood Creek plus at least another 200-m of forest to realign the river channel away from the valley wall. These removals would occur in a L5 vegetation community.

Route 1B and Route 3 were both deemed moderately preferred, but for different reasons. Route 1B requires the removal of at least 25 mature trees along the Waterfront Trail. While these trees were deemed not to be species of concern, and while the majority of the trees are located within L5 and L+ communities, they still do provide ecological function for birds and wildlife. Route 1B is ranked moderately preferred due to fewer tree removal requirements than Route 1. Conversely, Route 3 will cut through the middle of an L3 woodlot community. Though the proposed route does travel through an existing break in the woodlot, it requires the removal or relocation of a few mature trees. While the total number of trees requiring removal in Route 3 were low, the significance of the community that the route went through was deemed more significant that the other routes. Due to tradeoffs between the number of trees removed and the significance of the vegetation community, Route 3 was ranked as moderately preferred.

Routes 2 and 3b are both considered most preferred. Both routes involve removal of only a few trees along the route. The majority of their routes are located through L+ communities. No species of concern were involved.

All routes discharge out onto the beach through the L2 and L3 beach communities and as such, each route has the same relative effects with regards to those impacts.

Indicator: Potential for forest habitat fragmentation
Overall, Route 1 and Route 3 were deemed to be least preferred, again for two different reasons. Route 1 requires the removal of a large swatch of forest along the western end of the woodlot and requires the removal of an additional 200m swath within the woodlot to realign Applewood Creek. Additional fluvial geomorphological studies would be required to clearly delineate the location and length of that additional fragmentation of the woodlot. Given these extensive impacts, Route 1 was deemed least preferred. In contrast, the effects on habitat fragmentation for Route 3 were somewhat mitigated by the fact that there was already an existing gap in the woodlot that could mostly accommodate the proposed access road. However, ground-truthing highlighted the fact that this route would require the removal or relocation of species of concern, specifically Butternut trees. Furthermore, the proximity of such a haul route to the remaining mature woodlot, would involve extensive root protection works to ensure that further fragmentation of the woodlot (through mature tree die-off) did not occur.

Given the presence of these species of concern and the potential impacts to the remaining woodlot, Route 3 was also deemed to be least preferred.

Route 1B was deemed moderately preferred as it relates to habitat fragmentation. This is primarily due to the wider swath of mature trees requiring removal immediately east of Applewood Creek along the Waterfront Trail. This is a section of Waterfront Trail where tree canopy cover is nearly complete, despite the presence of the trail. To accommodate the road, this would require a significant opening in the tree canopy. As such, this route was deemed moderately preferred.

Route 2 and 3B require by far the least number of trees to accommodate the proposed access routes. No significant increase in habitat fragmentation would occur as a result of these two routes. As such, these routes were deemed Most Preferred.

6.3.2 Criteria: Disruption to Applewood or Serson Creek

Indicator: Length and nature of disruption to Applewood or Serson Creeks
Route 1 requires the realignment of at least 200-m of stream channel in Applewood Creek. This will have direct and significant impacts on fish habitat, water quality and riparian vegetation. Given these impacts, Route 1 was ranked as least preferred.

Route 1B requires the construction of a temporary bridge crossing over Applewood Creek. Overall, the construction of the bridge should not impact fish habitat quality substantially. However, because of the crossing, this does increase the potential for direct discharges from vehicles and debris into the stream as thousands of trucks cross directly over the water course. In addition, in the event of large flood events, the bridge structure may be designed to “fail” to ensure that the structure does not increase the risk due to flooding upstream. The failure of this structure could impact fish habitat quality downstream during the flood, and as a result of “retrieving” the structure after the event. As a result, Route 1B was ranked as moderately preferred.

Routes 2, 3 and 3B do not come within the regulated flood plain for Applewood Creek. As such, these routes will not impact the stream. Thus they were ranked as most preferred.

Indicator: Potential to impair water quality in off-line wetland areas
Three small wetland ponds are located within the Project Study Area. These wetlands are known to contain breeding populations of amphibians. Routes 1 and 1b do not come near any of these ponds. As such, Routes 1 and 1b were deemed most preferred for this indicator.

Routes 2 and 3b both come within approximately 50-m of one of these ponds. Given the distances and ability to avoid these ponds with the construction access routes, Routes 2 and 3b were both ranked as moderately preferred.

Route 3 is within 25-m of one pond and 50-m of another ponds. In fact, the pond that is within 25 m, the road does run along the entire length of the amphibian breeding area. Given the increased exposure and risk to these wetlands Route 3 was ranked as least preferred.

6.3.3 Disruption related to natural hazards (floodplain, erosion)

Indicator: Nature of change on flood conveyance and exposure to natural hazards
As indicated previously, this indicator looks at the level of risk to life and infrastructure associated with natural hazards along the various construction access routes. Road construction has the potential to interfere with existing runoff patterns by creating barriers and altering drainage within hazard lands. These impacts may result in restrictions in surface flow, thereby increasing flood risk upstream. It can also create risks to people, equipment and infrastructure from potential flooding of roads within the flood plain and potentially unstable valley slopes. Analysis was undertaken by professionals to assess the potential natural hazards to which each route is exposed. Routes deemed to have less impact on natural hazards are preferred.

