1 Port Street East Proposed Marina Environmental Assessment

Technical Memorandum | Aquatic Ecology

September 2023

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January 19, 2023

Memorandum

To: Beata Palka
The City of Mississauga

From: Michael Roy

cc:: Credit Valley Conservation

Subject: AQUATIC ECOLOGY TECHNICAL MEMORANDUM FOR THE 1 PORT STREET EAST PROPOSED MARINA PROJECT (1PSEM PROJECT)

1.0 INTRODUCTION

The City of Mississauga (the City) is undertaking the Environmental Assessment (EA) for the 1 Port Street East Proposed Marina Project (1PSEPM Project) to investigate expansion of the land base around the eastern breakwater to provide continued marina services at this site, as well as create public access to the waterfront, new parkland and enhance the site's ecological functions. This section of the Mississauga Waterfront has been the subject of many studies seeking to identify improvements to habitat function, public access, and recreational activities. The 1PSEPM Project was identified by Inspiration Port Credit as a key opportunity to "keep the Port in Port Credit", while enhancing public access and ecological function of the site.

SLR has been retained by Shoreplan Engineering Inc. (Shoreplan) to (among other disciplines) investigate and address the aquatic and terrestrial ecology and habitat conditions within the Study Area in support of the Baseline Conditions Characterization and the Environmental Effects phases of the study. This memo is provided at the request of Credit Valley Conservation (CVC), to facilitate their commenting process during the preparation of the Individual Environmental Assessment for the 1PSEPM Project.

This memo address:

1. Existing aquatic habitat conditions based upon the compilation of secondary source material and underwater field investigations performed by SLR ecologists
2. Potential effects to fish habitat
3. Conceptual fish habitat off-setting and enhancement opportunities
4. Existing terrestrial habitat conditions based upon the compilation of secondary source material and reconnaissance level field investigations
5. Potential effects to terrestrial habitat
6. Conceptual terrestrial habitat creation and enhancement opportunities

1.1 PURPOSE

The objectives of the aquatic and terrestrial ecology work are to provide meaningful input to the EA through the documentation of existing fish and terrestrial habitat conditions, assessing potential project effects, and identifying opportunities to improve the existing aquatic and terrestrial habitat of this location. This work also contributes toward the 1PSEPM Project achieving conformity of the with the *Fisheries Act.* The key tasks include:

- Obtain, review, and synthesize background information and data from Credit Valley Conservation (CVC), Fisheries and Oceans Canada (DFO), Ministry of Natural Resources and Forestry (MNRF), and the Credit River Anglers Association (CRAA), related to existing fish presence, usage, and aquatic habitat within the marina and nearshore area.
- Investigate and characterize the existing aquatic habitat and document critical habitat features.
- Evaluate potential effects to fish and terrestrial habitat.
- Identify habitat restoration and enhancement opportunities.

The challenge associated with this undertaking includes determining the need for, and if required, developing candidate offsetting measures to address potential harm or loss to known fish habitat. While working with CVC on the Lake Ontario Integrated Shoreline Strategy (LOISS) assessment projects, our Team has identified technically feasible opportunities to enhance the aquatic habitat within the CVC watershed. As the 1PSEPM Project moves through the EA process, it will be important to also identify onsite offsetting opportunities as that is typically DFO's preferred approach. SLR is also aware of other nearby projects within the Credit River, that may provide beneficial enhancement to offset this potential impacts of this project.

2.0 AQUATIC ECOLOGY OF THE STUDY AREA

2.1 METHODS

2.1.1 Desktop Analysis

As part of the desktop analysis, SLR ecologists collected, reviewed, and interpreted secondary source materials prepared by private consultants and government agencies, regarding existing fish and aquatic habitat conditions with the Study Area. Additionally, SLR reviewed available open-source reports and databases to support the characterization of existing conditions at the site. Documents reviewed as part of the desktop analysis are presented in Table 1.

Table 1: Information Source Summary and Description

Data Description	Source
LOISS Assessment and Mapping of Coastal Engineering Structures, December 2016	CVC, Shoreplan
LOISS Background Report APP B Fluvial Geomorphology, 2011	Aquafor Beech Limited
LOISS Characterization Final, December 2018	CVC
Credit River Estuary Report Final, March 31, 2014	CVC
Memo One Port Street – Heat Model, July 2017	CVC
Memo – Cost Estimate for One Port Street Fish Habitat Compensation, August 3, 2017	CVC
Aerial Imagery	Google Earth
Bathymetry Mapping	Online website

Data Description	Source
Ministry of Natural Resources and Forestry, Natural Heritage Information Centre (NHIC), Element Occurrences, 2018, Accessed on-line December 1, 2020 "Map A Natural Heritage Map"	Online website
Ministry of Natural Resources and Forestry, Land Information Ontario (LIO), Wetlands, ANSI, Natural Features, GIS shapefiles and metadata Downloaded December 1, 2020	Online website
Fisheries and Oceans Canada Distribution Maps for Fish and Mussel Species at Risk (modified 2019-08-23).	Online website

2.1.2 Agency Consultation

In addition to querying publicly available digital sources, data requests were prepared and submitted to organizations for additional fish and aquatic habitat information. This information will assist SLR in further characterizing flood limits, regulatory or jurisdictional boundaries or limits, surficial geology, wetland delineation and evaluation, fish community data, and known elemental occurrences for Species at Risk (SAR) and regulated habitat mapping within the Study Area. Data requests were submitted to the following organizations:

- Maricris Marinas, Planner, CVC
- Bohdan Kowalyk, District Planner, Aurora District, MNRF
- Ministry of the Environment, Conservation and Parks (MOECP)

To date, SLR has not yet received the requested data.

2.1.3 Aquatic Habitat Field Characterization

Information gathered as part of the desktop analysis was supplemented with observations and data collected by SLR ecologists, during recent field investigations. On May 19th, 2021, SLR ecologists completed an aquatic habitat assessment within the Study Area in Lake Ontario, to document and characterize existing aquatic habitat conditions, critical habitat features, and potential areas or opportunities for aquatic habitat restoration and enhancement. A boat and boat operator were hired and used to access the Study Area and perform habitat characterization activities. The field investigation was completed on a calm and sunny day to maximize the quality of data collected. Data was collected along multiple transects to aid in the translation of field observations to maps and figures, for use later in the EA. SLR ecologists executed transects perpendicular to the breakwater, to collect observations and data at various water depths.

For this field investigation, the Study Area was divided into three primary locations to support the characterization of aquatic habitat: east side of (eastern) breakwater, west side of (eastern) breakwater, and within the marina (basin). The Eastern Breakwater, Western Breakwater, and Marina Basin are presented on Figure 1 for reference.

Data to support the characterization of the existing aquatic habitat was collected using the following equipment:

- Heron Instruments underwater camera with a downrigger;
- Raymarine Axiom 3D Vision and Hummingbird GPS sonar;
- YSI Sonde;
- Fish Hawk wireless X4D temperature and depth console; and,
- Ponar dredge.

Specific habitat parameters recorded in the field, included:

- Substrate classification;
- Water depth;
- In-stream and riparian vegetation;
- Bank stability and cover;
- Areas of critical habitat for potential SAR;
- Habitat for various life stages of fish (e.g., spawning, rearing, migration, overwintering);
- Supplemental habitat features such as nursery or feeding areas; and,
- Presence of fish barriers and system connectivity.

In-situ water quality parameters collected in the field included electrical conductivity, water and air temperature, and dissolved oxygen concentration. Representative photographs of each sampling location were taken. Fish sampling activities were not included within this scope of work.

Substrate type was visually classified as a percentage, using six categories based on particle diameter: boulder (300 – 600 mm); rubble (100 – 300 mm); cobble (75 – 100 mm); gravel (5 – 75 mm); sand (1 – 5 mm); and fine (<1 mm). Aquatic vegetation cover was concurrently assessed, with percent cover classified into one of four categories: none (0%); sparse (0-25%); moderate (25-50%); and dense (50-100%). Substrate and aquatic vegetation cover were assessed at several points along a single transect.

The spatial extent of observed aquatic habitats were recorded by hand on base maps, which included representative aerial imagery of the Study Area. After returning from the field, maps were updated and generated by SLR GIS specialists to illustrate habitat features, functions, and dependencies.

3.0 PRELIMINARY KEY FINDINGS

3.1 DESKTOP ANALYSIS

3.1.1 Bathymetry

Water levels on Lake Ontario fluctuate on short-term, seasonal and long-term basis. Water levels of the Great Lakes, including Lake Ontario, are referenced to chart datum. Chart datum is generally selected so that the water level seldom falls below it. The referenced chart datum on the Great Lakes is the International Great Lakes Datum (1985). For Lake Ontario the chart datum is 74.2 metres above sea level (masl). Nautical charts refer to this datum.