In the case of Route 1, the access road descends a steep valley wall and requires 475-m of road construction within the flood plain. This valley wall feature and placing the primary construction access road within the flood plain represents a significant risk to life and infrastructure, and may potentially increase flooding upstream as well due to the infill of the flood plain. As a result, Route 1 was deemed least preferred.

Route 1b involves a single crossing of Applewood Creek. This crossing is determined to be 18-m long, but would result in the approaches remaining within the regulatory flood plain. As a result, under an extreme event, there is the potential that the approaches would increase flood levels upstream. To mitigate these effects, a longer span bridge could be constructed at much greater cost, or the bridge could be designed to fail at a certain cost. The latter would effectively shut the construction site down until the bridge could be restored. As a result of these issues, Route 1b was deemed moderately preferred.

Route 3 was in close proximity to two wetland ponds and would require crossings to be established over an unnamed ephemeral stream. Route 3 was not located within the regulatory flood plain for Etobicoke Creek. Given the proximity to these natural hazards, Route 3 was deemed Moderately Preferred.

Routes 2 and 3b do not come into proximity of Applewood Creek nor the unnamed ephemeral creek. They are approximately 50-m away from one wetland pond. Given their limited exposure to natural hazards, Routes 2 and 3b were deemed most preferred.

6.3.4 Summary from a Natural Heritage Perspective

From an overall Natural Heritage Perspective:

- Route 1 and Route 3 were deemed Least Preferred;
- Routes 1b was deemed Moderately Preferred; and
- Routes 2 and 3b were deemed Most Preferred.

7.0 MAINTENANCE

The naturalization components of the LWC Project Preferred Alternative will require on-going maintenance activities. These are described below:

- Removal of invasive and undesired plant & animal species from naturalized areas, as deemed necessary.
- Removal of invasive fish species and plants from the lake-connected wetlands if deemed to be negatively affecting the local vegetation communities.
- Removal of debris from wetlands and the low flow channel within Serson and Applewood Creeks following flood and rainfall events, as deemed necessary.
- Maintenance of constructed levee and wetlands systems will be required to ensure wetland function. Water control and carp exclusion structures associated with wetland feeder channels will require ongoing maintenance and monitoring.
- Periodic mowing, burning or manual removal of woody species in order to maintain meadow.
- AEM including monitoring of ecological elements may dictate additional actions required to sustain the intended ecological communities.

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Appendix 1: Fish Survey Records (TRCA and CVC, 2012)

Common Name	Regional Study Area (East)		Regional Study Area (West)				Project Study Area		
	Embayment	Open coast	Embayment	Estuary	Open coast	Stream	Estuary	Open coast	Stream
Alewife*	✓	✓	✓	✓	✓		✓	✓	
American Eel***	✓	✓	✓		✓		✓		
Atlantic Salmon****					✓				
Black Crappie	✓		✓						
Blacknose Dace					✓	✓			✓
Bluegill	✓		✓						
Bluntnose Minnow	✓		✓	✓	✓		✓		
Bowfin					✓				
Brook Silverside	✓								
Brook Stickleback					✓	✓			
Brown Bullhead	✓	✓	✓	✓	✓		✓		
Brown Trout*	✓	✓	✓	✓	✓		✓		
Central Stoneroller								✓	
Chinook Salmon*	✓	✓	✓		✓		✓		
Coho Salmon*	✓						✓		
Common Carp*	✓	✓	✓	✓	✓	✓	✓	✓	
Common Shiner	✓		✓	✓	✓		✓	✓	
Creek Chub					✓	✓			✓
Emerald Shiner	✓	✓	✓	✓	✓		✓	✓	
Fathead Minnow				✓	✓	✓	✓	✓	
Freshwater Drum	✓	✓	✓	✓	✓		✓	✓	
Gizzard Shad**	✓	✓	✓	✓	✓		✓		
Golden Shiner	✓			✓					
Goldfish*	✓	✓					✓		
Greater Redhorse			✓	✓					
Lake Chub	✓	✓		✓	✓	✓		✓	✓
Lake Trout		✓							
Largemouth Bass	✓	✓	✓		✓		✓	✓	
Logperch					✓		✓	✓	

Common Name	Regional Study Area (East)		Regional Study Area (West)				Project Study Area		
	Embayment	Open coast	Embayment	Estuary	Open coast	Stream	Estuary	Open coast	Stream
Longnose Dace			✓	✓	✓	✓		✓	✓
Longnose Gar					✓				
Longnose Sucker					✓				
Mottled Sculpin	✓	✓					✓		
Northern Pike	✓	✓	✓	✓					
Northern Redbelly Dace						✓			
Pumpkinseed	✓	✓	✓	✓	✓	✓	✓		
Rainbow Darter							✓		
Rainbow Smelt*	✓	✓		✓	✓		✓		
Rainbow Trout*	✓	✓	✓		✓		✓		
Rock Bass	✓	✓	✓	✓	✓		✓		
Round Goby*	✓	✓	✓	✓	✓		✓	✓	
Shorthead Redhorse	✓	✓	✓	✓	✓		✓	✓	
Smallmouth Bass	✓	✓	✓	✓	✓		✓	✓	
Spotfin Shiner				✓					
Spottail Shiner	✓	✓	✓	✓	✓		✓	✓	
Threespine Stickleback	✓	✓			✓	✓			
Trout-perch		✓					✓		
Walleye	✓								
White Bass*		✓		✓			✓		
White Perch*	✓	✓		✓	✓		✓		
White Sucker	✓	✓	✓	✓	✓	✓	✓	✓	
Yellow Perch	✓	✓	✓	✓	✓		✓	✓	
TOTAL	**34**	**29**	**26**	**27**	**35**	**11**	**31**	**17**	**4**

* indicates introduced and/or invasive species.
** indicates uncertainty regarding designation as a non-native species.
*** indicates listed Aquatic Species at Risk
**** indicates listed under COSEWIC as Extirpated (reintroduced)

Appendix 2: Flora Species Recorded Within the LWC Project Study Area

Taxa Type	Scientific Name	Common Name	COSEWIC Status	SARA Status	SARO Status	Provincial Rank	Regional Rank	Local Rank	7E4 Rarity	TRCA Ranking	Source
Fern	*Equisetum arvense*	Field Horsetail	-	-	-	S5	-	-	-	L5	TRCA
Fern	*Matteuccia struthiopteris var. pensylvanica*	Ostrich Fern	-	-	-	S5	-	-	-	L5	CVC
Fern	*Onoclea sensibilis*	Sensitive Fern	-	-	-	S5	-	-	-	L5	CVC
Forb	*Achillea millefolium ssp. millefolium*	Common Yarrow	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Actaea pachypoda*	White Baneberry	-	-	-	S5	-	-	-	L4	CVC
Forb	*Agastache scrophulariifolia*	Purple Giant Hyssop	-	-	-	S1	-	-	-	pL+	TRCA
Forb	*Agrimonia gryposepala*	Tall Hairy Groovebur	-	-	-	S5	-	-	-	L5	CVC
Forb	*Alliaria petiolata*	Garlic Mustard	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Ambrosia artemisiifolia*	Common Ragweed	-	-	-	S5	-	-	-	L5	CVC
Forb	*Ambrosia trifida*	Giant Ragweed	-	-	-	S5	-	-	-	L5	CVC
Forb	*Anaphalis margaritacea*	Pearly Everlasting	-	-	-	S5	-	-	rare	pL3	TRCA
Forb	*Anemone canadensis*	Canada Anemone	-	-	-	S5	-	-	-	L5	TRCA
Forb	*Anemone quinquefolia var quinquefolia*	Wood-anemone	-	-	-	SU	-	-	-	L3	TRCA
Forb	*Anemone virginiana*	Virginia Anemone	-	-	-	S5	-	-	-	L5	TRCA
Forb	*Apocynum androsaemifolium ssp. androsaemifolium*	Spreading Dogbane subspecies	-	-	-	S5	-	-	-	L4	TRCA
Forb	*Aralia nudicaulis*	Wild Sarsaparilla	-	-	-	S5	-	-	-	L5	CVC
Forb	*Arctium lappa*	Greater Burdock	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Arctium minus ssp. minus*	Common Burdock	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Arisaema triphyllum ssp. triphyllum*	Jack-in-the-pulpit subspecies	-	-	-	S5	-	-	-	L5	TRCA
Forb	*Artemisia vulgaris*	Common Wormwood	-	-	-	SNA	-	-	-	L+	CVC

Taxa Type	Scientific Name	Common Name	COSEWIC Status	SARA Status	SARO Status	Provincial Rank	Regional Rank	Local Rank	7E4 Rarity	TRCA Ranking	Source
Forb	*Asclepias syriaca*	Common Milkweed	-	-	-	S5	-	-	-	L5	CVC
Forb	*Asparagus officinalis*	Garden Asparagus	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Bidens frondosa*	Devil's Beggar-ticks	-	-	-	S5	-	-	-	L5	TRCA
Forb	*Boehmeria cylindrica*	False Nettle	-	-	-	S5	-	-	uncom mon	L4	TRCA
Forb	*Brassica rapa*	Bird's Rape	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Cakile edentula*	American Sea-rocket	-	-	-	S4	rare	rare	rare	L2	CVC
Forb	*Calystegia spithamaea ssp. spithamaea*	Low False Bindweed	-	-	-	S4S5	-	-	rare	L3	CVC
Forb	*Campanula rapunculoides*	Creeping Bellflower	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Chamaesyce sp.*	Spurge sp.	-	-	-	-	-	-	-	-	TRCA
Forb	*Chrysanthemum leucanthemum*	Oxeye Daisy	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Cichorium intybus*	Chicory	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Cicuta maculata*	Spotted Water-hemlock	-	-	-	S5	-	-	-	L5	CVC
Forb	*Circaea canadensis ssp. Canadensis*	Enchanter's Nightshade	-	-	-	S5	-	-	-	L5	TRCA
Forb	*Circaea lutetiana ssp. canadensis*	Intermediate Enchanter's Nightshade	-	-	-	S5	-	-	-	L5	CVC
Forb	*Cirsium arvense*	Creeping Thistle	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Cirsium vulgare*	Bull Thistle	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Coronilla varia*	Common Crown-vetch	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Daucus carota*	Queen Anne's Lace	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Desmodium canadense*	Showy Tick-trefoil	-	-	-	S4	-	rare	-	L5	CVC
Forb	*Dipsacus fullonum ssp. sylvestris*	Teasel	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Echium vulgare*	Common Viper's-bugloss	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Epifagus virginiana*	Beechdrops	-	-	-	S5	-	-	-	L4	TRCA