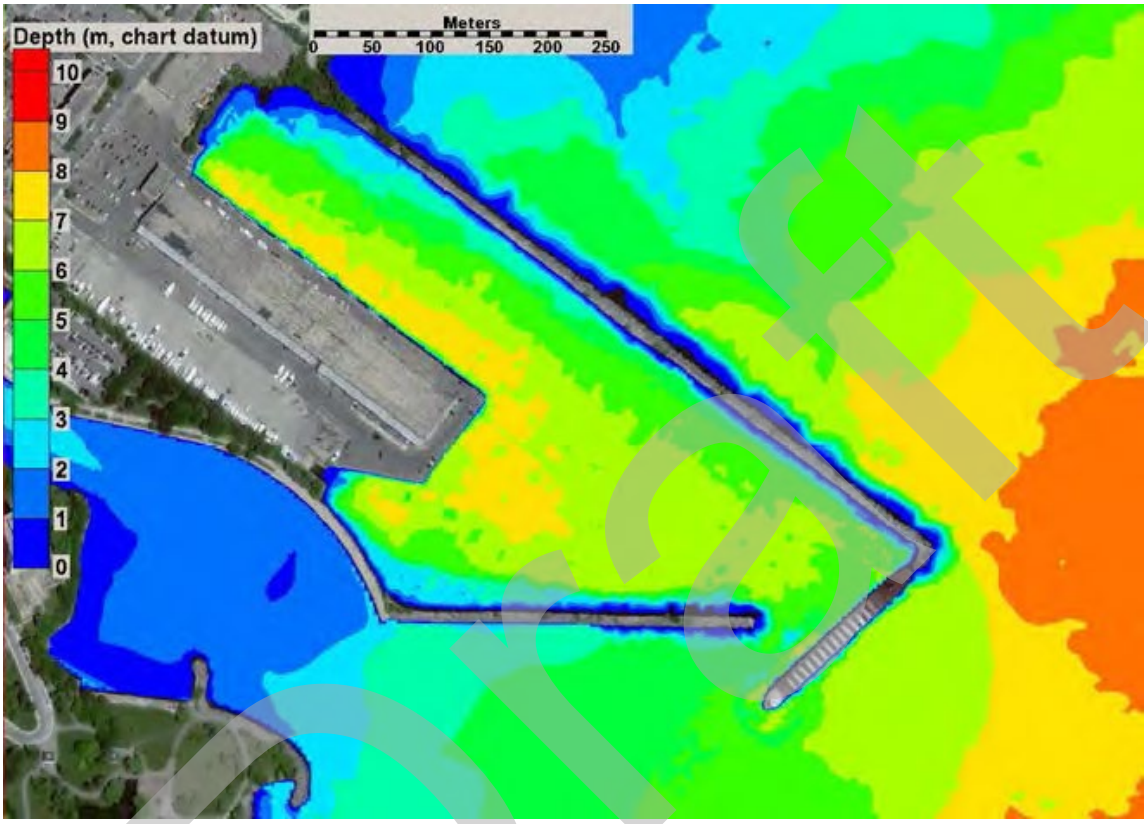
Figure 3.1 illustrates the bathymetry within the local and project study areas. Bathymetry reveals both the depth of water and the topography of the lakebed. This information is a key consideration in the evaluation the potential effects on fish habitat resulting from the placement of lakefill. The lake bottom elevation around the toe of the existing and proposed structures varies between a maximum of approximately 76.0 masl near the interface with the mainland, and a minimum of approximately 66.0 masl at the lakeward most point of the structure.

3.1.2 Littoral Sediment Transport

The shoreline from Burlington to Toronto is generally referred to as a non-drift zone due to the lack of littoral (coastal) sediments. On many shores of the Great Lakes, littoral sediment supply originates from erosion of shoreline bluffs and the nearshore lakebed. Within the regional, local and project study areas, the majority of the shoreline has been hardened, essentially eliminating bluff erosion, and the nearshore lakebed is erosion-resistant bedrock. Some sediment transport does take place because of nearshore bottom deposits, but there is no significant source of new littoral material. Sediment introduced via the watercourses (creeks,

rivers, etc.) that discharge into Lake Ontario is typically fine grained and tends to deposit in deeper water offshore of the littoral zone. Littoral Sediment Transport patterns will not be notably altered by any of the alternatives considered.

Figure 3.1 Bathymetry in the Project and Local Study Areas



3.1.3 Fish Presence

The Credit River and Lake Ontario are home to at least 65 cold, cool, and warm-water fish species, including forage, coarse, and sport fish, which are further identified in the Fishes of the Credit River Watershed document, produced by CVC (2002). It is further understood that of the 65 potential fish species, 58 native fish species have been recorded in the Port Credit region, of which, 23 are considered lake species (CVC 2018). It is anticipated that most fish species found within the Credit River and ultimately, Lake Ontario, may utilize the nearshore areas within the Study Area to complete all or some of the life cycles. It is also known that nearshore fish species diversity and productivity is higher than those of offshore habitats (CVC 2018); two thirds of adult fish species and three quarters of young of the year fish species show a high affinity for sand, gravel or silt substrates, which are often associated with vegetation in the nearshore area (Lane *et al.* 1996 in CVC 2018).

Fish sampling is an ongoing priority for CVC and is conducted using a boat electrofisher, within the Port Credit Coastal Reach (mouth of the Credit River). The results of fish sampling activities between 2008 and 2014 indicate that the Port Credit Coastal Reach has the highest fish species richness (31) and second highest average number of individuals per 1000 seconds (~210), of all assessed locations (CVC 2018). However, when

total fish biomass is considered, the Port Credit Harbour Marina is typically ranked 3rd or 4th, of the 7 locations surveyed. It should also be mentioned that when the total fish biomass is corrected to remove Common Carp from the calculation, the Port Credit Harbour Marina is roughly tied for 1st, with 3 other locations. This would seem to indicate that the Port Credit Harbour Marina provides less optimal aquatic habitat for Common Carp, when compared to other embayment's or river mouths assessed. Additionally, when considering embayment's and river mouth sites, embayment's are often the primary contributor to total biomass values and are known to contribute up to 80% of annual total biomass (CVC 2018). A list of documented fish species with potential presence within the Credit River, at the mouth of the Credit River, or within the vicinity of the Study Area is presented in Table 2. Not all fish species (or required habitats) will be present within the Study Area.

Table 2: Documented fish presence near or within the Study Area and associated potential habitat usage.

Common Name	Scientific Name	Documented Presence in Credit River (Y/N)	Documented Presence in Port Credit Coastal Reach (Y/N)
Bowfin Family (Family *Amiidae*)			
Bowfin	*Amia calva*	Y	N
Catfish Family (Family *Ictaluridae*)			
Brown Bullhead	*Ameiurus nebulosus*	Y	Y
Channel Catfish	*Ictalurus punctatus*	Y	N
Stonecat	*Noturus flavus*	Y	Y
Drum or Croaker Family (Family *Sciaenidae*)			
Freshwater Drum	*Aplodinotus grunniens*	Y	N
Freshwater Eel Family (Family *Anguillidae*)			
American Eel	*Anguilla rostrata*	Y	Y
Goby Family (Family *Gobiidae*)			
Round Goby	*Neogobius melanostomus*	N	Y
Herring Family (Family *Clupeidae*)			
Alewife (gaspereau)	*Alosa pseudoharengus*	Y	Y
Gizzard Shad	*Dorosoma cepedianum*	Y	Y
Lamprey Family (Family *Petromyzontidae*)			
American Brook Lamprey	*Lethenteron appendix*	Y	N
Sea Lamprey	*Petromyzon marinus*	Y	Y
Minnow Family (Family *Cyprinidae*)			
Goldfish	*Carassius auratus*	Y	N
Redside Dace	*Clinostomus elongatus*	Y	N
Northern Redbelly Dace	*Chrosomus eos*	Y	N
Finescale Dace	*Chrosomus neogaeus*	Y	N
Spotfin Shiner	*Cyprinella spiloptera*	Y	Y
Common Carp	*Cyprinus carpio*	Y	Y
Brassy Minnow	*Hybognathus hankinsoni*	Y	N
Common Shiner	*Luxilus cornutus*	Y	Y

Common Name	Scientific Name	Documented Presence in Credit River (Y/N)	Documented Presence in Port Credit Coastal Reach (Y/N)
Redfin Shiner	*Lythrurus umbratilis*	Y	N
Northern Pearl Dace	*Margariscus nachtriebi*	Y	N
Hornyhead Chub	*Nocomis biguttatus*	Y	Y
River Chub	*Nocomis micropogon*	Y	Y
Golden Shiner	*Notemigonus crysoleucas*	Y	Y
Emerald Shiner	*Notropis atherinoides*	Y	Y
Blacknose Shiner	*Notropis heterolepis*	Y	N
Spottail Shiner	*Notropis hudsonius*	Y	Y
Rosyface Shiner	*Notropis rubellus*	Y	Y
Sand Shiner	*Notropis stramineus*	Y	N
Mimic Shiner	*Notropis volucellus*	Y	N
Bluntnose Minnow	*Pimephales notatus*	Y	Y
Fathead Minnow	*Pimephales promelas*	Y	Y
Blacknose Dace	*Rhinichthys atratulus*	Y	Y
Longnose Dace	*Rhinichthys cataractae*	Y	Y
Creek Chub	*Semotilus atromaculatus*	Y	Y
Mudminnow and Pike Family (Family *Esocidae*)			
Northern Pike	*Esox lucius*	Y	Y
Central Mudminnow	*Umbra limi*	Y	N
Perch Family (Family *Percidae*)			
Rainbow Darter	*Etheostoma caeruleum*	Y	Y
Iowa Darter	*Etheostoma exile*	Y	Y
Fantail Darter	*Etheostoma flabellare*	Y	Y
Johnny Darter	*Etheostoma nigrum*	Y	Y
Yellow Perch	*Perca flavescens*	Y	Y
Logperch	*Percina caprodes*	Y	Y
Walleye	*Sander vitreus*	Y	Y
Salmon Family (Family *Salmonidae*)			

Common Name	Scientific Name	Documented Presence in Credit River (Y/N)	Documented Presence in Port Credit Coastal Reach (Y/N)
Pink Salmon	*Oncorhynchus gorbuscha*	Y	N
Coho Salmon	*Oncorhynchus kisutch*	Y	N
Chinook Salmon	*Oncorhynchus tshawytscha*	Y	Y
Rainbow Trout	*Oncorhynchus mykiss*	Y	Y
Atlantic Salmon	*Salmo salar*	Y	Y
Brown Trout	*Salmo trutta*	Y	N
Brook Trout	*Salvelinus fontinalis*	Y	N
Sculpin Family (Family *Cottidae*)			
Mottled Sculpin	*Cottus bairdi*	Y	N
Slimy Sculpin	*Cottus cognatus*	Y	N
Smelt Family (Family *Osmeridae*)			
Rainbow Smelt	*Osmerus mordax*	Y	N
Stickleback Family (Family *Gasterosteidae*)			
Brook Stickleback	*Culaea inconstans*	Y	N
Threespine Stickleback	*Gasterosteus aculeatus*	Y	N
Sturgeon Family (Family *Acipenseridae*)			
Lake Sturgeon	*Acipenser fulvescens*	Y	N
Sucker Family (Family *Catostomidae*)			
Longnose Sucker	*Catostomus catostomus*	N	Y
White Sucker	*Catostomus commersoni*	Y	Y
Northern Hog Sucker	*Hypentelium nigricans*	Y	Y
Silver Redhorse	*Moxostoma anisurum*	Y	N
Shorthead Redhorse	*Moxostoma macrolepidotum*	Y	Y
Greater Redhorse	*Moxostoma valenciennesi*	N	Y
Sunfish Family (Family *Centrarchidae*)			
Rock Bass	*Ambloplites rupestris*	Y	Y

Common Name	Scientific Name	Documented Presence in Credit River (Y/N)	Documented Presence in Port Credit Coastal Reach (Y/N)
Pumpkinseed	*Lepomis gibbosus*	Y	Y
Smallmouth Bass	*Micropterus dolomieu*	Y	Y
Largemouth Bass	*Micropterus salmoides*	Y	Y
Black Crappie	*Pomoxis nigromaculatus*	Y	N
Temperate Bass Family (Family *Moronidae*)			
White Perch	*Morone americana*	Y	N
White Bass	*Morone chrysops*	Y	Y
Trout-Perch Family (Family *Percopsidae*)			
Trout-perch	*Percopsis omiscomaycus*	Y	N

3.1.4 Aquatic Habitat

Night-time water temperatures and daytime air temperatures collected in the summer between 2008 and 2014 averaged 20°C and 21°C, respectively (CVC 2018). While these averages are important to consider, they are based on a relatively small sample size (nine).

The shoreline of the Port Credit Coastal Reach, which includes the Study Area, is highly engineered, with only 1% left in a natural state as documented by CVC (2018). This engineered shoreline is made up of rock armouring, the Ridgetown, and other breakwater structures. These erosion protection structures are necessary, due to the deep bathymetry of the area, which reduces the ability for large waves to break on shallow lakebed areas, thereby dissipating energy and reducing sediment transport from shore.

Flows and sediment from the Credit River are transported to the west, as far away as Tecumseh Creek (CVC 2018). Transport of sediment and particle-bound phosphorus from the watershed exceed Provincial Water Quality Objectives (PWQO) and reduce the water quality in the mouth of the Credit River and nearshore Lake Ontario (CVC 2018). These contributions may provide suitable food resources to harmful algae species, which may feed on the excess nutrients. Additional watershed contributions of chloride in the winter months also pose a risk to existing aquatic habitat.

Port Credit is known for historic and ongoing fisheries research and both recreational and commercial fishing activities. Incidental observations indicate that Burbot (*Lota lota*), Lake Whitefish (*Coregonus clupeaformis*), and Herring (*Clupeidae* sp.) were common occurrences in the past, however, both Burbot and Herring are very uncommon sightings in Port Credit today. It is expected that both wetlands and sheltered embayment's play a critical role in reproduction of these species and the loss of wetland habitat (Faulkner Marsh) may have reduced spawning sites for these species near the mouth of the Credit River (CVC 2018). Additional spawning areas, such as off-shore shoals, are important spawning sites for Lake Trout and while historically documented, are typically difficult to locate in present day.

3.2 AQUATIC HABITAT FIELD CHARACTERIZATION – KEY FINDINGS

3.2.1 East Side of (Eastern) Breakwater

Directly east of the existing (eastern) breakwater, large boulders extend into the water lot for several metres, at an estimated a 1.5H:1V slope. The boulders provide stability and erosion protection for the marina and nearshore area, while the bank irregularities and lakebed roughness provide instream cover for a variety of documented fish species. Beyond the large boulders, the lakebed substrate is dominated by coarse sand and cobble, with sand becoming more prevalent along the shoreline. An area of hardpan was documented east of the Study Area and was dominated with gravel. Multiple cobble dominated shoals were documented along the eastern edge of the Study Area and were oriented both parallel and perpendicular to the existing (eastern) breakwater. The composition and distribution of lakebed substrates as determined from the field investigations performed as part of this EA are illustrated on Figure 3-2.

No macrophyte presence was observed at the time of the aquatic habitat assessment, however, an assessment during late summer may provide additional observations on potential seasonal growth that may occur. Algae and Zebra Mussels (*Dreissena polymorpha*) were documented in places along the shoreline, existing (eastern) breakwater, hardpan area. The concentration of Zebra Mussels appeared to increase as water depths increased. Water depths of greater than 8 m were documented within the Study Area east of the existing (eastern) breakwater.

No fish were observed during the aquatic habitat assessment.

Aquatic habitat and substrates documented within the Study Area east of the existing (eastern) breakwater do not appear to be limited to the Study Area orientated parallel to shore and extending east well beyond the water lot boundary. The only exception to this is the large cobble dominated area located toward the terminus of the breakwater which is almost entirely positioned within the water lot. No areas of critical habitat for potential SAR were documented during the field investigation.

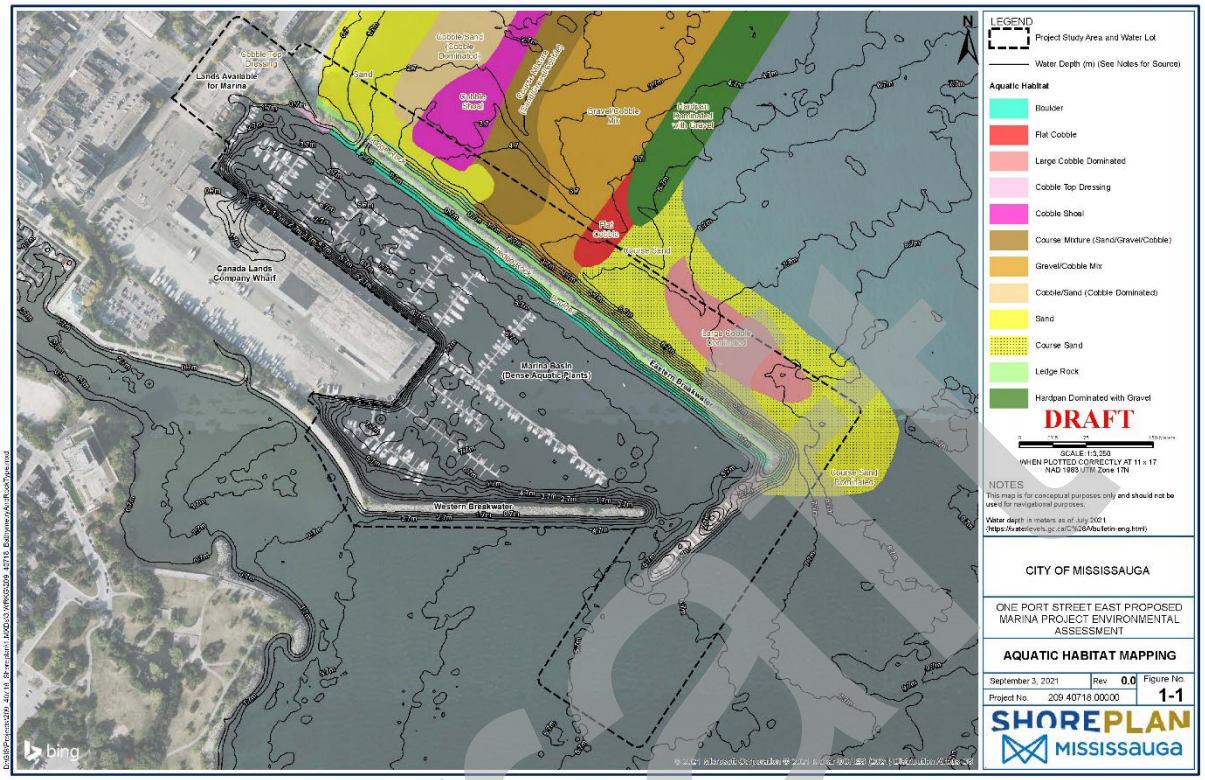
3.2.2 West Side of (Eastern) Breakwater

Directly west of the existing (eastern) breakwater, large boulders extend into the marina for several metres, at an estimated a 1.5H:1V slope. The boulders provide stability and erosion protection for the marina and nearshore area, while the bank irregularities and lakebed roughness provide instream cover for a variety of documented fish species. Based on the placement and organization of the boulders along the west side of the existing (eastern) breakwater, it is assumed that a barge was utilized from the west side. However, depending on the severity of weather events and wave action, the boulders along the east side of the existing (eastern) breakwater may have experienced movement since the time of construction. Beyond the large boulders, the substrate documented along the west side of the existing (eastern) breakwater is dominated by sand and cobble, with areas of soft detritus.