Taxa Type	Scientific Name	Common Name	COSEWIC Status	SARA Status	SARO Status	Provincial Rank	Regional Rank	Local Rank	7E4 Rarity	TRCA Ranking	Source
Forb	*Epilobium ciliatum ssp. ciliatum*	Hairy Willow-herb subspecies	-	-	-	S5	-	-	-	L5	TRCA
Forb	*Erigeron philadelphicus ssp. philadelphicus*	Philadelphia Fleabane	-	-	-	S5	-	-	-	L5	TRCA
Forb	*Erythronium americanum ssp. americanum*	Yellow Trout-lily	-	-	-	S5	-	-	-	L5	TRCA
Forb	*Eupatorium maculatum ssp. maculatum*	Spotted Joe-pye Weed	-	-	-	S5	-	-	-	L5	CVC
Forb	*Euphorbia esula*	Leafy Spurge	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Eurybia macrophylla*	Large-leaf Wood Aster	-	-	-	S5	-	-	-	L4	TRCA
Forb	*Euthamia graminifolia*	Flat-top Goldentop	-	-	-	S5	-	-	-	L5	CVC
Forb	*Eutrochium maculatum var. Maculatum*	Spotted Joe-pye Weed	-	-	-	S5	-	-	-	L5	TRCA
Forb	*Fallopia japonica var. Japonica / Polygonum cuspidatum*	Japanese Knotweed	-	-	-	SNA	-	-	-	L+	TRCA
Forb	*Fragaria vesca ssp. americana*	Woodland Strawberry	-	-	-	S5	-	-	-	L5	CVC
Forb	*Fragaria virginiana ssp. virginiana*	Common Strawberry	-	-	-	SU	-	-	-	L5	TRCA
Forb	*Galium palustre*	Marsh Bedstraw	-	-	-	S5	-	-	-	L5	TRCA
Forb	*Geranium maculatum*	Wild Crane's-bill	-	-	-	S5	-	-	-	L4	CVC
Forb	*Geranium robertianum*	Herb-robert	-	-	-	SNA	-	-	-	L+?	TRCA
Forb	*Geum aleppicum*	Yellow Avens	-	-	-	S5	-	-	-	L5	CVC
Forb	*Geum canadense*	White Avens	-	-	-	S5	-	-	-	L5	TRCA
Forb	*Geum urbanum*	Herb Bennet	-	-	-	SNA	-	-	-	L+	TRCA
Forb	*Hemerocallis fulva*	Orange Daylily	-	-	-	SNA	-	-	-	L+	TRCA
Forb	*Heracleum mantegazzianum*	Giant Hogweed	-	-	-	SNA	-	-	-	L+	CVC

Taxa Type	Scientific Name	Common Name	COSEWIC Status	SARA Status	SARO Status	Provincial Rank	Regional Rank	Local Rank	7E4 Rarity	TRCA Ranking	Source
Forb	*Hesperis matronalis*	Dame's Rocket	-	-	-	SNA	-	-	-	L+	TRCA
Forb	*Hieracium sp.*	Hawkweed species	-	-	-	-	-	-	-	-	CVC
Forb	*Hydrophyllum virginianum*	John's Cabbage	-	-	-	S5	-	-	-	L5	TRCA
Forb	*Hypericum perforatum*	Common St. John's-wort	-	-	-	SNA	-	-	-	L+	TRCA
Forb	*Impatiens capensis*	Spotted Touch-me-not	-	-	-	S5	-	-	-	L5	CVC
Forb	*Iris pseudacorus*	Yellow Flag	-	-	-	SNA	-	-	-	L+	TRCA
Forb	*Laportea canadensis*	Wood Nettle	-	-	-	S5	-	-	-	L5	TRCA
Forb	*Lemna minor*	Lesser Duckweed	-	-	-	S5	-	-	-	L5	TRCA
Forb	*Leonurus cardiaca ssp. cardiaca*	Common Motherwort	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Linaria vulgaris*	Butter-and-eggs	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Lotus corniculatus*	Birds-foot Trefoil	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Lysimachia ciliata*	Fringed Loosestrife	-	-	-	S5	-	-	-	L5	TRCA
Forb	*Lysimachia nummularia*	Creeping Jennie	-	-	-	SNA	-	-	-	L+	TRCA
Forb	*Lythrum salicaria*	Purple Loosestrife	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Maianthemum canadense*	Canada Mayflower	-	-	-	S5	-	-	-	L4	TRCA
Forb	*Maianthemum racemosum ssp. Racemosum*	False Solomon's-seal	-	-	-	S5	-	-	-	L5	TRCA
Forb	*Medicago lupulina*	Black Medic	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Medicago sativa ssp. sativa*	Alfalfa	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Melilotus albus*	White Sweet Clover	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Melilotus officinalis*	Yellow Sweet Clover	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Mentha arvensis ssp. Borealis*	Wild Mint	-	-	-	S5	-	-	-	L5	CVC
Forb	*Monarda fistulosa*	Wild Bergamot Bee-balm	-	-	-	S5	-	-	-	L4	CVC