Significant algal and macrophyte growth was documented, when compared to the east side of the existing (eastern) breakwater. This may be due to reduced wave action, flow, and potentially increased residence time of water within the marina. Water depths of greater than 2.5 m were documented within the Study Area west of the existing (eastern) breakwater.

Multiple fish species and individuals were observed within the marina, although only Brown Bullhead and Cyprinids Sp. were identified. It is assumed that many other fish species or families were observed but could not be identified.

Figure 3.2 Bathymetry and Substrate Composition and Distribution in the Project and Local Study Areas



Aquatic habitat and substrates documented within the marina basin appear to be consistent throughout the assessed area. It is assumed that the dense macrophyte growth within the marina basin provides suitable nursery and foraging habitat for many species documented in the Study Area. No areas of critical habitat for potential SAR were documented during the field investigation.

3.2.3 Within the Marina Basin

Within the marina basin, the substrate is dominated by sand, with fine sediments and other particulate matter resting in isolated pockets.

Moderate to dense algal and macrophyte growth was documented within the marina basin and provides significant cover and surfaces for important life process (e.g., refuge and spawning) of some fish species with documented presence in the Study Area. The density of plant life may be in part due to the sheltered nature of the waters within the marina basin and the potential accumulation of nutrients from overland or other sources.

Multiple fish species (e.g., Brown Bullhead, Cyprinid Sp.) were observed within the marina basin and it is expected that multiple life stages are present.

Aquatic habitat and substrates documented within the marina basin do not appear limited and are consistent through the assessed area within the marina basin. No areas of critical habitat for potential SAR were documented during the field investigation. The (eastern) breakwater appears to be stable on both the east and west side of the assessed area.

3.2.4 Fish Habitat Summary

Substrate to the east of the existing (eastern) breakwater are diverse, abundant, and well distributed both within and outside of the local Study Area. No areas of critical habitat for SAR were identified. Based on the findings of the desktop analysis and field investigation it appears that the Study Area provides a variety of substrates at varying depths that likely afford aquatic habitat opportunities for several fish species and life stages of fish with documented presence in or near the study area.

The areas within the existing marina basin and along the west side of the existing (eastern) breakwater provide important nursery and foraging areas for both small-bodied fish and large predaceous fish species. These habitats within the marina basin appear to be well distributed through the assessed area and are not limited to areas that may be impacted by potential short duration construction activities.

4.0 EVALUATION OF ALTERNATIVES

The three alternative plans of lakefilling are presented on **Figures 4.1 to 4.3** and illustrate a range of fill alternatives considered for assessment, Alternatives A, B, and C. Each landform has a "green" public space at the south end. These layouts were developed to allow for comparison of the fill alternatives. The figures also show associated dock layouts within the marina basin. Brief descriptions of the alternatives are provided below.

4.1 CONCEPTUAL SHORELINE PROTECTION STRUCTURES

For each alternative, armour stone revetment structures were designed to stabilize and protect the lakefill. Each alternative has been designed to be resilient to coastal conditions including high water and changes anticipated because of climate change. Construction of each alternative is assumed to be similar to that used at the Jim Tovey Conservation Area.