Taxa Type	Scientific Name	Common Name	COSEWIC Status	SARA Status	SARO Status	Provincial Rank	Regional Rank	Local Rank	7E4 Rarity	TRCA Ranking	Source
Forb	*Nepeta cataria*	Catnip	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Oenothera biennis*	Common Evening-primrose	-	-	-	S5	-	-	uncommon	L5	TRCA
Forb	*Osmorhiza claytonii*	Hairy Sweet-cicely	-	-	-	S5	-	-	uncommon	L4	CVC
Forb	*Papaver orientale*	Oriental Poppy	-	-	-	SNA	-	-	-	L+	TRCA
Forb	*Pastinaca sativa*	Wild Parsnip	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Penstemon hirsutus*	Hairy Beardtongue	-	-	-	S4	rare	rare	rare	pL3	TRCA
Forb	*Plantago lanceolata*	English Plantain	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Plantago major*	Common Plantain	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Podophyllum peltatum*	May Apple	-	-	-	S5	-	-	-	L5	CVC
Forb	*Polygonatum pubescens*	Downy Solomon's-seal	-	-	-	S5	-	-	-	L4	CVC
Forb	*Polygonum persicaria*	Lady's Thumb	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Potentilla anserina*	Silverweed	-	-	-	S5	-	rare	-	L5	CVC
Forb	*Potentilla norvegica ssp. norvegica*	Norwegian Cinquefoil	-	-	-	SU	-	-	-	-	CVC
Forb	*Potentilla recta*	Sulphur Cinquefoil	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Prenanthes altissima*	Tall Rattlesnake-root	-	-	-	S5	-	-	-	L5	CVC
Forb	*Prunella vulgaris ssp. lanceolata*	Lance Self-heal	-	-	-	S5	-	-	-	L+?	TRCA
Forb	*Ranunculus acris*	Tall Buttercup	-	-	-	SNA	-	-	-	L+	TRCA
Forb	*Rumex crispus*	Curly Dock	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Salsola kali*	Russian Thistle	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Saponaria officinalis*	Bouncing-bet	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Solidago altissima var. altissima*	Late Goldenrod	-	-	-	-	-	-	-	L5	TRCA
Forb	*Solidago caesia*	Bluestem Goldenrod	-	-	-	S5	-	-	-	L5	CVC
Forb	*Solidago canadensis var. canadensis*	Canada Goldenrod variety	-	-	-	S5	-	-	-	L5	CVC

Taxa Type	Scientific Name	Common Name	COSEWIC Status	SARA Status	SARO Status	Provincial Rank	Regional Rank	Local Rank	7E4 Rarity	TRCA Ranking	Source
Forb	*Solidago flexicaulis*	Zig-zag Goldenrod	-	-	-	S5	-	-	-	L5	TRCA
Forb	*Solidago gigantea*	Smooth Goldenrod	-	-	-	S5	-	-	-	L5	CVC
Forb	*Solidago juncea*	Early Goldenrod	-	-	-	S5	-	-	uncom mon	L4	TRCA
Forb	*Solidago nemoralis ssp. nemoralis*	Gray Goldenrod	-	-	-	S5	-	-	-	L5	CVC
Forb	*Solidago patula*	Roundleaf Goldenrod	-	-	-	S5	rare	rare	rare	L3	CVC
Forb	*Sonchus arvensis ssp. arvensis*	Perennial Sowthistle	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Stellaria graminea*	Little Starwort	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Symphyotrichum novae-angliae*	New England Aster	-	-	-	S5	-	-	-	L5	CVC
Forb	*Symphyotrichum oolentangiense*	Sky-blue Aster	-	-	-	S4	rare	rare	rare	L4	CVC
Forb	*Symphyotrichum cordifolium*	Heart-leaf Aster	-	-	-	S5	-	-	-	L5	TRCA
Forb	*Symphyotrichum ericoides var. ericoides*	White Heath Aster	-	-	-	S5	-	-	-	L5	CVC
Forb	*Symphyotrichum lanceolatum ssp. lanceolatum*	Panicled Aster subspecies	-	-	-	S5	-	-	-	L5	TRCA
Forb	*Tanacetum vulgare*	Common Tansy	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Taraxacum officinale*	Brown-seed Dandelion	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Thalictrum dioicum*	Early Meadow-rue	-	-	-	S5	-	-	-	L5	TRCA
Forb	*Thalictrum pubescens*	Tall Meadow-rue	-	-	-	S5	-	-	-	L5	CVC
Forb	*Torilis japonica*	Erect Hedge-parsley	-	-	-	SNA	-	-	-	L+	TRCA
Forb	*Tragopogon dubius*	Meadow Goat's-beard	-	-	-	SNA	-	-	-	L+	CVC

Taxa Type	Scientific Name	Common Name	COSEWIC Status	SARA Status	SARO Status	Provincial Rank	Regional Rank	Local Rank	7E4 Rarity	TRCA Ranking	Source
Forb	*Tragopogon pratensis ssp. pratensis*	Jack go to bed at noon	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Trifolium pratense*	Red Clover	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Trifolium repens*	White Clover	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Trillium grandiflorum*	White Trillium	-	-	-	S5	-	-	-	L4	TRCA
Forb	*Tussilago farfara*	Colt's Foot	-	-	-	SNA	-	-	-	L+	TRCA
Forb	*Typha angustifolia*	Narrow-leaved Cattail	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Typha latifolia*	Broad-leaf Cattail	-	-	-	S5	-	-	-	L4	CVC
Forb	*Typha x glauca*	White Cattail	-	-	-	SNA	-	-	-	L+	TRCA
Forb	*Urtica dioica ssp. dioica*	Stinging Nettle	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Verbascum thapsus*	Great Mullein	-	-	-	SNA	-	-	-	L+	CVC
Forb	*Verbena hastata*	Blue Vervain	-	-	-	S5	-	-	-	L5	CVC
Forb	*Viola pubescens*	Downy Yellow Violet	-	-	-	S5	-	-	-	L5	TRCA
Forb	*Viola sororia*	Common Blue Violet	-	-	-	S5	-	-	-	L5	TRCA
Forb	*Wolffia columbiana*	Columbia Watermeal	-	-	-	S4S5	-	-	rare	L4	TRCA
Forb	*Xanthium strumarium*	Rough Cocklebur	-	-	-	S5	-	-	-	L5	TRCA
Grass	*Agrostis stolonifera*	Spreading Bentgrass	-	-	-	S5	-	-	-	L+?	CVC
Grass	*Bromus inermis ssp. inermis*	Awnless Brome	-	-	-	SE5	-	-	-	L+	TRCA
Grass	*Bromus tectorum*	Cheat Grass	-	-	-	SNA	-	-	-	L+	CVC
Grass	*Dactylis glomerata*	Orchard Grass	-	-	-	SNA	-	-	-	L+	CVC
Grass	*Echinochloa crusgalli*	Barnyard Grass	-	-	-	SNA	-	-	-	L+	CVC
Grass	*Elymus repens*	Quackgrass	-	-	-	SNA	-	-	-	L+	CVC
Grass	*Festuca pratensis*	Meadow fescue	-	-	-	SNA	-	-	-	L+	TRCA
Grass	*Glyceria striata*	Fowl Manna-grass	-	-	-	S5	-	-	-	L5	TRCA
Grass	*Phalaris arundinacea*	Reed Canary Grass	-	-	-	S5	-	-	-	L+?	CVC
Grass	*Phleum pratense*	Meadow Timothy	-	-	-	SNA	-	-	-	L+	TRCA
Grass	*Phragmites australis ssp. Australis*	Common Reed	-	-	-	S5	-	-	-	L+?	CVC

Taxa Type	Scientific Name	Common Name	COSEWIC Status	SARA Status	SARO Status	Provincial Rank	Regional Rank	Local Rank	7E4 Rarity	TRCA Ranking	Source
Grass	*Poa pratensis ssp. pratensis*	Kentucky Bluegrass	-	-	-	S5	-	-	-	L+	CVC
Rush	*Juncus dudleyi*	Dudley's Rush	-	-	-	S5	-	-	-	L5	TRCA
Sedge	*Bolboschoenus fluviatilis*	River Bulrush	-	-	-	S4S5	rare	rare	rare	L3	TRCA
Sedge	*Carex blanda*	Woodland Sedge	-	-	-	S5	-	-	-	L5	TRCA
Sedge	*Carex cristatella*	Crested Sedge	-	-	-	S5	-	-	-	L5	TRCA
Sedge	*Carex lacustris*	Lake-bank Sedge	-	-	-	S5	-	-	uncom mon	L4	TRCA
Sedge	*Carex pensylvanica*	Pennsylvania Sedge	-	-	-	S5	-	-	-	L4	TRCA
Sedge	*Carex radiata*	Stellate Sedge	-	-	-	S4	-	-	-	L5	TRCA
Sedge	*Carex vulpinoidea*	Fox Sedge	-	-	-	S5	-	-	-	L5	TRCA
Sedge	*Schoenoplectus tabernaemontani*	Soft-stem Bulrush	-	-	-	S5	-	-	-	L4	TRCA
Shrub	*Acer ginnala*	Amur Maple	-	-	-	SNA	-	-	-	L+, pL+	CVC
Shrub	*Alnus incana ssp. rugosa*	Speckled Alder	-	-	-	S5	-	-	-	L3	CVC
Shrub	*Amelanchier sp.*	Serviceberry species	-	-	-	-	-	-	-	-	CVC
Shrub	*Berberis vulgaris*	European Barberry	-	-	-	SNA	-	-	-	L+	CVC
Shrub	*Carpinus caroliniana*	American Hornbeam	-	-	-	S5	-	-	-	L4	TRCA
Shrub	*Cornus alternifolia*	Alternate-leaf Dogwood	-	-	-	S5	-	-	-	L5	TRCA
Shrub	*Cornus rugosa*	Roundleaf Dogwood	-	-	-	S5	-	-	-	L4	CVC
Shrub	*Cornus stolonifera*	Red-osier Dogwood	-	-	-	S5	-	-	-	L5	CVC
Shrub	*Corylus cornuta*	Beaked Hazelnut	-	-	-	S5	-	-	-	L4	TRCA
Shrub	*Crataegus monogyna*	English Hawthorn	-	-	-	SNA	-	-	-	L+	CVC
Shrub	*Crataegus punctata*	Dotted Hawthorn	-	-	-	S5	-	-	-	L5	TRCA
Shrub	*Diervilla lonicera*	Northern Bush-honeysuckle	-	-	-	S5	-	-	-	pL4, L4	CVC
Shrub	*Elaeagnus angustifolia*	Russian Olive	-	-	-	SNA	-	-	-	L+	CVC
Shrub	*Elaeagnus umbellata*	Autumn Olive	-	-	-	SNA	-	-	-	L+	CVC
Shrub	*Hamamelis virginiana*	American Witch-hazel	-	-	-	S5	-	-	-	L3	CVC