Figure 4.1 Alternative A, Small Lakefill

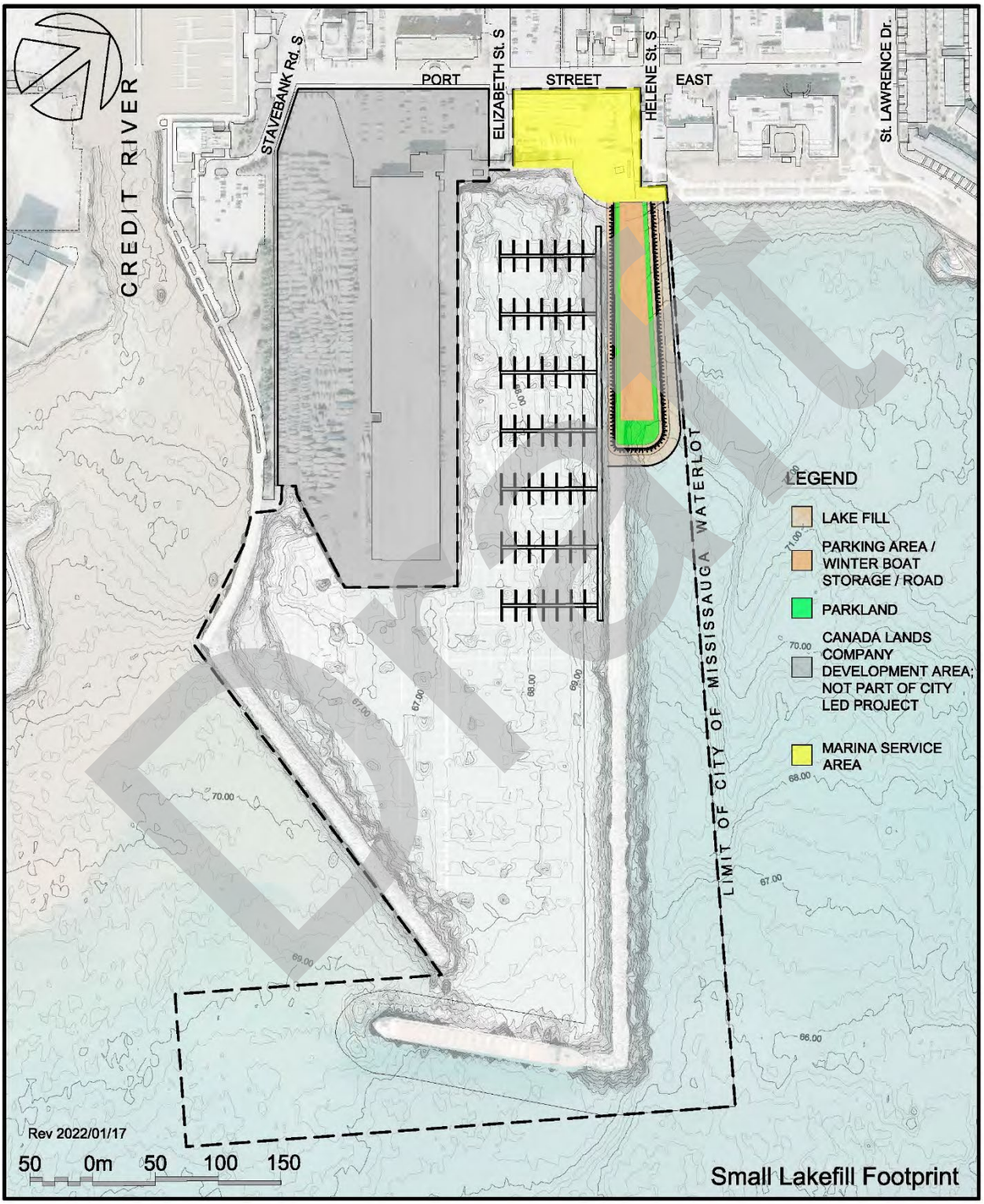


Figure 4.2 Alternative B, Medium Lakefill

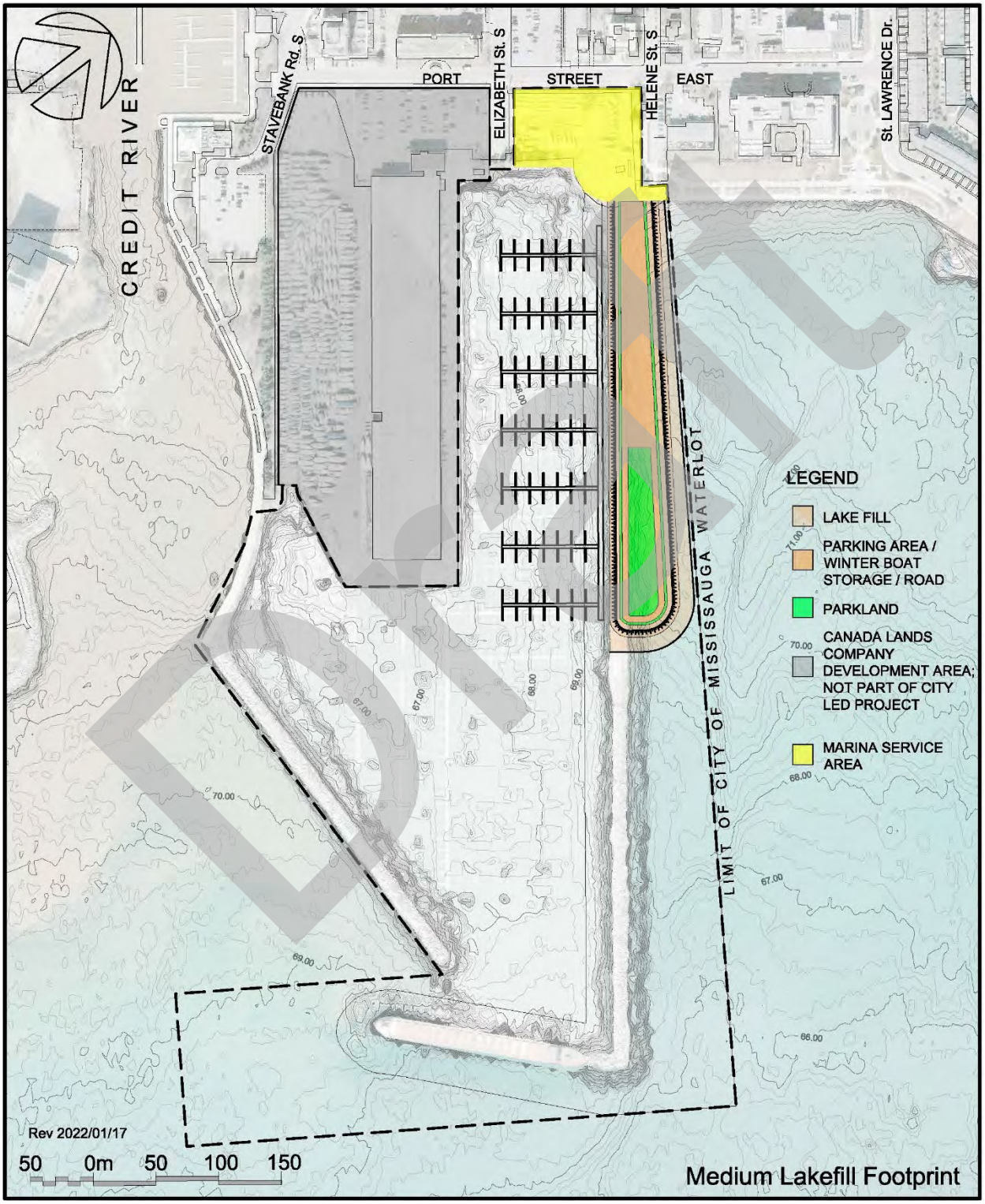
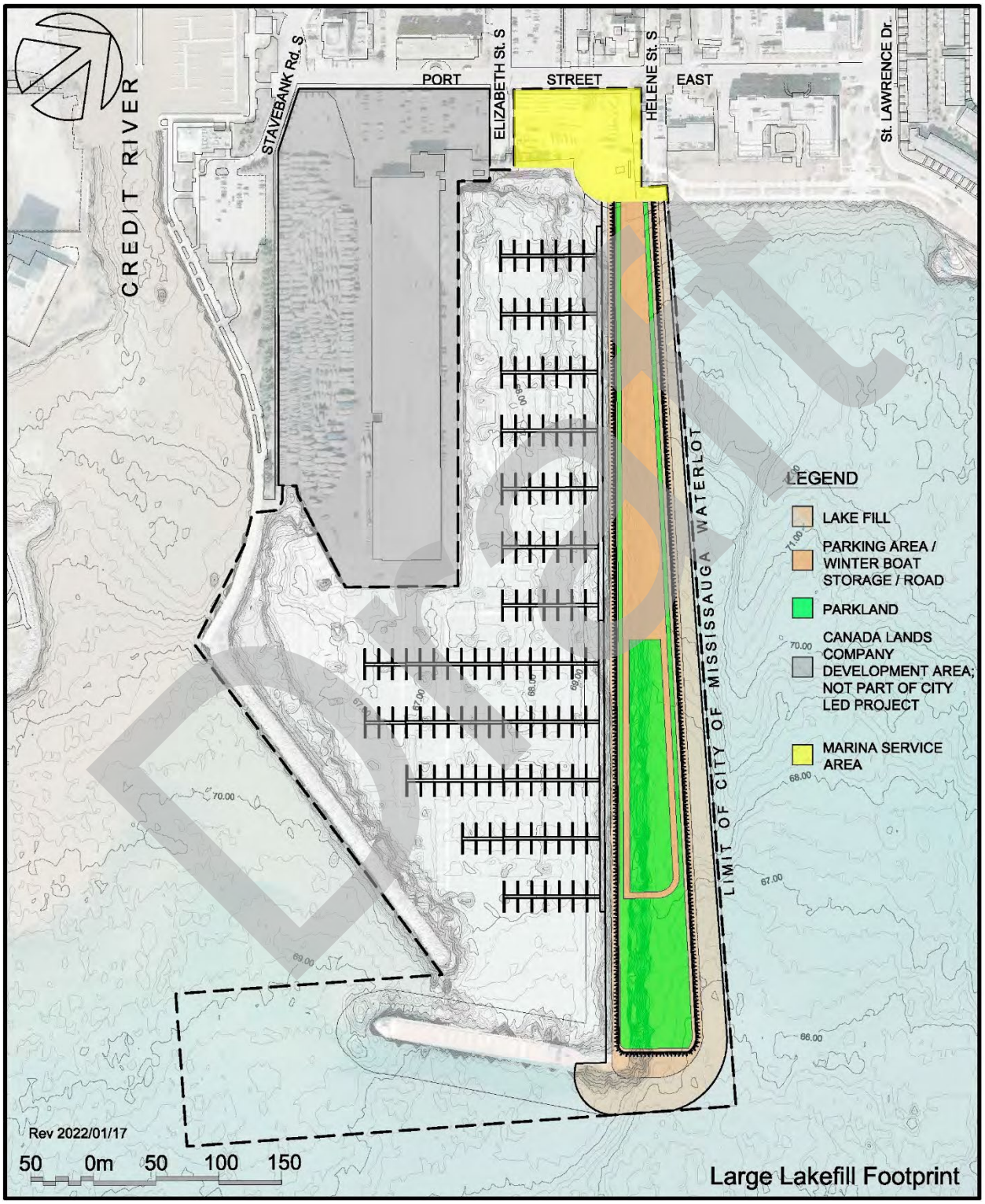


Figure 4.3 Alternative C, Large Lakefill



5.0 PREFRERED ALTERNATIVE

The preferred alternative for the 1 Port Street East Proposed Marina Project (1PSEPM) is the large lakefill alternative. This alternative provides the opportunity to create the largest area of parkland relative to the marina space required for parking, boat storage and marina facilities. It also provides for a similar sized marina to what exists today (greatest number of slips). With a larger footprint, perimeter, and location jetting into deeper waters in Lake Ontario this alternative proposes the largest removal of existing aquatic habitat area. However, baseline studies indicate that existing fish habitat that would be lost is not limiting in Lake Ontario, and opportunities exist to create new habitat of greater quality than what will be lost. With a large land base, this alternative offers the most potential to enhance terrestrial habitat over what exists now. Conversely, as the largest footprint alternative, it also has the highest cost and will take the longest to construct resulting in potential construction nuisance effects for the longest period. However, the effects from construction will be relatively short-term and mitigable while the lakefill area and its benefits will exist for the long-term. Overall, the Large Lakefill Footprint alternative, and therefore the preferred alternative.

5.1 BREAKWATER

The shoreline protection features of the 1PSEPM conceptual design consists of an armour stone revetment as well as a secondary breakwater structure at the lakeward end also protected with an armour stone revetment, which will shelter an aquatic habitat creation area. The slope of the revetment can vary but 2H:1V is the most common and is the proposed slope for most of the 1PSEPM Project, with the exception of certain areas of the structure reaching approximately 3H:1V.

With the lake bottom elevation around the toe of the structure varying between a maximum of approximately 76.0 m near the interface with the mainland, and a minimum of approximately 66.0 m at the lakeward most point of the structure, the depth at the toe of the revetment will vary between 0.2 and 10.2 m under design high water levels. The total area of fish habitat affected by the breakwater construction would include fill that occurs below the nearshore zone of the lake beginning at the shoreline which has been established as 74.2 masl based on the International Great Lakes Datum 1985. (Minns et al. 2005) and accepted by DFO as the elevation below which fish habitat occurs.

Structural aquatic habitat features will be incorporated along the toe of the revetment as described in the following sections.

6.0 IMPACT ANALYSIS

It is anticipated that the extent of some of these aquatic habitats within the water lot may be reduced by the placement of fill, however, these substrates habitat does not appear limiting with regional study area along the shoreline of Lake Ontario.

Habitat compensation will be used to address the proposed removal or disruption of fish habitat to occur due to the construction of the 1 Port Street East Proposed Marina Project.

6.1 EFFECTS OF CONSTRUCTION

6.1.1 Effects on surface water quality in the Local Study Area

Construction activities for the 1PSEPM Project are expected to involve land creation and protection by placing the armour stone shoreline protection and lakefill materials on the lake bottom.

Sediment re-suspension is unavoidable to some extent and occurs whenever materials are placed onto a lake bottom. The placement of armour stone on the lake bottom to create the shore protection structure will result in the disturbance and resuspension of existing sediments from the lake bottom into the water column resulting in increased turbidity and potentially reduced surface water quality. Turbidity is a reduction in water clarity. Water is considered turbid when the presence of suspended particles becomes conspicuous and considered to be impaired or of lower quality.