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Shrub	*Lonicera dioica*	Mountain Honeysuckle	-	-	-	S5	-	-	-	L3	TRCA
Shrub	*Lonicera morrowii*	Morrow Honeysuckle	-	-	-	SNA	-	-	-	L+	TRCA
Shrub	*Lonicera tatarica*	Tartarian Honeysuckle	-	-	-	SNA	-	-	-	L+	CVC
Shrub	*Lonicera x bella*	Bella Honeysuckle	-	-	-	SNA	-	-	-	L+	TRCA
Shrub	*Malus pumila*	Common Apple	-	-	-	SNA	-	-	-	L+	CVC
Shrub	*Prunus virginiana ssp. virginiana*	Chokecherry	-	-	-	S5	-	-	-	L5	CVC
Shrub	*Rhamnus cathartica*	Common Buckthorn	-	-	-	SNA	-	-	-	L+	TRCA
Shrub	*Rhus hirta*	Staghorn Sumac	-	-	-	S5	-	-	-	L5	CVC
Shrub	*Rhus radicans ssp. Rydbergii*	Poison Ivy	-	-	-	S5	-	-	-	L5	TRCA
Shrub	*Ribes americanum*	Wild Black Currant	-	-	-	S5	-	-	-	L5	CVC
Shrub	*Ribes rubrum*	Northern Red Currant	-	-	-	SNA	-	-	-	L+	CVC
Shrub	*Rosa blanda*	Smooth Rose	-	-	-	S5	-	-	-	pL4	TRCA
Shrub	*Rosa multiflora*	Multiflora Rose	-	-	-	SNA	-	-	-	L+	CVC
Shrub	*Rubus alleghaniensis*	Allegheny Blackberry	-	-	-	S5	-	-	-	L5	TRCA
Shrub	*Rubus idaeus ssp. strigosus*	Grayleaf Red Raspberry	-	-	-	S5	-	-	-	L5	CVC
Shrub	*Rubus occidentalis*	Black Raspberry	-	-	-	S5	-	-	-	L5	TRCA
Shrub	*Rubus odoratus*	Purple Flowering Raspberry	-	-	-	S5	-	-	-	L5	CVC
Shrub	*Salix eriocephala*	Heart-leaved Willow	-	-	-	S5	-	-	-	L5	CVC
Shrub	*Salix exigua*	Sandbar Willow	-	-	-	S5	-	rare	-	L5	CVC
Shrub	*Salix petiolaris*	Meadow Willow	-	-	-	S5	-	-	rare	L4	CVC
Shrub	*Sambucus canadensis*	Common Elderberry	-	-	-	S5	-	-	-	L5	CVC
Shrub	*Sambucus racemosa ssp. pubens*	Red Elderberry	-	-	-	S5	-	-	-	L5	TRCA
Shrub	*Solanum rostratum*	Buffalo Bur	-	-	-	SNA	-	-	-	L+	TRCA
Shrub	*Sorbus sp.*	Mountain-ash species	-	-	-	-	-	-	-	-	CVC
Shrub	*Syringa vulgaris*	Common Lilac	-	-	-	SNA	-	-	-	L+	CVC