Sediment / particle size combined with wave action and wind direction are key factors in determining whether, and how far, sediments move and are redistributed within the lake. Lakebed substrate where the lakefill is proposed to be constructed is dominated by coarse sand and cobble, with sand becoming more prevalent along the shoreline. An area of hardpan and multiple cobble dominated shoals along the eastern edge of the placement area also exist. These types of sediment are less likely to be resuspended and will likely resettle quickly near the area of disturbance. For the portion that may be resuspended, sediments are likely to be transported towards the shore and the existing beach by wave action.

Mitigation measures are warranted to minimize adverse effects on surface water quality during construction and will be detailed as part of the on-going effects assessment.

- Follow best management practices in "Fill Quality Guide and Good Management Practices for Shore Infilling in Ontario"
- Utilize only clean fill for lakefill construction. No contaminated fill shall be placed in the lakefill area or in Lake Ontario.
- Restrict operations to calm water days (i.e., suspend operations during periods of high wave action).
- The City will continue to seek the advice and input from Ontario MECP, the CVC and the federal DFO in developing its detailed design and mitigation plan.

6.1.2 Effects on Aquatic Habitat in the Local Study Area

The Study Area provides a variety of substrates at varying depths that likely afford aquatic habitat opportunities for several fish species and life stages of fish with documented presence in or near the study area. The preferred alternative will result in the largest area of lakebed infill and as a result require the removal or overprint of approximately 29,200 m^2 of fish habitat. This is in addition to the replacement of like for like habitat along the eastern face of the existing breakwater that is replicated in the proposed marina design.

It is important to recognize that the approx. 6,300 m2 of this total area consists of fish habitat that would be affected and removed for any of the lakefill alternatives under consideration. This common area represents the portion of the study area with relatively higher productivity potential that occurs in the shallow (1-3m depth) sand dominated and cobble habitat closer to shore. Similarly, approx. 4,700 m2 of an additional nearshore habitat in water depth between 3 - 5m with relatively uniform mixture and distribution of cobbles and gravel would also be removed by Alternative 2. The additional required 18,600 m2 of lake fill to create Alternative 3 occurs over relatively deep (5m -8m depth) nearshore habitat consisting of cobble apron surrounded by sand (Figure 3.2). While attractive in structure and substrate composition to some open coast fish species, this relatively deeper habitat in an area of high energy wave action (waves colliding with the existing break wall over deeper water generally contain/release greater energy than those that dissipate energy along the lake bottom before reaching shore) is considered less productive than the shallow nearshore habitat common to Alternative 2 and certainly that of Alternative 1.

The fish community likely to be affected by the 1PSEPM project consists of fish species typically found utilizing nearshore habitat with a variety of course substrates, including common fish such as White Sucker, Common Carp, Alewife, Lake Chub, Longnose Dace, Emerald Shiner and the invasive Round Goby.

7.0 AQUATIC HABITAT CREATION

The loss of approximately 29,200 m2 of fish habitat proposed to create the Preferred Alternative for the 1 Port Street East Proposed Marina Project (1PSEPM) will require the creation of a habitat off-setting strategy in order to conform with the federal *Fisheries Act* and achieve low to none net effect in the context of the EA A central component of the The *Fisheries Act* incudes the prohibition against causing the harmful alteration, disruption or destruction (HADD) of fish habitat (section 35) unless the carrying on of the work, undertaking or activity is authorized by the Minister and the work, undertaking or activity is carried on in accordance with the conditions established by the Minister.

An offsetting measure is one that counterbalances unavoidable death of fish and harmful alteration, disruption or destruction of fish habitat resulting from a work, undertaking or activity with the goal of protecting and conserving fish and fish habitat. Offsetting measures should support available fisheries management objectives and local restoration priorities and be conducted in a manner consistent with the department's offsetting policy. Offsetting measures may take a variety of forms ranging from localized improvements to fish habitat to more complex measures that address limiting factors to fish production.

In recognition of the need for habitat offsetting to address the potential loss of productive fish habitat, the development of the natural heritage components of the 1PSEPM project configuration of the Preferred Alternative has incorporated design elements to self-compensate for a portion of the proposed habitat alteration as well as deliberate fish habitat creation components.

7.1 SEMI-SHELTERED EMBAYMENT CREATION

As noted previously, 58 native fish species have been recorded in the Port Credit region, of which, 23 are considered lake species (CVC 2018). It is anticipated that most fish species found within the Credit River and ultimately, Lake Ontario, may utilize the nearshore areas within the Study Area to complete all or some of the life cycles with approximately two thirds of adult fish species and three quarters of young of the year fish species exhibiting a high affinity for sand, gravel or silt substrates.

The opportunity to undulate the shoreline and create aquatic habitat features along the east side was considered. However, such undulation would reduce the width of the created land and its functionality and ability to be programed to its full potential.

The fish habitat creation component of the 1PSEPM design proposes to create and enhance aquatic habitat at the southern (lakeward) terminus of the proposed lakefill. Here, the proposed shoreline will be sculpted westward to create a lakeward facing embayment that will be protected by an armour stone island to be created further out into the lake adjacent to the headland. The proposed feature will create approximately 2,400 sq. m of semi-sheltered moderately shallow water area where substrate can be selected, and structural habitat provided at varying depths. The concept is presented on Figure 6.1 with cross-sections illustrated in Figure 6.2.

The east side of the lakefill will be constructed in the same manner as the remainder of the infill area. Here opportunities may exist to flatten the side slope and or create a shallow underwater terrace along portions of the wall to be sheltered by the island and create littoral areas to provide productive areas for forage fish reproduction and feeding.

The island breakwater will be protected by a layer of randomly placed armour stone. Smaller sized material will line the interior of the berm on the embayment side whereas the larger material will protect the lakeside which is exposed to waves from the open lake. The base of the embayment will be lined with smaller boulder

and cobble sized material over a gravel apron to provide a variety substrate for aquatic vegetation and fish habitat.

It is envisioned that the embayment side will slope down to meet the boulder substrate at the bottom of the fish habitat area. In addition to shallow littoral areas along the side slopes, this will create relatively shallow fish habitat in an area of exiting deep water. These elevated bed elevations at the entrance will help to reduce the severity of waves that enter the aquatic habitat area to create a relatively shallow low energy sheltered refuge adjacent to deeper water of the open lake. The lower interior areas will provide variance in depth to maximize habitat diversity similar to that to be removed in the shallow areas. As a result, the lee side of the island habitat will provide quality spawning and foraging fish habitat for open coast fish species such as Alewife, Lake Trout and juvenile salmonids; sheltered habitat for important Lake Ontario feeder fish species such as Emerald Shiner, Lake Chub and Spottail Shiner as well as nearshore fish species such as White Sucker, Common Carp and Longnose Dace. Of note, LIOSS cites Alewife and Emerald Shiner being the most abundant coolwater open coast species along this portion of the shoreline.

It should be noted that the design of the aquatic habitat area and the shore protection structure is still at the conceptual level and details of the substrate and habitat features will be further developed by the project team in consultation with the regulatory agencies.

7.2 CONSISTENCY WITH LOISS

The Lake Ontario Integrated Shoreline Strategy (LIOSS) (CVC, 2018) aims to provide guidance for local, regional, provincial and federal governments for planning restoration initiatives, developments, and land-use decisions. This study emphasizes opportunities for protecting and restoring ecosystems along the shoreline, inland to the first major barrier on the Credit River, and into Lake Ontario's nearshore environment. A key element of LOISS is to improve the diversity and quantity of terrestrial and aquatic habitat of the shoreline. In doing so, it identifies fish habitat improvement priorities for the lakeshore and nearshore areas in the vicinity of the Credit River mouth, including the Local and Project Study Areas. The proposed creation of the semi-sheltered embayment aligns with one of the key priorities for the Port Credit Coastal Reach which is to create fish habitat (e.g., spawning, rearing, feeding, cover) along existing shoreline erosion structures and incorporate fish habitat features in design for repair and replacement structures.

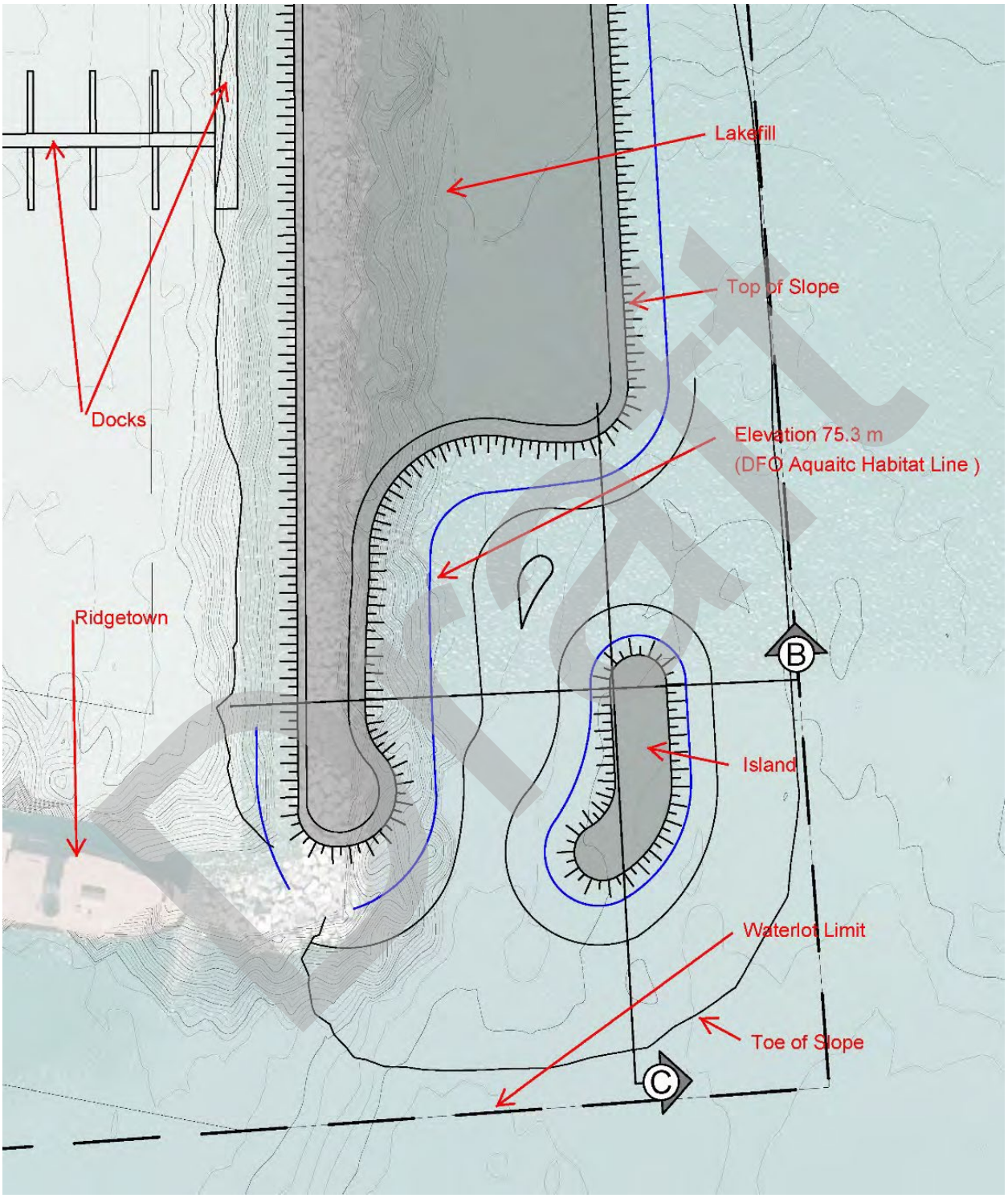


Figure 6.1 Semi-Sheltered Aquatic Habitat Area

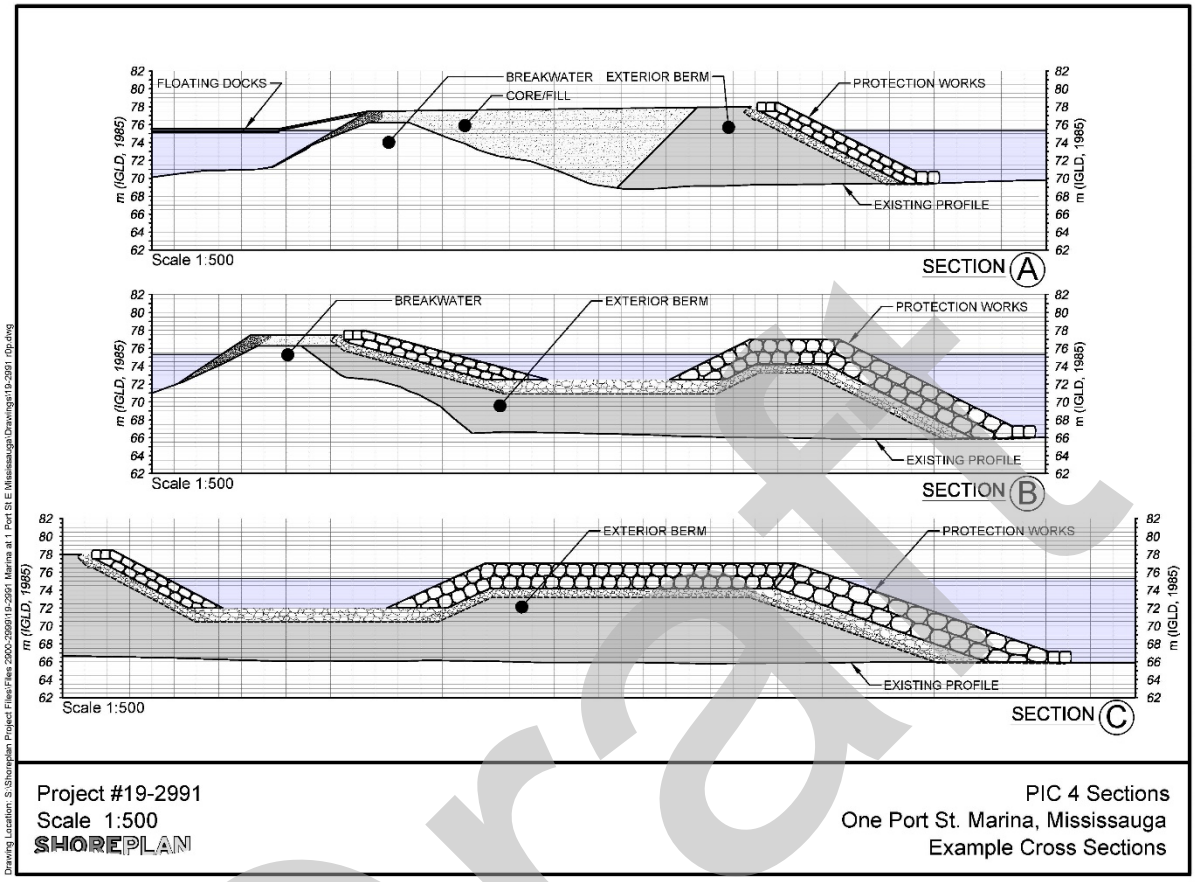


Figure 6.2 Cross-sections of the Proposed Lakefill and Semi-Sheltered Aquatic Habitat Area (see Figure 6.1 for cross-section locations)

7.3 ADDITIONAL HABITAT OFF-SETTING MEASURES AND OPPORTUNITIES TO CREATE FISH HABITAT

7.3.1 Creation of underwater crevices to afford fish cover to create shelter and improve predator/prey interactions

The outer wall of the proposed lake fill will be constructed in a similar manner to the existing break wall and extend no further lakeward. Consisting of armour stone, the slope of the revetment will typically be 2H:1V for most of the 1PSEPM construction. Consequently, the new break wall will replace (like for like) existing fish habitat along the eastern face of the existing armour stone peninsula at greater than a 1:1 area ratio due to the new revetment achieving a marginally less steep than the existing break wall. through the placement of rock fill to create the breakwater structure.

7.3.2 Introduction of Structural aquatic habitat features will be incorporated along the toe of the revetment

Submerged nearshore habitat is important for spawning and feeding. However, the extensive shoreline hardening that has occurred over the past 200 years combined with erosion-resistant bedrock within the

nearshore lakebed (largely a result of historic stonehooking activities), provides for limited habitat diversity in the nearshore area throughout the Regional Study Area.

The toe stones of the revetment are likely to have sizable crevices between them, although the stones should be touching their adjacent stones. These toe stones will be laid upon naturally occurring firm substrates such as sand, gravel and small cobbles. Together, these features (large armour stone and relatively smaller substrates) will create microhabitats for spawning, shelter and predator prey interactions for a variety of fish species known to utilize the nearshore area of the Project Study Area including Smallmouth Bass, White Sucker, Common Carp, Alewife, Lake Chub, Longnose Dace and Emerald Shiner.

In addition, structural aquatic habitat features could be incorporated along the toe of the revetment to replicate and improve the existing habitat along the east side of the breakwall. The habitat features would provide excellent forage, spawning and nursery habitat conditions for fish species such as Emerald Shiner, Yellow Perch and Johnny Darter that are commonly found in the littoral areas of the open coast (LIOSS, 2018). Note: due to the position of the proposed revetment toe to the boundary of the City's waterlot, permission from the provincial Ministry of Northern Development, Mines, Natural Resources and Forestry (MNDMNR) under the *Public Lands Act* may be required to construct a portion of this habitat improvement measure adjacent to the waterlot.

7.3.3 Off-Site Compensation

Nearshore aquatic habitat consisting of gravel, cobble and small boulder substrates used to occur in abundance along this portion of Lake Ontario. With the extent of historic stonehooking in this portion of Lake Ontario, most of the nearshore habitat elements that may have provided this function are now absent from the Project Study Area and much of the Regional Study Area.

Two other LIOSS priorities: Increase diversity of habitats (e.g., cover, vegetation, shoals, etc.) for suitable target fish species in the Credit River estuary, embayments and open coast; and investigate the feasibility to create shoals off Credit River mouth to enhance existing and historic Lake Trout/Whitefish habitat, provide opportunities for habitat creation in the Local Study Area should the undertaking require additional off-setting measures.