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Shrub	*Viburnum acerifolium*	Maple-leaf Viburnum	-	-	-	S5	-	-	-	L3	TRCA
Shrub	*Viburnum lentago*	Nannyberry	-	-	-	S5	-	-	-	L5	TRCA
Shrub	*Viburnum opulus*	Guelder-rose Viburnum	-	-	-	SNA	-	-	-	L+	TRCA
Tree	*Acer negundo*	Manitoba Maple	-	-	-	S5	-	-	-	L+?	CVC
Tree	*Acer platanoides*	Norway Maple	-	-	-	SNA	-	-	-	L+	CVC
Tree	*Acer rubrum*	Red Maple	-	-	-	S5	-	-	-	L4	CVC
Tree	*Acer saccharinum*	Silver Maple	-	-	-	S5	-	-	-	L4	CVC
Tree	*Acer saccharum ssp. saccharum*	Sugar Maple	-	-	-	S5	-	-	-	L5	TRCA
Tree	*Betula alleghaniensis*	Yellow Birch	-	-	-	S5	-	-	-	L4	CVC
Tree	*Betula papyrifera*	Paper Birch	-	-	-	S5	-	-	-	L4	CVC
Tree	*Carya ovata*	Shag-bark Hickory	-	-	-	S5	-	-	uncom mon	L3	TRCA
Tree	*Fagus grandifolia*	American Beech	-	-	-	S4	-	-	-	L4	CVC
Tree	*Fraxinus americana*	White Ash	-	-	-	S5	-	-	-	L5	CVC
Tree	*Fraxinus pannsylvanica*	Green Ash variety	-	-	-	S5	-	-	-	L5, pL5	TRCA
Tree	*Fraxinus pennsylvanica var. subintegerrima*	Green Ash variety	-	-	-	S5	-	-	-	L5	CVC
Tree	*Juglans cinerea*	Butternut	END	END (Sch 1)	END	S3?	-	-	-	L3	CVC
Tree	*Juglans nigra*	Black Walnut	-	-	-	S4	-	-	-	L5	CVC
Tree	*Juniperus virginiana*	Eastern Red Cedar	-	-	-	S5	-	rare	rare	L5	CVC
Tree	*Larix decidua*	European Larch	-	-	-	SNA	-	-	-	pL+, ? L+	CVC
Tree	*Ostrya virginiana*	Eastern Hop-hornbeam	-	-	-	S5	-	-	-	L5	TRCA
Tree	*Picea abies*	Norway Spruce	-	-	-	SNA	-	-	-	pL+, ?; L+	CVC
Tree	*Picea glauca*	White Spruce	-	-	-	S5	-	rare	-	pL3, ?; L3	CVC
Tree	*Picea pungens*	Blue Spruce	-	-	-	SNA	-	-	-	L+	CVC
Tree	*Pinus nigra*	Black Pine	-	-	-	SNA	-	-	-	L+	CVC
Tree	*Pinus resinosa*	Red Pine	-	-	-	S5	rare	rare	rare	L2	CVC

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Tree	*Pinus strobus*	Eastern White Pine	-	-	-	S5	-	-	-	L4	CVC
Tree	*Pinus sylvestris*	Scotch Pine	-	-	-	SNA	-	-	-	pL+; L+	CVC
Tree	*Populus balsamifera ssp. balsamifera*	Balsam Poplar	-	-	-	S5	-	-	-	L5	TRCA
Tree	*Populus deltoides*	Eastern Cottonwood	-	-	-	S5	-	-	-	L5	CVC
Tree	*Populus deltoides ssp. deltoides*	Eastern Cottonwood subspecies	-	-	-	SU	-	-	-		CVC
Tree	*Populus nigra*	Black Cottonwood	-	-	-	SNA	-	-	-	prL+	TRCA
Tree	*Populus tremuloides*	Trembling Aspen	-	-	-	S5	-	-	-	L5	CVC
Tree	*Populus x canadensis*	Carolina Poplar	-	-	-	SNA	-	-	-	pL+	TRCA
Tree	*Prunus serotina*	Wild Black Cherry	-	-	-	S5	-	-	-	L5	CVC
Tree	*Quercus alba*	White Oak	-	-	-	S5	-	-	-	L2	CVC
Tree	*Quercus palustris*	Pin Oak	-	-	-	S4	-	-	-	-	CVC
Tree	*Quercus robur*	English Oak	-	-	-	SNA	-	-	-	L+	CVC
Tree	*Quercus rubra*	Northern Red Oak	-	-	-	S5	-	-	-	L4	CVC
Tree	*Robinia pseudo-acacia*	Black Locust	-	-	-	SE5	-	-	-	L+	TRCA
Tree	*Salix alba var. alba*	White Willow	-	-	-	SNA	-	-	-	L+	CVC
Tree	*Salix fragilis*	Crack Willow	-	-	-	SNA	-	-	-	L+	CVC
Tree	*Thuja occidentalis*	Eastern White Cedar	-	-	-	S5	-	-	-	pL4, ?; L4	CVC
Tree	*Tilia americana*	American Basswood	-	-	-	S5	-	-	-	L5	CVC
Tree	*Tilia cordata*	Little-leaf Linden	-	-	-	SNA	-	-	-	L+	CVC
Tree	*Tsuga canadensis*	Eastern Hemlock	-	-	-	S5	-	-	-	L4	TRCA
Tree	*Ulmus americana*	American Elm	-	-	-	S5	-	-	-	L5	TRCA
Tree	*Ulmus pumila*	Siberian Elm	-	-	-	SNA	-	-	-	L+	CVC
Vine	*Cynanchum rossicum*	European Swallow-wort	-	-	-	SNA	-	-	-	L+	TRCA
Vine	*Echinocystis lobata*	Wild Mock-cucumber	-	-	-	S5	-	-	-	L5	CVC
Vine	*Vicia cracca*	Tufted Vetch	-	-	-	SNA	-	-	-	L+	CVC

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Woody vine	*Parthenocissus inserta*	Thicket Creeper	-	-	-	S5	-	-	-	L5	CVC
Woody vine	*Rhus radicans ssp. negundo*	Poison Ivy subspecies	-	-	-	S5	-	-	-	L5	CVC
Woody vine	*Solanum dulcamara*	Climbing Nightshade	-	-	-	SNA	-	-	-	L+	CVC
Woody vine	*Vitis riparia*	Riverbank Grape	-	-	-	S5	-	-	-	L5	CVC