For example, the Lakebed east of the water lot could be augmented through areas surcharged with point shoal and rock piles to create spawning habitat for Lake Trout/Whitefish. Similar to adding structural aquatic habitat features along the toe of the revetment, this option may require permission under the Public Lands Act to these habitat improvement measures adjacent to the waterlot.

A second viable habitat improvement / off-setting option is to manipulate or create habitat structure such as submerged woody cover and /or shoals strategically within the existing habour in proximity to the western interior wall, away from the primary access/egress boating channel. This shoreline associated with the habour embayment is fairly protected from coastal processes (waves, currents, erosion, etc.). These habitats support submergent aquatic vegetation containing diverse communities of warmwater species with some top predators. While Northern Pike and Smallmouth Bass are found regularly, LIOSS reports that species such as Largemouth Bass, Bowfin, Black Crappie and Yellow Perch are not found in high numbers in this area (Stewart et al. 2013). Installing or modifying habitat to target some of these less common occurring species would create high value habitat off-setting measures.

8.0 TERRESTRIAL FEATURES

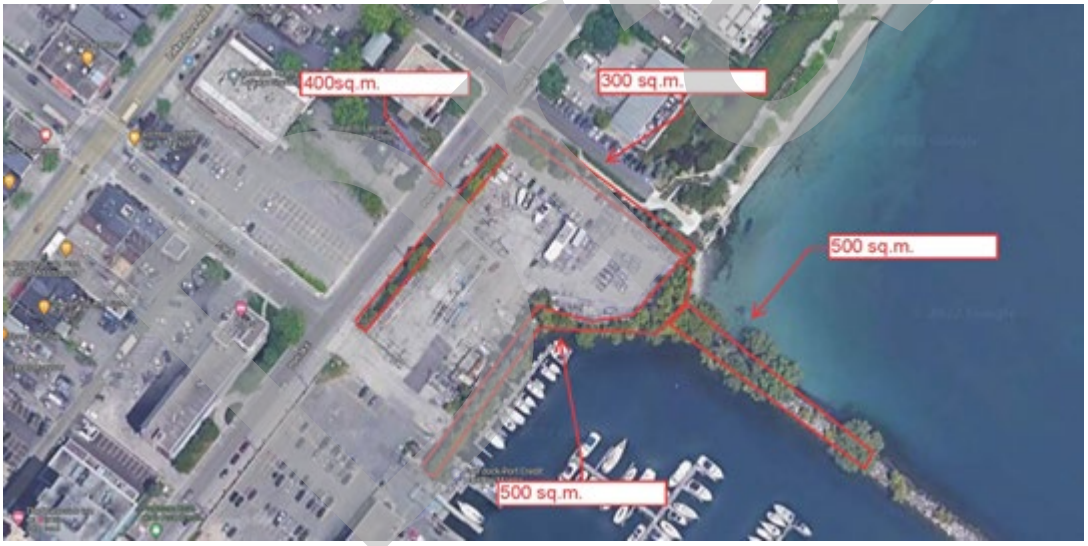
8.1 EXISTING CONDITIONS

In comparison to unaltered natural environments,the ecology of natural heritage systems in urban areas are typically composed of fragmented habitats, isolated woodlands and wetlands, lower biodiversity, impacted hydrology with lowered groundwater levels and flashier surface water hydrology, and the presence of invasive species. Urbanization and associated microclimatic changes affect species composition; thus, as habitats simplify, the resources and competitive requirements of many wildlife species are not met (Credit Valley Conservation, 2018).

The 1PSEPM Project study area occurs in the ecoregion 7E – Lake Erie - Lake Ontario. This ecoregion covers the northern shorelines alone Lake Ontario and Lake Erie and is divided into six ecodistricts. The flora and fauna in Ecoregion 7E are the most diverse in Canada and include several provincially significant plants, animals, and vegetation communities.

The Project Study Area is predominately urbanized and paved. Ornamental deciduous and coniferous trees and shrubs exist along most of the perimeter of the 1 PSEPMP site with clusters of trees growing on the breakwater near the shoreline. These tree clusteres were deciduous trees comprised predominately Silver Maple, (*Acer saccharinum), G*reen Ash (*Fraxinus pennsylvanica*), elms (genus *Ulmus*), willows (genus *Salix*) and mulberry (*Morus alba*). As shown in Figure 8.1, it is estimated that there exists approximately 1,700 m^2 (0.17 ha) of vegetation in the Project Study Area.

Figure 8.1: Existing Vegetation in the Project Study Area



While shallow depth in the Credit River due to sedimentation upstream of the CN Rail bridge to just upstream of the QEW overpass has provided suitable conditions for the establishment of the Credit River Marshes coastal wetland complex, no wetlands occur within the Project Study Area.

Waterfront parks offer some of the only remaining habitat within the larger landscape of urban areas to offer habitat supporting food resources and resting / touch-down areas for migrant birds. These parks also act as ‘stepping-stones’ or isolated islands of natural habitat that provide landscape level connectivity to species in an urban matrix. The Local and Project Study Areas are located within an important migratory zone, which includes portions of both the Atlantic and Mississippi flyways. While the existing vegetation offers approximately 0.17 ha of treed canopy for migrating and urban resident bird species, the mouth of the Credit

River and its eight provincially significant wetland units located immediately west of the project study area offer far more habitat diversity and area for migrating birds. Some existing buildings and structures at the marina and in Port Credit provide roosting and nesting habitat for some bird species including a colony of Common Tern.

In a naturalized setting, the nearshore zone of a lake provides essential habitat for biota by affording both shoreline corridor linkage functions and a link between the terrestrial and open water environments. In urbanized environments, these connections often become disrupted or removed entirely. Aside from the remanent sand beach occurring at the interface of the shoreline and the eastern side of the existing break wall, the existing shoreline within the project study area offers little to no opportunity for wildlife movement along the shore or between the lake and upland areas. The hardened sheet pile shoreline created along the waterfront creates a barrier between terrestrial and nearshore habitats and the extensive use of fences along the shoreline of the Local and Regional Study Areas create further fragmentation along the shoreline corridors for both people and wildlife.

8.2 EFFECTS ON TERRESTRIAL HABITAT IN THE LOCAL STUDY AREA

The construction of any of the 1PSEPM Project alternatives would require the removal of approximately 0.1 ha of trees fronting the shoreline of the existing marina and those positioned along the existing break wall: representing approximately half of the existing trees within the project study area (Figure 8.1). The remnant sand beach occurring at the interface of the shoreline and the eastern side of the existing break wall will also be removed by the construction of any of the three alternatives1PSEPM Project. Being common elements to be removed under all marina construction alternatives, the opportunity to recreate similar shoreline habitat, canopy cover and wildlife friendly nearshore habitat areas was a strong consideration in the natural heritage evaluation of the alternatives.

8.3 TERRESRTRIAL HABITAT CREATION AND NATURALIZATION

In addition to considering the fill required for the site, conceptualizing the topography allows for advantageous (but approximate) placement of landscape features such as primary trails, parkland, naturalized habitat and connections. These amenities and features are conceptual depicted in Figure 8.2.

An important advantage of the 1PSEPM Project preferred alternative is the ability to provide a relatively large parkland and trail system that will include naturalized areas and wildlife friendly elements. A larger parkland and trail system is envisioned to be created as part of the refinement of the preferred alternative. Microhabitat variations in topography, drainage and other habitat structures will be addressed at the detailed design stage.

During detailed design, efforts will be made to use plant species that are phenotypically best suited to the Great Lakes/St. Lawrence Lowlands, including species that are consistent with CVC's approved planting lists and the use of Carolinian species where appropriate. Another important consideration in the selection of plants will be the use of native suitable native trees and shrubs and other flora that are highly suited to meeting the needs of native fauna including fruit- and cone-bearing trees and shrubs and those producing autumn fruit such as Dogwood (*Cornus* sp.), Mountain-ash (Sorbus sp.), Nannyberry, Wild Raisin, Highbush Cranberry (*Viburnum* sp.) Winterberry (*Ilex verticillata*) and Staghorn Sumac (*Rhus typhina*).

The resulting mosaic of passive recreational parkland, trails and naturalized microhabitats will serve as a migratory rest and launching habitat for birds and butterflied flying over Lake Ontario, offering additional replacement habitat as compared to the area to be lost under any alternative scenario. The largely un-treed area of the parkland and other amenity areas would also serve as a potential raptor prey habitat.

Figure 8.2 Preliminary Preferred Concept

9.0 OTHER CONSIDERATIONS AND NEXT STEPS

9.1.1 Next Steps

The large lakefill footprint alternative will now be subject to refining the undertaking for the purposes of the detailed assessment. The detailed assessment will examine how the preferred alternative meets the purpose of the undertaking; it describes the net environmental effects; how it minimizes adverse effects and/or maximizes positive effects; and summarizes its advantages and disadvantages, according to the components of the environment identified in the study terms of reference namely: Physical Environment; Atmospheric Environment; Biological Environment; Socio-economic Environment; Cultural Environment (including Interests of Indigenous Communities); and Costs.

Through discussions with MNDMNRF, DFO and Conservation Authority biologists during detailed design, it is anticipated that the additional ecological benefits and suitable habitat compensation techniques will be developed to achieve a neutral (no) net effects on fish habitat.

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